The Oil & Gas Technology Centre

Your Innovation Partner

Subsea Decommissioning

The Oil & Gas Technology Centre Open Innovation Programme

Call for Ideas: Technical Documentation

Could a collaborative approach combined with innovation improve subsea decommissioning?

Our offer to you

Grab a slice of industry co-investment to develop and bring your idea to reality

The Oil & Gas Technology Centre is calling for innovative ideas and concepts that will have a material impact in reducing the cost of subsea decommissioning and we are looking to co-invest in a portfolio of projects that should be deliverable in a 6 – 24 months timeframe.

All ideas submitted will be pre-selected by industry experts (and potential partners) in order to choose the top ten ideas that will be invited to a ten minutes presentation here at our Innovation Hub. After the presentations, the successful applicants may be introduced to potential industry partners, if required, in order to finalise the project proposal that will go through the OGTC's internal project evaluation process at opportunity phase.

Our Open Innovation Programme

Our Open Innovation Programme helps us to identify, accelerate and deploy innovative technologies to unlock the full potential of the UKCS. We work with the oil and gas industry, academic institutions and the wider technology community to deliver theme-based technology showcases, Tech Talks and workshops that inspire new thinking and collaborative innovation.

The Call for Ideas process is a key part of our Open Innovation Programme. It's our primary means of reaching out to the technology community to identify, support, fund innovative solutions. We issue a diverse range of calls throughout the year to support our Solution Centre, attract new ideas to our Innovation Hub, and identify small and medium-sized enterprises to benefit from TechX, our technology accelerator. All our Calls are run through our Ideas Portal.

Our Challenge to you – Subsea Decommissioning

The primary objective for the UK Industry and government is for decommissioning to be carried out in a cost effective, environmentally sound and safe manner. The OGA and industry are together targeting a minimum 35% reduction in UKCS decommissioning costs.

Nearly all offshore topsides facilities have associated subsea infrastructure. For example, wellhead protection structures, manifolds, and subsea isolation valves. These structures are designed to accommodate the specific requirements of the field, use a variety of different foundation types, and hence are essentially unique. As such, decommissioning of subsea structures presents significant challenges for engineers. The potential for overall project cost increases due to unknowns is high, especially with regards to seabed uncertainty.

The bespoke nature of subsea infrastructure, the range of foundation options employed, differences between installation and reversal of this procedure and changes that have occurred since installation raise issues which need to be addressed with decommissioning solutions. In addition to these issues, an early focus on technical feasibility and constructability is required to find opportunities for efficiency and cost reduction in conjunction with mitigating risk.

Our latest Call for Ideas is seeking innovative technology concepts that will ultimately reduce the cost of subsea decommissioning over the next decade. We are also looking for ways of deploying existing technology in a more cost effective and collaborative way, reducing equipment and personnel requirements.

We're focused on six main subsea decommissioning themes:-

1. **Preparation for decommissioning (e.g. planning / comparative assessment)**
2. **De-energising**
3. **Innovative decommissioning solutions inc. net environmental benefits**
4. **Re-use / repurposing opportunities**
5. **Transportation**
6. **Managing residual Liability**

We would like to encourage alternative thinking and application of scientific knowledge to quantifying the ecosystem services provided by infrastructure in the marine environment. While technology is often thought of as widgets and cutting tools, the technology we are looking for also includes digital technologies and the application of skills and scientific research / knowledge to achieving a real world objective such as reducing environmental impact from any marine activity, while conforming with current regulations.

The industry partner is looking for:

- Extending the boundaries of existing technologies
- New and alternative solutions
- Other industry (e.g. salvage, military, etc..) approach – learnings

Your technology ideas should actively support our Innovative Removals and Residual Liability initiatives. http://ogtc.ldnprod.comprendhosting.com/roadmap/Decommissioning.html

This open call for ideas provides an opportunity to technology developers and the industry to together develop solutions for subsea decommissioning with support from the OGTC. Technologies already commercially deployed for this application will not be considered.

Timeline

- Stage 1: Discover
  - Call Opens -17th June
  - Submission deadline - 23rd August
  - Feedback – October 2019
- Stage 2: Develop
  - Innovator meetings - October
  - Feedback – 28th October
- Stage 3: Deliver
  - Presentations - 12th November
  - Feedback – November 2019

Challenge Themes

1. *Preparation for Decommissioning*

The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998. The responsibility for ensuring that the requirements of the Petroleum Act 1998 are complied with rests with the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) which sits within the Department for Business, Energy and Industrial Strategy.

Owners of oil and gas installations and pipelines are required to decommission their offshore infrastructure at the end of a field's economic life and the 1998 Act requires owners to set out the measures to decommission disused installations and/or pipelines in a decommissioning programme.

A decommissioning programme must identify all the items of equipment, infrastructure and materials that have been installed or drilled and describe the decommissioning solution for each. Further information can be obtained at https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines and the guidance notes can be found at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760560/Decom_Guidance_Notes_November_2018.pdf

Comparative Assessment (CA) is a detailed process that weighs up the pros and cons of various decommissioning options against key criteria identified by the regulator, Department for Business, Energy and Industrial Strategy (BEIS). The objective of these assessments is to show, on balance, which option provides the best solution.

In accordance with the requirements of OSPAR Decision 98/3 and the DECC Guidance Notes (issued by regulator the Department for Business, Energy and Industrial Strategy), technically feasible options should be assessed using the five main Guidance Notes criteria, namely:

- Safety
- Environmental
- Technical
- Societal
- Economic

When submitting your idea, please consider the information above. The planning phase for decommissioning consists of a significant part of the decommissioning cost. Please refer to the Oil & Gas UK Decommissioning Insight 2018 report for further information https://oilandgasuk.co.uk/product/decommissioning-insight-report/

We are also interested in ideas on how scope aggregation and alternative commercial arrangements could be implemented if conventional methods of procurement were challenged.

2. *De-Energising Subsea Infrastructures*

Prior to any removals, the facilities on the platform and pipelines used to recover and transport the hydrocarbons must be de-energised. This involves ensuring any pressure sources are removed and that the installation is free — as far as reasonably practicable — of hydrocarbons and contaminants.

Pipeline cleaning programmes are designed to ensure the hydrocarbon content and any deposits within the pipeline are dealt with, considering the future Decommissioning Programme.

