Solutions to Obsolete Equipment in Operating Nuclear Power Plants

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What is Obsolescence?

Obsolescence: having obsolete components in the plant or in the plant's inventory.

The term "obsolete" is used to refer to equipment in plant service that is no longer manufactured or supported by the original equipment manufacturer. In other words it is equipment the plants need but which cannot be easily procured.

Note that this usage of obsolete is different than that used in accounting practice where obsolete refers to items the plant has but no longer needs.

Obsolescence at Nuclear Plants

Obsolescence is a particular problem for nuclear plants because of their age and special requirements.

- Most plants built over 20 years ago.
- Safety related components at nuclear plant require stringent quality standards for materials and manufacture (10CFR50 Appendix B or equivalent).
- Significant number of applications require components qualified for seismic or harsh environment conditions.

Obsolescence problems are aggravated when plants extend operating life or increase capacity.

What Causes Obsolescence

Obsolescence occurs at nuclear plants when the OEM:

- goes out of business or is purchased by another company,
- stops producing the item,
- no longer maintains an Appendix B quality program,
- upgrades or modifies the product's specifications, or
- changes the product in a way inconsequential to non-nuclear customers (often undocumented or unpublicized)

Why does this problem exist?

Economics

- **Many suppliers exited the nuclear business after the nuclear boom of the 70's and early 80's because there was so little market for high quality nuclear products.**
- **Suppliers remaining in the nuclear market no longer produce or support older design equipment when the equipment is replaced by a new design.**
- **There is a significant cost for a supplier to maintain the quality programs required for nuclear applications.**

Technology

- **Some product technologies have changed with the advance in computer products. Example: in other industries, analog and electro-mechanical controls have been largely replaced by digital equipment.**

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Extent of Obsolescence

Surveys at several utilities indicate that a significant portion of the components that may need to be replaced are obsolete:

- Mechanical – 12%
- Electrical – 33%
- Instrument & Control – 27%
- Average – 25%

Risks and Costs of Obsolescence

Reliability and generation risks

- Extended reactor shutdown or derate
- Challenging Limiting Conditions of Operation
- Extending out of service time for important systems

Costs of solving obsolescence problems

- Engineering & Maintenance labor
- Expediting fees
- Outage duration

Average direct cost of obsolescence at a US nuclear plant has been estimated as over $1 million per year.

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Nuclear Utility Obsolescence Group

- NUOG was formed in 1999 to address issues of nuclear plant equipment obsolescence.
- NUOG composed of representatives from nuclear utilities, industry organizations (e.g., INPO, EPRI), and selected suppliers.
- Goal is to share information, coordinate joint efforts, promote communications between utilities, suppliers, user groups, and industry organizations and to provide information that helps suppliers develop solutions.

NUOG Projects

- Obsolete Items Replacement Database (OIRD)
- Nuclear Obsolescence Program Guideline, INPO NX-1037
- Obsolescence Assessment Process Guideline
- Obsolescence surveys
- Equipment Studies
  - ASME code equipment
  - Instrumentation power supplies
  - Capacitors
  - Pyrotronics equipment
  - Woodward governor components

Obsolete Item Replacement Database

- NUOG has championed the creation of the OIRD, which is maintained in conjunction with SCIENTECH's Rapidpartsmart.
- Data on obsolete items and solutions (if known) are provided by utility participants.
- The OIRD now has 11,054 items identified as obsolete, and solutions are currently available for 9,512 of these items. This means at over 80 % of the obsolete items have at least one available solution.

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Example Obsolete items without solutions

- **Pumps 36**
- **Valves 183**
- **Motors 50**
- **Monitors 33**
- **Switches 88**
- **Breakers 22**
- **Sensors 8**
- **Screws 14**
- **Instruments 32**
- **Cable 36**
- **Power Supplies 57**
- **Relays 83**
- **Transmitters 51**
- **Indicators 29**
- **Circuit Boards 86**
- **Connectors 14**

Note: While there are 183 valves without solutions, there are over 1,100 with identified solutions

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Obsolescence Assessment

NUOG Obsolescence Assessment Process Guideline based on the experience of several utilities.

Purpose of an obsolescence assessment is to identify, prioritize and resolve obsolescence concerns in a proactive manner.

