

Rigid flowline and riser systems

CONSISTENT AND RELIABLE DELIVERY OF CRITICAL INFRASTRUCTURE



Who we are

Subsea 7 is a **global leader** in the **delivery** of **offshore projects** and **services** for the evolving **energy industry**.

We create **sustainable value** by being the industry's **partner** and **employer of choice** in delivering the **efficient** offshore solutions the **world needs**.

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What makes us who we are



Why our clients choose us



Rigid flowline and riser systems

Rigid flowlines and risers are the veins of offshore oil and gas developments. Some of these pipelines transport high pressure water and chemicals to keep the hydrocarbon reservoir alive, while others transport the produced hydrocarbons from the bottom of the ocean to the land where they create energy and products that the world needs.

The Subsea 7 Pipeline Group supports clients' projects by offering consistent and progressive delivery of global rigid pipeline systems, through locally tailored solutions, automation and strategic supply chain partnerships.

Subsea 7 has installed thousands of kilometres of flowlines and risers and expanded its portfolio through investment in technology development, a state-of-the-art pipelay fleet and onshore fabrication facilities.

Subsea 7's pipelay fleet is capable of delivering solutions in both shallow and ultra-deep water using the most technically and cost-effective installation methods from reel-lay to S-lay, J-lay and Towed Pipeline Bundles.

Solution-focussed products

Subsea 7 offers an extensive portfolio of high performance and cost-effective flowline systems to enable optimal field architecture.

Our focus is to ensure reliable and economic flow of well streams from reservoir to the receiving facility, over increasing distances, without costly host modifications.

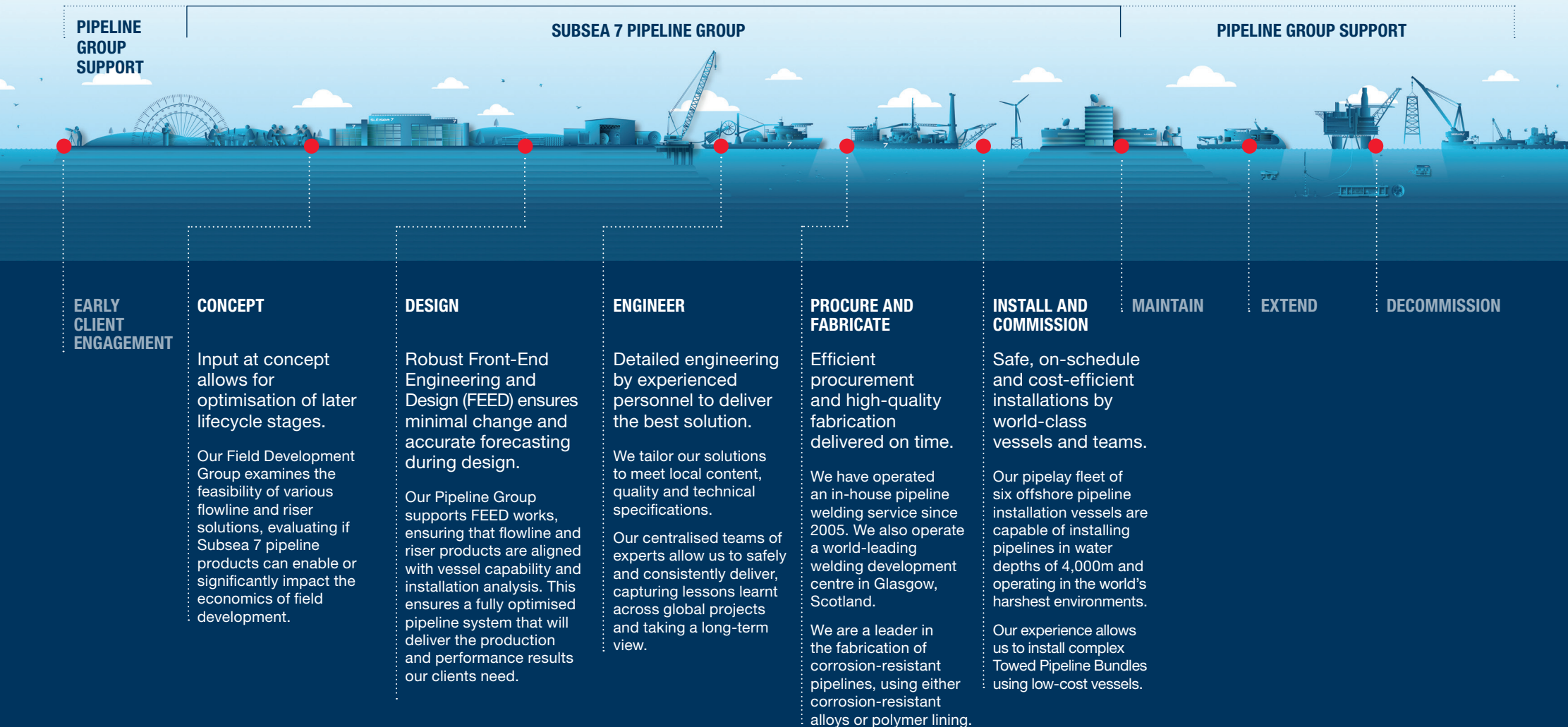
Flowlines and risers are fabricated from carbon steel, corrosion resistant alloys (CRA) or composite materials using the technological advances in corrosion resistance offered by non-metallics.

