Where energies make tomorrow

North Caspian Offshore Technologies Toolbox

A state of the art in-house suite of expertise

T.EN TECHNIP ENERGIES

A unique offering

Technip Energies is a leading engineering and technology company serving the energy industry and its transition. Through our extensive portfolio of technologies, products and services, we break boundaries bringing our clients' innovative projects to life while accelerating the energy transition for a better tomorrow.

A PRESENCE ACROSS THE ENTIRE VALUE CHAIN

PROJECT DELIVERY

- Project management
- Engineering, Procurement and Construction
- Technology integration on complex projects
- Digital applications for project execution and safe and cost-effective operations and maintenance
- Project financing

TECHNOLOGY, PRODUCTS AND SERVICES

- Process technologies and licensing
- Proprietary products: Loading Systems and Cybernetix
- Concept, feasibility, FEED studies
- Advisory (Genesis) and Project management consultancy

FULL COVERAGE OF DIVERSE MARKETS

- LNG & gas monetization
- Sustainable chemistry
- Hydrogen
- CO_2 management
- Offshore
- Refining
- Ethylene
- Petrochemicals
- Fertilizers
- Mining & metals
- Nuclear
- Life sciences
- Agritech

A Swiss-knife of offshore technological solutions that tackles the elements related to the challenges and developments in the North Caspian based on our collective state of the art inhouse expertise to improve CAPEX operability and extends certainty in delivery of our offering to our clients.

We have been firmly committed and highly motivated to expand our services and operations in the North Caspian. We have been supporting our customers to face their challenges, through the use of our state of the art technological solutions and expertise, while successfully contributing to the commercial viability of their investments.

We believe that the success of a development with respect to cost-effectiveness, schedule compliance, safety, operability, and maintainability depends among others on high-end technological advancements and expertise. Such expertise is of the essence through the various project life cycles ranging from feasibility studies, basic design and FEED, detailed engineering to fabrication, construction, installation, commissioning, start-up and support during operations.

The challenging North Caspian environment calls for high expertise in Arctic conditions, artificial islands, modularization, innovative solutions for fixed facilities, sour gas treatment & the ability to work under local procedures in the CIS and Russia.

Technip Energies' North Caspian Technologies Toolbox offers a wide ranging suite of offshore technologies and expertise that answers the key challenges associated with developments in the North Caspian.

Through this brochure, we cover such offshore technologies and expertise based on our differentiated capabilities and references in the following sections:

1 | Facilities Types Technologies

2 | Arctic Design Capabilities

3 | General Design Capabilities

4 | Fabrication & Installation Expertise

5 | Local Expertise

We remain available to answer all of your questions and look forward to further engaging with yourselves to leverage on this Technologies Toolbox to provide the best in class Services.

A Unique Footprint

Serving the Caspian Region

Our flexible organization with diversified centres of excellences leverages on our various group operating centres and extends a large and diversified pool of experts that caters to the key challenges associated with the developments in the North Caspian while ensuring the highest quality in our Services. We aggregate such extensive and renowned capabilities with the key resources of our local partnerships to provide best in class Services to the local market.

1 PARIS – FRANCE
TECHNIP ENERGIES OPERATIONAL HEADQUARTERS

Technip France has been active for more than 60 years in the engineering and construction for the oil and gas and chemical industries. Technip France is one of the major centers of excellence and expertise of the Technip Energies Group, capable of managing contracts from feasibility study to full EPC/EPCM and of providing a wide range of services for the oil and gas chain, petrochemicals and other energy industries

2 SAINT–PETERSBURG – RUSSIA
TECHNIP ENERGIES OPERATION CENTER

3 LONDON – UNITED KINGDOM
GENESIS ENERGIES HEAD OFFICES

Genesis is a global market-leading engineering and advisory company, established for 30 years, with headquarters in London, and is a wholly owned subsidiary of Technip Energies. Genesis is involved in Upstream Engineering Services, Onshore, Offshore and Subsea, for all stages of the project life from conceptual development to FEED and Detailed Design, Construction, Commissioning and Operational Support.

7 MOSCOW – RUSSIA
TECHNIP ENERGIES BRANCH OFFICE

8 ATYRAU – KAZAKHSTAN
TECHNIP ENERGIES SUPPORT OFFICE

11 AKTAU – KAZAKHSTAN
GENESIS BRANCH OFFICE

Genesis' Atyrau office together with the London office have been working for Kazakh clients continuously since 2006 for conceptual work. Genesis has been able through the course of this work to acquire and demonstrate a good understanding of how projects are executed in this region and how cost estimates are developed.

12 BAKU – AZERBAIJAN
TECHNIP ENERGIES BRANCH OFFICE

13 ASHGABAT – TURKMENISTAN
TECHNIP ENERGIES REPRESENTATIVE OFFICE

14 TASHKENT – UZBEKISTAN
TECHNIP ENERGIES BRANCH OFFICE

15 ROME - ITALY
TECHNIP ENERGIES BRANCH OFFICE

Operational Partnerships and Affiliations

4 KARAGANDA – KAZAKHSTAN
TKJV HEAD OFFICES

TKJV LLP, a joint venture between Technip Energies and KPSP, has been created to serve the local Kazakhstani market as an engineering company capable of extending qualified services in oil & gas, energy and mining investments by providing and further developing local content in Kazakhstan in terms of local employment as well as an important transfer of skills, capabilities and know how in engineering and project services.

5 KARAGANDA – KAZAKHSTAN
KPSP HEAD OFFICES

KPSP LLP (Karaganda Promstroyproekt) is a long established Kazakh Design Institute with more than 60 years of experience of design and engineering services in Kazakhstan. With its original specialization in mining industry, KPSP LLP provides a full range of services at the stages of basic design and detailed design such as collection of initial data, design and adaptation of technical documentation, permitting and obtaining of expert examination approvals, field supervision and participation in the commissioning of construction projects.

6 MOSCOW – RUSSIA
KPSP REPRESENTATIVE OFFICES

10 NUR-SULTAN – KAZAKHSTAN
KPSP BRANCH OFFICE

Facility Types Technologies

1 ARTIFICIAL ISLANDS

2 FIXED PLATFORM CONICAL SUBSTRUCTURES

3 GRAVITY BASE STRUCTURES

4 UNMANNED PLATFORMS

1 | Artificial Islands

TECHNOLOGY DESCRIPTION

Artificial islands are man-made islands that consist of dredged or quarried material. They represent a low cost means of providing real estate for oil and gas field developments in shallow water (typically below 20 meters water depth).
The island is protected against erosion by water scouring or ice impingement by a retention system that can include concrete caissons, rubble mounds with slope protection (eg. rock armour and concrete blocks/mattresses), sheet pile combi-wall system or concrete blocks.

TYPICAL DEPLOYMENT

Artificial Islands are deployed as offshore substructures for drilling facilities, process facilities and logistic bases (or a combination for all three) in shallow water areas.
They are used extensively in the Arabian Gulf, Alaska and in the North Caspian.

PROJECT EXPERIENCE RELATED TO ARTIFICIAL ISLANDS

Our teams in Technip Energies have built up experience in the modularization and island geotechnics through a number of projects successfully delivered in the Middle East:

- ADMA OPCO Sarb project: pre-FEED studies to determine the economic viability of the Sarb facilities on Zirku Island as well as the proposed location of the Sarb processing facilities
- ZADCO Upper Zakum 750K (bopd) project FEED and EPC phases (a 4 islands development including gas separation, gas lift compression, booster gas compression, as well as power generation, utilities, interconnecting pipelines and modification of existing facilities)

Upper Zakum 750 project

Genesis has worked extensively in the North Caspian on the following studies:

- NCOC Aktote & Kairan Assess Stage
- NCOC Kashagan Phase IIB/C Concept Select
- NCOC Kashagan FFD Assess Stage
- NCOC Kalamkas & Khazar Conceptual

VALUE POTENTIAL FOR CLIENT

- **A well proven and robust substructure option** for the Arabian Gulf, Alaska and North Caspian
- **Their footprint is much larger than a platform** and therefore well suited to a phased development. Space can be easily designated for future facilities and provides a greater flexibility for equipment change-out / maintenance and for well drilling and monitoring.
  Their adaptability for future expansion is better in terms of equipment size and especially height compared with offshore platforms
- **A field development strategy** can be based on a few drilling / production centers (on artificial islands) using extended reach drilling instead of numerous individualwellheadplatforms
- **Their large footprint provides additional safety** for well and production operations involving high H_2S fluids
- **Cost-effective** and well suited to relatively shallow water depth locations
- **Simple civil engineering/ marine construction work**
- **Flexibility to capture up-side potentials** during the field life cycle
- **Enhanced field operability at lower OPEX**
- **Artificial islands** far exceed the life expectancy of fixed steel platforms so replacements are required

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

The design of artificial islands involves a multi-discipline approach with island layout and geotechnics being key areas.
The island layout is driven not only by facilities on the island but by the external environment and marine access/escape. The geotechnics will vary depending on the source material for the island, whether dredged (typical for Arabian Gulf) or quarried (typical for North Caspian).
The consolidation time for dredged material is longer and may involve using wickes to assist with the de-watering phase. The source material used will also affect the type of foundations permissible.

Artificial island construction involvessignificantman-hours so construction safety needs to be well managed.

Island footprint and construction work/material supply can be significant and these need to be carefully planned and controlled to minimize environmental impact.

OTHER FACTORS THAT HELP TO MINIMIZE THE ENVIRONMENTAL IMPACT OF ARTIFICIAL ISLANDS ARE:

- Island location
- Island construction method to reduce the impact of any dredging activity
- Assessment of the best routes and island configuration to optimize future vessel traffic and logistics
- Assessment of impact on biodiversity: marine fauna and flora, absence of coral reefs or protected species, reclaimed land / unused former equipment providing nestling opportunities etc.

FOR THE NORTH CASPIAN, SPECIFIC AREAS FOR FOCUS INCLUDE:

Artificial islands in the North Caspian use quarried material and dredging is minimized.
This is critical given the special environmental issues related to the land-locked Caspian Sea and the particularly sensitive shallow waters in the north (eg sturgeon population).


Kashagan

The quarried material also shortensthe island construction schedule as islands can be constructed in one summer season and then foundation work for the facilities can commence at the start of the following season.

One major issue facing the North Caspian is the decline in water levels due to global warming and the ability for continued marine access to the facilities. Artificial islands are better suited to alternative access via ramps and causeways / bridges if road going transport ultimately replaces marine based craft due to the loss of workable seawater levels / minimum drafts.

