New technology opportunities – unlocking $30/bbl oil

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FPSO Asia: April 2016.

Typical Slide Banner

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Revision history					
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Classification		**Rule**
Crondall confidential		May not be shared outside Crondall
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*Client permission required to share beyond the Client project team, i.e. within the Client organisation as a whole		

Agenda

1. **Introduction to Crondall Energy**
2. **Areas of potential value improvement**
3. **Integrating technology - A Not Normally Manned Floater concept**
4. **Case study – North Sea low GOR oil facility**
5. **Conclusions & future developments**

1. Introduction to Crondall Energy

Crondall Energy?

Independent technical & strategic consulting organisation

Global service from offices in Europe, Asia, Australia and USA

Focus on floating production and subsea solutions

Multidiscipline teams for marine, facilities and subsea engineering

Global perspective

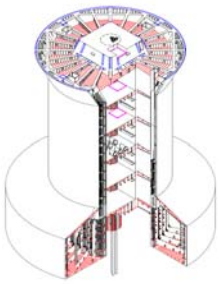
Experience of projects on a worldwide basis

Experienced team

Concept & front end engineering to delivery support

Floater design & technology development

Concepts developed and delivered for multiple clients



What we do

Field development

- **Concept, feasibility and Pre-FEED studies;**
- **Client engineer over full project lifecycle;**
- **Assurance reviews/verification studies;**
- **Specialist engineering studies.**

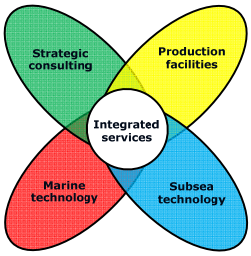
Business consulting

- **Strategic studies;**
- **Technical reviews & due diligence;**
- **Bank LTA;**
- **Expert witness/determination.**

Technology development.

- **FPSO/FLNG design development;**
- **Normally unmanned floating production facilities**
- **Storage and offloading (FSU/FSRU) solutions.**

Services - an integrated multi-disciplinary approach



Strategic Consulting

- Strategy
- Commercial
- Risk management
- Technology selection
- Procurement support

Marine Technology

- Naval Architecture
- Structural
- Hydrodynamics
- Moorings/risers
- Marine Engineering
- Advanced analysis

Production Facilities

- Process systems
- Utilities
- Structural
- Electrical & Inst.
- Topsides layout
- Safety

Subsea Technology

- Subsea architecture
- Pipelines
- Flow Assurance
- Trees & Controls
- Risers

Crondall provide integrated technical support through a multidisciplinary team of experienced industry professionals

2. Areas of potential value improvement

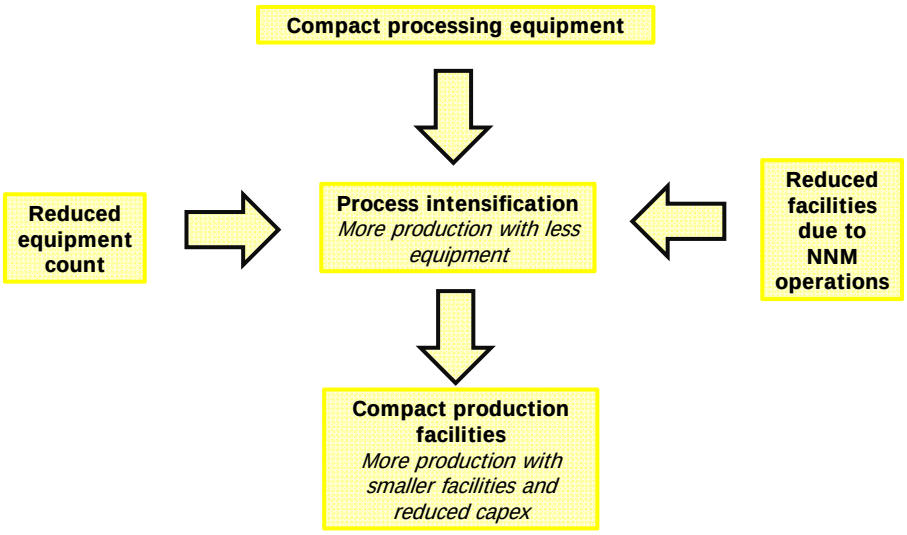
Three general themes for improving value