Guideline presents:

- Methodology for scoping and investigating obsolescence issues
- Interview protocol for capturing the experience of plant in dealing with obsolescence problems.
- Suggested performance indicators to monitor a plant's ability to address obsolescence efficiently and effectively

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Obsolescence Assessment Results

- Obsolescence assessment provides recommendations in the following areas:
  - Master list of obsolete items in the Plant's system(s)
  - The impact of obsolescence on the system and the plant if failure of hard to procure item(s) occurred
  - The availability of supplies of obsolete parts within the industry or surplus houses
  - The availability of alternatives
  - Prioritized actions for solution development and risk reduction
  - Evaluation of obsolescence practices
  - Evaluation of Obsolescence Performance Indicators

Obsolescence Solutions

As obsolescence problems are identified, there are a number of alterative solution approaches that may be evaluated.

- Shared Inventory/Surplus Markets
- Equipment Refurbishment
- Substitution
- Special Manufacture
- Reverse Engineering
- Design Change

Shared Inventory/Surplus Markets

- Simplest approach for obtaining an obsolete item is to procure it from another utility.
- Technical and commercial considerations for inter-utility transfer of nuclear plant equipment.
- Surplus markets include vendors, who specialize in the purchase and resale of discontinued products, and other power plants that have excess inventory.
- Solution is typically a short-term one, unless sufficient inventory can be purchased for the projected life of the plant.

RAPIDPARTSMART

- Rapidpartsmart is an on-line system for locating, buying, selling, and managing engineered parts in the power industry.
- Subscribers include all North American nuclear power plants, numerous fossil plants, and many suppliers to the power industry.
- Consists of four continually updated databases:
  - the member utilities' pooled active inventory,
  - the utilities surplus inventory catalogues,
  - the member supplier's catalogues,
  - the obsolete item replacement database.
- With over 5 million records, rapidpartsmart is the most widely used tool for locating parts at other utilities and suppliers

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Equipment Refurbishment

- Some obsolete components can be refurbished or repaired if suitable piece parts are available.
- Cannibalization is a special case of the refurbishment option where parts are scavenged from an identical item that is typically not operable.
- Refurbishment has been widely used for obsolete electronic components (power supplies and printed circuit board) for which spare parts continue to be available. However, this may degrade connections, causing performance problems.

Circuit Card Damage from Repeated Parts Replacement

Substitution

- Substitution involves replacing the original item with an equivalent item, either from the OEM or another supplier.
- Equivalency evaluations should be performed to analyze the interchangeability of the substitute item and its impact on system performance.
- OIRD provides tool for nuclear plants to identify substitution solutions for obsolete equipment
- In many cases, OIRD provides copies of equivalency evaluations of substitute items that have been performed at other plants

OIRD Equivalency Evaluation

SUBJECT: Equivalency Evaluation - NUS Instruments Complex Math Module Multiplier Function Model CMM500-1-08/08/00-08-08-01 part number MBA-E006PA-2 and Replaces Foxboro Multiplier/Divider Model 66DR-OH1.

PSSL No. 42	**SYSTEM NAME:** Safeguards System	**EIN:** FM-464A, FM-465A, FM-474A, and FM-475A
INITIATION REFERENCES: AR 2001-0334		
LEAD ENGR. GROUP: NEE	**TARGET INSTALLATION DATE:** April 2001	
ASSIGNED ENGINEER: Gary Cain	**SYSTEM ENGINEER:** Gary Cain	

1.0 REASON FOR THE EQUIVALENCY EVALUATION:

The existing Foxboro Multiplier/Divider Model 66DR-OH1 is obsolete and no longer supported by the Foxboro Company. The multiplier/divider installed at plant location FM-474A can not be calibrated to within procedure specifications, is degraded but operable and requires replacement. This evaluation will identify and document any differences between the Foxboro Model 66DR-OH1 and the NUS Model CMM500-1-08/08/00-08-08-01, part number MBA-E066PA-2 replacement.

2.0 CHANGE DESCRIPTION/SCOPE:

The new NUS Complex Math Module is a qualified replacement for the originally installed Foxboro Model 66DR-OH1 Multiplier/Divider. There are four (4) of the Foxboro Multiplier Dividers installed at Ginna Station in the main steam flow channels. The multiplier dividers perform a safety-related function providing indication for Operations during performance of EOP's. The new NUS math module is equal to or better than the currently installed Foxboro module. Form, fit and function are similar but have some identified differences. Technical information for the new NUS math module has been provided and needs to be added to the vendor manual program. Minor procedure and drawing changes are required due to the installation of the new module. Bus loading analysis changes are not required prior to module replacements due to the insignificant, conservative decrease difference in power required. Revision 01 updates the fuse/breaker coordination curve included as an attachment. No concerns were introduced as a result of the new curve.