2 | Fixed Platform Conical Substructures

TECHNOLOGY DESCRIPTION

A conical steel substructure that is piled into the seabed in shallow water where there is a prevailing sheet ice.

The inverted cone structure acts to break the sheet ice by introducing bending (tensile) force. The cone angle can be optimized using Technip Energies' Ice-MAS program to reduce pile number and size.

The platform substructure is ideally self-floating during transport and installation (or may need some additional buoyancy depending on the water depth between the construction site and final location).

The platform topsides is installed by the float-over method.

TYPICAL DEPLOYMENT

Used to support fixed platform topsides in shallow water with prevailing ice conditions (eg. North Caspian or equivalent).
Either one or two conical foundations can be used depending on the size and duty of the platform.

PROJECT EXPERIENCE RELATED TO FIXED PLATFORM CONICAL SUBSTRUCTURES

This is a platform concept and has not been built to date, however it is analogous to other conical gravity based substructures used for wind turbine foundations in the Baltic Sea (by Technip Energies Pori). However, Technip Energies has performed the engineering study of the conical structure for the development of Shell Pearl in 2013, an artificial island with ice environment in a protected area.

VALUE POTENTIAL FOR CLIENT

- **Lower environmental footprint** than artificial islands. Can be easily be removed and refloated during de-commissioning (assuming sea-levels are maintained)
- **No ice encroachment uncertainty** (as with artificial islands but this can be minimized using Ice-MAS)

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

The fixed platform conical substructure is an alternative to an artificial island and suitable for shallow water depths with ice conditions (eg. North Caspian). The cone is ideally self-floating by design and towed to site by tug where it is ballasted down using seawater and then piled. Two designs have been developed, one that protects the well conductors of a drilling platform and one which acts only as a platform support (see below).

3 | Gravity Base Structures

TECHNOLOGY DESCRIPTION

Gravity Base Structures can be constructed out of concrete or steel. They are self-floating structures and can be towed to their final location and grounded by ballasting. Their topsides are generally installed by float-over, either in a sheltered inshore site (such as a fjord) or at the field location. Sliding resistance is obtained either by self-weight, extra ballast or by the addition of skirts. If horizontal forces are very high (such as with ice loads) they may be piled and then are no longer regarded as GBSs.

TYPICAL DEPLOYMENT

Concrete GBS platforms (called Condeeps) became the norm in Norway to develop their shelf reserves. They are generally used in areas where it is difficult / costly to mobilize a heavy lift vessel for jacket and topsides installation (eg Australia and Caspian).

PROJECT EXPERIENCE RELATED TO GBSS

Chevron Wheatstone GBS platform (GBS concept) North West Australia

- **Technip Energies scope:** FEED in KL and Perth - direct contract with Chevron & Detailed Design in KL and Perth as subcontractor to DSME
- **35,000 tonne high air-gap float-over** – one of the largest float-over deck installations in the world
- **22,000 tonne steel gravity base substructure** (conceptual and FEED by Technip Energies. Detailed design by DSME)
- **71m water depth**

- **Technip Energies Scope:** E, P, C, PRE-COM, T&I, HUC, COM
- **In JV with MMHE**
- **Steel GBS ca 7,000 tonnes,** Topsides ca 6,000 tonnes
- **Conceptual and detailed** design by Technip Energies in KL
- **GBS detailed design by Ove Arup**
- **T&I by Technip Energies (2011)**

Petronas Carigali Turkmenistan GBS platform (GBS concept)

Technip Energies has also performed several engineering studies for developments in the North Caspian Sea where artificial islands have been designed subject to the ice environment and considering their location with an environmentally protected area. Pearls and Kalamkas being good examples.

In addition, in the Russian Sector or the North Caspian, a Pre-FEED for the Yu. S. Kuvikina Process Complex (with an ice resistant platform rated at around 20,000 tonnes) has been performed, including the ice-resistant substructures.

VALUE POTENTIAL FOR CLIENT

- **Potentially lower cost platform** in areas where a sheltered deep water mating site is available (eg fjord) or where mobilization of installation vessels is difficult / expensive.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

GBS structures were fully proven from the early development of the North Sea through the Condeep platforms. There are around 100 GBS platforms globally with three times as many being constructed from concrete compared with steel.

Concrete GBSs have been used in water depths up to 303m (Troll A) and up to 96m for steel (Conoco Phillips Maureen Alpha).

FOR THE NORTH CASPIAN, SPECIFIC AREAS FOR FOCUS INCLUDE:

Due to the increased horizontal loads imposed on platforms in the North Caspian due to sheet ice loads, gravity base platforms are generally not applicable. Their significant weight and floating draft also mean they are incompatible with very shallow water depths.

4 | Unmanned Platforms

TECHNOLOGY DESCRIPTION

Unmanned platforms typically utilize remote operations and campaign maintenance to achieve a “not normally manned” status. Manning is however required for short periods to complete maintenance activities.

Visitation frequencies of 1 or 3 times annually are typically specified with a visitation period ranging from several days to several weeks. Access is generally achieved using a walk to work vessel equipped with a motion compensated gangway.

TYPICAL DEPLOYMENT

Regularly utilized for wellhead platforms in water depths of up to 120m with simple mono pod or 4 leg jackets. Industry direction is towards deployment for installations with increased complexity, partial (and in the future) full processing facilities on either fixed or floating substructures

PROJECT EXPERIENCE RELATED TO UNMANNED PLATFORMS

Martin Linge (remote ops only) - for Total, now Equinor

- **Norwegian North Sea**
- **Scope includes engineering,** procurement, fabrication, transportation, hookup and commissioning of the topsides in consortium with SHI
- **Fixed 8-leg launched jacket** based platform with 21 well slots with drilling by a cantilever jack-up rig
- **9,000 tonnes integrated topsides** with well-bay, process, utilities and LQ
- **Remotely controlled** from onshore control room supplied by Technip Energies

- **Mediterranean Sea offshore Tunisia** in 60 meters water depth
- **Scope by Genesis:** Detailed Design engineering and Procurement, plus supply of tagged items to Heerema under a subcontract
- **Piled 4 leg jacket** based platform with 9 well slots
- **Normally Unattended Installation**
- **Produced water separated from oil** in the production separator and treated in a filter-coalescer before discharge to sea via caisson
- **Extensive Chemical Injection System** – wax, asphaltine, scale, corrosion and hydrate inhibitors, emulsion breaker and defoamer

Hasdrubal (partial processing / wellheads) for British Gas

Genesis has performed a similar scope on seven other normally unattended platforms. Also refer to OTC-29648 “Unmanned Minimal Floating Platforms” delivered by Genesis at OTC 2019 in Houston

VALUE POTENTIAL FOR CLIENT

- **Project execution and operational phase benefits** including reduced execution schedule and risk, simpler installation, reduced total life-cycle cost, reduced personnel exposure to offshore risk and improved environmental performance (CO_2 emissions)
- **Potential for increased production / annual production** through increased availability
- **Simplification of topsides and process** together with removal of facilities to support human habitation gives substantial CAPEX reduction (eg. ca 30% for small platforms)
- **Reduced maintenance man-hours** and reduced manning results in a lower OPEX together with simplified logistics
- **Exposure to offshore working environment** is minimized and helicopter shuttling exposure is completely eliminated (a significant contributor to residual risk in QRA for standard facilities)

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

Unmanned platforms provide a major opportunity for cost reduction by removing the living quarters and utility systems required to support human habitation. Operations are performed remotely either onshore or on another platform with permanent crewing. Maintenance is performed by occasional visits, typically once to three times a year using marine craft. In harsher environments a walk-to-work system (ie heave compensated bridge) is generally used. Depending on the distance and response time of a marine vessel to reach the platform, a helideck may be provided for unplanned visits / restarts but this is not the lowest cost option. In order to minimize maintenance hours and visit frequency, high reliability equipment with condition monitoring is used and this can lead to high availabilities and good uptime for the facility.

FOR THE NORTH CASPIAN, SPECIFIC AREAS FOR FOCUS INCLUDE:

Unmanned or low-manned facilities are particularly well suited to the North Caspian with its harsh environment and high H_2S levels.

THE ADVANTAGES INCLUDE:

- **Minimizing human** – exposure to toxic gas and extreme weather has a major HSE benefit
- **Transferring personnel to an offshore field location** and then accommodating them there is high in OPEX and has a high carbon footprint (especially when ice-breaking is required)
- **Designing facilities for limited human intervention** improves uptime / revenue where human intervention is difficult particularly during harsh weather and ice conditions

Arctic Design Capabilities

1 ICE SIMULATION TOOL

2 WINTERIZATION

3 FLOW ASSURANCE

1 | Ice-MAS - Ice Simulation Tool

TECHNOLOGY DESCRIPTION

Ice-MAS (www.ice-mas.com) is an industry leading numerical tool for the design of offshore structures interacting with ice. Ice-MAS is wholly owned by Technip Energies and has been developed together with Cervval (software developers) and Bureau Veritas (ice design expertise and validation). It combines a variety of models and approaches using a multi-agent technology and has the possibility to combine, in a common framework, multiple phenomena from various natures and heterogeneous scales (i.e. drag, friction, ice-sheet bending failure, local crushing and rubble stack up). It can simulate the ice loadings from a drifting ice-sheet (including ridges), broken ice and icebergs on any structure type (with user input geometry), generating detailed results for the different parts of the offshore structure.

TYPICAL DEPLOYMENT

Ice-MAS can be used on any project where offshore or at shore structures are subject to ice conditions such as within the Arctic Circle or in similar extreme cold regions, eg North Caspian, Sakhalin Island & Eastern Canada.

VALUE POTENTIAL FOR CLIENT

- **Ice-MAS is used to optimize the shape of a structure to minimize the ice loadings.** Following optimization, the final design can be modeled at scale in an ice basin at minimum cost (with a minimum number of cases/runs) in the event this is required to meet regulation/certification requirements. By reducing ice loads through optimization, the platform will have a lower CAPEX and be less prone to vibration / fatigue.

