Life of Field

obsolescence Management
Brownfield assets

Challenges for the operator... Life of Field

- Ageing equipment - degradation
- Uncertain condition of subsea equipment
- Limited existing umbilical cores
- Significant obsolescence exposure
- Limited power capacity
- Disparate modem technologies
- Poor existing equipment Reliability
- Missing Availability targets
- Upgrade - production disruption
- No vendor equipment interchangeability
- Paper-based manuals & record books
- Tied into OEM - proprietary protocols
- Limited data management tools
- Outmoded instruments & data mgmt
- Uncommon spares - differing SCMs
- Uncommon equipment interfaces
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- Break-fix service relationship
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Obsolescence – Transition from availability from the original manufacturer to unavailability (Ref: JOS 3428B)

Obsolescence Management Guide
IEC 62402

Project Obsolescence Management Plan
QP-PCS-NAI-ENG-601

Joint Operator Specification
3428A+B
Obsolescence Management & Product Life Cycle Profiling Risk

- Early lifecycle failures
  - new product available spares fully supported

- random failures
  - product entering EOL spares less available support cost increase

- wear out
  - 1st Generation, brand new unopened - $37000
Stage 1 Obsolescence Review

Stage 2 System Criticality Review

Stage 3 RAM Analysis

Stage 4 Asset Sustainability Status Report

Inputs: Field Architecture, Operational Spares, Asset Health Status, MTTF Rates, BOMs, Design Data, FMECA

COTS filtering

Criticality Matrix

Reliability

REPORT

~ 28,000 Components

~ 7,000 Components

~ 50-200 Components

Outputs: Actionable Client Recommendations

Commercial Off The Shelf (COTS)
• Power Supply Units
• Circuit breakers
• Switches
The easy stuff right?

What’s in Scope?
Where’s the cut off?
• Operator specific

What if?
• Location
• Spares
• Operations

Reliability
• Likelihood?

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Reliability
• Likelihood?
Risk Based Criticality Analysis

• Risk based methodology conforming to:
  Joint Operator Obsolescence Management Specification, 3428B
  (BP, Chevron, INPEX, Equinor, Total, Woodside)

• Components risk profiling considers:
  • Stock Levels
  • Stock Consumption Rate
  • Number of Manufacturing Sources
  • Years to End Of Life (YTEOL)
  • Operational Impact Criticality
Obscolessness RAM modeling

Spare parts availability have significant impact to production availability (ratio of production to planned production (ISO 20815))
To increase obsolescence awareness, dedicated „spare parts” driven RAM analysis proposed.

Objectives of RAM modeling:
• Estimate the impact of obsolescence to Production availability
• Provide evidence of spare parts holding
• Minimize of production availability losses due to lack of spare parts

Results of MAROS®:
• Comparison of Production availability of different „What if...” Scenarios:
  • No. Of Spares available, thorough the project life
  • Lead time – duration of restock
  • Start and duration of „obsolescence” etc.
RAM Model

Main Steps

1. Functional description of study cases (base case and potential sensitivity cases)
2. Definition of analysis objectives and scope
3. Definition of assumptions and limitation
4. Establishment of RAM model building blocks
5. Gathering of RAM model input data
6. Establishment of RAM analysis model
7. Verification and validation of RAM analysis model, input parameters and assumptions
8. Generation, evaluation and documentation of RAM analysis results
9. Generation of conclusions and recommendation

Subsea RAM Model
Results (case example)

Conclusions:
- Issues, with the spare parts availability, is foreseen from year 10, but the actual effect on production is visible, since year 11th and last for 4 years, until the situation normalize.
- The effect is visible with delay, because there were available parts in stock.
- The solution to avoid the potential drop in production:
  - is to either plan the obsolescence in advance and have ready solution (which will not affect the restock schedule)
  - Increase number of available, spare module, so always will be available module

Study case:
- Obsolescence starts in 10 year, duration 2 years.
- The spare parts lead time increased from 9 month to 18 months

<table>
<thead>
<tr>
<th>Case</th>
<th>Spare #</th>
<th>Restock level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC (no obsolescence)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>SP BC</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>SP+1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>SP+1 (OP)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SP+2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>SP+2 (OP)</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>
Design
Legacy BHGE Control Systems

Pre 2000 fields

25 fields

400+ SEMs still in active production

Post 2000 fields

49 fields

1,500 SEMs into the 2020’s
Controls roadmap

- **2000**: SEM2K
- **2007**: SemStar5
- **2011**: SemStar5 E&I, SIIS
- **2014**: SemStar5 Deployed
- **2017**: TRL7
- **Today**: All-Electric
- **2020**: Distributed
- **2024**: Controls