Innovation on this theme can reduce post cessation of production operation costs (post CoP OPEX), which has a significant impact on the overall decommissioning cost.

3. Innovative Decommissioning Solutions

Subsea decommissioning activities include vessel preparation for desired end-state (remove, trench, rock-dump), sea fastening and transportation. Infrastructure includes pipelines, umbilicals, subsea christmas trees, manifolds, subsea isolation valves and electrical cables.

A key objective of this Call for Ideas is to encourage innovation through alternative thinking and application of scientific knowledge to evaluate the ecosystem provided by subsea infrastructure in the marine environment. While technology is often thought of as widgets, technology also includes the application of skills and scientific research/knowledge to achieving a responsible objective such as reducing the overall environmental impact from an activity.

In some older fields which may have been in place for several decades, removing subsea infrastructure, especially pipelines is further complicated both technically and commercially by other pipeline crossings and communication fibre optic cables. These pipelines and cables are in service but are not owned by the platform owner, however the liabilities of interference or damage to these crossings are very significant. There are an estimated 35,000 - 40,000 mattresses, equating to approximately 200,000 tonnes of concrete and therefore represents a significant challenge to the market during field decommissioning. Mattresses were not designed for removal and therefore their decommissioning is expensive, difficult and time consuming. If there are any drill cuttings piles in close proximity then understanding whether removal operations are likely to disturb the drill cuttings pile is important. Disturbance of a drill cuttings pile may present a reasonably high level of risk to the marine environment as they may contain toxins which could then be released through the water column if disturbed.

The Oil and Gas UK Insights 2018 indicates that the cumulative forecast decommissioning expenditure over the next ten years on the UKCS is £15.3 billion — a significant reduction compared to recent years. Subsea Infrastructure includes activities related to pipelines, mattresses and subsea structures and amounts to £1.7 billion of the expenditure over the next decade. The proportion of spend on subsea infrastructure is relatively consistent across the regions with the central North Sea forecasting 10 per cent, the Southern North Sea with 11 per cent and the northern North Sea with 14 per cent. The proportion is perhaps greater in the northern North Sea due to the depth of water and the complexity of removals.

Over 30,000 kilometres of pipelines, cables and umbilicals related to oil and gas have been installed in the UKCS. This number continues to grow as new discoveries are developed and more infrastructure is installed. Over the next 10 years a significant amount of subsea infrastructure will need to be decommissioned including the following:

- 5,724 km of pipelines
- 18,136 mattresses
- 54,217 tonnes of subsea structures

There are many subsea structures installed on the UKCS, including manifolds, wellhead protection structures, subsea isolation valves, drilling templates, riser base structures and many more. These structures vary in size depending on their purpose and may be piled to the seabed, or gravity-based. They are typically made of steel, concrete or a mixture of the two.

For the purpose of this Call for Ideas, subsea infrastructure can be broken down into the following

sub themes -

a) Manifolds
    i. 'Large' manifolds ~1,000Te
    ii. "Small" manifolds <200Te
        - Piled
        - Gravity based
b) Pipelines
    i. Rigid
    ii. Flexibles
    iii. Umbilicals
c) Wells equipment removal
d) Spools
e) Mattresses, grout bag etc and general ancillary equipment

For any innovation on the above sub-themes, please ensure it conforms with the current regulation described in the Preparation for Decommissioning session.

4. Reuse & Repurposing

The waste hierarchy is a conceptual framework which ranks the options for dealing with waste in terms of their sustainability, beginning with reducing the generation of waste. Failing that, re-use either for the same or a different purpose should be considered ahead of recovering value from the waste through recycling. Only if none of these offers an acceptable solution should disposal be considered. OPRED is keen to encourage the re-use of facilities wherever this is practical and cost effective, and the decommissioning programme must demonstrate that the potential for re-use has been examined and discussed with the OGA, who would give OPRED a view on the reuse option.

Interest is growing in the concept of repurposing offshore oil and gas assets to support development of renewable power in the transition to a sustainable energy future.

An innovation to enable increase in re-use, repurposing and/or remanufacturing will improve the industry's contribution to a more circular economy.

5. Transportation

Alternatives to traditional methods or enhancing existing techniques to maximise operational timings.

The types of current service required for subsea infrastructure decommissioning are lifting equipment, lifting vessels, subsea intervention equipment and monitoring. Innovation around improved retrieval of subsea equipment for example work-class ROVs, grabs, re-reeling equipment could reduce vessel time by improving retrieval efficiency. Ideas on the transportation of subsea infrastructure that is to be removed from its original place, either for re-use or recycling will optimise the decommissioning cost.

6. Managing Residual Liability

Once the decommissioning of the topsides, substructures, pipelines and associated subsea infrastructure have been completed, operators are required to ensure that the seabed is made safe for third-party users of the sea. This involves the removal of any debris remaining around the facility as agreed within the Decommissioning Programme. After completing the offshore decommissioning works, an independent organisation is required to complete a seabed verification trial. These usually entail a fishing vessel undertaking a trawl trial over the site from numerous approaches, using various representative fishing equipment. However, verification could also be conducted with survey equipment which can detect and analyse any features remaining on the seabed. Within one year of a post-decommissioning survey, a Decommissioning Programme Close Out Report is required to be submitted for regulatory approval. This

report is required to satisfy OPRED that the approved programme has been carried out and describe any scope modifications required during execution. Close Out Reports are a key reference where learnings from decommissioning projects are shared. Site remediation activities represent a total of 1.2 per cent of the forecast decommissioning expenditure over the next ten years, or around £186 million.

Monitoring programmes are required for any infrastructure that is left in place under the Decommissioning Programme. Surveys will be conducted to check the status of infrastructure and assess changes over time to ensure no increased risk to other users of the sea. The frequency of these surveys will be determined in consultation with the regulator. Typically, an owner will assume a frequency for these surveys in their decommissioning cost estimates. The total forecast expenditure for post-decommissioning monitoring up to 2027 is £77 million, or 0.5 per cent of total expenditure.

