ASCE as a supportive tool for API RP 17N

Implementation of key reliability processes in subsea projects using ASCE

27th June 2012 – ASCE users forum

Fabien Martinez
A Growing Industry

Proven Resources

- 20% OIL
- 40% GAS

Found Subsea

Today

- 27% GAS
- 30% OIL

From Offshore Exploitation

Further Offshore and Deeper

- Growing energy demand
- Land based reservoirs depleting

(IFP figures 2008)
Failure is not an option

Subsea equipment **MUST** work

- Harsh and Remote Environment
- Maintenance extremely difficult and expensive
- Very long time to restore

Huge Financial Implications
The Reliability paradigm in Oil and Gas

- Maximise Production
- Minimise CAPEX
- Minimise OPEX
- Maximise up time
- Minimise down time
- High level of integrity
  - Hardware
  - Software
  - Human
  - Organisational

Achieved through

Reliability Engineering
Astrimar Ltd

Established in May 2010

- Reliability Engineering and Analysis
- Integrity Management
- Qualification Assurance
- Technical Risk Management
- Reliability Management practices
A more rigorous approach to subsea system reliability and technical risk management

• Reliability assurance
• Integrity assurance
• Technology assurance
API 17N “DPIF” Approach

Define
- Goals and Strategy
- Technical Risks
- Scope of work

Plan
- Meet goals
- Address technical risk

Implement
- The plan
- Risk management actions

Feedback
- Assurance
- Lessons learned

OPERATOR

ASCE GSN TOOL

ASCE ASSURANCE TOOL

SUPPLIER
<table>
<thead>
<tr>
<th>Define</th>
<th>Reliability Assurance</th>
<th>Integrity Assurance</th>
<th>Technology Assurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM goals &amp; strategy</td>
<td>Integrity goals &amp; strategy</td>
<td>Qualification goals</td>
<td></td>
</tr>
<tr>
<td>Technical Risks &amp; uncertainties</td>
<td>Integrity threats &amp; risks</td>
<td>Technical risks &amp; uncertainties</td>
<td></td>
</tr>
<tr>
<td>System scope</td>
<td>System scope</td>
<td>System scope</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan</th>
<th>Reliability analysis to understand and address technical risks</th>
<th>Inspection, monitoring, testing, maintenance &amp; sparing to address threats and risks</th>
<th>Qualification testing to verify functionality, reliability &amp; robustness</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Implement</th>
<th>Planned reliability analysis</th>
<th>Planned IMR program</th>
<th>Planned qualification testing &amp; analysis</th>
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</thead>
<tbody>
<tr>
<td>Reliability improvements and failure mode reduction actions</td>
<td>Intervention and continuous improvement on identified deterioration/failure</td>
<td>Design improvement and failure mode reduction actions</td>
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</table>

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Collate assurance and evidence of management of identified risks to reliability</th>
<th>Collate assurance and evidence of actions taken to respond to integrity threats and inspection</th>
<th>Collate assurance and evidence of testing carried out to verify functionality and reliability</th>
</tr>
</thead>
</table>
API 17N Key Reliability Processes

Define Goals and Requirements (KP1)
Feedback and Assurance (KP4)
Plan Organisation and planning (KP2)
Implement Design and Manufacture (KP3)
Verification and Validation (KP6)

Supporting Processes
- Project Risk Management (KP7)
- Supply Chain Management (KP10)
- Management of Change (KP11)
- Risk and Availability Analysis (KP5)
- Performance Tracking and Data Management (KP9)
- Reliability Qualification and Testing (KP8)

Organisational Learning (KP12)
Application of ASCE

- Facilitating tool for complex document and information management
- Goals and requirements definition made clear by use of GSN notation
- CAE notation for structured, easy to read supporting evidence
- Prepopulate networks based on a so-called “API RP 17N” schema
- “API RP 17N” network is a platform to supporting networks using KP specific or existing notations
Qualification...

... is driven by

| Industry continuously pushing new barriers in harsh environment | Renewable energy need novel marine technology options |

... is for

| Novel technology | Existing technology in the “unknown” | Reliability improvement |

... demonstrates

| Equipment meets requirements | Technology/product is robust and reliable | Reduction of technical risk and uncertainty |
API 17 Technology Readiness Level Ladder

**Test and Analysis Focus**

1. **Experimental research**
   - **TRL 0**: Pre-research technology proposed
   - **TRL 1**: Concept Demonstration
     - TRL 1 achieved – Technology is demonstrated
   - **TRL 2**: Concept Validation
     - TRL 2 achieved – Technology is validated
   - **TRL 3**: Validated but untested technology proposed
     - TRL 3 achieved – Technology is prototype tested, robust & reliable
   - **TRL 4**: Proposed product has not been field tested
     - TRL 4 achieved – Environment testing complete
   - **TRL 5**: Field environments
     - TRL 5 achieved – System tests complete
   - **TRL 6**: System integration
     - TRL 6 achieved – System installed, tested & commissioned
   - **TRL 7**: Operating
     - TRL 7 achieved – Product operating with acceptable performance

