SAIPEM
BIODIVERSITY

SAIPEM'S APPROACH TO AND PRACTICE OF BIODIVERSITY
CONSERVATION AND ENVIRONMENTAL PROTECTION
FOR A SUSTAINABLE WAY OF DOING BUSINESS

SAIPEM

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1.0
SAIPEM'S APPROACH TO BIODIVERSITY

Saipem is committed to protecting biodiversity and ecosystems and to minimising impacts on biodiversity in the areas where the Company operates.

1.1 THE IMPORTANCE OF BIODIVERSITY PROTECTION IN THE OIL & GAS SECTOR

The oil and gas industry interacts with a variety of different natural environments, many of which may be sensitive. A company operating in the sector therefore needs to employ appropriate technologies, management systems and operational practices that can guarantee safe and responsible operations, protect the natural environment and address concerns about the company's effects on local communities.

Biodiversity, in fact, can be defined as the variability among living organisms, including diversity within species, between species and of ecosystems. Biodiversity components comprise, at an increasing scale of ecological organisation, genes, species, habitats and ecosystems. Biodiversity quality and quantity is the basis of the integrity and effective functioning of ecosystems and the services they provide.

Biodiversity is recognised as the foundation of all ecosystem services which support and protect economic activity and property. Therefore, human lives, societies and economies depend, directly or indirectly, on biodiversity and its component resources.

The natural diversity of the living world is priceless, but is commonly undervalued by modern economies, resulting in its rapid and accelerating disappearance, mainly associated, directly or indirectly, with the production and consumption of goods and services to meet human needs.

1.2 SAIPEM'S COMMITMENT TO BIODIVERSITY PROTECTION

As stated in Saipem's Sustainability Policy, an essential component of the Company's sustainability approach is the conservation of biodiversity, ecosystems and the services they provide, all of which requires clear consideration and subsequent integration into the objectives and operating practices of projects along their entire life cycle.

As a contractor in the execution of projects, Saipem is committed to working with its Clients and stakeholders for:

- the identification and evaluation of all potential impacts on biodiversity and ecosystem services (BES) deriving from its operations, implementing appropriate mitigation actions to minimise any adverse effects;
- the promotion of research, development and technological innovation aimed at reducing the impacts on the environment and biodiversity;
- the implementation of initiatives, together with local communities and authorities, to create awareness and reinforce the concept of biodiversity and ecosystems as an opportunity for local socio-economic development.

By applying principles that are consistent with internationally recognised guidelines and standards on biodiversity, Saipem aims to be a leading contractor for BES management in its activities.

2.0
THE GLNG PIPELINE PROJECT

The GLNG Pipeline Project in Australia was particularly challenging considering the sensitiveness of the area. Saipem developed solutions to meet project requirements while ensuring biodiversity was being effectively preserved.

2.1 ABOUT THE PROJECT

The GLNG Pipeline Project in Central Queensland (Australia) involves the development of gas fields in the Bowen and Surat Basins, the construction of a 420 kilometre underground gas transmission pipeline to Gladstone, and a two-train LNG processing facility on Curtis Island in Gladstone.
The Project is managed by a Joint Venture, GLNG, made up of Santos, Total, Petronas and Kogas, who awarded Saipem Australia the engineering, procurement and construction contract for the Gas Transmission Pipeline.
The scope of work includes engineering, procurement and construction of the 420 km 42" gas transmission pipeline running from Fairview to Curtis Island. The last section of the GLNG pipeline runs across a wide tidal plain called the 'The Narrows' mudflat before it reaches Curtis Island using a 4.3 km submarine tunnel as a conduit for the pipeline.

2.2 ENVIRONMENTAL CHALLENGES

Located in the Great Barrier Reef Marine Park, the Narrows Marine Crossing is being constructed in a very sensitive environmental area for native flora and fauna. The mudflat intertidal zone is also characterised by the presence of acid sulphate soil. This particular soil, if exposed during excavation, can increase the acidity of the surrounding environment with severe consequences on the local ecosystem.
To minimise the environmental impact of pipeline construction activities in this intertidal and marine area, Saipem proposed to use a trenchless methodology during the bid phase as an alternative to the open trench solution comprised in the Tender scope. Following feasibility studies of different trenchless methodologies during the first year of the Project, a segment-lined tunnel method was selected to connect the mainland to Curtis Island and allow the installation of the GLNG Gas Transmission Pipeline. Saipem used its technological know-how to surround the coastal environment and avoid impacting the marine activities in Gladstone Harbour.

2.3 TRENCHLESS METHODOLOGY

The trenchless methodology used is essential for minimising the environmental impact of pipeline construction activities in this intertidal and marine area. Saipem opted for a 3.5 km tunnel with a minimum coverage of 12.5 m.
The excavation was performed using a Tunnel Boring Machine (TBM) with an internal diameter of 3.4 m, which lines the tunnel with precast concrete segments. The TBM was assembled and launched inside the launch shaft at the end of April 2013 and the excavation was completed on February 3, 2014.
Once completed, the tunnel was flooded with sea water in order to facilitate pipeline

WORLD'S LONGEST PIPELINE LAUNCH IN A TUNNEL WITH A THRUSTER MACHINE

Cutting-edge technologies providing environmentally sound solutions

installation by reducing the vertical load of concrete coated pipes and consequently the friction on the tunnel floor. The 42" pipeline was installed using a pipe thruster pushing methodology.
The pipeline installation was a complex sequence of interconnected activities: triple joint lowering into the launch shaft; jointing; quality checks and pushing, were all completed in 16 days.
The Narrows Marine Crossing Project is one of the world's longest trenchless marine crossings for a gas transmission pipeline.
It has permitted the GLNG Gas Transmission Pipeline to cross the Narrows without disturbing the marine habitat, wildlife and surrounding coastal environment and without impacting marine activities in Gladstone Harbour.
The commitment to technological innovation through the Narrows Marine Crossing is a clear example of Saipem's sustainable business solution, which also aims to reduce the environmental footprint of operations in difficult and sensitive areas with a view to safeguarding the ecosystem in which Saipem is called upon to operate.

