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# An alternative power supply for subsea production at long distances

DELIVERS. EVOLVES.

WHOLE LIFE SOLUTIONS FOR PIPELINE AND SUBSEA SYSTEMS

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# Content

- Arctic Prospects & Challenges
- Enabling Technologies & Gaps
- Power Demand & Supply
- Conclusions

# 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

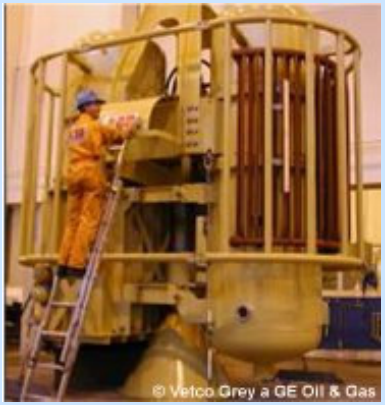
***We can not just use off-the-shelf solutions***

# 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

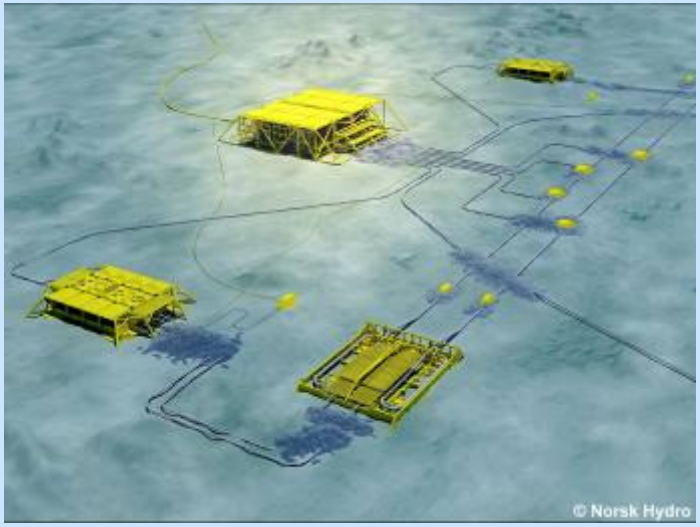
# Phased Subsea Developments - Ormen Lange

