Innovation and Technology

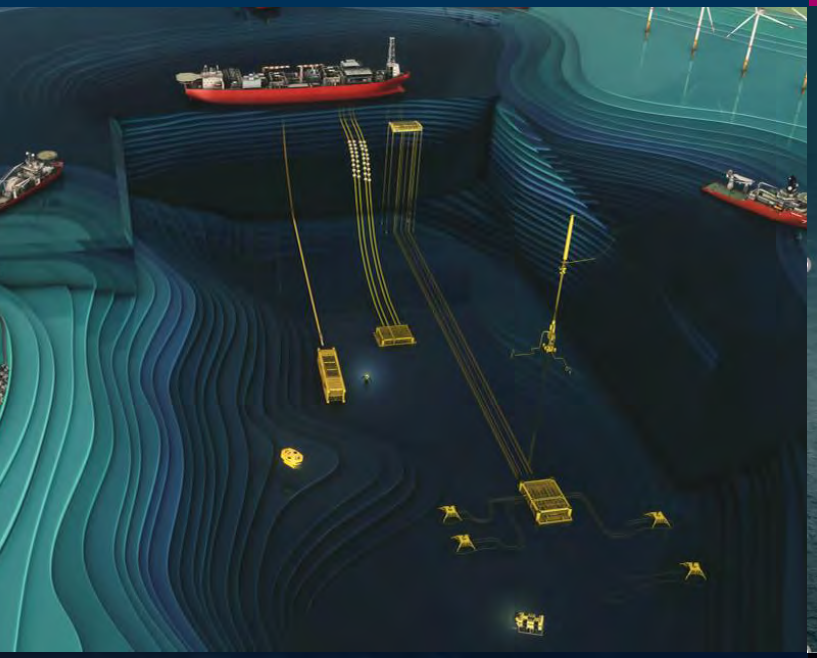
27 September 2019

Innovation Days Norway

Introduction

Isabel Green, Head of Investor Relations

EARLY ENGAGEMENT



LONG DISTANCE TIE-BACKS

TECHNOLOGY ENABLERS

Innovation Days Norway

COST-EFFICIENT PIPELINE MATERIALS

SUBSEA AUTONOMY, IRM & DIVING

RENEWABLE ENERGY & SUSTAINABILITY

Agenda

Welcome and Introduction to Subsea 7
Monica Th. Bjørkmann, Vice President Subsea 7 Norway

Innovation and Technology
Thomas Sunde, Vice President Strategy and Technology, Subsea 7

Field Development Group
Darren Cormell, Vice President Field Development, Subsea 7

Pipeline Capabilities
Giles Mitchell, Pipeline Group Early Engagement Manager, Subsea 7

Monica

Thomas

Darren

Giles

Arne

Michelle

James

Richard

Electrically Heat Traced Flowline
Arne Skeie, Engineering Specialist, Subsea 7

Swagelining's Integrated Liner System
Michelle Tinney, Business Development Manager, Swagelining

Autonomy and Remote Operations
James Jamieson, Strategy and Technology Development Manager, i-Tech 7

Offshore Wind Capabilities
Richard den Hollander, Busienss Development Director, Seaway 7

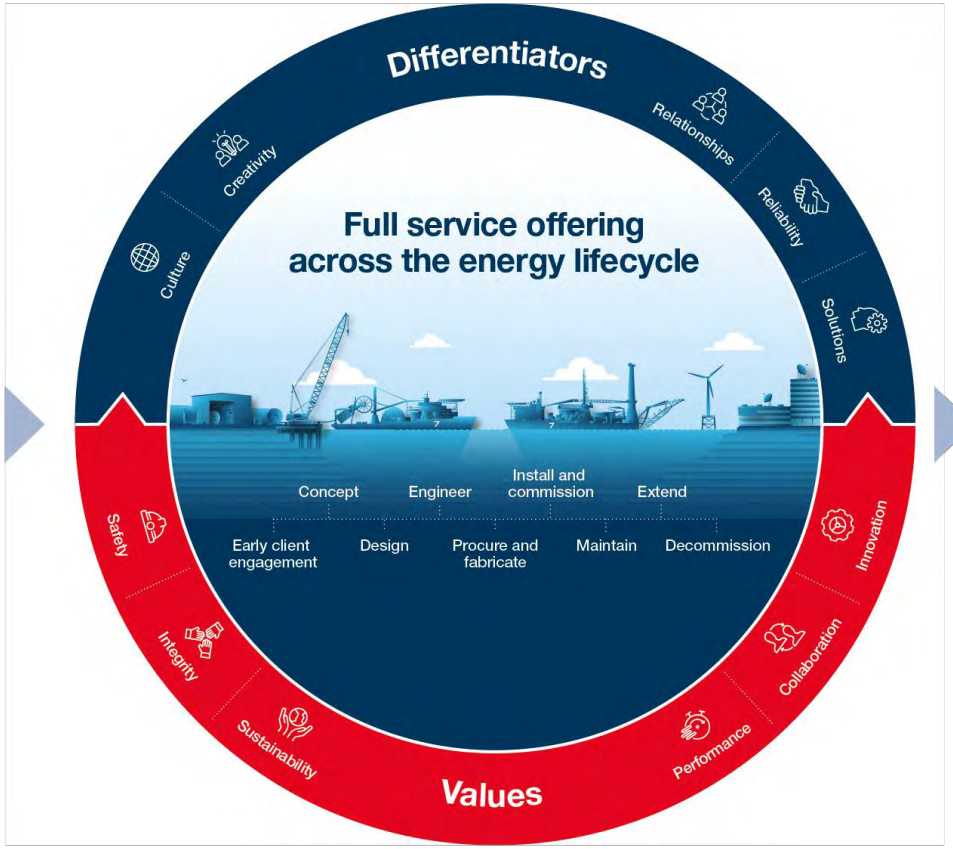
Our Vision and Values framework

Vision

To **lead the way** in the **delivery** of **offshore projects** and **services** for the **energy industry**.

Strategy

In an **evolving energy** sector, we create **sustainable value** by being the industry's partner and **employer of choice** in delivering the efficient offshore solutions the **world needs**.



Stakeholders

Delivering sustainable **value for our stakeholders**.

subsea 7

SUBSEA 7 **CAPABILITIES** ACROSS THE **ENERGY LIFECYCLE**

ENGAGE EARLY TO DELIVER VALUE
Creating value for clients in the earliest stages of project planning, lowering costs and streamlining schedules.

CONCEPT
Input at concept allows for optimisation of later cycle stages.

DESIGN
Robust FEED ensuring minimal change and accurate forecasting during design.

ENGINEER
Detailed engineering by experienced personnel to deliver the best solution.

PROCURE AND FABRICATE
Efficient procurement and high quality fabrication delivered on time.

INSTALL AND COMMISSION
Safe, on-schedule and cost-efficient installations by world-class vessels.

MAINTAIN
Effective and responsive maintenance reducing cost of ownership.

EXTEND
Maximised return on investment by utilising new technologies and tie-back solutions.

DECOMMISSION
Facilitated abandonment and decommissioning with heavy lift vessels.

SOLUTIONS THAT DELIVER VALUE TO CLIENTS

Early engagement through global alliances and client partnerships optimises the solutions Subsea 7 can provide

EXECUTING PROJECTS AND SERVICES THAT MEET CLIENT EXPECTATIONS

An extensive track record of safely executed projects worldwide makes Subsea 7 a market-leading provider

Subsea 7 in Norway

Monika Bjørkmann, VP Norway

Subsea 7 on the Norwegian Continental Shelf

Wick
Wester Fabrication Site

Glasgow
Pipeline Production Group

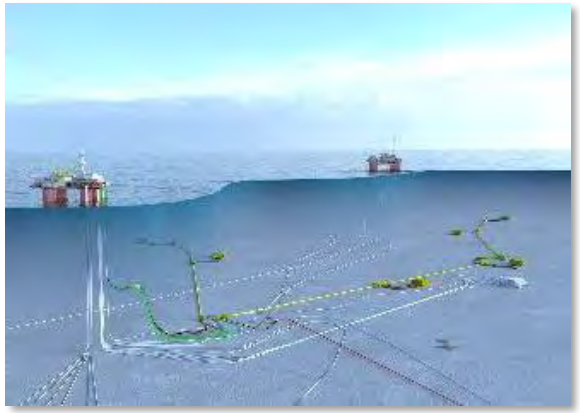
Vigra Spoolbase (6-300)

Tromsø Office (1)

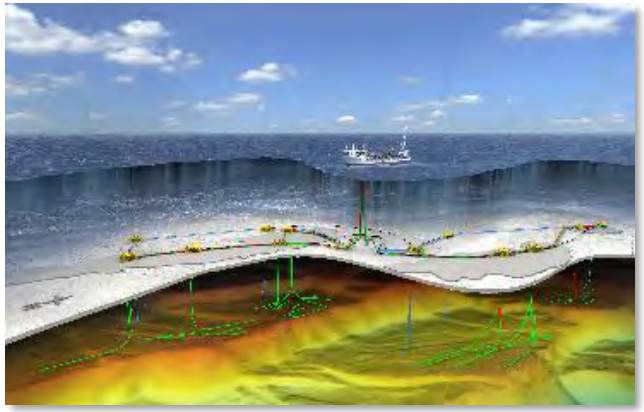
Stavanger Main Office (425)

Dusavik Base (24)

Norway 2019 Operational Highlights



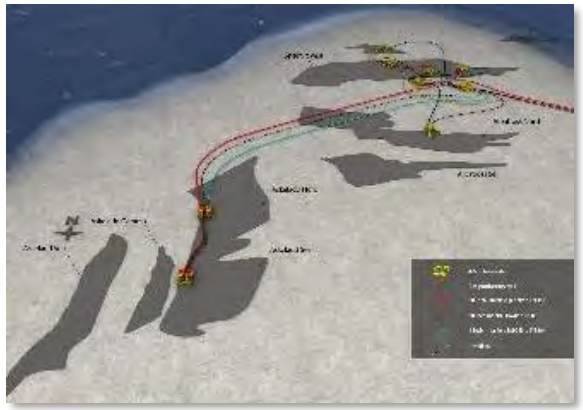
Equinor Snorre EP



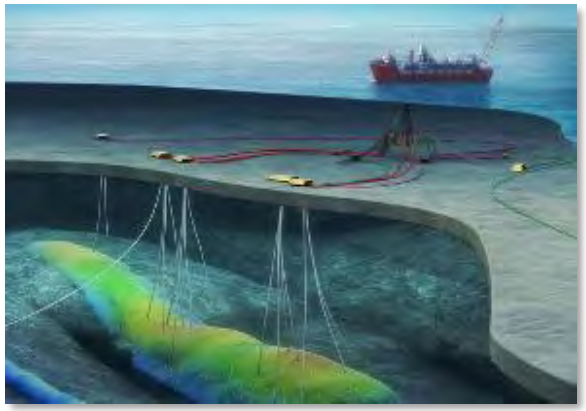
Equinor Johan Castberg

Equinor Johan Sverdrup

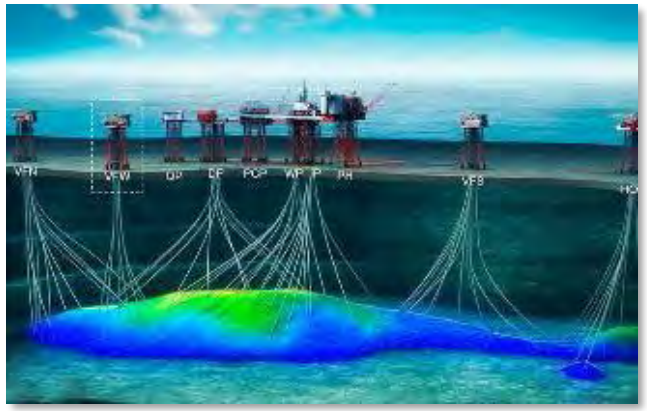
Equinor IRM



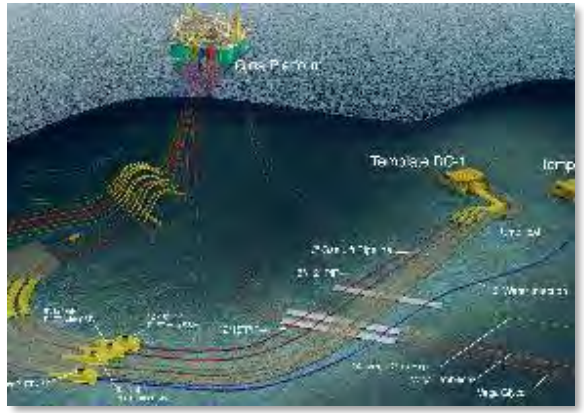
Equinor Askeladd



Aker BP Ærfugl



Aker BP Valhall Flank West and North



Wintershall Nova

Snorre Highlights

Snorre field life was originally expected to last until 2011- 2014. It is now expected to produce beyond 2040.

- Total length of 20,976m in three Pipeline Bundles.
- The west Pipeline Bundle, at 7.619m long, is one of the longest executed from Wick Fabrication Site.
- The east Pipeline Bundle at 147cm is the largest in diameter to date, and at 12.400t, the heaviest to date installed by Subsea 7.
- Total length equaling 3.4km of pipe spools, 7.6km of tubing spools and 3.7km flying leads.

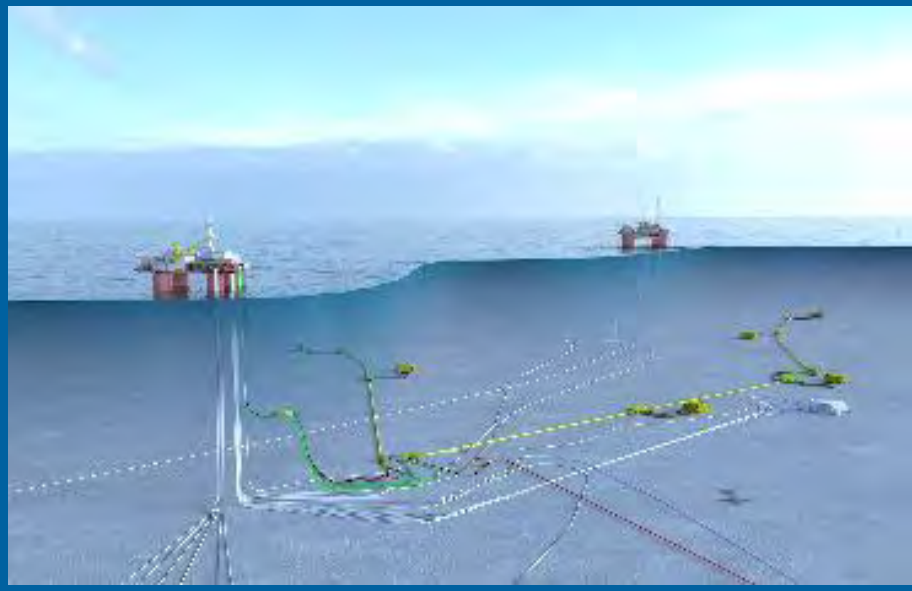
Snorre Expanison

Creativity

The Snorre Expansion Project features three Pipeline Bundles and 31 spools, linking six new drilling templates with the Snorre A tension leg platform (TLP), housing all necessary services for full field operation.

Technology and Innovation:

- First project to incorporate Swagelining Linerbridge technology in polyethylene lined water injection lines.
- Swagelining's LinerBridge® technology is the world's first all-polymer lining connector that removes the need for costly Corrosion Resistant Alloy (CRA) welding.
- Pipeline Bundles include electrical and fibre optic lines in preparation for the use of Underwater Intervention Drone/ Autonomous Underwater Vehicles.
- All electric controls system for operating bundle valves.
- Foundation design of tolerably mobile towhead structures extended to very soft clays, removing the need for rock foundation.
- Multibore umbilical spools.
- Standardisation of spool cassette installation with modular spreader bar.



Ærfugl Highlights

First use of new technology enables development of Ærfugl.

- Subsea 7's first awarded EHTF project.
- The application of Subsea 7's Electrically Heat Traced Flowline (EHTF) technology to prevent hydrate formation and improve production efficiency.
- Development and installation of a new EHTF fabrication line at Vigra spoolbase including helix machine, tensioner system and new buildings.

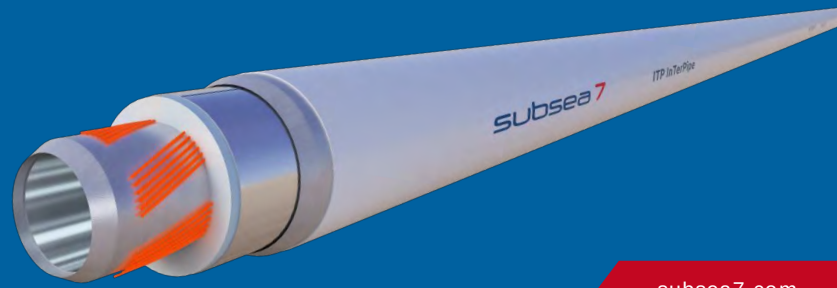
Ærfugl

Creativity

The project is executed by an integrated team of representatives from Subsea 7 (SURF), Aker Solutions (SPS) and Aker BP based at Subsea 7's offices in Forus, Norway.

Project Scope:

- 20.3km EHTF Pipe-in-Pipe (10-inch/16-inch) and related topside equipment
- Pipeline End Terminations, inline tees, inline power inlet structures and glass reinforced plastic covers.
- Dynamic and static power umbilical.
- Dynamic and static service umbilical.
- Flying leads for service umbilical and pow umbilical systems.
- 3x 6-inch flexible jumpers.
- 3x 10-inch flexible jumpers.
- Tie-in module.
- Umbilical riser base.
- 3x single slot templates.
- 3x vertical x-mas trees.
- Seabed intervention.



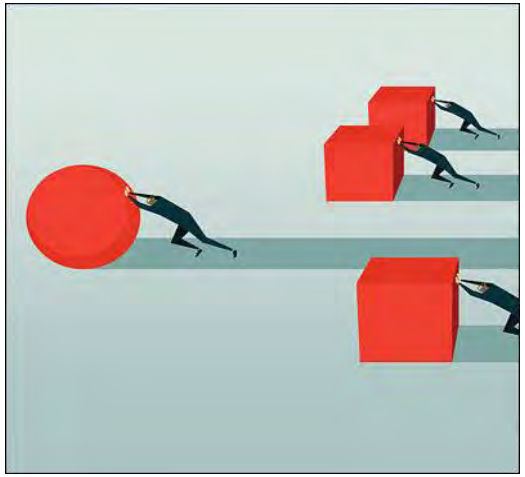
Our technology strategy

Thomas Sunde, VP Technology

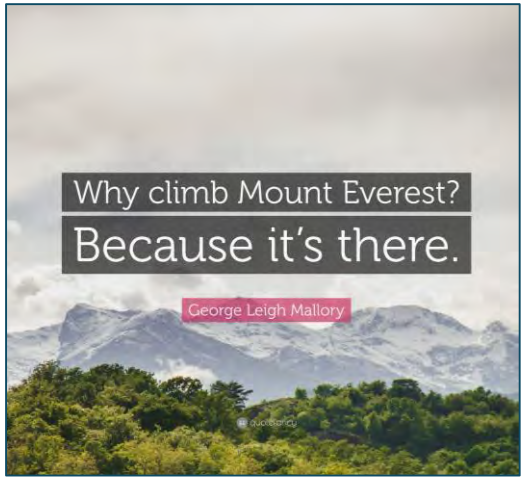
Why innovate?

Changing Business Environment

Advanced Technology



Increased Competition

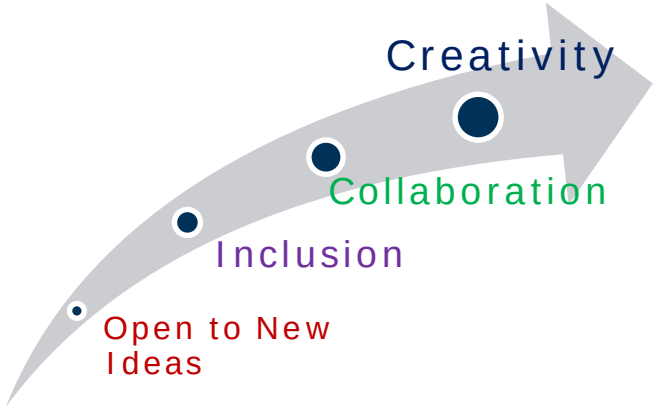


Human Nature

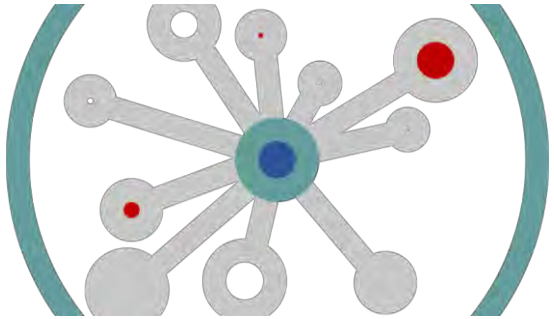
Make Change or Be Changed

Unlocking New Innovation Pathways

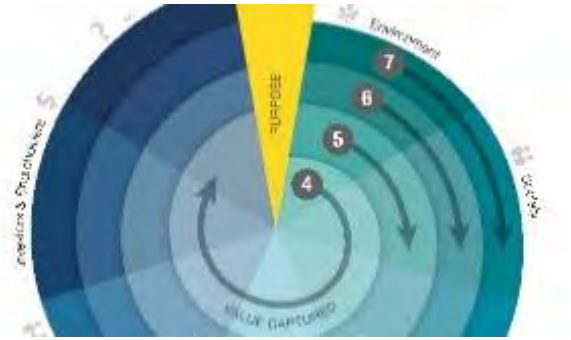
Innovation = Invention + Commercialisation



Creating a climate that enables innovation:
Within business and between businesses in a value network.



