



Peritus

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experts in difficult and deepwater environments



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The Peritus mission is to provide high end system engineering services to the offshore oil and gas industry with a particular focus on deepwater and difficult environments for:

- Subsea Systems
- Subsea Pipelines
- Risers
- Floating Structures
- Flow Assurance
- Specialist Engineering
- Field Development



➤ Subsea Systems

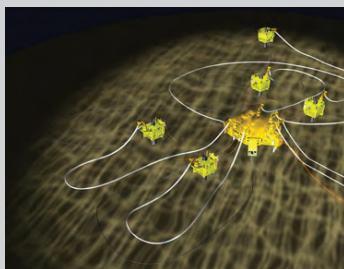
Peritus' capability in Subsea Systems is founded on leading industry personnel, with experience to develop innovative practical solutions for subsea systems.

Subsea systems include subsea trees, subsea hardware (connectors and structures), control systems (including umbilicals), pipelines / flowlines (including HPHT), jumpers and materials.

All projects have their individual challenges from a single well tie-back to a multi-well long distance subsea development. Peritus strive to bring smart, high value and economic solutions whatever the development.

Capabilities include:

- Through life cycle engineering – appraise, select, define, execute, operation support, decommission
- Subsea architecture (including difficult / hazardous terrain), P&ID and layout definition



- Horizontal and vertical remote connection systems
- Pipeline End Manifold (PEM), In-line Termination (ILT) and Flowline End Termination (FLET) structures
- Manifold and tree protection structures
- Control and workover systems definition
- Umbilical Systems definition and functional specification
- Tree systems definition and functional specification
- Flow Assurance analysis and development of field operability methods
- Material selection, corrosion and corrosion management
- Production of Tender Documents / EPIC packages for procurement, fabrication, construction / installation, testing and commissioning of subsea components
- Production of operating philosophies
- Management of factory acceptance testing and system integration tests
- Procurement / manufacturing / fabrication management
- Construction management including offshore installation, start up and commissioning

Experience:

Peritus' senior technical team consists of industry experts with extensive international knowledge and expertise in difficult or deepwater environments. Members of this team have worked on some of the most innovative projects of their time, in some of the world's most challenging offshore environments.

➤ Subsea Pipelines

Peritus' capability in Subsea Pipelines is founded on leading industry personnel, with experience to develop innovative solutions to the many challenges facing pipeline systems as they move into ever deeper waters.

Our personnel have experience in the design and construction of all types of subsea pipeline systems from conventional rigid and flexible pipeline systems in shallow and medium water depths to design solutions for the deep and ultra deep water (over 3400m) and ultra shallow. We have experience of reeled, S-Lay, J-Lay, Towed Pipe-in-Pipe and bundle installed systems.

Long distance and deepwater pipelines require careful planning and good understanding of limit state design to ensure optimum design and minimised material costs. At Peritus, we understand the capabilities of the pipe mills and installation vessels which enables our Concept and FEED designs to establish realistic project schedules and highlight critical activities.

Capabilities include:

- Through life cycle engineering – appraise, select, define, execute, operation support, decommission
- Bundle Flowlines Systems



- Arctic Engineering
- Long distance transmission pipelines
- HPHT and Pipe-in-Pipe flowlines
- Remote systems connections and tie-in spools
- Upheaval and lateral buckling, soil-pipe interaction and advanced mechanics
- Pipeline routing, bottom roughness, pre-lay and post-lay intervention design
- Advanced dynamic stability engineering
- Component design using advanced mechanics solutions, such as J-lay collar, buckle arrestor, end and intermediate bulkhead design
- Shore approach, stability, cathodic protection and crossing design
- Fatigue evaluation and ECA assessments
- J-lay, S-lay, Reel-lay and bundle installation analysis
- Material selection, corrosion and corrosion management
- Production of Tender Documents / EPIC packages for procurement, fabrication, construction / installation, testing and commissioning of subsea pipelines
- Production of operating philosophies
- Procurement / manufacturing / fabrication management
- Construction management including offshore installation, start up and commissioning
- Development and implementation of inspection, maintenance and repair strategies
- Interface management

Experience:

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Risers

Peritus' capability in Marine Risers is founded on leading industry personnel, with experience to develop innovative solutions. While our personnel have experience in the design and construction of conventional rigid riser systems in shallow and deepwater applications, our focus is on dynamic risers in deep to ultra-deep waters with challenging seabed conditions and current loadings. Our scope of work ranges from concept studies, FEED, through detailed design, to fabrication and installation engineering, supervision and management.

