DATA ANALYTICS FOR MANAGING OBSOLESCENCE

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SUMMARY

Material and equipment obsolescence continues to be a challenge in the nuclear industry. With suppliers exiting the market, dropping nuclear QA programs such as 10CFR50 App. B, and the discontinuation of product lines, utilities become challenged to maintain operability as critical parts become no longer available to support plant maintenance and regulation requirements for operation activities.

An estimated 35% of a utility's required installed parts are currently obsolete. With resource availability challenges, it is important to focus on those material challenges that impact or delay upcoming maintenance activities or critical spare support to ensure continued safe plant operations.

Westinghouse has developed analytics that utilizes planned maintenance activity (e.g., work orders, maintenance plans, etc.) critical spare requirements, inventory availability, OEM obsolescence status, historical part usage and other data points to identify material challenges associated with maintenance and critical plant system support. The analytics prioritizes the challenges to ensure solutions are developed to mitigate plant operation impacts or regulatory commitments.

Westinghouse then utilizes an extensive engineering team to address the prioritized material support challenges and provide solutions. Solution development includes the identification of equivalent material Item Equivalency Evaluations (IEE), commercial grade dedication (CGD) of commercially available items, reverse engineering to maintain original design, or bridging strategies that identifies available material in other utilities' inventory. These solutions are supported with engineering packages that incorporate EPRI (Electric Power Research Institute) guidance for engineering packages developed to support material/part requirements.

Combining data analytics with engineering solution support, Westinghouse prioritizes and solves part challenges to mitigate plant operation challenges, maintenance activity impact and regulatory requirements associated with critical spare requirements.

1 INTRODUCTION

Nuclear energy has a present and a future within our world as the demand for electricity continues to grow and we continue to aim for a low carbon energy portfolio. However, the nuclear industry is currently faced with several challenges such as ageing nuclear power plants, obsolete equipment, and increased maintenance costs challenging the future of nuclear power. As of April 2022, there were 441 nuclear power reactors providing over 10% of the world's electricity, operating in 32 different countries. Thirteen (13) of these countries rely on nuclear energy to supply over one-quarter of their total electricity. However, 322 of the 441 (~75%) operating nuclear reactors are 25 years or older, some dating as far back as 1969, and the cost of maintenance continues to grow. In addition, the industry has been struggling economically in the face of cheap natural gas, political uncertainties, and that many nuclear power companies are investing the bare minimum when it comes to maintenance and upgrades.

Each nation's regulatory body (e.g., NRC in USA, ONR in UK, etc.) has a licensing process which sets out the rules and regulations an owner/operator must follow to be granted permission to begin and continue operation for a set amount of time (e.g., 20 years, 40 years), with the option to extend. In cooperation with many international institutions such as IAEA, INPO, EPRI and WANO, a framework of fundamental equipment reliability and safety standards have been created, including:

- INPO AP-913: Equipment Reliability Process Description
- INPO/NUOG NX1037: Obsolescence Guidance
- EPRI: Preventive Maintenance templates
- IAEA/WANO: Operational Safety Performance Indicators
- IAEA SSG-48: Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants

These guidelines, paired with the advancements in data analytics and predictive tools, with the capability to manage and integrate much broader quantities of operational data, will allow nuclear experts to make better informed decisions to reduce inventory costs, help with obsolescence, and optimize their overall plant performance by improving reliability. Westinghouse's digital engineering services, focused on unlocking value by creating opportunities for greater power capacity output, increased reliability and minimized operating costs, are at the core of ensuring nuclear power is sustainable and competitive now and for the future.

2 Obsolescence Challenge

The issue of aging and obsolescence of nuclear components is a high priority for many nuclear facilities as many manufacturing firms who provided original parts to the plants in the 1970s and 80s are no longer in business or refuse to manufacture parts for which they don't believe there is a sufficient demand or are no longer appropriately certified to provide nuclear-grade parts. Specific to asset management, there are several ways obsolescence is introduced into the nuclear industry:

- Original Equipment Manufacturer (OEM) no longer exists
- Technological advancements push OEMs to create new models that supersede the old ones
- OEMs may design planned obsolescence of parts into a larger model or system
- Regulations and standards change requiring OEMs to upgrade existing models
- Lack of sufficient demand for nuclear parts to make it economically feasible for the OEM to support the manufacturing line for that product

