Enabling Operational Excellence in FPSO

Patrick Deruytter, General Manager
Emerson Process Management Korea
16-Sep-2008
**FPSO Challenges/Global Market Trend**

- New generation of highly complex vessels/plants
  - New builds and conversions

- End-user Requirement
  - Full Integration of all systems
    - Navigation + IAS + CTS + Other
  - Fast Track delivery
  - Highly reliable and easy to maintain

- Customer Requirement (Shipyards)
  - Integrated engineering and implementation (flexibility)
  - Reduce Manufacturing cost
  - Fast Track delivery
**FPSO Project Trends**

- One Stop Solution for Project Implementation
- Referenced on preferred vendor list to major shipyard as total solution supplier
  - Deliver tangible project life cycle savings to the shipyards
  - Deliver a total automation integration
    - From Propulsion to Sensors following the latest standards in Automation and Marine
- User Choice System (flexibility)
  - Cargo Part: Cargo handling, Ballast, VRCS, CTS with Transmitter
  - Mach. Part: Engine, PMS, Machinery control system with Transmitter
  - New Tech.: Re-liquefaction system, Re-Gasification system etc.

- Improve the Operational Excellence of a Ship Operation
  - Efficient, Predictable and Intuitive Operations, Maintenance & Support
Emerson Process Management
Total Solutions Strategy

Global Industry Services

PlantWeb

Best-in-class Technologies
Meeting the Challenges in Offshore Production

- Unique enabling technology to maximize production
- Remote monitoring and optimizing of process equipment for health index and remote assistance
- Solution ready for existing challenges and regulatory compliance requirements
- Highly flexible to enable fast track conversion projects
- Onboard manning and qualification requirements
- Intelligent solution to minimize necessary manning

Our architecture and application tailor made for FPSO will bring the onboard crew and the specialists closer together
Emerson Wide Breadth/Depth of Products, Solutions & Services

Systems & Solutions
- Control Systems
- Turnkey Project Capability
- Engineering Design
- Industry Centers
  - Chemical
  - Oil & Gas
  - Refining
  - Power & Water
  - Life Sciences
  - Metals & Mining
  - Pulp & Paper
  - Marine

Measurement
- Pressure
- Temperature
- Level
- Flow
- pH
- Conductivity
- Gas Composition

Valves & Regulators
- Control Valves
- Regulators
- Valve Actuators
- Valve Instruments

Asset Optimization
- Asset Management Systems
- Instrument and Valve Services
- Equipment and Plant Optimization
- Electrical Reliability Services
- Consulting
- Training
Emerson Marine Offshore Solution
Emerson Process Management offers One Window into all process onboard, which makes the operation of Offshore Production Units more reliable and easier for onboard staff than ever before. Add the AMS™ Suite, and you have predictive diagnostic for detection of potential problems.

**Oil/Gas Production**
- Generators
- Separators & Treatment
- Reinjections
- Compressors
- Auxilliary Systems
- Oil/Gas Fiscal Metering
- Offloading

**Subsea Control**
- Manifold & Subsea Valves
- Monitoring & Control

**Vessel Automation**
- Ballast/Bunker Control
- Oil Storage Monitoring & Control
- Offloading
- Power Management
- Auxilliary Control
- Tank Washing

**AMS**
Predictive Maintenance System for Machinery, Equipment and Instrumentation

**Safety**
- Vessel ESD/F & G System
- Oil/Gas ESD/F & G System

*One Window into the entire on board processes*
**FPSO Engine room Integrated Monitoring and Control**

Onboard applications integrated into Delta V Automation Systems

**Machinery**
- Main Boilers monitoring and Control
- Power Management
- Main/AUX Turbine Monitoring
- Auxiliary machinery Monitoring and Control
- Bunkers Machinery and Control
- UMS/EO Monitoring functions

**Cargo**
- Cargo loading/offloading
- Control
- Boil of Gas (BOG) Control
- LD/HD Gas Compressor Control
- Cargo Monitoring
- Load and Stability Calculator
Project Execution Strategy
Real distribution of Power, Control and Safety functions

One Window
- Oil and gas production
- Vessel automation
- Power management
- Subsea control
- Drilling

Modularized Controls
- Installation cost saving
- Safer design
- Easier to test
FPSO Module Arrangement, a challenge for Automation, Safety and Instrumentation
Distribute the Automation System close to the Process
We are lifting the ESD and F&G a step further in Offshore

Centralized ESD and F&G

All Installation, cable pulling and testing take place at the Yard
We build equipment into the Skid/Modules and do commissioning Locally

• **ON YARD;**
  Hook up ready tested module to the overall network

• **Saving**
  Installation time, testing and cable coat
Emerson ESD and Fire & Gas System is approved for Decentralized installation

A full distributed safety system on separate net
We provide a real distributed Smart Integrated Control and Safety System onboard
One view into all processes onboard
Comparing the centristic with a distributed modular approach

<table>
<thead>
<tr>
<th>Central Control Room</th>
<th>Remote I/O &amp; Control Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>- large control room</td>
<td>- small control room</td>
</tr>
<tr>
<td>- miles of cables</td>
<td>- short cable runs</td>
</tr>
<tr>
<td>- weight of cables</td>
<td>- modular design (pre-assemble, pre-test)</td>
</tr>
</tbody>
</table>

