INUOG-2019/001, REV.0

INUOG, International Nuclear Utilities Obsolescence Group

Guideline for establishing Management of Obsolescence.

INDEX

1. Executive Summary

Obsolescence in the nuclear industry is an increasing concern and plants are in the process of developing or improving programmes to specifically manage the problems related with plant equipment obsolescence.

This document has been developed by an International Nuclear Utilities Obsolescence Group (INUOG) Working Group to be used as a guidance document to obsolescence and it has identified a number of key references to help any utility to start an obsolescence programme at their utility.

2. Introduction

In February 2000, representatives from North American nuclear utilities formed the Nuclear Utility Obsolescence Group (NUOG), an organisation dedicated to solving problems related to obsolete plant equipment. In the spirit of the Institute of Nuclear Power Operations' *Principles of Sharing*[1] agreement signed by the leadership of all U.S. nuclear utilities, NUOG members exchange ideas and information in an amicable environment in the best interests of economy and nuclear safety.

Then, in July 2015, INUOG formed in Europe, and expanded to Asia, to support nuclear utilities in creating a proactive obsolescence programme and promote sharing of obsolescence information and solutions in these regions. The effectiveness of these groups in reducing the plant risk due to equipment obsolescence depends on independent management of each utility's obsolescence programme and the diligence with which these programmes exchange information within a common database that identifies specific obsolescence problems and their solutions. The central stations for this information are OIRD, POMS, and the NUOG & INUOG Project Centres. The process of information exchange is depicted below in a simple block diagram.

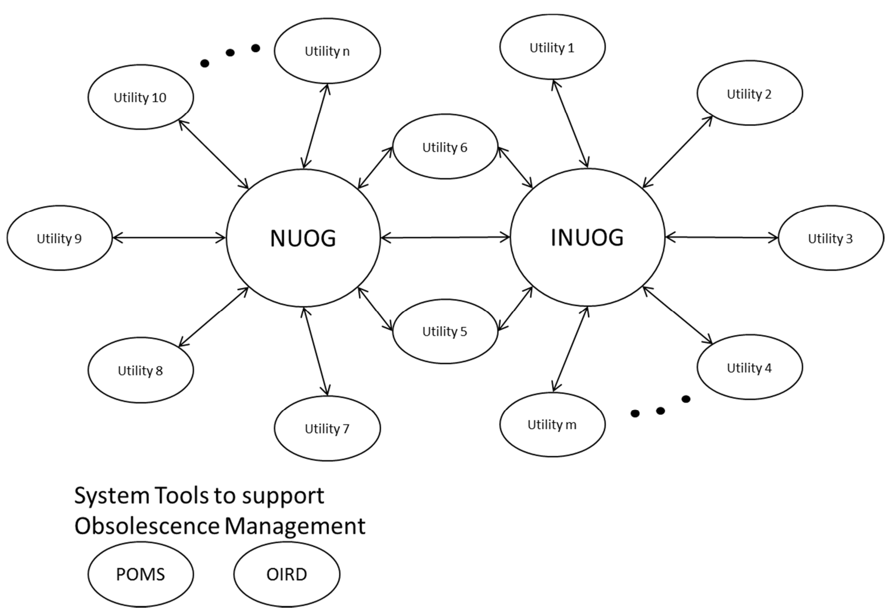

Figure 1. Information Exchange.

[1] Available on The Institute of Nuclear Power Operations website - http://www.inpo.org.

This guideline provides the framework for nuclear utilities to develop an interactive obsolescence programme and processes. The framework contains four main elements: Organisation (section 5.5), Methodology (section 5), Information Exchange and Collaborative Initiatives (section 6), and Monitoring (section 7). Although needs and resources for obsolescence programmes and processes vary among member utilities, each utility faces similar obsolescence problems that require similar solutions. Focusing the industry's problem-solving capabilities in a cooperative effort will strengthen the reliability of nuclear power stations and will benefit all participants.

3. Purpose

The intent of this guideline is to provide stations or fleets, which are at the beginning of their obsolescence journey, with a general format for development and implementation of a proactive obsolescence programme to manage the impact of obsolescence on the availability and reliability of systems, structures and components (SSCs). Each utility should tailor its programme to its specific needs and implement processes for communicating with other nuclear utilities through routine use of obsolescence tools, i.e. POMS or OIRD.