- Standardisation:
  - Specifications and delivery processes;
  - Adopting consistent specifications - delivering predictability;
  - Doing things smarter.
- Better cooperation:
  - Re-thinking relationships within the supply chain.
- New technology:
  - Reducing capex through process intensification;
  - Increased automation – reducing manning levels and opex.

"By taking a broader view and reducing complexity and standardising processes, materials and documentation, industry players can develop a long term sustainable cost base to adjust to this lower margin environment."

Elisabeth Torstad CEO DNV GL Oil & Gas

Technology for process intensification



Examples – compact processing solutions

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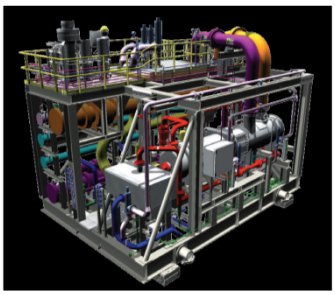
Cyclonic separation and eductor based pressure boosting devices from e.g. Caltec.

Compact compression packages from e.g. Dresser Rand

Direct electric heating solutions from e.g. Exheat Ltd.

Subsea water injection – (various).



Compact DATUM ICS compression package
Courtesy of Dresser Rand

Courtesy of Caltec Ltd

Direct electric heating
Courtesy of EXHEAT Industrial Ltd

Technology unlocking unmanned operations

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Simplified design for "Not- normally-manned" operations, *e.g.*
-high reliability components;
-plug and play maintenance;
-corrosion resistant materials.

Remote monitoring and control; CBM & RBI

Remote (onshore) operations.

Reduced (offshore) maintenance & repair workload

Reduced facilities due to W2W access

Low cost operations

SEE ALSO: UNMANNED WELLHEAD PLATFORMS - UWHP SUMMARY REPORT by RAMBOLL FOR NPD. MARCH 2016

Example - automation

"Last week six convoys of 44 tonne trucks left factories spanning the Continent from Stockholm to Munich, and crisscrossed Europe, arriving at Rotterdam's harbour on April 6. *The trucks were driving themselves." {Italics added}*

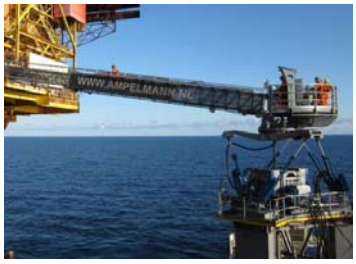
The Daily Telegraph 11th April 2016

However - adopting new technology in the oil and gas sector remains a challenge!

Examples - work to work systems

"Walk-to-work" systems used to carry out maintenance & production support operations on a variety of offshore oil and gas and wind farm applications.

Reduces both opex and platform complexity (maintenance crew live aboard W2W vessel).



Walk-to-work system and vessel
Courtesy of Ampelman.nl

Walk-to-work system and vessel
Courtesy of Uptime

Example:
Condition based monitoring (CBM) of diesel gensets

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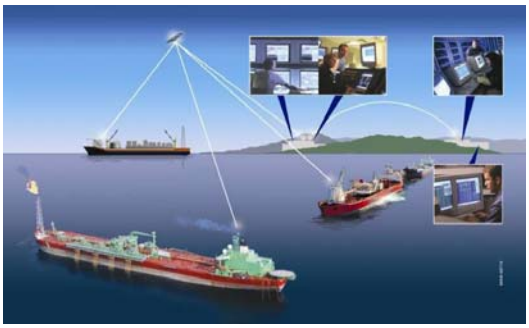
Service agreement objectives:

- **To find more than 80% of the critical cases 7 – 14 days in advance.**
- **To predict more than 80% of the required maintenance 1 – 4 months in advance.**
- **Reduce the maintenance cost by about 10-20%.**
- **Increase the total availability by 5 – 20%**



Graphics and data courtesy of Wartsila

Example - Not normally manned FSU

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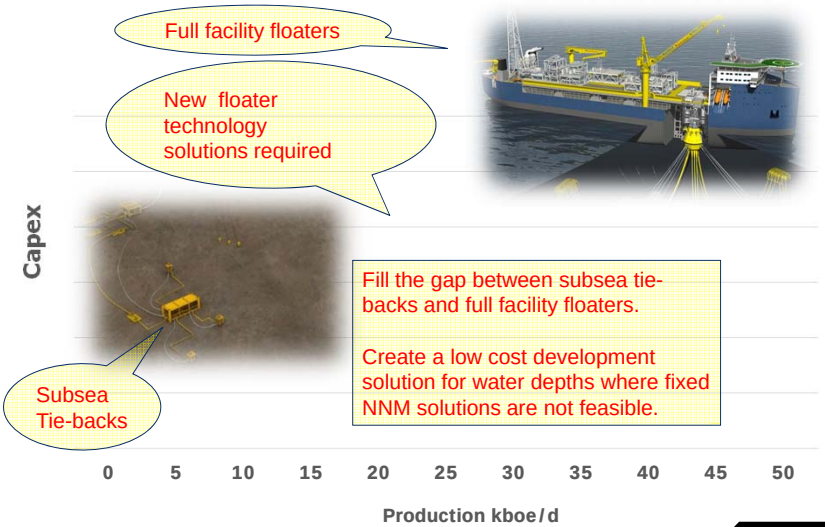
- **Njord B has been operated normally unmanned since 2000.**
- **Max POB 18 -Normally 8 people shuttled over for loading and maintenance (approximately once a month).**
- **All monitoring from Njord A in not manned periods.**

Graphics and data courtesy of Statoil

3. Integrating technology - A Not Normally Manned Floater concept

Filling a gap in the market?



Design objectives

Low cost: – a solution for small field developments in harsh and benign environments in water depths where fixed facilities are not viable.

- **Low capex** -compact facility with low equipment count, low steel weight, easy construction and low cost installation.
- **Low opex** – not normally manned operations, low maintenance equipment and material selection.

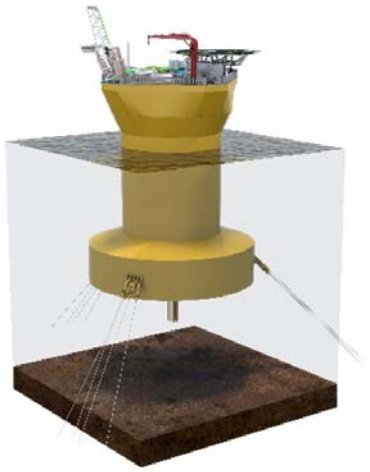
High performance:

- **Process intensification** - maximise benefits of compact processing technologies (and where appropriate – subsea technologies).
- **Operational efficiency** – design simplicity – component reliability.
- **Minimal motions** - improve process uptime and widen the choice for riser selection.

Enhanced safety – design simplicity & reduced exposure of operators to hazards.

A compact "Not-normally-manned floater" (Patent pending)

- Deep draught floater with single column "hull" structure and integrated (buoyant) "deck box".
- Integrates a number of vendor technologies into a coherent field development solution:
  - Compact technologies for process/separation/pumping/compression.
  - Subsea processing – e.g. water injection.
  - Remote operations control technology.
  - High efficiency multi-fuel diesel driven power generation.
  - Use of remote CBM;
  - Plug and play equipment maintenance;
  - High density ballast to increase payload.
  - Low maintenance materials e.g. FRP gratings/walkways; CRA
- Can be used for either stand alone oil or gas developments – or in support of long-range/complex tie-backs.