- field instrument
- remote I/O & control station
Remote I/O & Control Station

One cabinet per process module with

- PCS (DeltaV)
- PSD (DeltaV SIS)
- AC/DC power supplies
  - separate for PCS and PSD
  - circuit breakers
- fiber optic connectivity
  - fiber optic switches
  - patch panel
- illumination for the cabinet
Type Approved Systems and fit for Offshore environments
Additional Options for Smart Plants

Wireless Process Automation, Hardwired Safety

Redundant Wireless Process Automation, Hardwired Safety

Hardwired Process Automation and Safety

Wireless Automation, Hardwired Safety

Wireless Process Automation, Hardwired Safety

Redundant Wireless Process Automation, Hardwired Safety

Bridge
Wireless Signal Distribution inside Power Module
Customers Are Solving Real Plant Problems: StatoilHydro Grane Platform

- Application: Monitor wellhead annular pressure and heat exchanger pressures
- Smart Wireless delivered 100% reliability & stability in the crowded metal wellhead environment
- Easy integration of wireless data into third party system
- Customer identified operational improvements as a result of increased process visibility
  - Wireless solution eliminates the need for daily visits to the wellhead to manually record gauge readings
  - Continuous monitoring enables unusual readings to be identified earlier

“We are delighted with the performance of the Emerson Smart Wireless network in these challenging conditions. Following a short training programme, our instrument engineers are very confident about adding more wireless devices to our installation as required. These typically take around two hours to install compared with up to two days for a conventional wired unit.”

— Geir Leon Vadheim, Instrument Lead, Grane Platform
Remote Assistance & Operations Support

Shore Office
Operating Centre  Technical Staff

Remote Office
System Expert

...onboard anywhere at any time without physically being there
DeltaV Remote Client makes a thin client connection to a host server on the DeltaV LAN

- Provides fully functional operate and engineering capability
- Supports LAN, Wireless, satellite and dial-up modem communications
## Recently Realized FPSO Projects

International Offshore Oil & Gas reference with ICSS (SAS) delivery

<table>
<thead>
<tr>
<th>Company</th>
<th>Installation</th>
<th>World Area</th>
<th>Category</th>
<th>Engineering</th>
<th>AMS</th>
<th>Control System</th>
<th>Safety system</th>
<th>Inst &amp; Valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>B 18 Greater Plutonio</td>
<td>West Africa</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Total</td>
<td>Akpo</td>
<td>West Africa</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Kizomba A</td>
<td>West Africa</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Kizomba B</td>
<td>West Africa</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Yoho</td>
<td>West Africa</td>
<td>FSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Vaalco Gabon</td>
<td>Vaalco</td>
<td>West Africa</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Dominion</td>
<td>Devil's Tower</td>
<td>Americas</td>
<td>Spar</td>
<td>YES</td>
<td>YES</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Murphy</td>
<td>Front Runner</td>
<td>Americas</td>
<td>Spar</td>
<td>YES</td>
<td>YES</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BWG / Pemex(Norway)</td>
<td>Yuum k’ak naab</td>
<td>Americas</td>
<td>FSO</td>
<td>Yes</td>
<td>YES</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petrojarl / Petrobras (Norway)</td>
<td>Siri</td>
<td>Americas</td>
<td>FPSO</td>
<td>YES</td>
<td>YES</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Petrobra DPI (Norway)</td>
<td>Pipa2</td>
<td>Americas</td>
<td>Vessel(FPSO)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Murphy</td>
<td>Thunderhorse</td>
<td>Americas</td>
<td>TLP</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bluewater</td>
<td>Ulisse GOM</td>
<td>North Sea</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bluewater</td>
<td>Glas Dowr</td>
<td>North Sea</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Amerada Hess</td>
<td>Triton</td>
<td>North Sea</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ConocoPhillips</td>
<td>Bohai Bay Ph2</td>
<td>Asia</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CNOC</td>
<td>West Nanhai 13-1</td>
<td>Asia</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CNOC</td>
<td>West Nanhai 13-2</td>
<td>Asia</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sea Production (Norway)</td>
<td>Front Puffin</td>
<td>Australia</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Global Process System / Tanker Pacific</td>
<td>Coogee Montara</td>
<td>Australia</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Teekay Petrojarl</td>
<td>Che Guevara FPSO</td>
<td>Europe</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Petrojarl</td>
<td>Petrojarl 1 FPSO</td>
<td>Europe</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bergesen World-Wide Offshore</td>
<td>Berge Entreprise, FPSO</td>
<td>Europe</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Grenland Group ( Topside, BWO)</td>
<td>Berge Entreprise, FPSO</td>
<td>Europe</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sea Production (Frontline)</td>
<td>Front Puffin, FPSO</td>
<td>Europe</td>
<td>FPSO</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi Purpose Floater Corp.</td>
<td>MPF-1 Drill &amp; FPSO</td>
<td>Europe</td>
<td>Vessel (drill)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
A Digital Production Unit is a Smart Production Unit

Thank You