Verification of Offshore Installations

1st Offshore Protocol Working Group meeting

Siamack Atiabi
13-June-2013
DNV in brief

- established in 1864 in Norway
- objective: Safeguarding life, property, and the environment
- self-owned independent foundation

300 offices
100 countries
10,500 employees, of which 76% have university degree
DNV in O&G, today and tomorrow

40
Years of offshore experience

2800+
Oil & Gas professionals worldwide

DNV
Addresses the complete value chain from exploration to decommissioning

DNV GL Group

Maritime
• Headquartered in Hamburg, Germany
• Number of employees: approx. 5,600
• Representation in over 80 countries

Oil & Gas
• Headquartered in Høvik, Norway
• Number of employees: approx. 5,800
• Representation in over 30 countries

Energy
• Headquartered in Arnhem, Netherlands
• Number of employees: approx. 3,100
• Representation in over 30 countries

Business Assurance
• Headquartered in Milan, Italy
• Number of employees: approx. 2,000
• Presence in 50 countries
DNV services following the field life cycle

Access to acreage

Appraisal / Feasibility

Concept screening

Concept definition

Project execution

Operation & Production

Decommissioning

Business case

Feasibility and risk assessment

Integrated field development support

Area studies

Due diligence

Project risk management

Operational excellence studies

SHE

Reliability assessment

Technology qualification

Verification

Offshore Classification
Hierarchy of DNV Codes

- Service Specifications
- Offshore Standards (OS)
- Recommended Practices (RP)
- Internationally recognised codes
- Operation
- Construction
- Design

Note: OS’s & RP’s often the end result of a JIP
The big picture

- Subsea Drilling Systems
- Satellite Subsea Trees
- Smart Well Control Systems
- Subsea Manifold w/ trees
- Subsea Manifold
- Subsea Processing
- Work Over
- Risers
- Umbilicals
- Floaters & moorings
- Guidelineless Deepwater Satellite Trees
- Tie-In Systems
DNV Offshore Codes - Global standards, practices and related services for the oil & gas industry

Drill Plant:
OS-E101
RP-E101
RP-E102

SEMI-SUB
Safety:
OS-A101
Materials:
OS-B101
Hull:
OS-C101
OS-C103
RP-C103
OS-C-401
Stability:
OS-C301
Marine/Machinery:
OS-D101
Electrical:
OS-D201
Instrumentation:
OS-D202
Fire Safety:
OS-D301

Helideck:
OS-E401

FPSO
Safety:
OS-A101
Materials:
OS-B101
Hull:
OS-C101
OS-C102
RP-C102
OS-C-401
Stability:
OS-C301
Marine/Machinery:
OS-D101
Electrical:
OS-D201
Instrumentation:
OS-D202
Fire Safety:
OS-D301

Production Plant:
OS-E201

Risers:
OS-F201
RP-F201
RP-F202

Wire rope:
OS-E303

Mooring:
OS-E301

Chain:
OS-E302

Anchors:
RP-E301
RP-E302

Wellheads:
OS-E101

Pipeline:
OS-F101
RP-F101
RP-F104
RP-F105
RP-F106
RP-F107
RP-F108

FSO
Safety:
OS-A101
Materials:
OS-B101
Hull:
OS-C101
OS-C102
RP-C102
OS-C-401
Stability:
OS-C301
Marine/Machinery:
OS-D101
Electrical:
OS-D201
Instrumentation:
OS-D202
Fire Safety:
OS-D301

Anchors:
RP-E301
RP-E302

Chain:
OS-E302

Mooring:
OS-E301

SEMISUB
Risers:
OS-F201
RP-F201
RP-F202

Wellheads:
OS-E101

Pipeline:
OS-F101
RP-F101
RP-F104
RP-F105
RP-F106
RP-F107
RP-F108

FSO
Safety:
OS-A101
Materials:
OS-B101
Hull:
OS-C101
OS-C102
RP-C102
OS-C-401
Stability:
OS-C301
Marine/Machinery:
OS-D101
Electrical:
OS-D201
Instrumentation:
OS-D202
Fire Safety:
OS-D301

Anchors:
RP-E301
RP-E302

Chain:
OS-E302

Mooring:
OS-E301

ROUGH
Risers:
OS-F201
RP-F201
RP-F202

Wellheads:
OS-E101

Pipeline:
OS-F101
RP-F101
RP-F104
RP-F105
RP-F106
RP-F107
RP-F108

FSO
Safety:
OS-A101
Materials:
OS-B101
Hull:
OS-C101
OS-C102
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OS-C-401
Stability:
OS-C301
Marine/Machinery:
OS-D101
Electrical:
OS-D201
Instrumentation:
OS-D202
Fire Safety:
OS-D301

Anchors:
RP-E301
RP-E302

Chain:
OS-E302

Mooring:
OS-E301

ROUGH
Risers:
OS-F201
RP-F201
RP-F202

Wellheads:
OS-E101

Pipeline:
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OS-E302

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OS-E301

ROUGH
Safety Management Systems – Effectiveness Metrics
8x improvement in Occupational Safety in last 17 years

Occupational Safety Performance

Reportable incidents per 200,000 man-hours unless noted as LT (Lost Time Injury)

How about major accidents?