2.4 MEASURING THE SOCIO-ECONOMIC VALUE CREATED BY ECOSYSTEM SERVICES

What value is Saipem creating and sharing as a result of the way it manages its projects or due to its presence? And how can this value be quantified?
Pipeline construction, and activities associated with the Oil & Gas industry in general, are often linked to the disturbance and degradation of the social and environmental context. Specifically, impacts on the environment or on particular ecosystems are nearly always perceived as adverse. In reality, however, outputs of goods and services do in fact generate benefits for the human population.
To understand better the real social and environmental footprint of GLNG Pipeline Project activities, Saipem decided to quantify the ecosystem service value created from a specific aspect of the Project Environmental Management Plan.
The term 'ecosystem' refers to a dynamic complex of plant, animal and micro-organism communities and their non-living environment all interacting as a functional unit (MA, 2005). Effectively, ecosystems are the habitats of, for example, coral reefs, forests, grasslands, rivers, farmland and urban parks that support various species. 'Services' refers to the functions and products of the ecosystem that benefit humans in the short or long term. They depend on the attributes of the ecosystem, and include crops, fish, freshwater and timber. They also comprise climate regulation when trees sequester carbon, and there are cultural services, such as tourism, to say nothing of spiritual benefits.

2014 AUSTRALIA PREMIER'S SUSTAINABILITY AWARD

In the category 'Innovation in Sustainable Technologies' for the construction of the Narrows Marine Crossing

Saipem Australia, together with Santos GLNG and Thiess, was awarded the 2014 Queensland Premier's Innovation in Sustainable Technologies Award for the Narrows Crossing tunnel between Gladstone and Curtis Island. The prize is promoted by the Queensland Government's Department for the Protection of Environmental and Natural Heritage, and is supported by the Queensland University of Technology.
The innovative aspect of the Narrows Marine Crossing project was a Pipe Thruster Machine to insert a pipeline in a tunnel, a methodology never adopted before in the Oil & Gas sector. The excavation of the tunnel was achieved thanks to a 3.4 metre mechanical cutter, which covered the tunnel with precast concrete.
The 42-inch pipeline was installed inside the tunnel, then sealed and filled with sea water.
This massive pipeline project to cross 'The Narrows' waterway in Gladstone offers vastly improved environmental benefits compared to other construction options, such as trenching.
Building the tunnel eight metres below the seabed has prevented disturbance to marine habitats, wildlife and surrounding coastal environments.
The tunnel has set new standards for marine crossings in environmentally-sensitive areas and is already being adopted by industry peers as best practice.

The aim of the study was to understand the real footprint by quantifying the value of the ecosystem services created and associated with an increase in human well-being. Specifically, it examined the translocation and management of an ancient species of plant known as the Cycas Megacarpa (Cycad). Cycads, a small group of plants that can reach a height of 5-6 m, have existed for over 200 million years. However, their decreasing numbers and distribution are due to human induced destruction of their habitat.
The 'Cycas Megacarpa Translocation and Management Plan' (CTMP), developed by the Client, GLNG, aims to protect and increase the Cycads population in the area crossed by the project pipeline. Through the application of the CTMP in accordance with the Australian Government's Environment Protection and Biodiversity Conservation Act 1999, the Client has committed to preserving a population of 3,990 Cycads over 5 years following planting in selected sites along the pipeline route. Of 3,990 Cycads, approximately 3,220 will be nursery grown and 770 will come from GLNG Pipeline right of way (ROW) translocation activities.
The CTMP provides specific assessment, management, monitoring and reporting measures on:

- translocation of individual Cycads from ROW activities;
- nursery cultivation of Cycads, which not only includes seed collection and propagation, but also monitoring, management and evaluation.

For the purpose of the study, nursery grown Cycads were examined since they represent additional environmental and social value, whereas the ecosystem services value from the translocation of the Cycads was deemed negligible.
The ecosystem services value created by the CTMP was calculated by applying the model

ECONOMIC VALUE

Estimated value created over a 20-year timeframe	**20 mln AUD**
Estimated value created over a 200-year timeframe	**72 mln AUD**

developed by the World Business Council for Sustainable Development (WBCSD) and the International Institute for Sustainable Development (IISD). It is calculated using two components. The first is the indirect use value given by the social cost of carbon storage and sequestration, whereas the second is the optional value of future direct and indirect uses of Cycads seeds and plants.

The study shows that over a 20 year timeframe, the project investment for implementation of the CTMP will create a socio-economic value for local stakeholders of approximately 20 million AUD (net present value), with a social return on the investment of about 300%. Considering a broader timeframe, in 200 years the value created can be estimated at about 72 million AUD with a social return on investment of about 833%. The study outcomes are an important confirmation that management of project operations through a sustainable approach is a key way to create value for local stakeholders and that proper communication of the shared value created is essential for fostering a more supportive environment from within which to conduct operations.