PROJECT EXPERIENCE RELATED TO ICE-MAS - ICE SIMULATION TOOL

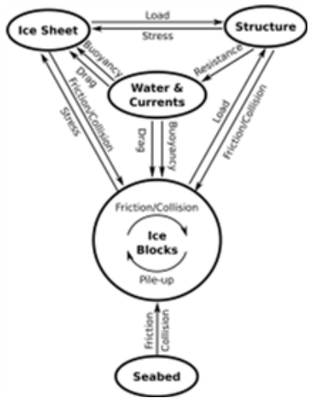
Ice-MAS has been the subject of several publications (eg.ATC2014-24644;POAC2015; ATC2015-25591; OMAE2017-61903; OMAE2017-61939) and has been used by Samsung Heavy Industries for LNGC and FPU hull designs. The program is validated by Bureau Veritas.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

The need for an ice simulation tool for offshore fixed (eg. Gravity Based Structures (GBS) or artificial islands) or floating platform designs is twofold: the first aim is to simulate the flow of ice around the platform structure to ensure there is no excessive pile-up and encroachment on the topside facilities and the second is to predict the ice loadings applied on the structure.

To address some of these challenges, in June 2012, Technip signed an agreement with Cervval (a specialist software company in Brittany, France) and Bureau Veritas to develop an ice-modeling simulation program called Ice-MAS (Ice Multi-Agent Simulator).

The simulator is based on a multi-model approach to predict ice behavior and can simulate different entities (eg. rigid body structure, level-ice sheet, ice fragments, ice pile-up, icebergs, water, currents and seabed) and the phenomena applied to these entities. Entities are implemented as data and phenomena are implemented as algorithms. At each time step, the simulation framework applies the relevant phenomena to the required entities, as illustrated below.

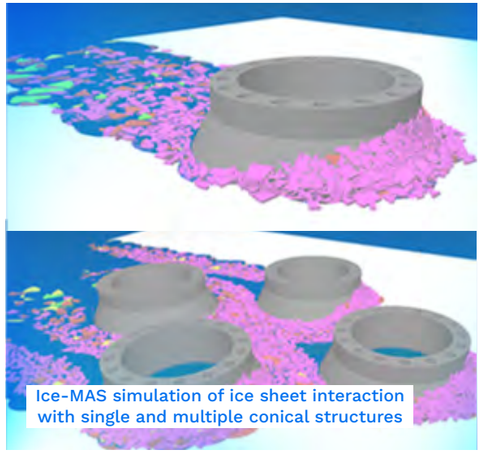


The ice-structure interaction can be simulated with simple structure geometries like cylindrical or conical structures, as well as more complex multi-leg or multi-column platforms such as a semi-submersible unit.
The user has the possibility to define a substructure in order to extract results for each part of the model. For example, the ice load on each leg of a semi-submersible or jack-up platform can be calculated independently.

It is possible to conduct sensitivity studies on the structure geometry and/or ice properties to better understand the parametric effect on the local and global results. The use of such tools in the design process of a structure allows its optimization by selecting the best geometry that will minimize the ice-loads.
It will also help to define the program of ice-basin testing to be conducted to make the final validation against the relevant codes and standards.

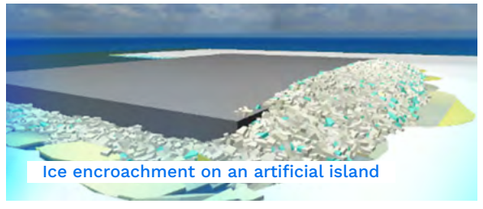
FOR THE NORTH CASPIAN, SPECIFIC AREAS FOR FOCUS INCLUDE:

Ice-MAS is particularly valuable at simulating ice loadings and ice rubble build up on shallow water piled conical structures, either single or multiple as shown below. These structures can be used for platform supports and to protect well conductors against ice loadings and encroachment.



Ice-MAS simulation of ice sheet interaction with single and multiple conical structures

If artificial islands are selected, Ice-MAS can predict the ice encroachment distance required for the safe protection of equipment and facilities on the island. This can be simulated for different ice sheet thicknesses (including ridges), varying ice sheet velocities, broken ice, as well as for different seawater / ice sheet levels and ice properties. Such multiple sensitivity runs can be used to develop a risk based approach to the optimized sizing of artificial islands with respect to ice encroachment.



Ice encroachment on an artificial island

2 | Winterisation

TECHNOLOGY DESCRIPTION

Winterisation covers the design of facilities to mitigate the effects of low temperatures on operations, maintenance and the safety of personnel. Typical winterisation mitigation measures include: Heat Tracing, Insulation, Blankets/ jackets, Heating coils, Antifreeze additives, Space heating, HVAC, Sloping, Draining,Circulation,Personnel protection, Surveillance, Operational procedures, Removal of snow/ice. Enclosing process equipment restricts free ventilation so overpressure protection measures may be required.

TYPICAL DEPLOYMENT

Winterisation is applied to any facility, fixed or floating, that is subject to significantly sub-zero temperatures.
The extent of winterisation depends on how harsh is the environment & is most challenging within the Arctic Circle or in similar extreme cold regions, eg. North Caspian, Sakhalin Island & Eastern Canada. Cold climate hazards include freezing, icing and falling ice, personnel exposure, condensation and heat loss.

PROJECT EXPERIENCE RELATED TO WINTERISATION

Technip Energies has considerable experience of designing and executing projects in Arctic conditions. The Yamal LNG project for Novatek in Northern Russia being the largest operational facility to date.

VALUE POTENTIAL FOR CLIENT

- **Well designed winterisation is a major benefit to personnel safety and reduces the risk of lost production.**

First cargo of LNG for the Yamal LNG project in Sabetta, North Russia offloaded on 8th December 2017

A fully winterised FPU design for the Shtokman development

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

For any project subjected to an Arctic-like environment, Technip Energies will implement many winterisation measures and actions to ensure personnel safety, structure robustness and plant operability considering the prevailing extreme weather conditions such as: temperature, wind, snow, icing, visibility and polar night (where applicable).

FOR A MAJOR PROJECT SUCH AS YAMAL LNG, THE ASPECTS STUDIED INCLUDED:

Structural Design:

- Snow load calculation
- Ice accretion allowance
- Permafrost study
- Elevation above ground

Coastal installation:

- Ice pile-up study
- De-icing of jetty decks and beths

Material Preservation:

- Intensive electrical tracing (including transport)
- Additional warm storages
- Injection packages, control valves and pumps in heated locals
- Heat traced pipes
- HVAC design margins.

Operations and maintenance:

- Meteorological monitoring website
- Overall plot plan review considering modules spacing, wind direction, utility corridors, HVAC, pipe racks access, utilidors location
- Specific trainings
- Exterior drainage systems
- Winter Diesel for vehicles

All these winterisation mitigation measures are proven technologies (TRL 8) but the skill is for the designer to select the most cost effective and safe options. Winterisation increases the cost of a development so good (experience-based) design decisions are essential to maintain project economics and personnel safety. Typically a risk based approach is adopted to provide the optimum balance between cost and safety.

FOR THE NORTH CASPIAN, SPECIFIC AREAS FOR FOCUS INCLUDE:

- In addition to extreme cold temperatures during winter, the North Caspian is subject to elevated temperatures during the summer, so material selection and stress designs have to accommodate a wide range of design temperatures
- The varying seawater level in the Caspian Sea and its effect in the shallow North Caspian area creates several challenges. These include a varying level for sheet ice and its contact with platform structures and encroachment onto artificial islands. It also influences the design of equipment used for escape and evacuation
- High H_2S levels require well ventilated facilities to maximize dispersion in the event of any leakage of toxic process gases. With extreme cold conditions and high winds, equipment and personnel need protection. Protection using enclosures reduces or eliminates natural ventilation and consequently introduces the risk of toxic and explosive gas cloud accumulation. Low cost mitigation measures include the use of perforated plate or mesh panels. Perforated plate or mesh panels located around equipment / topside areas reduces the wind chill index and provides a protected working environment for personnel, without jeopardizing the natural ventilation and therefore the safety of the facility.

3 | Flow Assurance (including hydrate and wax management)

TECHNOLOGY DESCRIPTION

Flow assurance refers to ensuring successful and economic flow of a hydrocarbon stream from a reservoir to the point of sale. It covers multiphase heat transfer, fluid mechanics, thermodynamics, fluid characterization and production chemistry. It encompasses network modeling and transient multiphase simulation, and involves the effective handling of many solid deposits (eg sand, gas hydrates, asphaltene, wax, scale, and naphthenates) and liquid emulsions. Fluid modeling includes simulation of steady state conditions, start-up (warm-up) and shutdown (cool-down) and transient flow conditions such as liquid slugging. Thermal behavior, insulation properties, pipeline heating and chemical injection (to maintain flow, assist separation and minimize corrosion) are all covered under flow assurance.

For this section relating to the North Caspian, the focus is on hydrate and wax management.

TYPICAL DEPLOYMENT

Flow assurance expertise is required for all offshore oil and gas projects. It is most demanding in the following circumstances:

- Platforms in extreme low atmospheric temperature environments (such as the North Caspian)
- Deep water field developments involving subsea systems subject to low seawater temperatures and hence prone to hydrate formation and wax precipitation
- HP/HT fields where low temperatures are created by the Joule-Thomson effect causing hydrate and wax formation risks and special requirements for material selection
- Sour fields where CO_2 and H_2S create corrosion/material selection and toxicity risks. High concentrations of H_2S also increase the hydrate formation risk
- Projects with long export (or infield) pipelines subject to low temperatures where fluid properties change along the length of the pipeline causing the potential for gelling and wax deposition (especially with high wax appearance temperature fluids)

PROJECT EXPERIENCE RELATED TO FLOW ASSURANCE

Both Technip Energies and Genesis have extensive experience of flow assurance as it features in every major project.

