OBSOLESCENCE IN NUCLEAR INDUSTRY

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Abstract

Most nuclear plants around the world are roughly 15 to 30 years old. The design and procurement of CANDU plants took place from the late 60's to mid 80's (i.e., 20 to 30 years vintage). Most equipment originally installed in these plants is obsolete or the manufactures are out of business or their production has been discontinued due to technological evolution. In order to maintain operation of nuclear plants with safety integrity and commercial viability, certain spare parts must be available at the plant all the time.

The objective of this paper is to identify an optimum cost-effective approach that solves obsolescence problem efficiently and without duplicating efforts. The Nuclear Utility Obsolescence Group (NUOG) has embarked upon the following major tasks:

- Developing a Guideline for use by the utilities that addresses obsolescence,
- Collection of obsolescence data in a database (Web-based) to be shared by all members,
- Motivation of the suppliers to engage them in obsolescence solutions,
- Increase in awareness among the utility management to consider obsolescence as a priority issue and allocate funds to address them pro-actively.
- Coordination with other industry groups (EPRI, INPO, NEI, BWROG etc.) to avoid duplication of effort in obsolescence resolution process.

The NUOG strategy is based upon the principles of sharing. It advocates sharing of obsolescence solutions and concerns among the utilities.

Candu Owners Group Inc. (COG) has initiated self-assessment of obsolescence in the members' plants. The purpose of self-assessment is to provide baseline information that would help identification of obsolescence and coordination of their solutions. The following areas are covered in the self-assessment initiative:

- Identification of obsolete components in selected systems in the plant.
- Assess effectiveness of the current obsolescence identification process and in resolution of obsolescence Issues in the plant
- Identification of common Candu plant design specific obsolescence issues
- Benchmarking of good obsolescence practices followed in the plant

The benefits of Obsolescence Self-assessment would be shared among the COG members. It will also provide an opportunity to solve common obsolescence issues collectively.

The author believes that the combination of initiatives taken by NUOG and COG would lead to cost-effective and pro-active identification of obsolete components and sharing of solutions among all participating nuclear utilities. The nuclear industry will be the net beneficiary in achieving safer, productive and competitive operation.

1.0 Introduction

The majority of operating nuclear plants were designed and built from the mid sixties to late eighties in the North America. Most vendors who supplied original equipment are not in business any more. A major segment of nuclear pressure boundary component suppliers have dropped their qualification program and it has made the operation and maintenance of these components challenging. Due to stringent quality and performance requirements of nuclear components, it is not easy to find replacements that meet form, fit and function of the original component. In short, the nuclear business world is shrinking in North America due to lack of growth in the nuclear industry and shutdown of nuclear reactors in US and in Canada.

Technological evolution and demise of traditional analog design forced many equipment manufacturers to switch to digital technology. It accelerated the rate of obsolescence of analog technology that is considered as the workhorse of process controls in all nuclear plants. For most industries this evolution was not a major challenge, as switching from analog to digital also contributed to improvement of their performance. However, changing safety significant component in a nuclear plant is not an easy task. It is not the reluctance of making such changes by the industry, but the total process involved in making such changes that appear to add significant financial burden to industry.

On the other hand switching to digital technology was not a permanent solution to the industry's obsolescence problem. It has been found that digital technology faces much faster obsolescence than the analog technology itself. Most digital equipment becomes obsolete in the time span of 3 to 5 years.

Customized electronic components faces faster obsolescence due to a limited user base which manufacturers do not have much incentive to support. The obsolescence problem is compounded further when buy-outs and mergers occur and the new owners drop nuclear product lines. The process computer and the process control industries experienced such outcomes within the last decade. The changes also affected many software companies that served the needs of nuclear industry.

This paper discusses the options available to address a wide range of obsolescence issues and how to coordinate sharing of their solutions. It is expected that such initiatives would save a large amount of resources by the nuclear power industry and help keeping them competitive.

2.0 Problem definition

When the design of most of today's operating nuclear plants was carried out from late sixties to early eighties, no one anticipated major obsolescence of their selected equipment. Most were concerned with obtaining the manufacturers' assurance that the equipment would perform for projected 40-year plant life. Hence no budget and management strategy was contemplated how to deal with the equipment obsolescence. The technological advances caused the equipment obsolescence faster than the manufacturers going out of business. Those who could not adapt to the new technology or industry changes were out of business sooner than the others. In short, the nuclear industry was not well prepared to face the wide scale obsolescence situation.

