MCEDD

DEEPWATER DEVELOPMENT

28 - 30 March 2023 | Millennium Gloucester Hotel | London, UK

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Hub & Spoke Strategies
Using Utility Buoys to Enhance the Value of Subsea Tie-backs

30th March 2023

Buoyant Production Technologies

Agenda

1. An introduction to the Crondall Group and BPT

2. Hub and spoke strategies

3. Case studies: Umbilical v Utility buoy

4. Conclusions

Crondall's consulting services

Crondallenergy

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Hub & spoke strategies

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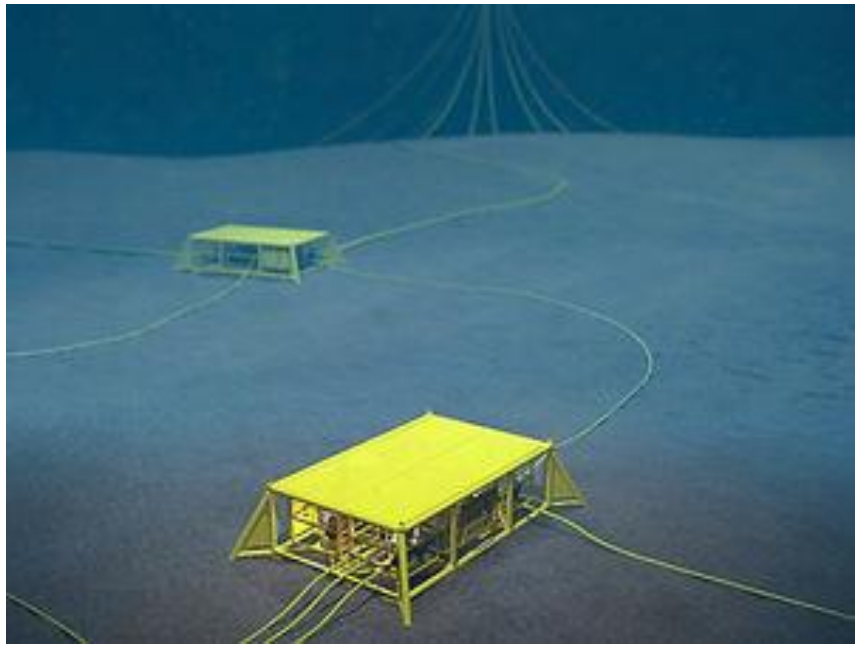
Hub and spoke strategies

- Hub and spoke strategies have been used for many years as a way to:
  - Deliver low cost developments for smaller fields/reserves through subsea tie backs
  - Increase production and maximise the economic potential of existing hub and surrounding infrastructure.
- However, in some deep water basins, the majority of the shorter range tie-backs have been done.
- There is a significant value opportunity with tie back prospects further out.