To maintain the flow of fluids through these pipelines, insulation is sometimes required to protect the hydrocarbons from the cold of the oceans. Pipelines can be coated in high

specification insulation or a double wall Pipe-in-Pipe can be fabricated like an insulated flask. In extreme requirements heating wires can be installed inside the double-wall which can be switched on to heat up the valuable fluids within.

How we deliver

The full value of Subsea 7's rigid flowline and riser offering can be realised through early engagement from the concept stage. Our pipeline products form an integral component of the field development plan and can enable optimisations in topside design as well as subsea.



We are different

Pipeline products and teams that add value.



Culture

Global team with expertise, passion and commitment to deliver.

- We have a culture of continuous improvement. At our Global Welding Development Centre we capture lessons from all our global projects and improve and develop our ways of working and technology to apply to local projects around the world
- Our passion for simplification sees us apply automation technology across worksite and business processes – improving quality, reducing lead-times and lowering cost.



Creativity

Ability to innovate through technology, processes and partnerships.

- 122 flowline and riser system patents
- Our approach for Engineering Criticality Assessments (ECA) by Finite Element Analysis has led the industry since 2008
- We were the first contractor to develop and deploy the Residual Curvature Method for pipeline lateral buckle control
- Our new reel-lay asset has been specifically designed to handle the high-tech pipelines of the future such as Pipe-in-Pipe, Electrically Heated Traced Flowlines (EHTF) and large inline structures
- We have qualified and installed the world's first all-polymer connector, LinerBridge®, for polymer lined pipelines.



Relationships

Working and learning together to achieve success for all.

- Being transparent and open across our pipeline delivery allows a one-team approach with clients encouraged to be part of the solution
- We work in partnership with clients to develop new technologies and products ensuring they are tailored to industry needs and bring value to market faster
- We work collaboratively with key supply chain partners to remove non-value-add tasks and realise opportunities and efficiencies across our portfolio of work.



Reliability

Trusted partner in delivering projects.

- We installed our first offshore pipeline in 1947 and have delivered thousands of kilometres of offshore rigid flowlines and risers globally since
- We operate an in-house pipeline welding service to ensure schedule certainty and the right high-quality solution
- We invested in Swagelining, the world's leading provider of subsea polymer lined pipelines, to offer our clients a solution to improve the reliability of critical water injection pipelines.