FOR TECHNIP ENERGIES, SOME MAIN REFERENCES ON EPC PROJECTS FOR FLOW ASSURANCE, HYDRATES & WAX MANAGEMENT, AND INTEGRATED MODEL (DYNAMIC SIMULATION) INCLUDE:

- Oil FPSO (Dalia, Akpo)
- Gas FPSO (Karish, Tortue)
- FLNG (Prelude, Coral)
- North Sea platforms (Martin Linge)

Both Technip Energies and Genesis have the following range of experience:

- Multiple Flow Assurance engineers, some of whom have PhDs in multiphase flow
- Experience in projects ranging from pre-feasibility through EPC to operations support
- Interfaces management with external parties (Client, Contractors)
- Shallow water, Deep water and onshore development experience
- CO_2 Transport and Injection

Production Chemistry

- Fluid characterization and tuning (simple and complex fluids)
- Wax characterization, tuning and deposition analysis
- Experience in high H_2S, high CO_2 fluids and emulsions
- Extensive knowledge in Multi-flash and PVTsim
- Multiphase Flow
- Experts in steady state and transient analysis (incl. HIPPS design validation, slug management)
- Gas condensate, volatile oil and heavy oil experience.
- Significant slug flow knowledge
- Extensive experience in multiphase flow simulators including OLGA/PIPESIM/ LedaFlow

Hydrate, Wax and Liquid Management

- Experts in design of hydrate, wax and liquid management strategies

Single Phase Flow

- Single phase hydraulics and pressure surge analysis
- Extensive experience in SPS / PIPEPHASE / PIPENET

In-house Design Tools

- Simulation control tools to make workflow more efficient
- Data extraction tools allow efficient management of large quantities of data

VALUE POTENTIAL FOR CLIENT

- **Flow assurance is critical to any development.**
- **When it is executed properly,** and as its name implies, it results in the most efficient, consistent, successful and economic flow of hydrocarbons from the reservoir to the point of sale. So it maximizes the revenue and hence rate of return for the development.
- **When not executed properly,** throughputs and uptime are negatively affected when flows become unstable/slug or in the worst case pipelines can block, with hydrates or wax, or become unusable through corrosion.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

The following sections list the general considerations for hydrate and wax management that also apply to the shallow water regions of the North Caspian region

SPECIFICALLY FOR HYDRATE MANAGEMENT THE FOLLOWING SHOULD BE CONSIDERED:

Insulate and Depressurise

- Longer tie-backs are at increased risk during well restart
- Large volumes of gas to be handled / flared
- Large volumes of liquid to be handle

Continuous MEG Injection

- Large injection rates required to inhibit produced water if water cuts are high
- Reclamation and regeneration facilities necessary
- High CAPEX and OPEX
- Souring of MEG is an issue for high H_2S fields

LDHI (Low Dosage Hydrate Inhibitors)

- In some cases where hydrate formation is marginal, LDHIs can be considered

Electrical Heating

- Required to maintain fluid temperature following shut-in
- Direct Electrical Heating (DEH) is a well proved option. Alternatives are Electric Heat Tracing Pipe-in-Pipe (EHT PiP), or EHT flexible or rigid pipeline bundles
- Longer pipeline lengths pose technical challenges
- Can also be used for wax management at turndown

Displacement

- Complete removal of uninhibited fluids following shut-in
- Large displaced volumes to be managed

Dehydration

- Removing water at source removes hydrate issues
- Requires more complex offshore processing

Specifically for wax management the following should be considered:

- Pipeline burial (insulation) may retain temperature above WAT
- Risk of dropping below WAT at low flow-rates
- Electrical heating could be used if selected for hydrate management
- Inlet heating can expand pipeline operating envelope
- Wax inhibitor used alongside other options
- Periodic pigging to minimize wax build-up

General Design Capabilities

1. SOUR GAS TREATMENT
2. MODULARIZATION
3. VALUE ENGINEERING
4. HEALTH, SAFETY & ENVIRONMENT
5. ROBOTIC SOLUTIONS
6. ULTRA FRONT END COST ESTIMATING
7. BIRD INVIGILATOR

1 | Sour Gas Treatment

PROJECT EXPERIENCE RELATED TO SOUR GAS TREATMENT

Focusing on gas sweetening, Technip Energies has designed over 50 plants for the removal of carbon dioxide and Sulphur components from natural gas using chemical or physical solvents for a total installed capacity of about 20 BSCFD with the largest single unit capacity at around 1.5 BSCFD. The acid gas content ($H_2S + CO_2$) of gases ranges from a few ppm to 60%.

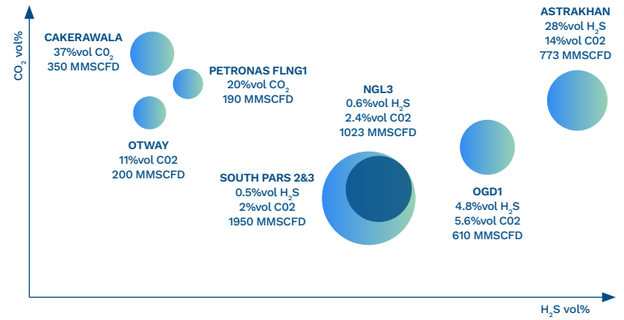
Technip Energies designs gas purification plants (sweetening, sulfur removal) based on generic open-art solvents as well as proprietary formulated solvents such as UCARSOL (Dow Chemicals), GAS/SPEC (Ineos) among others.

Technip Energies has also access to most licensed technologies includingAdvAmine™,HySWEET®, COSweet® or SweetSulf®

(Total/Prosernat), OASE® (BASF), Amine Guard™ FS (UOP) as well as Sulfinol or ADIP technologies (SGS).

In addition, Technip Energies has non-exclusive agreements with OASE® (BASF) and UOP to be sub-licensor of their AGRU processes.
Technip Energies has also major references in CO_2 removal on membranes and works with the main membrane technology suppliers such as UOP, Cameron, Air Liquide, Porogen, MTR to provide optimized solutions to our clients.

A selection of Technip Energies references is plotted in the following chart against the feed gas CO_2 and H_2S content. The size of the circle corresponds to the plant capacity.




Plateau Maintenance Project for Qatargas

Technip Energies has used this extensive experience in AGRU desighn, combined with its offshore experience, to design AGRU units for several floating LNG projects, such as Petronas SATU FLNG (currently in operation), ENI Coral FLNG, Petrobras FLNG, Bonaparte FLNG, Prelude and Browse FLNGs. For these projects,

Technip Energies has worked closely with most of the major AGRU licensors (BASF, PROSERNAT, SHELL and UOP) to challenge their design, and in particular the motion study and the sizing of the columns (absorber and regenerator) thanks to its knowledge in mass transfer.

Re-FEED (2008), FEED (2006-2007) and EPC project including a 1100 MMSCFD acid gas removal unit (AGRU) using PROSERNAT technology and a 99,8% sulfur recovery unit (SRU, 880 t/d) on KTI technology (Ras Laffan, Qatar, 2010- 2013)

2 | Modularization

TECHNOLOGY DESCRIPTION

Traditional or conventional onshore construction is referred to as “stick-built”. In this case the equipment is individually transported to site, placed in its final position and all interconnecting piping and cabling are assembled around it on site. This method requires a large onsite construction workforce.

Modular construction involves a group of equipment items being assembled together within a structural steel frame together with all their interconnecting pipework and cabling. The module is usually fabricated at a specialist construction yard and often within the controlled environment of an assembly hall. The module is much larger and more difficult to transport to the final site, than individual equipment items, but once there the interconnection of modules takes relatively few man-hours.

A stick built refinery (oaoa.com) compared with a large offshore module / integrated deck

TYPICAL DEPLOYMENT

Modular construction has always been used in offshore projects to minimize expensive offshore construction man-hours. Early large offshore platforms had module support frames on which multiple modules were lifted into place. As offshore crane / lifting capacity increased over the years, “integrated decks” were used where the entire topside facility was incorporated in one single module. By using the float-over method, even larger/heavier integrated decks could be installed beyond the capacity of crane vessels.

Onshore construction has traditionally been performed using the stick-built method but through the success of projects like Yamal LNG by Technip Energies more onshore operators are now considering the modularisation option, including for refineries.

Modularisation is particularly advantageous where the final site is in a remote and/or an extremely harsh weather environment such as Yamal (Western Siberia, N.Russia).

Yamal Module Transportation

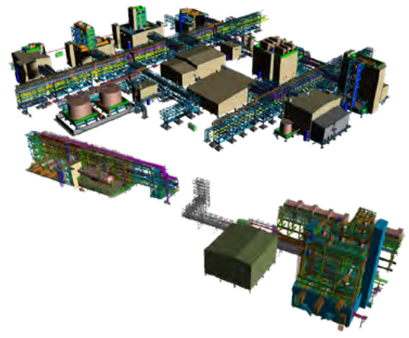
PROJECT EXPERIENCE RELATED TO MODULARIZATION

Technip Energies has developed a leading expertise in modular design, construction, transportation and installation through an extended track record in large Offshore projects from the pre-FEED stage through to EPC delivery. This experience covers a wide range of module sizes and weights, from a few hundred tons to integrated decks of more than 30,000 tonnes. This unique Offshore experience has enabled Technip Energies to transfer this expertise to onshore projects and unlock major savings in mega projects like Yamal LNG.

The Yamal project gives a clear demonstration of Technip Energies capability to manage large-scale modular based projects, with a supervision team of around 300 managers and engineers working on 10 Asian yards.

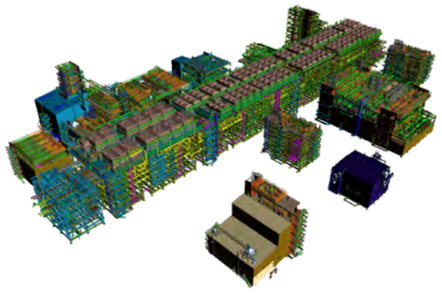
Technip Energies managed the construction of more than 450,000 tonnes of process/ utility and pipe-rack modules for this onshore LNG facility. This achievement brings a unique experience in Yard management and supervision, to helps ensure future projects also maintain their fabrication on schedule whist still meeting the highest standards of Project Quality and HSE requirements.

The Yamal LNG site in West Siberia, North Russia



off-site & utilities

MORE THAN
450,000
TONS OF PROCESS / UTILITY AND PIPERACK MODULES



process trains

Technip Energies also executed the BP Shah Deniz project whereby the TPG 500 production jack-up platform was designed in modular self-floating strips. They were fabricated in a Singapore Yard, dry transported to Rostov and then pushed by barges through the Volga Don canal and across the Caspian Sea to Baku where they were assembled into a 22,000 tonnes topsides in a floating dock. As a result, Technip Energies has significant experience of the logistics of transporting equipment and modules into the North Caspian.

VALUE POTENTIAL FOR CLIENT

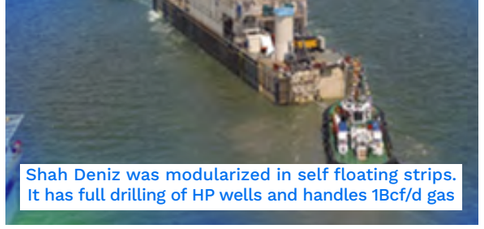
- **Modularization can create significant value on projects** in remote and/or an extremely harsh weather environment such as Yamal or in the North Caspian.
- **The benefits include lower overall project cost and schedule,** improved safety and quality leading to lower OPEX.