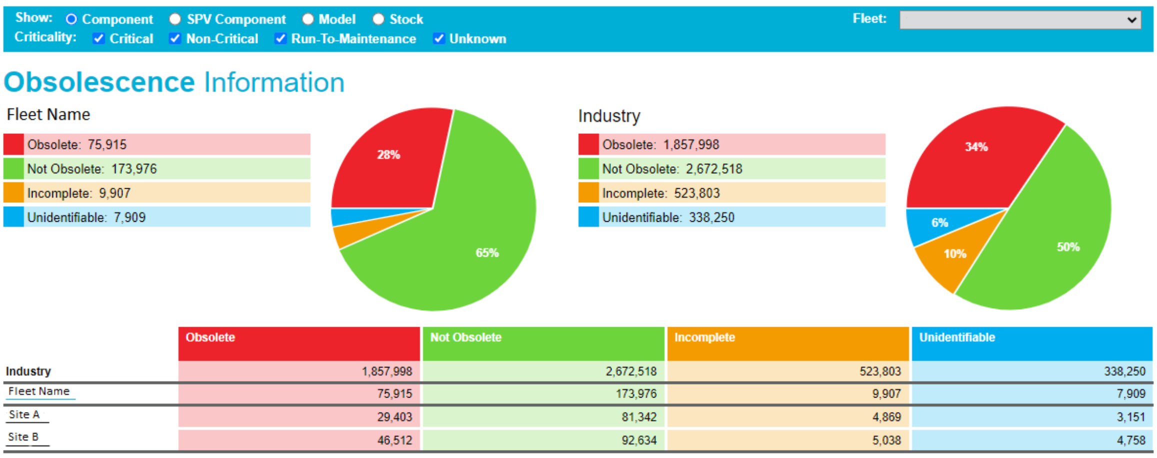

Figure 1. POMS: A site's obsolescence information compared to the industry.

While some power stations continue to meet the challenge with individual efforts or through local networks on a planned, emergent, or reactive basis, a proactive obsolescence approach would prevent the need for quick turnaround and the high costs of expediting both engineering work and the delivery of replacement parts to provide a solution in the least amount of time.

3 PROACTIVE OBSOLESCENCE AND INDUSTRY SOLUTIONS

There are several key steps central to the development of an effective proactive Obsolescence Management Program. At the core of these steps is a clear procedure. This procedure should outline division of work and track branching action paths to provide effective solutions to obsolescence issues. The industry should also benefit from the latest technology and innovative solutions available, such as the Proactive Obsolescence Management System (POMS). With the proper planning and with partners like Westinghouse, utilities can ensure that obsolescence and aging challenges are being addressed in the safest, most competitive manner available, meeting all regulatory and industry requirements.

Roles in an Obsolescence Program: When building the framework for a plant obsolescence program, it is important to understand who will be responsible for actions falling within the scope of the program. The responsible personnel need to ensure clear and concise communication between responsible plant organizations during the obsolescence process. An Obsolescence Management Program requires participation from various plant organizations and the owner of the obsolescence program is responsible for coordinating the activities of this interdisciplinary program.

Methodology: Proactive obsolescence can include activities such as identifying obsolete items before they become an issue, proactively installing upgrades or modification to improve plant performance, and optimizing maintenance so that spares and replacements last longer on the shelves. For example, without a proactive program, most plants would not realize items are obsolete until they attempted to purchase them, which is likely too late to find a solution and work would be cancelled. The industry currently focuses on four major elements for a proactive approach – identification, prioritization, solution implementation and monitoring performance of the obsolescence program.

Sharing Solutions: It is important to recognize that obsolescence is an industry issue and that it is best undertaken collaboratively. Sharing solutions is becoming increasingly more important as more and more utilities tackle obsolescence issues and discover solutions. Industry involvement and participation in events such as NUOG conferences can be very beneficial to stay up on the industry best practices, and the largest issues facing the industry.

Industry Tools: An effective program can utilize existing industry software tools, such as the Proactive Obsolescence Management System (POMS), to assist in several tasks. These tasks can include identification and prioritization of obsolescence issues impacting sites, developing both temporary and permanent solutions, sharing potential solutions through industry collaborative efforts, monitoring solutions to ensure obsolescence has minimal to no effect on plant production, and tracking the effectiveness of developed obsolescence programs.

4 CURRENT CHALLENGES

Beyond the Obsolescence Management challenge, nuclear utilities have been faced with the challenge of reducing overall operating costs while maintaining or improving equipment reliability to stay competitive in today's energy market. Some of the current challenges that the nuclear industry is facing now include:

- The nuclear site's Preventive Maintenance (PM) programs are providing acceptable reliability but are expensive and resource intensive creating a need to optimize the level of PM tasks necessary to achieve a balance between equipment performance and effective resource use.
- Operating organizations typically have limited resources and capabilities to meet all identified needs.
- Incomplete equipment BOMs
- A small volume and narrow market targeted procurement process for individual sites

- As it pertains to material procurement, it began to be understood that the volume flow rate of the procurement process organization is limited (analogous to a piping system). If one orders more than the capacity of the process, one will not get all the material requested. This flow rate is limited by the most resource constrained activity (i.e., the most ‘bottlenecked’ organization).