Many plants have already implemented a proactive obsolescence programme. Studying these processes can provide lessons learned and challenges or strengths experienced by plants. Obsolescence good practices and lessons learned can be adapted from, e.g.:

- Data from enterprise asset management systems may be incorrect or incomplete, therefore it is recommended to review the data and verity its accuracy and completeness. Data clean-up or quality of data in your management systems may be required to be cleansed before entry into POMS or OIRD;
- A complete plant equipment database with manufacturer and part information is an important prerequisite for a successful obsolescence programme. Therefore, data clean-up efforts are considered and performed as needed with data for safety-related and critical equipment first;
- Maintaining an obsolescence Top-10 list and other priority lists is a good practice that can be valuable as a visible way to track the most important obsolescence issues;
- Management buys in to the obsolescence programme and regular meeting structure to support the obsolescence;
- Monitoring the goals and milestones for the obsolescence programme, typically on a quarterly basis;
- Identifying and sharing successes and failures associated with obsolescence issues; and
- Industry software tools may help in proactive programme development and implementation, i.e. POMS or OIRD.

The plant can use a benchmarking questionnaire and perform similar self-assessment at the operating organisation and compare their results / responses with results of benchmarking in obsolescence processes and management.

4. Scope

This guideline covers a five stage approach focused on "parts obsolescence," and "component obsolescence". This guideline does not address "design or system obsolescence," which refers to the wholesale replacement of plant systems and other major apparatus that require unique large-scale project management.

4.1 Re-Active vs Pro-Active

There are two routes by which obsolete items and obsolescence of parts are identified and managed, reactive and proactive.

- Reactive whereby obsolete parts and components have been identified internally or the site has been informed by suppliers that a part is to become obsolete in the future.
- Proactively where suppliers are contacted to find out if the part is obsolete or if there is a planned future obsolescence date.

Within each of these two routes there are advantages and disadvantages. The figure below provides some further details of each of these routes through which obsolescence is identified.

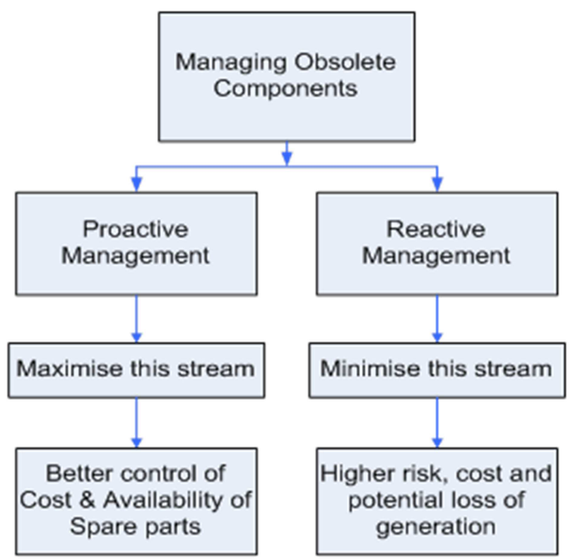

Figure 2. Reactive vs Proactive.

5. Five Stage Approach

In alignment with industry guidelines and international best practices, the following five stage approach is recommended for the development of a strong obsolescence strategy.

- Identify
- Prioritise
- Implement solutions
- Monitor, improve, and share
- Develop organisational interfaces to support the four basic elements