On the other hand, equipment performance is one of the key elements of success in the nuclear business. Lack of spares due to obsolescence affects the performance of nuclear equipment. Often the industry attempts to fix the problem in a hurry enduring lots of financial drain and manpower efforts. Obviously, it is not a sound business practice and the initiative can be noted as fire fighting. No utility can be successful unless the business processes are designed to recover from the fire fighting mode to sustained improvement mode. The industry has already

recognized that in addition to improvement in the areas of Human Performance, Maintenance of System Health and managing the risk of nuclear accidents, Equipment Performance is one of the essential elements of success in the nuclear power business. The improvement in equipment performance depends on how the utilities address the following:

- Equipment maintenance
- Quality of Equipment and its workmanship
- Maintenance of spares

Readily available spare is a crucial element in enhancing equipment performance and reduced equipment unavailability. In other words, if equipment spares are not available, the equipment may have faced obsolescence. However, the definition of obsolescence has many interpretations depending on a given situation. For example, when a vendor drops its N-stamp, the equipment is not available in accordance with the same quality requirements and such a situation could very well be as that of an obsolescence, unless other means are available to address the quality deficiency.

3.0 Impact of Obsolescence in Nuclear Industry

Although documented evidence is hard to find, there is convincing evidence that obsolescence has been the cause of loss of production in many utilities around the world. More than 75% utilities do not plan to find obsolete components, as the discovery of obsolescence was made when one tried to buy the spare. Only 25% utilities routinely attempt to identify an obsolete component.

The effort spent by Procurement and Component Engineering to find a replacement component has been increasing continuously and has been found to be inadequate to meet the demand. It has also been found that the utilities rarely share their efforts in solving obsolescence problems with other utilities. Most experts believe that unless something is done sooner by the industry to solve obsolescence problems, the Utilities will face a tremendous challenge in order to keep the nuclear plants economically viable. The option of doing nothing may find many plants and utilities on the brink of shut down, as the cost of finding replacement of critical components in a hurry would be financially prohibitive. In brief, the following are the effects of obsolescence in the Nuclear Industry:

- The obsolescence remains unknown until one tries to buy the component.
- As the parts get old, the aging effect accelerates the failure of components and thus the effect of obsolescence in the plant is further compounded.
- The suppliers are frustrated as individual utilities try to solve obsolescence in isolation. The suppliers find it difficult to support the industry in a cost-effective manner.
- Duplication of efforts is making the nuclear industry less competitive in comparison to other forms of generation.

4.0 Industry Initiatives

In the US, industry leaders have assessed the degree of threat posed to the Nuclear Industry due to obsolescence. There have been many initiatives in the past to address obsolescence. However, most of the initiatives were short lived and did not make any lasting effect to the industry.

- INPO organized a meeting on Instrument Aging and Obsolescence in October 23 & 24, 1995. The author is not aware of any follow-up actions taken by the attendees.
- INPO organized a meeting on I&C obsolescence on May 27 & 28, 1998. Again, the results of specific actions taken by the attendees are not known or well publicized within the nuclear industry.
- EPRI established a database to identify obsolete items about 10 years ago. This database has not been updated to capture new obsolete components and the solutions. In addition, the EPRI database is not accessible to utilities that are not members of EPRI.
- Readily Accessible Parts Inventory Directory (RAPID) established an obsolete items database in 1999, consisting of a handful of sub-components and components, which had very limited benefit to the users.
- The Nuclear Utility Obsolescence Group (NUOG) was set up in November 1999 under the leadership of Wolf Creek Nuclear Station. Currently the membership consists of 30 Nuclear Utilities and 54 Nuclear Stations around the world. NUOG has developed plans to address obsolescence as a collective approach rather than isolated initiatives. The key element of NUOG's initiative is "Sharing".
- The Candu Owners Group (COG) is working with its members to set up a common database of obsolete items and solutions. Obsolescence Self-Assessment among the COG members has been initiated to identify common obsolescence issues, benchmarking of good processes and sharing obsolescence solutions.

The NUOG approach and initiatives to solve obsolescence problems have received support from EPRI, INPO, NEI and other leading industry organizations. The following paragraphs highlight the NUOG approach to date in addressing obsolescence and the Obsolescence Self-assessment among the COG plants. These initiatives will identify obsolete components proactively and share replacement solutions. The RAPID database will be the repository of obsolete components and their solutions. The data shared among the participants of NUOG and COG will alleviate the utility's burden of obsolescence.

