



Engineering & Consulting
Oil & Gas ▪ Offshore Wind

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Table of Contents

General Information	3
Exploration & Production Facilities	9
Oil & Gas Treatment	13
Pipelines and Landfalls	18
Offshore Structures	22
Offshore Wind	25
Cooling Water Systems and other Utilities	31
3D Laser Scanning and As-builts	33
Research & Development	35

General Information

IMPaC is an independent company with over 30 years of experience, offering a broad range of engineering and consultancy services to the oil & gas industry and the offshore wind energy industry.

Based upon sound designs and robust execution strategies as a “one-stop shop” we develop integrated systems and tailor-made solutions for the challenges you present. Our team of experienced engineers, university graduates and technical experts build the foundation for successful project execution. IMPaC’s potential contributions include

- ▶ Project and Design Management
- ▶ Professionality
- ▶ Creativity
- ▶ Flexibility
- ▶ Broad Range of Competence
- ▶ Extensive National and International Network

Facts & Figures

IMPaC	International Marine & Petroleum Engineers and Consultants
Head Office	IOE IMPaC GmbH Hohe Bleichen 5, 20354 Hamburg, Germany
Registered with	Register Court Siegen
Ownership	Private, independent
Managing Director	Philippe Steiner
Clients	Oil & Gas Companies Energy Suppliers Major Contractors
Experience	Gained in more than 1000 projects worldwide
Projects	For investment up to 420 million USD
Engineering Disciplines	Process Civil and Structural Mechanical Naval and Marine Technology Piping Pipeline Procurement and Logistics Project services
Engineering Tools	State-of-the-art software for all relevant engineering tasks
Certificates	IMPaC's Integrated Quality and Health, Safety & Security (QMHSSE) System is certified according to DIN EN ISO 9001:2008

OUR SERVICES

IMPaC specialises in developing fully integrated designs – from Concept to Commissioning. We take your ideas and transform them to concepts and designs in compliance with the highest standards and Authority requirements. We continuously review our developing designs always with an eye to safety and functionality, the balance between CAPEX and OPEX and constant risk management. In the process, rough drafts mature to highly detailed 3D models reflecting the philosophies of your company with regard to project and location specific concepts.

Being well established in the Oil & Gas sector IMPaC decided, to extend their range of interests to include the expanding Renewable Energy market, mainly Offshore Wind. We have now accumulated more than a decade of experience including involvement in major North Sea and Baltic Sea projects. Our successful performance record now ranges from Concept Development through Basic Engineering Design (BED) or Front End Engineering Design (FEED) and Long Lead Item Procurement through to Detail Engineering Design and attendance on Fabrication, Construction, Commissioning and Operations.

During the Project Realisation Process IMPaC prioritises respectively safety, quality and cost effectiveness throughout the entire life of the asset from Construction to De-commissioning.



Consulting

Our broad expertise enables us to provide overall consultancy services to our Clients. This applies to all phases of a project and includes general consultation and also advice on specific issues. IMPaC can also act as the Owner's Engineer in order to represent the interests and intentions of our Clients. This function can include the supervision, review and approval of third parties' services and supplies. IMPaC also provides Authority Engineering services to complete our overall consultancy service.

Basic Design & FEED

Oil and Gas: For upstream projects we can perform Basic Engineering Design (BED) or Front End Engineering Design (FEED) according to international and local regulations and standards or according to the customer's specific set of regulations. After safety and quality, overall cost effectiveness is our major consideration in order to prepare the best possible basis for the application for Final Investment Decision (FID).

Offshore Wind: We prepare the entire set of design documents including philosophies, concepts and design documentation incl. calculations, drawings and analysis to give the FID application a solid basis. The engineering codes and standards to be used in the final asset location will always be established before the design work commences, as will all applicable local regulations and authorisation processes.

Detailed Engineering Design

We carry out Detailed Engineering Design (DED) as the logical continuation of the previous Basic Engineering Design (BED) or Front End Engineering Design (FEED) phase following the Client's Final Investment Decision (FID). Its purpose is to detail the engineering design to a level which allows for the continuation of procurement of bulk items (the procurement process for Long Lead Items would normally be started as early as possible in the BED or FEED Phases to minimise project duration), Fabrication, Installation, Construction, Pre-commissioning, Commissioning and Hand-over to the Client for continuing operation of the plant or the facility. The post BED or FEED phases are normally executed in an overlapping and carefully planned sequence in order, again, to minimise the overall project duration.

Our integrated designs generally follow high quality system and proven process based approaches in accordance with internationally recognised HSE standards. Our engineering design is supported by state-of-the-art software systems for 3D computer modelling, 3D analysis, simulation and visualization to guarantee the design's reliability, availability, maintainability and operational safety throughout its lifetime. If required, these developments are verified by model and prototype tests.

Procurement & Logistics

Procurement is the link and the phase between the engineering design and the Fabrication, Installation or Construction phases of the project. Our procurement team offers international purchasing, expediting and inspection of goods and services. IMPaC's objective is to procure on agreed quality, on schedule and at competitive prices. Special consideration is given to delivery, performance reliability, spare parts supply, technical service and safety. The management of logistic services completes our procurement services.

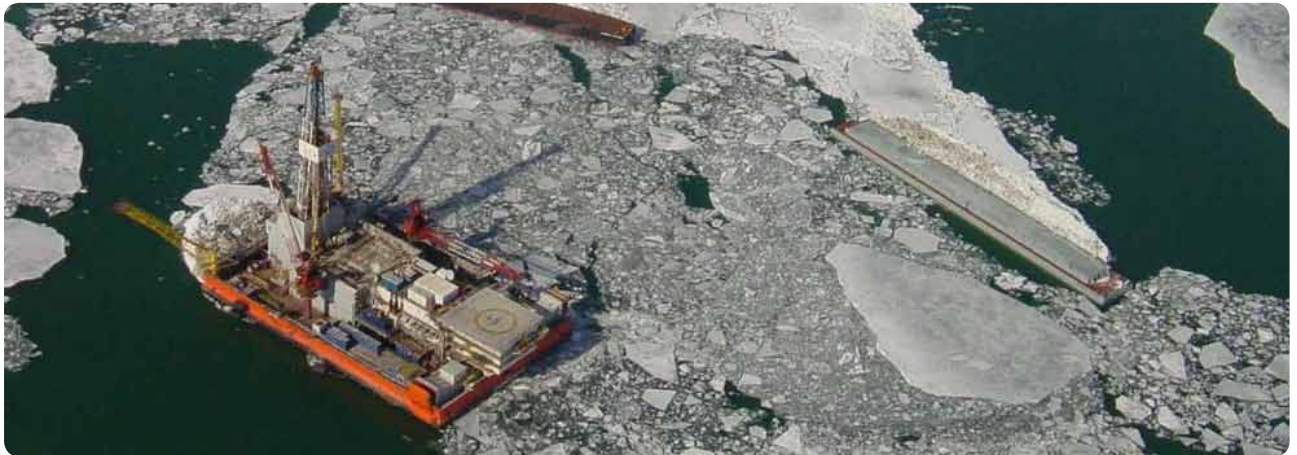
Project Management

Project Management includes Project Services which are necessary throughout the lifetime of a project from 'Opportunity Recognition' to 'Hand-over' and sometimes beyond. IMPaC has the in-house capability to support projects in the areas of e.g. Project Planning, Project Cost Control, Change Management, Contract Management and Contract Administration.