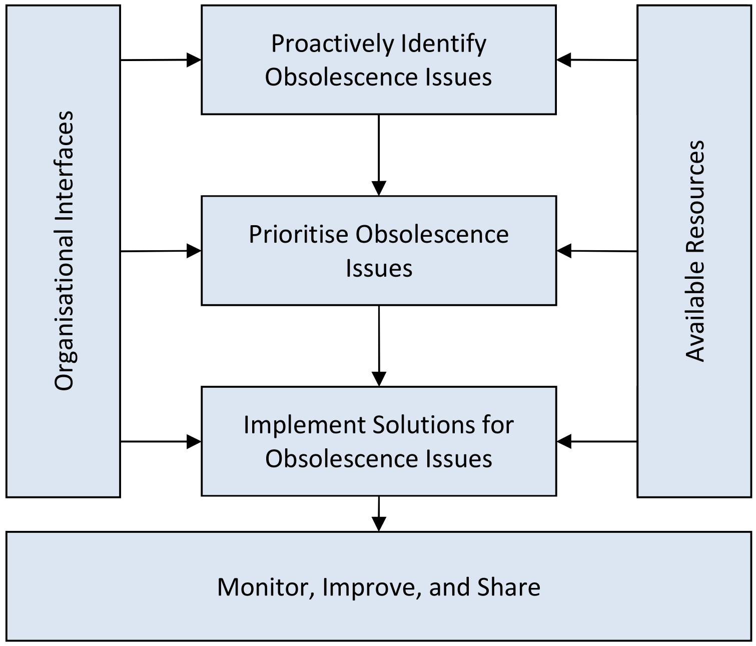

Figure 3. Five Stage Approach.

5.1 Identify

Identifying the scope of installed equipment and replacement items that are no longer manufactured or are otherwise difficult to procure and qualify is the first step. Obsolescence can be identified through the processes listed below:

- Demands due to reduced spare inventory;
- Demands due to plant preventive and corrective maintenance;
- Plant personnel who identify issues during daily plant activities;
- Inputs from suppliers;
- Information from other plants or from external sources;
- Proactive vulnerability reviews (targeted reviews of plant equipment to identify obsolescence problems in advance of discovery through equipment failure or through the daily procurement process);
- System, programme, and/or component health reports and assessments;
- Industry obsolescence databases; and
- Supplier contact reviews or other relevant factors.

5.2 Prioritise

A priority ranking should be developed to risk rank obsolescence priorities for the obsolete components in a manner that determines the highest obsolescence vulnerabilities to the plant. Three focus areas are taken into consideration for an initial assessment:

1. The importance of the component to the plant; criticality of equipment should be used as an indicator of importance to the equipment reliability
2. The plant demand for the part; and
3. Spare part availability in the plant warehouse.

Once a solution is identified, a time test should be performed to evaluate the duration and/or complexity of the solution. This could be assessed as a short, medium or long term solution and the utility will decide if that solution is applicable or not or look for other alternatives.

This prioritisation scheme is performed based on component criticality classifications, work order information, stock history, failure history, or any additional criteria determined by operating organisation. The relative importance of each factor is determined by the operating organisation, and a relative weight or importance is assigned for each factor based on operating experience, the prioritisation scheme changes over time as the programme matures to incorporate lessons learned.

It is possible to have enough spare parts in stock of the obsolete item in good conditions to guarantee safe and reliable operation for a reasonably long period of time. Each site can have plant specific priorities. Generally, the following factors are considered when prioritising proactive obsolescence challenges:

- Number of identical equipment in operation in the plant;
- Current inventory levels;
- Consumable history of spare parts;
- Failure rate of equipment;
- Historical lead time;
- Maximum and minimum stock revision;
- Upcoming demand for maintenance;
- Ageing of equipment in stock;
- Classification of the equipment based on criticality (critical, non-critical, run to maintenance);
- Safety impact and reliable operation of the plant if failure/unavailability of that item occurs;
- Ability to maintain obsolete component using available spare parts.

5.2.1 Component/ System Serviceable?

The decision making process should ascertain if the component/system is in service and working or if it is defective and irreparable.

If the component/system is in service and working then carry out a risk of failure assessment which should consider:

- Critical component analysis;
- Risk of trip;

- Operability and availability;
- Historical data;
- Mitigation against failure i.e. increased maintenance, performance monitoring, etc.

5.3 Implement Solutions

Implement solutions for obsolete items in an effective and timely manner. The types of solutions can vary from minor design changes and equivalency evaluations to reverse engineering and major design modifications. Based on available response time, the least expensive solutions can be researched, and a parallel path approach can be taken until the issue is resolved. Usually operating organisation prefers a graded approach to identify the least costly and resource intensive solution to solve the problem. Possible solutions are the following:

- Equivalent replacement, surplus markets, and special manufacturing runs;
- Rebuild/repair, reverse engineering, and re-engineering;
- Re-use, Use from other components, life-time buy;
- Design change; and
- Do nothing.

The optimum solution should be determined on a case-by-case basis. However it may be possible to group issues together e.g. by supplier or type and alternatives sourced together.

5.3.1 Solution Options

The following are the typical obsolescence solutions that should be considered in each case. It is not an exhaustive list.

