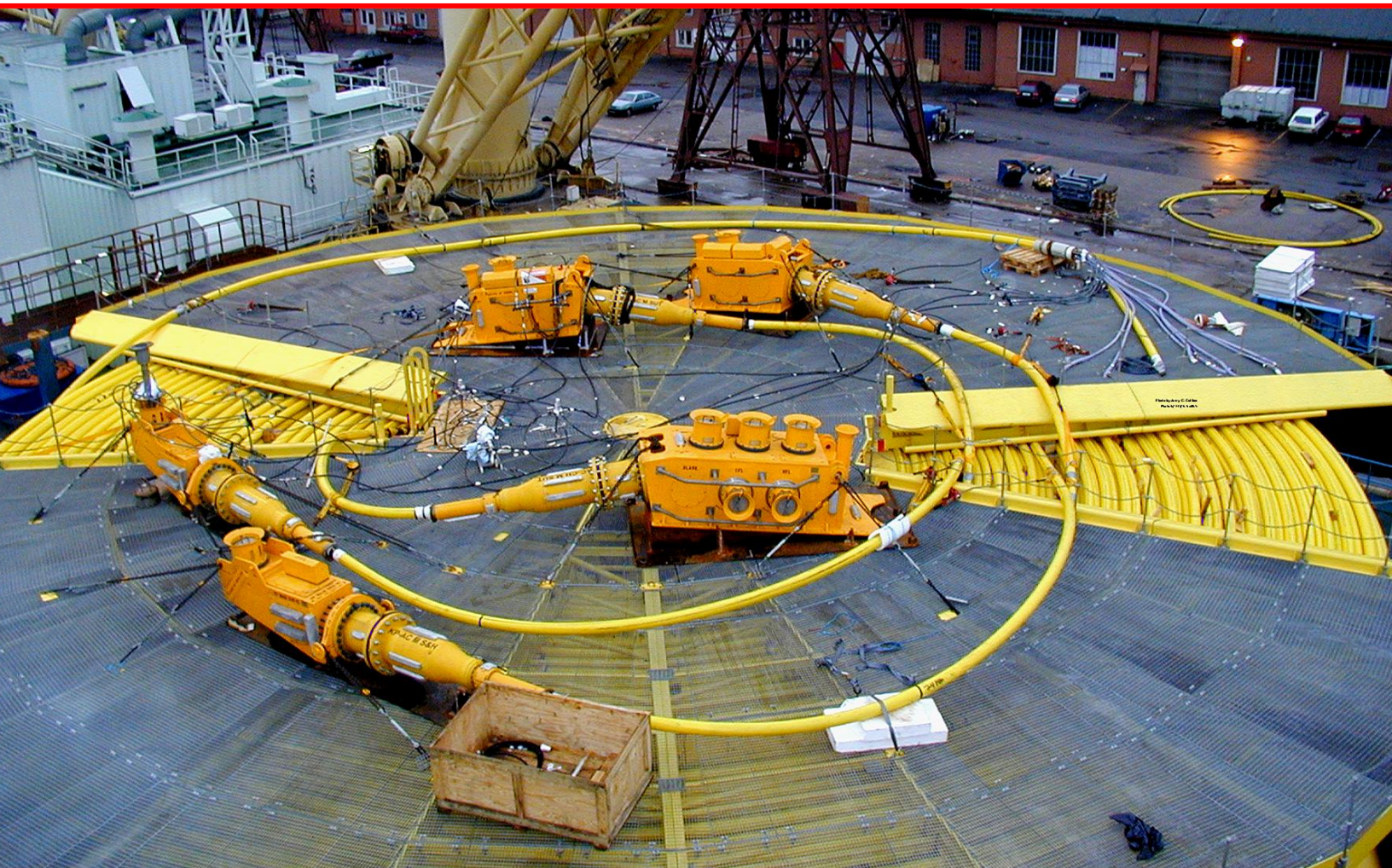
INTECSEA
WorleyParsons Group

Systems Engineering

Capability and Experience



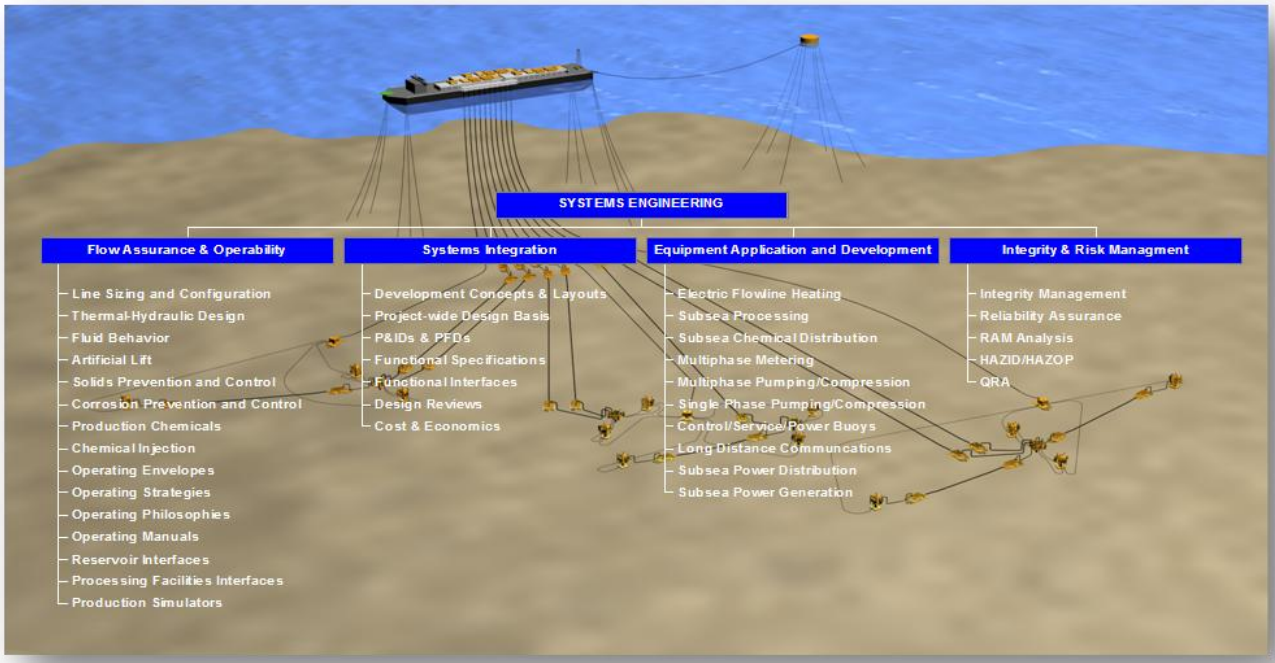
Capability Overview

Successful design and operation of a multiphase production system (or subsystem), particularly one that is long distance and/or in deep water, must consider the entire system; from the reservoir to the production facility. To assure that the entire system can be designed, built, and operated successfully and economically, system designers must consider and/or control reservoir characteristics and production profiles, produced fluids properties and behavior, the design of major system components, operating strategies, and other system variables. Additionally, management of the numerous interfaces between stakeholders and technical disciplines is crucial to the success of such developments. Economic benefits for "getting it right" are critical.

To "get it right", INTECSEA endeavors to execute its engineering services with appropriate attention to inter-disciplinary system aspects that affect our work and that our work affects. INTECSEA's Systems Engineering Discipline Group strives to provide focus on – and to develop expertise in – Systems Engineering work areas and to help assure that issues that underlie the work of all project groups are appropriately considered and applied on all INTECSEA projects.