Drivers for subsea tiebacks are evolving

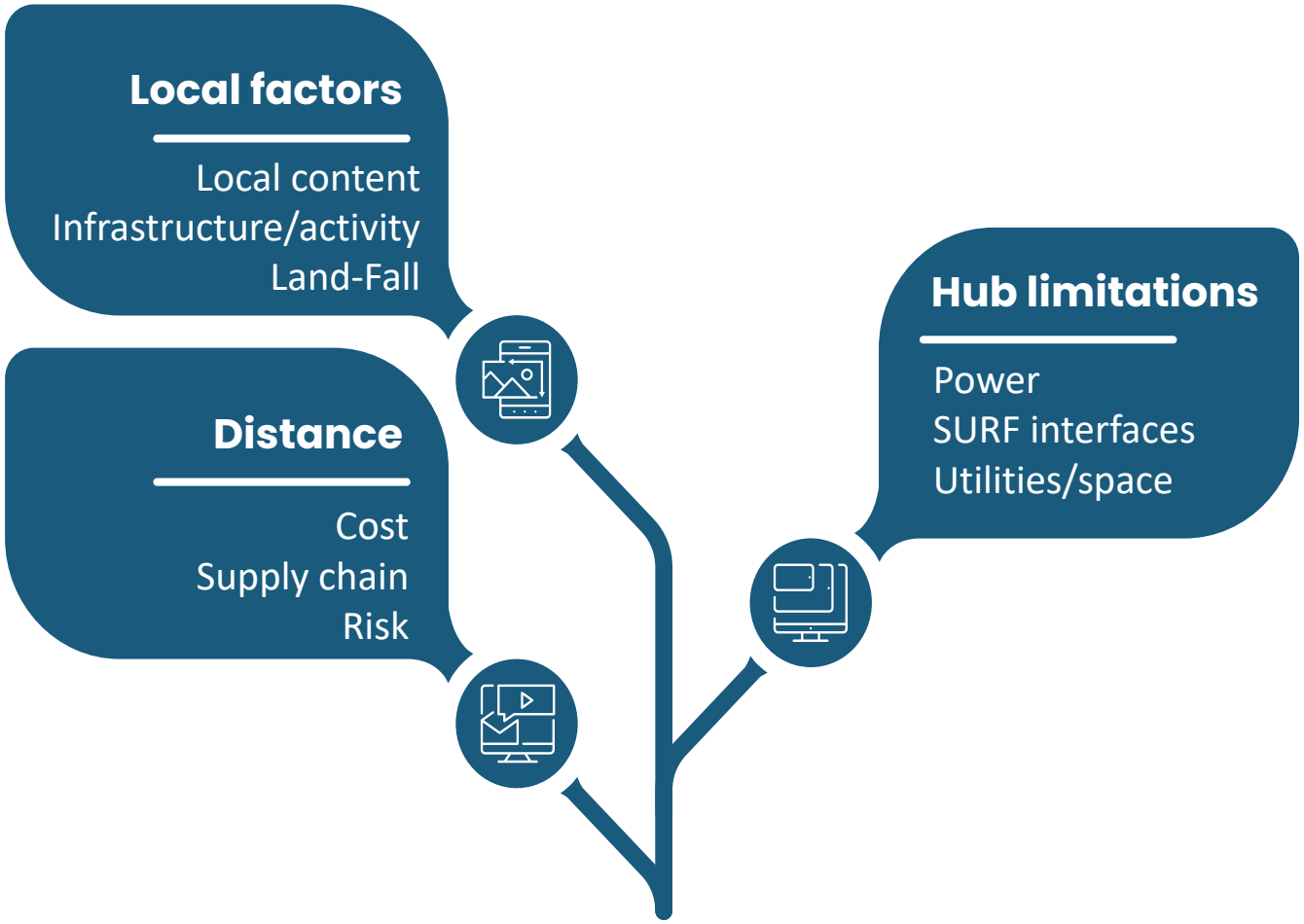
- Reduced CAPEX for new production facilities.
- Focus on extending life of existing assets.
- Longer distance tie-backs to hubs.

- Deepwater & remote gas developments
- Lifetime beyond existing O&G infrastructure
- Offshore CCUS

- New subsea technologies such as subsea separation, pumping, water injection, etc. offer the opportunity to significantly expand the range of future tie-backs and turbocharge hub and spoke arrangements.

- BPT's utility buoy technology is designed to provide the power, control, chemicals and other utilities to support these new technologies.