Understanding the relationships between stakeholders:
Seek more collaborative arrangements.



Taking a broader view of value creation:
Identify value opportunities and develop supporting business models.

Source: Cambridge Method for Value Generation ©

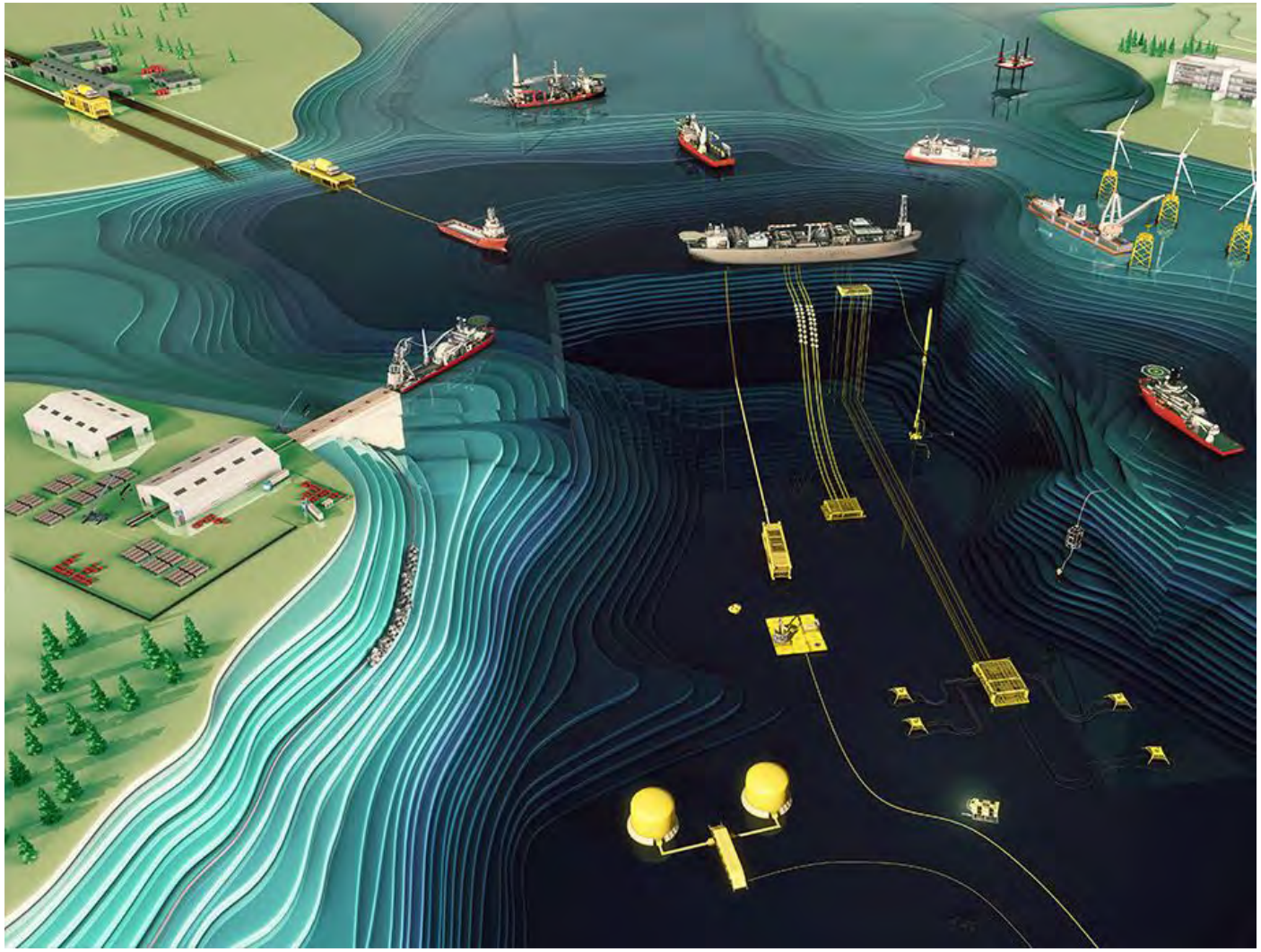
Creating value through technology

- Business driven technology innovation
- Balanced portfolio of fast to market technologies and next horizon game changers

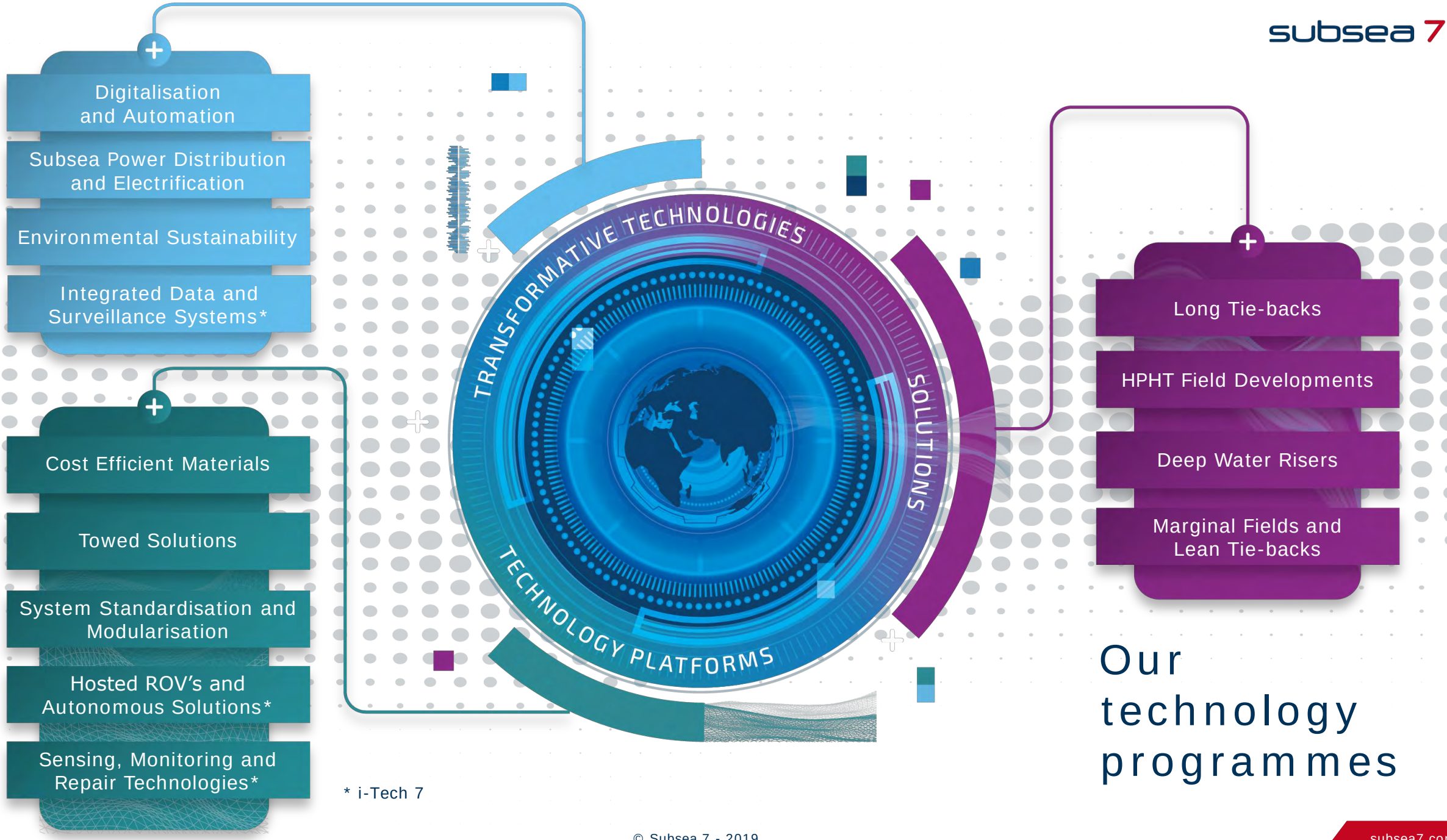
Defend Leading Position

Differentiate

Disrupt



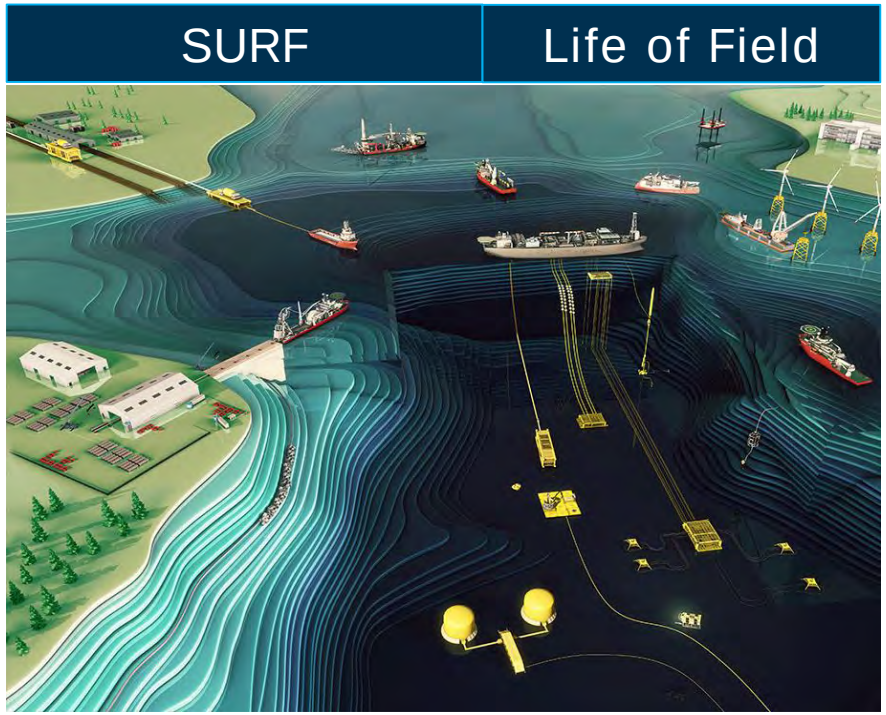
Our technology programmes



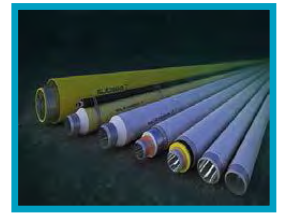
* i-Tech 7

Integrated SPS SURF technology solutions

- Technology provides opportunities within:
  - Overall System Innovation
  - Enhanced product portfolio
  - Collabration creates joint value

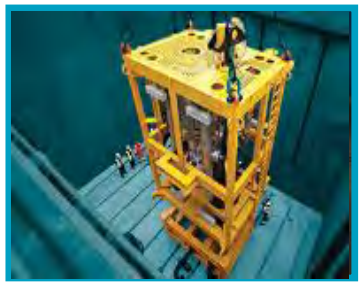


Riser Systems



Flowline Systems

Bundles



Subsea Processing

Flexibles

Umbilicals

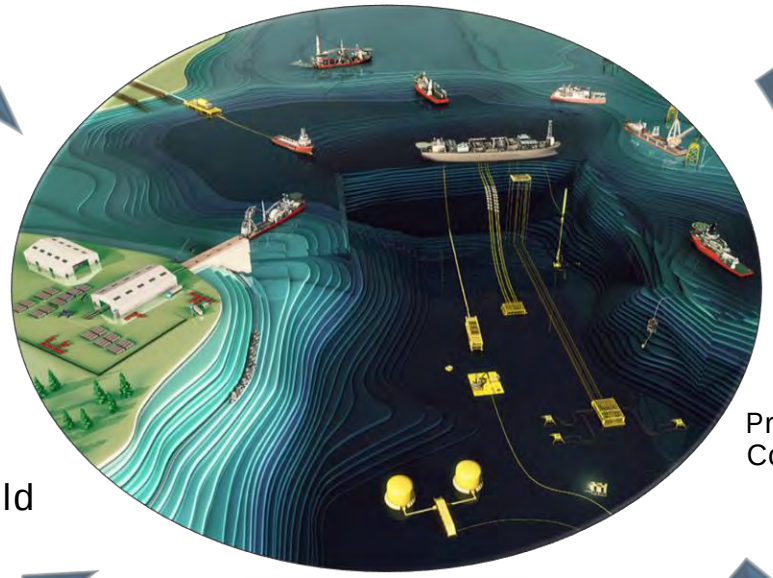
Subsea Production Systems

Digitalisation and Automation

Source: Fieldap

Concept/
FEED

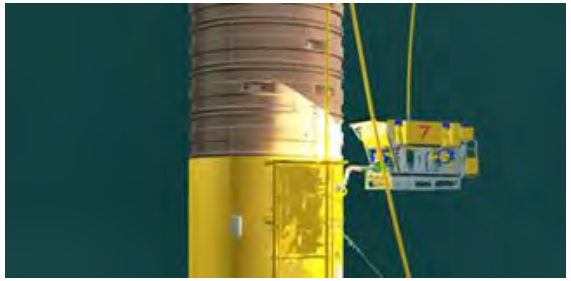
Engineering



Procurement
Construction

Source: Livemint

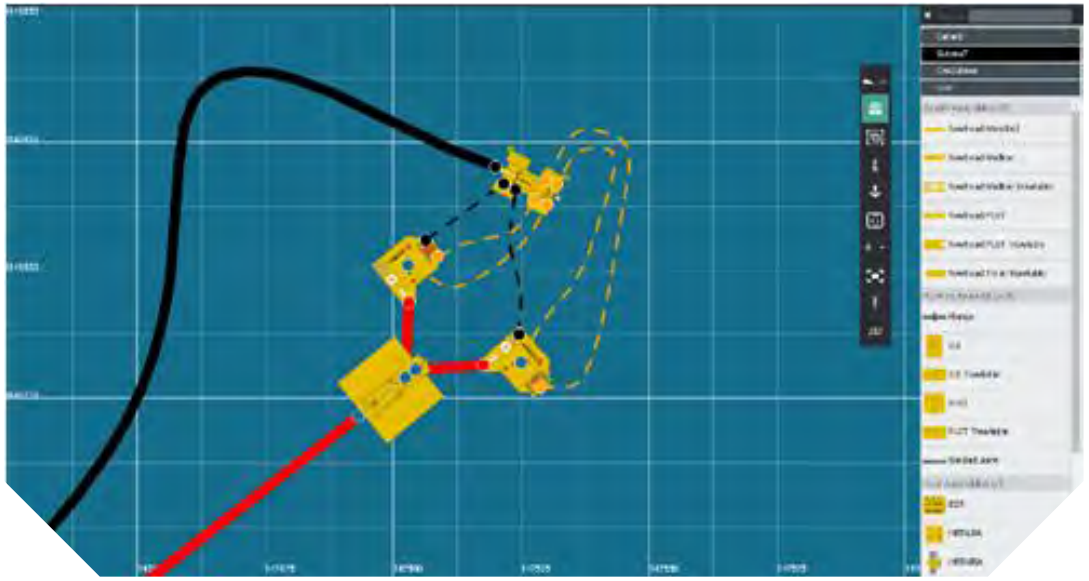
Life of Field



Installation

Digitalisation

- Strategy in development with new VP assigned. Focus areas within i-Tech 7, early engagement and Pipeline Bundles
- Planning software made available by Schlumberger to Subsea Integration Alliance for early engagement
- i-Tech 7 and Leidos have a 5 year digitalisation partnership agreement – using artificial intelligence and automation to reduce the costs of life of field services
- Monitoring equipment incorporated into Pipeline Bundle Towhead

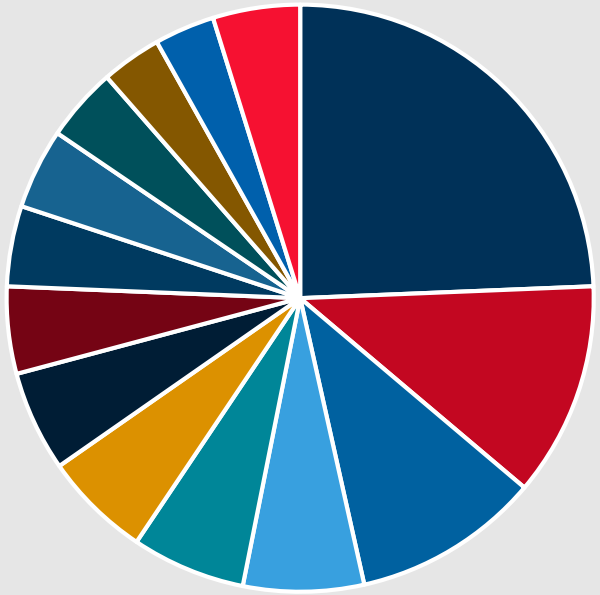


Intellectual Property (IP) in numbers

- ~1500 granted and pending patents
- ~230 patent families
- 19 trademark families

Patent Families : 228

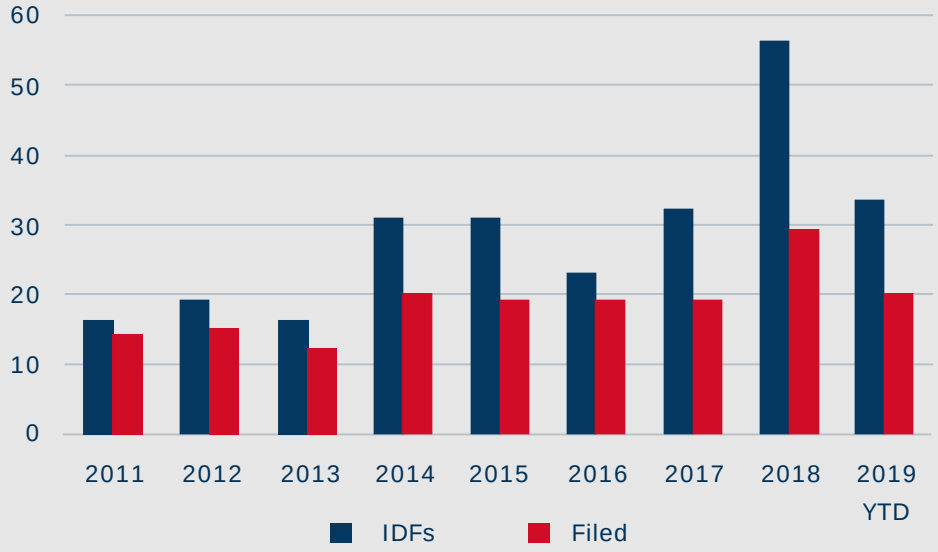
RECORD COUNT



CATEGORY

- Rigid Pipelines
- Dynamic Riser Design
- i-Tech
- Structures
- Swagelining
- Welding and Materials
- Flow Assurance
- Offshore Resources
- Lifting, Rigging and Subsea Construction
- Bundle
- Geotechnics
- Flexibles, Umbilicals
- Corrosion Coating, FJC
- Other

IDFs & New Inventions Per Year



IDF: Invention Disclosure Form

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Field development

Darren Cormell, VP Field Development

Early engagement

- Forming collaborative relationships
- Accelerating the development process
- Improving predictability of CAPEX, OPEX and TOTEX
- Identifying and managing risk
- Providing robust and reliable solutions

Our flexible approach to early engagement

- All stages of the field development planning process
- Integrated Field Development (IFD)
  - Subsea Integration Alliance
  - Customer alliances, partnerships, affiliates and frame agreements
  - Integrated Customer and 3rd party teams
  - Other
- Integrated SURF and SPS EPCI studies
  - Subsea Integration Alliance
  - Alliances, partnerships and frame agreements
  - Other
- SURF only EPCI studies
- Marine and constructability / feasibility studies
- Technology studies

Subsea Integration Alliance
OneSubsea & Subsea 7

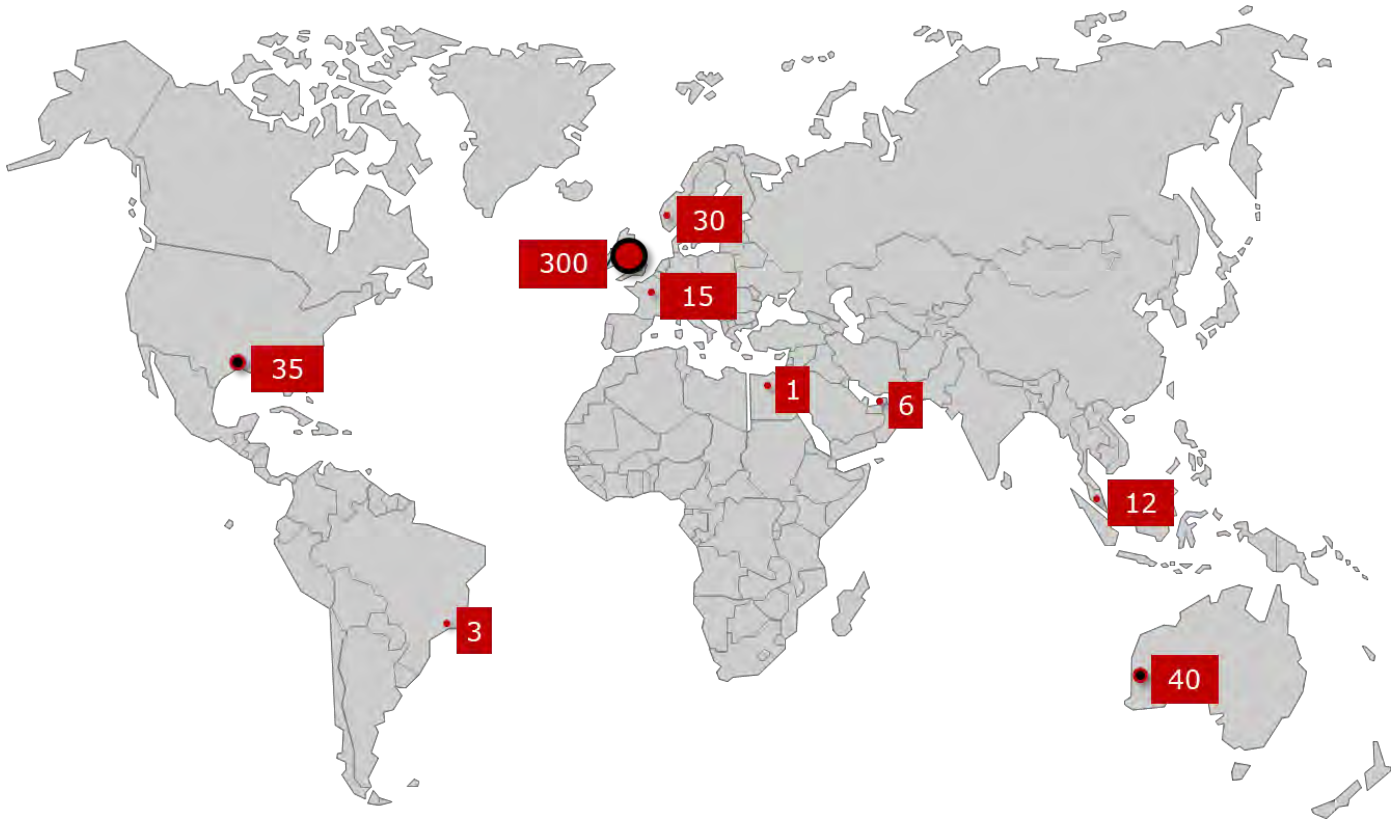
SUBSEA ALLIANCE
Integrated work. Outstanding solutions.