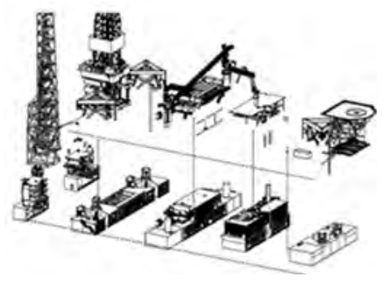
TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

For a given development, the modularization strategy will be optimized to adjust to the project context, and a mix of 'stick-built' & 'modular' approaches can sometimes be chosen to best comply with project constraints and requirements.

The advantages of modularization are as follows:

- The productivity of skilled shop craftsmen is ca 30% to 50% higher than field craftsmen. This difference results in a considerable saving in the total project man-hours. This saving offsets and can often exceed the difference in greater modular engineering and transportation costs.
- Reduction in overall manpower and resources on site reduces the number of personnel being to exposed to risks due to a reduction in labour density during construction
- Quality is more easily assured for modules fabricated at the yard and reduces costly rework at site
- Testing and pre-commissioning can be performed at the yard
- Weather related delays do not occur with shop fabrication.
- Temporary construction site facilities are not required to be very elaborate as total man-hours and duration are greatly reduced
- The availability of skilled craftsmen in certain areas is a major problem. For remote locations, skilled craftsmen may have to be relocated from other areas which adds cost to the project
- Labour disputes are a part of the site-construction scene and can have adverse effects on the cost and schedule. In the shop, the labour relations are more predictable and are often much better due to the stability of the work force. This, in part, is also due to the better working conditions and environment in a fabrication shop
- In modular construction, the site construction time is very short, it is often possible to schedule the installation of the modules during the most favourable time of the year
- The foundation requirements are simplified. And for onshore projects, as most of the concrete foundation work cost is labour, this simplification often results in considerable savings
- Quality control in the fabrication shop environment results in a higher quality plant at lower inspection and testing cost
- Control of the incoming materials and issuing materials to the shop floor are simplified by standard procedures. Inventory control in the shop is far better than in the field due to the stability of the situation
- Availability of different disciplines at the fabrication shop such as insulation, paint, non-destructive testing, pressure testing, pre-commissioning, commissioning, etc., results in a shorter schedule and increased cost savings
- Shorter overall project schedule
- Lower overall project cost
- Due to the fact that access to a fabrication yard is easier than an erection site from a security point view and cheaper transportation options, engineering teams can provide far greater and faster technical backing to fabrication activities. Furthermore young engineers could gain great experience from such visits


Shah Deniz was modularized in self floating strips. It has full drilling of HP wells and handles 1Bcf/d gas



The modularization method also has increased advantages under certain conditions, such as:

- Modular arrangement requires lesser footprints as a result of equipment stacking which is desirable where real estate is a premium
- Limited plot space to accommodate a large number of construction crew
- Remote site location (eg artificial islands, mountains etc.)
- Bad weather conditions at the plant-site such as extreme heat or cold, frozen ground, snow, etc.

For North Caspian projects, modularization is essential for minimizing offshore construction, cost and schedule.

3 | Value Engineering

CAPABILITY DESCRIPTION

The key objective of Value Engineering (VE) is to optimize a project's overall cost and schedule by identifying, selecting and implementing the most economical design solutions and working processes, without compromising quality, HSE, performance, operability and reliability.

It implies a constant cost-driven spirit supported by some in-depth reviews to be conducted between disciplines and partners working on a project from the very beginning and all through the project's execution, with the main objective to find savings and to tailor the project to meet (and not exceed) the strict functional requirements.

TYPICAL DEPLOYMENT

VE CAN BE UTILISED DURING ANY OF THE DIFFERENT EXECUTION PHASES OF A DEVELOPMENT:

- **Proposal :** to define the most competitive execution plan, design, and bid,
- **Basic Design (BD)**
- **Front End Engineering Design (FEED)**
- **Detail Design (DD):** to execute the project in the most economical way

PROJECT EXPERIENCE RELATED TO VALUE ENGINEERING

Technip Energies performs VE on many of its projects.

VALUE POTENTIAL FOR CLIENT

- **VE has the potential to improve the financial performance** of any project and may even enable seemingly uneconomic developments to achieve the economic metrics required for sanction.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

Technip Energies operates a formal VE Procedure that gives guidelines:

- **To define** the Value Engineering strategy
- **To develop** the execution plan
- **To organise** and manage the different creativity workshops
- **To monitor** and report the results

The Project Manager is responsible for initiating the formal VE process, where this is deemed necessary. The VE process begins with a specific VE strategy meeting, organized by the Project Manager, in order to define and set up the VE strategy that will be applied on the project. This meeting will decide the objectives; the constranits & flexibilities/ opportunities; and the allocation of objectives per discipline.

A VE kick-off meeting will follow with the appropriate project team members to cover the following areas that will ultimately constitute the Project VE Execution plan:

- **Provide** a clear definition of the VE strategy
- **Define** key milestones for implementing the VE actions within the project schedule
- **Discuss** the list of Disciplines VE Reviews that are appropriate to the project (the VR Review documents define the scope of the VE review per discipline)
- **Confirm** the Methodology and Tools that will be used during the various steps of the process for:
  - Identification, follow-up, selection of the ideas during the reviews
  - Evaluation of the ideas (feasibility, economic impacts, risks and mitigation plan)
  - Monitoring of the disciplines progress

Following the kick-off meeting, the disciplines revert with an updated list of VE Reviews and the Project VE Manager issues the approved Project VE Execution Plan for implementation.

The VE reviews are then organized with the appropriate disciplines in order to identify any cost or schedule savings, by challenging the status quo. Joint VE reviews with vendors of critical packages are often held using a similar process using a checklist for guidance. Similarly a joint VE review with a construction sub-contractors would normally be performed using the checklist of the constructablility review as guidance.

The success of the VE process relies on having the requisite experienced discipline input and good preparation before the VE review meetings, including checklists of points to challenge.

The creativity workshops are led by a facilitator to chair the sessions, to encourage the voicing and development of ideas and monitor the timing. Another participant is tasked with accurately tabulating the ideas and recording any relevant points discussed and actions proposed.

During the creativity workshop, and based on a preliminary cost and risk evaluation made during the session, a pre-ranking of each idea is decided using the following scale:

1 = Rejected
2 = To be evaluated
3 = To be implemented

Following the creativity workshop, ideas graded 2 and 3 are subject to an analysis phase when they are substantiated and subject to a more detailed evaluation of cost (CAPEX and OPEX), schedule and risks (including mitigation measures).

The decision to select which ideas are to be implemented (taking due account of the risks, and the potential beneficial impact on cost and schedule) is taken during a dedicated meeting. The participants of the decision meeting will normally include the Project Manager, Project VE Manager, Engineering Manager, the Project Cost Control and Schedule Engineers, the relevant Discipline VE Leader(s), the person(s) who was in charge to substantiate and evaluate the idea, and the client where appropriate.

During the implementation phase, the selected ideas are either implemented in the current project phase, or retained for the following one, as the case may be. During this phase the target achievment is monitored and reported on a monthly basis and a corrective action plan issued if needed.

At the end of the VE process, each selected cost reduction opportunity is recorded and shared within the relevant discipline department / division to be easily reused for future VE reviews on future projects. A best practices list is updated accordingly.

By using these rigourous VE procedures, Technip Energies has been able to add considerable value to previous projects.

Genesis has a similar but simplified process for the evaluation of VE opportunities during the ultra front end phases of projects based on **what? why? how else?**

METHODOLOGY

4 | Health, Safety & Environment

CAPABILITY DESCRIPTION

Within Technip Energies, we are all responsible for considering HSE not just as a goal, but as a means to create a culture where HSE performance allows us to succeed in our business.

HSE is conceived holistically, i.e. encompassing accidents, harm to people and damage to the environment. We look at ways to reduce emissions and optimize energy consumption as well as deliver facilities that can be safely used by our clients.

At Technip Energies, we use targets to measure our HSE performance, listen to anyone for suggestions on how to improve, and work with partners to raise the bar and transparently report outcomes. We are all empowered to show leadership to ensure HSE is strongly embedded into our, and our team's, day-to-day activities to drive Technip Energies to the top of HSE reference companies.

TYPICAL DEPLOYMENT

HSE is a vital component of every phase of a project from design through construction to operations. In Technip Energies HSE is enshrined in two of our five foundational beliefs: safety and sustainability.

OUR FOUNDATIONAL BELIEFS

In everything we do, we never compromise on:

- Safety
- Integrity
- Quality
- Respect
- Sustainability

PROJECT EXPERIENCE RELATED TO HSE

Technip Energies has unrivalled recent HSE experience on its two (one recent and one current) mega projects in Russia: Yamal LNG and Arctic 2. These projects, through their complexity and execution in an ultra-harsh environment demonstrate our ability to deliver outstanding HSE performance on demanding / frontier projects.

VALUE POTENTIAL FOR CLIENT

- **The benefits of outstanding HSE performance** are building trust, an enhanced reputation and a better and more sustainable business outcome.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

IN TECHNIP ENERGIES, THE HSE MANAGEMENT SYSTEM IS AT THE HEART OF OUR LEADERSHIP CULTURE. IT INCLUDES:

- **Preparation of an HSE Risk Assessment** for all jobs to be performed
- **Setting of HSE objectives** consistently with the various risks analysis
- **Compliance** with Technip Energies HSE Management procedures and Project HSE Management Plan
- **Latest feedback** from Project Management
- **Synergi Life:** our global HSE & Quality reporting and follow-up tool for incidents
- **Mobilization** of proper personnel to lead and/or perform incident investigations (TOPSET methodology)
- **Management of Change process** considering all dimensions, especially HSE
- **Clear and objective information** including periodic comprehensive HSE reviews, not just tracking numbers

As a complement to its HSE Management System, Technip Energies operates the "Pulse Programme" a global HSE Culture and engagement program. The Pulse Program includes the following:

- **Develops leadership** behaviors to prevent HSE incidents
- **Provides a single and global HSE Culture**
- **Supports people** to effectively use the principles, standards and tools
- **Helps us realize** the company's global HSE policy, support our Code of Conduct, and deliver upon our vision and values
- **In Technip Energies,** we create, improve and sustain a positive HSE Culture by influencing the perceptions of our employees through our own behaviors as leaders.

IN TECHNIP ENERGIES, OUR ENVIRONMENT FOCUS IS ON REDUCING THE IMPACT OF OUR ACTIVITIES ON THE ENVIRONMENT.