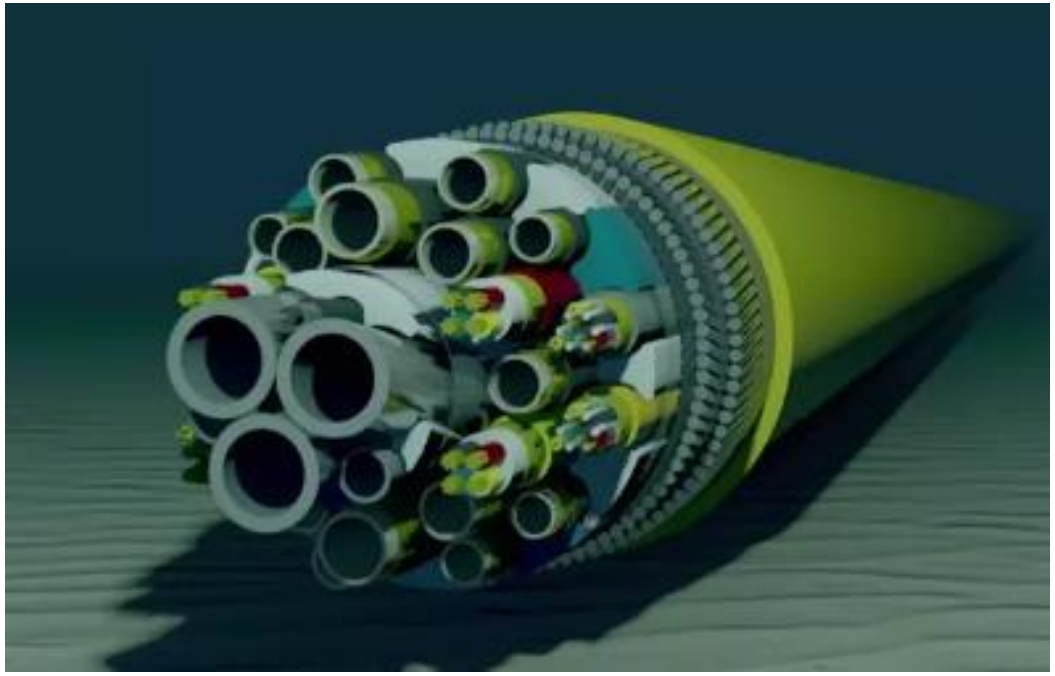
Subsea tieback power and control



Key project considerations

- Subsea tiebacks are typically controlled via a static umbilical.
- Umbilical supplies power, chemicals, hydraulics for well control.
- Alternative approach is to provide these utilities from a utility buoy at the well site.

Long-distance control umbilical



- Traditional approach to tieback control
- Long distance proven out to 180km (Zohr)
- All utilities provided from hub
- Procurement cost increases with length & function
- Installation cost increases with length & water depth
- Umbilical failures not uncommon:
  - Open circuit/ short circuit – risk increases with distance
  - Low insulation earth faults due to umbilical degradation

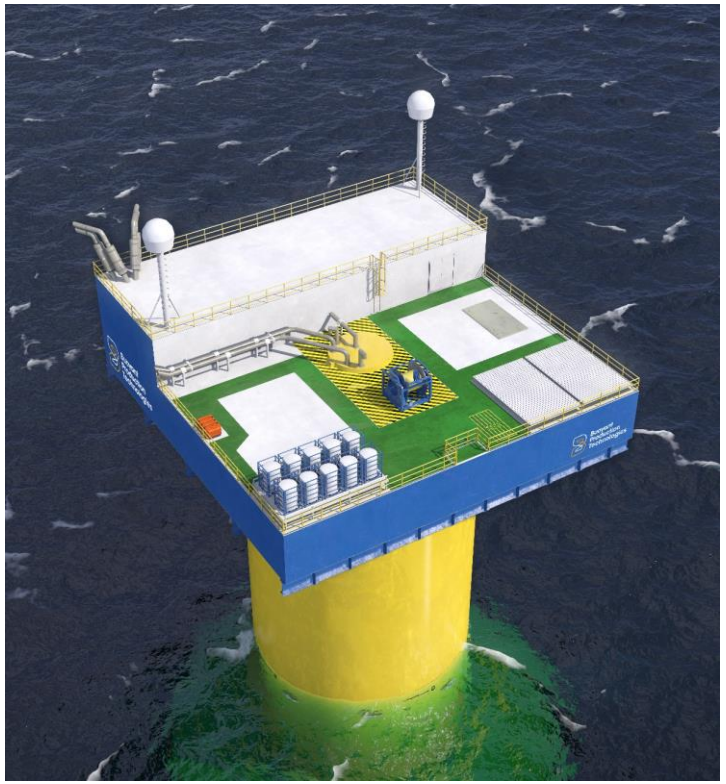
Hub facilities – supporting umbilical services

Hub facility supplies all services to the umbilical

- Upgrade may be required for:
  - Control system
  - Subsea control and power (HPU, MCS)
  - Power generation
  - Chemical injection & storage
  - Umbilical interfaces

- Hub modification scope and costs can vary:
  - Small brownfield modification and umbilical pull-in
  - Major brownfield modification
    - New power swivels (FPSO specific)
    - Additional power generation modules, WI, chemical injection skids
  - Topsides expansion e.g. bridge linked platforms

Utility buoy at the well-site



Local supply of power, control, chemicals and utilities with a floating “Normally Unattended Installation” (NUI)

- Limited use to date (2 projects)
- All utilities from local buoy – no hub upgrades
- Procurement cost independent of tieback distance
- Installation cost increases with water depth
- Unmanned system reliability and maintainability determines system uptime:
  - Unmanned power generation (renewables and/or engines)
  - Dual redundant VSAT
  - Remote control and monitoring
  - Campaign maintenance