Systems engineering discipline activities are organized into four primary service areas

- Flow Assurance and Operability
- Systems Integration
- Equipment Application and Development
- Integrity and Risk Management



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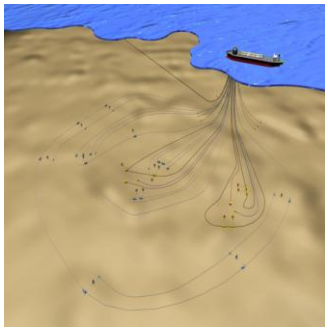
Engineering Services

Flow Assurance and Operability

Flow Assurance and Operability, or Production System Design, encompasses line sizing, solids management, flowline and hardware configuration, and overall operating strategies and philosophies/procedures that are key to the success of most offshore development projects. System design can't be accomplished without intimately addressing system mechanical design, flow assurance, operability, and a host of other key aspects of the system.

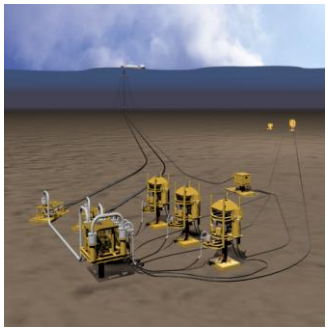
System Integration

Systems Integration can be broadly described as the collection of tasks and work areas that assure that the total system has been defined, conceived, and executed with appropriate attention to all system requirements and constraints. Systems Integration personnel work closely with client functional leaders (reservoir, drilling and completions, operations, flow assurance, facilities engineering, process engineering, etc.) and with other contractors and vendors throughout the life of the project to coordinate, assist, and/or execute system-wide work activities.