**2012**
- PC-based
- PLC
- ‘SMCS’

**Key**
- Complete
- Planned or underway

**SemStar5** - Designed for Obsolescence
- Common Single Board Computer on hot-swappable card
- Chip 20% utilization - FPGA latent capacity
- Commercial RTOS: QNX - 25 years BHGE experience
- Expandable modular SEM platform
- Integrated PLM & Obsolescence Mgt tools

**Controls for BHGE Compact XT**
- API 17 F rev 4
- Multiband, long-offset Copper comm.
- Legacy ‘SEMulation': SEM2K MD
- eActuator Control (iFocus)
- Safety Systems (HIPS)
- Legacy ‘SEMulation': SemStar5 PTP
- Legacy ‘SEMulation': SEM3
- Legacy ‘SEMulation': SEEMA
- Comms Filtration
- Subsea Transformer
- Automated Test Equipment
- Subsea Routing and Power Switching
- Production SEM

**Applications**
- Increased Functionality
- Subsea Routing and Power Switching
- Subsea Transformer
- Comms Filtration
- eActuator Control (iFocus)
- Safety Systems (HIPS)
- Legacy ‘SEMulation': SemStar5 PTP
- Legacy ‘SEMulation': SEM3
- Legacy ‘SEMulation': SEEMA
-分管 Loop controls - subsea processing
- Integrated sensing - DAS/DTS/Naxys

**Features**
- All Electric Control System
- Split Controls for BHGE Compact XT
- Safety Systems (SIL2 PSD)
- DC input
- High Voltage Switching
- Reduced power consumption
- Closed Loop controls - subsea processing
- Integrated sensing - DAS/DTS/Naxys

**Tools**
- Commercial RTOS: QNX
- BHGE experience
- Expandable modular SEM platform
- Integrated PLM & Obsolescence Mgt tools

**Baker Hughes**
- A GE company

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SemStar5 Platform

**Designed for Reliability & obsolescence mgt**

**Common platform:** S43100-00
- Communications and routing
- Sensor and valve control
- Power management / switching
- Electric actuation control
- Safety-system control (HIPPS/PSD/IWOCS)
- Pump / processing control
- Backwards Compatible for legacy field swap-out

TCP/IP Open communications
Step-change for industry in SEM Reliability
MTBF 10x OREDA average

Installed: Statoil TVCM, Nexen GEAD, Chevron IDD, Apache Julimar, INPEX Ichthys, ENI OCTP, Apache Beryl, Exxon Balder, Statoil Snorre B, Statoil Troll B, Stone Pompano, ENI Ghana

Installed 2011
Ordered 664 off
Delivered 406 off
Deployed 226 off
BHGE Equipment upgrades

“Square peg in a round hole”

Reuse of existing SCM base plate and cover including tools
BHGE Equipment upgrades – options

1. Full Controls System
   - ModPod SCM
   - SemStar5

2. Controls Upgrade Subsea
   - ModPod SCM
   - SemStar5

3. Controls Refurb Subsea
   - Legacy SCM
   - SemStar5

‘SEMulation’

Existing MCS

New MCS

Existing MCS

Legacy SCM & SEM

Existing MCS
‘SEMulation’ – project technology insertion

**Statoil Snorre B**
SEM4
Profibus Legacy comms
Bespoke SemStar5
Limited application

**ExxonMobil Balder**
SEM3
TC57 Legacy comms
S/W Now configurable for all SEM3 Projects

**Cooper Sole**
SEM2K
SEM2K software on SemStar5 hardware
SEM2K S/W consistent across projects

Reliable partner over Life-of-Field
Standard Master Control Station (SMCS)

Product Overview

- **Real Time Control System on industrial PC hardware**
- The technology runs on a protected layer (under Ring 0 / on a Kernel) which ensures the run time behaviour is un-affected by the demands of higher level applications.
- Standard software architecture based on three abstraction layers:
  1. **Com Master**: responsible for all communications with the assets, including protocol negotiation, message composition and transmission, prioritization, queuing, response decoding and other auxiliary communication related functionalities
  2. **Logic Engine**: The ‘brain’ of the control system, responsible for the correct operation of the system and its components such as valves, chokes, interlocks etc.
  3. **Interface Manager**: enabling the Real Time Control (RTC) system to interface to virtually any other application or software service, using the industry standard OPC-UA communication protocol (expandable to other protocols). Compatible with MDIS.
- Bumpless data transfer between Real Time Controllers ensuring seamless duty/standby negotiation (supported by a dedicated gigabit Ethernet link that ensures real-time synchronisation and controls transfer as required)
- Hardware agnostic s/w architecture, backward compatible to legacy systems
- Scalable solution, supporting up to 30 wells on a single cabinet (expandable if required)
- Supports Cimplicity and WonderWare HMIs products (e.g. InTouch and System Platform)
- Virtual EDGE device, with seamless integration to analytics platforms
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