## Initial Phase

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

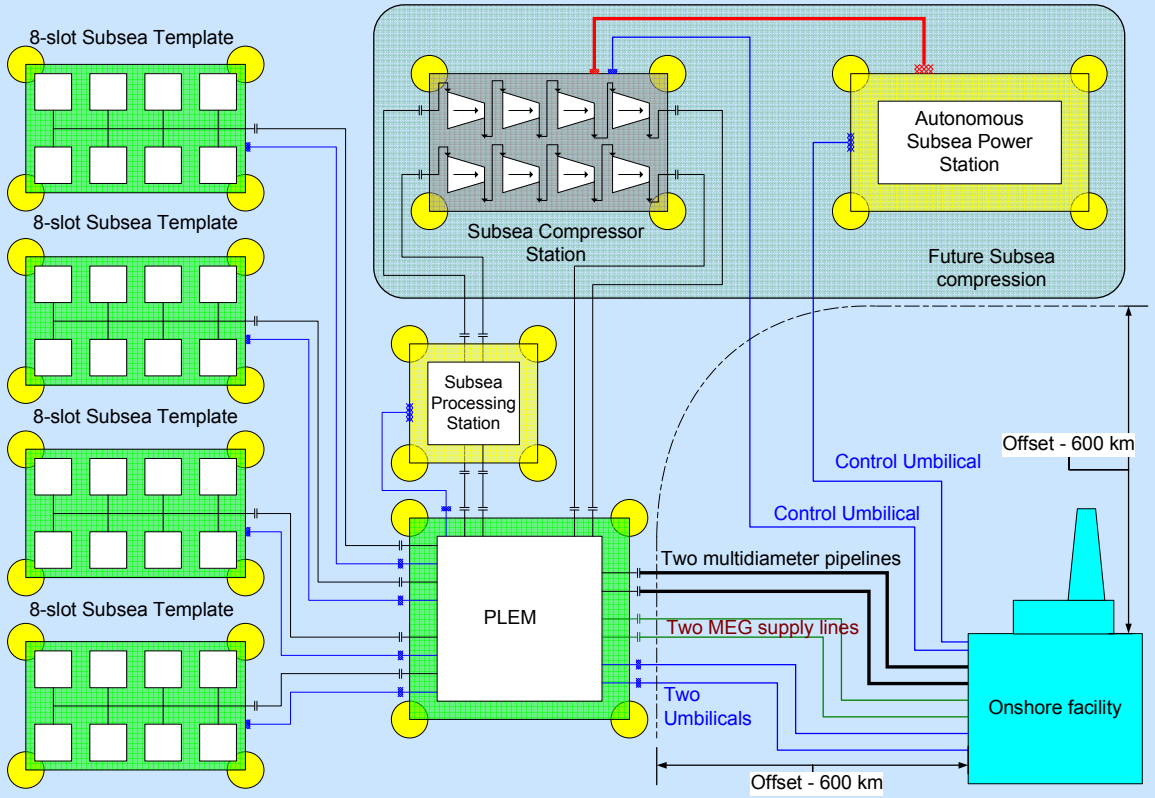

## Compression Phase

- Large power investment when boosting needed in later life (100 MW)
- Allows time to develop needed technologies

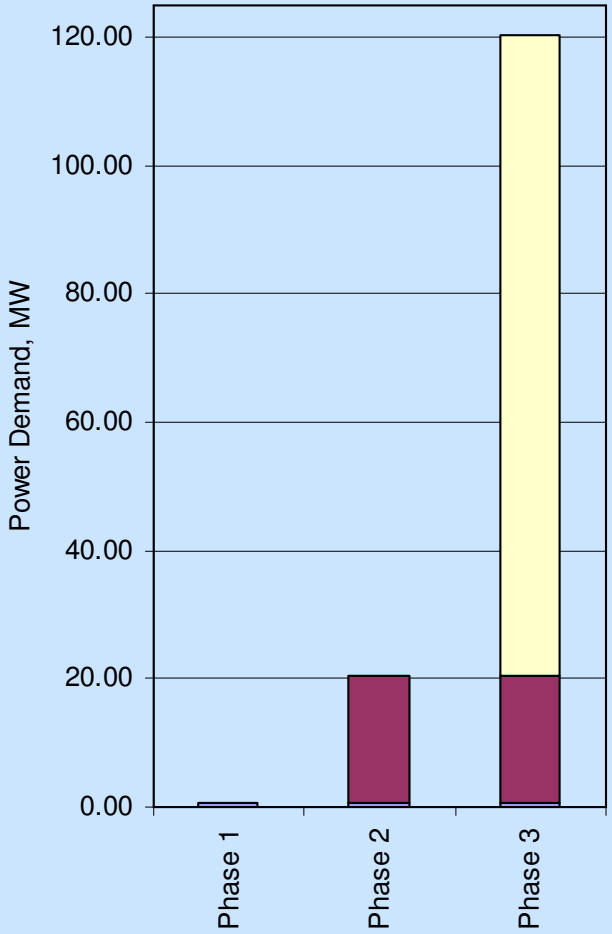


# Large All-Electric Subsea Production System

- **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




| Subsea power consumer | Power demand |
|---|---|
| Control system | approx. 10 kW |
| Valves | 1 kW to 350 kW |
| Water injection pumps (per well) | 1 MW to 5 MW |
| Multiphase pumps (per well) | 2 MW to 5 MW |
| Downhole pumps (per well) | approx. 1 MW |
| Subsea gas compression (per well) | approx. 5 MW |
| Subsea separation and processing | 10 MW to 50 MW |

# Power supply to All-Electric Subsea Production System

Few Possibilities:

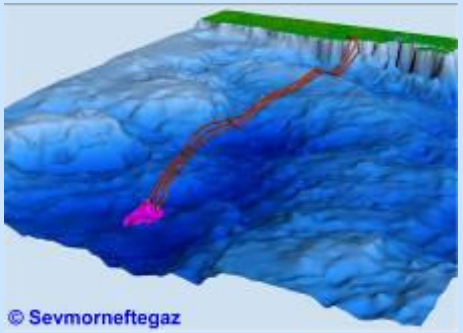
- Power transmission from shore;
- Offshore power generation
  - Surface
  - Subsea