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Special Manufacture

- Suppliers who no longer manufacture an item sometimes can be persuaded to tool up for a special manufacturing run.
- Some manufacturers have been reluctant to produce replacement parts for obsolete systems when they are offering newer systems as an alternative.
- Relatively high cost for small lots.
- Utilities have used OIRD to identify other utilities that might collaborate on the procurement and share the cost.

Reverse Engineering

- Reverse engineering: developing engineering specifications sufficient to duplicate an item
- Reverse engineering projects are undertaken when the item is not available from the original manufacturer and no acceptable substitutes are available
- Potential barriers include legal issues, patents, trade secrets and proprietary data.

Reverse Engineering of Safety Related Items

- Safety related obsolete equipment can be replaced with reverse-engineered equivalents available from specialty suppliers having an appropriate QA program
- Items are designed to be form, fit, and functionally equivalent to the original components; meeting or exceeding the performance requirements.
- Due to cost, reverse engineering particularly effective when there is a large population of similar components
- Examples:
  - I&C Components
  - Motor Control Centers
  - Power Supplies

Reverse Engineered Instrumentation Modules

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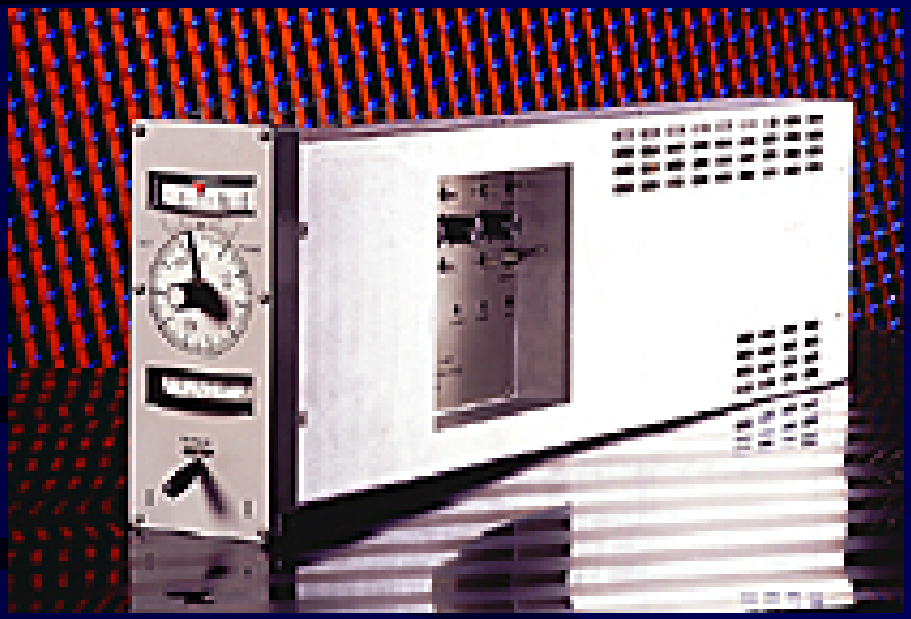
Replacements for Foxboro Modules



Plants Currently Using

- Ginna Station
- Beznau 1 & 2
- KORI
- Indian Point #2
- Indian Point #3
- Point Beach
- Kewaunee
- Sequoyah

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Replacements for GE/MAC Modules

Current and Pending Users

Hatch: *570 power supplies, *540 controllers, alarm, various
Duane Arnold: *540 controllers, *570 power supplies, various
Pilgrim: *540 controllers, various
Fitzpatrick: 560 alarm, 550 RTL, 544 M/A transfer, 570 power supplies,
542 manual loading, controllers, signal converters
Monticello: *540 controllers, various
VY: Various (548, 544, 540, 563, 560, 570, others)
Davis Besse: signal conditioner
Nine Mile: 560 alarm, 550 RTL, various
BWROG: All items