OKEA Subsea Frame Agreement

SPIRIT ENERGY

xodus GROUP

Front end resources and capability



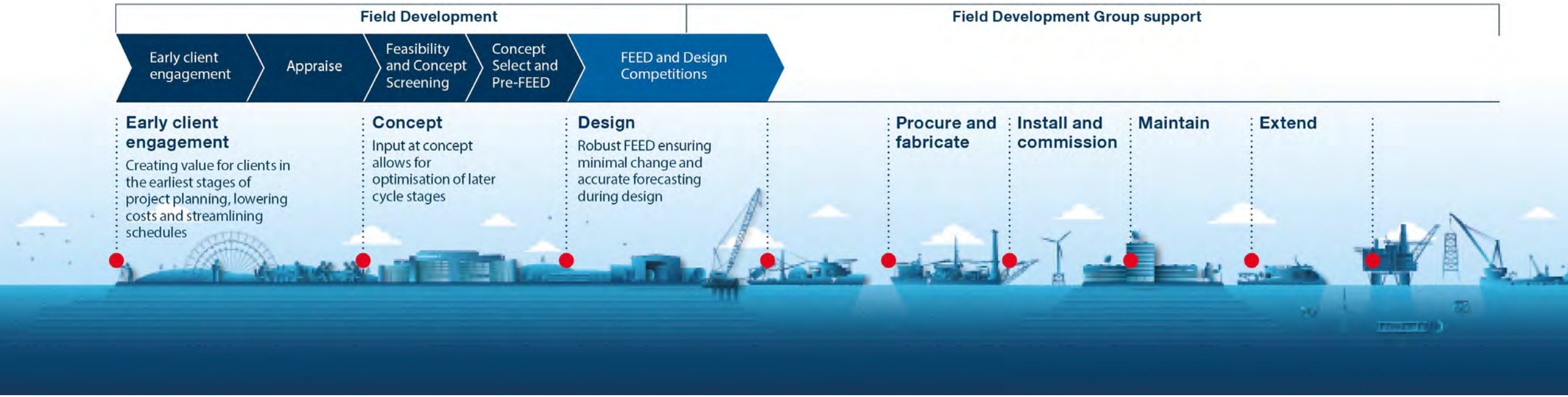
- Access to more than 400 dedicated front end resources worldwide
- Globally connected
- Supported by parent company organisations
- More than 600 personnel deployed on front end work daily
- Extensive global study track record

subsea 7 + OneSubsea A Schlumberger Company + xodus GROUP

Field Development Group

More than ever before, operators are seeking innovative, creative and reliable field development solutions to overcome the complexities facing today's industry.

From early engagement to seamless execution



Our supplier-led solutions

- Combining field development planning with execution and delivery knowhow – underpinned by foundation of core technical skills

- A growing story of success – delivering value to our customers

Completed study record

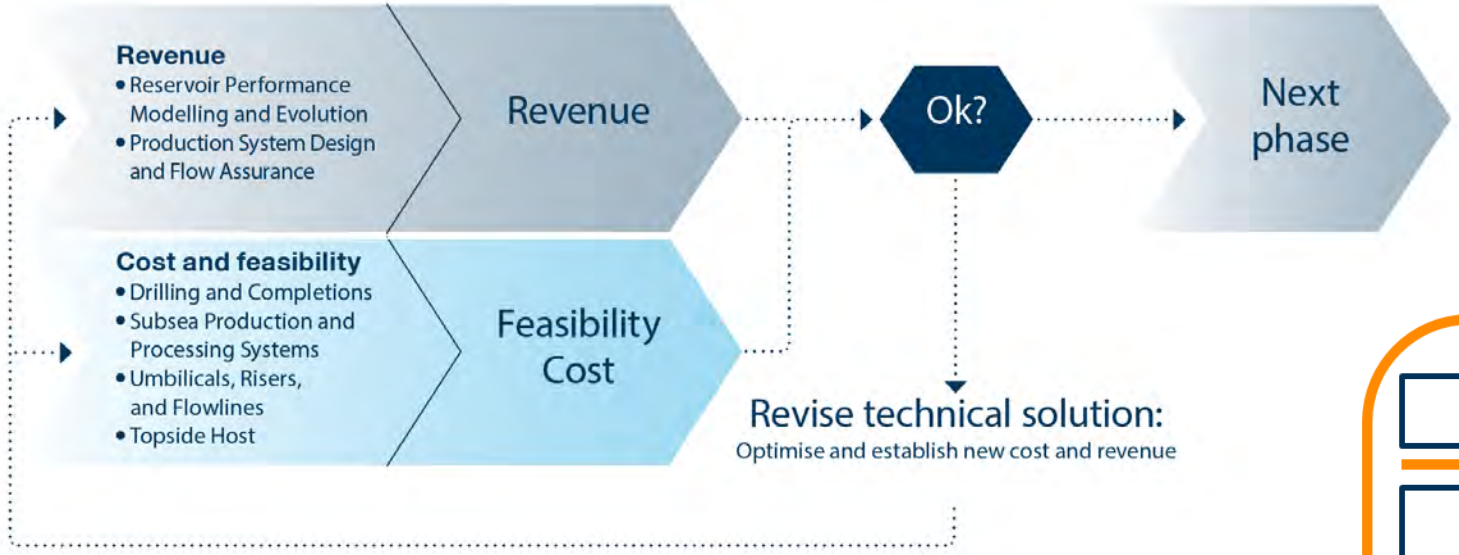
Our activity levels continue to grow rapidly. Our track record covers all stages of early field development planning.

Development planning

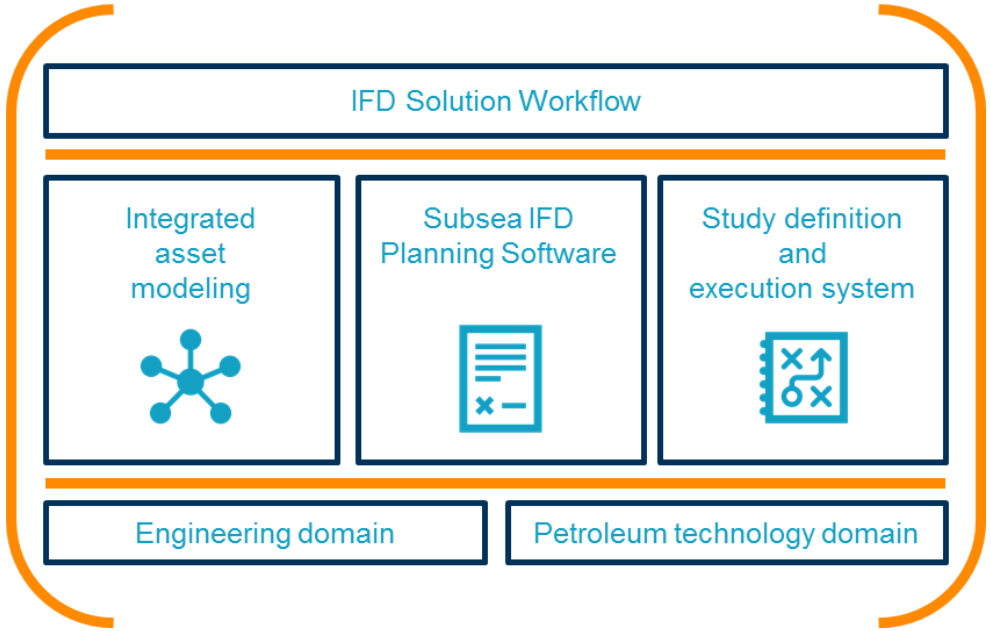
Sub surface and reservoir	Production assurance	Subsea production and processing systems	Subsea umbilicals, risers and flowlines	Host, topside and process	Operations and life of field	Technology and innovation
• Geology and geophysics • Reservoir engineering • Modelling and representation • Drainage and production strategy • Drilling and completions • Production system interdependency	• Thermal and hydraulic simulation • Production chemistry • Artificial lift • Pressure, temperature and liquid management • Operating process and procedures • Material selection	• Wellhead and tree systems • Structures and connection system • Power and controls • Sensor and metering • Subsea separation and processing • Subsea boosting and compression	• Geotechnical and survey • Rigid flowline systems • Pipeline Bundles and towed production systems • Riser systems • Flexibles and umbilicals • Installation and construction	• Fixed and floating structures • Mooring foundation system • Process modelling • Process technologies • Riser and subsea system interdependencies	• Start-up and commissioning • Reliability and operability • Asset integrity • Production management • Monitoring and intervention • Remote intervention operation • Enhancement and life extension • End of life and decommissioning	• Key technology value drivers • Market innovation landscape • Internal development projects • Risk management • Commercialisation, integration and delivery • Digital enablement and enhancement

Execution and delivery

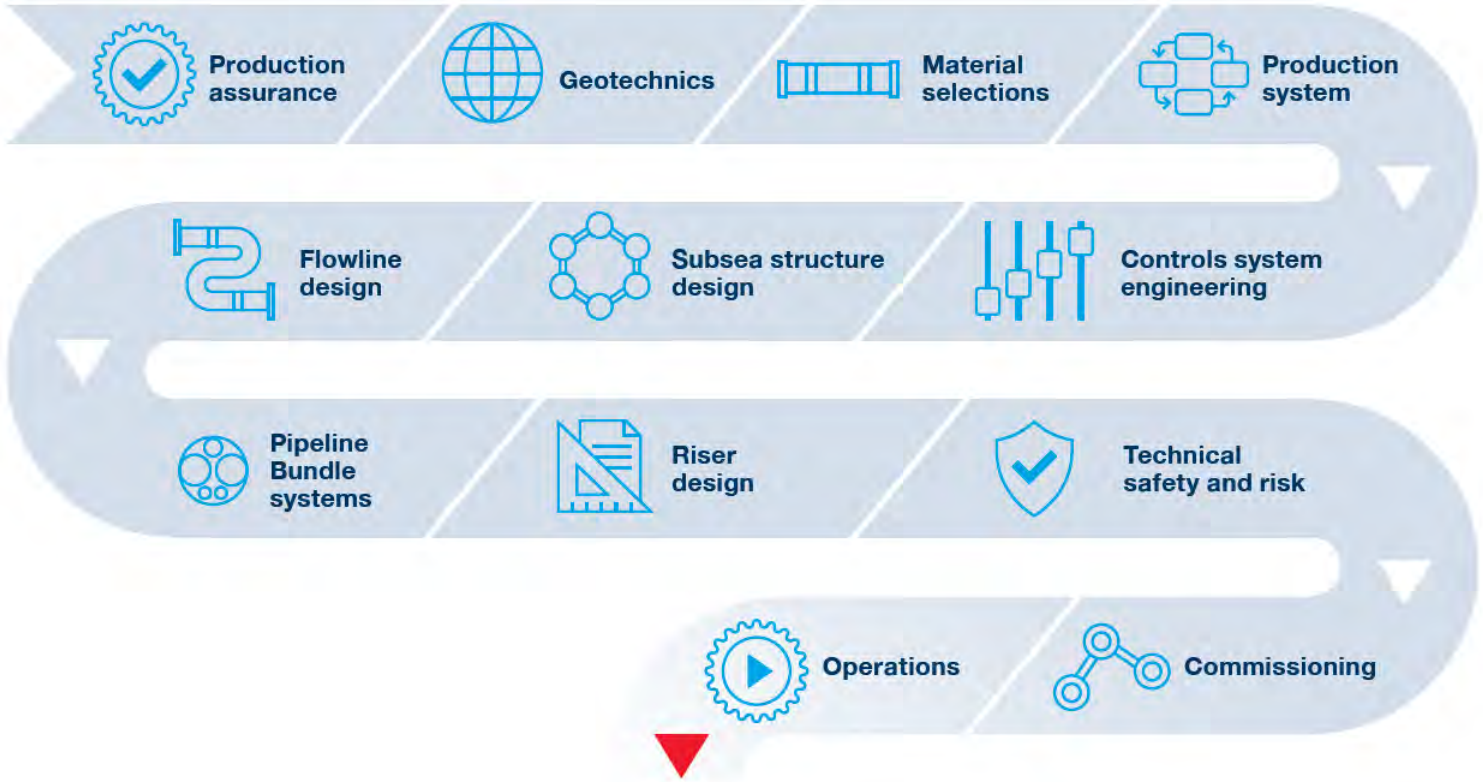
Integrated Field Development Framework



- Taking a holistic approach to field development – understanding to impact to production & cost for our solutions
- Working within an integrated framework – deliver consistent results with confidence



Evolution to solution – efficient supplier-led solutions



These as a minimum will include:

- Summary report
- Concept layout
- Cost estimate
- Project schedule
- Execution plan

Study deliverables to meet client requirements.

Value Delivery Framework – Uncover the true value

CAPEX

- SPS & SURF costs
- Well construction
- Topside facilities and process
- Hosts

OPEX

- Asset operation
- Manpower
- Power consumption
- Logistics
- Chemicals for injection
- Inspection and maintenance
- Repair and intervention

Environment

- CO2 emissions (tonne)
- CO2 financial impact (taxes)

Uptime & Reliability

- Improved facility availability
- Reduced shutdown & start up impacts

Incremental Recovery

- Value of additional hydrocarbons produced

Accelerated Recovery

- Monetary impact of accelerated delivery / production

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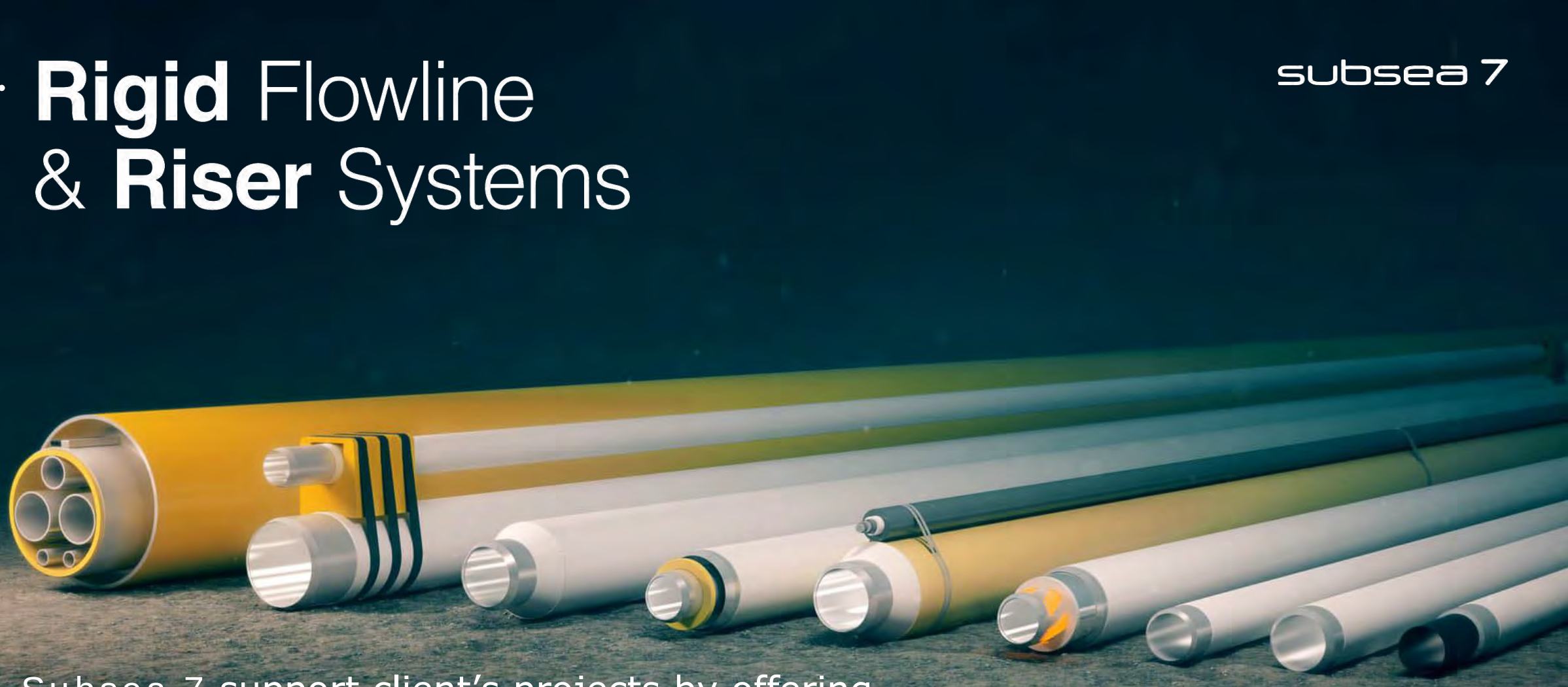
Pipeline capabilities

Giles Mitchell

Rigid Flowline & **Riser** Systems

subsea 7



Subsea 7 support client's projects by offering consistent and progressive delivery of global rigid pipeline systems, through locally tailored solutions, automation and strategic supply chain partnerships.

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PIPELINE BUNDLE

A solution which integrates multiple flowline and control systems within a single steel carrier pipe with manifold structures at each end. Subsea processing functions can also be incorporated.

Following full function testing onshore, the pipeline bundle is launched and transported to its offshore location using the Controlled Depth Tow Method (CDTM).

Subsea 7 has developed a Pipeline Bundle refloat concept allowing temporary or permanent recovery and repositioning of a bundle. Refloating of bundles can mitigate the risk posed from iceberg strikes in polar regions and assist with meeting the needs of marginal field developments.

Bundles up to 7km in lengths
80+ Pipeline Bundles installed to date

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PIGGY-BACK PIPELINE

A solution to improve the efficiency of offshore installation by allowing two products to be installed simultaneously and also minimising seabed preparation.

In 2012 Subsea 7 developed and patented an automated piggy-back machine allowing piggy-back pipeline installation rate to be increased from 350m/hr to over 1,000m/hr and reducing operator fatigue and improving safety.

1,000m/hour installation rate

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WET INSULATED PIPE

A solution to improve the thermal performance of a single pipe by applying high performance insulation coatings.

We have worked with a variety of suppliers and coating systems, qualifying up to 100mm thick IMPP, and high performance Ultra and NEMO FJC products.

We work with clients to optimise repair procedures where needed, to allow cost efficient remedial work, if required, to avoid costly schedule issues.

Up to 100mm thick injection molded polypropylene

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PIPE-IN-PIPE (PIP)

A solution to improve thermal performance of a flowline by sleeving the production pipeline within an outer pipe with high performance insulation material contained within the dry annulus.

Subsea 7's high-performance PIP solution uses insulation with reduced internal pressure, offering unrivalled performance.

Subsea 7 has developed the next generation of PIP systems with a variable u-value, Dynamic ARrival Temperature (DART). This technology is specifically suited to HPHT fields where operators will benefit from operational flexibility by adjusting the production fluid arrival temperature at the host facility.

U valves of 0.5 W/m^2K or better

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DIRECT ELECTRICAL HEATING (DEH)

A solution which enables the development of subsea fields through enhanced thermal performance avoiding hydrates and wax formation.

The pipeline heating system for wet insulated pipelines creates an electrical loop from a current generator located on the topsides directly connected to both ends of the pipeline.

From 2007 Subsea 7 has been successfully installing electrical heating systems

Install of World's Deepest
open loop (DEH) system

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ELECTRICALLY HEAT TRACED FLOWLINE (EHTF)

A solution which offers significantly enhanced flow assurance properties.

EHTF technology allows the carried fluid to be maintained above wax or hydrate appearance temperature along its journey from the wellhead to the host facility.

The system can operate either in a passive or active functionality. The heat-traced technology can be applied with all pipe metallurgies, at high temperatures and in permanent operation. It offers significantly lower power requirements and lower costs than DEH systems.

Simplification of field architecture removing the second leg of the production loop often required to enable pigging with dead oil for preservation.

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SINGLE PIPE

A solution for simple field developments and where flow assurance is not a concern. Typically, the single pipe is fabricated from carbon steel with an external anti-corrosion coating.