Solutions

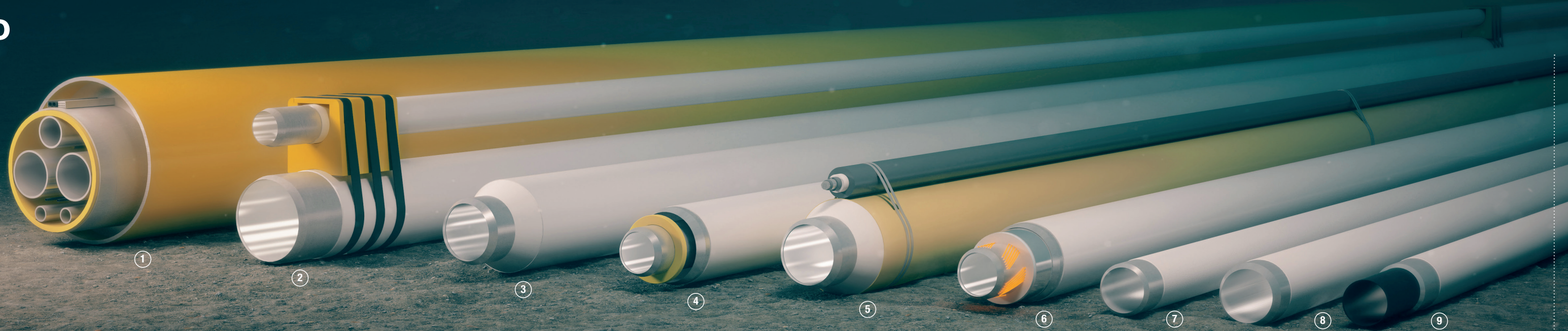
Client-focussed mindset to create the right solution.

- Industry leaders in corrosion-resistant pipelines
- Largest portfolio of deepwater riser systems in the world
- We are the only contractor to offer all pipeline installation methods, inclusive of reel-lay, J-lay, S-lay and Towed Pipeline Bundles
- We are industry leaders in high pressure high temperature (HPHT) solutions, with qualified heavy wall in-house welding solutions, variable U-value flowline and pre-strained Pipeline Bundle systems
- We have qualified X80 high strength line pipe and welding solutions to further enable deepwater production.

Our product portfolio

Extensive portfolio of high performance and cost-effective flowline systems to enable optimal field architecture.

We focus on enabling the reliable and economic flow of well streams from the reservoir to the receiving facility over increasing distances without costly host modifications.



① PIPELINE BUNDLE

A solution that 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 (up to 7km in length) is then launched and transported to its offshore location using the Controlled Depth Tow Method (CDTM). We have installed over 80 Pipeline Bundles to date.

Subsea 7 has developed a Pipeline Bundle refloat concept allowing temporary or permanent recovery and repositioning of a Pipeline Bundle, enabling risk mitigation from iceberg strikes in polar regions or assisting pipeline reuse for marginal field developments.

② 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.

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.

③ 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 injection moulded polypropylene, and high performance Ultra and NEMO field joint coating products.

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

④ 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 in combination 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. This technology is specifically suited to high pressure high temperature fields where operators will benefit from operational flexibility by adjusting the production fluid arrival temperature at the host facility.

⑤ 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.

Subsea 7 has been successfully installing electrical heating systems since 2007 including the world's deepest open loop (DEH) system.

⑥ 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. This enables simplification of field architecture by removing the second leg of the production loop often required to enable pigging with dead oil for preservation.

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.

⑦ 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). Subsea 7 is a world leader in the fabrication of CRA pipelines having welded and installed over 500km of pipelines, with sizes varying from 2" to 48" in diameter.

⑨ SWAGELINING® POLYMER LINED PIPE

One of the most cost-effective corrosion resistant pipeline solutions for water injection service. Our in-house Swagelining® system offers clients a 50-year design life, reduced weight, enhanced flow, 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.

⑧ 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.

Subsea 7 offers unrivalled experience and know-how for the installation and application of MLP.