5.3.1.1 Substitution / Equivalent Replacement

Substitution is probably the most common solution to equipment obsolescence problems. Any substitution requires a formal engineering review to analyse the inter-changeability and its impact on system performance, and the applicable plant design drawings may need to undergo formal revisions.

If the obsolescence issue is due to not being able to obtain a safety related item that was controlled under the auspices of a QA programme, safety-related subcomponents may be procured as commercial grade items and dedicated by the licensee under their approved QA programme. Commercial-grade dedication[2] is a method of accepting commercial grade items for use as basic components in safety-related applications. A safety related item meets the regulatory definition of basic component.

5.3.1.2 Repair/ Refurbishment

Repair and refurbishment are sometimes interchangeable. However, there are important differences that may need to be considered when looking at these options.

[2] ELECTRIC POWER RESEARCH INSTITUTE, Plant Engineering: Guideline for the Commercial-Grade Items in Nuclear Safety-Related Applications (EPRI 3002002982), EPRI, Palo Alto, CA, September 2014.

Refurbishment refers to the restoration of existing equipment plant items or spares which may involve replacement of sub items that make up the equipment or components which may or may not be defective.

Repair involves the replacement of damaged, worn, or faulty equipment or components to a specified condition.

The repair of an existing plant item is an option that should be considered if:

- The cost of a new item is significant;
- Alternatives are not available;
- The EC and safety case requirements are high in resource and cost making an alternative unattractive;
- Item Equivalency – low cost option;
- The cost of repair / refurbishment is low;
- Suitable repair vendors are available;
- Suitable repair / test specification are available.

The repair of items can only be sustained whilst the item is in a “fit” state for re-use once repaired. At a point in time, the item will be beyond repair and an alternative must be sought. The repair option will however give the station time to consider other options for a longer term solution.

To ensure the item is repaired to the appropriate “quality”, the repair vendor will require specifications, drawings, test details etc.

If the above information is not available then a repair would involve potential risks because the station may receive non-conforming parts and, if not detected, may fit non-conforming parts to plant which may result in plant failure.

If appropriate specification details are not available an option may be to initially carry out some reverse engineering (section 5.3.1.3) to produce sufficient details to continue with repair.

5.3.1.3 Reverse Engineering

Reverse engineering is the process of developing product specifications sufficient to duplicate an item function by reviewing technical information and conducting physical examinations of an original specimen [Note: this may require application of different / new technology]. The process can be expensive depending on the complexity of the items involved, and there must be legal considerations such as patent infringement or violation of a trade secret or proprietary agreement. Check before proceeding with Legal Department to avoid any violation of commercial or intellectual property rights. Re-manufacture may carry a medium level of risk as a solution due to the potential knowledge gaps resulting from unanticipated changes or configuration control; it is also worth a consideration of the elevated costs and time to deliver the right solutions for the Utility.

In general, reverse engineering projects are undertaken because the original manufacturer is no longer in business or has been unable to supply the product, and no acceptable substitutes are available. Confirmation of this should be gained from the OEM via Supply Chain to ensure this is the case. Once an item has been successfully reverse engineered and validated, it may be manufactured.

5.3.1.4 Re - Engineering

Re-engineering is the process of developing product specifications sufficient to duplicate an item function by reviewing technical information and conducting physical examinations of an original specimen, while retaining the same technology platform. The above (section 5.3.1.3) warnings of legal, patent and commercial infringement still apply and advice must be sought to avoid risk exposure.

5.3.1.5 Re-Use

When an item is obsolete, re-use should be considered as an interim solution to complement the rebuild/repair option. It is only an interim solution for obsolescence issues, as each repair depletes the total inventory of spares with no replacement unless other ‘used’ spares are purchased.

The re-use of plant items is defined as the removal of parts needed to rebuild a component from components containing identical spares. The following outlines the strategy:

- Defective items are to be identified as suitable for re-use.
- They are to be suitably stored and clearly identified with faults as ‘quarantined’, or ‘hospital spares’.
- Separate catalogue IDs should be created to ensure they are not fitted to the plant.
- Once fitted, adequate testing must be performed to ensure full functionality of the equipment.
- Work Orders associated with the plant should carry a warning of the obsolescence, so that equipment is not disposed of as scrap until it has been assessed for useable spares.

Note: AVOID disposal before a full review of re-use potential has been carried out.