IMPaC frequently provides services for the 'on-site' phases of a project, offering Construction Management and Supervision as part of our overall Project Management. Practical Management and Supervisory Services range from Construction Planning to Construction Management, Completions Management, Pre-commissioning and Commissioning, Plant start-up and Hand-over. IMPaC can also provide Operations Management, if required.

Research & Development

Technically demanding and rapidly growing markets require new and unconventional solutions to meet constantly changing needs and challenges. To secure and strengthen its position as technology leader, IMPaC applies its experience and know-how in various Research and Development (R&D) projects that focus on developing innovative and cost effective solutions for the on- and offshore Energy and Petrochemical industries as well as for the Offshore Wind industry.



Oil & Gas

Since its incorporation in 1983 IMPaC has had continuous involvement with both national and international oil and gas exploration and production companies, mainly in the upstream market. IMPaC carries the benefit of decades of experience ranging from Exploration and Field Development through to Detailed Engineering Design of a multitude of installations including the hydrocarbon transport and gathering systems and the associated power generation and its distribution. IMPaC provides complete and integrated solutions for field developments and can support projects through construction and commissioning phases and into operation.

- ▶ Exploration and Production Facilities
- ▶ Oil and Gas Field Developments
- ▶ Cables, Pipelines, and Landfalls
- ▶ Process Safety, Automation and Control
- ▶ Energy Generation and Distribution
- ▶ Cryogenic Gases - LNG, LPG, Liquid H₂
- ▶ Authority Engineering
- ▶ Offshore Structures
- ▶ Ice Technology
- ▶ Marine Operations
- ▶ Operation and Maintenance Management System
- ▶ Subsea Technology (both shallow and deep water)
- ▶ Risk Analysis and Management

Offshore Wind

IMPaC sees the activities required for the design of an offshore wind asset as integrated plant engineering. Consequently, throughout design and verification, IMPaC always keeps the entire asset in focus. This focus is maintained when IMPaC is awarded the design of components or subsystems and communication and interface management become increasingly important.



- ▶ Authority Engineering
- ▶ Fixed Platforms (Foundation, Jackets and Topsides)
- ▶ Floating Platforms incl. Anchorage & Mooring Systems
- ▶ Cable laying
- ▶ Geotechnics
- ▶ Marine Operations
- ▶ Subsea Technology (both shallow and deep water)
- ▶ Ice technology
- ▶ Operation and Maintenance Management Systems
- ▶ Risk Analysis & Management

Exploration & Production Facilities

For all phases of an offshore exploration, development or refurbishment project IMPaC provides complete engineering for highly automated oil & gas treatment. IMPaC's capabilities include all necessary utility systems on platforms or vessels, e.g. power generation & distribution and safety systems for vessels including FPSOs and FSOs (Floating Production, Storage and Offloading vessels and Floating Storage and Offloading vessels). Our designs address cost-benefit optimisation for both CAPEX and OPEX. Our engineering normally includes for transportation and installation of topsides and modules. Additionally IMPaC supports the Client's interests during procurement, construction, installation and commissioning.

From field development plans through to Operation & Maintenance Manuals IMPaC provides engineering and consultancy for onshore oil & gas projects. By adapting proven offshore technology IMPaC contributes to successful projects in terms of quality, cost and time. Although our main focus to date has been on the upstream sector, we also offer services and solutions to the offsites or utilities in petrochemical complexes.

Petromar Offshore Upgrade Development Programme

for SC Petrom S.A. | Romania

The Histeria Block oil field installations are located 50 km offshore Constanta in the Romanian sector of the Black Sea and consist of six satellite platform complexes feeding into a central platform based production hub. Developments of new offshore oil & gas reservoirs required life extension, upgrade and automation of the existing facilities including subsea tie-back and a new Sinoe platform. The Petromar Offshore Upgrade Development Programme was initiated to upgrade the safety process & automation for the entire offshore production installations and systems, central power supply and management solution, upgrade of all firefighting systems, production water treatment and injection systems, Non-associated Gas (NAG) compression solution and 're-classification'.



Production platform in the Black Sea

Scope of Work

- ▶ Feasibility & Conceptual Studies
- ▶ Integrated Program Management
- ▶ Project office for integrated team in Constanta
- ▶ FEED Engineering
- ▶ Procurement Management
- ▶ Installation & Construction Supervision
- ▶ Commissioning
- ▶ Technical Assessments, HAZOP, Risk Analyses and Safety Cases
- ▶ As-built documentation by 3D laser scan and point cloud data modeling



Process modules

IMPaC's Services

- ▶ 150 000 hours

Kalaekule Improvement Project

for The Shell Petroleum Development Company of Nigeria | Nigeria

SPDC's objective for the KC Platform Improvement Project was to extend the operational life of two wellhead platforms (KCDP-A and KCDP-B), a production platform (KCPP-A) and a flare structure (KCVJ-A) in 20 m water depth for another 20 years, changing their operation mode from normally manned to not normally manned and improving the facilities to meet Department of Petroleum Resources (DPR) safety and environmental requirements.

In the first phase of the project IMPaC inspected the facilities and the existing documentation and prepared a concept for the project. The improvement philosophy consisted of, for example, optimisation of the operating configuration as a result of process recalculation, improvement of security, returning test separators and chemical injection equipment into service and the procurement of a variety of items.

The second phase of the project followed discussions with SPDC and their acceptance of the concept. In that phase IMPaC provided Basic Engineering Design (BED) and Detailed Engineering Design (DED) for the required improvements.

During the course of the project the platform KCDP-B was accidentally damaged by a supply vessel. Subsequently IMPaC carried out a damage assessment and made recommendations for temporary emergency repairs. IMPaC designed a new jacket and developed the concept for removal and re-installation of the new jacket, the topside and the new risers.