3.0
ETIHAD RAILWAY PROJECT

Biodiversity protection in a railway construction project located in a desert environment.

3.1 ABOUT THE PROJECT

On September 22, 2013, the first train of Etihad Rails ran on the Infrastructure built by Saipem. Etihad Rail (the Client) and the local population cheered with enthusiasm for the success achieved.
The line consists of 290 km of freight railway lines between the new Gas facilities in the Abu Dhabi desert in Shah and Habshan, to the port facility of Ruwais: it is a core part of the UAE Railway Network that will link the principal population and industrial centres of the GCC, (Gulf Cooperation Council).

3.2 ENVIRONMENTAL CHALLENGES

The line crosses Baynounah Forest, a 592 km^2 Protected Area (also known as the Houbara Protected Area) located approximately 15 km east of Ruwais along the Al Gharbia Mainline of the railway. The Baynounah Forest is a Protected Area for the conservation of the Macqueens Houbara Bustard, a bird which is listed as vulnerable on the International Union for the Conservation of Nature and Natural Resources, IUCN Red List. This species is bred in captivity here.
The area was also recorded as important because of the several animal and plant species and habitat types, including jebels, saline coastal plains, sand sheets, low dunes and alluvial gravel plains.

3.3 A BIODIVERSITY-ORIENTED PROJECT DESIGN AND IMPLEMENTATION

The project received approval from the Environment Agency of Abu Dhabi (EAD) and a Terrestrial Ecological Management Plan and a Construction Environmental Management Plan were prepared in the early phase of project execution. These Plans required several mitigation measures in order to safeguard habitat, flora and fauna and to minimise environmental impacts.
To address the stringent licensing procedure, Saipem appointed a Project Environmental Manager and a dedicated team to regularly supervise site activities, report to environmental authorities and manage the

ENVIRONMENTAL CHALLENGES

Railway line segment in a conservation area
Baynounah Forest Protected Area is home to Macqueens Houbara Bustard, a bird holding symbolic importance for local heritage and culture

49 km

Protected animal crossing
To allow camels, gazelles and reptiles to pass from one side to the other

110 tunnels

APPROPRIATED CONSTRUCTION TECHNIQUES

To minimise impacts on the ecosystem

several audits received from environmental agencies and third parties.
The environmental project requirements were implemented in the design from the very first stage in close coordination with the Engineering Team. A series of workshops were organised in order to agree on mitigation measures and fulfil the expectations of the stakeholders both during railway design and construction.
One of the requirements of the Environmental Impact Assessment and of the Terrestrial Ecology Management Plan was to carry out a pre-construction survey. The habitat and fauna survey was conducted to identify reptiles, mammals and birds living in the construction corridor and minimise the risks for their survival in the area. Following that, during the final design, Saipem proposed adjustments to the railway route in order to optimise the distance from particularly sensitive and valuable environments, or areas where shy animals like Spiny-tailed Lizard burrows were identified during the preliminary ecological survey.

Another design optimisation proposed was the reduction of the cross section of the railway located inside the forestry area, resulting in approximately 6,500 trees being saved.
The largest impact associated with the railway was the creation of a permanent ecological barrier which risked fragmenting habitats and dividing fauna populations. Culverts were therefore designed at intervals of 1 to 5 km, which reduced the impact of the ecological barrier, allowing the free passage of gazelles, as well as smaller mammals and reptiles.

3.4 SAFEGUARDING FLORA AND FAUNA DURING CONSTRUCTION

The Baynounah Forest Protected Area has the greatest habitat diversity recorded anywhere along the project route, with several species being of high value. Saipem specialist environmental professionals performed very specific activities within the area, such as tree tagging and transplantation, and relocation of several species of reptile living in the construction area. A high proportion of the area within the project corridor was irrigated and native trees and shrubs were planted.
One of the main actions provided for in the Terrestrial Ecological Management Plan was the removal from the construction corridor of a high valued reptile species known as the Spiny-tailed Lizard. A reptile proof fence was installed around the construction corridor, where appropriate, in order to capture the reptiles prior to commencement of construction. After capture, reptiles were

brought to a translocation area to acclimatise before release into suitable habitats.
Moreover, environmental induction training was delivered to all personnel before they entered the Baynounah Forest to illustrate the peculiarities of the area and the preventive measures to be adopted in order to avoid disturbing local flora and fauna.
A project 'Snake Response' procedure was developed to safeguard site personnel and ensure survival of the animals recovered.
A dedicated training course was delivered to set up a team of qualified snake handlers capable of intervening promptly and effectively in order to remove reptiles. The course examined all types of dangerous animals in the UAE, and in particular taught attendees how to minimise interactions with snakes and how to intervene in the event of a snake bite. It also gave instructions in snake-catching techniques using appropriate handling tools. A monthly snake response drill was organised to verify the responsiveness of security personnel, snake handlers and first aiders.
Other mitigation measures included:

- construction works did not take place during the breeding bird season between February and May;
- night time construction was avoided in this area as it could have affected the feeding habits of nocturnal mammals and birds;
- excavations were checked in case animals fell into them and ramps were placed at regular intervals to allow animals to get out;
- project vehicles could not be driven and personnel could not walk outside the fenced construction area or designated access roads as this could have caused indirect adverse impacts on the habitats, flora and fauna;
- there was a strict 'no approach' policy enforced onsite for wildlife: personnel was not allowed to handle or touch wildlife and wildlife was not removed from the Protected Area.