For flowlines transporting aggressive fluids the single pipe can be fabricated from solid or metallurgically clad corrosion resistant alloys (CRA).

World Leader

Pioneering the fabrication of CRA pipelines having welded and installed over 500km with sizes varying from 2" to 48" in diameter.

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MECHANICALLY LINED PIPE (MLP)

A more cost-effective corrosion resistant pipeline solution as an alternative to more expensive options such as solid corrosion-resistant alloys or metallurgical clad pipe.

Subsea 7 qualified MLP for use in the challenging, deepwater Sapinhoá-Lula NE field development, Brazil. MLP offers cost savings over alternative clad pipe systems and Subsea 7 has since deployed MLP in both fatigue and non-fatigue sensitive zones for pipelines and risers.

Unrivalled experience and know-how for the installation and application of MLP.

Innovation Days Norway

SWAGELINING® POLYMER LINED PIPE

The most cost-effective corrosion resistant pipeline solution for water injection service.

Our in-house Swagelining® system offers clients lower OPEX, reduced operational complexity and increased oil recovery through ensured injection water cleanliness.

Development continues to expand the application of Swagelining® to hydrocarbon service, dynamic steel catenary risers (SCR) and S-lay installation.

Our LinerBridge® connector, the world's first to eliminate the need for costly CRA welding and enable cut-to-length, has now been deployed successfully in Pipeline Bundles and reel-lay applications thus driving down the cost of corrosion mitigation.

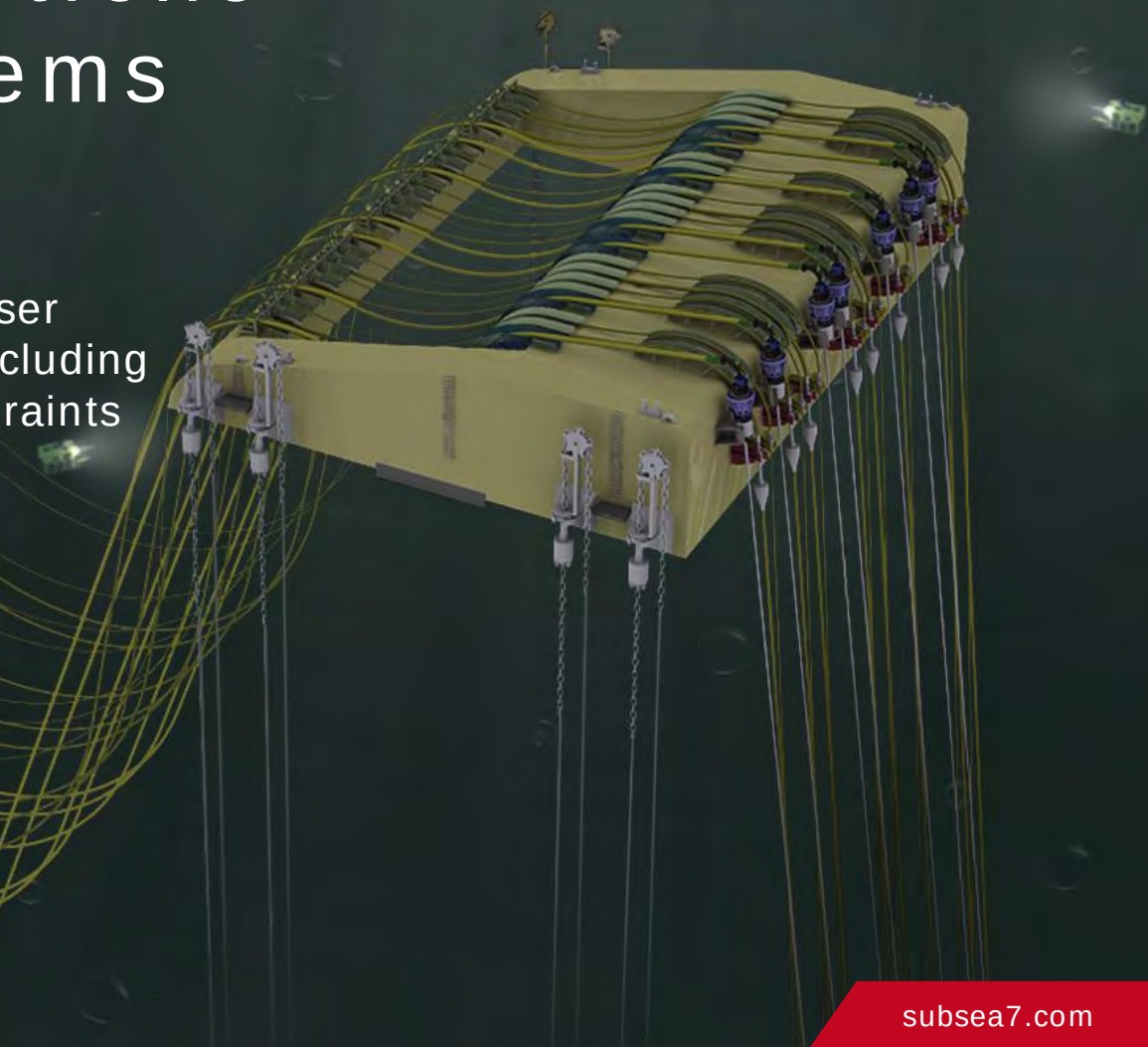
50-year design life
Reduced weight
Enhanced flow

Rising from the deep

subsea 7

We have the largest portfolio of deepwater riser systems in the world.

Subsea 7 provides deepwater and ultra-deepwater riser technology best suited to your field characteristics including extreme water depth, harsh environment, host constraints or hydrocarbon composition.



Rigid Flowline & **Riser** Systems

subsea 7

We have expanded our portfolio through investment in:

- Technology development
- State-of-the-art pipelay fleet
- Onshore fabrication facilities

Subsea 7 has installed over

6,000km

of flowlines and risers globally.

Rigid Flowline & **Riser** Systems

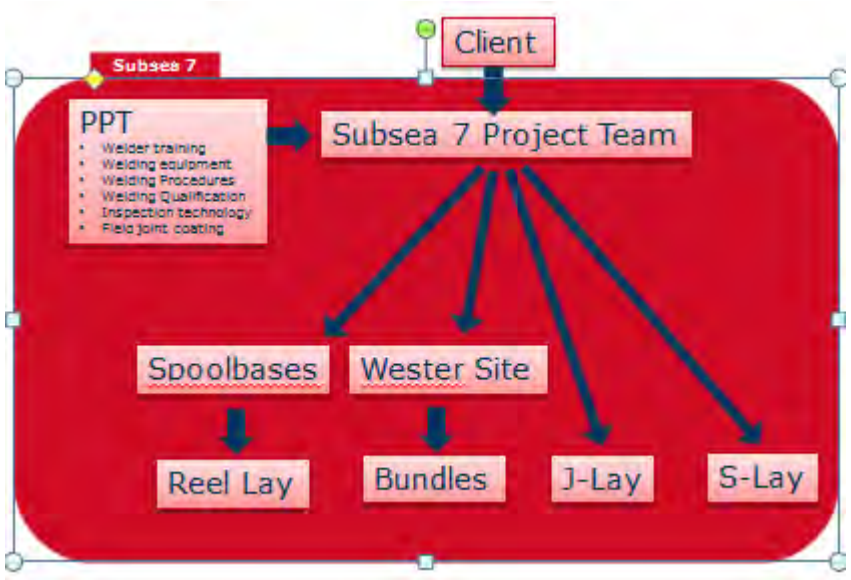
subsea 7

Subsea 7's pipelay fleet is designed to ensure the most technically suitable and cost-effective installation methods can be used to deliver your projects.

Reel-lay, S-lay, J-lay and Towed Pipeline Bundle solutions from shallow to ultra-deepwater.

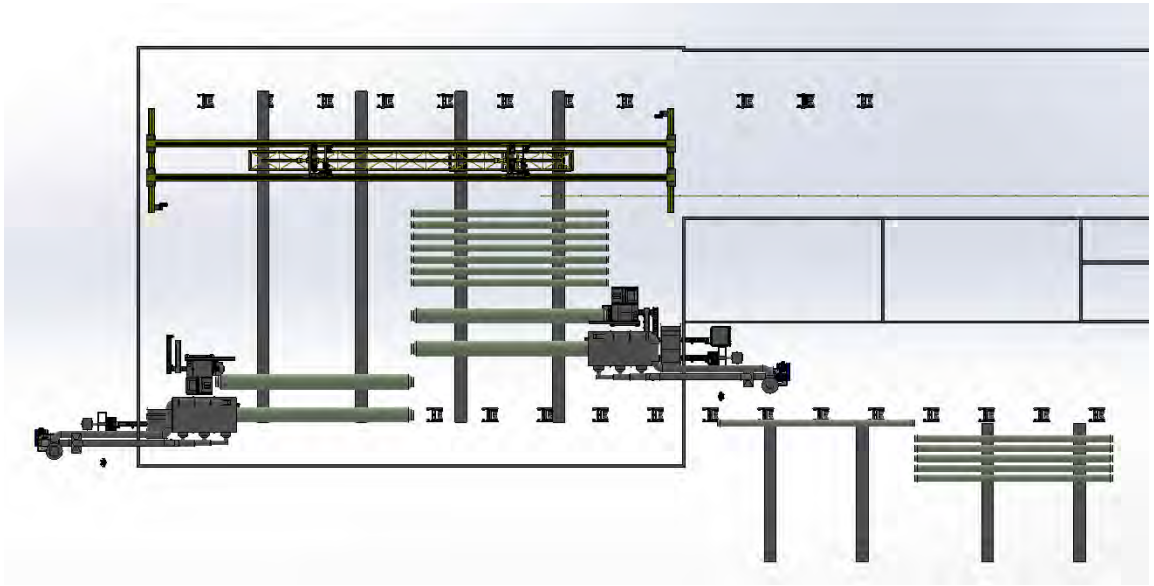
Subsea 7 Pipeline Welding Technology

- Dedicated Pipeline Production Team responsible for the strategic development and deployment of all aspects of pipeline welding both onshore and offshore
- Fully integrated approach gives clients reduced project risk and greater schedule certainty
- Global welding development facility and Centre of Excellence in Glasgow, UK, fully equipped to roll out technology advancements to fabrication facilities world wide

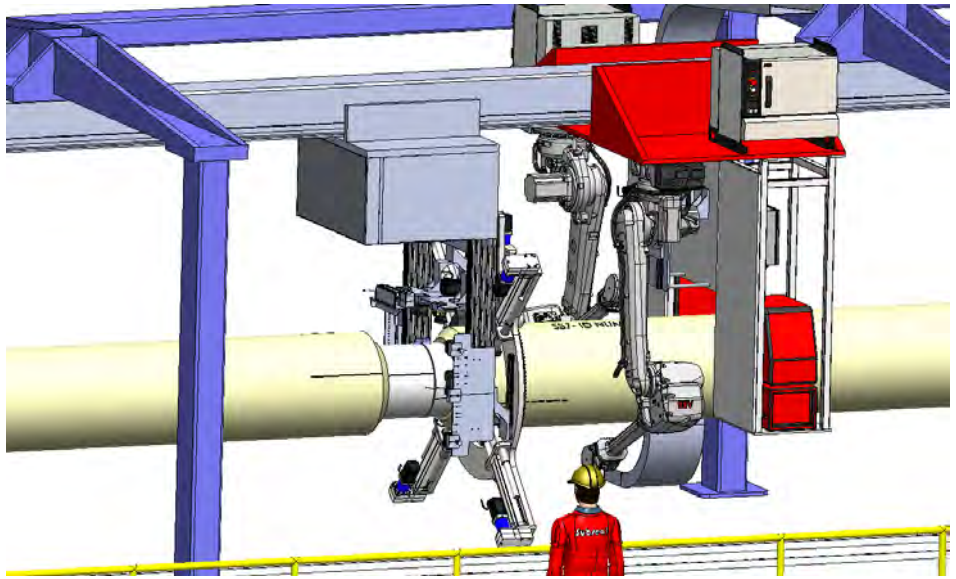


Future for pipeline welding- Automation of pipeline fabrication

- Automation feasibility study in progress including
  - Automation of firing line manufacturing processes
  - Elimination of manual operations
  - Automation of material movement through the firing line
  - Digital data capture and management
- Improved safety, productivity and schedule



Incoming pipe material area



Automatic pipe fit up and welding at Station 1

Innovation Days Norway

Electrically Heat Traced Flowline

Arne Skeie, Specialist Engineer

Background for the Electrical Trace Heating Flowline technology

- Flow assurance – EHTF solutions can remove flow assurance challenges related to hydrates and wax formation

- Subsea 7 has been developing the Electrical Trace Heating Flowline (EHTF) technology for more than 10y

- EHTF technology is an alternative to:
  - Other pipeline heating solutions as DEH and Bundle hot water circulation
  - Investment in new platform/FPSO/Host facility close to well
  - MEG injection
  - Wax and Hydrate inhibitors
  - Circulation of hot diesel

Subsea 7 Electrical Heat Tracing Flowline technology differentiators

- Vacuum/reduced pressure in PiP annulus resulting in a very low U-value PiP and subsequently less required power input
- Low voltage (1KV) – Reduced electrical aging of EHTF Heating wires and less challenging wet mate connections
- A High number of EHTF Heating wires (up to 39) – Improved redundancy and less space requirements in PiP annulus
- Developed the Subsea Electrical Power and Distribution Unit (SEPDU) which allows step-out distances technically only limited to AC Power technology

EHTF Projects in progress

BP/Manuel - GoM

- 8km tie-back in 1900m water depth
- 8″/12″ EHTF pipeline
- Fabrication 2019 and installation 2020

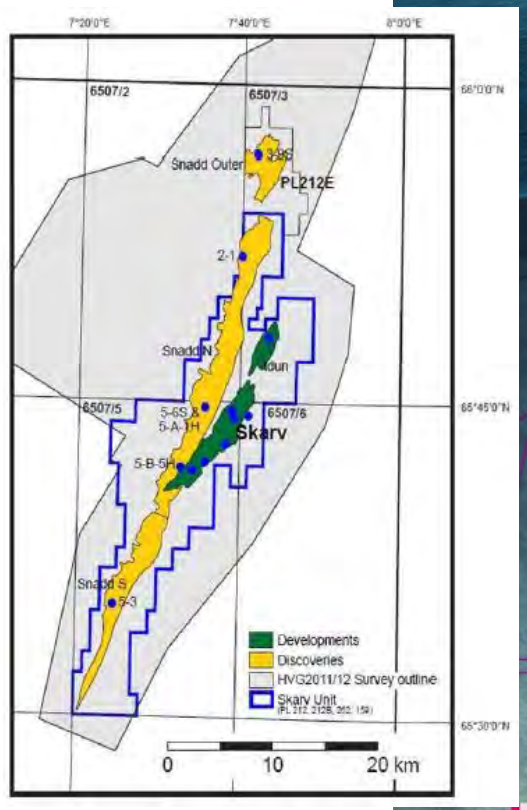
AkerBP/Ærfugl phase 1 - Norway

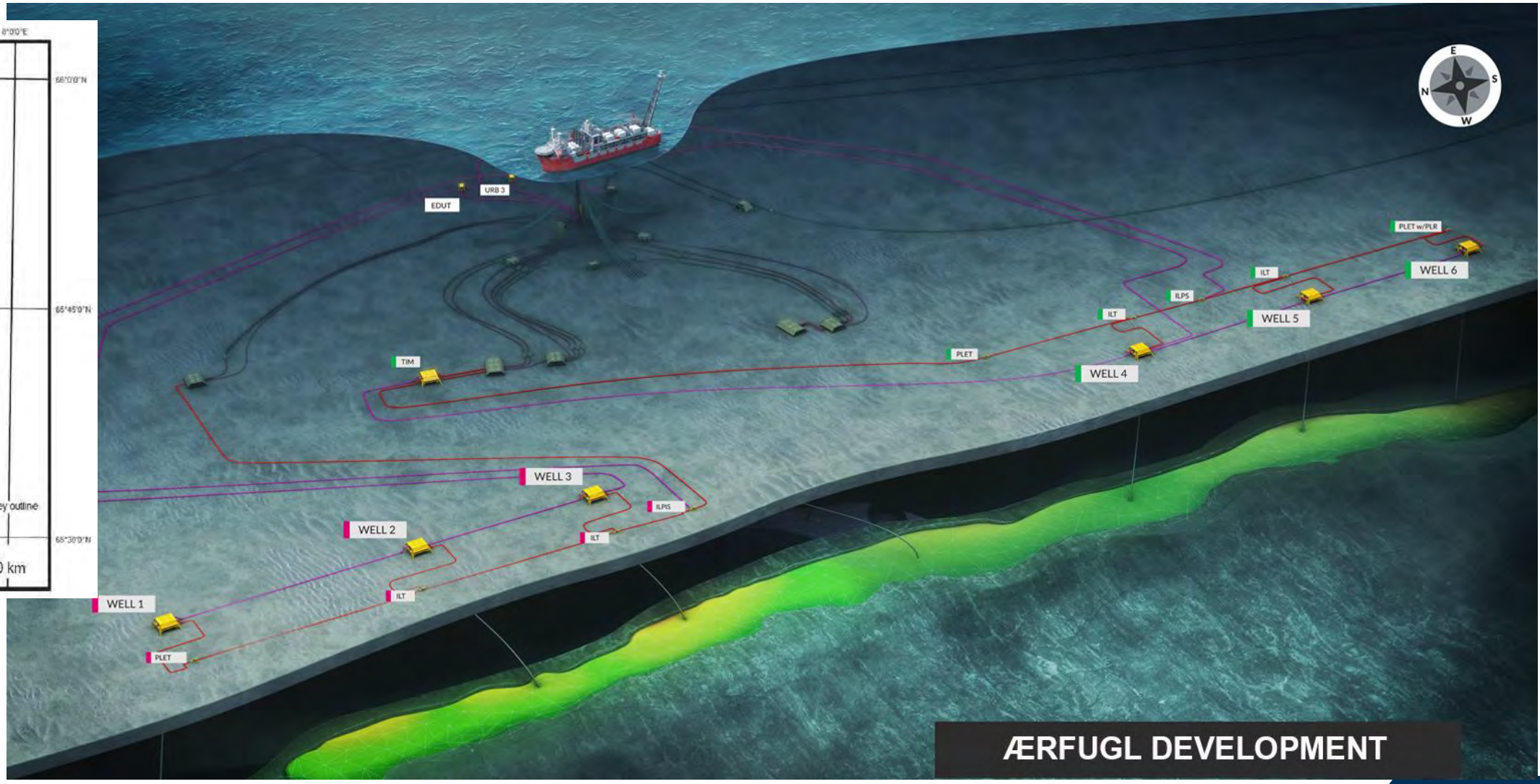
- 20km tie-back in 450m water depth
- 10″/16″ EHTF pipeline
- Fabrication 2019 and installation 2020

AkerBP/Ærfugl phase 2 - Norway

- 13.5km tie-back in 450m water depth
- 10″/16″ EHTF pipeline
- Fabrication 2020 and installation 2021

Ærfugl field layout





Ærfugl EHTF Pipe-in-Pipe Cross Section

Performance Requirements

- Arrival temperature topside 45 degrees – steady state mode
- Keep production fluid at minimum 25 degrees during shut down – maintenance mode
- Elevate temperature in water filled flowline from 3 C to 25 C within 40 hours – heat-up mode

Cross section details

- 10” inner pipe with 16” carrier pipe (PiP)
- Centralisers
- 2 x 16 mm-thick Izoflex
- 10 heating wire triplets (30 individual cables)
- 2 FO cables (FIMT)
- The reduced pressure ensured good insulation (U-value ~ 0.4 w/K*m2). Requires limited power for heating, allows long NTT.

