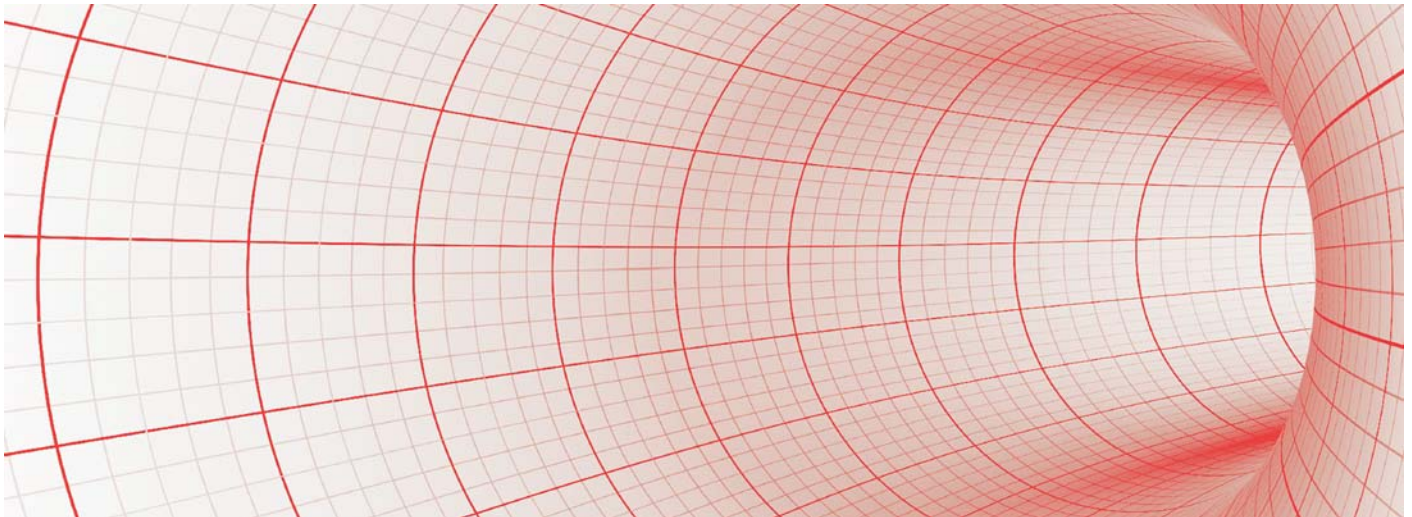




Maximising Pipeline Transportation Systems

Flow assurance is a structured, multi-skilled engineering approach to optimising the flow of hydrocarbons from reservoir to processing plant and from export point through to target market. The central aim is to ensure that hydrocarbon product is extracted, processed and transported as efficiently and economically as possible.



Integrated field development and optimisation

Developing subsea fields requires advanced skills in multiphase flow and flow assurance analysis. Xodus expertise in steady-state and transient thermohydraulic analysis provides a solid basis for developing newly discovered fields, optimising existing operations, and supporting existing systems with suitably robust operating strategies.

We can devise procedures for managing transient issues such as hydrate formation, wax deposition, slugging, corrosion and other potentially disruptive phenomena. We can then help you implement, monitor and fine-tune those procedures in operation.

Broadly speaking, our flow assurance activities can be divided into three main areas:

We use **steady-state thermohydraulic analysis** to assess the capabilities of your system, whether in operation or in development. This includes pipeline sizing, insulation requirements, back pressure calculations, basic slug analysis, hydrate formation calculations, and other calculations to determine the ideal steady-state parameters for your operation.

Based on fluid composition, your projected production profile and any other operating requirements, steady-state thermohydraulic analysis is a key stage in appraising subsea requirements such as mechanical pipeline

design and materials requirements.

It is also an essential tool for planning and selecting appropriate solutions, from hydrate and wax management strategies through to the interfaces with topside processing facilities.

We can produce conceptual feasibility studies with appropriate recommendations, or help you analyse the optimal throughput and targets for your existing facilities, no matter how challenging the conditions in which they are operating. Where applicable, we can use Integrated Production Modelling (IPM) techniques to identify the production profile differences and subsequently the economic impact of various system configurations at the development planning stage.

We use **transient thermohydraulic analysis** later in design to analyse your systemic requirements in more detail. This phase allows us to build a clear picture of system operability, based on detailed slugging analysis, start-up and shutdown calculations and an understanding of deposit mitigation options.

Our experience in transient simulation and operation of subsea systems allows us to predict the type, extent and potential mitigation of flow instabilities within any system, whether the cause is flow regime, topographical effects or transient operation. Crucially, we have experts in the management of all types of instability from slug suppression for severe slugging, to control system setup to manage other forms of instability.

Accurate **transient thermal analysis** is a crucial technique in optimising both the subsea design of complex systems and understanding the chemical requirements for life-of-field operation. The Xodus flow assurance team understands these interfaces and the complex fluid dynamics and thermodynamics knowledge that is required to optimise all aspects of the design. We work with topsides and subsea specialists to ensure that the system design is robust, operable and optimised for all steady

state and transient eventualities. Our practical understanding of the start-up and shutdown issues for subsea developments ensures that robust operation of the field can be maintained within the design envelope.

Keeping products flowing

We provide you with operational support to keep your products flowing using the steady-state and transient approaches outlined above, combined with sophisticated simulation and modelling tools. Our engineers, experienced in the methods available for tuning transient models to match reality, provide accurate, reproducible results that can be used for analysis and optimisation of operating systems. Production management tools, purpose-built by Xodus, correlate simulated with real-time data to provide fast, effective solutions for enhanced monitoring and optimisation in challenging subsea developments. This allows operators and engineers to make informed decisions in the areas that will benefit the asset in terms of production, stability and availability.

Our flow assurance expertise is based on an in-depth understanding of fluid behaviour, including fluid rheology, hydrate prediction and mitigation, wax deposition, PVT characterisation and other production

chemistry issues. Better still, all our engineers have a good understanding of the impact of transient analysis on topside infrastructure. They are trained to recognise the constraints that may be imposed by existing platform or terminal equipment.

Flow assurance toolset

Our mastery of the flow assurance toolset embraces all the major process modelling and multiphase flow simulation tools, including industry standards such as OLGA®, HYSYS® (including Upstream), PIPESIM®, PIPE-FLO®, PVTsim®, Multiflash®, GAP® and PROSPER®. Our familiarity with the tools means we use them intelligently, as guides rather than crystal-ball predictors. Our own tools include XPLORE¹, capable of combining real-time data input with simulated models for simultaneous process monitoring and optimisation.

XPLORE is used by a growing number of operators to manage and monitor their operations to enhance production, increase availability or gain knowledge of system operation through simulation and calculation based on real-time data collection.

Industry challenges

ITF have recently identified long tie-backs as one of the major technology challenges confronting oil and gas operators seeking to exploit wells and reservoirs at increasing depths in increasingly hostile environments. At Xodus, we thrive on the flow assurance issues involved in production from deep and ultra-deepwater fields. We use sophisticated software tools to combine predictive simulations and real-time data to produce accurate, constantly updated models.

Our techniques seamlessly bridge the gap between conceptual design and in-process monitoring. Our cross-disciplinary expertise anticipates issues at the various interfaces in the transportation chain, devising appropriate operating strategies and procedures and providing the practical support you need as solutions are implemented and put into operation.