Our lifecyle perspective allows us to reduce environmental impacts by:

- **Performing** a risk and opportunity analysis, based on context, on obligations and onoperationalconditions(ENVID)
- **Determining** the significant aspects and objectives, in alignment with Technip Energies focus
- **Periodically** reviewing our performance.

As HSE leaders, we:

- **Always integrate the environment** when setting objectives
- **Ensure** the existing competences / resources contribute to system effectiveness
- **Support** staff and subcontractors in protecting the environment
- **Request** the evidence of environmental audits or inspections conducted by sites
- **Ensure** a continuous monitoring of an action plan and the reporting / communication of its environmental performance
- **Ensure** a continual improvement approach is set up

FOR THE NORTH CASPIAN, THERE ARE SPECIFIC AREAS OF FOCUS FOR HSE TROUGHOUT THE PROJECT PHASES:

Design

- The extremely harsh environment (ultra-cold and large temperatre range) creates challenges for the design of structures to resist sheet ice / ridge loads and to avoid damage from ice rubble encroachment onto artificial islands. Technip Energies uses its Ice-MAS program to simulate ice loadings and optimise structures and island layouts to prevent damage to facilities.
- The typically high toxicity / H_2S content of the well fluids in the region is a lethal hazard to personnel and can create ultra-fast corrosion of unsuitable materials. Technip Energies are experts at CFD simulation of toxic gas cloud dispersion and can determine safe distances for personnel and set the facility layout accordingly.
- Escape / evacuation from platforms and islands surrounded by water, or ice, or a combination of both, requires specialist knowledge of survival craft and their capabilities/ maturity. This has been addressed in detail on previous projects in the region and is updated as new products arrive on the market.

Construction

- The efficient operation of fabrication and construction yards in extreme low temperatures is an area in which Technip Enegies has extensive experience through its two mega-projects (one recent and one current) in Arctic Russia: Yamal LNG and Arctic 2. The yard productivity and safety record on these projects have been exemplorary.

Operations

- The safety of personnel and protection of the environment during the operations phase of a facility starts with a roboust design and relies on an ongoing adherence to good operating and maintenance practices. Technip Energies, through its wholly owned subsidiary Cybernetix, is developing a service offering based on robotics (crawler robots with arm/manipulation/ intervention capabilities and drones for aerial visual inspection) to assist with facilities operations and maintenance tasks.

5 | Robotic Solutions

TECHNOLOGY DESCRIPTION

Offshore Robotics covers several areas including crawler-based robots for inspection only and with manipulation, drones for aerial inspections (including some NDT functions) and magnetic crawlers for vessel inspections and maintenance (cleaning and re-coating). The robots are capable of performing tasks normally handled by human operators either in a teleoperated or autonomous mode. The robots are good at performing repetitive tasks with high accuracy and collecting data for condition monitoring purposes. They are also well suited to tasks involving high risks to human operators, such as confined vessel entry and general operational surveillance and intervention in toxic gas environments.

TYPICAL DEPLOYMENT

Robotics can be deployed on any Offshore projects / operational assets (eg fixed platform, artificial island, FPSO, FSO, FLNG, semi, TLP's..Etc).

Technip Energies is using drones in a construction yard to monitor progress and safety (eg wearing of PPE).

To date, drones have been used on Offshore platforms for inspection tasks (eg flare tip and under deck inspections) to avoid the use of scaffolding and minimize human exposure/risk.

Crawler based robots have only been used offshore in pilot schemes involving inspection tasks such as Shell's Sensabot robot and the Total sponsored Taurob robot.

PROJECT EXPERIENCE RELATED TO ROBOTIC SOLUTIONS

Technip Energies, through its 100% owned subsidiary Cybernetix, has extensive robotic solutions experience gained in the harsh environment of the nuclear industry. On these projects, Cybernetix has supplied heavy duty crawler based robots with multiple tooling capable of performing plant decommissioning / dismantling.

Remote operation of a Cybernetix heavy duty crawler based multi-tooled robot

Since 2016, Technip Energies has pursued and sponsored a program enabling Cybernetix (CYX) to develop an offshore platform robot. By the end of 2019, CYX had fully designed a robot comprising of a crawler and robotic arm capable of performing useful tasks on an offshore platform. It had created a Demo & Mock-up center at its facility in Marseilles where a highly successful Proof-of-Concept (PoC) was performed with multiple clients in November 2019. At the PoC, crawler navigation and collision avoidance were demonstrated as well as complex arm manipulation (including force feedback) to perform dexterous tasks such as taking liquid/gas samples. Now in 2020, CYX are integrating the ATEX arm and crawler with the intention to pilot test this robot on client facilities starting in 2021. The Offshore platform robot will have the capability for high definition visual inspection, lower definition night / infrared vision, gas detection, vibration sensing, acoustic sensors with spectral signature analysis plus dexterous manipulation of valves and liquid/gas sampling (including high toxicity fluids).

One of the major differentiators for Cybernetix is their development of a force feedback system for its manipulator arms that enables the teleoperator to feel how much force is being applied to an item such as a valve spindle. This eliminates the risk of equipment damage that has been experienced when using high force / high torque arms used on conventional ROVs.

VALUE POTENTIAL FOR CLIENT

- **Robotic solutions** such as crawler robots and drones have the potential to reduce OPEX by performing accurate and repetitive inspections to support condition monitoring schemes. Drone inspections can eliminate the expense and time taken to erect scaffolding.
- **They also improve safety** by reducing operator risk by performing confined vessel entries and operational tasks in toxic gas environments. They can also intervene in hazardous situations (eg H_2S releases) to isolate the leak source using manually operated valves (where actuated valves are not available or are not functioning).
- **For unmanned developments, robots and drones** can be deployed remotely and provide additional operational feedback to the remote control center and thereby assist with production restarts by checking facility status not covered by other devices (eg gas detectors, CCTV).
- **Robots** have the potent to significantly lower CAPEX if used to enable the unmanning of a facility and the removal of living quarters and life support utility systems required for permanent manning.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

Robots are of limited use unless the information they receive as they perform their function cannot be digitized and made available in a useful form and can be interfaced with existing platform systems.

Cybernetix has developed a sophisticated software system called CyxPro which is used for robotic mission planning and execution and that can interface with 3rd party robots and drones and manage multiple mission of different devices in parallel. The software provides a report via the internet (eg to a mobile phone or via email) when a mission is completed.

CyxPro collates the information from all robotic devices, analyses it and communicates key parameters / alarms to the facility ICSS.

Within the timescale of future greenfield Caspian projects, offshore robotics has the potential to unlock significant value by reducing OPEX and improving the up time of ultra-sour fluids production where human intervention can be difficult or risky.

Cybernetix robotic test facility in Marseilles and the fully ATEX heavy duty robot design

6 | Ultra Front End Cost Estimating

TECHNOLOGY DESCRIPTION

A suite of bespoke cost estimating tools, based around Genesis' in-house cost estimating software, ADEPT, that rapidly develop the technical definition to produce Class 4 and 5 cost estimates. The tools are used by Genesis Advisory to maximize operators profit by identifying and assessing opportunities to optimize designs at the project Ultra Front End i.e. Assess, Select and Pre-FEED stages.

PROJECT EXPERIENCE RELATED TO ULTRA FRONT END COST ESTIMATING

Genesis has extensive global experience of UFE cost estimating. Within the North East Caspian region Genesis has executed the following studies for NCOC:

- **Kashagan Future Gas Export Assess,** Select and Pre-FEED Studies
- **Kashagan Full Field** Assess Study
- **Kashagan Sour Gas** to 3rd Party Assess and Select Studies
- **Kashagan D-Island** Debottlenecking Select Study
- **Aktote** and Kairan Fields Assess Study
- **Kashagan New Compression** Facilities Assess and Select Studies
- **Kashagan Gas** Re-Injection Project Assess and Select Studies
- **Kashagan Pipeline** Optimization, HDD Installation, UHP Pipelines Studies
- **Kashagan DC-05** Tie-Back Assess and Select Studies

VALUE POTENTIAL FOR CLIENT

- **Field developments** can only achieve their maximum value potential if they are subject to the rigorous identification and screening ofw options using accurate and rapid ultra front end estimating techniques.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

In order to select the optimum field development plan, a rapid estimating of total project costs is required including DRILLEX, CAPEX, OPEX and Economics for the facilities, logistics and the supporting infrastructure.

The unique features of the ultra front end cost estimating tools used by Genesis for the North East Caspian Region include:

- **Ice resistant offshore satellite** drilling islands with modularised HPHT sour topsides with detailed evaluation of construction support vessel requirements
- **Ice resistant offshore** processing and logistics hubs on elevated barges, artificial islands, grounded barges, air-cushioned barges
- **Extreme shallow water pipelines,** umbilicals and cables installation, including HDD, dredge tow, string tow and push pull installation methods
- **Offshore facilities installation** in extreme shallow water including dredged marine access channels, causeways, submerged roads, air cushioned vehicles, wading vehicles
- **Onshore world class** sized modularised or stick build processing facilities and supporting infrastructure, including MEG Reclamation and desulphurisation
- **Detailed logistics models,** including global yards to offshore and onshore Caspian sites through the Russian Inland Waterway System and Caspian Transportation Route Channel
- **Brownfield modifications** in offshore and onshore sour gas environments

7 | Bird Invigilator

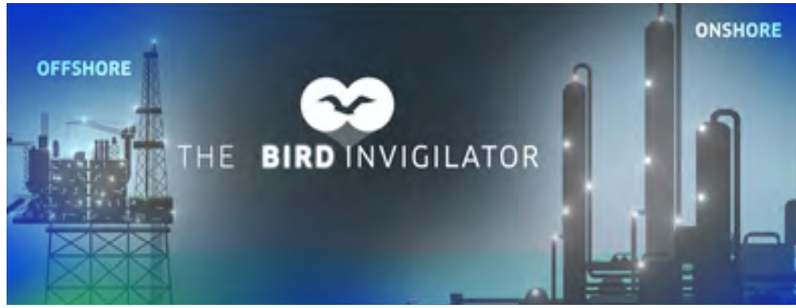
TECHNOLOGY DESCRIPTION

The purpose of the Bird Invigilator is to predict, up to 10 days in advance, the arrival of migratory birds crossing the plant location and propose a reduction in the facility lighting down to an adequate level for the birds.

TYPICAL DEPLOYMENT

The Bird Invigilator is appropriate for deployment in areas crossed by the flight path of migratory birds for the following facilities:

- **Offshore structures** operating 24h a day
- **Onshore structures** operating 24h a day
- **Urban infrastructure** with high light intensity (eg stadiums, skylines)



PROJECT EXPERIENCE RELATED TO THE BIRD INVIGILATOR

The Bird Invigilator will be implemented on Energean's KARISH FPSO by the end of 2020.