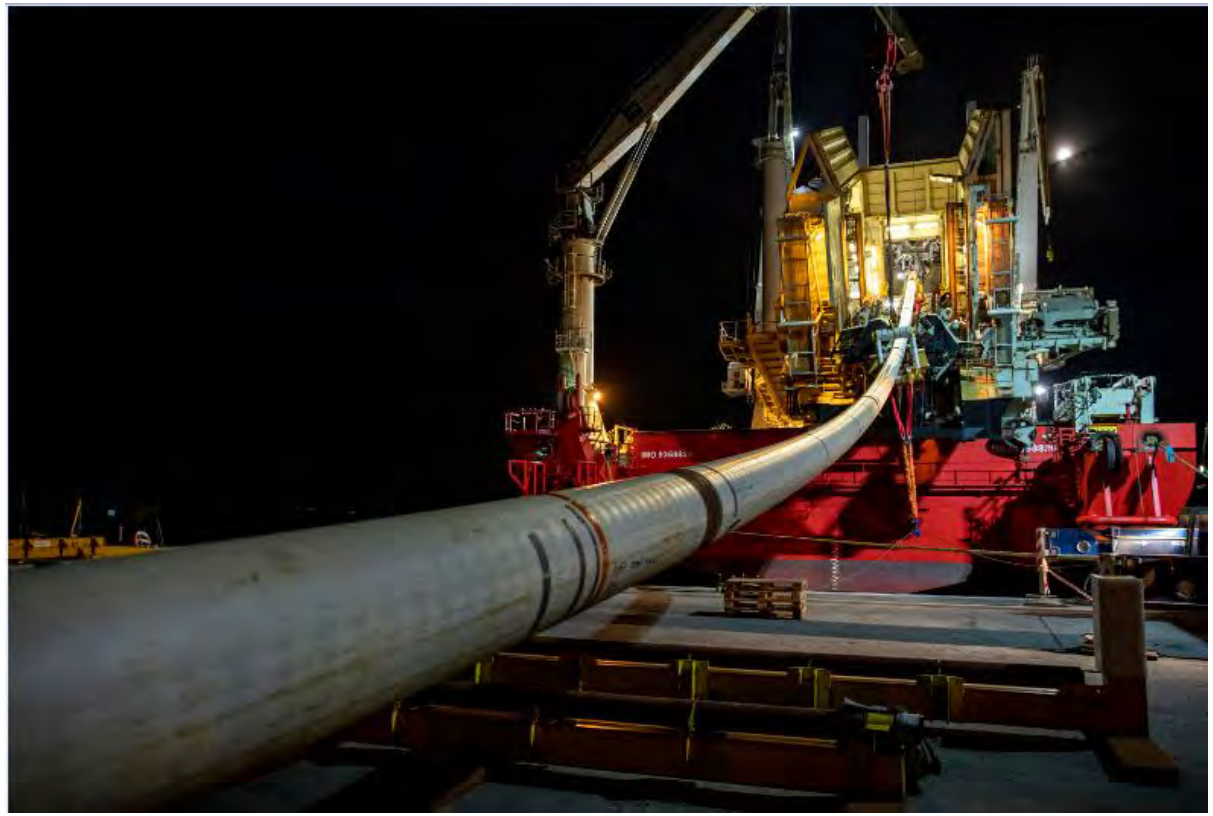
EHTF - Technology Qualification Status

- Qualified according to API 17n and complying with DNV-RP-A203
- Technology Readiness Level 4 qualification testing completed last year.
- TRL 5 qualification almost complete:
  - Structure mock-up tests (ILT, ILPIS, Special Joint) - Complete
  - Bend tests (A, B & C) - Complete
  - Insertion tests (friction factor, wear, centralisers) - Complete
  - Onshore and offshore FO and electrical splices - Complete
  - 200m fabrication trial at Vigra spoolbase – Complete
  - Testing of U-value – Complete
  - Tooling development and testing - Complete (but upgrading some tools to generation 2 based on experience from testing)
  - Mock-up of offshore tie-in in ramp - planned

EHTF - Technology Qualification Status – 200 m Test at Vigra

EHTF - Technology Qualification Status – 200 m Test at Vigra

- 2 x 100m PiP stalks fabricated at Vigra
- Welded and spliced together to a 200m long stalk
- Heating cables used to heat stalk, thermal testing performed
- Reeled onboard lay vessel Seven Oceans
- Electrical testing (IR, continuity) prior to during and after reeling



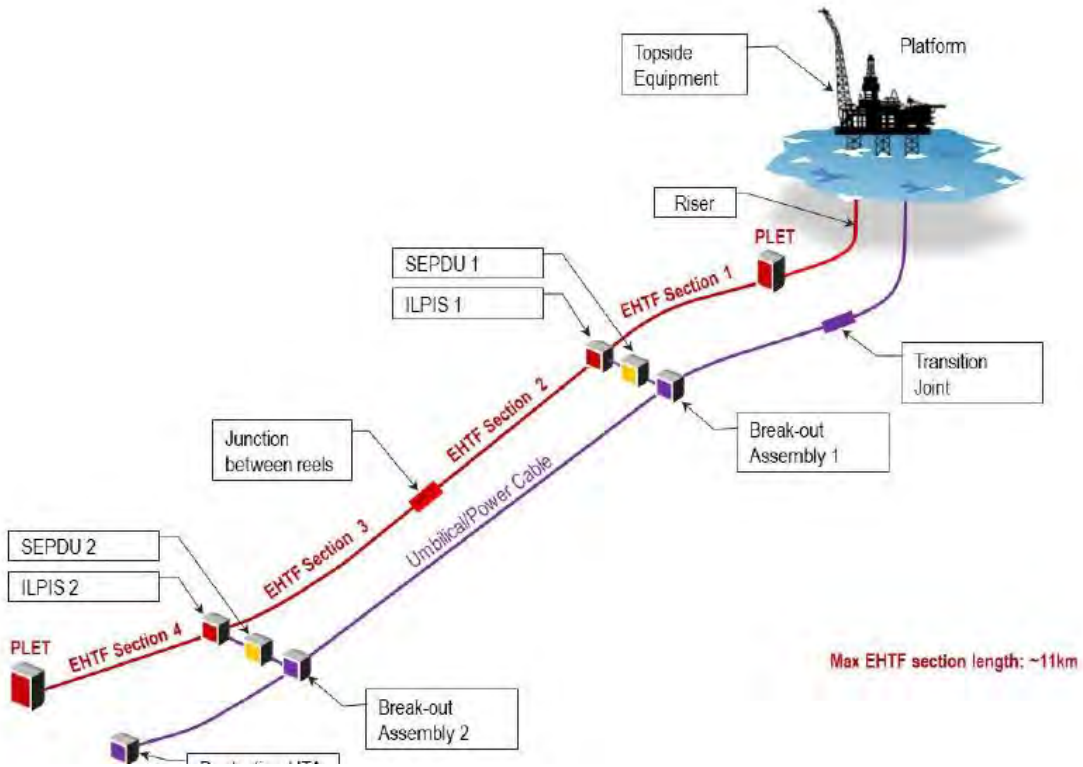
Subsea Electrical Power Distribution Unit (SEPDU)

Objectives:

- Enable a long step-out heating system
- Reduce topside scope
- Simplify subsea power cable design

Status:

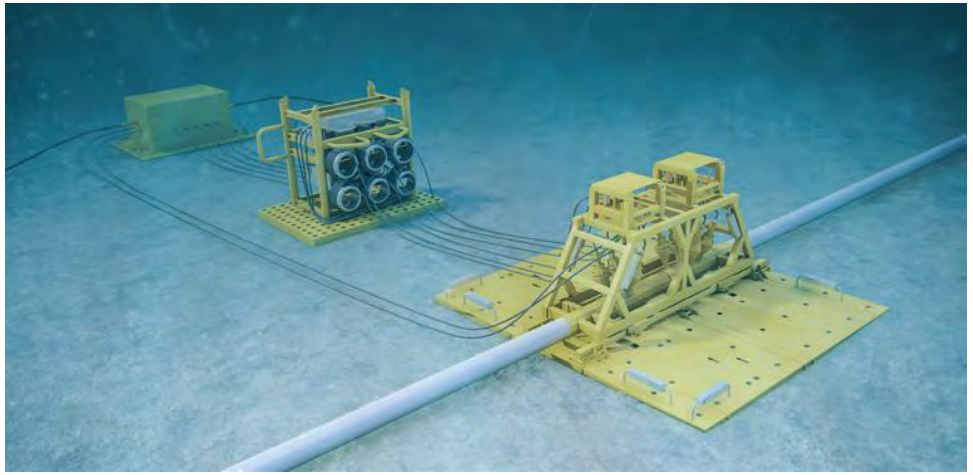
- TRL4 achieved in 2018
- TRL5 achievement expected Q1 2021
- Several EHTF prospects require 1 or more SEPDU(s)



SEPDU Concept

SEPDU principle:

- Receives MV electrical power from the host facility (e.g. a production platform or FPSO)
- Reduces the voltage to the value required for EHTF heating
- Provide power outputs to the EHTF power cable triplets
- Can power other equipment such as MEG pump etc.



SEPDU design:

- Contains remotely operable switchgear to enable power to each triple to be controlled

Conclusion

- EHTF is enabling tenchnology for a number of current projects and future prospects
- All qualification tests performed to date were successful and show a robust technology development
- The system demonstrates high flexibility with several ways to configure electrical architecture and outstanding thermal performance
- High redunancy with high number of heating cables is a key differentatiator
- Low power requirement allows for low voltage bringigng very high reliability on unreparably sybsea system

Innovation Days Norway

7

Swagelining and Liner Bridge

Michelle Tinney, Swagelining

Subsea 7 - Swagelining's Integrated Liner System

- Polymer lining - to provide a 50year internal corrosion barrier with material selection and full liner design service
- Connectors - LinerBridge® to join pipeline stalks together to provide a continuous end to end polymer corrosion barrier
- InsuLine™ sleeves - to provide heat protection should high temperature field joint coatings be specified
- End terminations - Flanged or PLET's installed onshore or offshore using LinerBridge®

Benefits of Polymer Lining that add up

DESIGNED FOR LIFE

Our polymer liners have a 50 year design life, ensuring no loss in hydraulic performance and providing more operational certainty.

LOWER LIFE CYCLE COSTS

We can lower the total life expenditure (totex) of your pipeline system. Reduced CAPEX, OPEX & knock-on CAPEX.

ENHANCE FLOW

Our pipeline liners are the thinnest in the industry, offering optimum flow performance.

Corroded carbon steel pipeline

INCREASE OIL RECOVERY

Swagelining® liners ensure cleanliness of water injection fluids offering maximum water flood through your reservoirs.

REDUCE WEIGHT

Allows for lower cost installation vessels and reduced top tension on offshore installations.

REDUCE OPERATIONAL COMPLEXITY

The integrated lining system helps you keep it simple, no requirement for minimum velocities, routine pigging and chemical injection uptime.

Polymer lined after 13years service

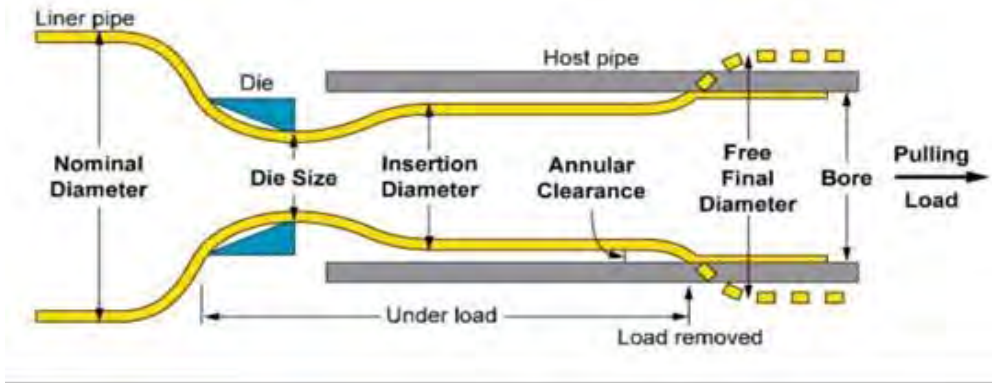
Swagelining Process Overview

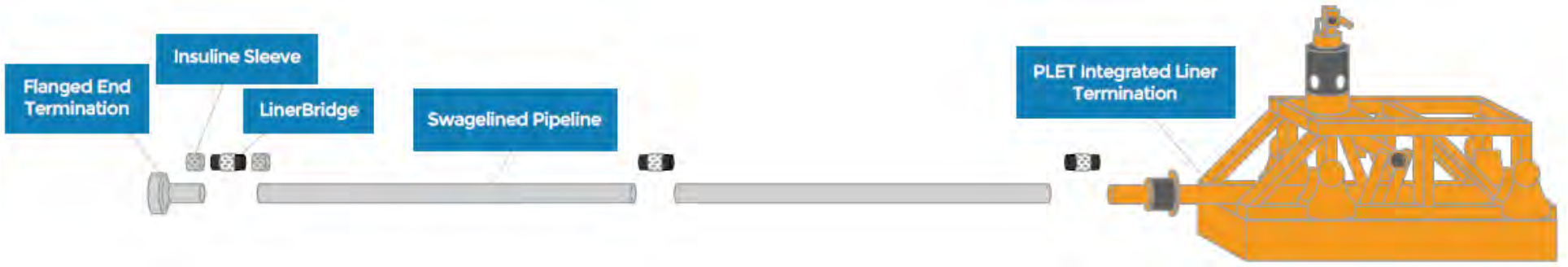
The Swagelining Technique

- Uses principle of cold die drawing to induce residual elastic strain which results in a tight compression fitting liner, offering advantages over alternative lining methods.

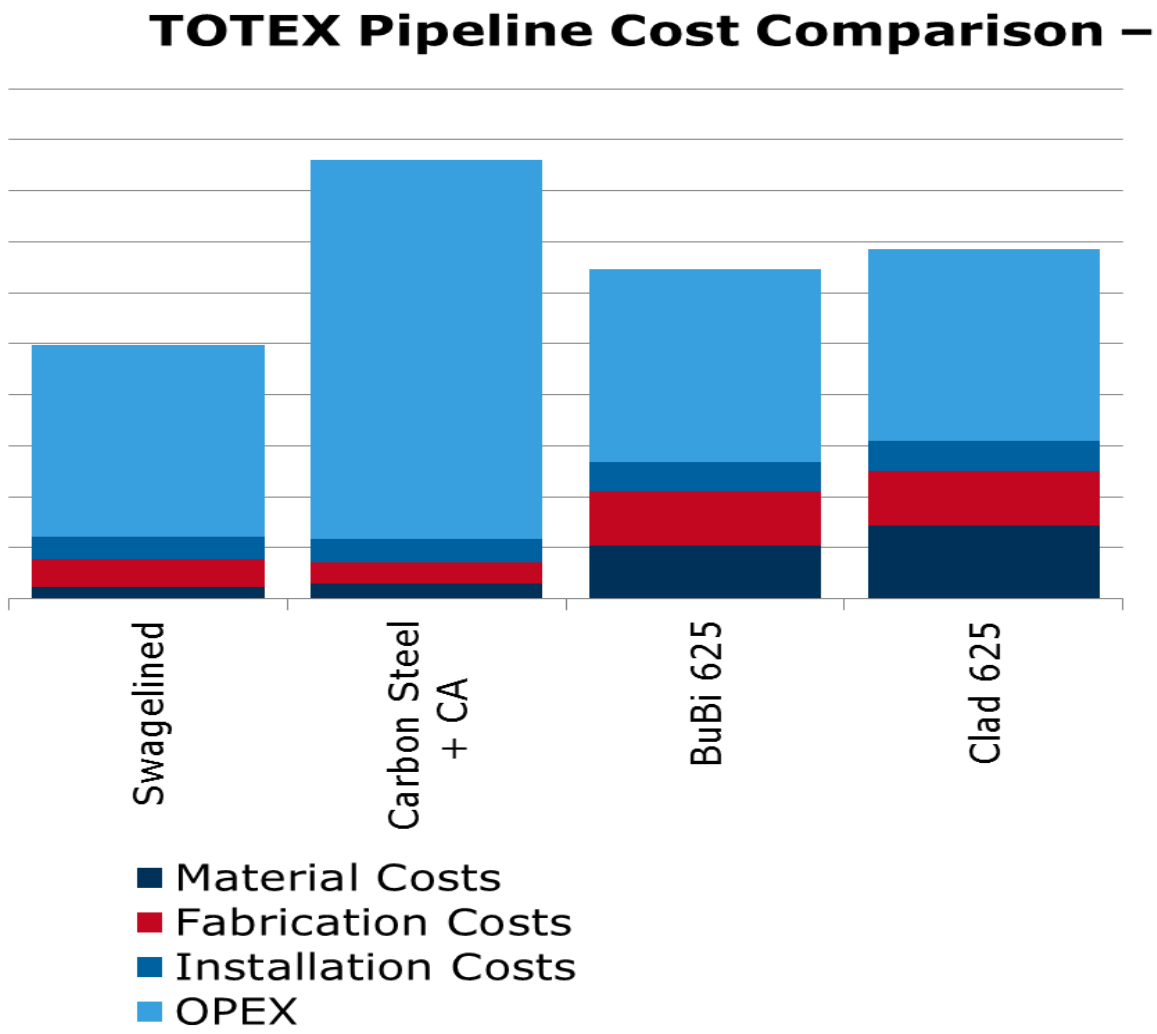
Long length pulls

- 12-20m polymer sticks are fusion welded onsite to produce stalk insertion lengths of up to 1500m





Potential for a TOTEX Saving view



Potential 35% cost reduction between CRA mechanically lined and polymer lined solution for reel-lay over life of line

LinerBridge®

A polymer connector removing the need for CRA connectors

Simple, Yet Ingenious

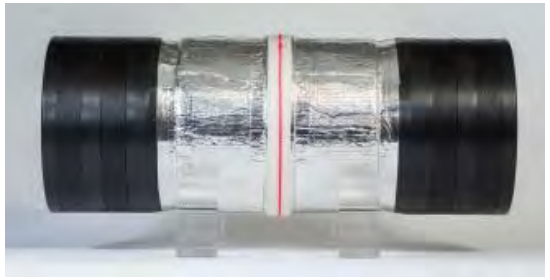
Offers a step change in project economic and risk profile, through complex CRA application removal

Proven Technology

Utilises robust and proven electrofusion welding technology, from utilities industry

Size Range

Qualified connectors from 8” – 16”



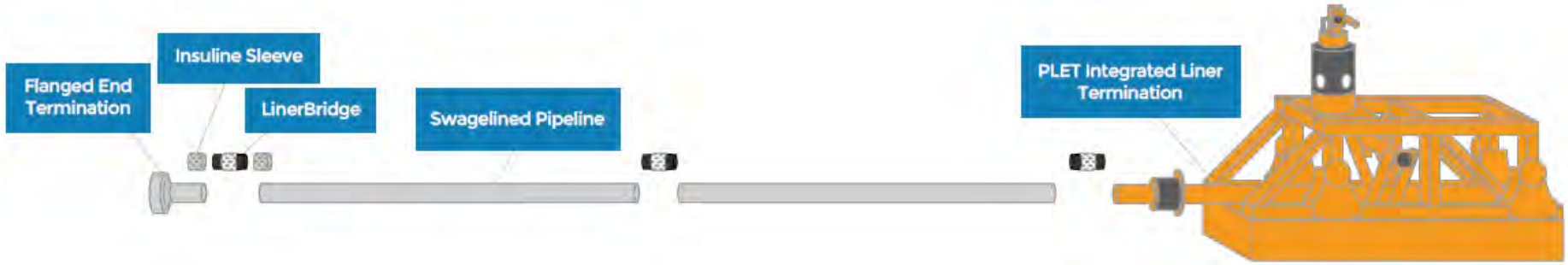
End terminations

Elimination of reeled CRA welding from lined pipelines

- Made possible through Swagelining's innovative use of WeldLink® technology within flange or structure terminations.

Improved offshore flexibility

- LinerBridge® technology allows for cut-to-length reducing metrology spool lengths and also allows for offshore repairs as a robust contingency.



Track Record

- 350km + pipelines protected from internal corrosion since 1994 using our proven technology:
- 1994 - 1st polymer lined subsea pipe installed for Shell on Brent South Field in 1994
- 1995 – BP Foinaven water injection 10” x 12km & 12” x 4km
- 1996-2003 - 53km of BP Schiehallion water injection lines
- 2008 – Statoil Vigdis water injection line 16” x 9.5km
- 2009 – ENI M’Boundi seawater injection line 24” x 55km
- 2015 – Tullow Ten water injection line 8” x 19km & 10” x 14km
- 2016 – Wintershall Maria water injection line 12” x 46km
- 2017 – Work begins on Mad Dog 2 project – First GoM WI deployment
- 2018 – First LinerBridge ® projects commence – Equinor Snorre Bundle
- 2019 – 3 of Live Reeled LinerBridge ® projects installed for North Sea – circa 50km of reeled pipe
- 2019 – Commence DNV and IOC dynamic fatigue qualification for Integrated Liner system and all components

ITHACA ENERGY · REPSOL SINOPEC Resources UK · wintershall · dana PETROLEUM · SPIRIT ENERGY · bp · PremierOil · Canadian Natural · Eni · equinor · enQuest · Chevron · ConocoPhillips · Kuwait Oil Company · Shell

Swagelining for steel catenary risers (SCR)

Fatigue resistant liners

The inherent fatigue resistance of Swagelining's polymer liner materials makes them the logical choice when selecting a cost effective corrosion barrier for riser applications.

Weight reduction

When compared to a carbon steel pipe with corrosion allowance, the system will provide an overall pipeline weight reduction. This reduces top tension on the lay vessel providing an opportunity to install risers in deeper water or possibly change to an alternative lower cost lay vessel.

System Simplicity

Optimised Connection, annulus and system design - LinerBridge® and WeldLink ™ suitable for dynamic service

Potentially avoiding need for complex flexible risers integration with rigid pipe flowline, and need for multiple assets/installation trips, single rigid line and installation campaign

Swagelining for S-Lay

Adapting qualified LinerBridge® technology

Offering the industry a polymer lined pipeline solution suitable for high efficiency mechanised welding.

Step-change in economics

With no negative impact on current S-lay CRA weld cycle times, LinerBridge® enables a significant cost reduction in S-lay for aggressive fluid service.

Modified LinerBridge® internal energisation system under testing

InsuLine™ Sleeves under testing at 250 degC

Swagelining for hydrocarbon service

Industry value

The development of a polymer lining solution for hydrocarbon transportation has the capacity to deliver industry changing results.

LinerVent®

LinerVent® allows management of any gas permeation through the polymer liner.

Qualification

COREL JIP (2000) demonstrated successful performance of technology. Ongoing TWI JIP with Saudi Aramco to assess use of LinerVent® in a multiphase sour service hydrocarbon environment.