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Size and scalability

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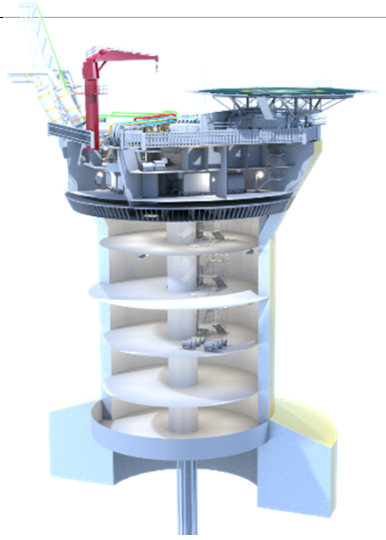
Design concept is scalable to meet

- ✓ Different payload requirements;
- ✓ Different metocean conditions.

Initial design concept has been sized to meet identified niche opportunities, but with additional topsides payload capacity available.

Crondall have developed a sizing and optimisation tool that allows rapid re-sizing to meet new functional and payload requirements.



Design philosophy

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Focus on simplicity and reduction of both equipment and fabric maintenance.

All design decisions have to be made in support of the unmanned philosophy.

Project team have sought feedback from operators with existing normally unmanned facilities.

Key challenge is to maintain discipline regarding decision making:

- ➢ Keep things simple;
- ➢ Invest in reliable equipment;
- ➢ Work closely with equipment vendors on e.g. material selection and sparing philosophy;
- ➢ Avoid cost cutting measures which will compromise reliability and ability to operate remotely e.g. avoid manual resets.
- ➢ Focus on use of healthcare/service agreements with key vendors.

Operations and maintenance philosophy

Reduced equipment count:

- Eliminate/reduce equipment e.g. direct electric process heating.
- No cargo handling equipment;
- No on-board mooring winches;
- No active ballasting.
- Eliminate helideck, accommodation and some utilities if W2W is employed.

Simplified fabric inspection & maintenance:

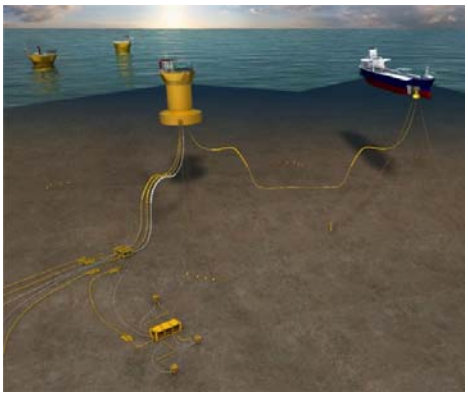
- Extensive use of CBM – e.g. diesel gensets;
- Focus on exchange replacement of parts for maintenance rather than in situ; (Easy handling of units – plug and play maintenance)
- No cargo spaces to inspect;
- High reliance on RBI – high fatigue design factors in fatigue sensitive areas; Easy access for inspection.
- Low maintenance material e.g. corrosion resistant materials, FRP walkways, high quality coatings.

