Conceptualising a new Infrastructure Hub West of Shetland (WoS)

Hurricane
Basement Reservoir Specialists
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Presentation overview

- Introduction
- Background to Hurricane’s CPR concept selection
- Optimising the Lancaster story
- An option for a Hub West of Shetland
Full Field concept selection process commenced in early 2012 and concluded in mid 2013. The latest series of concepts and costs being included in the CPR dated Nov 2013.

Costain Upstream, acquired EPC Offshore’s trade and Assets with an effective date of 1st Feb 2014. Prior to 1st Feb 2014, Hurricane used EPC Offshore to undertake it’s Project Management and conceptual studies.

SPD Ltd, current Well Management Contractor (WMC), a role previously undertaken by AGR.


Regulator includes DECC, HSE and recently formed OSDL.

Acknowledgements

Thanks to all the Service Companies that have supported, offered guidance and had input into our concept selection process over the last 36 months.

In particular a special thanks to:
- Costain Upstream – Peter Kirkbride and his team
- SPD Ltd – Mohammad Pajouhesh and his team
- AGR – Patrick Tawse and his team
- RPS Energy – Ian Linnett and his team

In addition, thanks to the Regulator and OGA for their encouragement and direction.
Hurricane formed in 2004 under the leadership of Dr Robert Trice CEO

Based in Eashing with an operational office in Aberdeen

Hurricane currently holds 3 licences WoS, P1368, P1485 and P1835
• Resources (MMboe's) sourced from CPR dated November 2013
• Whirlwind volumes (MMboe) based on oil case
• The commercial flow rate was recorded from the Lancaster Horizontal well test in 2014. The well test achieved a sustainable natural flow rate of 5,300 STB/d and a flow rate using artificial lift (using an electrical submersible pump) of 9,800 STB/d. Both rates were constrained by surface equipment.
Hurricane’s assets: Contingent & Prospective Resources – Source CPR November 2013
Lincoln and Lancaster lie on crestal positions on the Rona Ridge, whilst Whirlwind is located on the flank of the Rona Ridge.
This map illustrates our assets locations versus existing producing fields, currently developing and future exploration development opportunities. The map also shows existing infrastructure and a possible route for the Rosebank pipeline.
Hurricane’s Lancaster asset: Contingent & Prospective Resources – Source CPR November 2013
High-level challenges considered during the concept selection process:

Location – WoS, approx. 70km west of Shetland / Water depth circa 150m

Environment – Climatic conditions / Metocean conditions

Lack of Infrastructure – refer earlier slide depicting limited surrounding operating, exploration and development opportunities in comparison to the more established SNS, CNS and NNS in the UKCS
A slide depicting Hurricane’s approach to the challenge of commercialising assets WoS
Moving forward...

*Given our resource base, we:
  - Worked with Costain Upstream to undertake a concept selection process over 18 months, during which we:
    - Assessed over 45 possible concepts
    - Floating vs platform
    - Owned vs leased vs 3rd party host
    - Shortlisted 10 for further evaluation
• A high-level list of technical and commercial considerations, considered during the concept selection process for a full field development of Lancaster.

• Refer later slides for thought processes involved in considering and selecting the optimum solution re the above elements
Further definition on evaluation criteria and the “perfect score” weighting assigned against which 10 Full Field concepts were evaluated during the conceptual phase.
Whilst the CPR base case reflects an FPSO, the team accepted that during FEED (front end engineering and design) a more detailed assessment of alternative floating process and storage systems such as the SEVAN and Octobuoy would need to be re-examined against market conditions applicable at the time.
A summary of the internal objectives agreed within Hurricane between the Executive and Project Management team

- Provide long-term production data to support Full Field Development planning
- Deliver an acceptable return on capital invested with appropriate allowance for development risks and production efficiency
- Minimise CAPEX spend and any associated lease costs, without compromising Full Field Development planning
- De-risk and optimise the Lancaster Full Field Development
- Duration c. 5 years
  - 2 years subsurface evaluation
  - 3 years delivery of Full Field solution
A summary of the internal objectives agreed within Hurricane between the Executive and Project Management team for Phase 2

Lancaster upside in this context refers to the 456 Mmboe 3C contingent Resource case – Source CPR dated November 2013
A side depicting the results of the concept selection process, referring back to previously presented slides and long term Phase 2 objectives. Yellow items identify concept selections / solutions

Leased vs Purchased element circled and discussed in more detail in next slide
FPSO Lease v Purchase costs

Transition point between leased & purchased c. 8 years
(Calculated by Costain Upstream (EPIC Offshore) during conceptual evaluation c. 2012)
As a consequence of Phased Plan and review of optimum commercial position wrt Lease vs Purchase, two distinct phases were identified and within each as a result of their duration different commercial models were assumed for the Base Case.