4.0
MEDGAZ PROJECT

Caring for the biodiversity of the Mediterranean Sea in an ultra-deep water pipeline project of strategic importance for Europe's energy sourcing.

4.1 ABOUT THE PROJECT

The Medgaz Project consisted in building an Algerian-European gas pipeline via Spain.
The subsea gas pipeline goes from Beni Saf on the Algerian coast up to the landfall on the Spanish coast of Almeria. The Project also included the construction of the compressor station in Beni-Saf and the receiving terminal in Almeria.
The single 24-inch pipeline, approximately 210-km long, reaches a maximum water depth of approximately 2,160 m.
The gas pipeline has a capacity of 8 billion m^3/year.
Saipem was awarded the contract for engineering, procurement, supply, construction and pre-commissioning of the marine pipeline from Algeria to Spain, as a strategic project for the transportation of natural gas from Algeria to Europe across the Mediterranean.

4.2 ENVIRONMENTAL CHALLENGES

An Environmental Impact Assessment was conducted, covering the entire pipeline route, and in particular the receiving terminal at Rambla Morales in Spain, and the compressor station at Beni Saf.
In the shore approach sectors where dredging took place, the route crossed sea grass areas in the Cabo de Gata-Nijar Marine Reserve (Spain) and, to a lesser extent, also on the Algerian side.
In particular, two species of sea grass, *Posidonia oceanica* and *Cymodocea nodosa*, included in the European Habitats Directive, were present along or in the vicinity of the pipeline route.
The importance of conserving sea grasses lies in the fact that they are an important marine community, and these particular species are only found in the Mediterranean basin.
The *Posidonia* sea grasses are important as hatcheries for a variety of fish. They also retain sediments, as well as oxygenate the seawater.
The *Cymodocea* sea grass has a high re-colonisation capacity, and therefore functions as a pioneer habitat.

SEA PRAIRIES

Posidonia has a vital role in Mediterranean coastal marine ecosystems

4.3 ENVIRONMENTAL MONITORING OF WATER TURBIDITY

Saipem carried out an underwater monitoring programme to assess the impact on the marine ecosystem of building a gas pipeline from North Africa to Europe.

Following the project Environmental Impact Assessment (EIA), Saipem undertook a programme of surveillance trial activities (STA) to understand the effects of dredging on the sediment in the Spanish shore approach area. Dredging was carried out using the Backhoe Dredger (BHD) and the Trailer Suction Hopper Dredger (TSHD). The specific objective of the STA was to assess if the silt screens were needed as a form of mitigation, particularly to reduce the impact on the sea grasses of Cymodocea nodosa and Posidonia oceanica. The sea grass meadows Cymodocea nodosa and Posidonia oceanica are biological indicators, as they are sensitive to contaminants of different origin. Like other sea grasses, Cymodocea nodosa and Posidonia oceanica act as water transparency regulators.

Each survey consisted of 8.5 hours of continuous measurements, carried out at 8 points placed along 2 cross-sections.

The following parameters were measured in order to evaluate the main chemical and physical parameters of the water column:

- depth of siltation (sediment suspended);
- turbidity - or cloudiness;
- the size of suspended solids and grains;
- currents;
- correlation between turbidity and silting thickness.

The activities showed several interesting results and the two main outputs can be summarised as follow:

- all the siltation measures were measured as being in compliance with the limit of 2.5 cm set out in the EIA;
- the highest value of measured turbidity during dredging carried out with the Backhoe Dredger was 32 NTU, which is comparable to the maximum natural turbidity of 30.13 NTU generated by rough sea conditions, as recorded during the baseline survey; while during dredging carried out with the Trailer Suction Hopper Dredger, all values of measured turbidity were one order of magnitude lower than the natural turbidity during rough sea conditions.

The Suspended Solids Concentration (SSC) analysis revealed higher values inside the pipeline trench. However at 10 metres from the trench the values were comparable to the natural background levels. In particular, the correlation between turbidity and siltation demonstrated that, for future similar activities, monitoring turbidity will suffice to predict the siltation induced by backhoe dredging at distances of 5 and 10 metres from the edge of

A CLEANER DREDGING

Maximum turbidity measured during dredging operation
A value comparable to natural turbidity

32 NTU

the trench. Benthos identification analysis was carried out before the start of dredging and after backfilling activities. Even if the percentages of the detected species were slightly different, the ratio between the groups was unchanged. This result proves that no impacts on benthic communities occurred in the project area.

4.4 REINSTATEMENT

The Algerian onshore route extends from landfall to inland mainly through agricultural land, not crossing environmentally sensitive areas other than a river crossing and a short slope section which required special attention during reinstatement.

No specific plants requiring special protection were identified during the pre-construction surveys along the pipeline route.

However, restoration was carried out with two objectives:

- in the shorter term, to reinstate the land contours, establish drainage patterns, stabilise the soils by installing permanent erosion control and redistribute the topsoil to allow vegetation to grow;
- in the longer term, to establish sufficient vegetation cover to reinstate the local plant species and ecology.

After the pipeline was buried and backfilled, reinstatement took place in three phases.

Phase 1: clean up, soil profiling/contouring and stabilisation.

Phase 2: technical reinstatement-erosion control measures (e.g. sack breakers in the trench across slopes, rock rip rap at river crossings) and distribution of topsoil over the full width of the ‘right of way’.