Possible field development applications

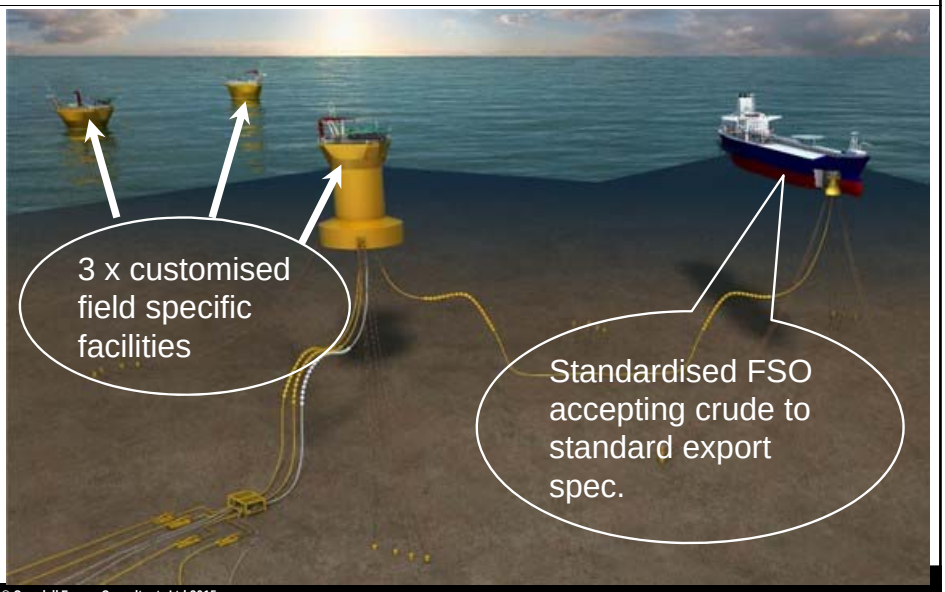
1. Small low GoR oil developments where the gas is consumed for power generation for e.g. ESPs, WI etc.
2. Small gas fields with or without nuisance condensate – gas treatment and compression – with an export route.
3. Small oil and gas developments with moderate GoR;
4. Longer subsea tie-backs – support facilities including power, controls, chemicals, gas dehydration.

Can be combined with low cost, readily available export/storage/offloading solutions or other host facility e.g.

- Pipeline;
- Stand alone FSU;
- Twin SAL loading;
- Host FPSO.



Small pool cluster – 3 fields – 3 operators



4. Case study – North Sea low GOR oil facility

Low GOR oil field case

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A topsides design has been developed for a low GOR North Sea field :

NORTH SEA LOW GOR CASE STUDY	
Total liquids (kbbl/d)	25
Oil/condensate production (kbbl/d)	20
Water handling (kbbl/d)	22.5
Gas handling (mmscf/d)	8
Gas injection/export (mmscf/d)	0
Installed power generation (MW)	12.3

Key design factors:

- Oil is exported via pipeline;
- Gas is consumed as fuel (production may be constrained to limit flaring);
- Water is treated and discharged overboard;
- Power provided to subsea water injection facility;
- Well fluids are free from significant contaminants:
  - Sand. CO_2, H_2S, etc.

Low GOR facility dimensions

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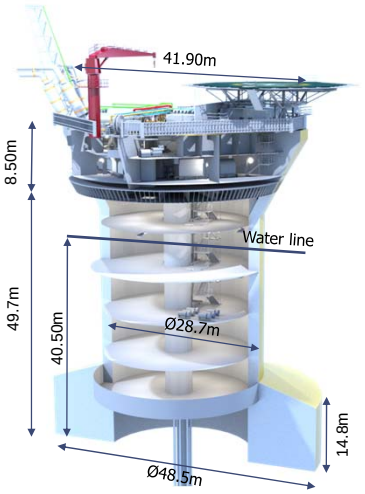
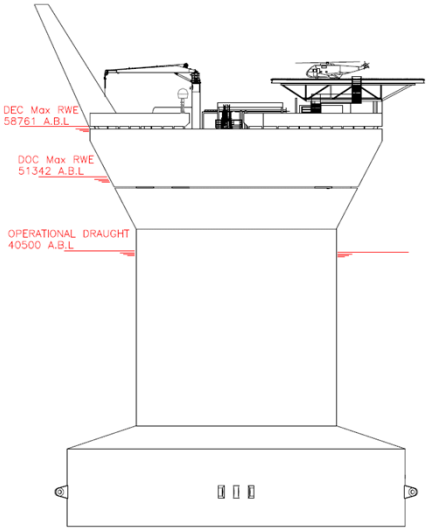
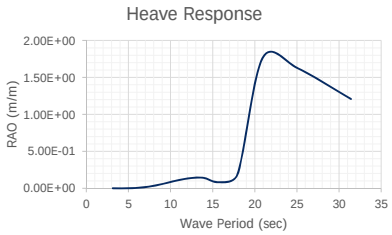


	Total Weight (te)	Weight in Deck structure (te)	Weight in Hull structure (te)
TOTAL	14 825	4 575 *(31%)*	10 250 *(69%)*

Note 1: Includes 40% allowance on all items.
Note 2: Approximately 1,000te of additional topsides payload available with expanded use of HD ballast, subject to CoG limits.