Rising from the deep

We have one of the largest portfolios of deepwater riser systems in the world.

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

Coupled Risers

Advantages: cost efficient, simple mono-product, minimum components, wet storage ability

- **Steel Catenary Risers (SCRs)**
- **Weight-Distributed SCRs**
- **Steel Lazy-Wave Risers**

De-coupled Risers

Advantages: low hang-off load, pre-installation before FPSO arrival, maximise local content, fatigue and dynamic performance

- **Single Hybrid Riser**
- **Hybrid Riser Tower**
- **Buoy-Supported Risers**
- **Gimbal Joint Riser**

A leader in the delivery of Steel Catenary Risers

Subsea 7 are industry leaders in the design, fabrication and installation of reliable and robust steel catenary riser systems. Our world firsts and technical successes include:

- **First application of mechanically lined pipe (MLP) in dynamic risers for the Sapinhoá-Lula NE Project.**
- **In progress qualification of first polymer lined SCR to offer a corrosion-resistant light-weight riser using our Swagelining technology.**
- **24 CRA SCRs installed using the reel-lay installation method.**
- **Industry-leading in-house welding solution has enabled multiple SCRs installed with zero automated ultrasonic testing (AUT) rejects.**
- **In-house design expertise offering complete SCR design optimisation including strakes for vortex induced vibration (VIV) and buoyancy modules.**
- **Robust design for long term SCR wet storage requirements disconnecting FPSO schedule.**
- **Installation of first end SCR on reel-lay vessel without anchor to control the SCR touchdown point offering significant schedule optimisation.**

Driving advances in welding and materials

Our in-house world-class welding facility develops welding and materials solutions for use in our pipeline fabrication bases and vessels around the world.

Subsea 7's Global Pipeline Welding Development Centre serves as a technical authority for welding and materials enhancements to all Subsea 7 fabrication bases globally, greatly reducing client uncertainty and risk. The centre incorporates 19 welding bays and allows us to perform realistic pre-production welding trials, operator training and research and development activity.

A digital future

With the adoption of automation, artificial intelligence and machine learning we plan to improve quality and productivity. We will have the ability to remotely review operations and processes allowing us to improve availability of skilled resources, improve training techniques, aid familiarisation, increase equipment uptime and reduce safety risks.



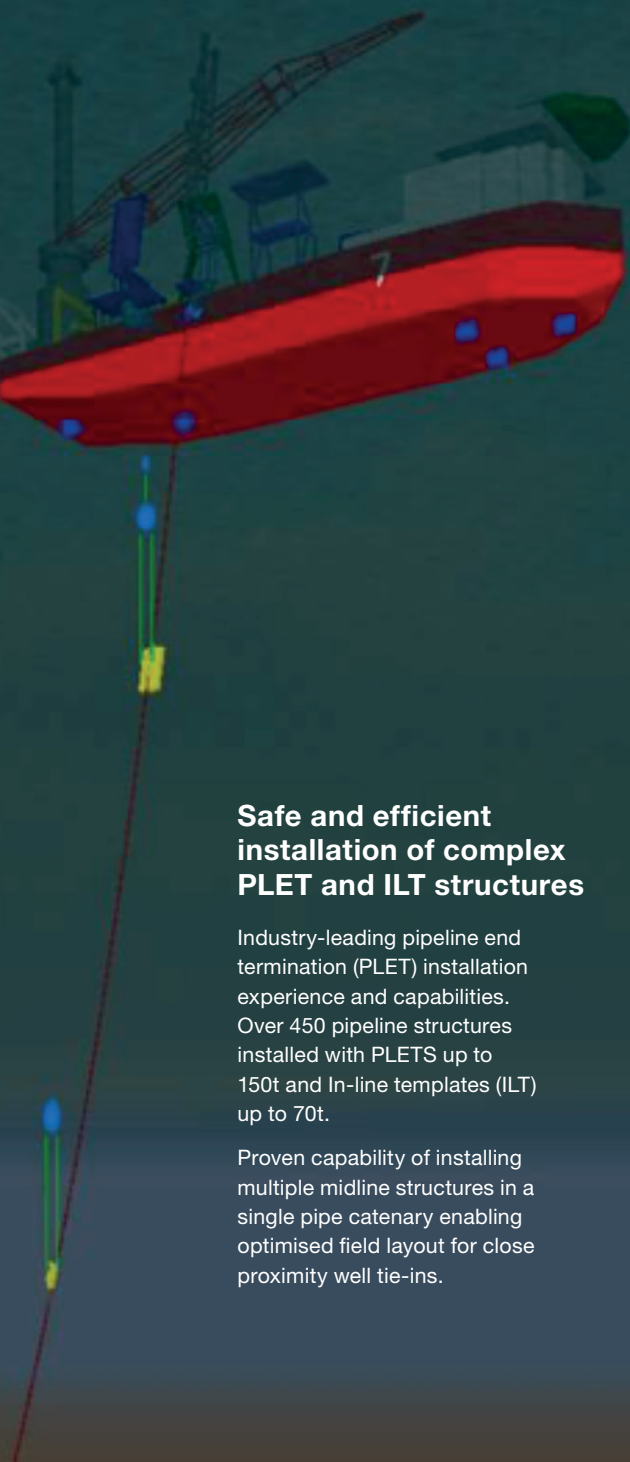
Global Pipeline Welding Development Centre