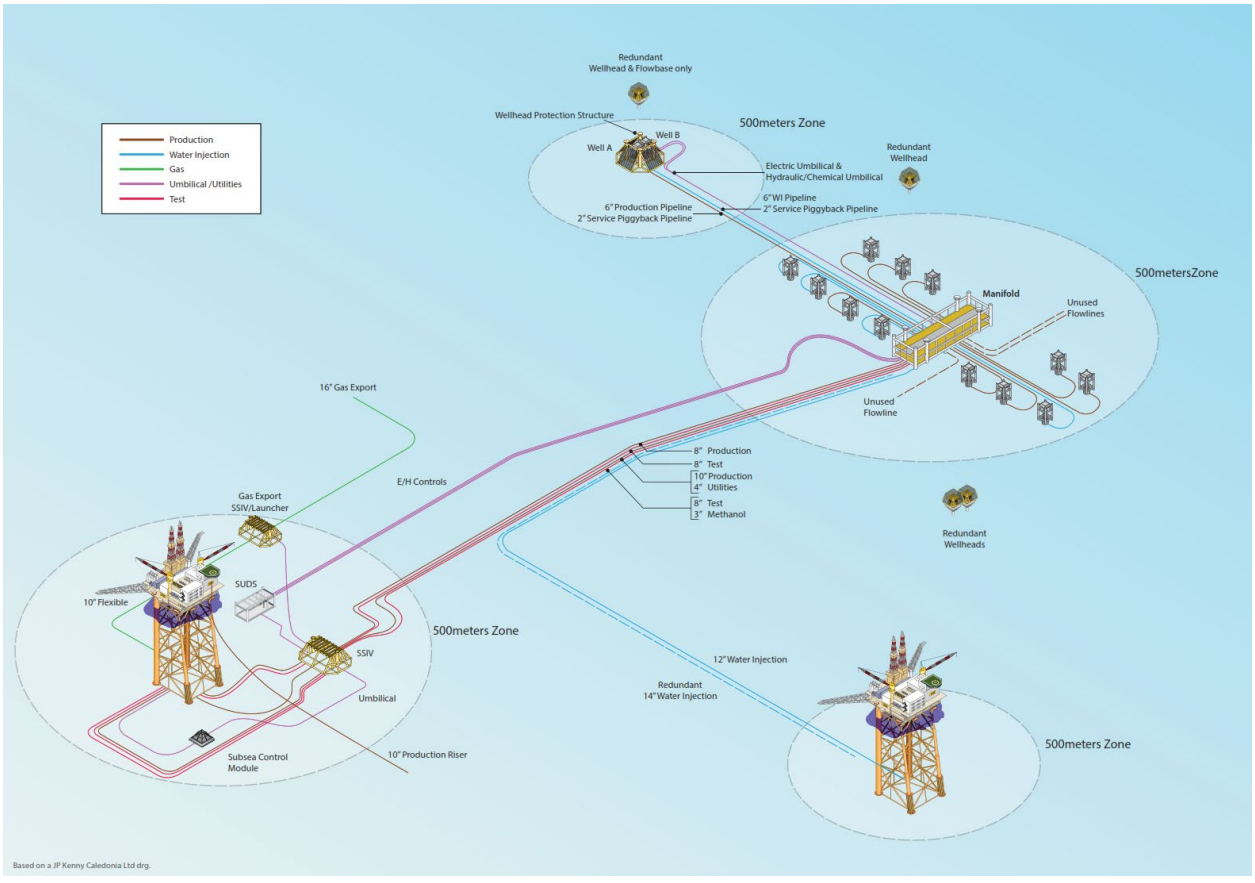
Currently, monitoring surveys are carried out with manned survey vessel commissioned especially for this particular task. Innovation on the residual liability monitoring is starting to emerge, however, there is a wide range of opportunity to improve current practices, aiming in a safer and more cost effective solution.

Case Study

In order to ensure your idea matches reality, the data shared in this section represents an actual subsea producing field that requires decommissioning in the future. It is believed that the types, sizes and arrangement of this subsea field, reflect the vast majority of the overall subsea infrastructures currently installed in the North Sea.

Please refer to the data below when submitting your idea.

The subsea development proposed is a tie-back facility to a Northern North Sea platform in a water depth of approximately 140m. Current production at the facility is enhanced by water injection from a neighbouring platform. This development is typical of a subsea tie-back in the North Sea but with a unique subsea manifold, one of the largest in the North Sea at 972Te. The field has a range of large and small diameter subsea pipelines including rigid and flexible tied into a total of six subsea structures in various configurations on the seabed including surface laid, open trenched and buried. Trenched pipelines both buried and open trenched sit around 1m below seabed surface.



Structures

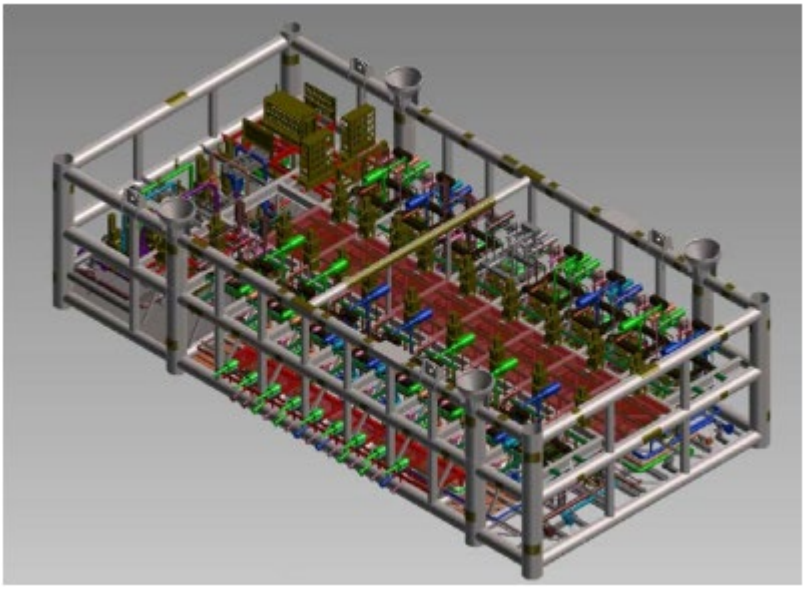


Figure 2 - Production Manifold

The production manifold structure is one of the largest manifolds in the North Sea. Its function is to provide a route for the subsea well array back to the host facility.