Hydrodynamic responses





Responses dominated by heave motions – heave natural period >21 secs to minimise motions.

Structure configured to ensure maximum relative wave elevation does not reach above the green water protection screens which surround the process deck in the Design Extreme Condition (DEC).

Roll/pitch responses are negligible < 5 degrees in DEC.

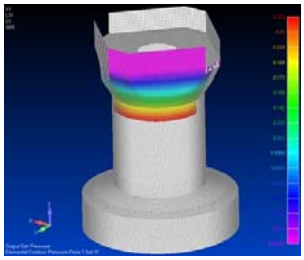
Heave accelerations < .1g in DEC.

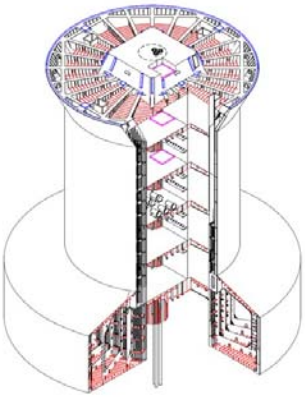
Structures

Preliminary scantlings developed for both hull and deck box, based on loading from:

- ✓ Waves (including intermittent wetting), and;
- ✓ Hydrostatic loading;
- ✓ Wind;

Preliminary MTO carried out to feed into weight and cost estimate.



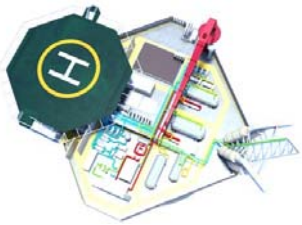


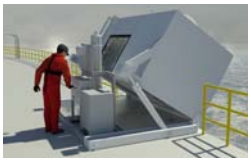
Layout & safety

Follow philosophy of Kletz* and others on inherently safer and simpler design:

"What you don't have can't leak"

- Minimise equipment count;
- Separation of hazards following same principles as FPSO design;
- Hazardous areas separated from non-hazardous areas by blast wall;
- Layout to NORSOK working environment standards in terms of access and escape routes;
- Main access/escape route by helicopter;
- Secondary escape by Marine Evacuation Chute;
- Accommodation and Temporary Refuge (TR) for 12 persons;

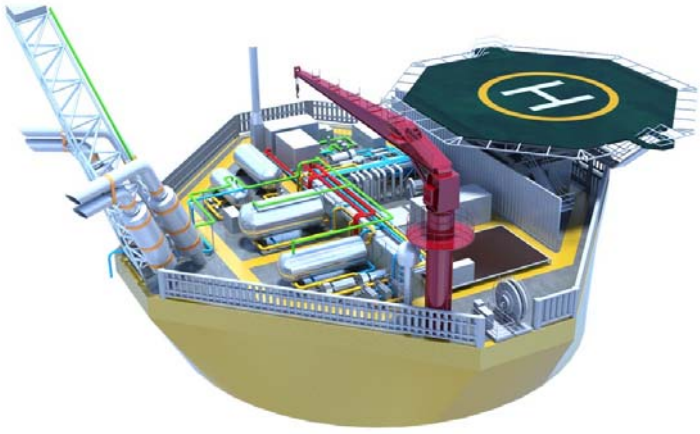




Courtesy Viking

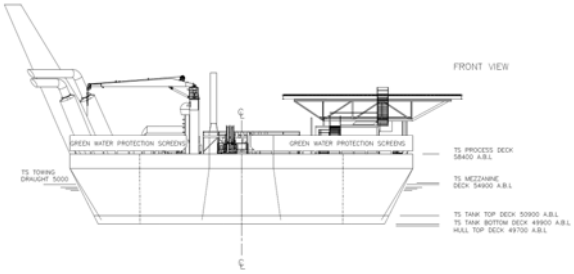
***Kletz T.A. What you don't have can't leak" Jubilee lecture. Chemistry and Industry 1978**

