WAAP-10156

# Maintain, or replace; both are needed!

## Energiforsk seminar:
## Life time extension of nuclear I&C 2016

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# Agenda

- Long-Term Operation
- I&C Asset Management
- Case studies:
  - Utility in USA – Several analog platforms
  - Utility in Europe – Two digital platforms
  - ASEA-Atom BWR's – Analog platform

# Long-Term Operation & I&C Systems

- Long-term Operation (LTO)
  - Global, broad concept
  - To enable license extensions from a nuclear regulatory body
- Material studies from 70's - qualified life for materials up to this limit
- Identify components of concern - material studies to 60/80 years is appropriate
- Replace or upgrade is the choice
  - I&C systems many components, e.g. power supplies, printed circuit boards, relays, etc. - continued operation past 40 years
  - Cabinet infrastructure component are more difficult to replace
  - Plant design and lack of original separation – complex projects

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# I&C Asset Management:

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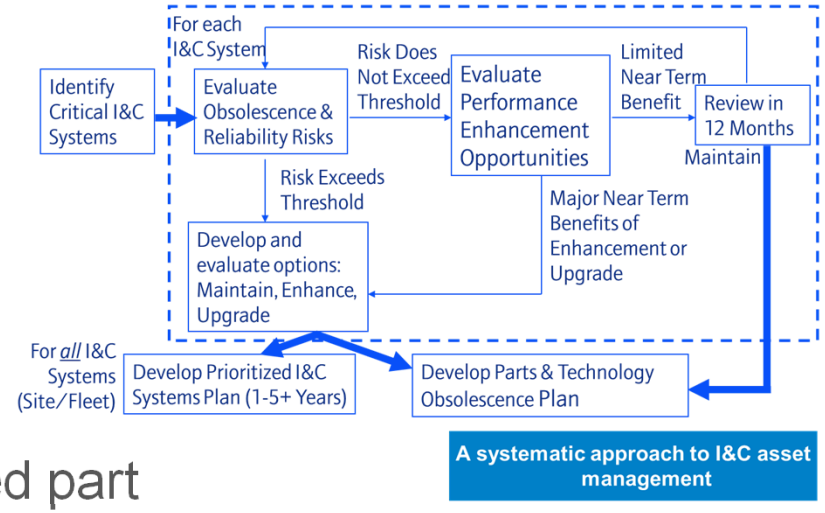
## Establishing a Vision: System/Modernization Options

- Run to maintenance
- Preventative maintenance until end of plant life
- Component replacement
- Component Upgrade
  - Possible need for reverse engineered part
- System form, fit, and functional replacement
- System upgrade




**A systematic approach to I&C asset management**

Note! options are NOT mutually exclusive

**What is the process used to make these decisions?**

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# Case Study 1:
# Utility in USA – Several Analog Platforms

**Table 1: I&C Systems**

| System | Priority | Obsolescence | OEM Support | Recommended Action | Comments |
|---|---|---|---|---|---|
| **7300 Process Control** | M | None | Full | Upgrade | Full proven Ovation upgrade available, or small targeted solutions, which will provide advanced automation. |
| **7300 Process Protection** | L | None | Full | Maintain | Safety Related |
| **Nuclear Instrumentation System** | M | None | Full | Partial Upgrade | |
| **SSPS** | L | None | Full | Maintain | Replace all boards and provide staff training |
| **Rod Control** | M | None | Full | Partial Upgrade | Upgrade Logic Cabinet to Ovation – difficult to troubleshoot; get staff training |
| **Rod Position** | M | Partial | Partial | Full Upgrade | Display Boards and not supported- full low cost upgrade available |

