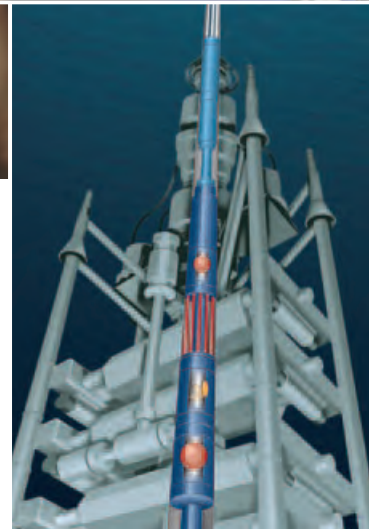


**Schlumberger**



# Subsea Well Control Services





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Advanced systems  
and centrally managed  
worldwide support of  
personnel and processes  
for subsea well control

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**Schlumberger**



Advanced systems and centrally managed  
worldwide support of personnel and  
processes for subsea well control

# Subsea Well Control Services



Our subsea well control services are supported by experienced, trained personnel from program design to project completion.

## THE UNIQUE CHALLENGES OF COMPLETING AND TESTING SUBSEA WELLS

The subsea environment presents technological challenges unlike any encountered by operators developing platform- and land-based assets. To maximize asset value and ensure safety, development strategies must consider the complexities of the offshore environment—water depth, weather conditions, ocean currents, equipment reliability, and well accessibility, to name but a few. As the trend toward drilling in deeper waters continues, seeking safer, more effective technologies for well testing, completion, and intervention operations has never been more important.

## PUTTING A TURNKEY GLOBAL RESOURCE AT YOUR DISPOSAL

Achieving operational efficiency in this challenging environment requires more than optimally engineered systems. True assurance of efficiency comes when your local operation receives the full support of a centrally managed global network. A network with an ever-increasing knowledge base and proven expertise developed through long-term experience in the most challenging subsea environments. In its 30-plus years of providing subsea well control services, Schlumberger has developed such a network.

To each operation, we commit a local team dedicated to exceeding our clients' expectations for quality, health, safety, and protection of the environment (QHSE) performance and supply chain management. The worldwide Schlumberger organization enables us to staff your projects

with our own employee specialists, not subcontractors, who understand the particular requirements in your geographic area.

Ensuring global consistency of all local operations are Schlumberger personnel in our

- Subsea Headquarters, Paris, who set standards and guidelines for consistent business conduct, training, and service implementation
- Schlumberger Reservoir Completions Center, Rosharon, Texas, who focus on engineering and sustaining product excellence for integrated completion and production systems



*Each local operation is fully supported by a centrally managed global network.*

■ Europe Learning Center, Paris, who provide all levels of project management and subsea well control training for engineers, specialists, and operations personnel. The structured courses conducted here ensure a consistently high standard of operations throughout the world.

Also underpinning the efforts of the onsite teams are dedicated engineering resources available 24/7 through an internal online support and knowledge management system.

**SUPPORTING YOUR OPERATION, FROM BEGINNING TO END**

Schlumberger subsea well control specialists work with you from project planning, through implementation, to project completion. We partner with you to define functional requirements for your well control system and to establish interfaces with all operational groups. We have the

established processes, the people, the technologies, and the engineering and manufacturing capabilities to deliver integrated solutions for any subsea completion and testing operation.

Schlumberger well control specialists at client sites are experienced and highly trained. They are prepared to respond quickly to any change in conditions and to interface smoothly with all other operational personnel.

Additionally, we assign a skilled project manager to serve as your single-point contact for all technical, commercial, and contractual matters. Our program of life-of-the-field project management support includes expert input to hazard and operability studies, and it helps optimize operations, maximize production, and minimize operator risk.

**GROWING THE KNOWLEDGE BASE**

To aid in operations efficiency and safety, we use the Quest knowledge management system for reporting, scheduling inspections, recording all QHSE incidents, performing risk analyses, and tracking all aspects of employee QHSE training and development. In this Internet database, we capture, review, and refine best practices and lessons learned to ensure that each of our clients gets the full benefit of every one of our subsea well control experiences and successes.

**ONGOING SUBSEA WELL CONTROL TRAINING AND DEVELOPMENT**

All Schlumberger subsea well control personnel participate in our worldwide LMS Learning Management System training program, and they are commissioned to support our clients only after meeting criteria

related to field seniority and familiarity with the hardware and operational routines.

Field engineers, field specialists, and operators attend fixed-step training programs at our dedicated facilities in Paris.