# 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

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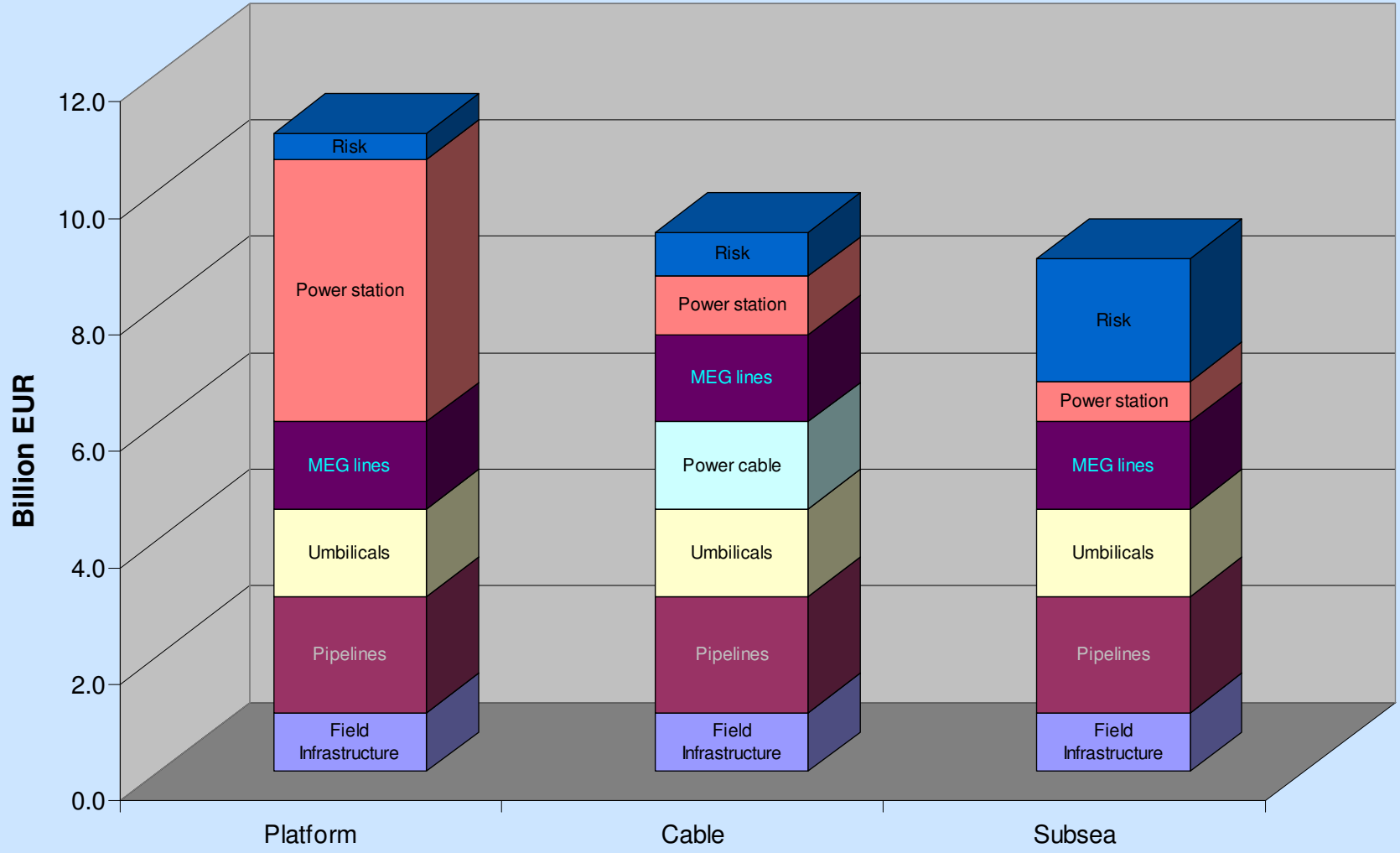
# Cost Comparison



# 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