| | | | |
|---|---|---|---|
| OEM Support Field Services | 0 | 10 | OEM Rank = 0 fully supports, 5 limited, 10 no support |
| Operational/ maintenance Challenges | 10 | 20 | Plant Events in last five years = 0 none, 10 two or more, 20 five or more |
| SNC Spares supply for next ten years | 10 | 20 | Spares Rank = 0 full complement, 10 limited, 20 none |
| Spare operability | 5 | 10 | Rank =0 tested each outage, 5 tested every five years, 10 not tested |
| System Documentation | 5 | 10 | Rank = 0 current, 5 partially up to date, 10 dated |
| System is pneumatic | 0 | 10 | Rank = 0 digital/analog, 5 full analog, 10 pnuematic |
| Regulatory Ties/Tech Specs | 10 | 10 | Rank = 0 none, 5 some, 10 full safety compliance or applicable tech specs |
| OEM FFF upgrades available | -10 | 10 | Rank = -10 yes, -5 some, 10 none |
| System Impact on plant performance | 0 | 20 | Rank = 0 none, 10 some, 20 full potential |
| EMI/RFI Issues | 0 | 10 | Rank = 0 none, 5 some, 10 many & unknown origins |
| **Priority Rank Score:** | 40 | 170 | Priority: Low > or equal to 55 ; Med:> or equal to 80, High greater than 95 |

## Case Study 2 cont.

# Utility in Europe – Two Digital Platforms

- Criteria's used in I&C system asset management strategy:
  - Licensing and regulatory implications
  - Possibility to down-grade classification
  - Overall ROI of the upgrade vs. investment in special long term operation support
  - Technical complexity of the upgrade
  - Expectation for long term support of upgraded solution
  - Feasibility, availability, and guarantee of long term operation

**Upgrade vs. Long Term Support Solution Depends on Evaluation of Set Criteria**

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# Case Study 2:
# Utility in Europe – Two Digital Platforms

The evaluated systems can be assigned to one of the following three categories:

- **Option 1** - Long term support of existing system is strongly recommended
- **Option 2** - Long term support of existing system is preferred
- **Option 3** – Upgrade is a viable option once obsolescence issues start to prevent reliable and safe operation

| SYSTEM DEFINITION | | | | RECOMMENDATION |
|---|---|---|---|---|
| EXISTING | | | UPGRADE | |
| SYSTEM | PLATFORM | CLASS | PLATFORM/CLASS | |
| PRPS | Eagle | 1E | Common Q / 1E | OPTION 1 |
| PAMS | Eagle | 1E i N1E | Common Q / 1E | OPTION 1 |
| 1E NPL | NPL | 1E | ALS / 1E | OPTION 1 |
| MCR / ECR | D-CARDS | 1E i N1E | Standard AP1000 | OPTION 1 |
| EXCORE | Eagle | 1E | Custom / 1E | OPTION 2 |
| DPS | DPS | 1E | Ovation / N1E | OPTION 2 |
| RCLS | Eagle | N1E | Ovation / N1E | OPTION 2 |
| N1E NPL | NPL | N1E | Eliminated | OPTION 2 |
| PCS | WDPF | N1E | Ovation / N1E | OPTION 3 |
| INCORE | WDPF | N1E | Custom / N1E | OPTION 3 |
| UIS | WDPF | N1E | Ovation / N1E | OPTION 3 |
| NUIS | WDPF | N1E | Ovation / N1E | OPTION 3 |

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# Case study 3:
# ASEA-Atom BWR's – Analog Platform

The evaluated platform is installed in most ASEA-Atom BWR's

- I&C-structure/Structure of Plant Systems, depends on the generation of the unit
  O1/R1 / O2 / **F1/F2/OL1/OL2** / **F3/O3**
- Evaluation criteria's
  - Cost, Installation time, Documentation, Risk, Competence, Complexity etc.
- Westinghouse conclusions differs depending on:
  - I&C-structure of the plant
    - Cases with highly integrated internal wiring benefits of a solution where functionally equivalent cabinets can be used for replacement (computerized or analog)
    - Cases with "stand alone type" cabinet design benefits from a like-to-like replacement
  - Time to end-of-life
  - Licensing requirements

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# Conclusions

- Westinghouse experience:
  - There is no general answer to what strategy to use when planning for life time extension of I&C systems
- Every plant is different!
- All parts of the plant need to be considered
  - Plant design (Separation, Safety class, CCF approach etc)
  - I&C technology
  - Interfacing equipment (push buttons, back planes, internal wiring etc.)
  - External wiring
  - Etc.

**The devil is in the details!**

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