For many deepwater systems, risers are an integral part of the subsea development or export system. At Peritus, we adopt a system level overview to ensure individual components fit with the overall functional requirements. The interface between risers with subsea, flowline/pipeline, floating structure, for example, is constantly evaluated to ensure the most efficient and reliable system is adopted.



Capabilities include:

- Through life cycle engineering – appraise, select, define, execute, operation support, decommission
- Steel Catenary Risers (SCR), Flexibles and Top Tensioned Risers (TTR) ranging from small diameter flowlines to large diameter export system
- Hybrid risers, including freestanding riser towers and/or bundles
- Flexjoint, stress joint, keel joint, J or I-Tube and buoyancy tank concept evaluation and design
- Dynamic, floating and seabed founded riser base spools
- Static, quasi-static, dynamic (time and frequency domain) based analysis
- Clashing, interference and interaction analysis
- Material selection, fatigue evaluation, and safety factor calibration analysis
- Component design using advanced mechanics solutions, such as finite element methods and/or testing with statistical simulations, including test program design, implementation, management and supervision
- Development and implementation of inspection, maintenance and repair strategies
- Interface management

Experience:

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➤ Floating Structures

Peritus' capability is founded on leading industry personnel, with experience to develop innovative solutions for floating structures.

Floating structures include FPSO's, FSO's, TLP's, Spars, Semisubmersibles, Control Buoys, and Marine Terminals.

Determining which floating structure is the best solution for any particular development is crucial. Key factors in the selection include the number, location and type of wells, flow assurance issues, hydrocarbon product (oil, gas, multiphase, water cut etc), development schedule, availability of yards etc. Peritus strive to bring smart, high value and economic solutions whatever the development.

Capabilities include:

- Through life cycle engineering – appraise, select, define, execute, operation support, decommission
- Field development engineering

- Floating structure engineering / naval architecture, including new build and conversion engineering
- Vessel availability and surveys
- Response based analysis of floating structures
- Structural engineering
- Mooring system design
- Mooring and offloading buoys
- Material selection, corrosion and corrosion management
- Production of Tender documents / EPIC packages for procurement, fabrication, construction / installation, testing and commissioning
- Procurement / manufacturing / fabrication management
- Seafastening design and transportation analysis
- Float-over deck engineering
- Construction management
- Interface management

Experience:

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➤ Flow Assurance

Peritus' capability is founded on leading industry personnel, with experience to develop innovative solutions for flow assurance. Flow assurance embraces the entire system in the development and the interaction of the hydrocarbons with the system elements and ensures successful and economical flow of hydrocarbon stream from reservoir to the point of sale. Flow assurance is extremely diverse, encompassing many discrete and specialised subjects and bridging across the full gamut of engineering disciplines. Besides network modelling and transient multiphase simulation, flow assurance involves effectively handling of solid deposits, such as, gas hydrates, asphaltene, wax, scale, and naphthenates. Flow assurance is the most critical task during deep water energy production because of the high pressure and low temperature involved. (Production interruption or asset damage due to flow assurance mishap can cause catastrophic blockage formation in pipelines and result in flow assurance failure).

Flow assurance is fundamental to designing a system that can be operated successfully and in an economic manner.

Key factors in the flow assurance work are reservoir type / characteristics, production profiles, produced hydrocarbon chemistry, number and type of wells and environmental conditions. Peritus strive to bring smart, high value and economic solutions whatever the development.