Phase 3: biological reinstatement (including revegetation around the river crossing by direct seeding), to provide long-term protection of soils against surface erosion. Establishment of vegetation also provides additional stability to erosion control structures such as slope breakers, drainage channels, as well as promoting a return of natural soil processes. Finally, good vegetation cover reduced the visual impact of the project.

5.0
DOLPHIN PROJECT

Saipem solutions to address biodiversity protection issues in a complex gas development project involving both marine and terrestrial environments.

5.1 ABOUT THE PROJECT

The Dolphin Project is a gas development project undertaken by Dolphin Energy Limited (DEL) of Abu Dhabi, UAE. The project consists of a strategic energy initiative designed to produce, process, transport and supply substantial quantities of natural gas from offshore Qatar to the United Arab Emirates (UAE). The exploitation area is located in the Arabian Gulf, north-east of Ras Laffan. Gas is extracted from Qatar's 'North Field' in order to deliver export sales gas to the UAE. The reservoir fluid is produced from two offshore wellhead platforms located at approximately 70 and 85 km from Ras Laffan. The well fluids are transported to shore by two multiphase sealines. The onshore production plant at Ras Laffan processes all reservoir fluids and exports sales quality gas to Taweelah, in the UAE, through the 48" export pipeline which is approximately 361 km in length.
Saipem's scope of work in the context of the Dolphin Project was as follows:

- detailed Design and Construction of two 36" submarine gas pipelines for the transportation of wellhead fluids to the shore of Ras Laffan Industrial City (Qatar);
- detailed Design and Construction of a 48" submarine export gas pipeline and receiving facilities in UAE;
- detailed Design and Construction of the onshore sections of the pipelines from the shore approach to Ras Laffan Industrial City (Qatar);
- detailed Design and Construction of the onshore section of the export pipeline from the shore approach in Taweelah to the receiving facilities in the UAE.

5.2 ENVIRONMENTAL CHALLENGES

Taking as its reference the Environmental Impact Assessments and Environmental Baseline Reports, Saipem developed several Environmental Plans and Procedures describing the interactions between the activities and environment, evaluating the mutual impacts between these, and providing mitigation measures to reduce any potential adverse impacts to within acceptable limits. Whenever feasible, the principles of Best Available Technologies Not Entailing Excessive Cost (BATNEEC) and Best Practical Environmental Options (BPEO) were applied. Once the interactions between the activities and environment were assessed, the process led to the identification and evaluation of the significant environmental aspects and the consequent environmental impacts resulting from planned or unplanned project activities.

5.3 MARINE FAUNA

The marine mammals and reptiles listed as endangered species that might be potentially affected by human presence during construction works were:

- dougongs and dolphins, which might potentially lose their habitat due to the pipeline crossing their main feeding grounds - the seagrass areas;
- marine turtle species, which have their prime distribution area in the UAE coastal zones south of Abu Dhabi, but which were known to be nesting on the beaches at the projected pipeline landings.

Marine mammal and reptile observers were located onboard the key vessels (dredgers and lay barges), while a biologist was appointed to

monitor the beach at Ras Laffan Industrial City (RLIC) during the turtle nesting and hatching period, as per the Supreme Council for the Environment of Natural Reserves (SCENR) Clearance. In RLIC, Saipem monitored 1,250 m of coastline, which included the Right of Way (ROW), about 450 m north-west of the ROW and about 650 m south-east of the ROW.
After the observation of the last hatching emergence, in daytime a broader area was monitored (up to 1.5 km from the ROW) to record the hatch success of nests that were not in close proximity to the ROW.
Daily inspections were performed within 650 m from the ROW, prior to the start of works.
The position of nests and turtle tracks was recorded using a GPS and loaded in a GIS. If a nest was detected within the 75 m of ROW, the RLC Relocation Protocol (which Saipem worked on jointly with the Authorities) was applied and any eggs found were moved to the Relocation Area designated by the RLC authorities.
All nests within 150 m from the ROW were fenced with high visibility tape, to prevent trampling and access to the nest by unauthorised people.
Between the period of inspections, 12 nest attempts were recorded. All turtle tracks observed were identified as the tracks of the hawksbill turtle *Eretmochelys imbricata*.
During the hatching period, the shoreline 650 m from the ROW was patrolled 4-5 times per night to record the emergence of hatchings and to prevent external disturbance.
Moreover, after the observation of the last hatching emergence, a broader area was monitored in daytime (up to 1.5 km from the ROW), to record the hatch success of nests that were not in close proximity to the ROW.
The mitigation measures adopted to avoid the interactions between works and hatchings (such as reduction of light emission, strict monitoring of nests in proximity to the ROW, protection of nests and induction of construction personnel and personnel onboard vessels) were successful.
Moreover, the lower mortality and predation rates in the nests close to the ROW suggest that the continuous monitoring was successful in increasing the hatch rate of hawksbill turtles in this area.

6.0
NORD STREAM PROJECT

Saipem achieves a milestone in Europe's energy sourcing strategy and accomplishes a successful project execution in terms of biodiversity conservation.

6.1 ABOUT THE PROJECT

Nord Stream is the largest subsea pipeline project carried out to date. It brings natural gas supplies to Europe directly from Siberia.
Its ambitious objective is an overall transport capacity of 55 billion cubic metres of gas per year. Years of study brought Nord Stream to the conclusion that the offshore pipeline project represents one of the safest, most economical and most environmentally friendly ways to increase gas supplies to Europe.
It consists of two parallel pipelines, for a total length of 2,448 km. These link Vyborg in Russia to Greifswald in Germany, passing through the Baltic Sea. It is a strategic infrastructure for Europe's energy sourcing.