Production and wellhead platforms KCPP-A and KCDP-A



Wellhead platform KCDP-B

Scope of Work

- ▶ Structural re-analysis
- ▶ Basic & Detail Engineering Design for change out of Export Pumps, conversion of Cold Vent Flare, Electric Power Generation for pumps, Instrumentation upgrade to electronic type, Installation of Umbilical j-tubes
- ▶ Detail Engineering Design for new jacket
- ▶ Installation Engineering
- ▶ Cost Estimate
- ▶ Procurement assistance
- ▶ Preparation of Invitation to Tender (ITT) for Construction Contract
- ▶ Bid Evaluation

IMPaC's Services

- ▶ 20 000 hours

Prinos / Epsilon Field Development

for Kavala Oil S.A. | Greece

The Prinos/Epsilon offshore facilities comprise the existing Alpha, Beta, Gamma, Delta platforms (oil), existing subsea storage tank, existing Kappa platform (gas), and new Epsilon platform (satellite oil field). The associated 8" subsea oil pipeline and 2" glycol injection line run over a distance of 3.8 km to the onshore Sigma plant. For storage of subsea oil surge a settlement tank with a capacity of 270 m³ was installed. The high content of sulphur and asphaltenes presented an additional challenge for the facilities. The Epsilon Field is located in an active earthquake zone.

IMPaC has prepared an integrated field development plan and Basic Engineering Design (BED) for the Epsilon satellite oil field platform in 51.4 m water depths and for associated pipelines and umbilicals. As prime contractor for the subsea tank IMPaC provided Basic & Detailed Engineering Design, Procurement, Construction/installation Management and Commissioning services.



Production platform in the Aegean Sea

Scope of Work

- ▶ Project Management
- ▶ Integrated Field Development Plan
- ▶ Basic & Detailed Engineering Design
- ▶ Construction & Installation Management
- ▶ Commissioning

IMPaC's Services

- ▶ 25 000 hours



Subsea storage tank

Oil & Gas Treatment

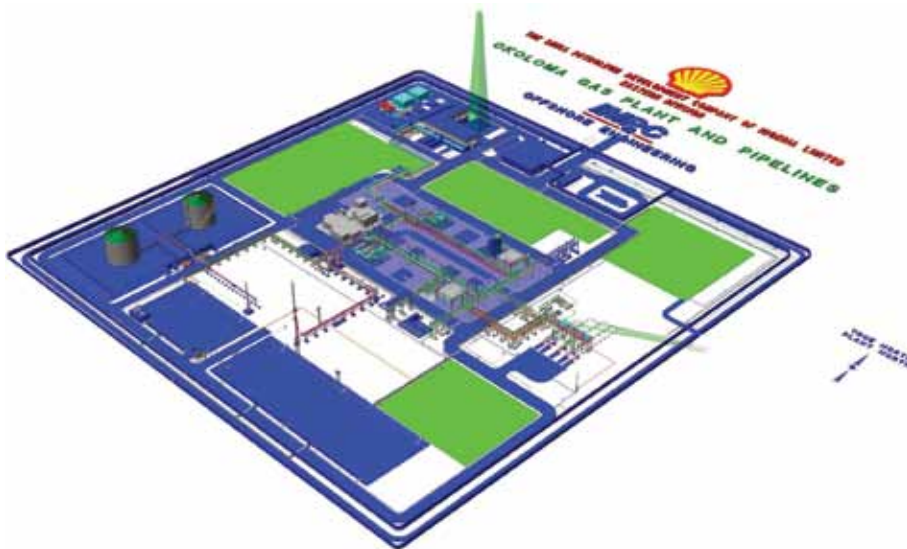
IMP_aC provides complete engineering for highly automated oil & gas treatment. Our design capabilities cover all necessary utility systems, e.g. power generation & distribution and safety systems for onshore and offshore installations including all types of platform and vessels like FPSOs and FSOs. Our designs always address cost-benefit optimisation for both CAPEX and OPEX. Formal HAZID (Hazard Identification Study) and HAZOP (Hazard and Operability Study) processes are a vital component of our design processes.

Okoloma Gas Plant & Pipelines Project

for The Shell Petroleum Development Company of Nigeria (SPDC) | Nigeria

The 240 MMscf/d Okoloma Gas Plant and Pipelines scope of the Afam Integrated Project is intended to supply the base load gas requirement (190 MMscf/d) for the new combined cycle power plant Afam VI (650 MW) and about 50MMscf/d swing supply to the Aluminium Smelting Company of Nigeria (ALSCON) through the existing Nigerian Gas Company (NGC) manifold and pipeline. The Afam VI Power Plant supplies about 20 % of Nigeria's 2009 operational power generation capacity. The fast track Okoloma Gas Plant & Pipelines Project comprises the following facilities:

(1) A 120 MMscf/d JT-LTS (Joule Thomson-Low Temperature Separation) High Pressure Gas Processing Train, with a 33 kV distribution and transmission network and 33 kV switchboards (2) A 120 MMscf/ Twister LTS Low Pressure Gas Processing Train, Condensate Stabilization with Off-gas Compression, Metering, Storage and Export facilities, (3) The Afam Field Non-associated Gas (NAG) manifold with five incoming 8" flowlines from the Afam wells and one 12" 11 km bulk line from the Afam Field NAG manifold to the Okoloma Gas Plant and (4) Various other gas and condensate pipelines & flowlines of diameters from 4" to 16" with lengths from 1.2 up to about 12 km, (5) two transformer stations (33 kV to 6.6 kV) with a distribution to remote consumers and export pumps.



Model of the Okoloma Gas Plant



Okoloma Gas Plant during construction

Scope of Work

- ▶ Review of FEED
- ▶ Detailed Engineering Design
- ▶ Procurement (in cooperation with UTT/Slott)
- ▶ Construction & Commissioning Supervision

IMP_aC's Services

- ▶ 250 000 hours

Bonny Non-associated Gas Project

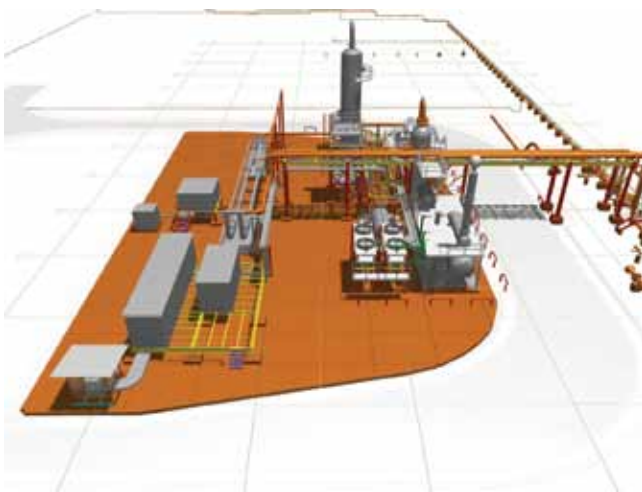
for The Shell Petroleum Development Company of Nigeria (SPDC) | Nigeria

The Bonny Non-associated Gas (NAG) Project is a greenfield onshore gas field development project in Rivers State, Nigeria. It includes a treatment plant with 600 MMscf/d capacity, a 10 km 14" raw gas pipeline, a 1.6 km 16" export pipeline to the Bonny Nigeria Liquid Natural Gas (NLNG) plant and 1 MW power generation.