Design Parameters	Data
Length (m)	34
Width (m)	17
Depth (m)	9
Foundation Type	Piled
Number of Piles	4
Pile Diameter (mm)	914
Pile Wall Thickness (mm)	38.1
Weight in air (Te)	972

Table 1 - Production Manifold Parameters

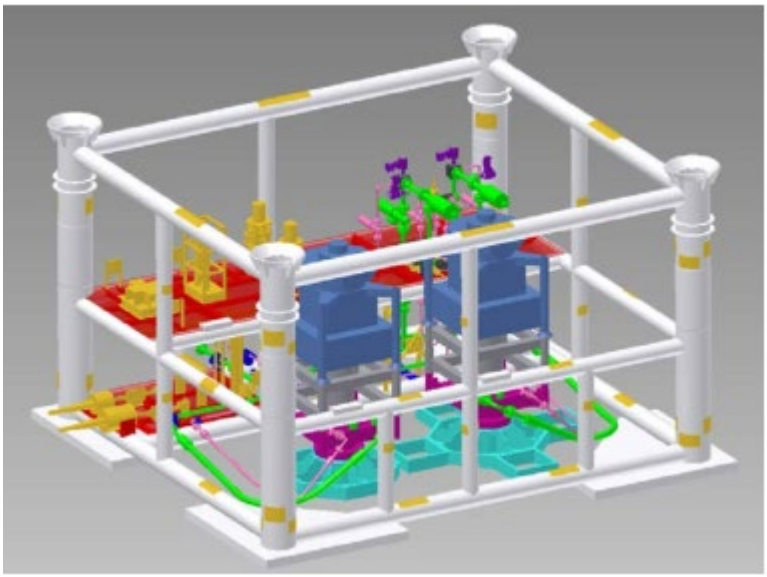


Figure 3 - Wellhead Protection Structure (WPS)

The Wellhead Protection Structure or WPS protects two satellite wellheads and is located approximately two kilometres from the main production manifold.

Design Parameters	Data
Length (m)	14.5
Width (m)	12.5
Depth (m)	8.4
Foundation Type	Piled
Number of Piles	4
Pile Diameter (mm)	914
Pile Wall Thickness (mm)	38.1
Weight in air (Te)	170

Table 2 - WPS Parameters

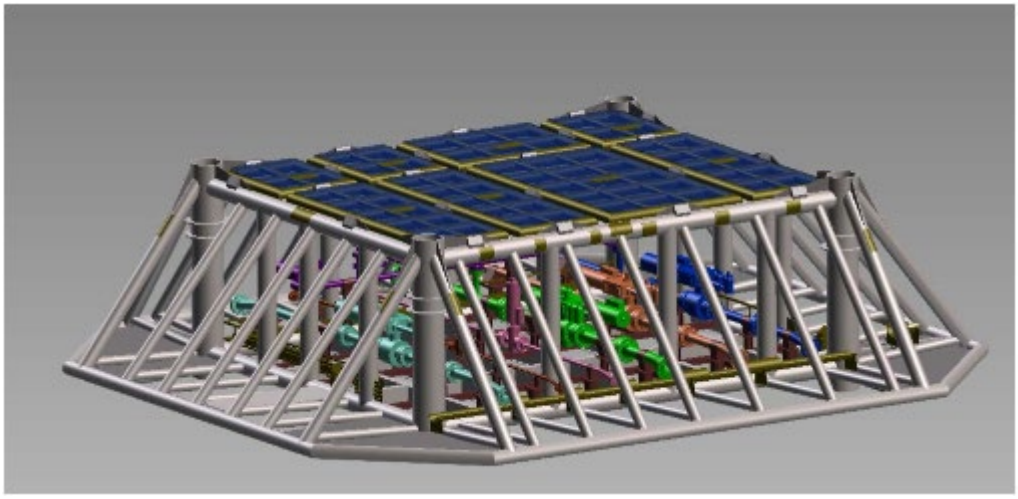


Figure 4 - Subsea Isolation Valve Structure (SSIV)

The Subsea Isolation Valve Structure or SSIV is located close to host facility. Its primary function is to close and isolate hydrocarbon pipelines or process in an emergency. Unlike a piled structure, the SSIV is secured to the seabed by gravity. The tapered design of the structure sides

Design Parameters	Data
Length (m)	18.5
Width (m)	16.5
Depth (m)	4
Foundation Type	Gravity Base
Number of Piles	n/a
Pile Diameter (mm)	n/a
Pile Wall Thickness (mm)	n/a
Weight in air (Te)	154

Table 3 - SSIV Design Parameters

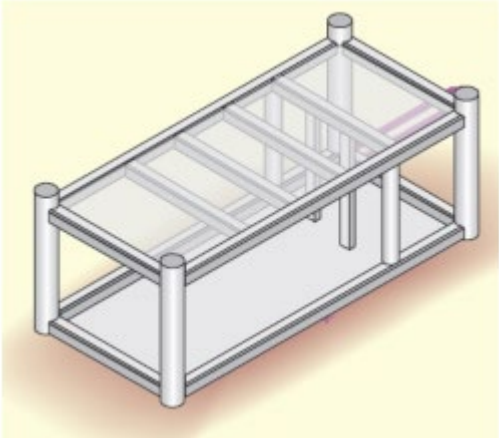


Figure 5 - Subsea Umbilical Distribution Skid (SUDS)

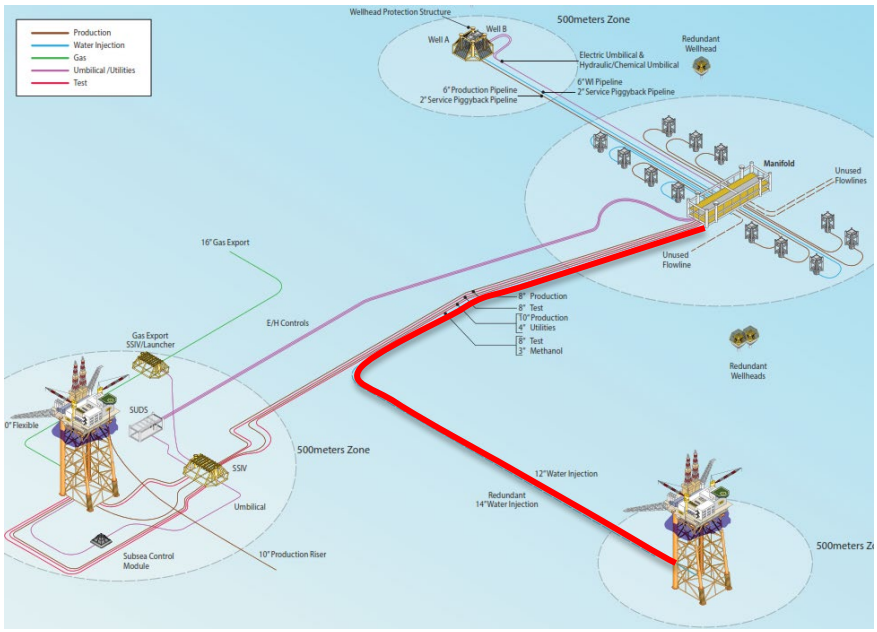
The Subsea Umbilical Distribution Skid or SUDS, is located within the host facility's 500m zone. The skid contains and protects the control system for a number of subsea structure controls including the large production manifold.