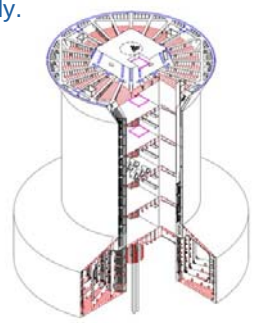
Layout - All process equipment on deck



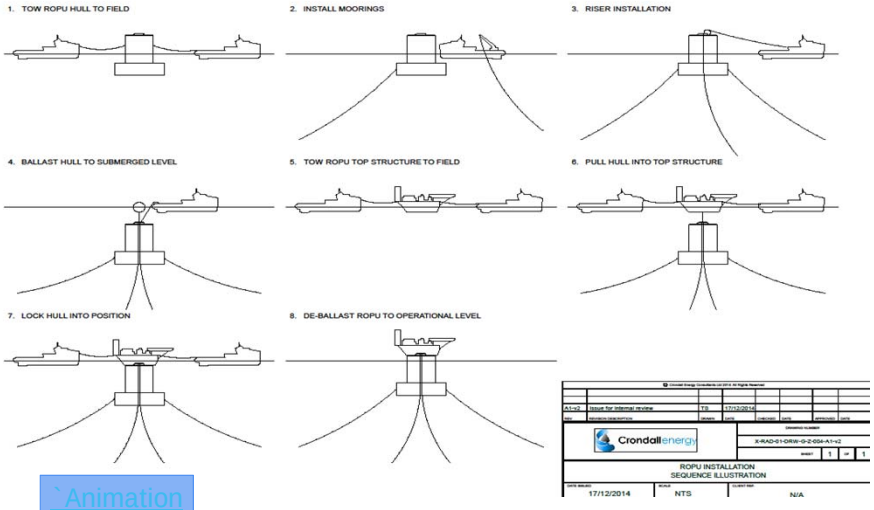
Construction

- Hull and deck box have been designed to be able to float at a quayside (light) draft of maximum 5m. This allows access to a wide range of yards all over the world;
- Hull and deck box will be fabricated separately;
- Once hull is completed it can be towed out to deeper waters and ballasted to a deeper towing draft;
- Hull and deck box will be towed to the field separately.





Installation



`Animation

North Sea operations philosophy

Objective is to have the facility unmanned during normal operations.

Access required for planned maintenance (every 4-6 weeks), expect 3-6 days per visit.

Access for Northern North Sea operations by helicopter, but “Walk-to work” (W2W) being considered for Central North Sea and other less harsh metocean environments.

Remote operations (control and monitoring) from onshore control room.

Control: Dual redundant VSAT links to onshore control room. FleetBroadband for backup and other data traffic. Automatic shutdown on loss of communications.

5. Conclusions & future developments

Summary and conclusions

Technology exists which enables offshore engineers to design simple compact production facilities at reduced cost. Integrating that technology into an overall compact production facility, amplifies the benefits of the technology.

Control and monitoring technology allows the development and operation of "not normally manned" oil and gas production facilities.

The use of walk-to-work boat access technology reduces the cost of platform access and significantly reduces the complexity of the facilities (reduced capex and opex).

Crondall's "Not normally manned" floating production facility provides a low cost field development solution which can unlock otherwise stranded assets in a low oil price environment.

The future is likely to see further improvements in the current technology and allow a significant reduction of permanent offshore manning, which will both further reduce opex and increase worker safety.

Contact us

For more information go to

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