All subsea well control services employees carry a Schlumberger QHSE passport that documents a rigorous review cycle to ensure complete awareness of, and compliance with, required training and competency standards. Exact records are maintained in QUEST or LMS for

- certification
- courses
- objectives
- other essential QHSE information.

Schlumberger is committed to ensuring that our subsea well control service capabilities are ever-expanding and ever-improving.



## APPLICATIONS

- Well control
- Well operations management
- Subsea completion installation
- Intervention
- Well testing and cleanup

## FEATURES AND BENEFITS

- Modular flexibility for meeting specific requirements without having to design custom systems for each operation
- Simplified integration with any subsea BOP stack
- Standardization of modular components to improve safety and reliability
- Monitoring and feedback capabilities to reduce operator risk and provide data and communication for operations management
- Proven technology and a long history of subsea experience that ensure reliable system performance
- Support by experienced, trained personnel from program design to project completion
- Reliable operations in deep-water and ultradeepwater environments
- Range of control systems to facilitate efficient, low-risk operations
- Two-way communications technology that enables rapid shutdown operations from anchored or dynamically positioned vessels
- Well isolation and landing string disconnect capability with no shearing
- Reduced rig time for completion, Christmas tree installation, and flowback operations
- Completion installation verifications, including tubing hanger setting and sand control integrity
- Early reservoir information available upon completion installation

## RELIABLE, VERSATILE SUBSEA CONTROL SYSTEMS

The SenTREE\* subsea well control systems are versatile performers for completion and testing operations. Ranges of sizes, pressure and temperature ratings, and control system configurations permit designs for a variety of subsea completion and well-testing applications, water depths, and wellbore conditions.

The SenTREE family of well control systems includes the SenTREE 7 and SenTREE HP subsea completion test trees (SCTT) and the SenTREE 3 subsea test tree (SSTT). The flexibility of these systems makes them ideal for integration with any subsea configuration.

The SenTREE system's standardized modules provide the flexibility to meet the specific requirements of each project with minimal system customization. SenTREE modularity reduces system and interface complexity, thus enhancing reliability and service quality while increasing safety and operations efficiency.

## QUALIFIED THROUGH RIGOROUS TESTING

To ensure performance reliability, SenTREE well control systems are thoroughly tested and qualified through in-house factory acceptance techniques and external testing facilities. SenTREE systems and components are tested in a specially constructed hyperbaric chamber at the Schlumberger Reservoir Completion Center in Rosharon, Texas, where pressures can be created to match the subsea conditions for any job.

## OUR EXPERIENCE RUNS DEEP

Building on many years of experience providing subsea well control services, Schlumberger launched the SenTREE family of completion landing string systems using direct hydraulic control for operations from anchored vessels. While times vary depending on water depth and umbilical length, the direct hydraulic control system requires approximately 120 s to close the SenTREE valves and disconnect.