Design Parameters	Data
Length (m)	9
Width (m)	5.3
Depth (m)	4
Foundation Type	Gravity Base
Number of Piles	n/a
Pile Diameter (mm)	n/a
Pile Wall Thickness (mm)	n/a
Weight in air (Te)	17.6

Table 4 - SUDS Design Parameters

10” Water Injection Pipeline

The 10” Water Injection lines runs between the second host facility and the production manifold.

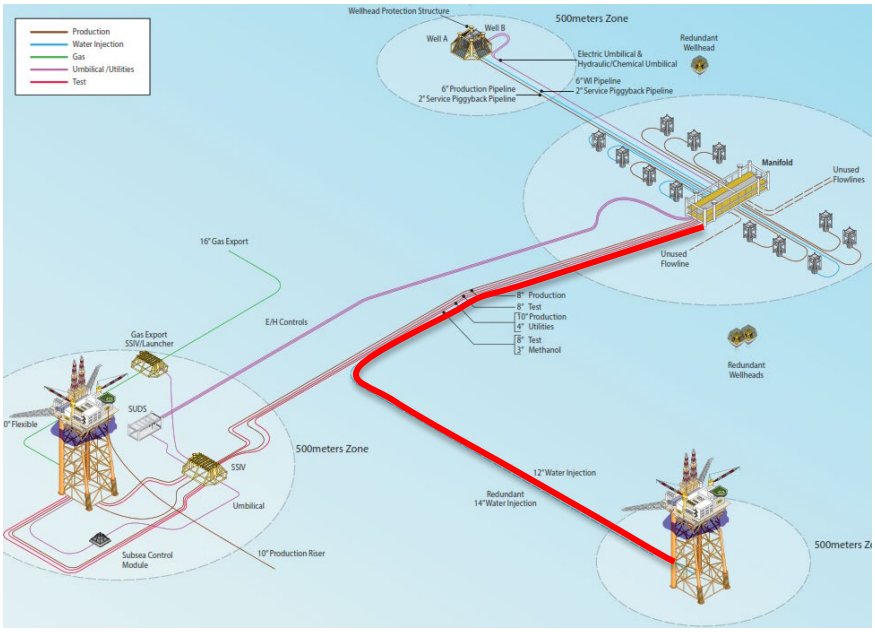


Design Parameters	Data
Length of Sections (m)	3369, 7010, 300, 9965
Outside Diameter (mm)	332.1
Material/Type	Flexible
External Coating	Medium Density Polyethylene (MDPE)
Content	Injection Water
Installation Year	2005
Design Life (years)	15
Weight of Pipeline (kg/m)	162.7
Protection	Open Trench & Mats

Table 5 - 10" Water Injection Design Parameters

12” Water Injection Pipeline (Disused)

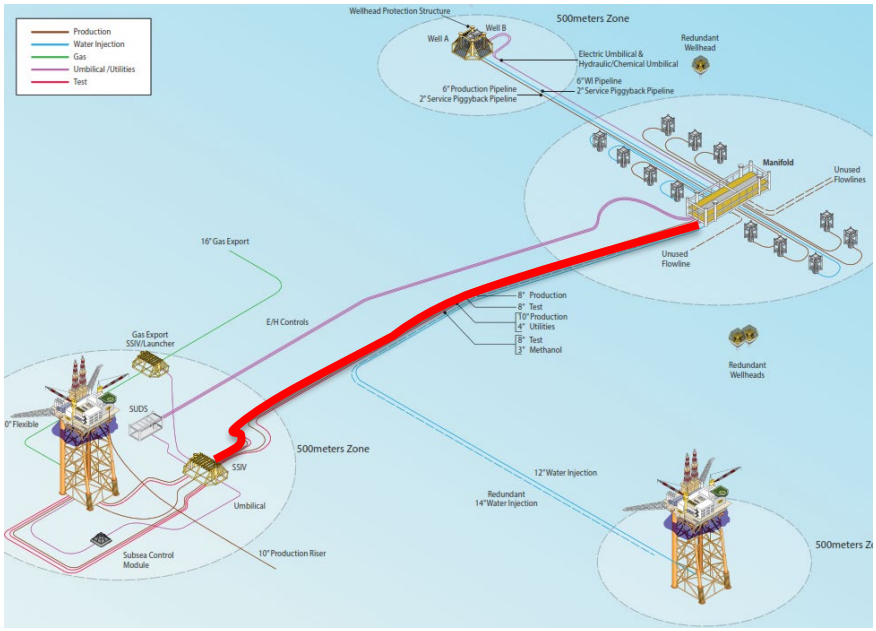
The discussed 12” pipeline was replaced in 2005 for the new flexible. The jumper connected to the pipeline were reused for the new pipeline.