Capabilities include:

- Through life cycle engineering – appraise, select, define, execute, operation support, decommission
- Field development engineering
- Pipeline / Flowline sizing – steady state and transient
- Definition of transient start-up and cooldown temperature profiles for assessment of buckling and walking
- Hydrate prediction, prevention (inhibition) and remediation including chemical injection requirements for start-up, normal operation and shutdown – throughout the field life
- Insulation requirements definition, type and required performance characteristics
- Operational envelope development – minimum, maximum, ramp-up
- Production chemistry issue resolution, such as wax and asphaltines
- Slug prediction, sizing and slug catcher sizing
- Through life production system optimisation
- Production system operability analysis
- Development of operations manuals
- Interface management

Experience:

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➤ Specialist Engineering

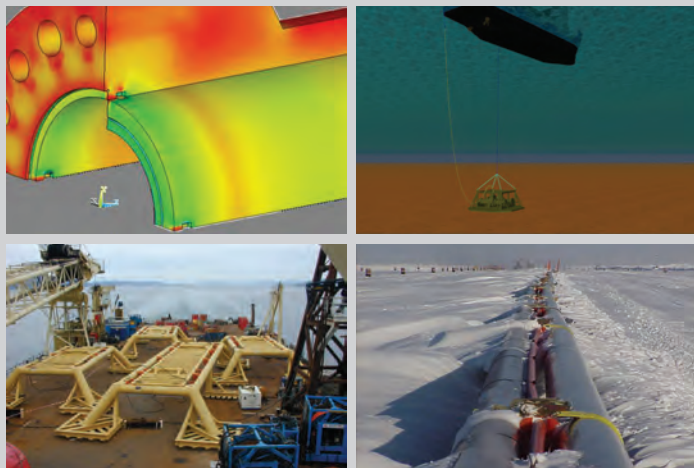
Specialist Engineering for Peritus incorporates four key disciplines:

1. Advanced Mechanics
2. Risk and Integrity Management
3. Materials and Corrosion
4. Geomechanics

Peritus' capability is founded on leading industry personnel with the experience to develop innovative solutions using state of the art tools and analytical methods.

The Oil and Gas industry has undergone major changes in recent years including the emergence of High Pressure High Temperature (HPHT) oil and gas transport systems which place very onerous conditions on system components and can take them well beyond conventional design limits. Projects in ever deeper water, on very soft soils, and projects in harsh environments, including the Arctic, require specialist techniques and methods to accurately assess and model conditions. Deepwater developments are typically characterised by extremely soft soils with complex loading and response characteristics and associated settlement issues. Advanced mechanics is often essential in providing solutions to these complex issues.

Understanding risk is increasingly important as the consequences of failure become more extreme and we strive to make our industry safer and more reliable. Being able to predict the likely performance of the system, potential failure modes, and the frequency and consequences of failures enables us to design safer and more reliable systems.



Peritus recognises the need for advanced materials selection, corrosion, welding and NDE technologies in readiness for complex projects with associated complex materials issues. Materials are increasingly being tested to their limits with HPHT Fields often in combination with high H₂S and CO₂ conditions.

Expertise in Geomechanics is critical as offshore developments move into the deeper and more challenging regions. Design of offshore facilities require a detailed understanding of seabed conditions including strength, stability, mobility and seismic conditions and how these will interact with facilities founded on the seabed.

All projects have their individual challenges. Peritus strive to bring smart, high value and economic solutions whatever the development.

Capabilities include:

Advanced Mechanics

- Two and three dimensional system and component level modelling using proprietary finite element modelling programs, including ANSYS and ABAQUS
- Structural analysis using first principles with closed formed solutions and/or model testing
- Pipeline lateral and vertical (upheaval) buckling control solutions
- Pipeline walking control solutions
- Ice load development and gouge analysis and solutions
- Advanced pipeline and riser installation analysis
- Rough and/or steep seabed terrain modelling
- Seismic acceleration and displacement modelling
- Modelling of pipelines under debris flows
- Advanced solid modelling – including SURF components such as turret swivels, riser flex joints, bulk heads, buckle arrestors, J Lay collars
- Transient/Dynamic FEA of Bundled pipelines including stability, trawl gear interaction, thermal, earthquake, turbidity and debris flow interaction
- Novel testing methods and pushing the boundaries of design codes

Risk and Integrity Management

- Reliability, Availability and Maintainability (RAM) analysis
- System and equipment failure mode analysis (FMEA and FMECA) to predict the performance of new systems and components
- Execution of HAZID, HAZOP, SAFOP, ENVID reviews and management to satisfactory close out