In the first phase the gas plant was designed to treat 300 MMscf/d. In the second phase the capacity of the plant was extended to 600 MMscf/d. First gas was delivered on schedule. IMPaC provided integrated project development and advanced process automation applying cutting edge Foundation Field Bus technology. Efficiency and adequacy of safety and control functions were checked during the design stage by 'Instrumented Protection Function' procedures.



Bonny NAG treatment plant



Model of the Bonny NAG treatment plant

Scope of Work

- ▶ Basic Engineering Design
- ▶ Detailed Engineering Design
- ▶ ITT for Construction Tender
- ▶ Procurement Assistance
- ▶ Construction Supervision
- ▶ Commissioning

IMPaC's Services

- ▶ 50 000 hours

NC 193 Gas Oil Separation Plant

for RWE Dea | Libya

The concession NC 193 is located in the Sirte Basin in Libya, approx. 120 km south of the Mediterranean Sea. The distance between the Oil Field A and Oil Field B is approx. 20 km. The mean elevation in that area is about 250 m above sea level. RWE Dea planned to develop concession NC 193 in two phases. In the first Phase produced fluids (oil, saline water and associated gas) are treated in a new Gas Oil Separation Plant (GOSP) with a daily production capacity of 10 000 barrels of oil and 20 000 barrels of water. The GOSP is fed via several flow lines from the production fields A & B. The produced water is re-injected into both fields.

For the second Phase further production wells were drilled and an additional oil treatment train was installed to increase the capacity to 20 000 BOPD and 60 000 BWPD. A crude oil stripping unit was selected to reduce the H_2S content to less than 55 ppm. Separated H_2S in the gas phase is burnt to produce hot water. The oil is exported via an 8" (approx. 60 km) pipeline to Bahi, where it is tied-in into a 20" pipeline terminating in the As Sidrah Loading Terminal at the coast.



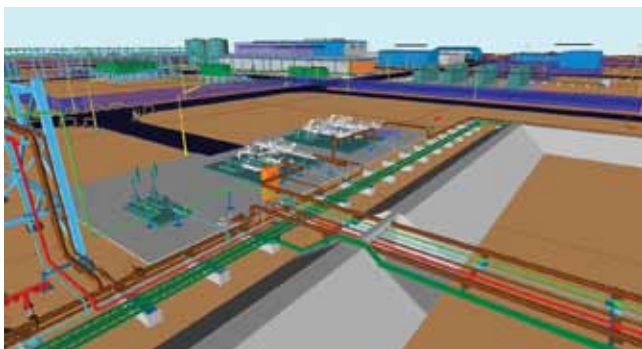
Gas Oil Separation Plant model

Scope of Work

- ▶ Review of FEED
- ▶ Detailed Engineering Design of entire GOSP
- ▶ Detailed Engineering Design of the offsites and utilities for GOSP including Potable Water Systems, Waste Water System, Water Treatment and Fuel Supply Systems for the camp facilities
- ▶ Procurement assistance

IMPaC's Services

- ▶ 26 000 hours



GOSP model

Pipelines & Landfalls

Pipelines are used worldwide for the transportation of fluid hydrocarbons, water and, in special applications, other products. Over the years IMPaC has successfully contributed to numerous onshore and offshore pipelines in all project phases from the conceptual design through Detailed Engineering Design (DED), Construction and Operation up to and including Decommissioning. Springing from the skills and experience available within the IMPaC team a number of innovative solutions have been developed and implemented in the design, construction and operation of pipelines.

Landfalls are often an integral part of offshore projects as the subsea pipelines; cables, etc. connect to their respective onshore systems. Whilst widely used and proven standard construction methods are available for the long distance on- and offshore installation, special attention is always given to the design of landfalls for subsea pipelines and cables. Generally, water intakes and outfalls also fall within the category of landfalls. Typically, these landfalls cover the section of the route from some 10 to 20 meters water depth up to an onshore tie-in point. Often environmentally sensitive areas such as reefs and sandbars with shallow waters, dykes, dunes, cultural heritages etc. are to be crossed. Each landfall location therefore has its own characteristics and challenges and requires its own tailor made unique solution. The IMPaC team has successfully carried out a number of landfall projects. Individual solutions included specialised installation methods for shallow waters, tunnels, micro-tunnels, horizontal directional drilling and also conventional open cut trenches.

Nord Stream Pipeline Project

for Nord Stream AG, Snamprogetti SpA, WINGAS GmbH & Co KG | Germany

The Nord Stream Pipeline is a subsea natural gas pipeline transmission system from Russia to Germany comprising of two parallel pipelines. Each pipeline has a diameter of 48" and a length of 1 220 km. The twin pipelines are designed for complex operation with a staged design pressure of 220/200/177 bar and a transport capacity of 55 billion m³/year.

IMPac has provided engineering services to Nord Stream from the early stages of the project which included Authority Engineering & Permitting support, preparation of detailed documentation and maps for the Construction, Commissioning and Operation of the pipelines and for the national & international permitting processes. Within the project IMPac has also developed and evaluated alternative pipeline routes and installation concepts incl. hydraulic and temperature simulations and calculations and emission reports. The detailed design of the Dry Section Pipeline Facilities comprised Pipeline Stress Analyses, Dry Section Layout Optimization and multidisciplinary design and engineering work. IMPac also developed and prepared the overall operation management system and provided Construction Management and consultancy services for offshore and onshore installation works. In addition IMPac contributed to the Certification of the Automation System.



Pipelay barge 'Castoro 10'

Scope of Work

- ▶ Authority Engineering & Engineering services throughout all project phases
- ▶ Detailed Engineering Design for the German Dry Section
- ▶ Construction Management
- ▶ Operation Management System

IMPac's Services

- ▶ 100 000 hours



German landfall at Lubmin

Feasibility Study NEXT - Nord Stream Extension Project

for Nord Stream AG

Subject of the Feasibility Study for the Nord Stream Extension Project is an offshore gas transmission system for transporting natural gas from Russia to Europe with a landing point at the German Baltic Sea Coast. The main characteristics of the gas transmission system were twin subsea pipeline, 48" x 1 200 km each, telescopic design pressure concept with 220, 200, 177 bar, wall thickness ranging between 26.8 mm to 41 mm and a transport capacity of 2 x 27.5 billion sm³/year.