Design Parameters	Data
Length of Sections (m)	20,604
Outside Diameter (mm)	323.9
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Content	Injection Water
Installation Year	1993
Design Life (years)	20
Weight of Pipeline (kg/m)	162.7
Protection	Open Trench

8” Production Pipeline

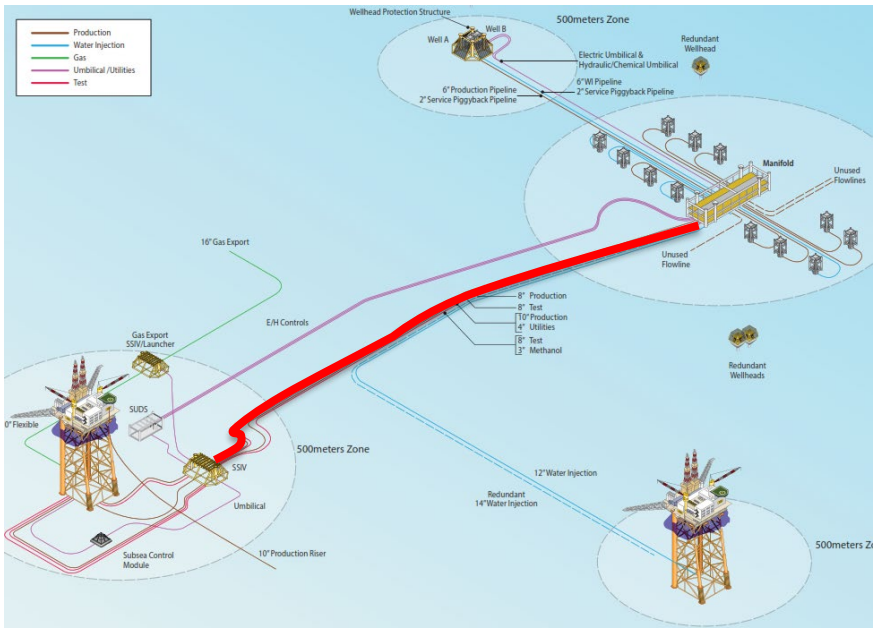
The 8” Production line runs from the main host facility to the production wells via the SSIV and the production manifold structure.



Design Parameters	Data
Length of Sections (m)	15,067
Outside Diameter (mm)	219.1
Wall Thickness (mm)	20.6
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Insulation	Syntactic Polyurethane (SPU)
Content	Gas Condensate
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	101
Protection	Trenched and Backfilled

8” Production Test Line

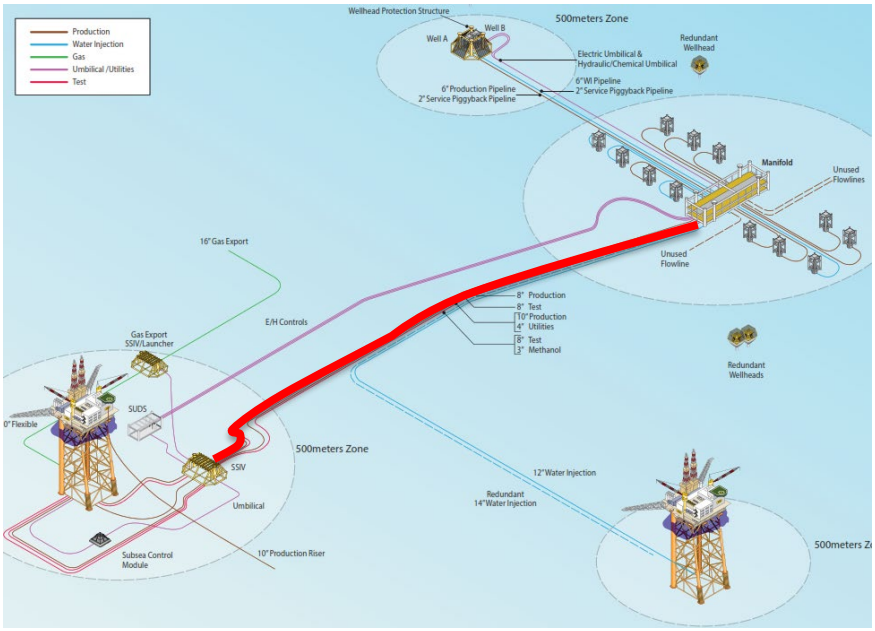
The production test line runs from the host platform via the SSIV and Production manifold structure to the trees. This pipeline has a 3” methanol line piggybacked on top.



Design Parameters	Data
Length of Sections (m)	15,011
Outside Diameter (mm)	219.1
Wall Thickness (mm)	20.6
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Insulation	Syntactic Polyurethane (SPU)
Content	Gas Condensate
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	101
Protection	Trenched and Backfilled

3” Methanol Pipeline

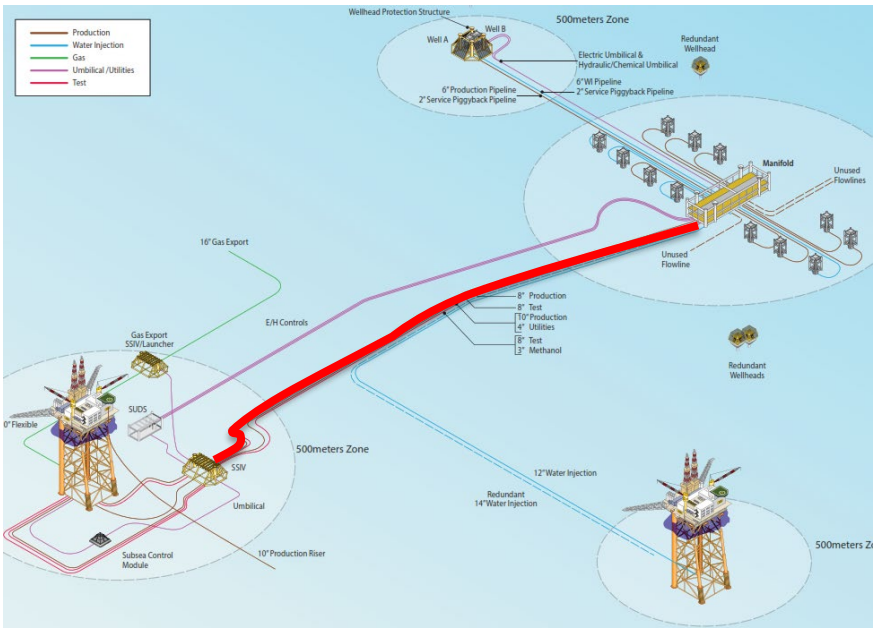
The 3” methanol line runs from the host platform to the production manifold via the SSIV. The 3” methanol pipeline is mounted piggyback on the 8” production test pipeline.