5.3.1.6 One off Purchase / Lifetime Buy

This is an option to be considered if:

- We have been advised by the OEM that the item will no longer be produced and there is no alternative supply
- There are no alternatives available based on a comprehensive investigation
- The cost of the items is minimal & therefore outweighs the cost and resource requirements of an EC or IEE
- The cost of the items is significant however the items are complex and critical to plant
- The items are not shelf life inhibited (i.e. will deteriorate within the station life and therefore will not sustain the plant through the station life including extensions and de-commissioning).
- Could be used as an interim measure whilst seeking alternative longer term options if there is limited supply or shelf life issues.
- The manufacturer is prepared to manufacture a “one off” production run.

5.3.1.7 Do Nothing

This is an option to be considered if:

- If the risk is low value
- Solved as reactive obsolescence solution at the time of plant failure.

5.4 Monitor, Improve & Share

Effective obsolescence management considers performing an obsolescence programme or process assessment and developing health report and metrics. Programme metrics are directed to senior management to identify risk, progress, financial resources, and to gain alignment of priorities for an obsolescence programme. A description of metrics can be found in section 7. An obsolescence programme assessment is typically performed to identify gaps relative to plant obsolescence programme, international guidelines and other operating organisation programmes and processes. The assessment identifies recommended actions for strengthening the effectiveness of the obsolescence programmes and processes.

It is important to monitor the effectiveness of the obsolescence programme and continuously seek to improve performance and efficiency.

Two types of activities are recommended:

- Periodical obsolescence programme assessment; and
- Development and monitoring of meaningful performance indicators on a periodic basis (e.g. quarterly).

Consider the following obsolescence questions and attributes when developing the assessment scope:

- Is there an obsolescence programme or process description or guideline describing implementation?
- Does it include roles and responsibilities?
- Is there a designated obsolescence owner?
- Is there an obsolescence committee involving key departments such as operations, maintenance, engineering, procurement?
- Are obsolescence vulnerability reviews performed to identify critical obsolescence issues?
- Is there a tools being utilised to support identification, prioritisation, and research of solution for obsolete components?
- Are there information exchanges or collaboration initiatives with other operating organisation?
- Do system and/or component health reports contain a section on obsolescence vulnerabilities?
- Are metrics used to monitor the programme and process health?
- Has the programme proactively resolved any obsolescence challenges?
- What lessons have been learned (what could have been done better) from the obsolescence programme development and implementation?

- How the plant measures success? What are the key performance indicators?

Successes and best practices obtained in relation to the obsolescence programme are encouraged to be shared within the industry. INUOG is one available forum for sharing and collaborating in the area of obsolescence. INUOG organises an annual face to face meeting, with telephone conferences being held on a monthly basis, where utilities can join to share or learn from peers in the industry. Sharing best practices may also come from other areas in the industry such as benchmarking trips to other utilities or WANO & SALTO Peer reviews.

5.5 Organisation

The purpose for developing a proactive programme or process is to have the right organisation setup to manage the obsolescence process. This programme should detail the specific roles and responsibilities for each group with a shared responsibility for obsolescence. The organisation starts with one individual, the obsolescence owner/lead. As the programme or process evolves, its success will depend on enlisting expertise from a wide spectrum of plant disciplines with defined roles and responsibilities.

A proactive obsolescence programme can be developed for a stand-alone site or for a utility with multiple sites. The images below depict sample organisation structures for a fleet setup and a single site setup.