Innovation Days Norway

7

Autonomy and remote operations

James Jamieson, i-Tech 7

Global Trends

- The environment
- Cost of services
- Digitalisation

Customer

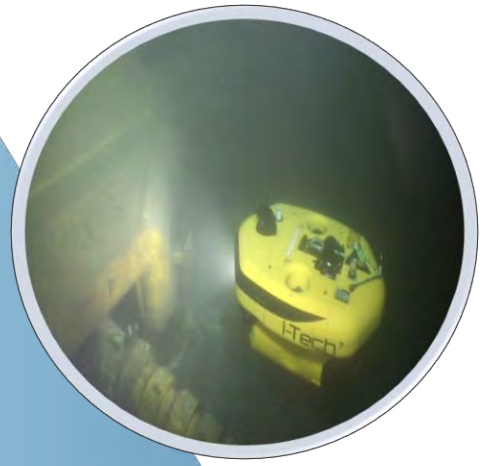
- Environmental Impact, reduced CO2
- Increased value, lower cost
- Smarter use of data

Technology

- High bandwidth communications, 4G/5G
- Portable energy, batteries
- Autonomous systems

Landscape

- Market sector in downturn
- Wide range of varying commercial drivers
- Challenging image of O&G industry



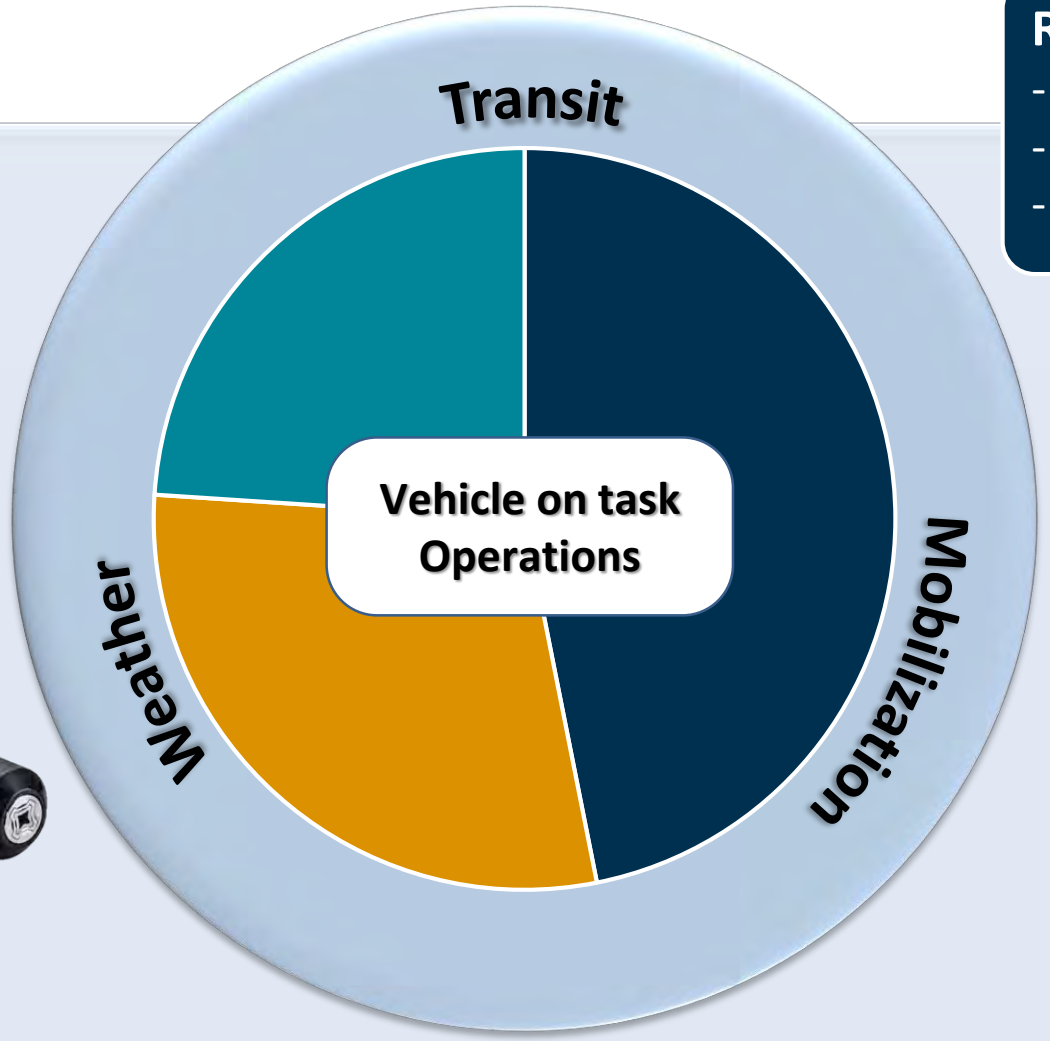
Vehicle Remote Control & Autonomy

Remote Control Centre

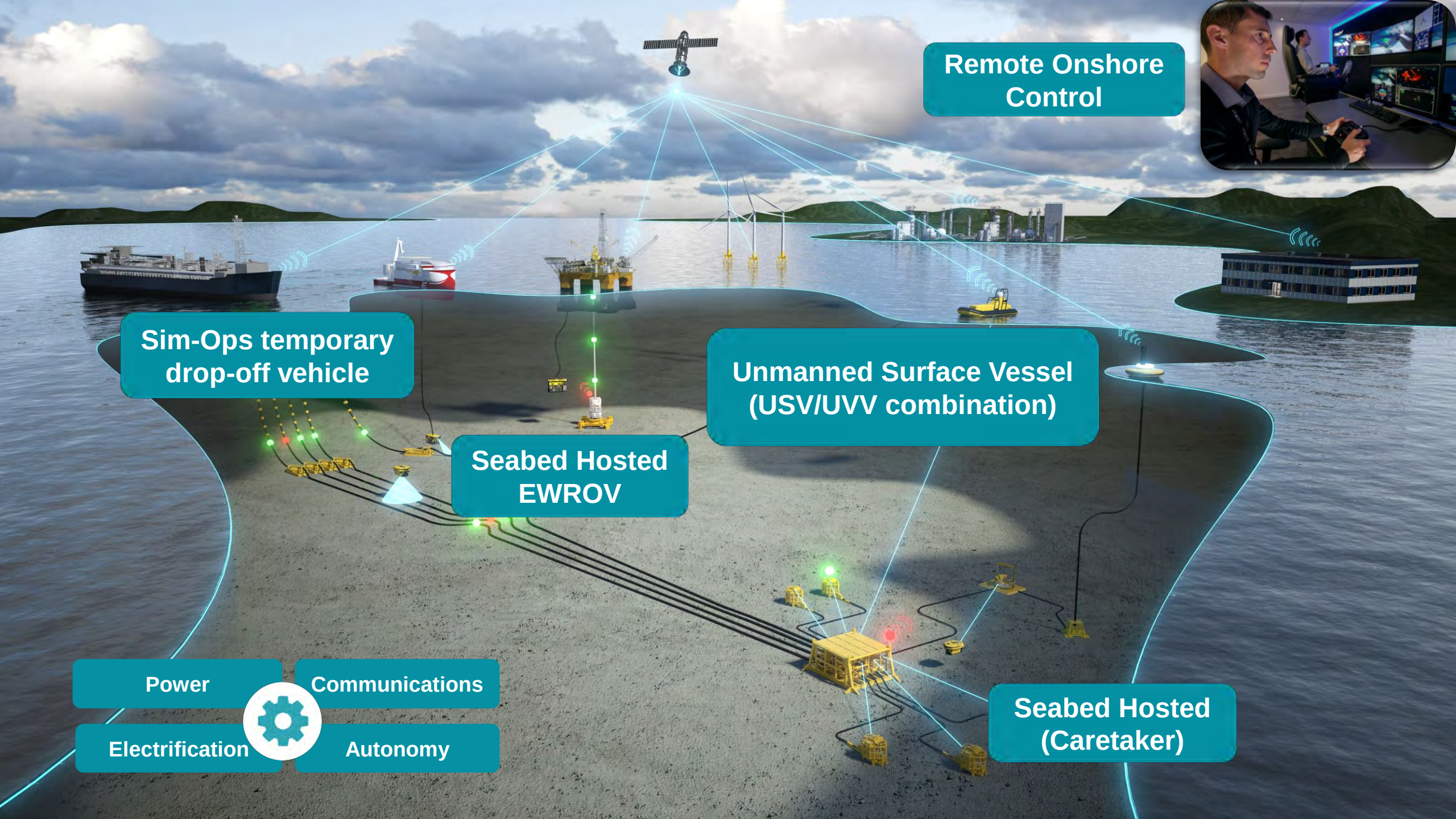
Remote Tasks

Inspection
- ROV
- General Visual Inspection

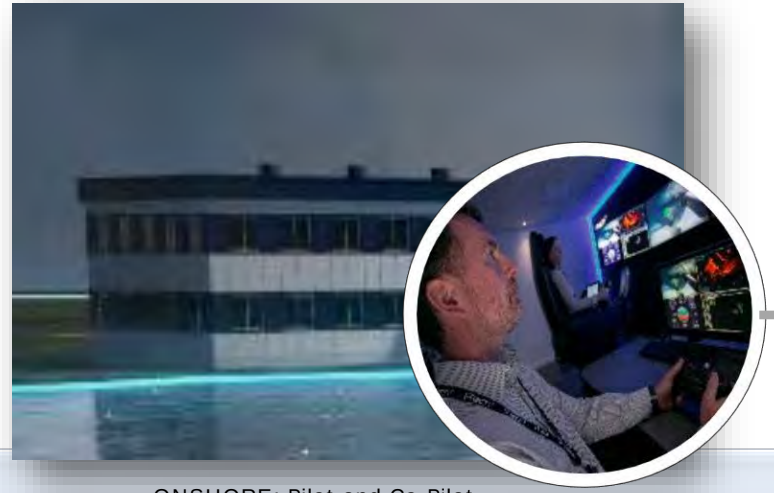
Maintenance
- Light Intervention
- Torque tool
- Manipulator operations



Repair
- Heavy Intervention
- Crane / Module handling
- High power tasks


Remote Onshore Control
Sim-Ops temporary drop-off vehicle
Unmanned Surface Vessel (USV/UVV combination)
Seabed Hosted EWROV
Power
Communications
Electrification
Autonomy
Seabed Hosted (Caretaker)

WROV Remote Piloting & Onshore Control Centre



ONSHORE: Pilot and Co-Pilot

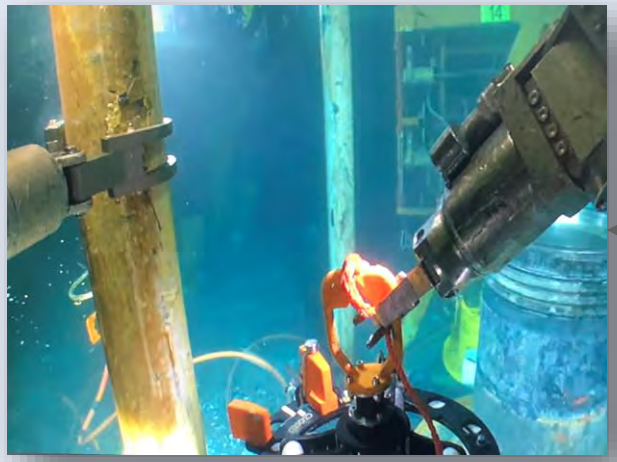
4G

Connection via 4G

Onshore Control Centres established, UK & Norway.

Technology building block

- High quality Low latency image transmission
- 4G LTE network access *(fourth-generation, high speed low latency)*
- Advanced control of vehicle and manipulation
- Generic" Control supports different vehicle types

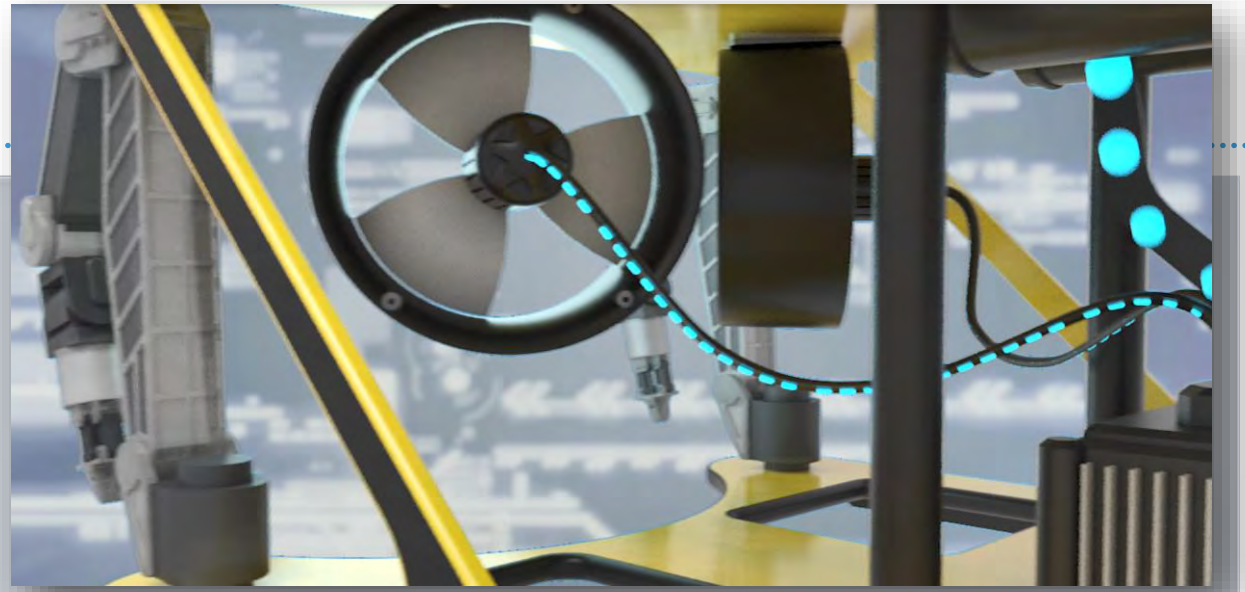


ROV System

OFFSHORE: ROV Control Room

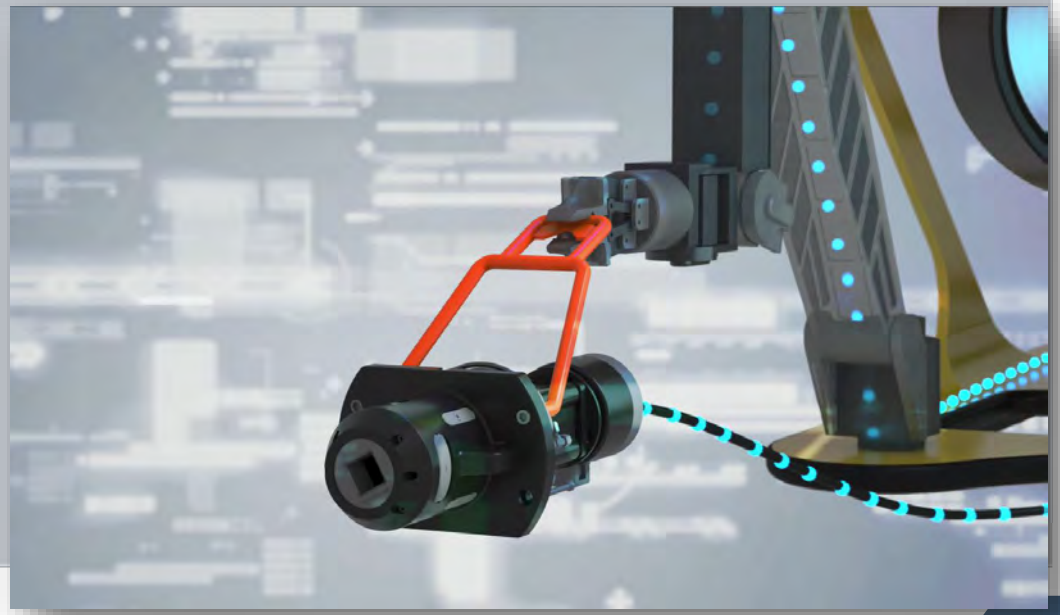
Electrification

- Electric Work Class ROV
- Electric propulsion and tooling
- Increased reliability
- Environmentally clean
- Seabed hosted enabled



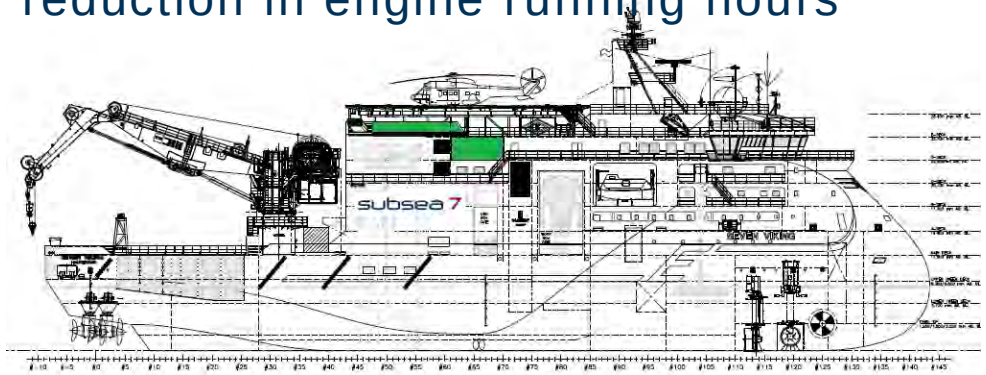
Technology building block

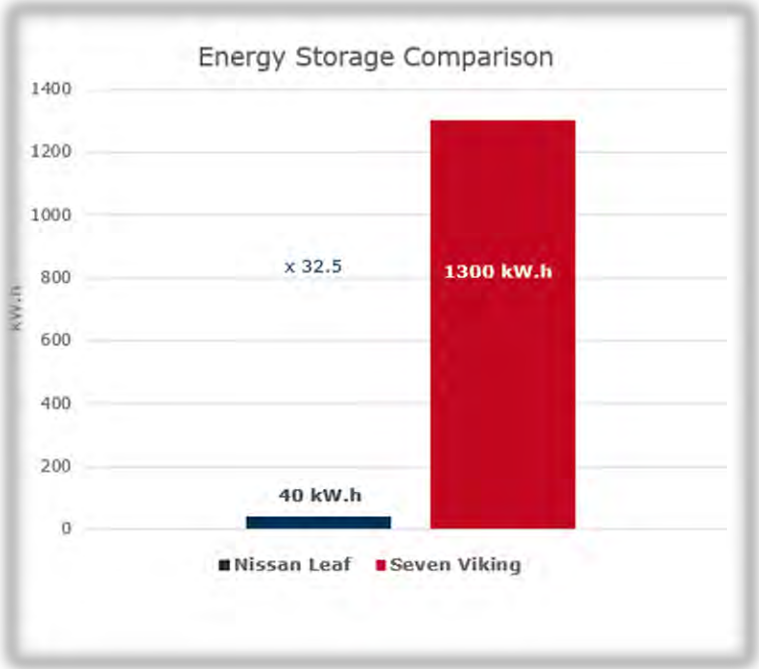
- Advancement in POWER components
- Data enabled components
- Mature autonomy control
- Inductive power connections
- Advances in manipulation control



Seven Viking IRM vessel hybrid upgrade

- 1300 kWh energy storage (33x more than Nissan Leaf car)
- Fuel saving of up to 20%
- 33% reduction in engine running hours