Initially these challenges prompted companies that operate North America’s nuclear energy facilities to have partnered on a multiyear strategy to transform the industry and ensure its viability for consumers, as well as its essential role in protecting the environment. According to the NEI, “This strategic plan, called Delivering the Nuclear Promise®, strengthens the industry’s commitment to excellence in safety and reliability, assures future viability through efficiency improvements, and drives regulatory and market changes so that nuclear energy facilities are fully recognized for their value.” The US Nuclear Industry continues to work to improve their response to material availability in support of safe continued plant operation. Similarly, nuclear power plants in Europe adopted similar measures to optimize their operating costs. It is important to note that suppliers play a key role in this initiative providing specific ideas that could redesign, modify or re-engineer a nuclear power plant operating or support process or processes.

5 THE VALUE OF DATA

With the use of world class analytics, the vast amount of data being collected in the power generation industry can be examined to uncover hidden patterns, unknown correlations and other useful information that can be used to address the site’s current challenges, make better decisions, and reduce downtime. This data analytics can allow the focus of utility resources on material challenges based on plant maintenance and operation activities impact dates.

6 OBSOLESCENCE AND ASSET MANAGEMENT INNOVATION

The principles that have driven the obsolescence management program can be applied to other areas of the station to understand the installed base, forecast the parts that the station will require, prioritize engineering solutions, and optimize performance. This can be achieved through Westinghouse’ proven digital technology designed to optimize the operational lifetime of nuclear power plants. The digital technology utilizes worldwide nuclear operating data to provide best-in-class asset management services to the nuclear industry. This enables Westinghouse to convert that intelligence into valuable insights to help sites improve the operational efficiency of its plants. The approach is as depicted in Figure 2, below.

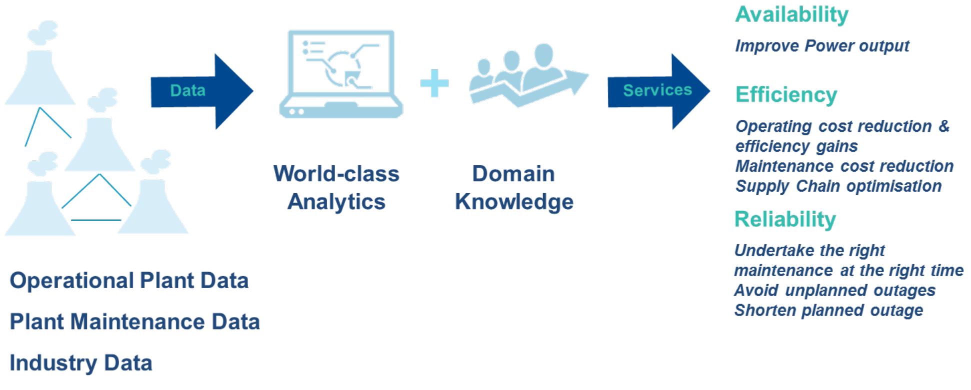

Figure 2. Approach for Obsolescence and Asset Management.

The approach offers the ability to identify opportunities to optimize processes, improve equipment reliability, reduce unnecessary maintenance, improve schedule stability, and planned work survival rates, eliminate parts readiness challenges, and reduce maintenance costs in order to achieve the vision of excellence of the Nuclear Promise. Westinghouse has divided this process into the following four process phases:

1. Verify Parts Demand
2. Optimize Inventory

3. Verify Parts Readiness
4. Create Sourcing Plan

Westinghouse assesses the existing 104-week window (T0 to T-104), evaluating both online and outage Work Orders (WO) as well as Work Plans that will be executed in the window, to identify existing challenges which may be mitigated and opportunities which may be gained to realize near-term benefits.

This includes Preventive Maintenance (PM), Corrective Maintenance (CM) / Deficient Maintenance (DM), and other planned work such as Design Modifications. Westinghouse simultaneously identifies and evaluates each new scope of work entering the 104-week window. This process is underpinned by leveraging Westinghouse's industry experience and industry information from over 170 nuclear units worldwide while combining industry proven data analytics, and equipment health monitoring.

To analyze the material impact of the confirmed obsolescence issues, Westinghouse' POMS has two modules to assist in prioritization: Obsolescence Manager (OM) and PM Forecaster.