VALUE POTENTIAL FOR CLIENT

- **Biodiversity conservation / improved** environmental impact
- **In case of mitigation required by EIA** (Environmental Impact Assessment) for migratory birds, the Bird Invigilator can be proposed instead of blue / green light, with a potential cost reduction on a large facility of around 2 millions euros for the whole structure on the lighting CAPEX budget.
- **Lighting minimization** and energy saving creates a minor OPEX reduction
- **Limits operator accidents** related to blue / green lighting and to migratory bird catching

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

- **The first software** is based on a theoretical model (birds species are divided according to their type of migration)
- **The second software** is based on a machine learning model

Fabrication & Installation Expertise

1 LOGISTICS

2 FABRICATION OPTIONS

3 T&I: FLOAT-OVER

4 PIPELINES DESIGN AND INSTALLATION

1 | Logistics

CAPABILITY DESCRIPTION

Logistics is the activity of organising and implementing the transportation of equipment and materials to a fabrication yard(s) and then of modules from the yard(s) to site in an efficient and timely manner. Logistics involves transportation, inventory, packaging, supplies and warehousing.

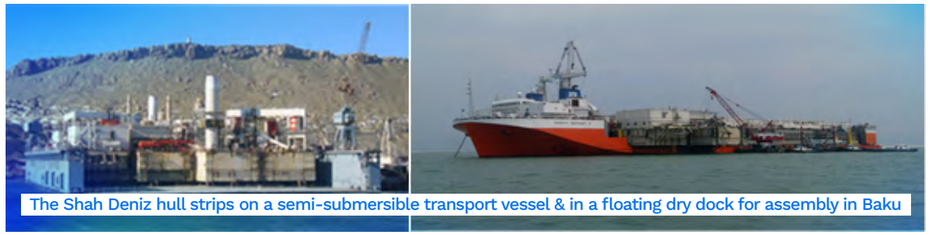
TYPICAL DEPLOYMENT

Logistics is a particularly critical part of projects being developed in frontier regions or areas where access is restricted by geography, climate or a lack of infrastructure.

Logistics related to North Caspian projects have to contend with the land-locked geography of the Caspian Sea and the restricted physical size and seasonal access into it via the Volga Don and Volgo Balt canal systems. Transport into the North Caspian region via rail and road have to cope with harsh sub-zero/ icy weather conditions, and hence limitations, during the winter months.

PROJECT EXPERIENCE RELATED TO LOGISTICS IN THE NORTH CASPIAN

Technip Energies executed the BP Shah Deniz project whereby the TPG 500 production jack-up platform was designed in self-floating strips. They were fabricated in a Singapore Yard, dry transported to Rostov and then pushed by barges through the Volga Don canal and across the Caspian Sea to Baku where they were assembled into a 22,000 tonnes topsides in a floating dock. As a result, Technip Energies has significant experience of the logistics of transporting equipment and modules into the North Caspian.



The Shah Deniz hull strips on a semi-submersible transport vessel & in a floating dry dock for assembly in Baku

In 2018, Genesis performed a logistic study for the NCOC Aktote and Kairan fields. For this development, the potential size of topside modules was reviewed considering a range of transport options from yards to site including: dredging a channel or fabricating a trestle structure (long bridge) or a causeway. Such studies help to identify the most practical module size for the project and the most cost efficient means of delivering them to site.

VALUE POTENTIAL FOR CLIENT

- **Logistics related to North Caspian projects** is one of the most critical factors at determining the cost efficiency of the overall development. Well planned and executed logistic are the foundation for a successful project in the North Caspian region.

CAPABILITY DETAILS AND NORTH CASPIAN FOCUS

On the BP Shah Deniz project, Technip Energies played a major role within BP's integrated 'River's Management Team' (RMT). The team was formed to ensure an efficient working relationship with the various Russian authorities and to facilitate the permit application process and associated activities in order to enable timely and safe transport of all out of gauge cargo through the Russian Canal and River system into the Caspian Sea.

The team was centered on Moscow but included participants from other locations including naval architects and marine warranty surveyors. It was the sole point of contact with the Russian authorities and issued all the required permits, in the required format, for out of gauge cargo that traveled through the Russian Canal System. Despite the involvement of BP, the responsibility for physical execution of all canal movements still remained at all times with Technip Energies.

An essential part of this logistical effort was to obtain and maintain an up-to-date survey of the Russian Canal and River System waterway including locks, air draft limitations from bridges and overhead cables (including during flood conditions), other obstructions and operational water levels / draft limitations during the open season.

2 | Fabrication Options

CAPABILITY DESCRIPTION

Fabrication options refers to the evaluation of different construction alternatives / construction companies and the selection of the optimum one.

TYPICAL DEPLOYMENT

Technip Energies does not own any construction capability therefore on every EPC project, they will either partner with a construction company (in JV or Consortium) or subcontract the work to a construction company. Given the global reach and number of Technip Energies projects, it has established many long term partnerships with construction companies and therefore has an intimate knowledge of their capabilities (both strengths and weaknesses). Technip Energies monitors the major construction company's activities on an on-going basis, recording the work they are bidding and winning in order to maintain an up-to-date and independent view of their capacity for additional project work.

However, when Technip Energies executes projects in frontier regions or areas where they have not operated for some time, they need to perform a complete and thorough review of construction companies that are relevant to the development. This involves a complex process and is the subject of this section.

PROJECT EXPERIENCE RELATED TO LOGISTICS IN THE NORTH CASPIAN

During the early engagement phase of the BP Shah Deniz project, it became obvious to Technip Energies that a radical design and construction options would be required for the project to succeed. This was because the conventional platform design (ie jacket and topsides) that BP had adopted for its ACG project phases was utilizing the main fabrication yard in Baku and the sole large installation barge (STB-1).
So that the Shah Deniz project could be executed in parallel to the ACG projects, Technip Energies proposed the TPG 500 self-installing platform which did not require a large installation vessel, only tugs.
To cope with the fabrication limitations in Baku at the time of the ACG projects, Technip Energies designed the TPG 500 platform in self-floating strips so it could be fabricated outside the region, brought through the Volga Don canal system and assembled in a floating dock and completed in the Zykh yard. The project success depended on the assessment of the floating docks and various fabrication options in Baku. The final selection of the Zykh yard was made for its potential for upgrading and its location to attract local labor not already deployed on the ACG projects. Details of the yard upgrade are covered in the local content section of this document.

On the Turkmen GBS project for Petronas Carigali, Technip Energies performed a similar yard assessment. Having defined the yard upgrades, Technip Energies oversaw the work and successful fabrication of the 7000 tonne GBS, 5500 tonne topsides. On that project a new barge (the "Dagbasy") was designed and built specifically for the topside installation and for load-out of the GBS from the chosen yard.

The Turkmen project with GBS, topsides and new installation barge "Dagbasy" all built in Turkmenistan

On the Kashagan project, Technip Energies performed a detailed evaluation of yard capabilities in 2012 for NCOC/ Shell as part of the Pearls De-risking Study.
This comprehensive review covered the following areas:

Fabrication yard capacity (incl condition, committed and anticipated workload, tonnage), yard layout (incl shops, laydown, assembly areas, storage, quay length and load-out capacity, water depth), upgrades, equipment (incl. cranes/ lifting devices, forklifts, welding, coating), track record (incl productivity by trade), material control procedures, T&I capabilities (incl barges, tugs, load-out equipment), subcontracting strategy, engineering capability, IT systems, HSE procedures and record, QA/QC, sustainability, normal and extended working hours, local labor content, fabrication methodology, organization (incl interface management), others.

More recently in 2018, Genesis performed an initial construction fabrication and logistics report for the Aktote and Kairan development Assess Stage. This study evaluated logistics (including marine access, water level uncertainty, dredging, the available barge fleet and their draft requirements, potential module sizes and weights, tressle access structures using the marine and cantilever method, and causeways) and fabrication options inside and outside of the Caspian.

VALUE POTENTIAL FOR CLIENT

- **Selection of the optimum fabrication option** is one of the main drivers for a successful project. It has a major influence on project outcome in terms of cost, schedule, quality, HSE, local content and sustainability.

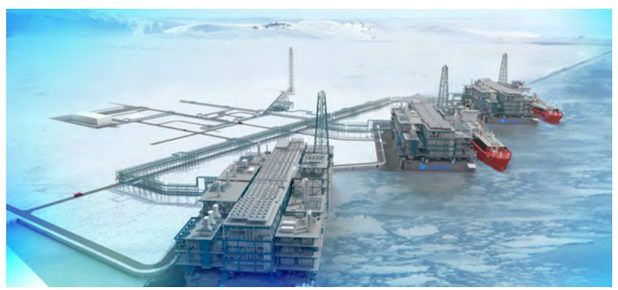
CAPABILITY DETAILS AND NORTH CASPIAN FOCUS

Technip Energies, through its track record of successful major projects, has the capability to select the best fabrication option and manage its outcome for any given development from small through to mega projects like Yamal LNG and Arctic LNG 2.

Arctic LNG 2

A major EPC contract for Novatek located in the Gydan peninsula in West Siberia, Russia. This development consists of three liquefied natural gas (LNG) trains, each with a capacity of 6.6 Mtpa.

Fixed near-shore terminal for production storage & offloading of LNG & stabilized gas condensate on gravity based structures (GBS). Preparation of the Proekt based on the results of the FEED in accordance with applicable Russian laws and regulations including procurement of positive reports from GlavGosExpertisa.



3 | T&I: Float-over

TECHNOLOGY DESCRIPTION

Transport and Installation (T&I) using the float-over method involves the single installation of an integrated topsides by using a transportation vessel or barge. There are two distinct float-over methods:

- **Passive installation :** Load Transfer is performed by ballasting a vessel or barge. A hydraulic jacking system can be used to perform an active load-out from the yard onto the transport vessel or barge.
- **Unideck installation :** Active System, comprising of hydraulic jacks, allows installation of large topsides in long swell environments (typically West Africa, India, Western Australia...) and can enable the use of a smaller vessel or barge.

