Flow assurance encompasses the thermal-hydraulic design and assessment of multiphase production/transport systems as well as the prediction, prevention, and remediation of flow stoppages due to solids deposition (particularly due to hydrates and waxes).

Flow assurance designs must consider the capabilities and requirements for all parts of the system throughout the entire production life of the system to reach a successful solution. Successful system designs must be developed with system unknowns and uncertainties in mind and should be readily adapted to work with the system that is found to exist after production starts, even when that system is different from what was assumed during design.

To assure that the entire system can be designed to operate successfully and economically, system designers must consider flow assurance fundamentals such as reservoir characteristics, production profiles, produced fluid chemistry, and environmental conditions.

Important system parameters established as part of the design effort include tubing and flowline diameters, insulation, chemical injection requirements, flow blockage intervention provisions, host facility requirements, capital and operating costs, operating boundaries, and risk mitigation.

**Services**

- Life of field analysis (IPM)
- Dynamic/transient analysis
- Wax and asphaltene
- Hydrates remediation and MEG management
- Slugging and slug mitigation/catching
- End-to-end transient multiphase simulation (OLGA-HYSYS)
- Wellbore (and Reservoir) modelling
- Operational management tools
- Hydrate, wax control and remediation
- Operability reviews
- System design and engineering
- Systems architecture
- Functional interface management
- Flow assurance manuals
- Operating manuals
- Fluid characterization
- Chemical injection design
- Pigging system design
Engineering Services

Thermal Hydraulic Simulations
In performing thermal-hydraulic simulations, fluids are modeled with black oil and/or compositional models, as appropriate and as detailed compositions are available. When tuning data is available, fluid characterizations are developed. Insulation characteristics of downhole production tubing and subsea flowlines are realistically modeled. Schlumberger’s PIPESIM or FEESA’s Maximus multiphase simulator is used for steady state, multiphase, thermal-hydraulic simulation of both single-line and network models. Life of field simulations are performed to examine the operability of the system with time. The OLGA transient multiphase simulator is used for dynamic simulations such as startup, shutdown, slugging, and pigging.

Production Chemistry – Scale Management
Understanding of scales formation and their prevention/remediation are important for seamless operation of oil and gas production facilities. Scale formation may be due to changes in temperature, pressure, out-gassing, shifts in pH, and contact with incompatible brines. INTECSEA personnel have extensive experience in the management of scales along with their prevention and remediation.

Production Chemistry – Wax and Asphaltenes Management
The selection of chemicals to prevent or inhibit wax and asphaltenes deposition is often challenging. It is likely that field experience will be required to reliably determine what chemicals work and at which injection rates they will be required. Chemical inhibition issues strongly influence flow system design, chemical inhibition design, and system operating philosophies/strategies and procedures. For instance, the technical issues and the costs and benefits of chemical inhibition, wellbore and flowline insulation, and pigging for deposition control all have to be considered together to arrive at an overall design solution. INTECSEA can assist customers with inhibitor test plans. Wax deposition modelling with OLGA is an important analytical simulation in determining the impact of wax formation on the development.

Slug Prediction and Slug Catcher Sizing
In general, for offshore floating and/or platform-based systems, slug catchers are undesirable from a weight and space perspective. Where possible, and particularly for oil/gas systems, it may be preferable to use separator inlet chokes (possibly brought into play by the level control circuitry) to control separator liquid ingress and/or dump rate, and the resultant separator volume. The use and/or design of slug catchers are part of the overall system hardware and operational design. Liquid management in large complex offshore gas-condensate projects, is a challenging issue. INTECSEA can examine a range of operational constraints to evaluate the slug catcher size and operational procedures.

Hydrate Prediction, Inhibition, and Remediation
Operability is intrinsic to the Flow Assurance and System Design Process. INTECSEA has made significant contributions in the assessment of system operability issues and in developing operating philosophies and strategies to avoid the formation of hydrate or wax at any time during system operation. These capabilities have been developed on long-offset, deepwater, subsea development projects for several clients. "Operability" is the set of design provisions and operating strategies that ensure that the production system can be started, operated, and shut down under all conditions (planned and unplanned) throughout the operating life of the total system.
Project Experience

**Canyon Express**
- **CUSTOMER**: Total, BP, and Marathon
- **LOCATION**: Gulf of Mexico, USA

Canyon Express was a first-of-a-kind industry initiative to jointly develop three gas fields in the Gulf of Mexico. The three separate fields include Aconcagua in Mississippi Canyon 305 operated by Total, King’s Peak in Desoto Canyon 177 and 133, and Mississippi Canyon 173 and 217 operated by BP and Camden Hills in Mississippi Canyon 348 operated by Marathon Oil. A gathering system consisting of dual 12-inch pipelines transport the gas from the three fields approximately 55 miles to Williams Canyon Station Platform located in Main Pass 261 with water depth of 299 ft.

**Agbami Field Development**
- **CUSTOMER**: Chevron
- **LOCATION**: Agbami Field, Nigeria

Agbami Field Development concept is based on a new build Floating Production Storage and Offloading (FPSO) system and subsea wells. The export system consists of a single point mooring system with dual rigid pipe offloading lines extending from the FPSO to the SPM. Each of six subsea production systems is configured as a four well cluster with a central manifold to commingle production from each well. The manifolds are tied back to the FPSO by dual 8-inch insulated flowlines and risers. The trees are connected to the manifold using flexible jumpers.

**K2 Field Development Production Facilities**
- **CUSTOMER**: Eni Petroleum
- **LOCATION**: Gulf of Mexico, USA

The K2 Project ties-back 3 - 5 subsea oil wells in approximately 3,900 to 4,500 feet of water in Green Canyon Block 562 of the Gulf of Mexico back to Marco Polo TLP, the host facility. The subsea system consists of two well centers tied back to the TLP via dual pipe-in-pipe insulated flowlines in a piggable loop configuration and Steel Catenary Risers (SCRs). One umbilical will be suspended from the host facility in a dynamic catenary configuration.

**DeepStar Flow Assurance Design Guide**
- **CUSTOMER**: Texaco
- **LOCATION**: Project location

As part of the Texaco-led DeepStar Program, INTECSEA developed a comprehensive Flow Assurance Design Guide. The Flow Assurance Design Guide set forth basic engineering requirements and recommended practice deemed necessary for the reliable and cost effective design and operation of multiphase production systems. Because flow assurance is a multi-discipline activity, the Flow Assurance Design Guide addressed each discipline and explains how each fit in the overall design process.

**West Delta Deep Development**
- **CUSTOMER**: Burullus Gas
- **LOCATION**: Offshore Egypt

INTECSEA has been working on the West Delta Deep Development since 2001. The water depth in the West Delta Deep Development area ranges from 250 m to 1000 m. The development consists of over 60 wells that will produce 1500 MMSCFD of gas via three export pipelines to an onshore gas processing plant. Following treatment, the gas is exported to a tie-in to the Egyptian National Transmission System.

**Olowi Project - Flow Assurnace FEED**
- **CUSTOMER**: Pioneer Resources
- **LOCATION**: Olowi Field, Gabon

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 a FSO.
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