An alternative power supply for subsea production at long distances
Content

- Arctic Prospects & Challenges
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Arctic Prospects

- Up to 25% of the World hydrocarbon reserves
- Today’s technologies make these reserves attainable
- Russian scientific knowledge provides solid foundation for development
Arctic Challenges

Unique combination of:

- Extremely low winter temperatures
- Ice coverage
- Deep seas
- Very large fields
- Ultra long offsets
- Extremely sensitive ecosystem

*We can not just use off-the-shelf solutions*
Enabling Technologies

- All-Electric Subsea Production
- Long distance subsea power and communication
- Subsea processing
- High voltage subsea distribution & connection systems
- Long distance gas transportation systems
Technology Gaps

• High Power DC / AC Subsea Inverters (145kV-450kV)
• Very High Voltage High Power Subsea Connectors
• Standards for interfacing subsea electrical equipment
Phased Subsea Developments - Ormen Lange

**Initial Phase**
- Initial Power investment is limited to template controls (up to 1MW)
- Duration approx. 10-15 years

**Compression Phase**
- Large power investment when boosting needed in later life (100 MW)
- Allows time to develop needed technologies
Large All-Electric Subsea Production System

- **Phase 1**
  - 4 x 8-slot templates
  - 28 x production wells
  - 4 x water injection wells
  - Two Umbilicals
  - Two 10” MEG lines
  - Two 36”-42” pipelines

- **Phase 2**
  - Subsea processing

- **Phase 3**
  - Subsea compression
Power demand by All-Electric Subsea Production System

<table>
<thead>
<tr>
<th>Subsea power consumer</th>
<th>Power demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control system</td>
<td>approx. 10 kW</td>
</tr>
<tr>
<td>Valves</td>
<td>1 kW to 350 kW</td>
</tr>
<tr>
<td>Water injection pumps (per well)</td>
<td>1 MW to 5 MW</td>
</tr>
<tr>
<td>Multiphase pumps (per well)</td>
<td>2 MW to 5 MW</td>
</tr>
<tr>
<td>Downhole pumps (per well)</td>
<td>approx. 1 MW</td>
</tr>
<tr>
<td>Subsea gas compression (per well)</td>
<td>approx. 5 MW</td>
</tr>
<tr>
<td>Subsea separation and processing</td>
<td>10 MW to 50 MW</td>
</tr>
</tbody>
</table>
Power supply to All-Electric Subsea Production System

Few Possibilities:

- Power transmission from shore;
- Offshore power generation
  - Surface
  - Subsea
Power supply from Platform

• Platform based power generation is most common;

• Gravity Base Structures proven effective in Arctic

• Ice-resistant GBS platform applicable to deep Arctic seas likely to cost more than 4,5 Billion EUR.

• Special means of crew evacuation must be in-place for safe platform operation.

• In order to alleviate safety concerns unmanned platform should be considered
Power Transmission from Shore

- Construction of onshore power station required
- HV/AC technology is limited to about 100-200 km.
- HV/DC requires high capacity inverters.
- High capacity subsea power cable is expensive (both materials and installation)
Subsea Power Generation

- High development cost;
- Relatively low construction and operational costs;
- Very high voltage connectors and inverters not needed;
- Virtually unlimited expansion possibilities;
- High level of overall safety is achievable;
Autonomous Subsea Power Station

- Nuclear power generation can be adopted from icebreakers propulsion (50MW-100MW)
- Can use present technology of subsea power distribution & connection systems
- Can be modular for simplified installation maintenance & repair
- Can be monitored and controlled from shore
- It doesn’t require huge amount of raw materials
Conclusions

• ASPS has potential for powering future subsea field developments at lower cost – it deserves further investigation

• Russian scientific community and industry can provide important contribution

• A JIP should be formed to put in place standards and guidelines etc.
Thank you

Thanks for Your attention