Autonomy

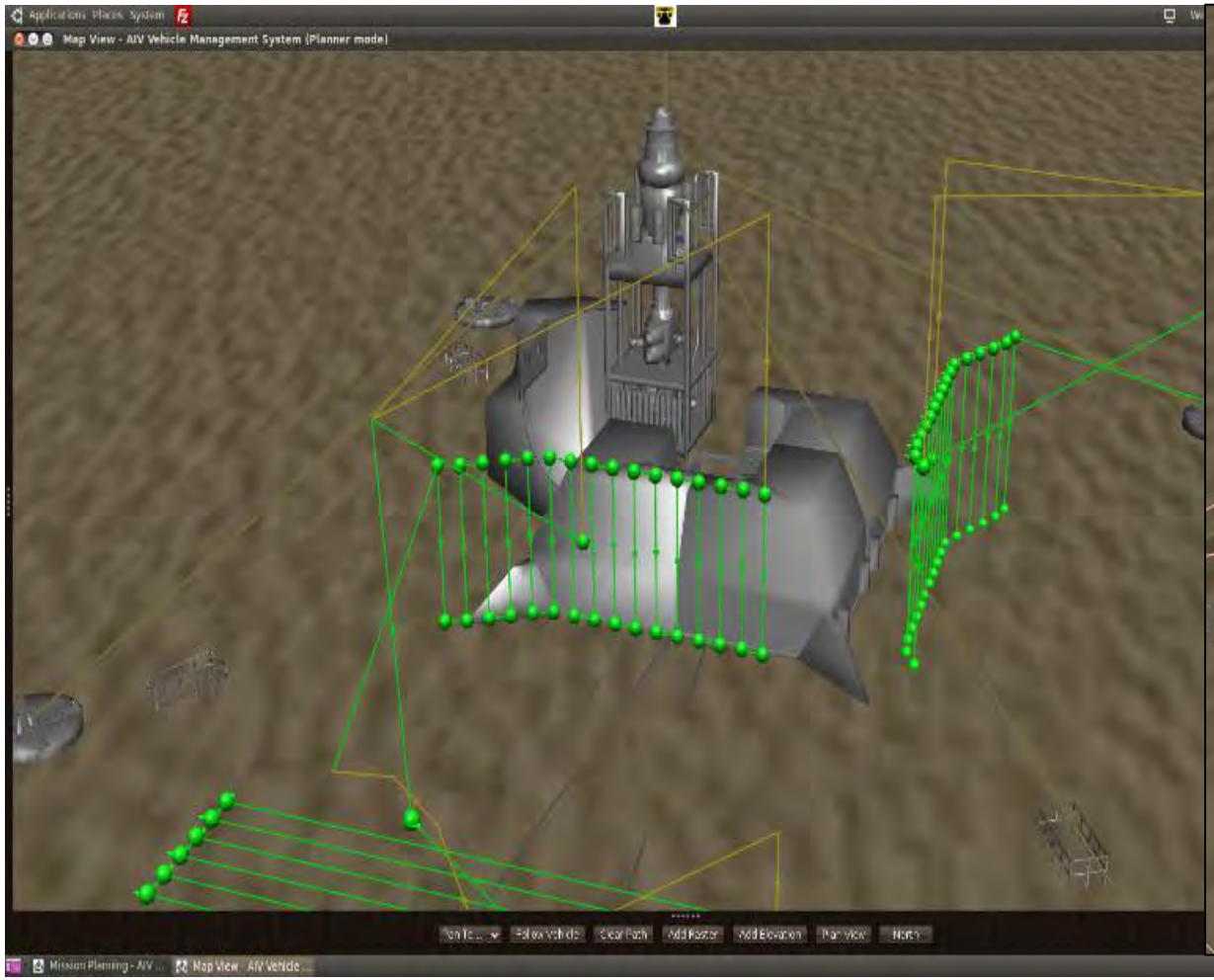
What we mean by Autonomy Underwater

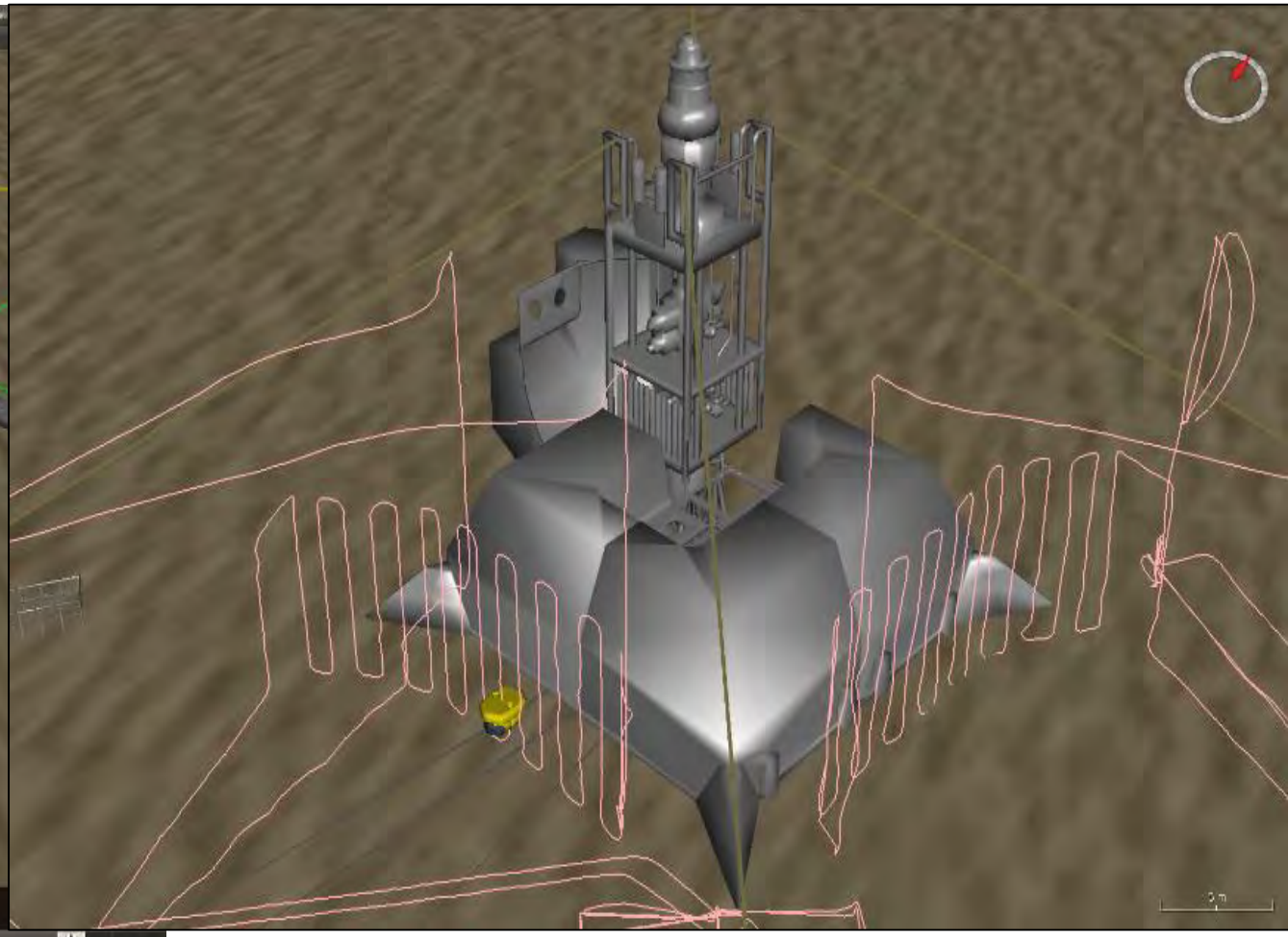
- Application of intelligent behaviours that enable underwater systems to operate independently
- Reduce the dependency on surface vessel support & required resources
- Increasing efficiency

Technology building block

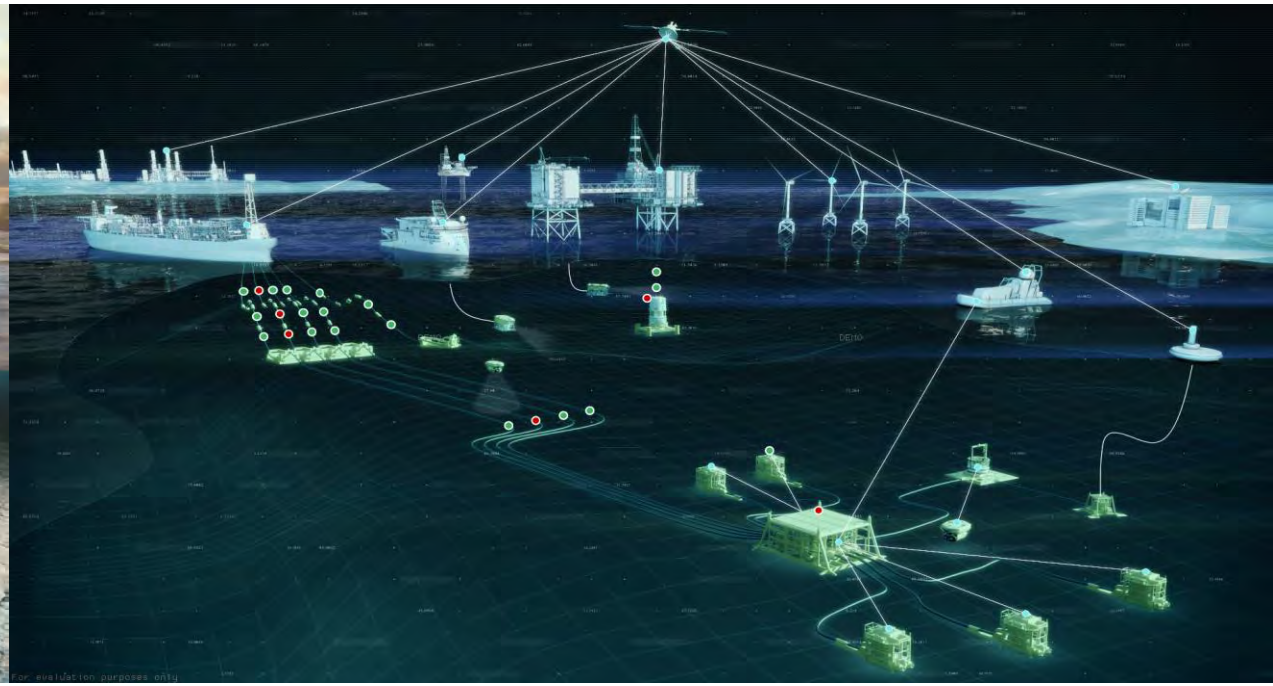
- Intelligent autonomous vehicle systems
- Advanced adaptive navigation
- Safe close autonomous inspection
- Simple robust mission planning
- Robust Launch and Recovery
- Vessel independent operation

AIV - Planned mission vs executed



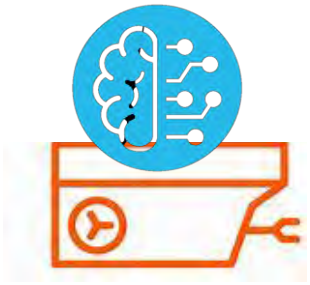


Transforming Operations

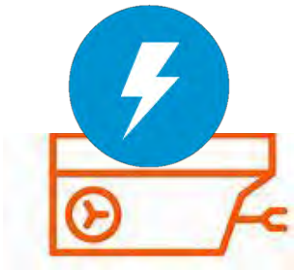


Remote Control

Autonomy



Electrification



Deployment

Innovation Days Norway

Offshore wind and the Beatrice project

Richard den Holland, Seaway 7

Seaway 7
Business Unit Structure

subsea 7

subsea 7 

seaway 7 

Renewables & Heavy Lifting

i-Tech 7 

Life of Field

Heavy Lifting	Cable Installation	Integrated Solutions
Foundations & Substations Transport & Installation	IAG & EXP Cable Systems EPIC, T&I & IMR	Renewables EPCIs Integrated Projects
Zoetermeer (Netherlands)	Leer (Germany)	Aberdeen & Paris

- An experienced partner for the delivery of offshore wind farm projects and a specialist heavy lifting and cable installation services contractor
- Ability to offer specialised T&I as well as integrated EPCI solutions

Seaway 7 – Fixed Offshore Wind Capabilities Resources

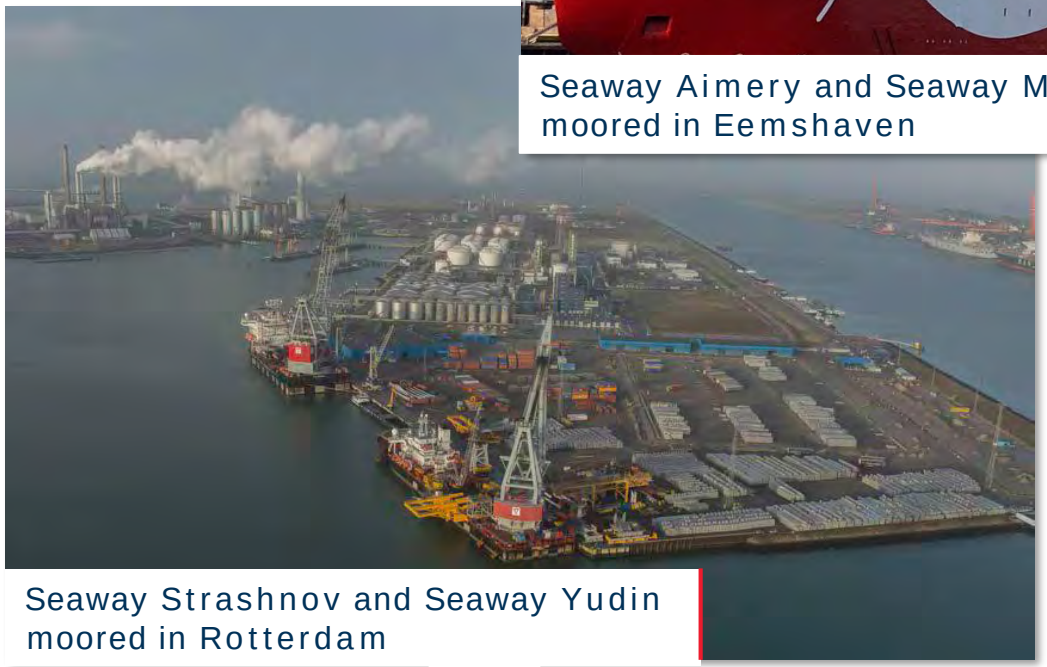
Offices
- Zoetermeer, Netherlands
- Paris, France
- Aberdeen, Scotland
- Leer, Germany
- Hamburg, Germany
- Taipei, Taiwan
- Local project offices

Personnel
- ~500 Onshore, ~550 Offshore

Fleet
- HLV Seaway Strashnov
- HLV Seaway Yudin
- CLV Seaway Aimery
- ISV Seaway Moxie

Support Bases
- Rotterdam, Netherlands
- Eemshaven, Netherlands

Seaway Aimery and Seaway Moxie moored in Eemshaven



Seaway Strashnov and Seaway Yudin moored in Rotterdam

Seaway 7 – Fixed Offshore Wind Capabilities
Some Track Record

Seaway Heavy Lifting

Wikinger (substation)
Walney extension (substation)
Galloper (substation)
Merkur (substation)
Arkona Becken (substation)
Beatrice (substation)

East Anglia substation
Borssele Alpha & Beta substation
Elia substation

Borkum West II (Jacket foundations)
Meerwind Süd|Ost (MP foundations)
Baltic 2 (Jacket foundations)
GlobalTech I (Jacket foundations)
Sherringham Shoal (MP foudations)
Dudgeon (MP foundations)

Beatrice - EPCI of Jackets and Cables
Borkum West II - EPCI of Monopiles and TPs

Seaway Offshore Cables

Baltic 2 OWF, 33kV Inner Array Grid Cable System (2014-2015)

Humber Gateway, 33kV Inner Array Grid Cable System (2014)
Amrumbank West OWF, 33kV Inner Array Grid Cable System (2014-2015)

Nordsee 1 OWF, 155kV Export Cable System (2016)

Nordsee 1 OWF, 33kV Inner Array Grid Cable System (2016)

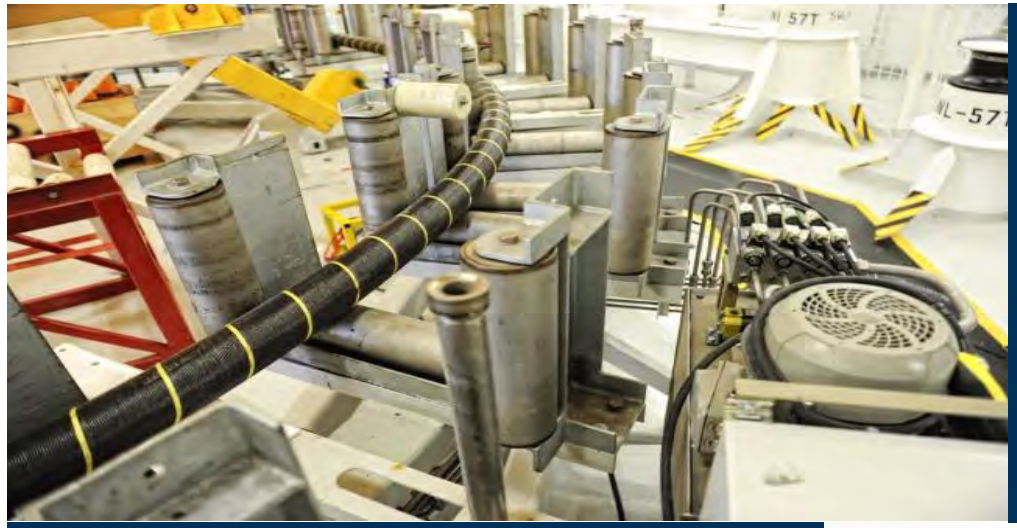
Veja Mate OWF, 33kV Inner Array Grid Cable System (2016-2017)

Seaway 7 – Fixed Offshore Wind Capabilities
Experience – Foundations EPCI and T&I

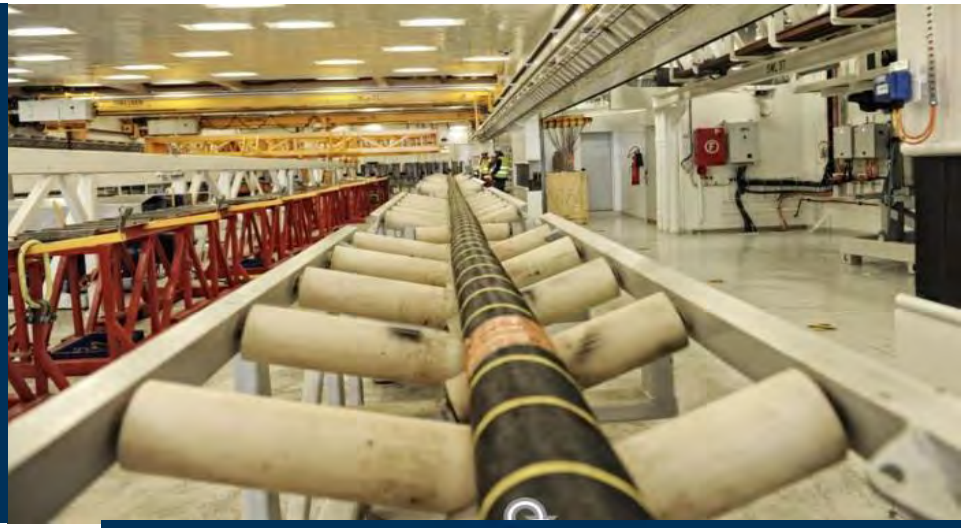
600+
WTG
Foundations

30+
Substations

Seaway 7 – Fixed Offshore Wind Capabilities
Experience - Submarine Cable Systems EPIC, T&I and IMR



194815
WALK TO WORK
PERSONNEL TRANSFERS



1461 KM
SUBMARINE CABLES INSTALLED

502 WIND TURBINE GENERATORS
CONNECTED AND COUNTING

Seaway 7 – Fixed Offshore Wind Capabilities
Currently ongoing Renewables Projects

Trianel Windpark Borkum II (GER) Completed
- EPCI FOU
- EPCI IAC
- 32x Monopiles
- 32x Transition Pieces
- 36x 33kV Cables (59 km)
- 2x Fab. Yards

Triton Knoll (UK)
- T&I FOU
- T&I OSS
- 90x Monopiles
- 92x Transition Pieces
- 2x OSPs

Substations (Europe)
- T&I OSS
- Borssele Alpha & Beta
- Elia OSY
- Deutsche Bucht

Formosa 1 (Taiwan) Completed
- T&I FOU
- 20x Monopiles
- 20x Transition Pieces

Coastal Virginia Offshore Wind (USA)
- T&I IAC
- 1x 33kV inner array grid and 1x 33kV export cable (~46km)

Formosa 2 (Taiwan)
- T&I FOU
- 47x Jackets

Yunlin (Taiwan)
- EPCI IAC + EC
- 69x 66kV inner array grid
- 12x 66kV export cables (~272km)

Hornsea Project One (UK) Completed
- T&I IAC
- 81x 33kV inner array grid (~154km)
- Additional
- 8x 33kV inner array grid (~16km)

Hornsea Project 2 (UK) JUST AWARDED
- T&I IAC
- 165x 66kV inner array grid (~420km)

Seaway 7 – Fixed Offshore Wind Capabilities Technology Development

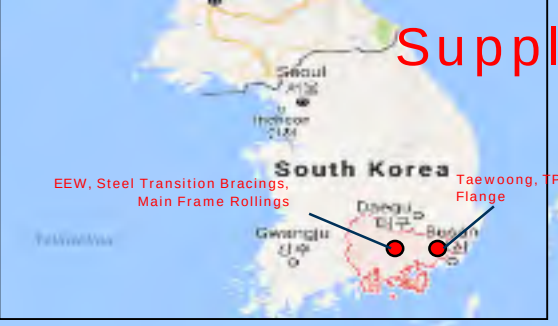
Q4 – 2019 Mono Pile Installation on DP

Q3 – 2020 Crane Upgrade Boom Extension

EPCI fixed wind case study: The Beatrice project

- £2.6B project. One of the largest ever private infrastructure projects in Scotland.
- Expected to power on average 450k homes over a 25 year lifetime.
- Worlds deepest bottom founded offshore wind farm (55m)
- Subsea 7/SHL scope at $1.3Billion is the largest project in the companies history.
- In-house technical team of over 120 people working on it.
- Been involved in the project since 2011, ahead of concept engineering and the consent application.