Design Parameters	Data
Length of Sections (m)	15,034
Outside Diameter (mm)	88.9
Wall Thickness (mm)	7.1
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Content	Methanol
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	14.3
Protection	Trenched and Backfilled

10” Production Pipeline

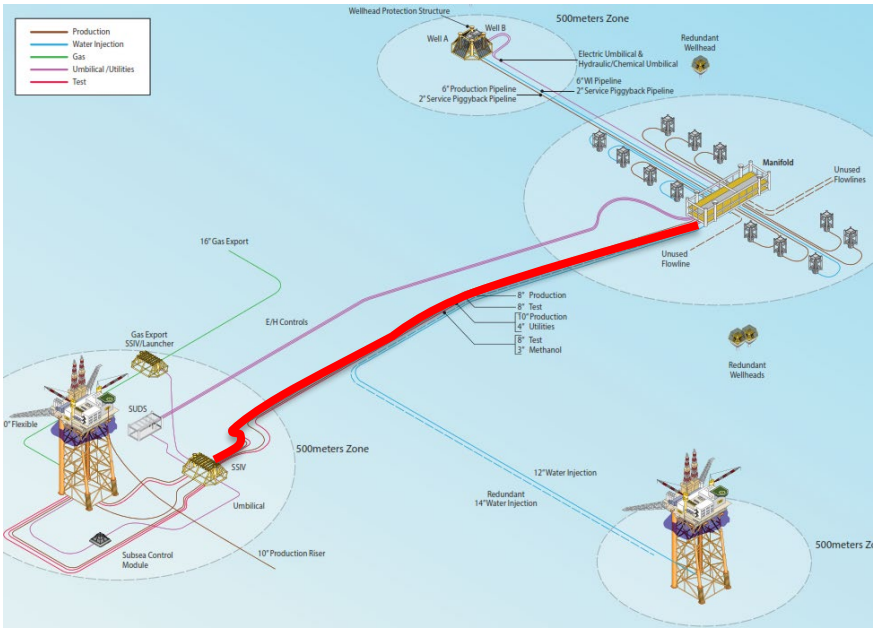
The 10” Production line runs from the host platform to the production wells via the SSIV and production manifold structure. The pipeline has a 4” Utilities pipeline mounted piggyback prior to it being laid in the trench and buried.



Design Parameters	Data
Length of Sections (m)	15,058
Outside Diameter (mm)	273.1
Wall Thickness (mm)	23.8
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Insulation	EPDM/PVC Foam
Content	Crude Oil
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	146.3
Protection	Trenched and Backfilled

4” Utilities Pipeline

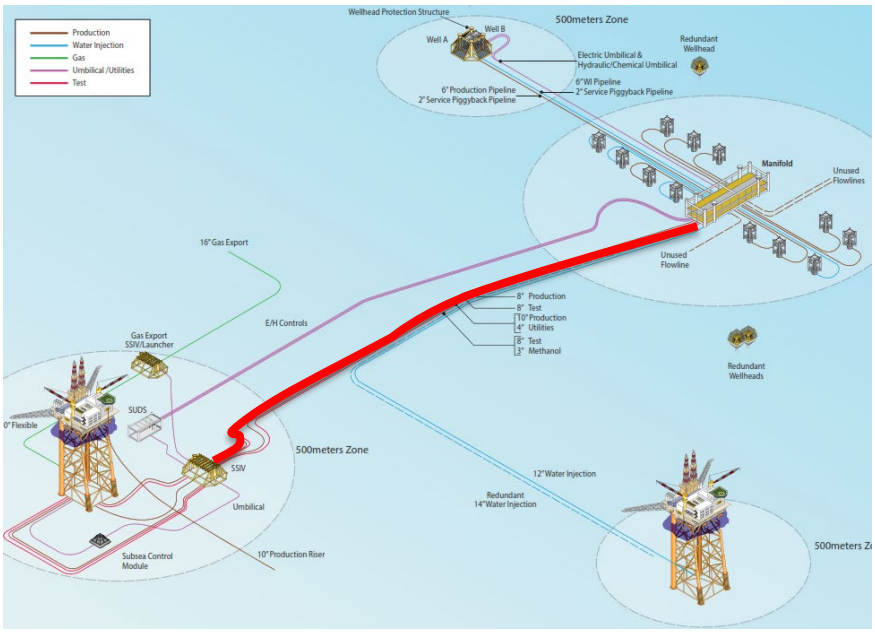
The 4” Utilities line runs from the host platform to the Production manifold structure via the SSIV. The 4” Utilities pipeline is mounted piggyback on the 10” Production pipeline.



Design Parameters	Data
Length of Sections (m)	15,055
Outside Diameter (mm)	114.3
Wall Thickness (mm)	17.1
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Content	Utilities
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	41
Protection	Trenched and Backfilled

8” Production Pipeline

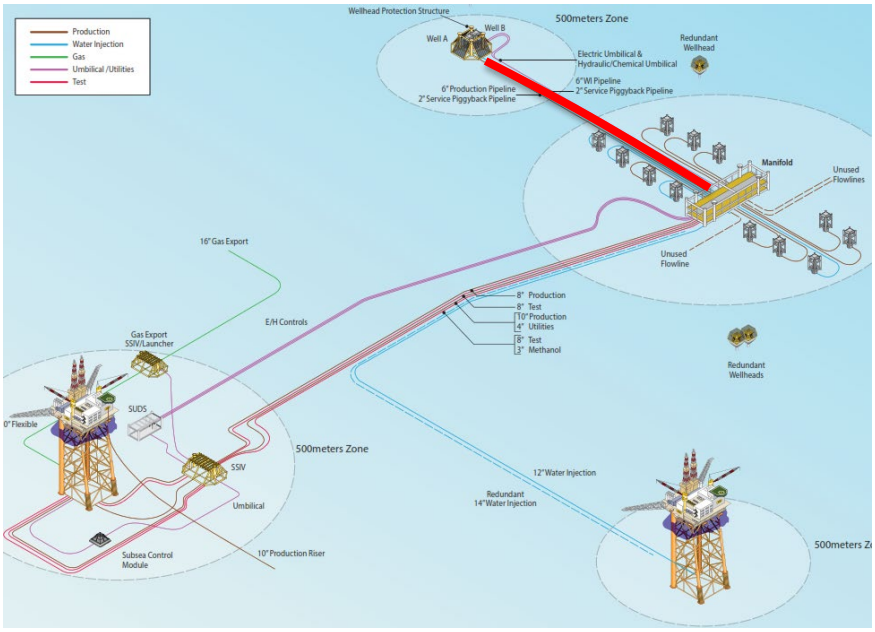
The 8” Production line runs from the host platform to the production wells via the SSIV and production manifold structure.