- CPR refers to both this case and alternative cases including carrying a lease throughout life of field

- CPR 2C Lease vs Purchase case includes outage circa 2023 / 2024, i.e. approx 5 years after Phase 1 1st oil to allow Phase 1 FPSO to be replaced / upgraded by Phase 2 vessel
Shuttle Tanker – given the lack of oil infrastructure in the area, the requirement to minimise capex and flow assurance management, a shuttle tanker was selected as the optimum export solution.

Elements considered under the banner of Flow Assurance and Gas Lift are explained in more detail in the following two slides.
Flow assurance studies considered the requirement for chemical injection, insulated tubing and heated flowlines / pipelines
Subsequent studies assessing artificial lift requirements have now been extended to include HSP’s (Hydraulic Submersible Pumps) given potential benefit re availability and power fluid / heating requirements.
Under Artificial Lift pros and cons discussed re Gas Lift vs ESP’s, availability / reliability etc, Impact on both with respect to power usage and topside equipment availability (power generation and compression) also mentioned at a high level.

Use of associated gas for power generation / compression and impact on reduced flaring
Sourced from Hurricane’s internal engineering documents

CPR in Phase 1 is constrained at 30,000 bopd, this reflects Phase 1 nameplate capacity of 37,500 bopd constrained by assumed 80% production efficiency

Production Efficiency used for design and economic evaluation purposes within Hurricane is 80%
Cost estimating methodology used both for development of Full Field cost estimates (Phase 1 and 2) and EPS alternate cases

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>Budget estimates / quotes (if available) / historical performance plus IHMC databases</td>
</tr>
<tr>
<td>Procurement</td>
<td>Budget estimates / quotes (if available) plus Costain Norms database</td>
</tr>
<tr>
<td>Fabrication</td>
<td>In-house Costain Norms database</td>
</tr>
<tr>
<td>Logistics</td>
<td>Based on installation schedules and % of total procurement and fabrication</td>
</tr>
<tr>
<td>Storage</td>
<td>% of total procurement and fabrication</td>
</tr>
<tr>
<td>Project Management</td>
<td>% of total procurement, fabrication, logistics and installation</td>
</tr>
<tr>
<td>Engineering</td>
<td>% of total procurement, fabrication, logistics and installation</td>
</tr>
<tr>
<td>Installation</td>
<td>Based on installation schedules and vessel rates from Costain Norms database</td>
</tr>
<tr>
<td>Growth Allowances</td>
<td>Waiting on weather, SPT (drilling only) and project contingency</td>
</tr>
</tbody>
</table>

Notes:
1) Pre 2nd February 2014 transfer of EPC offshore trades and assets to Costain pipelay, EPC, Norms database used.
• Figures extracted from CPR dated November 2013 – 207mmboe 2C case (lease / purchase option)

• 10,000bopd / well (pre production efficiency 80%, 8,000bopd with Production Efficiency included) based on CPR predicted 2km horizontal well profile, declining monthly after 1st oil

• Over the last 24 months, with a declining oil price and increasing financial market constraints, we challenged ourselves to deliver an alternative to the CPR Phase 1 at reduced CAPEX but one that provided the same reservoir data set for Full Field planning

• Triangle colours represent Hurricane’s perception of challenge in today’s oil price and financial environment and do not reflect Hurricane’s view on project viability and delivery
Optimising the Lancaster story

Over the last c. 18 months, with a declining oil price and increasing financial market constraints, we challenged ourselves to deliver an alternative to the CPR Phase 1 at reduced CAPEX, but one that provided the same reservoir data set for Full Field planning.
• EPS case represented in schematic, also referred to as EPS Reference Case

• Schematic represents current “Reference Case” concept, consisting of two horizontal wells (existing 205/21a-6 well plus a 2nd new well), a small infield pipeline or flowline and a versatile / small leased FPSO

• Planned duration, 5 years as per Full Field Phase 1 concept

• Limited subsea infrastructure, focus on acquiring long term quality production data

• Option existed to tie-in or run gauges into 205/21a-4z (currently suspended inclined well, tested in 2010)

• Ability to use on our other assets WoS refers to vessels characteristics to move easily between fields with limited impact on subsea systems

• FPSO – Dynamically Positioned – a number of alternative DP concepts considered from DP2 to DP3
Last year's horizontal well resulted in a high quality data set from which it was possible to infer very high production rates and sustainable flow. This new data caused hurricane to re-evaluate its EPS plans.

Source Hurricane Presentation DEVEX – Thursday 21st May

Triangle colours represent Hurricane’s perception of challenge in today’s oil price and financial environment and do not reflect Hurricane’s view on project viability and delivery.

Following 205/21a-6 well test, Hurricane believes the EPS Reference Case design as presented previously has the potential to be simplified as our current analysis indicates the existing horizontal well may initially be sufficient to commence production from the EPS.
• Rationalising the concept to a single well, enabled the project team to look at the subsea infrastructure and move towards a single well tie-back concept with the flowline being reduced and tied directly into the infrastructure at the existing suspended well

• Vessel centre (turret) potentially moved to less than 300m from current top hole position rather than circa 3km in Reference Case concept

• Hurricane’s opinion today is that this revised concept with a second well being drilled at an optimum location post first oil still achieves the required objectives of the EPS and at substantially reduced costs.