Case studies:
Umbilical v Utility buoy

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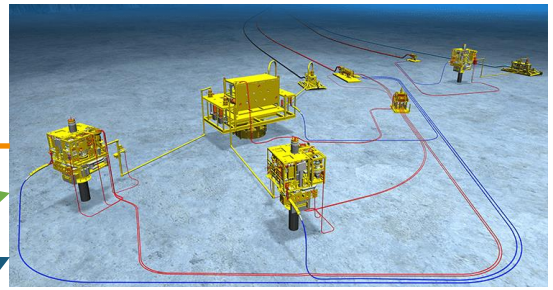
Case study 1 – 120km gas tieback

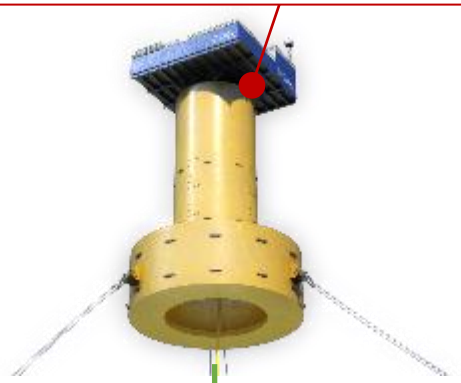
~70kW peak power
- Chemical pumps
- HPU
- Operational personnel offshore