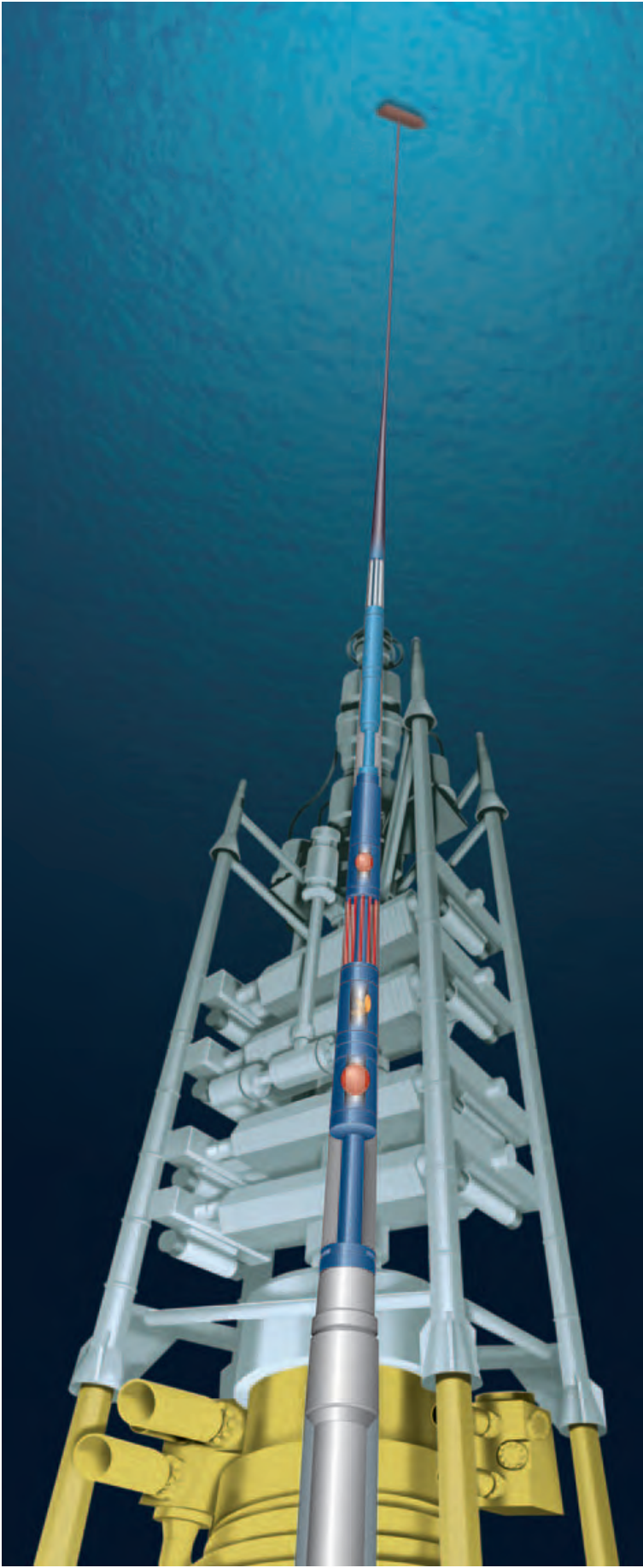
For operations from dynamically positioned vessels, Schlumberger developed another special control system. In 2001, the Commander\* system became the industry's first fast-acting control system to enable completion installation and flowback operations from dynamically positioned vessels.

The fast-acting Commander control system requires only 15 s to close the SenTREE valves and disconnect. It is an intelligent, integrated control system that requires one simple, small-diameter umbilical to operate the SenTREE family and all associated tubing hanger running tool and completion equipment functions. A communications system for control and telemetry feedback provides data to enhance well operations management.

To date, Schlumberger has completed hundreds of subsea well control jobs using SenTREE SCTT systems with direct-hydraulic or fast-acting control systems.



*Fast-acting control systems are ideal for completion installations and well test applications performed from a dynamically positioned vessel and can provide function-status monitoring to assist with management of completion operations.*



Completion and testing services for subsea wells can be performed from anchored or dynamically positioned vessels using the SenTREE family of systems.



The flexibility of SenTREE systems suits them ideally for integration with any subsea BOP stack and completion, well-test, or Christmas tree system. Completion operations before installation of conventional Christmas tree or DST operations (left) and completion operations with a horizontal Christmas tree (right) are shown above.



## A SMALLER IN-RISER CONTROL SYSTEM FOR THE SenTREE FAMILY

With the introduction of the SenTURIAN\* fast-acting control system in 2007, Schlumberger reinforced its technology leadership position for subsea completion installation and testing operations. Evolutionary upgrades have been incorporated into the SenTURIAN system based on the knowledge and experience gained with the market-leading Commander control systems.

System features include simple operation and maintenance, along with modularity that enables customization to meet project-specific requirements.

The SenTURIAN system design adds a smaller footprint and increased operational flexibility, requires less inline offshore time for rig-up, simplifies hardware handling, and reduces hardware installation and running time. Additionally, it uses a form of direct electrohydraulic

control that lowers the number of electrical lines, thereby reducing the overall diameter of the umbilical cable.

This fast-acting system provides total control of the SenTREE family, tubing hanger running tool, and completion equipment functions, along with monitoring to assist in management of the completion installation and flowback operations. It can close all valves within the SenTREE system and unlatch in 15 s.

The SenTURIAN control system is engineered for use with all SenTREE systems, in water depths ranging from shallow to 4,572 m [15,000 ft], for completion installation and flowback operations from dynamically positioned vessels. The simplicity of the SenTURIAN control system also suits it for some applications from anchored vessels.

The SenTURIAN control system is designed in accordance with reliability specifications IEC 61508, SIL 2 for safety-related systems. This design approach sets a new industry benchmark for reliability of in-riser subsea well control systems.



*Like the Commander system, the SenTURIAN fast-acting control system can close all the valves in a SenTREE system and unlatch in 15 s.*

**SenTREE Subsea Well Control Systems**  
**Reliable, Versatile, Efficient**  
**Global Support Network**

- **Safer, secure well access**
- **Versatile system combinations**
- **End-to-end project management**