- Quantitative risk analysis (QRA) – frequency and consequence analysis considering risk to personnel, environment and facilities
- Root Cause Analysis (RCA) to investigate incidents and find their causes to prevent reoccurrence
- SIL (safety Integrity Level) and SIF (safety instrumented function) analysis in accordance with international standards IEC 61508, IEC 61511 and ISA S84.01
- Risk-based inspection planning and management for subsea systems, pipelines, risers and mooring facilities
- Preparation of operating and maintenance manuals
- Emergency pipeline repair system evaluation, design and project Management
- Support to operators in the development and implementation of risk and integrity management systems to API 17N and ISO 20815

Materials and Corrosion

- Internal / external corrosion evaluation and control
- Materials selection
- Welding and NDE during fabrication, installation and operation
- Fitness for Service assessments
- Fatigue and ECA assessment
- NDE of the fabrication of components and during operation
Corrosion monitoring

Geomechanics

- Geophysical and Geotechnical Survey specification and management
- Seismic and slope stability analysis and interaction with the pipeline
- Bottom founded structures and anchor foundation design
- Pipe-Soil interaction modelling

Experience:

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➤ Field Development

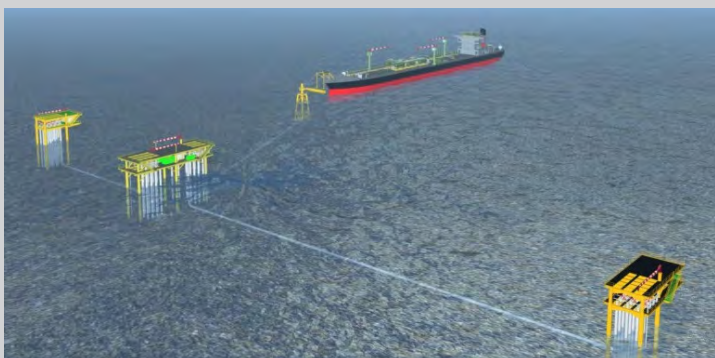
Peritus' capability is founded on leading industry personnel with extensive experience of all stages of offshore oil Field Development.

Field Development consists of identifying and defining, as a system, all components required for successfully developing and operating offshore oil and gas fields. It is a multi-disciplinary task, requiring both technical and commercial skills, including subsurface, drilling, facilities, project, operations and commercial competences.

Field Development activities can occur early in support of oil companies' exploration efforts. More typically, Field Development begins following exploration success when Oil Companies commence the Assess phase of project development which, if successful, continues through to the Define phase and FID. In some cases Field Development addresses brown-field redevelopment opportunities.

Capabilities include:

- Pre-exploration quick field development concept selection and cost estimating in support of exploration or farm-in economic assessment.
- Post discovery, multi-disciplinary development concept selection, cost estimating and trade off.
- Field Development coordination of other disciplines including subsurface, drilling, process facilities, operations, commercial, HSE and regulatory.



- Management of all Field Development activities including technical definition of concept, capex and opex cost estimating, and execution planning.
- Management of or contribution to typical project stage / gate processes including independent verification, preparation of documentation from concept through FID.
- Where Field Development activities are managed by others, Peritus can provide independent review.
- Provision of Peritus SURF and Floating Systems technical disciplines for Field Development projects as well as provision and coordination of third party sub-surface, drilling, process facilities, operations, commercial, HSE and regulatory approval consultants, as required.
- Cost estimating for Field Developments.
- Preparation of project contract strategies and, if required, management of project execution tenders.
- Provision of, or contribution to operators' Field Development project teams for all phases of Field Development from concept, to FEED, detailed engineering, construction, and commissioning.
- Brown-field re-development concepts or execution same as for Greenfield developments.

Experience:

Peritus' team includes former Oil Company and Contractor Engineering, Construction and Operating senior staff with significant experience as project directors, engineering managers, project delivery managers and engineers. Peritus staffs have been responsible for all phases and all styles of offshore developments all around the world, from concept to commissioning. Peritus also has access to subsurface and drilling consultants and has an effective in-house conceptual cost estimating tool.

Peritus has been extensively involved in field development studies, reviews, and cost estimates for discoveries, prospects, brown-field redevelopments, and potential farm-ins globally.