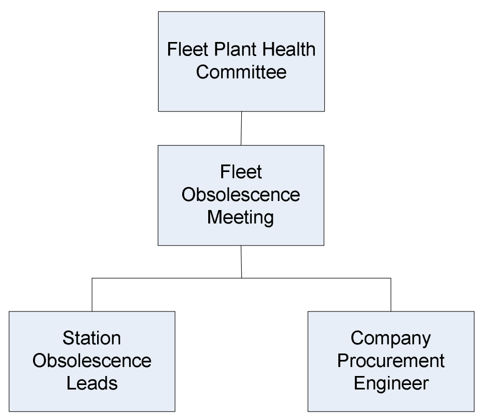

Figure 4. Fleet Obsolescence Structure

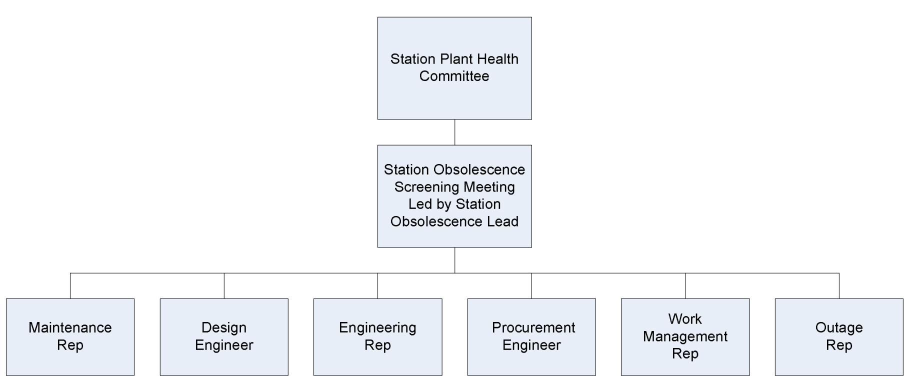

Figure 5. Single Site Obsolescence Structure

5.5.1 Obsolescence Owner/Lead

The obsolescence owner delivers the obsolescence programme on behalf of their utility, reports up to the Management team on performance of the obsolescence programme, and leads the coordination of the obsolescence programme cross functionally across departments. Management reporting includes governance of the obsolescence programme and processes, including establishment of expectations for utilisation of proactive obsolescence tools, i.e. POMS & OIRD. The obsolescence owner/lead should also develop fleet/station KPI's / key metrics to measure success of the programme and process effectiveness, improvement opportunities, and resource requirements. The obsolescence owner should link into the station's equipment reliability programmes and processes, and integrate into station and fleet processes with defined roles and responsibilities.

5.5.2 Obsolescence Screening Meeting Committee

A successful obsolescence programme should have a cross functional committee to support delivery of the programme with different departments working together to identify, prioritise and resolve obsolete components on the power plant. The obsolescence committee would provide an update regularly to the station or fleet plant health committee to report on successes and support and identify any plant risk and recommended actions.

6. Various sources of Obsolescence

In order to integrate obsolescence management processes into the organisation, sufficient resources should be in place throughout the organisation to identify obsolescence threats, using internal and external organisations to support the resolution of the obsolescence vulnerabilities.

For example, the Supply Chain organisation can provide forward–looking information when it learns that a supplier may discontinue a product line or that certain replacement items are becoming prohibitively expensive and requiring longer lead time due to custom manufacturing runs. This is in addition to the reactive day–to–day identification of obsolete items due to 'no–bids' from previous suppliers.

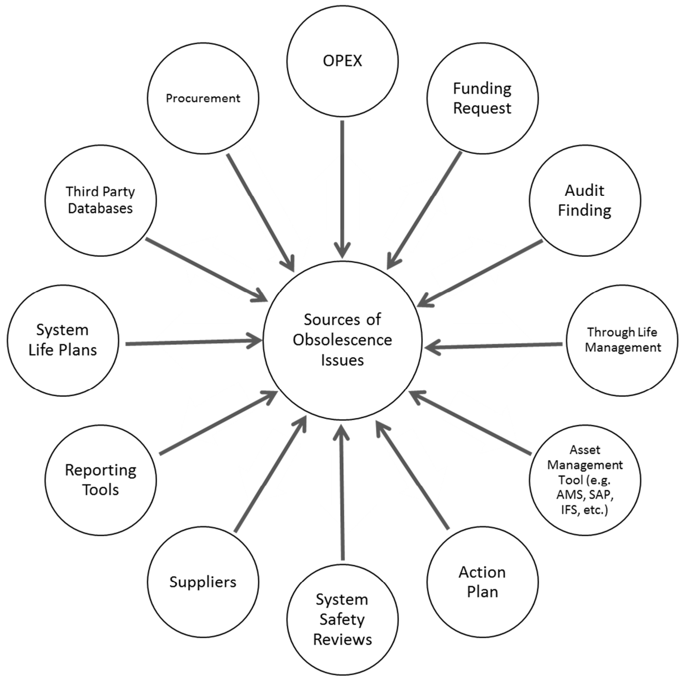

Figure 6. Information Exchange

The system health reviews may also be used as a resource to identify items that have become obsolete. Input to system/component health reports should include a review of spare parts availability for critical systems and components – such review may identify obsolescence issues that require resolution.

