Delivering Next Generation Subsea Reliability & Performance for Ultra Long Tiebacks

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GE imagination at work
- Challenges for ultra-long offset controls
- Long term support to remote locations
- Sustaining production through the life of the field
- Flow assurance
- Innovations
- Summary
Challenges for ultra-long offset controls
StatoilHydro’s ‘Snohvit’ project – the industry ‘benchmark’ development

World’s longest offset subsea control system by GE-Oil & Gas. First gas – 20\textsuperscript{th} August 2007 [220Km design]
Subsea communications router technology – distributing power and data – Snøhvit example

Fibre optic comms & 3.3KV power system

Askeladd

High speed electrical comms

Fibre optic comms

Hammerfest

Snøhvit
The digital oilfield

Web interfaces

Topsides supervisory system (SCADA/DCS/ICSS)

Subsea control station

Subsea data router principles

3rd Party interfaces (Downhole)

Subsea Data Router

Tree control

Tree control

Tree control

Subsea process controls

Subsea process controls

3rd Party interfaces (Subsea)
Optical communications

Steady growth of performance – 2003 to 2009

- Technology base – aerospace & defense contractors
- Class 2 Laser
- Bit rate 10 Mbits/second @ 220km
- 60 dBm loss budget – gives 16dBm for connectors, splices, and design margins.
- Target fibre 0.2 dBm/km

- Technology base – telecomms industry
- SFP (Single Form-Factor Pluggable) optical components
- Visible LED based
- Performance
  - Bit rate 1GBb/Sec @ 80km range
Subsea power & data hub – PCDM
(Power & Comms Distribution Module)

• Data routing
• Power step down
• Power switching

• Physical realisation
  • Pod like object
  • Internals
  • SEM as a router

• Back up comms capability
  • Diverse redundancy
  • Slow but robust back-up
PCDM - Power & Comms Distribution Module

Functionality

• Central power and communications distribution node
• Located 145km offshore from Melkøya
• Two redundant PCDMs deployed on the CDU structure
• Future field developments supported by additional PCDMs located on a second CDU
Seabed communications router – remotely installed & retrieved

Optical connector

Hi-voltage electrical connector

Control distribution unit uses the same running/retrieval tools as the control module
Subsea control distribution unit – Internal components

- Power transformer
- Communications router module
- Back-up comms module
- Power monitor, protection & switching module
Subsea communication routing

- Dual fibre-optic links
- Back-up combined power & signal
- Parallel channels A & B
- Standby intervention

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Long term support to remote locations
Case study – Snohvit remote support

Event
- Unable to start-up well after scheduled maintenance stop

Result
- Identified error in start-up procedure
- On-line update effected to fix problem

Value
- Avoided potential 1 week shutdown of subsea well for service engineer mobilisation

Problem resolution within 2 hours!
SmartCenter

Remote connectivity to the field

Support major start – up & commissioning exercises

Prediction of intervention/maintenance action

Health monitoring & trend diagnosis

Support on line flow assurance advisory tools - delivers flow regularity & improved system availability
SmartCenter – remote link to enhance GE regional service centers

SCM site receipt testing and pre-strip diagnostics
Off-line scenario emulation via GE mimic system
SEM / SMU Go / No Go remote tester

Improves turn around times

Angola Montrose Stavanger Singapore
Future SmartCenter offerings – 2010 / 2011

Flow Assurance - 2010

On-line and off-line support from GE resident team

- Deployment of OLGA software, collaboration with SPT
- Condition based monitoring of controls and other subsea systems

- Trend diagnostics advisory for gradual degradation detection
- Predictive maintenance advisory shifts the balance of intervention activity from unscheduled to scheduled
- Early impending fault detection enables alternative operating strategies to maintain production flows
Sustaining production through the life of the field
Reliability fundamentals

The Technology

- Must have a fundamentally sound system
  - Good design
  - Redundancy where required
- The VetcoGray ‘ModPod’ is a very robust design
  - Manifolding minimises piping
  - ‘Step and repeat’ modular design has allowed optimisation
- SEM – if not fully redundant then we always employ redundant front end within a single vessel

More incremental improvements to add to robustness
Delivering the reliability

**Learnings**
- GE DPS systems have demonstrated world class availability
  - Bonga 99.62%
  - Gunashli 99.5%
  - Exxon Kizomba ‘c’ 99.9%
- Current performance is a “hard won battle”
- In-field data collection & analysis has been largely ‘manual’

**Present & Future focus**
- Product – incremental improvements
- Process – 6 Sigma Lean
- Sourcing quality control

Generate additional resource to concentrate on customer needs
Healthcare delivery organisation