The project was commissioned and developed under the supervision of Nord Stream AG, an international joint venture composed of Gazprom (51%), Wintershall - a BASF subsidiary (15.5%), E.ON Ruhrgas (15.5%), N.V. Nederlandse Gasunie (9%) and GDF Suez (9%). Nord Stream AG chose Saipem on account of its experience and reputation for innovation, cutting edge methods, schedules and technical approach. It commissioned the Company to lay the two sections of pipelines in their entirety. Saipem met the challenge by assigning a Task Force and two of its prized vessels, the Castoro Sei and Castoro 10, suitably refitted and modernised, along with the subcontracted Allseas DP vessel Solitaire and an overall fleet of more than 40 support vessels.

6.2 ENVIRONMENTAL CHALLENGES

The Baltic Sea is considered a fragile ecosystem, with limited exchange of water with the North Sea and very low oxygen levels in deeper waters. Fish and marine plants are under threat and concerns over the potential risk of environmental damage during project execution were high. No dumping of any kind of waste at sea was permitted. All pipelaying operations were carried out with specific procedures aimed at safeguarding the unique natural habitat of the Baltic Sea.
A detailed and rigorous programme of environmental and social controls was drawn up before and after installation of lines and extending to 2016. In short, a project within a project, with operations to restore flora and fauna individually tailored to specific areas and protected species.

STRINGENT PROJECT EXECUTION TECHNIQUES

Using Saipem's cutting-edge technology and assets

6.3 ENVIRONMENTAL MONITORING PROGRAMMES

As set out in the national permits granted by Russia, Finland, Sweden, Denmark, and Germany, Nord Stream developed five national environmental monitoring programmes. Each documents the environmental impacts from construction and pipelines operations in the respective jurisdictions, following a scheme containing all the key tasks. Saipem was involved in the following monitoring operations:

- recovery of historical remains from the seabed, with the removal of tonnes of munitions that have remained on the seabed (mostly from World War II);
- the mammal population, with monitoring of benthic or aquatic fauna to oversee its recovery when dredging or trenching disturbed the seabed;
- air emissions and their reduction, light and noise levels, testing in landfall areas where construction took place close to residential zones;
- quality of water and water movements around the pipelines to ensure that natural currents were not disturbed or changed by the facility.

During these activities, Saipem also observed bird and fish populations to assess whether they had been affected by increased seawater turbidity or project operations. Finally, Saipem undertook visual inspections of objects of cultural value along the route both before and after pipelaying. The programme scrupulously followed the strictest regulations on environmental protection and used innovative tools such as underwater vehicles (ROV), controlled from the support vessels that enable better results with a minimum impact on the seabed; and passive acoustic system, to monitor mammals and prevent them from approaching operational zones.

Subject	Russia	Finland	Sweden	Denmark	Germany
Physical and chemical environment					
Water quality	+	+	+	-	+
Seabed sediment	-	+	+	+	-
Hydrography and seabed topography	+	+	+	+	+
Onshore soil	+	-	-	-	-
Landscape and topography	+	-	-	-	+
Air quality	+	-	-	-	-
Noise and pressure waves	+	+	+	-	+
Biological environment					
Fish	+	+[1]	+	+	-
Birds	+	+[1]	+[1]	-	+
Marine mammals	+	+[1]	+[1]	-	+
Benthic flora and fauna	+	+	+	+	-
Terrestrial flora and fauna	+	-	-	-	-
Socio-economic environment					
Fisheries	-	-	+	-	-
Cultural heritage	+	+	+	+	+
Munitions objects					
Conventional munitions objects	+	+	+	-	+
Chemical munitions objects	-	-	-	+	-

+: monitored in 2010 at selected/relevant locations

-: not monitored in 2010

1: observations during munitions clearance only

7.0
SAKHALIN II PHASE 2 PROJECT

Saipem accomplished a challenging project in one of the most sensitive environments and harshest climates on the planet.

7.1 ABOUT THE PROJECT

Located in the Russian Far East, just 40 kilometres from the northern tip of Hokkaido Island (Japan), Sakhalin Island extends almost 1,000 kilometres from north to south covering an area of 90,000 km^2.
Sakhalin II Phase 2, sanctioned in 2003, is one of the largest integrated oil and gas projects in the world and its onshore pipelines among the most complex. Onshore pipelaying extended over more than 800 kilometres in the environment of Sakhalin Island, a remote region with hardly any infrastructures and in a harsh sub-arctic environment.
The cooling effect of the Siberian continental monsoon system during the winter, and of the cold waters of the Okhotsk Sea in the summer, make the local climate cooler and harsher than other locations at the same latitude.
The pipelines were laid in temperatures as low as -40° on a common Right of Way (ROW) covering approximately 285 km of wetlands, 110 km of mountainous routes, more than 1,000 watercourses, 19 seismic fault crossings, 40 km of landslide areas, 18 rail crossings and 36 main road crossings. Several natural reserves and archeological areas were also crossed by the ROW.
Logistics were one of the main challenges on the project. Many areas are difficult to access, especially in the extreme weather conditions that are quite common in the region.

7.2 ENVIRONMENTAL CHALLENGES

During construction of the Project, Saipem faced a number of environmental challenges, mainly related to the peculiar environment where construction was developed.
The main challenges related to the fact that the pipelines crossed more than 1,000 rivers and streams, many of which were classified as highly sensitive; moreover, 3 wildlife sanctuaries and 4 natural parks of regional significance were located in the area potentially affected by pipeline and plant construction.