5.0 NUOG Initiatives

NUOG was formed in November 1999 under sponsorship of Wolf Creek Nuclear Station. 15 Utilities in the US and COG were the founding members of NUOG. NUOG has set the principles of addressing obsolescence and adopted the resolutions on "Principles of Sharing" passed by North American CEOs under INPO sponsorship.

5.1 Principles of Sharing

- **"As nuclear professionals, we affirm our commitment to share information with each other to enhance the safe and reliable operation of our nuclear power plants. The cooperation is fundamental to our future success"**
- **"Not one of us can achieve excellence alone, and not one of us will fail alone"**
- **"Commercial competition must not erode nuclear operation"**

NUOG members believe that we must not duplicate the effort and as a consequence, a common database would help in sharing obsolescence solutions with others. The NUOG members agreed to develop a common process that would help address obsolescence. The component suppliers will be encouraged to take initiatives for offering obsolescence solutions in order to alleviate utility's burden considerably. These initiatives will not be successful unless there is considerable cooperation among the utilities in sharing their efforts.

5.2 Process Development

NUOG has developed a Flow Chart, which is a pre-cursor of the process that would standardize obsolescence identification and solution. The NUOG members have reviewed the flow charts and the draft methodology, which will be available for issue to the members in early 2001. This process is meant to standardize the members' search for obsolescence identification and replacements. Some of the solutions provided in the preliminary process are:

- Surplus Inventory Market
- Special Component Production Run
- Rebuild Program
- Cannibalization
- Substitution
- Reverse Engineering
- Design Change

5.3 Database Development

The industry needed a means to exchange information on obsolescence identification and solution. The database development is now complete. NUS Information Services has been given the responsibility to set up obsolete items linked to Internet Web based RAPID (Readily Accessible Parts Information Directory) database. This database will be available to NUOG members around early November 2000. The suppliers also have access to this database, so that they can assess the industry need.

5.4 Supplier Involvement

In the past, the suppliers were not given ownership in solving generic industry problems. The suppliers were invited in the August 2000 NUOG meeting to share their expertise in resolving obsolescence issues faced by the nuclear industry. NUOG had an excellent response from the suppliers who were actively involved in offering obsolescence solutions. 16 suppliers from the US and 3 from Canada participated in the Toronto NUOG meeting. In future NUOG committee meetings, the supplier representatives will be invited to participate and contribute in resolving common issues that affects the supply-chain.

5.5 Business Case Development

The NUOG members felt that management had to be sensitized about the negative impact of obsolescence in the nuclear industry, particularly in the areas of competitiveness, production and safety. The members experienced many situations when obsolescence caused loss of production, but lacked appropriate documentation of data. A task team has been formed to develop a business case why obsolescence issues need to be solved on a priority basis.

5.6 Coordination with Industry Groups

A NUOG task team has been set up to coordinate its activities with those of other industry groups, such as EPRI, INPO, NEI etc. INPO has developed EPIX (Equipment Performance and Information Exchange System), that identifies information related to equipment failures, the cause of failure, and the resolution or replacement. The task team is reviewing the logistics of linking

EPIX database with the Obsolescence database in RAPID. NUOG and EPRI held meetings with the objective of elimination of duplication of efforts in addressing obsolescence in the nuclear industry.

6.0 Candu Owners Group (COG) Initiative

The COG initiative is based on COG's basic mandate, "Strength through Cooperation". The sharing of information on obsolescence is clearly an area that will reduce the effort of individual utilities in solving this difficult issue. As a first step, COG has initiated Obsolescence Self-assessment to promote continuous improvement and to identify programmatic issues in dealing with plant obsolescence. The self-assessment process strives to identify low-level precursor issues or trends for early resolution before significant problems occur that could adversely affect plant safety, reliability and continued production. The obsolescence identification and strategy evaluation is a pro-active process. The self-assessment also identifies strengths applicable to plant groups. The following are targeted outcomes of a self-assessment program.

- Identify obsolete components in selected systems in the plant.
- Assess effectiveness of the current obsolescence identification process and in resolution of obsolescence Issues
- Identification of common Candu plant design specific obsolescence issues
- Benchmarking of good obsolescence practices developed by the CANDU plant members

6.1 Self-Assessment Team

The self-assessment team consists of a team leader; two staff members from the host site, one visiting member from another COG member site, one guest member from a US plant and the COG manager.