High pressure, high temperature

Riser designs for high pressure and high temperature (HPHT) field developments, are driving a need for heavier wall pipe welding capability or high strength steels. Subsea 7 offers a fully qualified reel-able linepipe and welding solution for X80 pipe and up to 45mm wall thickness X60 pipe. Feasibility work has also been completed for X80 mechanically lined pipe.

Leading the industry in corrosion resistant pipelines

Subsea 7 led the industry by qualifying Mechanically Lined Pipe (MLP) in 2010 for use in the challenging, deep water Sapinhoá-Lula NE project in Brazil. Furthermore, in 2016 Subsea 7 acquired Swagelining, the world's leading polymer lining specialist for subsea pipelines and has since completed qualification of the LinerBridge® connector system and is conducting research and development into expanding the application of non-metallic pipeline solutions to dynamic riser service, S-lay installation and multi-phase sour service hydrocarbons.



The installation experts

Subsea 7 installation experts have delivered many world firsts, reducing the cost of field developments, improving predictability and enabling the world's most complex projects.

Pioneering Residual Curvature Method (RCM) for pipeline lateral buckle control

Subsea 7 pioneered this lay method in 2012 using the pipe straightener on the reel-lay vessel to create local curvature zones in the pipeline to lay engineered pipe curves on the seabed. This method offers a low-cost solution to manage lateral pipeline buckling caused by thermal expansion of the pipeline when in operation. RCM has been used successfully for three North Sea field developments with others planned globally.

Industry leading engineering criticality assessment – offering optimised schedules while maintaining safety

Since 2008 Subsea 7's approach to Engineering Criticality Assessment (ECA)-by finite element analysis (FEA) to cover partially under-matched welds has gone beyond commonly accepted industry boundaries. Our internal research and development team has investigated aspects such as: the safety factor for fatigue crack growth, tearing limit through multiple reel cycles, girth weld residual stress relaxation during reeling, biaxial stress adjustment etc. This helps to optimise post-weld allowable defect size and minimise weld repair rates, whilst providing clients with ensured reliability.

Cost optimisation enabled through expert knowledge

Subsea 7 can install pipelines using more cost-effective vessels whilst maintaining safety factors through industry-leading installation expertise.

This expert knowledge and in-depth understanding has enabled an increase of weather operability, heavier pipelines and deeper water to all be realised from existing assets offering lower-cost solutions to our clients.

Solution providers for the non-standard pipelay

Subsea 7's installation expertise means we are the partner of choice to ensure reliable and consistent delivery of non-standard pipelay.