For the German sector of the NEXT Feasibility Study IMPaC undertook numerous tasks such as:



Pipeline Route Russia - Germany
Source: www.nord-stream.com

- Identification and development of offshore routing alternatives, landfall and onshore options
- Site visits
- Development of route selection criteria
- Route maps
- Data bases for project risks, quantities, cost etc.
- Time schedules
- Explanatory reports
- Compilation of final overall feasibility study documentation



Pipe laying vessel and survey support vessels
Source: www.nord-stream.com

IMPaC's Services

- 4 500 hours

Current Status

- The project is being implemented since 2015 as the Nord Stream 2 Pipeline

Europipe Development Project

for Statoil, ARGE Landfall (Hochtief + Bohlen & Doyen), ARGE Balje Pipelay (Bohlen & Doyen / Ludwig Freytag), KBB | Germany

The 620 km 40" gas pipeline runs from the 16/11-E platform to receiving facilities in Germany with a design pressure of 156 bar. The landfall is located at the North-West German Wadden coast. Since this area is a natural park, a telescopic pipe jacking method was used for the crossing of the ecologically sensitive tidal flats to the mainland. IMPaC was involved in the nearshore pipelaying in very shallow water ranging between 4 and 14 m water depth and in the 2.5 km landfall tunnel section.



Shallow water pipelaying



Pipelay barge 'Baas Kobus III'



Pipeline installation at landfall tunnel

Scope of Work

General Landfall

- ▶ Development of Landfall Concepts

Shallow Water Section

- ▶ Detailed Engineering Design of barge conversion to suit the large diameter heavy wall pipe
- ▶ Study of mooring system including design, installation, removal, schedule, cost
- ▶ General Project Management, Engineering and Construction Supervision Services

Tunnel Section (during the project Statoil decided to install 2 pipelines in the tunnel section)

- ▶ Installation Concept and Procedures
- ▶ Detailed Engineering Design
- ▶ Stress Analysis
- ▶ Design of access shaft and cover of tie-in chamber for offshore pipeline
- ▶ Construction Supervision
- ▶ Engineering Management
- ▶ Project Management Consultancy
- ▶ Study for Corrosion Protection System of the tunnel pipeline

IMPaC's Services

- ▶ 50 000 hours

Offshore Structures for Oil & Gas

With over 30 years of offshore related project experience IMPaC has gathered extensive 'know-how' on the challenging interaction of wind, waves, currents and ice loads with different kinds of offshore structures. Based on our long-term specialist knowledge of extreme boundary conditions, IMPaC provides complex engineering solutions in harsh environments for floating or fixed foundations for the offshore energy industry incl. platforms, foundations, semisubmersible drilling units, drilling rigs, jack- ups, etc. In order to evaluate the optimum technical solution considering costs, risks and environmental aspects we prepare analyses and compare different foundation options.

Kuzey Marmara Field Development

for TPAO | Turkey

The Kuzey Marmara Field is located in the gas-rich Thrace-Gallipoli Basin in the Sea of Marmara. IMPaC provided engineering and project management consultancy services for the design, fabrication and installation of TPAO's Kuzey Marmara production platform (not normally manned) and associated pipelines in 43 m water depth.

The gas production platform is a 4-legged jacket with inclined skirt piles with the following weights: (1) Jacket: 482 t, (2) Topside: 160 t and (3) Piles: 4 piles, 108 t each.

The associated 8" subsea gas pipeline and 2" glycol injection line between the platform and the onshore facilities run over a distance of 2.5 km.



Jacket load out

Scope of Work

- ▶ Project Management
- ▶ Engineering Consultancy
- ▶ Site Engineering
- ▶ Construction & Installation Supervision

IMPaC's Services:

- ▶ 10 000 hours



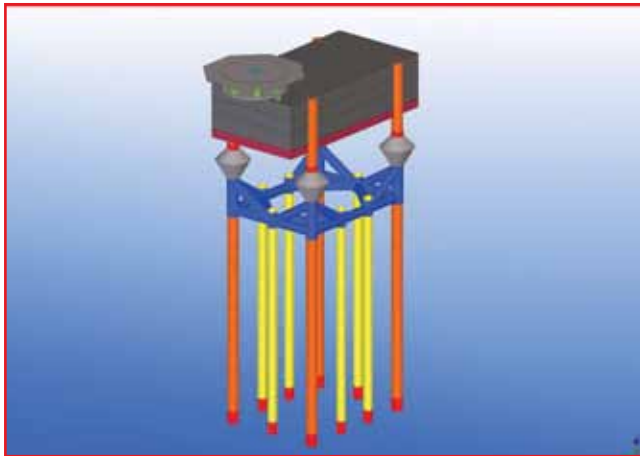
Gas production platform

Yuri Korchagin Field Development

for McDermott Caspian Sea Contractors Inc. | Russia

The Yuri Korchagin field is located in the Russian waters of the North Caspian Sea at a sea depth of 11- 13 m. IMPaC provided special expertise in ice technology and shallow water technology and developed a conceptual design for a fixed offshore ice-resistant platform. The platform is of piled jacket type including accommodation facilities.

Extra piles are required to withstand ice loads resulting from the interaction with pressure ridges. Conical collars are arranged at water level to reduce dynamic forces generated by level ice sheets and rafted ice.



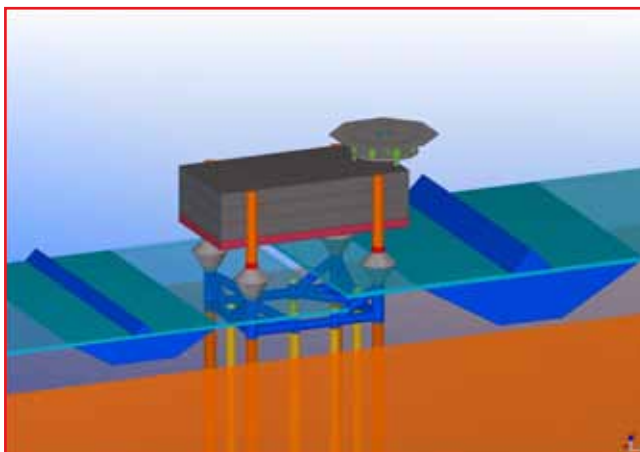
Ice resistant Platform

Scope of Work

- Conceptual Design of piled jacket taking deck with accommodation facilities

IMPaC's Services:

- 900 hours



Platform with conical collars and pressure ridges

Offshore Wind

Contributing to the growing market and increasing interest in renewable energy, IMPaC has carried out numerous projects for the offshore wind energy industry. IMPaC provides state-of-the-art analysis and design solutions for the development and installation of offshore wind parks based on our extensive long-term experience with offshore platforms and structures.

We offer comprehensive design and consultancy services for components of the offshore wind industry including foundation structures for wind generators, complete design of high voltage substations, converter platforms, met-masts and inner & outer park cabling.