2. **Lab rigs and mock ups**
   - **TRL 0**: Pre-research technology proposed
   - **TRL 1**: Concept Demonstration
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3. **Life test to destruction**
   - **TRL 0**: Pre-research technology proposed
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4. **Field environments**
   - **TRL 0**: Pre-research technology proposed
   - **TRL 1**: Concept Demonstration
     - TRL 1 achieved – Technology is demonstrated
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5. **System integration**
   - **TRL 0**: Pre-research technology proposed
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6. **System + environment**
   - **TRL 0**: Pre-research technology proposed
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7. **Operating**
   - **TRL 0**: Pre-research technology proposed
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     - TRL 1 achieved – Technology is demonstrated
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**TRL Stage**

Pre-research technology proposed

Conception

TRL 0 – Basic Research achieved

Unproven technology proposed

Concept Demonstration

TRL 1 achieved – Technology is demonstrated

Demonstrated but unvalidated technology proposed

Concept Validation

TRL 2 achieved – Technology is validated

Validated but untested technology proposed

Prototype Qualification Testing

TRL 3 achieved – Technology is prototype tested, robust & reliable

Proposed product has not been field tested

Environment Qualification Testing

TRL 4 achieved – Environment testing complete

Proposed product has not been system tested

System Qualification Testing

TRL 5 achieved – System tests complete

Technology has never been installed subsea

Qualification of Installed System

TRL 6 achieved – System installed, tested & commissioned

Technology has never been operated subsea

Proving Technology over time

TRL 7 achieved – Product operating with acceptable performance

Technology is field proven

**Understand function and performance**

**Make it Reliable as a device**

**Reliability Growth & Uncertainty Reduction**

**Technology Readiness Level Ladder**

01234567
System Analysis and detailed TRL

- Identify requirements for each component
- Assess TRL of each component against its requirements
- Test assembly to include item to be qualified and interfaces

May need to address level 6 (parts)
Qualification Schema in ASCE

TRL
Reliability
Validation and Verification status
Plugins for node properties definition

Technology Readiness Level

Technology Readiness Level Definition

One assessment method which can be used to underpin the qualification process is the technology readiness level which indicates the extent to which an item is ready for use given specified qualification factors/requirements. The concept of TRL used to determine the qualification requirements has been adapted from work performed by the Seafloor.
### INITIAL QUALIFICATION PLAN

<table>
<thead>
<tr>
<th>System - Level 5</th>
<th>System ASB</th>
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<tbody>
<tr>
<td>Initial TRL</td>
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<tr>
<td>Required TRL</td>
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#### Qualification Activities

<table>
<thead>
<tr>
<th>Task Ref.</th>
<th>Description</th>
<th>Qualification Task Notes</th>
<th>Deliverable</th>
<th>Person Responsible</th>
<th>Start</th>
<th>End</th>
<th>Duration (Days)</th>
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<tbody>
<tr>
<td>Q-SA-01</td>
<td>Prepare Technology Specification</td>
<td>Follow guidance in DNV-0203</td>
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<tr>
<td>Q-SA-02</td>
<td>Determine qualification requirements</td>
<td>Follow guidance in technical practice (XYZ-12345)</td>
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<tr>
<td>Q-SA-03</td>
<td>System taxonomy</td>
<td>Follow guidance in IMO-HHZ1</td>
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<tr>
<td>Q-TA-01</td>
<td>Gather data requirements</td>
<td>Provided by Technology Developer</td>
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<tr>
<td>Q-TA-02</td>
<td>Detailed TRL Analysis</td>
<td>Follow guidance in API-REP-17</td>
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<tr>
<td>Q-TA-03</td>
<td>System reliability assessment</td>
<td>Develop system safety analysis</td>
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<tr>
<td>Q-TA-04</td>
<td>FMECA</td>
<td>Follow guidance in BS-2750</td>
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<tr>
<td>Q-TA-05</td>
<td>Initial report on Qualification Plan</td>
<td>Use Report Template GT5000</td>
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**Tailored node content**
Plugins for nodes indicators properties update
On-going development

- Enhancing API 17N bespoke Graphical User Interface
- Extending schemas to incorporate additional KP specific notation
- Providing new functionalities through the development of KP specific plug-ins
- Incorporation of additional document templates and analyses tools
Conclusions

• API 17N schema provides a prepopulated network with links to KP specific networks (with appropriate notation)
  • Using principle of modular GSN

• Gives structure to the application of API 17N reliability activities

• Provides dashboard for monitoring status of current activities and managing documentation

• Provides templates for supporting evidence and assurance documentation

• Facilitates creation of assurance reports (plugin) for operators, investors and regulatory bodies
  • dynamic link to supporting evidence such as FMECA, Qualification Plan, etc...
Thank You