Subsea Active Production Technologies

Subsea Active Production Technologies focuses on the subsea equipment and subsystems needed to enable deep-offset Long Distance Delivery Systems. The purpose of this group is to monitor and champion the application and development of Subsea Processing and other Active Production Technologies, including subsea separation, subsea pumping, subsea compression, multiphase metering, electric flowline heating, etc. INTECSEA's combination of mechanical and electrical expertise and systems engineering focus allows INTECSEA to add value to projects wherein active production technologies should be considered and/or applied.



Integrity and Risk Management

Integrity and Risk Management (IRM) is a continuous process applied throughout the asset lifecycle to help assure project success by ensuring that facilities are operated safely, environmentally, and economically and that they remain fit-for-purpose throughout life. INTECSEA's IRM services focus on supporting our clients in achieving their business objectives through Risk Management, Operability Assurance, and Integrity Management. It is essential to initiate IRM activities at the earliest stage of the project to avoid issues such as delayed startup, low initial operating efficiency, higher operating costs, and operational failures.

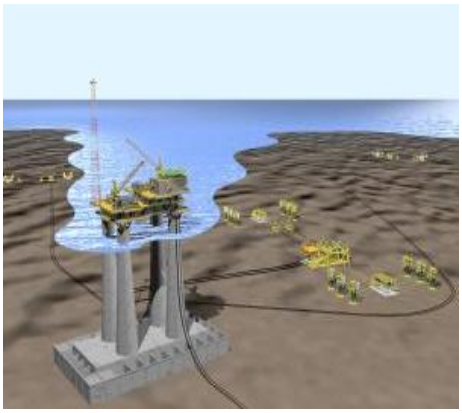
Project Experience

Project: **Gorgon Subsea Study**
Client: **Texaco and Mobil E&P Australia**
Phases: **N/A**

Gorgon Field, Australia

Conceptual screening and feasibility studies to develop the optimum field configuration

The Gorgon Field consists of several reservoirs located in water depths of 200 to 1,000 m approximately 60 km west of Barrow Island, offshore Western Australia. Each reservoir will be developed by the use of multiple subsea wells tied back to individual manifolds, which are subsequently tied back to a shallow water-gathering platform. A large diameter gas trunkline will extend from the shallow water platform to an LNG plant to be located on Barrow Island.



Project: **Canyon Express**
Client: **Total**
Phases: IDENTIFY EVALUATE DEFINE EXECUTE OPERATE

Gulf of Mexico, USA

FEED and Project Execution for the complete development and preparation and evaluation of ITB packages for all subsea equipment and installation

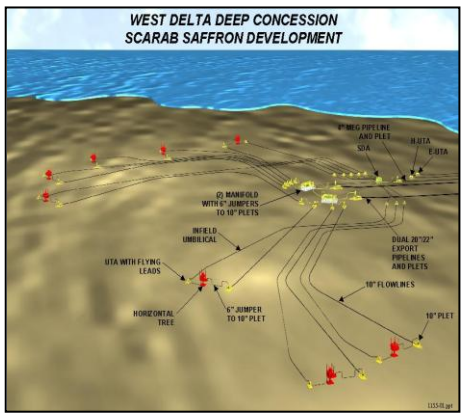
The system must produce three fields under different operating regimes and varying production rates from multiple zone completions without any field taking on the performance risk of another field. Accurate flow allocation is therefore essential, which resulted in the use of subsea multiphase flow meters on each of the subsea wells. Multiple well manifolds and infield flowlines have been eliminated through the use of inline well tie-in sleds. These sleds have been designed to accommodate individual wells. As a result, flowline routing is dictated in large part by the location of the subsea wells. Wells are connected to the flowline tie-in sleds using conventional inverted 'U' shaped jumpers.

Project: **Scarab/Saffron Subsea Development**
Client: **Burullus Gas**
Phases: IDENTIFY EVALUATE DEFINE EXECUTE OPERATE

Scarab and Saffron Field, Egypt

FEED and the preparation and evaluation of ITT packages, and management of the contracted suppliers of services and equipment

The water depth in the Scarab/Saffron Development area ranges from 250 m to 850 m. The development consists of eight wells that will produce 600 MMSCFD of gas via a dual export pipeline system to a new onshore gas processing plant. Following treatment, the gas is exported via a new pipeline to a tie-in to the Egyptian National Transmission System.



Project: **Shell Malampaya Subsea Project**
Client: **Cooper Cameron (Singapore) PTE. Ltd.**
Phases: **N/A**

Malampaya Field, Philippines

Pipeline conceptual engineering and final pipeline route selection

The Malampaya field is located offshore NW Palawan, Philippines in 750 to 1,150 m of water. The field was developed using a manifolded cluster of subsea wells tied back to a production platform located 30 km away in shallow water.