A UNIQUE WORKING ENVIRONMENT

Pipeline laying weather condition: temperature
Sakhalin Island is exposed to cold continental air currents from the Arctic

-40 °C

Length of the pipeline
Crossed over 1,000 watercourses, 110 km of mountain ranges, 40 km of landslide areas, 19 seismic faults, 18 railways, 285 km of wetlands

over 800 km

Particular protection programmes were developed to mitigate disturbance and protect rare species of flora and fauna, such as the Steller's Sea Eagle and the Wild Pacific Salmon. However, the main focus was on preserving archeological sites.
After the conclusion of construction activities, technical and biological reinstatement was completed to return impacted areas to a pre-agreed condition, as per regulatory and landowner requirements.

7.3 RIVER CROSSING STRATEGIES

The pipeline route crossed more than 1,000 perennial and temporary watercourses, 480 of primary fishery importance. The Environmental Impact Assessment (EIA) demonstrated that a number of watercourses were important for salmon fisheries and provided habitat for a wide range of species, including several protected aquatic species. The commercial salmon fishery on Sakhalin Island is socio-economically important.
From an ecological perspective (e.g. the effect of increased suspended solids concentration and turbidity on migrating salmonids), impacts can be mitigated or avoided by timing in-stream construction activity to coincide with periods of reduced sensitivity and by choosing the best suited construction method.
For this reason, 190 river crossings were performed during wintertime, thus avoiding the spawning period and the period when eggs/embryos are present in stream gravels. Construction methods (wet cut, dry cut, HDD crossing, etc.) were determined according to EIA conclusions.
Trenching was the main approach for pipeline crossing. Only 7 highly sensitive rivers were crossed by Horizontal Directional Drilling (HDD). Crossing had to be finished before the end of the work shift, including temporary river bank protection activities. Moreover, in each sensitive stream both pipelines were laid simultaneously so as to ensure a short impact on the aquatic environment (in terms of physical disturbance to habitats and salmon spawning grounds) and only a single temporary increase in suspended sediments.
Monitoring (river morphology, hydrochemistry, suspended sediment sampling and turbidity, ichthyofauna and benthos, fishery characteristics, etc.) before, during and after crossing was performed to assess negative impacts on the rivers and to intervene promptly if remediation was needed.
Monitoring was an important part of the overall implementation of a successful project and was crucial in determining the scale and magnitude of effects during construction, relating these to predicted and observed impacts and ensuring that mitigation measures were successful in either reducing or avoiding them.
Proper construction techniques for further stream crossings, passing from a wet to a dry cut method, were selected to mitigate an increase in sediment suspended in certain categories of stream.
Due to the high sensitivities of Sakhalin watercourses, the bank protections were installed as soon as reasonably practicable after the crossing. The methods used were

AWARD WINNING

Saipem won the 'Best Environmental Project 2008' from the Russian Ministry of Ecology and Natural Resources for the Sakhalin II Project

recultivation (mainly grass seeding), stone pitching, Reno Mattresses and Gabion according to hydrology studies and engineering design.

7.4 REINSTATEMENT IMPLEMENTATION

The soil types found on Sakhalin Island are generally considered to be moderately to highly erosive due to a lack of cohesion and organic matter. This has been exacerbated by the relatively thin topsoil layer. Even on relatively shallow slopes, the sand and silt soils that are found on the ROW can be highly mobile, requiring additional efforts to prevent erosion. Considerable precipitation in summer and huge run-off contribution during the spring thaw make reinstatement challenging.

For this reason, the reinstatement phase was considered an important point of the overall project environmental performance and was a major challenge for Saipem. It was divided into technical and biological reinstatement.

The main focus of technical reinstatement was to restore the ROW to its original condition (or as near as practicable in the context of pipeline integrity) according to legal requirements. This phase involved topsoil stripping and storage, the removal of construction debris, pipeline right of way clean-up, levelling and re-contouring to pre-construction contours where possible, installation of permanent erosion control measures, return of fertile topsoil to the reinstated area, soil preparation and seeding. Technical reinstatement also included stabilisation of watercourses, cut slopes and landslides.

The main purpose of biological reinstatement, on the other hand, was to provide long-term protection of soils against surface erosion. Establishment of vegetation on the ROW also provided additional stability to erosion control structures such as slope breakers, drainage channels, energy dissipaters, terracing, rip rap and erosion matting protection, as well as promoting a return of natural soil processes. Finally, good vegetation cover reduced the visual impact of the project.

7.5 BIODIVERSITY PROTECTION AT WORK

Three wildlife sanctuaries and four natural parks of regional significance are present in the area affected by pipeline and plant construction activities.

Makarovski sanctuary, for example, was established for the protection and reproduction of rare and disappearing species of plant, animal and bird and also of economically valuable animal species, safeguarding the biotopes of mountain forests of the southern part of Sakhalin Island.

Particular attention was paid to the Steller's Sea Eagle, found especially in the dynamic and productive coastal ecosystem on the north-east of the Island. Steller's Sea Eagles are found only in Russia, Japan and the Aleutian Islands and are one of the world's largest birds.

Since 2003, Russian ornithologists have been involved in extensive studies of the eagle in north-east Sakhalin. An EIA was developed for the project based on these studies. Special programmes were then developed to mitigate impacts on this rare species. These included human activities, such as noise from machinery and equipment and other disturbances, which could have led to nest abandonment. Damage to the aquatic habitat also needed to be avoided, since it could have caused a reduction in prey and consequent feeding irregularities, all of which could have compromised success in rearing the young.