- The self-assessment team is responsible for conducting assessment of obsolescence identification and provides solutions where possible.
- The team members are familiar with the spare parts strategy of the plant, procurement engineering, component engineering and design engineering functions in general. Knowledge of material purchase, procurement engineering functions, inventory management and database tools is required.
- The team members also identify and document findings of obsolescence concerns, parts availability history, equivalency evaluation, commercial grade dedication, configuration management, etc.

6.2 Self-Assessment Methodology

There are four basic steps in the self-assessment methodology. These are:

- Selection of systems
- Identification of components in a system
- Identification of obsolete components
- Recommendations for replacement strategy for the obsolete components

6.3 Selection of Systems

The assessment is limited to 10 systems important to safety and power generation or where obsolescence has threatened the performance of system functions. The systems are generally selected from the following list:

Moderator System	Emergency Core Injection System
Primary Heat Transport System	Liquid Zone Control System
Emergency Power Supply	Digital Control Computers (DCC)
Airlock and Transfer system	Reactor Regulating System
Negative Pressure Containment	Turbine Supervisory Equipment (TSE)
Shutdown System I (SDS 1)	Shutdown System II (SDS 2)
Electrical Class I/ II Power Supply System	Standby Generator

6.4 Identification of Obsolete Components

The assessment is limited to the 'standard' off the shelf components (e.g. valves, sensors, and relays) and will exclude custom-designed parts and components. The sub-components are not included in the assessment process due to enormity of the volume of work. The first task of the assessment process is gathering of data on the system components, traditional sources are Passport, the Master Equipment List (MEL), Instrument Schedule, Valve List, Technical Specification Sheets etc.

The next step is to identify obsolescence components found in the list via expert knowledge, contacting the vendors on the status of components manufactured by them.

6.5 Recommendation of Replacement Strategies

The last step in the self-assessment is to assess and recommend obsolete parts replacement strategies. The evaluation includes pros and cons of various strategies including refurbishment, form, fit and function replacement, like for like part replacement, reverse engineering, cannibalization etc. as identified in NUOG process flow charts

6.6 Self-Assessment Process

In order to plan and prepare for the self-assessment, the Self-Assessment Team Leader visits the plant prior to the actual self-assessment to work out the logistics of assessment activities. During the week of in-plant self-assessment, the team meets the plant staff members performing functions of Maintenance, Components and Equipment Engineering, Procurement Engineering, Materials Management, Inventory Management, Plant Design Engineering, System Performance etc. Interviews with the host plant staff are conducted to obtain their feedback on various obsolescence issues and their replacements. Good benchmarking process are also identified during the interview process.

6.7 Obsolescence Database

COG is in the process of creating an internet web based Obsolescence Database for the use of the participating COG members. This database is used to identify common obsolescence issues, common solutions etc. The database would be shared with the NUOG database when ready.

6.8 Self-assessment Reports

The report lists the obsolete items found in the Self-assessment process, solutions of obsolete components, programmatic issues, benchmarking good practices in the assessed plants and recommendations. This report will be available to all participating COG members.

- **Phase 1 Report**: After completion of self-assessment at a plant, the report identifies obsolescence issues, programmatic issues, good bench-marking processes etc.
- **Phase 2 Report**: After completion of Self-assessment at all participating COG member plants, the report identifies common issues, common solutions available at another plant and sharing of solutions among the assessed plants.

7.0 Conclusion

Obsolescence is a major concern that has the potential to question the viability of the current nuclear power business. In comparison to other industries, solution for an obsolescence replacement component is much more severe, due to qualification requirements, maintenance of design basis, configuration management, software qualification etc. Hence, all Nuclear Utilities need to respect and practice the principles of sharing agreed by the utilities under the COG and INPO leadership. Sharing of data and obsolescence solution information is a key to survival of nuclear industry in the competitive marketplace. NUOG and COG initiatives are based on these principles. We believe that the utilities are ready to respond to this call and that this initiative will be successful as an important component in improving the performance of nuclear business and competitiveness in the marketplace.

8.0 References

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3. Summary of INPO meeting, Atlanta, Georgia, November 11, 1999
4. NUOG Minutes of August 2000 Meeting in Toronto, Ontario
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