Customer operational unit
- Offshore platform
- Onshore rig
- Maintenance facility

Regional service groups – *Contract manager*
- Local GE workshop facilities – Overhaul & repair
- Healthcare / life of field support contracts
- Local 3rd party facilities (hyperbaric testing, welding, etc)
- Storage facilities
- Local engineering support
- CSE’s
- In region commissioning and installation support

Functional support
- Core procedures, competencies
  - Service engs
  - Maintenance shops
  - Fleet & equipment management

Specialist support offerings
- Controls support hub
- SmartCenter
- Trees / controls / manifolds
- Centers of excellence

*GE’s region is the key interface*

Supplementary / complimentary support from other regions
Focus on equipment qualification & factory acceptance testing

- ESS testing for Subsea electronics on site in environmental test chambers - temperature cycling + shock/vibration cycles
- Hyperbaric test facility for subsea controls deliveries
  - Provides 100% acceptance testing on site
  - Depth capability to 4400 metres
Flow assurance
Online flow assurance

Operational flow assurance – real-time advisory
Stabilize and optimize production
Reduce OPEX
Provides added value to the control system...
Additional Unique features with VetcoGray Control Systems

Transparent Production System
Virtual Instrumentation
Slug Advisor
Inhibitor Inventory Advisor
Pig Tracking Advisor
Choke Control Advisor

Hydrate Advisor
Leak Detection Advisor
Ramp-Up Advisor
Gas-Lift Advisor
Cooldown Advisor
Dead-Oil Inventory Advisor
Slug Control Manager
Inhibitor Injection Manager

3rd party Applications

OPC interface

OLGA®
Real-time model
Look-ahead model
What-if model

Tuning System
Alarm System
Instrument Validation & Replacement

Real-time Data Archive
Historical Data Archive

OPC interface (client-server)

Field data
P, T, F and valve positions

Control System

Historical Database
OSI PI - Aspen IP21
Innovations
Virtual metering & multi-phase flow simulation & modelling

- WMS & WRIPS installation on ‘Bonga’
  - First oil Nov ’05

- IDUN & Fantoft PPS on ‘Simian/Sienna/Sapphire’
  - First oil March ’05

- VetcoGray ‘FlowDis’ on Kizomba ‘C’
  - First oil Jan ’08
  - >5% accuracy cf topside flowmeter

- SPT “OLGA Simulation” on Kizomba Satellites

building up the experience bank
VetcoGray FloDis – Kizomba ‘C’ installation
The SemStar5

- Fully modular approach with backwards compatible & obsolescence management built into design
- Thermal management and modelling integral part of design
- Simplified motherboards for greater quality control and improved reliability
- Leverage GE Technology
- Common processing power where needed: Any card, any slot “Plug & play” architecture
- Full range of communications options: optical, low, medium, high speed options

Ultra Reliable: Built on Field Proven Heritage
Flexibility & modularity

• Common processing power where needed
• Any card any slot plug & play architecture
• Cards split by functionality
• 1, 2 & 3 bay variant

Support

– Traditional DCV & 4-20mA interfaces
– HIPPS
– Communication routing
– Subsea power switching
– SIIS (Levels 1, 2 & 3)
– IWIS (Options 1, 2 & 3)
Example SemStar5 applications

SemStar5 as a: As a communications hub

- Optical – 1 Gbits/sec
- DSL – 2 Mbps
- Copper backup
- On manifold ethernet (70m)
  Or RS422 LR (800m)
Example SemStar5 applications

SemStar5 as a: As a communications hub

- High-speed universal connectivity
- VSCM multidrop
- Optical – 1Gbits/sec
- Copper backup

Diagram showing connections and components of SemStar5 Data Hub and Subsea Networks.
Example SemStar5 applications

**SemStar5 as a:** Hybrid system (local control and a data hub)

**Features**
- Independent networks within common vessel
- Segregates process critical & data acquisition traffic
- Allows mixed comms technologies

**Safety & automation system**

**Process monitoring/optimisation**

**Comms On Power**

**Optical @ 1GBps**

**Process Control Bay's**
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module

**Data Acquisition Bay**
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module
- Support Module
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- Support Module

**Data acquisition network**

**Smart instrumentation downhole & process**

**Smart instrumentation downhole & process**
Summary
Faster, Deeper, Further...  
... continued focus on key technologies, capabilities & innovations contributing to the success of subsea developments.
....demands faster, deeper, further subsea comms

Data rates up to 100 Mbits/sec
Depths up to 3000 metres
Offsets up to 300Km