- Major accidents have been more resistant to improvement
  Onshore: Many major accidents in 1980’s 90’s and 2000’s
    Toulouse, Sandoz, Antwerp, Texas City, Longford, etc.
  Offshore: also many accidents
    Alexander Kjelland, Piper Alpha, Macondo, Montara etc.
Development of the UK & Norway Offshore Legislations

The North Sea experience

UK and Norway adopted different safety regulations
• Both do require a focus on barriers – to be identified by risk assessment
• Safety critical elements, performance standards, and how maintained at that level

Safety results in past 25 years
• No major disasters since 1988
• Major leaks have reduced significantly in frequency
• But smaller leaks continue without much reduction – still a concern
• Challenges still happen – but when called for the safety barriers have worked and terminated incidents before they became major accidents
• This suggests the focus on risk assessment, safety barriers, performance standards and maintaining barriers, appears successful
Intent of the Safety Case Regulations

The primary aim of the Regulations is to reduce the risks from major accident hazards to the health and safety of the workforce employed on offshore installations or in connected activities.

In simple terms to prevent another Piper Alpha or Aleksander Kjelland
Verification - What is it?

An examination to confirm that an activity, a product or a service is in accordance with specified requirements.

Risk Assessment

Identify Hazards & Threats - Evaluate Consequences

Identify Critical Systems/Elements

Performance Standards

Verification Scheme

Execution

ICP Comment

ICP Comment

Duty Holder is responsible!

An examination to confirm that an activity, a product or a service is in accordance with specified requirements.
Definition of Major Accidents

*Paraphrased but effectively:*

- death or serious personal injury due to fire, explosion or dangerous substance release
- major damage to structure or plant, or loss of stability of the installation
- helicopter collision with structure
- failure of diving operations life support systems, detachment of a diving bell or trapping of a diver
- any event involving death or serious personal injury to 5 or more people
Verification and Risk - Types of Risk

- Asset Damage
- Environmental Impact
- Personnel Fatality / Injury
- Production Loss
- Social / Political Impact
- Loss of Reputation
- Timing
DNV’s Risk Based Verification

Risk Estimation of Components A-N

Traditional Verification
Resources **may not be** focused on risks

Risk-based verification
Resources **are** focused on risks
The definition of risk and risk levels

What are the critical elements of the object that needs to be verified?

Risk = Probability x Consequence of failure
Three Tiered Verification Scope Low - Medium - High

- **Low**: Review of general principles and principal design documents.
- **Medium**: Detailed review of principal and other selected designed documents with support of simplified analyses.
- **High**: Detailed review of most design documents with support of simplified and advanced independent analyses.

Standard description for **design** phase
Three Tiered Verification Scope Low - Medium - High

Increasing volume of work

Standard description for construction phase

**Low**
- **Review** of main procedures and qualification reports.
- **Visit** during final system test.

**Medium**
- **Review** of procedures and qualification reports.
- **Full time** attendance during procedure qualifications.
- **Visit-based** presence at site.

**High**
- **Detailed review** of procedures and qualification reports.
- **Full time** attendance during procedure qualifications.
- **Full time** presence at site for most activities (production, testing).
There is a “Food Chain” involved:

- IOC
- EPIC CONTRACTOR
- PACKAGE CONTRACTOR/CONSTRUCTION YARD
- EQUIPMENT VENDOR/DESIGNER
- EQUIPMENT MANUFACTURER
- EQUIPMENT SUB-SUPPLIER
- LOCAL FABRICATORS

“External” Influences:

- Customer Corporate Governance
- Regulator
### Example – Fabrication of Subsea umbilicals

Table E.1.5 Subsea control umbilicals manufacturing, sub-unit / unit and integration testing