As the repository of information regarding system/component health, system and component health reports should include a discussion on obsolescence threats. This may also be applicable to programme health reports, if utilised.

7. Measuring Metrics & Successes

The processes that are implemented at each site are monitored with the final intention of controlling the process, analysing the efficiency and improving it. What we need to measure and the type of output will be different depending on where you are on your obsolescence journey.

There are numerous classifications for such indicators, but the division will be only in two groups, these are: Leading and Lagging.

- Leading indicators are output orientated; these indicators will measure normally the end of a process. Ex. Number of obsolescence cases solved.
- Lagging indicators are input oriented; these indicators will measure the aspects that affect to the process. Ex. Number of man-hours expended in obsolescence issues.

See reference document INUOG-2018/002 for more details on establishing obsolescence indicators.

8. Reference Documents

As a guide for establishing a proactive obsolescence programme, the following tables provide a list of industry references.

Obsolescence Management documents

	Document Reference	Document Title
1	IAEA TOP401	Technological Obsolescence Programme, IGALL
2	NUOG/INPO NX-1037, Revision 3	(International) Nuclear Utility Obsolescence Group Obsolescence Guideline
3	EPRI 1015391	Plant Support Engineering: Obsolescence Management - A Proactive Approach
4	EPRI 1016692	Plant Support Engineering: Obsolescence Management: Program Ownership and Development
5	EPRI 1019161	Plant Support Engineering: Proactive Obsolescence Management: Program Implementation and Lessons Learned
6	EPRI 3002001694	Obsolescence Program Manager Computer Based Training
7	NUOG Rev. 0	Component-Based Solution Guide
8	NUOG 2017	Obsolescence Metrics Desktop Guide
9	INUOG-2018/002	Guideline for establishing obsolescence indicators.

Other Industry documents that address obsolescence management

	Document Reference	Document Title
10	IAEA DS485	Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants
11	IAEA NS-G-2.12	Ageing Management for Nuclear Power Plants, Safety Guide
12	SALTO Missions Highlights_2015-2018	SALTO Missions Highlights 2015–2018, Long term operation safety practices in nuclear power plants

9. Definitions

NUOG: The Nuclear Utility Obsolescence Group, an organisation dedicated to solving problems related to obsolete plant equipment. NUOG's obsolescence-related informational web page contains guidelines, equipment studies, Obsolescence Programme Business Case, survey results, INPO AFI summaries, NUOG meeting minutes, reports and papers, database instructions, and other NUOG-related information, available at http://www.nuog.org.

INUOG: The International Nuclear Utilities Obsolescence Group has been formed to drive the International Nuclear Industry's effort to further collaborate in the area of obsolescence. Developing synergies across the industry and a platform for nuclear utilities to openly share thoughts, ideas and successes in relation to obsolescence, INUOG is a forum for development of process, tools, measures, and techniques to mitigate risks at a station level with the goal of supporting and improving Equipment Reliability and Availability.

POMS: The Proactive Obsolescence Management System is a service that determines what installed equipment is no longer supported by the manufacturer, and contains tools for obsolescence prioritisation and resolution, available at *http://www.pkmj.com.*

OIRD: The rapidpartsmart® Obsolete Item Replacement Database.

Metric / indicator: A business metric is a quantifiable measure businesses use to track, monitor and assess the success or failure of various business processes. The main goal of measuring business metrics is to track cost management, but the overall point of employing them is to communicate a company's progression toward certain long- and short-term objectives. This often requires the input of key stakeholders in the business as to which metrics matter to them.

KPI: A quantifiable measure used to evaluate the success of an organisation, employee, etc., in meeting objectives for performance.

Lagging indicator: Indicator that gives information about the input of one process.

Leading indicator: Indicator that gives information about the output of one process.

10. Acronyms and Abbreviations

EC	Engineering Change
IEE	Item Equivalency Evaluation
INUOG	International Nuclear Utilities Obsolescence Group
KPI	Key Performance Indicator
NUOG	Nuclear Utilities Obsolescence Group
OEM	Original Equipment Manufacturer
OIRD	RAPID’s Obsolete Items Replacement Database
OPEX	Operating Experience
POMS	Rolls-Royce’s Proactive Obsolescence Management System
QA	Quality Assurance
SPV	Single Point Vulnerability
SSC	Systems, structures and components
WANO	World Association of Nuclear Operators
SALTO	Safety Aspects of Long Term Operation