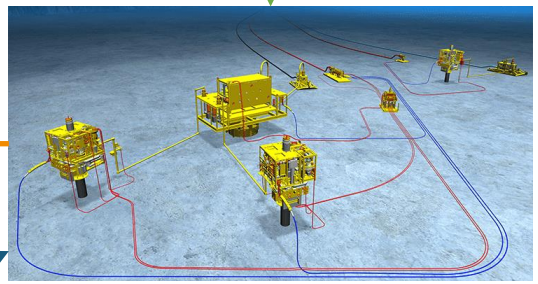
Gas
Umbilical
MEG

UMBILICAL CONTROL

~100kW peak power
- Chemical pumps
- HPU
- Operational personnel onshore



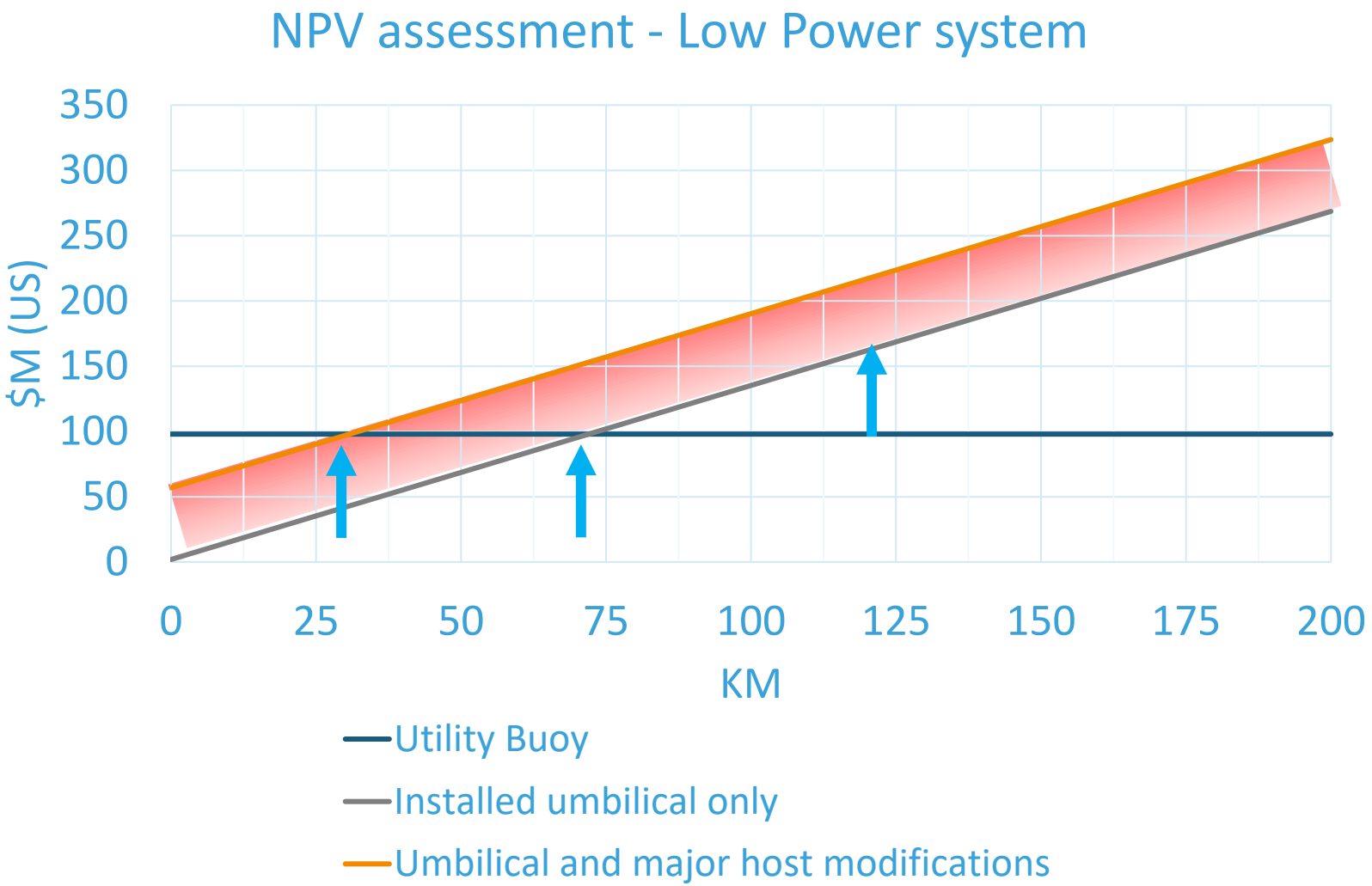
Umbilical



Gas
MEG

BUOY CONTROL

Umbilical vs buoy: NPV vs distance



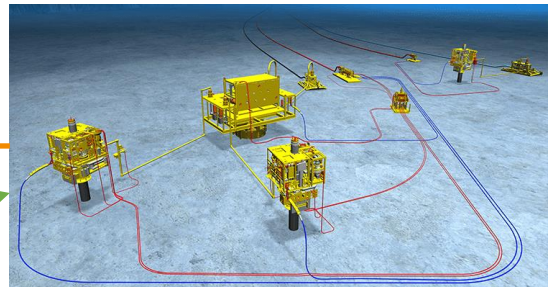
For the 120 km tie- back case, the utility buoy offers $70-$125M NPV saving over the umbilical solution

Case study 2 – 50km oil tieback

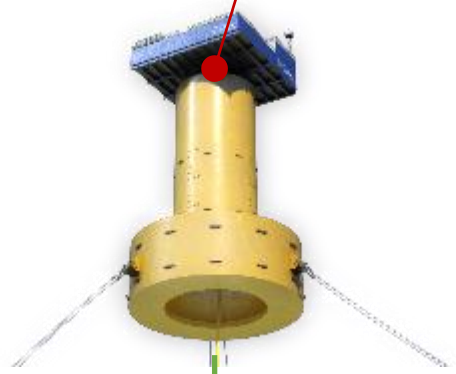
5MW peak power
- Chemical pumps
- Power gen.
- HPU
- Operational personnel offshore

Multiphase fluid

Umbilical

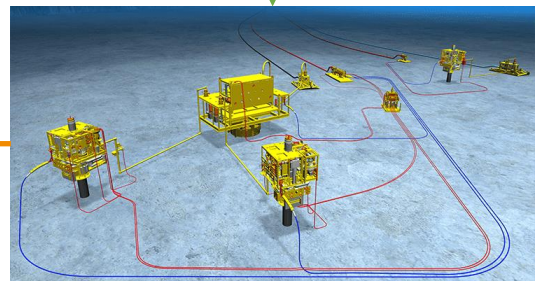


~7MW peak power
- Chemical pumps
- Power gen
- HPU
- Operational personnel on hub