Supply Chain Management
> 100 Contracts



EEW, Steel Transition Bracings, Main Frame Rollings

Taewoong, TP Forged Flange

Technip, Levator Subcontractor

SSAB, Secondary Steel Plates

Levator, TP

Bifab, Jacket Fab

Ecosse, Boulder Clearance

Signs Express, Signage

Eblast, Painting Jacket Tubulars

Canyon , Cable Trenching

SPS, Grout Pipe

Hydrasun, Flexible Hoses

Malin, TP – Internal / Switchgear Platform & Ladders

Bifab, Jacket Fab

Regal Rubber, J Tube Neoprene Lining

Gray Fabrication, J Tube-Guides

Edgen Murray, Primary Steel

Edgen Murray, TP-Plates, J Tube Material

Tekmar, Cable Protection

Francis Brown, Boat Landings

JDR, Cable Manufacture

Wilton, TP -Working Platform

Sarens, Cranes & SPMT

Granada, DAVIT Crane

IHC, Jacket Pile Grippers / Hydraulic Components

SIF, Storage/Loadout Piles

EEW, Assembly of Pile Sections

Angle Ring Co, J Tube-Pulled Bends

Aras, Galvanisation & Coating of Handrails

Latchways, Fall Arrest AFL, Fibre Optic Cable

Smulders, Jacket Fab

Iemants, Fab of TP Tubulars Coating of Secondary Steel

Willems, TP Fab Assembly

Sanistaal, Secondary Steel (UB Beams)

Bladt, pin outfitting

ROM Gummi, Vulcanisation

Bladt, Jacket Fab

Dan Vals, Grout Lines

Helens, Secondary Steel

Yurope Steel, Secondary Steel

BAC, Anodes

Siem, Cable EPCI

EKS, Term & Test

Sperling, SAW of lower jacket legs

EEW, Complete Pile Fabrication

SIF, Fab Piles -Cluster 2 & 3 / Fab TP Barrels

EEW, Transition Bracings, TP, Corner Pipe, Fab & assembly of Pile Sections Single Tubular Fab

Siegthaler, Forging of Lifting Bucket Tubulars

Western Constructions, Pin outfitting

Cermar, Fab of Lifting Buckets

JW Steel, Boat Landings & Ladders

PUP GoTech, Secondary Steel, Working Platform & pin outfitting

Spomasz, Secondary Steel

Promostal, Secondary Steel, J Tube Supports

Inkomet, Secondary Steel, Internal Platform

Telefonika, Copper Core

ArcelorMittal, Plate Material for TP-Center Cans

Euskal, Forged Flange

PFF, TP -Forged Flange

Emirate Techno Castings, Anodes

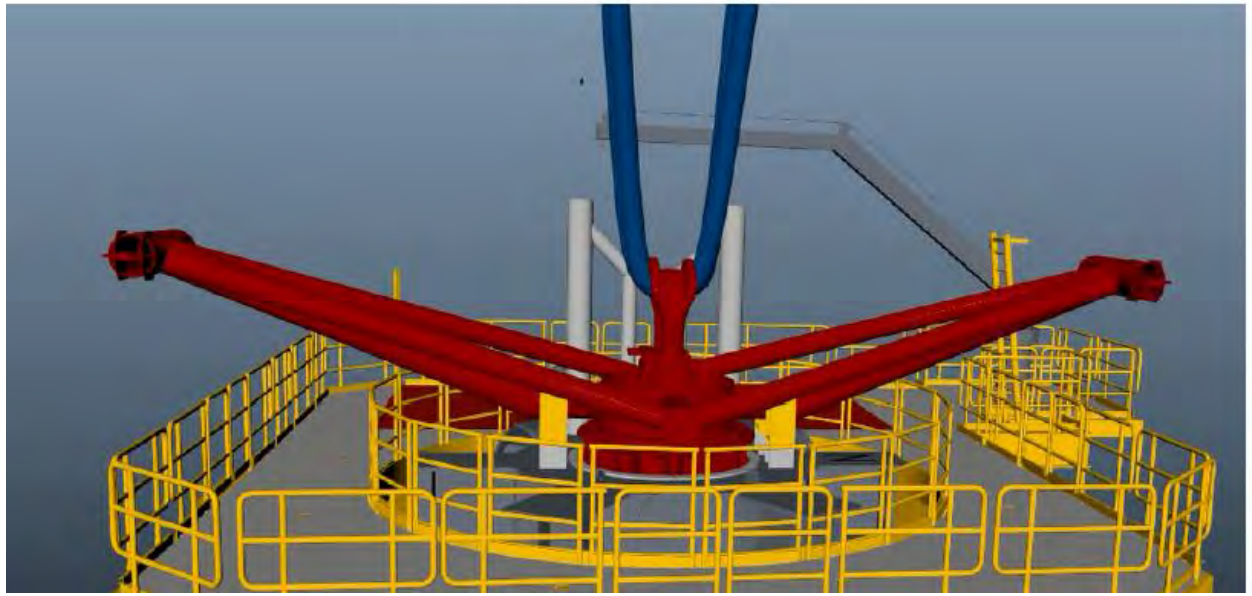
Preparation
Some Technology Developments

- Diverless installation.
- Jacket to pile grout:
  - BASF MasterFlow 9800
  - Design code evolution
- Tooling:
  - Pre-piling template
  - Pile cleaning tooling
  - Bauer drilling
  - Remote lifting

Preparation
Safety Moment

Standardisation

Simulation



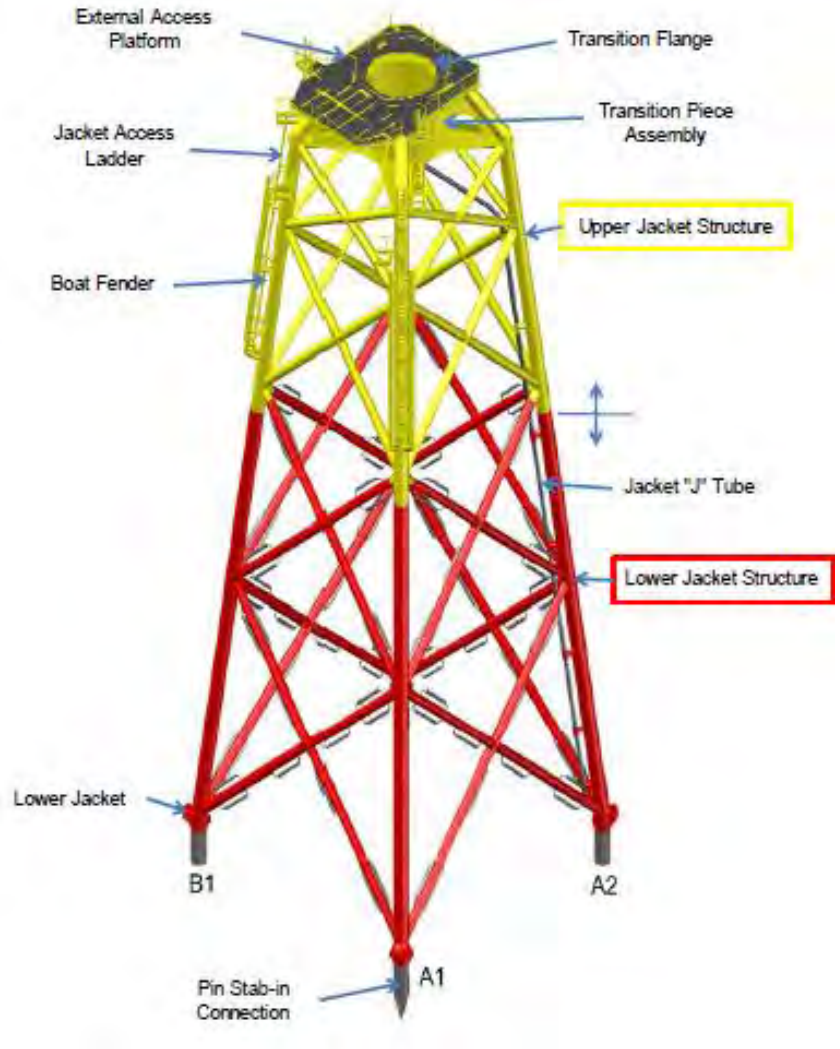
Actual Image

Remote Jacket Lifting Arrangement

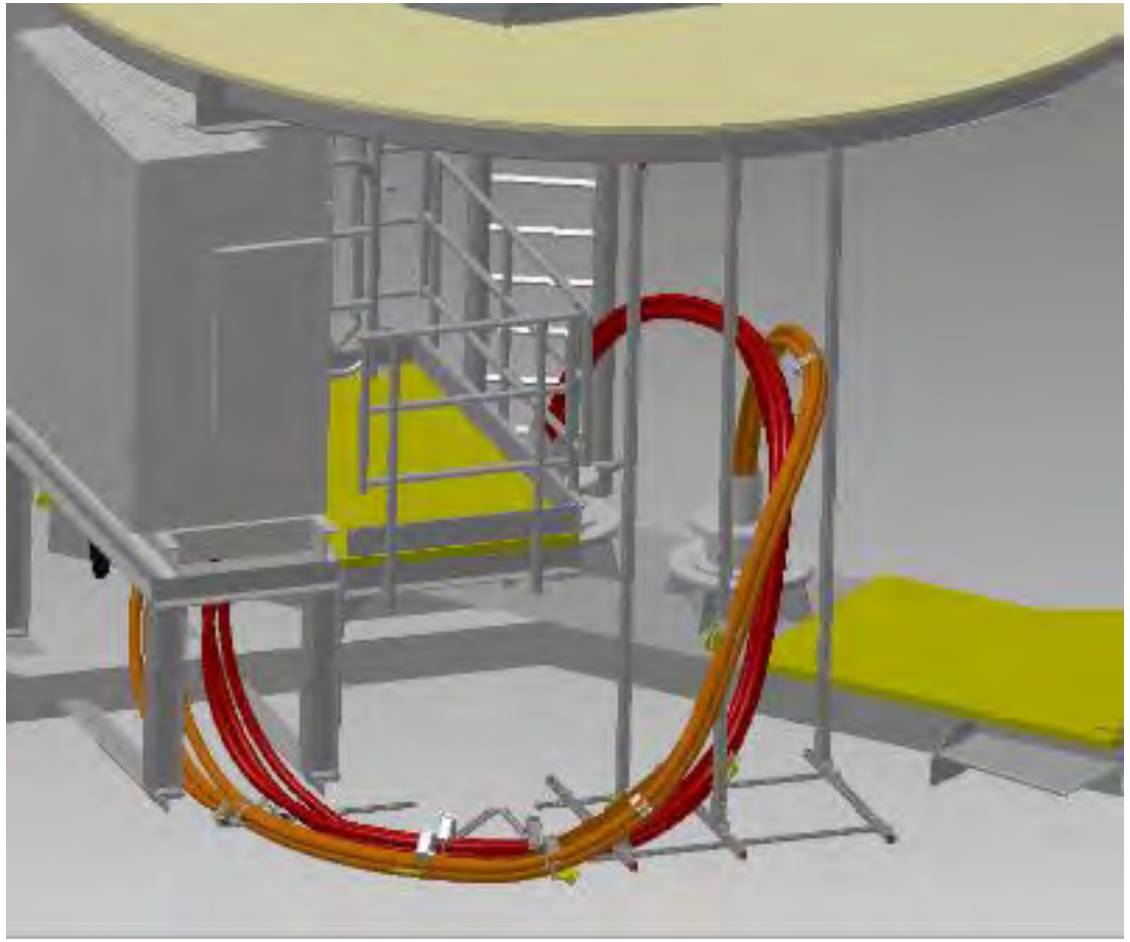
Foundations
Wind Turbine Foundations

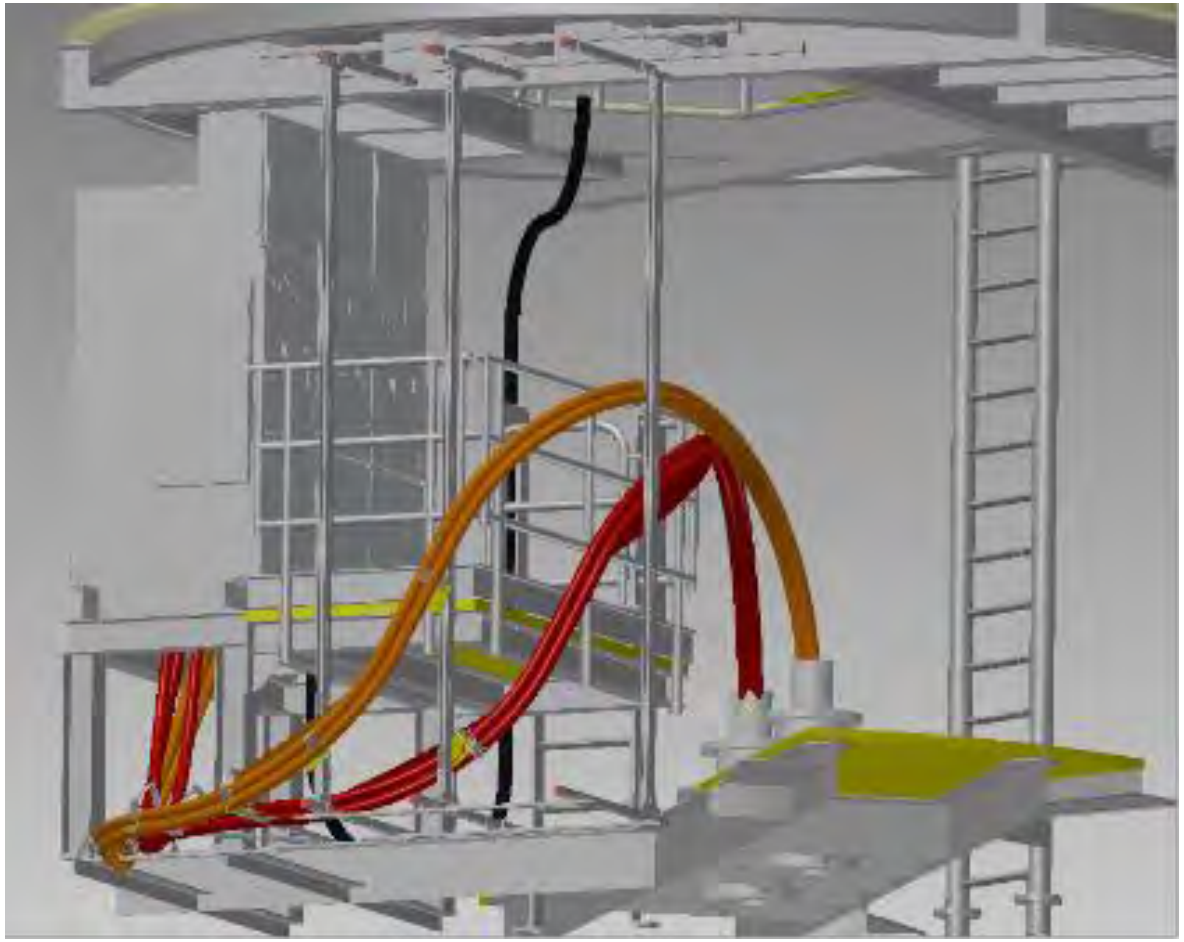
- 84 Number
- Atkins design
- 4 leg 4 bay jacket
- Top 2 bays and TP standardised across the site.
- Fixed pile spacing 24m centres
- 5 clusters
- Pile stick-up range 2 - 6m
- Pile diameter 2.2m
- Pile penetration typ. 40m.

Jacket Cluster No.	Water Depth Range LAT (m)		No. Jackets in Cluster
Cluster 1	-38.0	-42.0	27
Cluster 2	-42.0	-46.0	21
Cluster 3	-46.0	-50.0	20
Cluster 4	-50.0	-53.0	10
Cluster 5	-53.0	-55.8	6

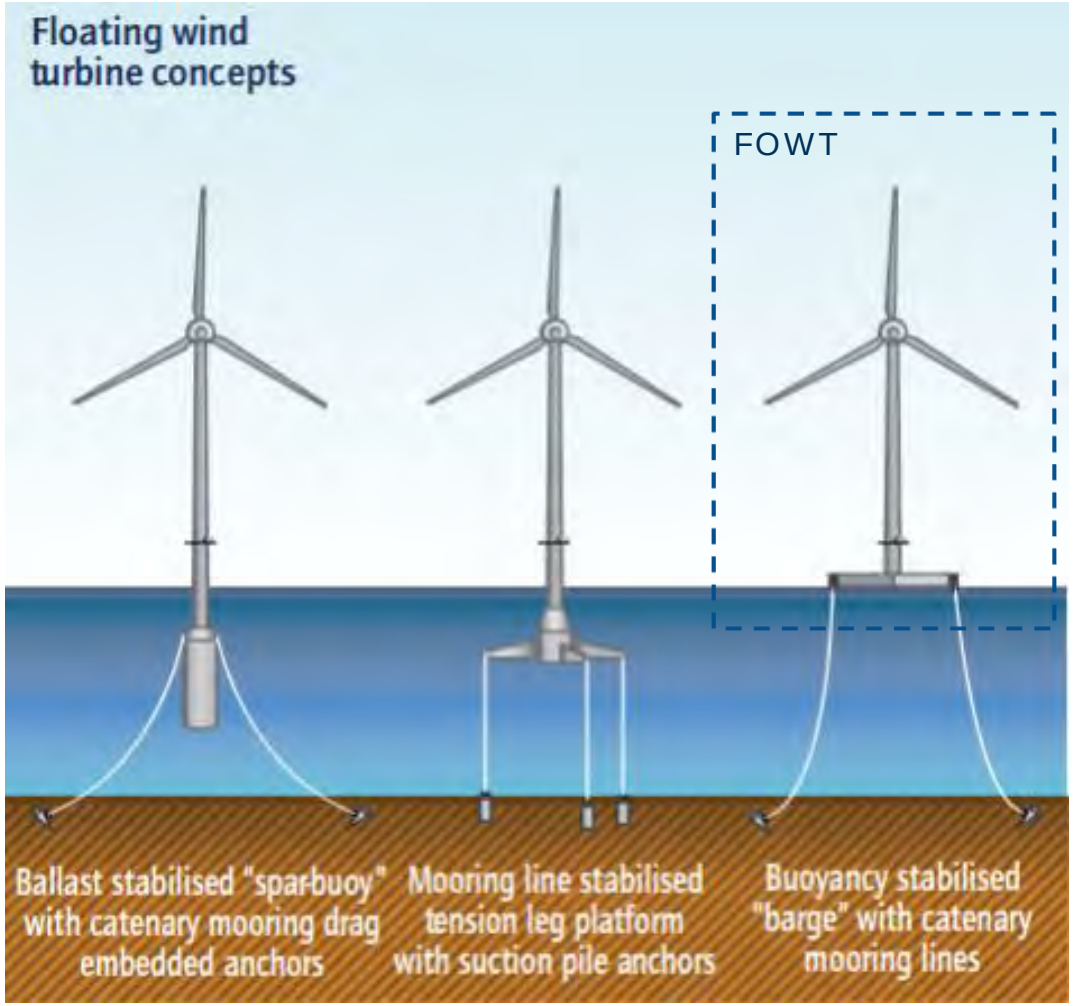


Inner Array Cables
Cable Routing in TP





Floating wind expertise
Major Contracted Components of an Offshore Floating Windfarm



Seaway 7's positioning for floating wind farms:

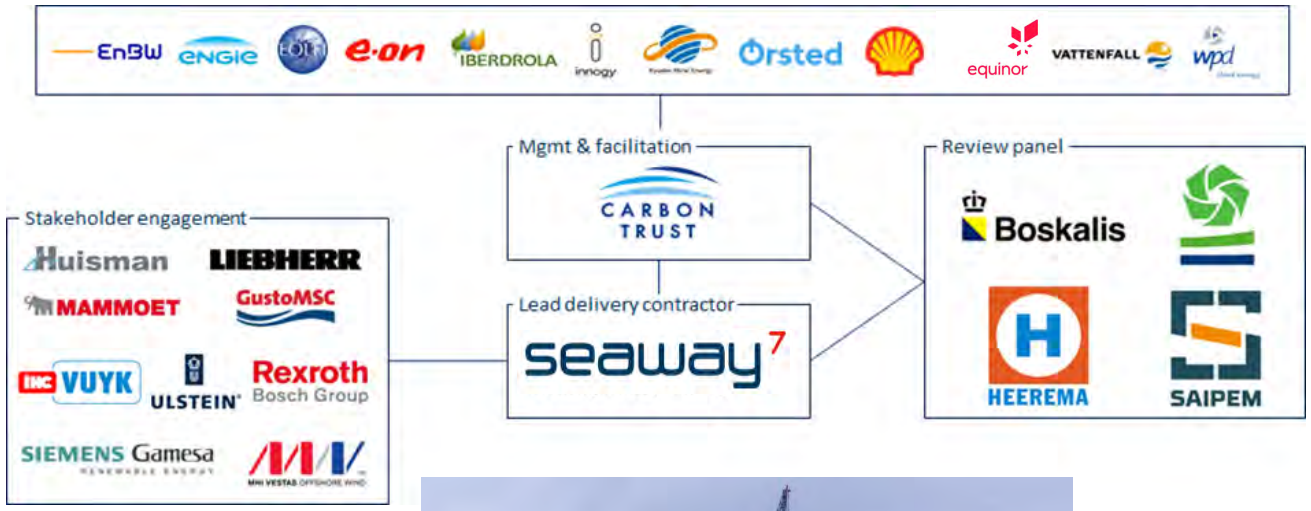
1. EPC of floaters & moorings
2. Integration & final assembly of the Floating Offshore Wind Turbine unit (FOWT) @ quay or in shelter area.
3. Installation of the FOWT with associated mooring lines
4. Design, procurement and installation of Inner Array Cables (static or dynamic) and Export Cables.

Floating wind expertise
Carbon Trust - Contribution to Floating Wind JIP

Floating Wind Joint Industry Project (JIP)

Seaway 7/SHL Lead delivery contractor

Seaway Heavy Lifting (SHL) lead a second study into heavy lift offshore operations during the installation and maintenance of floating wind farm.



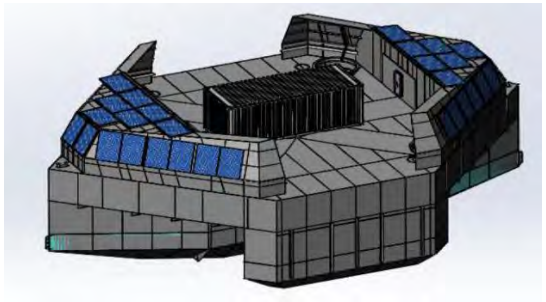
Renewables Floating Technology Development
GEPS-Techno - Le Croisic 150kW demonstrator

Wave Energy converter
A rolling buoy
seawater turbines

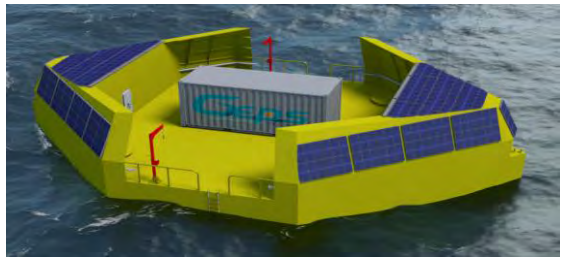
Support a start-up
a technology to maturity
WAVEPEARL®

Operational since August 2019 @ SEMREV site in France

Seaway 7 contribution to GEPS-Techno
- Installation engineering
- Mooring op's assistance & analysis
- Long term partnering



Built by STX
@ St Nazaire



THANK YOU