Subsea 7 has installed offshore pipelines using spiral wound line pipe, pushing beyond the industry standard for submarine pipelines. To achieve this Subsea 7 has developed a full internal engineering method to successfully install such pipelines.

Safe and efficient installation of complex PLET and ILT structures

Industry-leading pipeline end termination (PLET) installation experience and capabilities. Over 450 pipeline structures installed with PLETs up to 150t and In-line templates (ILT) up to 70t.

Proven capability of installing multiple midline structures in a single pipe catenary enabling optimised field layout for close proximity well tie-ins.

Globally capable

Subsea 7 has an extensive track record of safe and successful installation of rigid pipelines in shallow and deepwater fields throughout the world.

Pipeline installation fleet



SEVEN BOREALIS



SEVEN CHAMPION



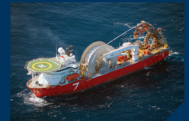
SEVEN ANTARES



SEVEN VEGA



SEVEN OCEANS



SEVEN NAVICA

1 **BP Mad Dog 2**

The project is the first substantial project in the US to use Subsea 7's Swagelining polymer lining technology. First project to install in-house designed steel lazy wave riser systems which will be initially wet stored on the seabed. First application of mechanised welding processes for offshore riser tie-in. Design of an ROV removeable flexjoint anti-rotation collar in collaboration with BP.

2 **Shell Bonga**

38km of production flowlines, 24km of polymer lined water injection flowlines, nine steel catenary risers (SCR) and an 88km 16" gas export pipeline. This was the first time that SCRs have been suspended from an FPSO and the first time that corrosion-resistant alloy clad pipes were used in a dynamic SCR application.

3 **Petrobras Sapinhoá-Lula NE**

Four submerged riser buoys, each weighing 2,800t, were installed at 250m below the sea level. 27 steel catenary risers (includes a number of mechanically lined risers) installed using an innovative 400t tension capable Riser Installation Tool. Project technology was shortlisted for the Best Mechanical Engineering Achievement Award by ASME Petroleum Division.

4 **Total CLOV**

130km of pipes including 40km of Pipe-in-Pipe production lines, 60km of water injection lines, 32km of gas export lines, two hybrid riser towers and a single hybrid riser at the end of the gas export pipeline.

5 **Cooper Sole**

65km of reel-lay 12" sour gas pipeline from directionally drilled landfall to 125m water depth. Temporary spoolbase established and local workforce specifically trained for project to deliver fully localised solution.

6 **Wintershall Dea Nova**

Two 16km Pipe-in-Pipe production flowlines, a 17.5km water injection line and a 12.7km 6" gas line was installed, all flowlines were layer polypropylene coated. Largest diameter Pipe-in-Pipe at 16.1-inch x 12-inch. First reeled installation of Swagelining Linerbridge® technology in water injection line.

7 **Equinor Askeladd**

42km of 20" concrete coated Mechanically Lined Pipe (MLP) installed with complex modified polyurethane (PU) and PU/gravel field joint coating systems. Subsea 7 in-house welding solution delivered almost zero AUT repairs resulting in the vessel completing the scope ahead of schedule.

8 **Equinor Snorre**

Three Pipeline Bundles totaling 21km, all with significant intermediate structures. The west Pipeline Bundle, at 7,619m long, is one of the longest executed from Wick Fabrication Site in Scotland. The east Pipeline Bundle with a diameter of 147cm, is the largest diameter to date, and at 12,400t, by far the heaviest installed to date. First project to incorporate Swagelining Linerbridge® connection system for polymer lined pipelines.

9 **Saudi Aramco Hasbah**

393km of pipe laid from shore pull-in to 60m water depth, ranging from 6" to 36". Included within scope was 21km of corrosion-resistant alloy pipelines. First full dynamic positioning pipelay for Saudi Aramco.

▲ Spoolbase ● Pipeline Bundle Site ▲ Global Welding Development Centre



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