TYPICAL DEPLOYMENT

The float-over method is used for the following:

- **Integration of topsides** onto fixed substructures
- **Mating of topsides** onto a lower (floating) hull
- **High airgap platforms**

A typical large topside installation by float-over into a fixed jacket

PROJECT EXPERIENCE RELATED TO FLOAT-OVER

A partial project list of Technip Energies float-over operations is as follows:

Passive float-overs (by ballasting)

- ADMA - UMM LULU / GPF
- QP - FMB
- PETRONAS - SK-316
- CONOCO - NORTH BELUT
- MURPHY - KIKEH Spar (catamaran float-over)

Active float-overs (using hydraulic jacks)

- ONGC - HRD
- TOTAL - OFON 2 / AMP 2
- EXXON - EAST AREA
- ADMA - UMM LULU

VALUE POTENTIAL FOR CLIENT

- **Installation** of integrated topsides (fully commissioned onshore & limited offshore hook-up)
- **No mobilization** of additional marine spread (heavy lift crane)
- **No limitation** on topsides weight
- **Weight** saving for active compared to passive

CAPABILITY DETAILS AND NORTH CASPIAN FOCUS

Technip Energies pioneered the first topsides installation in open seas by float-over in 1987, invented the Unideck jack-assisted method that was first deployed in 1996, and has been a leader in this technology ever since. Technip Energies has designed and been responsible for the offshore float-over operations of topsides onto multiple fixed jackets, semi-submersibles, and a spar using a catamaran barge configuration.

In sheltered waters or open seas with short period waves, the topsides can be set down using ballasting of the installation vessel or barge. The volumes of water that need to be pumped to lower the vessel or barge are vast and therefore it is a lengthy operation.

In areas prone to long period swell, the installation vessel or barge will heave in a resonant manner and this can cause repeated impact damage to the topside, installation vessel or barge, or the substructure / foundation during the lengthy set down period associated with ballasting. In an active float-over, jacks are used to set the topsides down typically within a minute and therefore eliminate the risk of repeated impact damage.

The active hydraulic jacks can also be helpful in very shallow water where there is insufficient water depth to ballast the installation barge down to set the topside onto its foundation. In very shallow water, such as the North Caspian, the topsides set down operation can be performed by the hydraulic jacks.

For active floatovers, Technip Energies owns 8 jacks of 1500T + 8 jacks of 1250T with a fast retracting speed.

The hydraulic jacks are tested in the fabrication yard during a trial deck lifting operation which also gives an accurate measurement of topside weight and center of gravity.

The hydraulic jacks are tested in the fabrication yard during a trial deck lifting operation which also gives an accurate measurement of topside weight and center of gravity.

Transport and installation of the Kikeh Spar topsides by catamaran bargeset

4 | Pipelines Design and Installation

CAPABILITY DESCRIPTION

- **Material Selection:** A potential opportunity has been identified to replace CRA material typically selected for cladding multiphase pipelines (Nickel Alloy 625) with lower cost Nickel Alloy 825
- **Direct Electrical Heating (DEH):** A potential opportunity exists for hydrate management via DEH rather than MEG injection with cost savings associated with removing the MEG system
- **Pipeline Installation:** Pipeline Installation methods in the region are well established and limited by vessel access to the Caspian Sea via the Volga Don route

TYPICAL DEPLOYMENT

Multiphase Sour Pipelines associated with North East Capsian Projects.

PROJECT EXPERIENCE RELATED TO RELATED TO PIPELINES DESIGN AND INSTALLATION

Genesis has extensive global experience of Pipelines Design and Installation. Within the North East Caspian region, Genesis has executed the following studies for NCOC:

- **Aktote** & Kairan Assess Study
- **Kashagan Phase IIB/C** Pipeline Installation Study
- **Kashagan Phase IIB/C** Sour Gas to 3rd Party Assess and Select Studies
- **Kashagan Phase III** Full Field Development Assess Study

VALUE POTENTIAL FOR CLIENT

- **Robust pipeline design and installation** are essential to the success of any project. This is particularly the case for ultra-sour field developments.

TECHNOLOGY DETAILS AND NORTH CASPIAN FOCUS

Material Selection

Typical material selection for multiphase sour pipelines has been based on carbon steel metallurgically clad with Nickel Alloy 625. There may be an opportunity to consider Nickel Alloy 825 as an alternative to Nickel Alloy 625. Nickel Alloy 825 is less expensive than Nickel Alloy 625. Nickel Alloy 825 is less resistant to corrosion by untreated seawater in comparison to Nickel Alloy 625 so this must be considered during the installation and pre-commissioning phases of pipelines. However it is considered that this can be managed.

Direct Electrical Heating

Typical material selection for multiphase sour pipelines has been based on carbon steel metallurgically clad with Nickel Alloy 625. There may be an opportunity to consider Nickel Alloy 825 as an alternative to Nickel Alloy 625. Nickel Alloy 825 is less expensive than Nickel Alloy 625. Nickel Alloy 825 is less resistant to corrosion by untreated seawater in comparison to Nickel Alloy 625 so this must be considered during the installation and pre-commissioning phases of pipelines. However it is considered that this can be managed.

Pipeline Installation

Pipeline installation methods in the region are well established based on previous development campaigns, and are driven by installation water depths:

- **Water Depth >1.8m** - S-Lay
- **Water Depth between 1.8m and 0.3m** - Dredge and Tow
- **Water Depth <0.3m** - Push/ Pull from Shore

Active installation contractors in the region are limited due to access issues bringing vessels into the Caspian Sea via the Volga Don canal river system. Opportunities to investigate alternate installation techniques which eliminate the requirement for large installation vessels (tow out from shore to deeper water) have been considered.
The requirement for pipeline burial adds further installation complexity.

In addition, pipelines must be buried to protect pipelines from damage via stamukha (a grounded accumulation of sea ice that develops along the boundary of sea ice and fast ice). Burial depths range from >2.2m at island locations to 1m onshore.

Local Expertise

1 LOCAL CONTENT

2 RUSSIFICATION

1 | Local Content

CAPABILITY DESCRIPTION

Local content relates to the development of local skills, technology transfer and the use of local manpower and manufacturing capabilities.

Local content may be regarded as the value that an oil and gas project brings to the local, regional or national economy beyond the revenue from the oil and gas sales.

Local content requirements (LCRs) are policy measures that typically require a certain percentage of a project's expenditure to be sourced from domestic providers.

LCRs may change over time (as in the case of Brazil), when if set too high they may act as a barrier to development.

TYPICAL DEPLOYMENT

LCRs apply to most projects either as clear mandated standards or stated expectations. Compliance with LCRs may be difficult where the requirements are unclear or unrealistic.

PROJECT EXPERIENCE RELATED TO LOCAL CONTENT

Technip Energies helped to upgrade the Zykh yard in Baku to be suitable for the construction of the TPG 500 platform derrick, the jack-up legs and spud can foundations and the final integration of the platform.

The original condition of the Zykh yard and after upgrade ready for assembly of the platform legs

Welding of the high strength steel leg rack and chord shells and final vertical leg assembly

One of the many project successes was the local assembly of the high strength steel platform legs. For this highly skilled welding procedure, local welders were trained and qualified. The operation was such a success that the weld failure rate was significantly below that of most established international fabrication yards.

VALUE POTENTIAL FOR CLIENT

- **There are many benefits** derived from local content.
- **By developing skills and technology transfer,** the projects of the future can be engineered by local personnel. Technip Energies has a successful track record of developing local engineering centers in several countries.
- **Developing local procurement** can stimulate economic activity and attract further investment by suppliers engaging sub-suppliers and through the multiplier effects of employees of local businesses spending their wages in their own communities.
- **Helping to upgrade local fabrication** facilities and train their workforce is a way to improve productivity, quality and safety and thereby reduce overall project costs.

CAPABILITY DETAILS AND NORTH CASPIAN FOCUS

Sustainability is one of Technip Energies' foundational beliefs and a cornerstone of our core values. It reflects how we do business and is something we'll never compromise on. We act responsibly and always consider our impact on the planet, people and communities.

Our sustainability commitment is to promote a continuous, positive and responsible contribution for all.

For a typical development we will aim to maximize the nationalworkforceparticipation across the execution of the project. We will encourage sustainable local employment, transfer of knowledge, and use of local suppliers and services, wherever possible.

We will develop a Local Content Management Plan with stated objectives such as:

- Endeavor to use Local Content wherever possible
- Identify and implement, appropriate efforts to develop local workforce and local suppliers including SMEs

The Local Content Management Plan will also define the local content development strategy which will be structured around:

- Employment and training
- Local market and sourcing
- Local Community Engagement Programs

Technology and knowledge transfer can be achieved by:

- Collaboration with local universities
- Traineeships at Technip Energies operating centers for engineering and project management support personnel
- Community engagement will generally involve:
- Education sponsorship
- Medical Facility Scheme
- Sustainable Skill Training (eg computer skills)

Training will generally include the following areas:

- Technical training
- Supervisory training
- HSE training
- Quality Management training
- Basic & Advanced Computer Literacy & Training
- HSE and Quality training and induction programs for subcontractors

2 | Russification

TECHNOLOGY DESCRIPTION

Russification refers to the performance of all or some of the following activities depending on the stage of the project:

- **Ensuring technical** compliance of documents with the requirements of Russian norms and standards
- **Formatting of documents** in accordance with Russian standards for Proyekt documentation
- **Producing specific documentation** required by Russian standards for RDD not developed within the project scope
- **Translation / production** of bilingual documents

TYPICAL DEPLOYMENT

Russification is required on any project performed in Russia or other countries that fall under Russian jurisdiction.

PROJECT EXPERIENCE RELATED TO RUSSIFICATION

Technip Energies has unrivaled recent experience of Russification on its two (one recent and one current) mega projects in Russia: Yamal LNG and Arctic 2.

VALUE POTENTIAL FOR CLIENT

- **Russification** is an essential part of any project performed in Russia or to Russian standards and unless the process is efficiently managed can lead to significant project delay.

CAPABILITY DETAILS AND NORTH CASPIAN FOCUS

At the start of any project requiringRussification,Technip Energies will prepare a Russification and RDD (Russian Design Documentation) Procedure. The procedure will define responsibilities and authority, especially for the RDI (Russian Design Institute). It will include a MDR (Master Document Register) listing the documents that will be prepared for the RDD submission as part of the project and any additional documentation required but not included within the project scope. The procedure will define the main steps of the working process and the timing for incorporation of any comments from the RDI. A gating process is used to determine when deliverables are "Ready for Russification" and can be "Issued for Proyekt" and submitted to the expert authorities. Through mega projects in Russia like Yamal LNG and Arctic 2, Technip Energies has current working knowledge and successful experience of the complete Russification process.

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