The Obsolescence Value Ranking (OVR) score in the POMS OM provides a vulnerability-based priority ranking system. The OVR is based upon the risk consequences of a specific plant obsolescence issue that takes current inventory level and overall demand into consideration. The OVR Algorithm is developed for each utility based on their specific requirements and produces a unique material OVR. OM allows users to establish a prioritized listing of obsolescence issues for a site and can be sorted by affected systems and impact dates. It is also a management tool for tracking a top list of items and the solution progress for obsolescence issues.

The PM Forecaster module allows users to forecast the demand of parts based on open demand through work orders and maintenance plan frequency. It is a planning assistance tool that gives users a method of proactively identifying and prioritizing potential future obsolete part demand issues as part of a site's obsolescence management process.

7 MATERIAL SUPPORT SOLUTIONS

Once plant obsolescence issues have been prioritized, each station can manage their site obsolescence issues using Action Plans. Action Plans enable sites to disposition and track site specific solutions for each item, as well as to plan and graphically determine when obsolescence items will be resolved. This allows site users to cross items off their Top Obsolescence list, tracking issues from identification through full solution implementation. The NUOG Obsolescence Guideline, NX-1037 Rev.2, outlines seven basic solution paths. The paths and their descriptions are listed below in ascending order from the ones that generally require the least resource (engineering, cost, time) allocation to the solutions that require the most resource allocation.

- Surplus Market – The model is in surplus in another location and is available for purchase. This option can be supported through suppliers who sell discontinued inventory, utilities with surplus, or utilities that are shutting down.
- Special Manufacturing Run – This generally stems from an industry collaboration effort. Utilities will join and convince a manufacture to reproduce an item that is needed on a large scale.
- Rebuild/Repair/Refurbish – Sometimes an obsolete component may have piece parts that are still available for purchase. These parts could be used to rebuild/repair the item. A manufacturer may support refurbishments of the item.
- Cannibalization – Parts required for an installed component are taken from a spare that is in storage, abandoned in place, or inoperative. This is most useful as a temporary solution in an emergent need scenario.
- Substitution – A comparison between technical information from a new model and an obsolete model is made in this process, and an equivalency evaluation is completed. These are typically replacements recommended from the original manufacturer, or a discovered compatible item from another utility through shared solutions.

- Reverse Engineering – This involves establishing product specifications and definition of critical characteristics acceptable to duplicate the obsolete item and recreating it through some manufacturing process.
- Design Change – This is a modification to the plant. It is generally the costliest solution, and one that requires the most resources to complete.

The focus is to optimize the engineering that goes into finding a solution. The process recommended by NUOG is one that focuses on the least expensive solution first, then moving onto more expensive and difficult solutions until a viable solution is found. This has two effects: it minimizes cost and provides a strong justification for more expensive solutions.

Westinghouse is conscious of its role as a leading nuclear supplier and has dedicated engineering teams to provide support to any of the seven solution paths. In the areas of substitution, reverse engineering, and design change Westinghouse can take advantage of thousands of replacement parts being supplied to the industry every year. This includes identification of possible replacement items used in the nuclear industry, in terms of acceptance as an equivalent or alternatively acceptable product through the design change process, Commercial Grade Dedication services (includes testing and seismic and/or environmental qualification) - dedication of commercial grade items for use in safety related applications. Westinghouse utilizes the applicable nuclear industry standards (EPRI NP-5652, NQA 1-2015) as well as station specific requirements to develop the appropriate engineering support documentation package. This includes analyzing and developing the specification / project of a product, by using the technique of “reverse engineering”, sufficiently detailed, so that based on it a product with identical characteristics to those of the original product can be manufactured and procured

Westinghouse Procurement Engineering services develops Commercial Grade Dedication instructions which are used in conjunction with our Westinghouse product expertise to provide Commercial Grade Dedication testing and inspection services. This identifies technical critical characteristics to provide reasonable assurance that the item supports the identified safety function of the item.

CONCLUSION

Obsolescence management requires continuous identification, prioritization, resolution, and program monitoring. By deriving insight from data, through the application of advanced analytics, site can benefit from early and informed decision making. A successful obsolescence management program also requires the creation of a dynamic procedure that supports the plant processes, industry involvement, and stakeholder communication. In hand with the process, utilization of industry tools, such as POMS, can increase efficiency and plant reliability, improve data integrity, and add value by ensuring the most appropriate solution method is selected. Industry and supplier involvement will also aid in a strong program by gaining synergies in solution development. The knowledge and capacity of nuclear suppliers engineering expertise will allow obsolescence solutions for fleets/sites to continue safe, reliable, and economical long-term operation.

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