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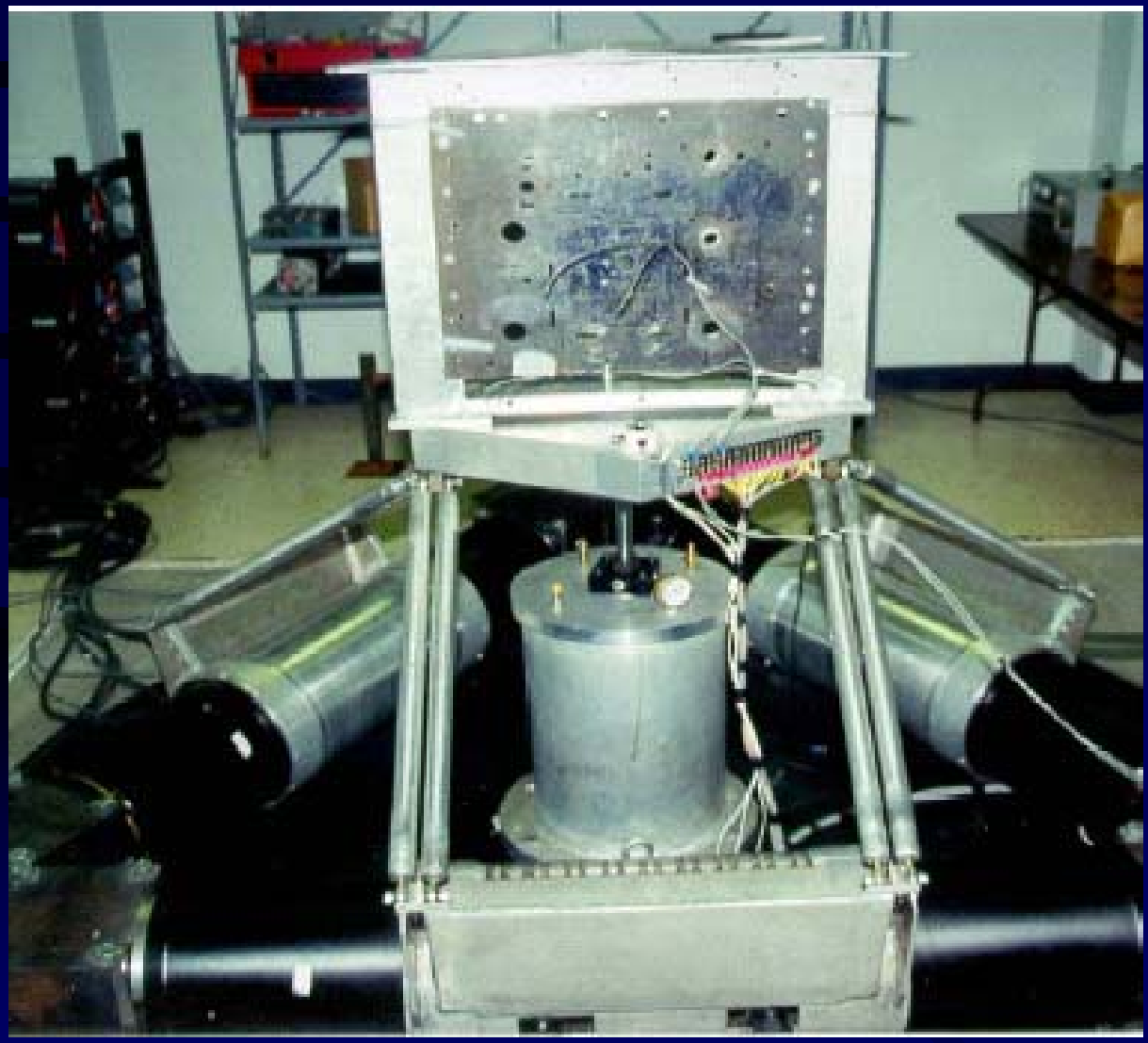
Design Change

- Design change typically requires plant modification, typically the most expensive option.
- Replacement of obsolete analog I&C systems with digital systems is an example of obsolescence design change under consideration at several nuclear plants.
  - Improved capabilities
  - High cost for engineering, installation, and outage time
  - Procedures and training requirements
  - Regulatory risk
  - Risk of future obsolescence

Summary

- Obsolescence is a significant and growing problem for operating nuclear plants.
- NUOG and the OIRD provides a forum for sharing experience and lessons learned in dealing with obsolescence issues.
- Obsolescence assessment and proactive program for determining obsolescence solutions can provide significant benefits in system reliability and reduced maintenance costs.
- Most obsolescence problems have identified solutions
- Reverse engineering of obsolete components has been shown to be an effective solution when components are widely used in the industry.

Shake Table for Seismic Qualification



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