8.0
KASHAGAN PROJECT

Saipem worked in harsh conditions, including sea ice during the winter, with temperatures varying from -35 to 40 °C, extremely shallow water for one of the most challenging oil megaprojects ever – with a biodiversity protection approach.

8.1 ABOUT THE PROJECT

The Kashagan field, located in the North Caspian Sea, is one of the largest oil finds in the past three decades. The development of this complex project was a major challenge due to the need to operate in very shallow waters, from 4 m in Kashagan East to 0 m near the shore. The ultra-shallow water depth, combined with extreme environmental conditions (temperatures ranging from -40 °C to +40 °C), led Saipem to develop unique innovative solutions. In particular, Saipem built a fleet of dedicated vessels for pipelaying and post-trenching. These included the pipelay barges Castoro 12 and Castoro Sei, the trenching barge Saipem TRB and the ancillary TRB Tenders. The EPCI contract for the pipeline system was carried out in an isolated area, characterised by freezing temperatures and major concern for the environment. In addition to the Trunkline project, Saipem was awarded other projects, including hook-up and commissioning of Complex 'D' and Island 'A' Offshore Facilities. The trunklines and production flowlines project mainly consisted in laying 3 offshore trunklines about 70-km long, in addition to onshore pipelines about 30-km long. Flowlines, umbilicals, power and fibre optic cables were also laid. With this project, Saipem established an industry record for the longest pipeline shore pull, involving two lines of 28" and one line of 18".

8.2 ENVIRONMENTAL CHALLENGES

The Caspian Sea is the largest inland body of water in the world, with a level of salinity in excess of 13.7‰. The change in the sea level over time, the presence of shallow areas surrounded by large marshlands as transition zones to the mainland, all combined with the enormous semi-arid steppe surrounding it, constitute a potential danger for biodiversity, particularly for the area's many endemic species. The biodiversity found in the Caspian Sea and on its coasts makes the region one of the most precious ecosystems in the world, with a very high degree of biological endemism. A large number of the world's

SAIPEM ADAPTED TO AN EXCEPTIONAL ENVIRONMENT

Extreme weather condition: temperature
In the Caspian Area temperatures rage from -40 °C to +40 °C

-40 °C

Operational water depth for Saipem Mondine pipelaying ship
Some project areas in the Caspian Sea located in very shallow water are home to ecosystems very rich in biodiversity

0.5 m

major phyla and a broad range of different habitats (from large river systems to wetlands) make the region home to a wide variety of flora and fauna. The most important fauna in the Caspian Sea is the sturgeon, which constitutes 85% of the standing stock of the world's sturgeon population.
The sensitivity of the area constitutes a technological challenge for Saipem to minimise the ecological footprint of its activities. For marine operations, the main factor to be considered is the zero-discharge policy, applied to the entire Caspian Sea, along with the restrictions and limitation on the types of materials that are to be used. On the transition zone, i.e. the area formed mostly of marshlands and swamps, the ecological limitations come mostly from the sensitivity of locations that are nesting areas for migratory and local avian species and also for the local biota. Because of this sensitivity the design and construction of safe vessels and technologies with a low environmental impact have become a primary objective for the entire Kashagan project.

8.3 TECHNOLOGICAL INNOVATION FOR BIODIVERSITY PROTECTION

Within the Trunkline project, Saipem has developed a system of small boats called 'Mondine' (rice weeders) that can lay piping in shallow depths of about 50 cm, where no other craft can operate.
The system enables excavation of a trench of the desired depth while at the same time using the material removed during excavation to backfill the pipe without contaminating the surrounding environment.
Furthermore a dedicated vessel 'Storione' was used to lay the pipes in shallow water.
The pipes, previously laid by the Castoro 12 and positioned at the minimum depth, were towed afloat into the transition zone by the same vessel equipped with a winch tensioner used to keep the pipe string under traction and then winch it towards itself at each 12 metre launch.
In total, a pipe string of almost 10 kilometres in length was launched. Once the floats were removed and the pipe laid on the sea bed, the pipe was buried in a covering of at least 1 metre to minimise environmental impact, leaving the seabed as flat as possible following operations.
This new system meant that the dredging of a wide canal to enable access for 'standard' vessels (which would have required the excavation of huge amounts of soil with serious physical and biological effects, especially on the seabed sediments and the benthic community) was avoided.
In addition to the Mondine, the extreme conditions made it necessary to develop a number of other pieces of equipment specifically for the project. These included the Gerris excavator, submersible floats in rotationally moulded polyethylene, a machine called Derive used to control the lateral movement of the pipe string and to maintain trajectory during launching, gantry cranes for lifting and two floating platforms for performing the tie-in.
The technological and operational solutions adopted enabled the laying of 5.5 kilometres of 18" piping at a minimum depth of 1 metre under the ground, fully exploiting the time

window available for operations (September-October) before the beginning of winter and the onset of ice formation.

Furthermore, in order to minimise the environmental impact in the event of an accidental oil spill, which in such sensitive areas could cause huge environmental damage, Saipem chose to adopt a 100% biodegradable fluid on its trenching and shallow water post trenching spread vessels working in the area. The product does not contain substances at concentrations considered hazardous to health and its long- and short-term toxicity is negligible. In the event of leakage, the product is fully decomposed naturally by soil or water microorganisms within a few hours, without affecting the environment and leaving no deposits.

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