Offshore Accommodation Platform „Dan Tysk“ - Design

Owner Vattenfall | Germany

The accommodation platform for the offshore wind farm „DanTysk“ in a water depth of 25 m (LAT) is designed to provide accommodation and boarding facilities for up to 60 persons, offices and meeting rooms. The dimension of the topside is 30 x 30 x 20 m with a weight of 2 500 t. The jacket weight amounts to 1 000 t. A new type of boat landing has been developed and implemented with focus on ease of operational human safety as well as on Fabrication & Installation.



3D OAP model



Photorealistic rendering of OAP model

Scope of Work

- ▶ Review and finalization of platform conceptual design
- ▶ Preparation / finalization of asset design philosophies for
 - safety
 - fire fighting
 - operation & maintenance
 - access & transfer
 - waste management
- ▶ Basic Engineering Design of jacket and topside incl. all systems & utilities (acc. to Eurocode)
- ▶ Elaboration of design briefs (steel structure, safety & systems)
- ▶ Assistance to detail design of jacket and topside
- ▶ Engineering Management incl. QHSSE
- ▶ Interface management, planning & scheduling of all design activities

IMP_aC's Services:

- ▶ 25 000 hours

Offshore Accommodation Platform „Dan Tysk“ - Follow-up Consultancy

Owner Vattenfall | Germany



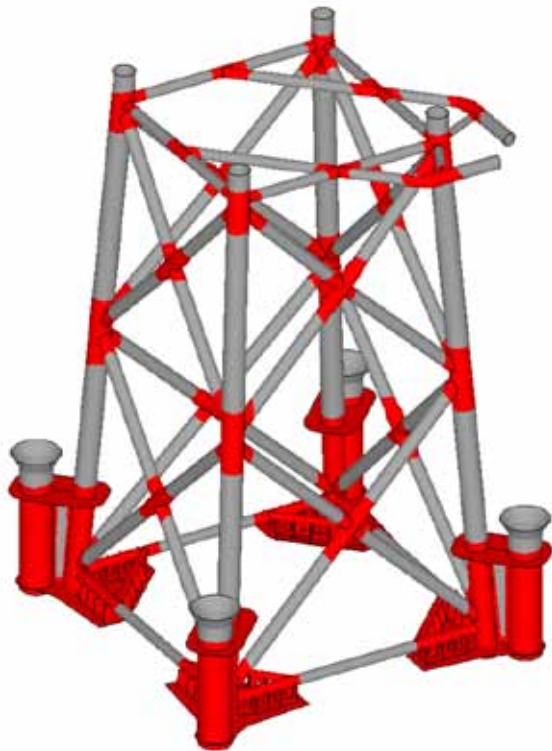
Topside installation

Scope of Work

- ▶ Consultancy services for the installation phase including
 - Update of drawings
 - Refinement of FE calculations with specified installation procedures
 - Update of installation drawings
- ▶ Development of monitoring concept (together with WTM Engineers) for operation phase
- ▶ As-builts:
 - Update of design drawings (P&IDs)
 - Verification of as-built status (foundation piles, grouted connections)

IMPac's Services:

- ▶ 3 500 hours



FE modell of jacket

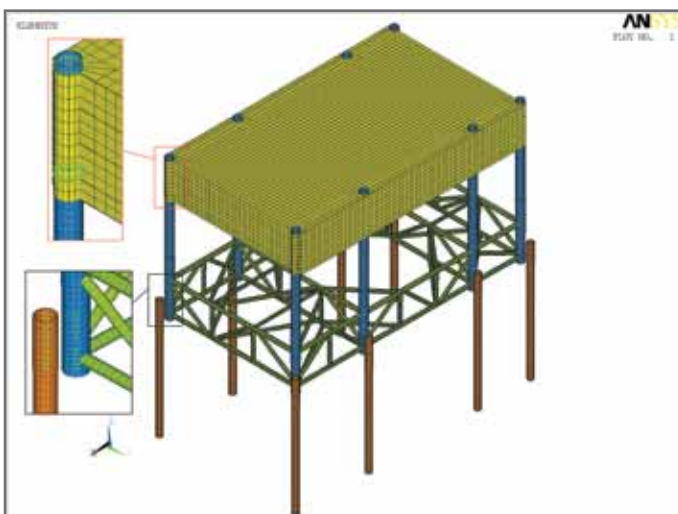
Offshore Converter Platforms

for Siemens | Germany

For offshore wind farms with larger distances to shore conversion of the produced AC power to DC is required. Siemens was contracted to design, construct, install, commission and operate various HVDC converter platforms in the German sector of the North Sea. IMPaC supported Siemens from early phases on with the following tasks:



Artist Impression of concept for Converter Platform HelWin beta



Converter Platform FE Model

Scope of Work

- ▶ Bid support
- ▶ Design & Operating Philosophies
- ▶ Design Basis
- ▶ Conceptual Designs
- ▶ Transport & Installation Methods
- ▶ Fire Prevention Concepts
- ▶ Operation & Maintenance Management Concepts
- ▶ Platform Manning Concepts
- ▶ Platform Marking Concepts
- ▶ Access & Transfer Concepts
- ▶ Emission Studies
- ▶ Support for Authority engineering, first, second and third release by BSH (German Federal Maritime and Hydrographic Agency)

IMPaC's Services:

- ▶ 5 500 hours

Detailed Design of Met Mast for Wind Farm ‚Nordsee Ost‘ and ‚Ijmuiden‘

for Van Oord | Germany

The offshore wind farm ‚Nordsee Ost‘ with a capacity of 295 MW is located 35 km west of Amrum in the German North Sea. IMPaC has carried out detailed design of the met mast foundation including Finite Element (FE) based analysis with ANSYS software including:



Met mast deck before load out



Met mast ‚Nordsee Ost‘

Scope of Work

- ▶ Detailed Engineering Design for met mast foundations incl.:
- ▶ Ultimate Strength Analysis of:
 - met mast tower
 - working platform
 - foundation
 - grouted connection between monopile and transition piece
 - Ultimate strength analysis of overall structure
- ▶ Fatigue Strength Analysis of overall structure
- ▶ Boat impact analysis
- ▶ Lifting analysis
- ▶ Flange connection analysis
- ▶ 3D Model, Drawings, Material Take Offs

IMPaC's Services:

- ▶ 2 200 hours

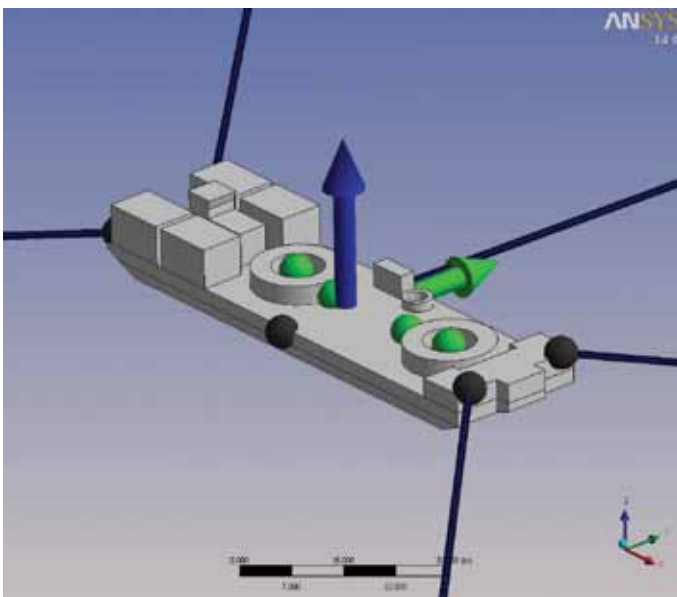
Offshore Cable Projects

for various Clients | North Sea & Baltic Sea

To date IMPaC contributed to numerous offshore cable projects including innerpark cabling, grid connection to shore and other subsea power cables. The services comprised:



Cable laying Barge BoDoInstaller



Mooring analysis for cable laying barge (Ansys AQWA)



Subsea trencher

- ▶ Cable Route Engineering
- ▶ Cable Installations and Burial Methods (cable protection) incl. Route Preparation & Logistics
- ▶ Feasibility & Emission Studies
- ▶ Mooring Analyses for Cable Laying Barges
- ▶ Cost Estimates & Scheduling
- ▶ Authority Engineering and Permitting Support incl. comprehensive Documentation
- ▶ Risk Analyses for various Cable Installation Operations
- ▶ UXO (unexploded ordnance) Consultancy
- ▶ Procurement Assistance
- ▶ Certification Assistance
- ▶ Offshore Construction Management
- ▶ Consultancy for Development of an operational Risk Management System
- ▶ Owner's Engineering services for
 - Surveys
 - UXO Clearance
 - Route Preparation
 - Dredging
 - Offshore & Onshore cable laying
 - Landfalls

IMPaC's Services:

- ▶ more than 50 000 hours

Cooling Water Systems and other Utilities

We have gathered extensive experience in the engineering design of cooling water systems for power plants and petrochemical plants incl. water intakes and outfalls, pump stations, buried and over ground large diameter pipes (steel, GRP and concrete), headers, surge vessels, etc. IMPaC also carries out pressure loss calculations, water hammer calculations, detailed stress analysis of headers and mitered and lobsterback bends, equipment specifications, testing & commissioning procedures, quality plan, etc.

Mobin Utilities Complex

for Sadra | Iran

The sea water cooling system for a petrochemical plant of the Mobin Utilities Complex has a total water demand of 500 000 m³/h and pipeline diameters up to 3 m. After endorsement of the Basic Engineering Design for offshore pipelines and facilities IMPaC was contracted to prepare the Detailed Engineering Design (DED) of the entire cooling water system and weirs including equipment and material specifications. IMPaC carried out steady state and transient stress analyses.

Within this major project with an investment of approx. 400 million USD IMPaC also prepared the construction tender as well as commissioning and testing procedures. The following in-house disciplines have been involved in the project execution: Process, Instrumentation & Control, Pipeline, Piping, Civil & Structural, Electrical, Mechanical and Procurement.



Cooling system for petrochemical plant

Scope of Work

- ▶ Endorsement of Basic Design
- ▶ Detailed Engineering Design
- ▶ Steady State and Transient Stress Analysis
- ▶ Invitation to Tender (ITT) for Construction
- ▶ Procedures for Testing and Commissioning

IMPaC's Services

- ▶ 45 000 hours



Sea water intake basin

3D Laser Scanning and As-builts

Laser scanning is a contact free survey method to achieve 'exact' ± 5 mm (± 1 mm within a single scan) as-built data for all visible items of a facility. The direct result of laser scanning is a registered (merged) point cloud, with each point in the cloud carrying its own coordinate information. The point cloud is used to generate a first basic model consisting of simple shapes.

This model forms the basis for discussion in the first Phase of an as-built generation to set priorities for further modelling. At this stage first layout drawings and views of relevant plant areas can already be generated.

In the second Phase attributes such as material grades, pipe classes, weights etc. can be added to the model. From the resulting (smart) model Material Take Offs (MTO's), Isometrics, Center of Gravity (COG) data etc. can be derived.

The basic model allows engineering with 3D design software, e.g. PDMS, Tekla Structures and the like, as all dimensional data is present and thus tie-in points, battery limits and foot prints of equipment can be shown and arranged.

The point cloud is the sole original data pool for geometrical information for all models. All checks are performed against this point cloud.

3D Laser Scanning of FPSO Bonga

for The Shell Nigeria Exploration and Production Company (SNEPCO) | Nigeria

For replacement of water flood piping by pipes with a larger diameter for FPSO Bonga IMPaC has carried out 3D laser scanning and engineering services. Project challenges were fabrication & erection of class 2500# high pressure 16" NPS pipes (WT up to 1.9") and maximize pre-fabrication in order to minimize field welding requirements. For the survey in a non-stable setting like a swaying vessel, special non-standard surveying methods had to be developed to guarantee results offering accuracy identical to ordinary survey on-shore.

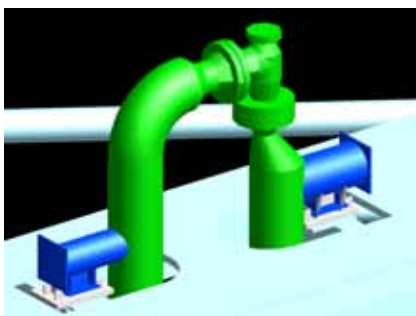
3D laser scanning technology as part of brownfield engineering offers several advantages. In this project all fabrication, examination and testing was completed prior to start of shutdown, and hazards associated with in-field hot work operations, as well as safety risks associated with manual measurement techniques were eliminated. Cost savings due to potentially lost production were considerably high as the shutdown period was reduced by approximately four weeks. Pre-fabricated spools were scanned prior to transporting them to site (offshore) to ensure no problems occurred in fit-up due to fabrication tolerances. Re-work caused by inaccurate manual measurements could thus be eliminated.



Water flood piping of FPSO Bonga



Point cloud



PDMS model

Scope of Work

- ▶ On-site Laser Scanning of water flood piping
- ▶ Modeling of all relevant parts
- ▶ PDMS import of all data
- ▶ Generation of Isometrics for new pipe spools of 16" NPS
- ▶ Laser scanning of all pre-fabricated pipe spool pieces to confirm dimensional accuracy

IMPaC's Services

- ▶ 950 hours

research & development

Technically demanding and rapidly growing markets require new and innovative solutions to meet constantly changing needs and challenges. To secure and strengthen its position as technology leader, IMPaC applies and enhances its experience and know-how in various R&D projects that focus on developing innovative and cost effective solutions for the energy industry – offshore and onshore.