<table>
<thead>
<tr>
<th>Description</th>
<th>Level</th>
<th>Low</th>
<th>Med</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td><strong>Initial activities</strong></td>
<td></td>
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<tr>
<td>1. Review quality management system</td>
<td></td>
<td>R2</td>
<td>R2</td>
<td>R2</td>
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<tr>
<td>2. Quality system audit at relevant manufacturers and suppliers</td>
<td></td>
<td></td>
<td>A</td>
<td>A</td>
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<tr>
<td>3. Review of specifications and procedures</td>
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<td></td>
<td>R2</td>
</tr>
<tr>
<td>4. Technical / kick-off meeting and review of manufacturers documents</td>
<td></td>
<td>R1</td>
<td>R1</td>
<td>R2</td>
</tr>
<tr>
<td>5. Verify the performance and testing during the procedure and personnel</td>
<td></td>
<td></td>
<td>S1</td>
<td>H</td>
</tr>
<tr>
<td><strong>Surveillance and review activities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6. Confirm items manufactured according to specifications</td>
<td></td>
<td>R1</td>
<td>R2</td>
<td>R2</td>
</tr>
<tr>
<td>- review manufacturing records are in accordance with manufacturing quality plan and relevant specifications/procedures</td>
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<tr>
<td>- review non-conformance logs</td>
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<tr>
<td>12. Confirm correct system function, in particular attention to hydraulic fitness</td>
<td></td>
<td>S1</td>
<td>S3</td>
<td>S3</td>
</tr>
<tr>
<td><strong>Final activities</strong></td>
<td></td>
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<tr>
<td>13. Confirm manifold/template functions by review of:</td>
<td></td>
<td>I</td>
<td>R1</td>
<td>R2</td>
</tr>
<tr>
<td>- FAT records</td>
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</tr>
</tbody>
</table>
Reliance KGD6 Gas & MAD6 Oil Deepwater Project

Challenge
- Competence: First ultra-deep water project in the region (about 2000 m).
- Fast track green field project, 6.5 years from conceptual phase to commissioning.

Solution
- Careful management of multi-discipline capabilities using DNV worldwide multi-discipline capabilities related to flowlines, umbilicals, templates, PLEMs, manifolds, deepwater jacket etc.
- Close project coordination among various DNV internal units.
- Use of the state-of-art DNV codes

Value Delivered
- Assured Reliance of sound design, procurement, fabrication, integration and commissioning of the field
Ormen Lange: first subsea to shore development
Storegga slide area

Survey coverage of the slide area

DEVELOPMENT AREA
WATER DEPTH = 850 m

TO SHORE

TOP OF SLIDE EDGE
WATER DEPTH = 250 m

10 KM
Challenges

- Very steep topography
- Long free spans
- Uneven seabed and extensive seabed preparation
- 900 m water depth
- Long tie back to shore
- Low seabed water temperature
- Flow assurance

DNV role:
- Extensive Verification activities
- Qualify SN-curves → DNV fatigue tests
- VIV Model test → Project specific design guideline
- Developed Subsea Integrity Management System (SIMS)
- Qualification of down-hole safety valves according to DNV-RP-A203
Project: Martin Linge

- Basic Engineering QRA and Safety assessment
  - Safety barriers
  - Performance standards

- Project Risk Manager Role
  - Establish and maintain risk matrix
  - Develop management reports

- Jacket design verification

- Cyber security assessment.

- Environmental Impact Assessment

- Review design spec for cranes
  - gap analysis

- Gap analysis design specification FSO
  - Mooring design verification

- Risked based verification plan top side structure
The Blue Stream - Energy needs of Turkey

- The industrialisation of Turkey
  - Historically energy needs met through
    - Gas import from Russia via Balkan pipeline
    - LNG from Algeria
    - Crude oil import
    - Natural gas consumption
      - 10BCM in 1998
      - Expected to reach 80 BCM in 2020
  Challenges:
    - Competence, financing, insurance
    - Supply reliability
The Blue Stream Pipelines

- Sediments with high levels of H2S
- Seismic activity
- Landslides and sediment flow
- Difficult topography on the Russian coastal slope (very steep slopes)
- Technological innovation
- Tight schedule
- Development of repair systems

2 lines; 16 BCM capacity
24” diameter (610 mm)
31.8 mm wall thickness
390 km long
Very deep water

K.P. 15

-2500
-2000
-1500
-1000
-500

Turkish side

Russian side

Abyssal Plain

2,150 m
Summing up

- Authorities moving towards a goal-setting regime with functional requirements
- A transparent, global, risk-based and fully independent approach to verification, certification, quality surveillance and marine warranty is vital
- Independent verification should address an asset’s entire life cycle: from concept to commissioning, operations and recycling
- Reduced and managed risk from early phases, thereby increasing the likelihood of successful project and safe operations in-service
Safeguarding life, property and the environment

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