The manifold consists of a three-pile foundation installed with the aid of a spacer template, a manifold support structure to support the manifold, and tie-in porches. The retrievable manifold contains three header ball valves and 10 gate valves. The work included the detailed design of a subsea production manifold for gas production in a water depth of 854 m, offshore Palawan, Philippines.

Project: **NaKika Electrical Flowline Heating Project**
Client: **Shell International E&P**
Phases: **N/A**

Houston, Texas

From client-supplied Design Basis information, INTECSEA designed the power system to supply continuously variable pipeline voltage

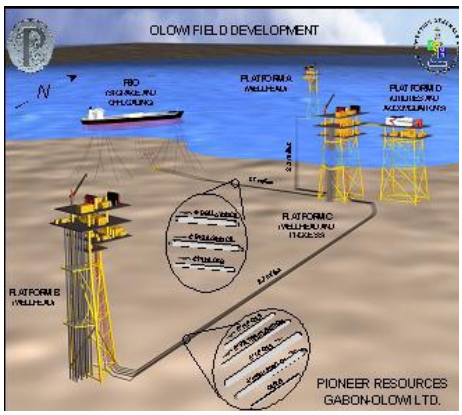
The Electrical Heating Ready Intervention System, (EHR-IS) is a project specific modular package required for possible hydrate remediation on the Northern Flowline Loop of the NaKika Development Project, located in the Gulf of Mexico. Heating is achieved by mobilization of a portable electrical power and control system, which is loaded onto a vessel of opportunity and taken to site. The flowlines are equipped with midline electrical assemblies, as part of the flowline design, and these accept the power system through ROV-operated connections, subsea transformer, and umbilical from the topside spread.

Project: **Olowi Project – Flow Assurance FEED**
Client: **Pioneer Resources**
Phases: IDENTIFY EVALUATE **DEFINE** EXECUTE OPERATE

Olowi Field, Gabon

INTECSEA began by reviewing previous design work to verify that the proposed design met requirements for producing high wax content oil. INTECSEA continued into FEED developing the detailed design for the Olowi production and transportation systems.

Pioneer is developing the Olowi Field, offshore Gabon, with four fixed platforms. The oil has a high pour point and this poses many flow assurance challenges. The produced oil and gas from wellhead platforms A and B are sent via flowlines to platform C and commingled with production at C and processed. The gas is pressurized and transported back by flowlines and re-injected into the reservoir. Water injection flowlines run from platform C to A and B. Processed oil is exported via two insulated pipelines and flexible risers to an FSO.



About INTECSEA

(click here to learn more about INTECSEA)

For more than 25 years, INTECSEA has provided frontier technology leadership for the energy industry's most challenging offshore field development and pipeline projects.

INTECSEA was formed in 1984 and provides design for floating systems, risers, pipelines, and subsea engineering and construction management services within the global WorleyParsons Group. INTECSEA has established operating offices in Houston, Kuala Lumpur, Singapore, Delft, Rio de Janeiro, Jakarta, Angola, Cairo, St. John's, Perth, Melbourne, and London. (see all WorleyParsons' locations)

INTECSEA's major areas of expertise include deepwater subsea and floating production systems, marine pipeline and riser systems, Arctic pipelines, marine terminal systems, and Arctic structures. Additional areas of expertise include flow assurance and operability, marine surveys, marine operations, and offshore equipment design.

A History of Innovation and Benchmark Achievements…

SUBSEA

- Deepest Subsea Production
- Longest Oil Tieback
- Longest Gas Tieback
- First Subsea Allocation Flow Meters
- First 15,000 psi Subsea Trees
- First Electrically Heated Pipe-in-Pipe Flowlines
- Deepest Multiphase Subsea Pumps
- First Super Duplex Umbilical
- First Diaphragm Chemical Injection System

RISERS

- First Pipe-in-Pipe Steel Catenary Riser
- First Reeled Steel Catenary Riser
- Deepest Steel Catenary Risers
- Most Shallow Catenary Riser
- Largest Diameter Flexible SCR Joint
- First SCRs on an FPSO
- Most Direct Vertical Access Risers
- First GOM Free-Standing Riser

FLOATING SYSTEMS

- Largest FPSO
- Deepest TLP at Time of Installation
- Deepest SPAR at Time of Installation
- Most Installed TLPs
- First Deepwater FPU Operated with a Drilling Tender
- Most Types of Floating Systems

MARINE PIPELINES

- Deepest S-lay Pipeline
- Deepest J-lay Pipeline
- Longest Offshore Pipeline
- First Offshore Arctic Pipeline
- First Arctic Pipeline Leak Detection System
- First Piggable Wyes
- First Arctic Pipeline Bundle

(for more capabilities information click here)

INTECSEA
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Global Reach,
Local Knowledge,
Global Solutions

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