• New EPS concept referred to as EPS Capex Lite to distinguish it between itself and EPS Reference Case, re layout, wells, costs, etc
• A schematic of a potential solution, illustrating the compact and simple nature of the conceptual vessel.

• Topside processing facilities effectively limited to oil separation, overboard produced water clean-up technology and fuel gas systems for marine and process and subsea power.

• Riser tied back into turret by disconnectable turret which support the use of DP (dynamic positioning) rather than tethered systems. The disconnectable system also provides flexibility with respect to vessel management and operational challenges.
An illustration of the vessel topside layout
A comparison of the Full Field Technical conclusions with the EPS - solution
## FPSO capacities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>EPS</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nameplate Steam Flute Capacity</td>
<td>bpd</td>
<td>15,000</td>
<td>70,000</td>
<td>10,000</td>
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<tr>
<td>Nameplate Deoxygeniser Capacity</td>
<td>bpd</td>
<td>20,000</td>
<td>75,000</td>
<td>20,000</td>
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<tr>
<td>Nameplate Water Treatment Capacity</td>
<td>bpd</td>
<td>10,000</td>
<td>75,000</td>
<td>156,000</td>
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<tr>
<td>Nameplate Gas Export Capacity</td>
<td>MMscf</td>
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<td>12</td>
<td>18</td>
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<tr>
<td>Fuel Oil</td>
<td>MMscf</td>
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<td>12</td>
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<tr>
<td>Nameplate Gas FI Capacity</td>
<td>MMscf</td>
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<td>12</td>
<td>36</td>
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<tr>
<td>Nameplate Water Injection Capacity</td>
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</tr>
<tr>
<td>Nitrogen Injection Capacity</td>
<td>bpd</td>
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</tr>
<tr>
<td>Separation Train Arrangement</td>
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<td>2 x 100%</td>
<td>2 x 100%</td>
<td></td>
</tr>
<tr>
<td>Compression Train Arrangement</td>
<td>None</td>
<td>2 x 100%</td>
<td>2 x 100%</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. "Nameplate" capacities
2. If imported gas is required in later field life for fuel gas unit(s) or production well kick-off, not applicable for EPS.
3. Phase 2 capacities are not incremental to Phase 1 - Not applicable for EPS.

Sourced from Hurricane’s internal engineering documents
Exploring commercial options to overcome the challenge of typically required Letters of Credit (LoC) (or equivalent) when a relatively small Operator seeks to secure an option to use an FPSO
• When reviewed in light of the:

  • Well Test (205/21a-6)
  • The reduced capex “EPS Capex Lite”; and
  • Progress made to transition from an LoC to an upfront capital contribution on the FPSO

• In Hurricane’s opinions traffic lights moved to “green”
Hurricane’s opinion that EPS Capex Lite achieves the EPS Reference Case objectives and has the potential to also achieve the two additional objectives
• The impact of EPS Capex Lite on the Full Field development sequencing

• At this stage of the assessment studies suggest an option to go from EPS to Phase 2 (Full Field) exists, subject to the results of the EPS subsurface evaluation phase during years 1 and 2 of production and the ability to drill further wells from cash flow.
• Hurricane’s Lancaster & Lincoln assets: Contingent and Prospective Resources, Source: CPR November 2013, Mmboe

• Considering the option to include Lincoln within the Lancaster Hub concept – scene setting

• Highlighting distances involved i.e. circa 10km, predicted similar fluid types, similar water depths, etc.
• Location of Lincoln to Lancaster

• Potential creation of a Greater Lancaster Area (GLA)

• Possibly first stage in a Hub creation depending on future drilling success on Lincoln
Illustration of Lancaster and Lincoln (GLA) conceptual hub layout
Implication, location and timing of Whirlwind and “other” interested parties

Concept for Hub would not preclude either Strathmore (discovery) and / or Typhoon / Tempest being also subsequently included within West of Shetland hub.
Illustration showing a jacket on Whirlwind incorporated into the Lancaster / Lincoln (GLA) hub.

The conceptual infrastructure providing a flexible hub option for third parties.
Slide illustrates removal of question mark over whether a Shared Hub works by showing all jigsaw pieces in place.
Potential opportunities for the industry to examine and benefits achieved from a Shared Hub concept
Slide illustrates removal of question mark over whether a Shared Hub works by showing all jigsaw pieces in place.
Conclusions

• Acquiring a high quality dynamic dataset from the 2014 horizontal well has improved Hurricane’s understanding of the behaviour of the fractured basement reservoir

• The analysis of the well test and subsequent concept simplification provides, a viable EPS solution utilising the existing well stock

• The EPS is a natural precursor to a larger phased development providing the required data to optimise the Lancaster Full Field Development

• For a hub located close to Lancaster, in shallow water, we believe there is a real opportunity for the industry to demonstrate a collaborative approach to maximising the economic recovery of the area
Thank you