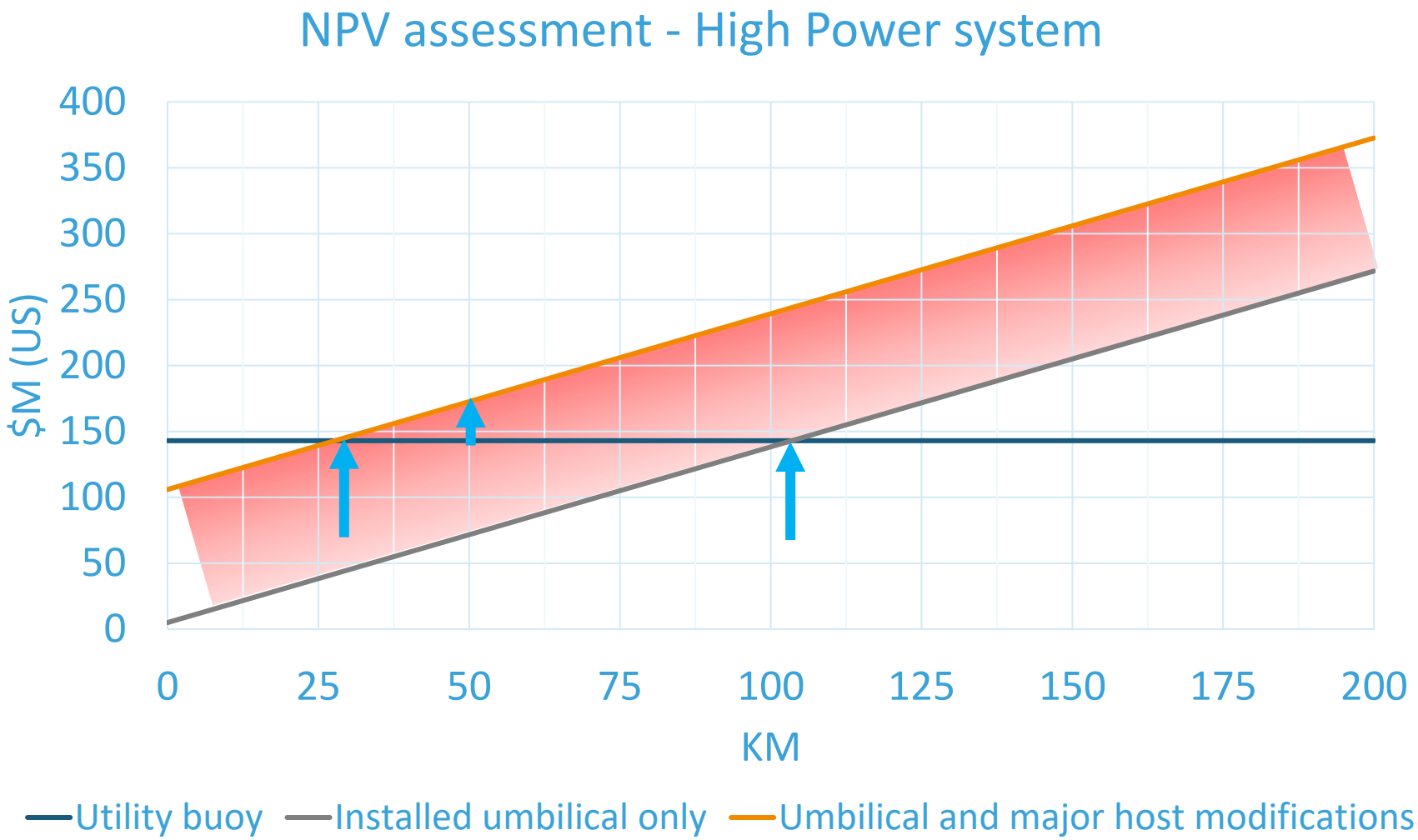


Umbilical

Multiphase fluid



Economics – project NPV vs distance



At 50km, the economics are more marginal, but heavily contingent on the ability of the hub to provide the required power.

Non-financial factors

UMBILICAL	UTILITY BUOY
Strengths • Established technology • Standard manned operating model	**Strengths** • NPV savings • Renewable (zero emission) power options • Supply chain flexibility • Local content opportunities • Minimal impact on hub
Weaknesses • High criticality & consequence in case of umbilical failure • Supply chain constraints • Limited by hub facility capabilities and upgrade cost/feasibility	**Weaknesses** • Unmanned operational model • New technology risk

Conclusions

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Summary

- A utility buoy, located at the well site, can be employed as an economically attractive alternative to a long distance static umbilical.
- Generally the economic tipping point is around 50+km, but reduces when hub modifications are complex.
- The economic (NPV) benefit is greatest when the host or hub facility is constrained in terms of the required utilities and/or space or weight.
- More challenging projects with complex & power hungry subsea infrastructure may exceed the hub's capacity to support an umbilical solution.
- Floating Normally Unattended Installation (NUI) utility buoy systems at the well site provide an opportunity to unlock the hub and spoke strategy for these challenging tie-backs.

Questions

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