Design Parameters	Data
Length of Sections (m)	15,078
Outside Diameter (mm)	219.1
Wall Thickness (mm)	20.6
Material/Type	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)
Insulation	EPDM/PVC Foam
Content	Crude Oil
Installation Year	1994
Design Life (years)	20
Weight of Pipeline (kg/m)	101
Protection	Trenched and Backfilled

6” Production Pipelines

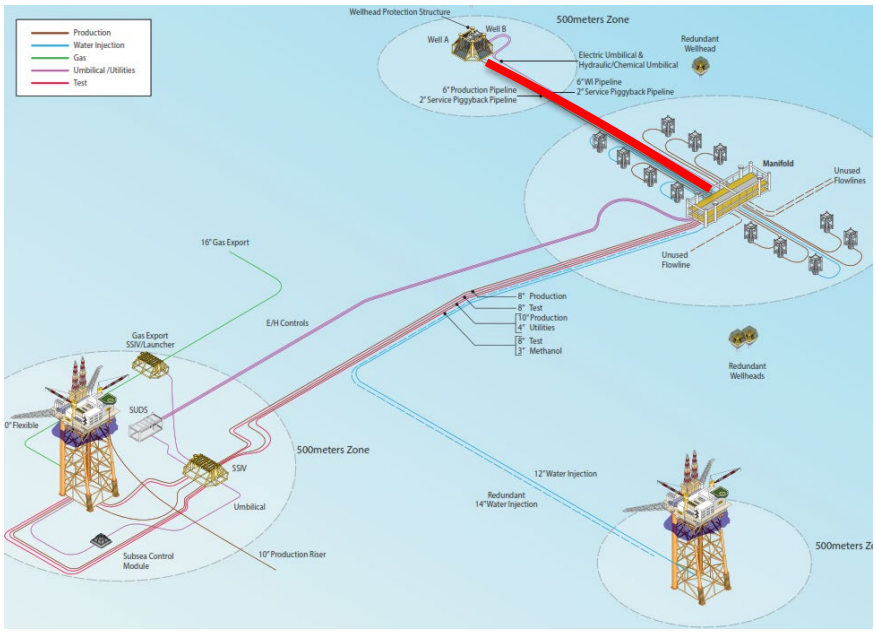
The two identical 6” production pipelines run between the production manifold structure and the satellite wells. Both 6” production lines have 2” service lines piggybacked before being trenched and buried.



Design Parameters	Pipeline 1	Pipeline 2
Length of Sections (m)	1,800	1,800
Outside Diameter (mm)	168.3	168.3
Wall Thickness (mm)	18.3	18.3
Material/Type	API 5L X65 Rigid	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)	Fusion Bonded Epoxy (FBE)
Insulation	Ethylene Propylene Diene Monomer (EPDM) / Polyvinyl Chloride (PVC) foam	Ethylene Propylene Diene Monomer (EPDM) / Polyvinyl Chloride (PVC) foam
Content	Crude Oil	Crude Oil
Installation Year	1994	1994
Design Life (years)	20	20
Weight of Pipeline (kg/m)	67.7	67.7
Protection	Trenched and Backfilled	Trenched and Backfilled

2” Service Pipelines

The two identical 2” service lines run between the Production Manifold structure and the satellite wells. The service lines are piggy-backed onto the 8” production lines to the wellhead satellite wells.



Design Parameters	Pipeline 1	Pipeline 2
Length of Sections (m)	1,800	1,800
Outside Diameter (mm)	60.3	60.3
Wall Thickness (mm)	11.1	11.1
Material/Type	API 5L X65 Rigid	API 5L X65 Rigid
External Coating	Fusion Bonded Epoxy (FBE)	Fusion Bonded Epoxy (FBE)
Insulation	Ethylene Propylene Diene Monomer (EPDM) / Polyvinyl Chloride (PVC) foam	Ethylene Propylene Diene Monomer (EPDM) / Polyvinyl Chloride (PVC) foam
Content	Chemicals/hydrocarbon	Chemicals/hydrocarbon
Installation Year	1994	1994
Design Life (years)	20	20
Weight of Pipeline (kg/m)	13.5	13.5

Protection	Trenched and Backfilled	Trenched and Backfilled

Umbilicals

There are four basic types of control umbilicals used within this field development. Details of the Chemical Injection and Hydraulic Umbilicals, Electrical and Hydraulic Umbilicals, and Hydraulic Umbilicals are presented in the tables below.

Design Parameters		
Chemical Injection and Hydraulic Umbilicals	**19 Core**	**7 Core**
Length (m)	420, 420, 15,571	15,571
Outside Diameter (mm)	151.6, 151.6, 134.1	88.3
Material	Nylon / Hytel	Nylon / Hytel
Content	Corrosion Inhibitor (CI)/ Pore Point Depressant (PPD)/ Demulsifiers	Corrosion Inhibitor (CI)/ Pore Point Depressant (PPD)/ Demulsifiers
Wet weight (kg/m)	33.22, 33.22, 25.12	12.8
Electrical and Hydraulic Umbilicals	**2 Elec/2 Hydr**	**10 Elec/10 Hydr**
Length (m)	355	475
Outside Diameter (mm)	70.9	126.3
Weight (kg/m)	7.1	24.3
Electrical	**6 Power / 6 Signal**	**4 Power / 8 Signal**
Length (m)	510	15,571/ 2,010
Outside Diameter (mm)	115	86
Weight (kg/m)	24.2	15.4
Hydraulic	**7 Core**	
Length (m)	Range 20m – 2,010m	

Outside Diameter (mm)	88.3	
Weight (kg/m)	12.8	

Ancillary Equipment

T The subsea field also includes an array of ancillary equipment such as grout bags and concrete mattresses which provide stability and protect the pipelines at field approaches and in construction of crossings over or under other pipelines. Typical dimensions of a subsea mattress are 6m x 3m x0.15mm and weigh in the order of 7-11te depending on thickness and density of the concrete.

Figure 6 - Concrete mattresses at quayside