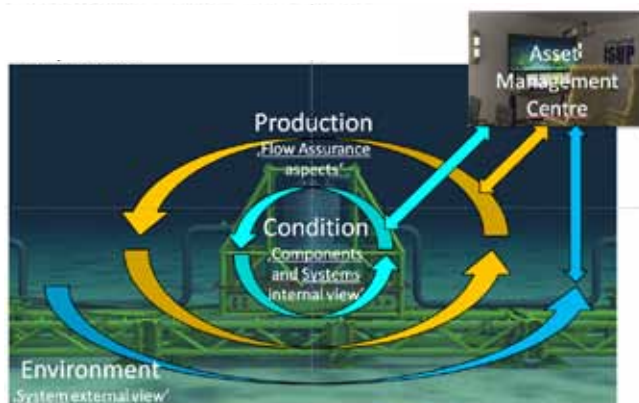
Integrated Systems for Underwater Production of Hydrocarbons (ISUP) and Enhanced Control of Underwater Production (ECUP)

for BMWi - Federal Ministry of Economics and Technology | worldwide

Aim of the ISUP Project was the development of major components and subsystems for underwater production of hydrocarbons. The project was carried out in co-operation with Aker WirthSolutions, Bornemann and the University of Karlsruhe – KIT. The second phase of the project, called ECUP has been partnered with Bornemann, KIT and the University of Bochum.

Within the scope of the ISUP project IMPaC developed a distributed control and automation system called “IMPaC-dCAS”, which allows remote control of all relevant subsystems and tasks in a subsea production plant via broadband Ethernet connection. The current subsea electronic module design is depth rated 2.000 mw and allows a step-out distance to shore of at least 100 km. This system serves as a key component for subsea production plants and shall be responsible for the safe and reliable automation of the production, resulting in a more effective and economic operation. “IMPaC-dCAS” facilitates a maximum degree of integration, which allows a variable set-up of subsystems.

With the development of a web based SCADA system with an interactive Human-Machine-Interface (HMI), IMPaC qualifies itself as a supplier for asset management of underwater process plants.



Correlation of Monitoring Components

Scope of Work

- ▶ Integrated Project Development
- ▶ Design and web based Subsea Control System
- ▶ Animation and visualization of Process Control
- ▶ Tests with virtual and real life facilities
- ▶ Project Management

IMPaC's Services

- ▶ 16 000 hours (ISUP)
- ▶ 12 000 hours (ECUP)



Electric subsea control module for deep water application

»Maritime Pipe Loading System - MPLS20«

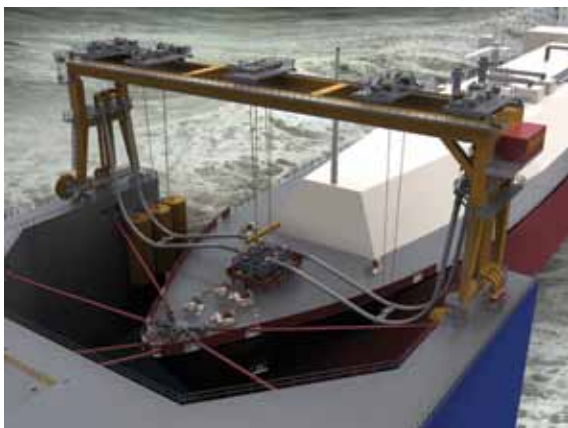
for BMWi - Federal Ministry of Economics and Technology | worldwide

The MPLS20 Project was funded by the BMWi and was carried out in co-operation with Nexans Deutschland, Brugg Pipesystems and the Technical University of Berlin. The aim of the project is the development of an innovative concept for an offshore LNG transfer system, based on vacuum insulated, flexible cryogenic pipes with inner diameters of 16" up to 20".

Within the project IMPaC developed an innovative tandem 'Mooring Bay' concept for LNG transfer operable in harsh environmental conditions up to $H_s = 5.5$ m. This new and patented concept allows cargo transfer between floating LNG terminals and LNG carriers in tandem configuration with safe and reliable – fully aerial – handling of flexible transfer pipes and its standard couplings (QCDC and ERC) which makes the system especially suitable for use under ice conditions.



LNGC entering the 'Mooring Bay'



Minimized relative motions due to the 6 point mooring configuration to assure safe load transfer

Scope of Work

- ▶ Integrated Project Development
- ▶ Complete Concept Design
- ▶ Motion and Mooring Analysis
- ▶ Project Management
- ▶ System Verification by means of model tests (in co-operation with partner TU Berlin)
- ▶ Mooring Bay System patented
- ▶ System Certification (approval in principle) by Germanischer Lloyd

IMPaC's Services

- ▶ 15 000 hours

Side-by-Side Concept for LNG and LPG Transfer in Open Sea Conditions

BMW - Federal Ministry of Economics and Technology | worldwide

The new transfer system 'SOTLL (Sideways Offshore Transfer of LNG and LPG)' enables the ship-to-ship transfer of cryogenic fluids (e.g. LNG, LPG or LH2) in a side-by-side configuration in open sea conditions. The system thus closes the technological gap between the more challenging cargo transfer in tandem configuration, which is considered and suitable for use in harsh environments and the cargo transfer via rigid loading arms, which should only be used in benign conditions in ports, bays or other sheltered waters.

Compared to rigid loading arms the new SOTLL system requires less deck space and less deck substructure as it works with only one crane instead of 4 to 5 rigid loading arms which also reduces the maintenance effort. The required flexibility for ship-to-ship transfer in open sea conditions is achieved by the use of corrugated pipes certified up to 16-inch ID (EN-1474-2) providing a monitored double containment system for highest safety standards. Thus, no fluid swivels are required with the SOTLL system. Nevertheless, in the rare case of a malfunction a pipe can be easily replaced by a spare in short notice, guaranteeing an optimal uptime of the SOTLL transfer system.

In order to cope with differently sized Shuttle Tankers for LPG, LNG and other cargos a flexible positioning of the cargo transfer system and the fender system has been designed. This gives the possibility to accommodate each tanker at the most favourable position alongside the FLNG or FSRU during cargo transfer. As this position depends on the vessel size and the environmental conditions extensive numerical analyses and model tests have been carried out. These have shown that all relative motions in x-, y- and z-directions as well as all occurring loads in the mooring lines between the both ships resulting from second-order wave (drift) forces can be accommodated with standard mooring lines and the new innovative fender system.



The loading system during coupling of the flexible pipes



The loading and fender system waiting for approach of a shuttle tanker

Scope of Work

- ▶ Project Management
- ▶ Integrated Project Development
- ▶ Complete Concept Design
- ▶ Motion and Mooring Analysis
- ▶ System Verification by means of model tests (in co-operation with partner TU Berlin)
- ▶ Flexible positioning of the transfer system patented

IMP_aC's Services

- ▶ 8 000 hours