Spar and TLP Drilling and Production Systems
Dril-Quip, Inc. is one of the world’s leading manufacturers of offshore drilling and production equipment that is well suited for use in deep-water applications. The Company designs and manufactures subsea, surface and rig equipment for use by oil and gas companies in offshore areas throughout the world. Dril-Quip also provides installation and reconditioning services and rents running tools for use with its products.

Dril-Quip’s principal products consist of subsea and surface wellheads, subsea and surface production trees, mudline hanger systems, specialty connectors and associated pipe, drilling and production riser systems, wellhead connectors and diverters. The Company has developed its broad line of subsea, surface and offshore rig equipment exclusively through internal product development efforts. Dril-Quip has continually introduced new products and product enhancements since its founding in 1981.

Dril-Quip’s manufacturing operations are vertically integrated, with the Company performing essentially all of its forging, heat treating, machining, fabrication, inspection, assembly and testing at its own facilities.

The Company’s common stock is traded on the New York Stock Exchange under the symbol “DRQ”.

Facilities

Headquartered in Houston, Texas, Dril-Quip has manufacturing facilities in the United States, Scotland, Singapore and Brazil. The Company also has sales and service offices in numerous locations throughout the world.
CAPABILITIES

PROJECT MANAGEMENT
Project management capabilities have enabled Dril-Quip to better manage the design, manufacture and delivery of Dril-Quip products on large, integrated projects throughout the world.

The project management techniques utilize time-proven processes, which are defined at the start of a project via a formal Project Execution Plan (PEP). This formalized project management system has proven invaluable for successful management of the resources necessary to complete projects on time and to the customers’ requirements.

ENGINEERING
Dril-Quip’s technological leadership in the industry is the result of an ongoing commitment to a professional engineering staff with in-depth experience in the design of drilling and production equipment. This experience is supported by state-of-the-art computer systems networked to expedite and optimize the process of modeling, analyzing, modifying and testing each design. These capabilities enable Dril-Quip to consistently provide new and improved products to the oil and gas industry worldwide.

MANUFACTURING
Dril-Quip products are manufactured from selected high-grade forg- ing material. Computer Numerically Controlled (CNC) machine tools are used for dimensional accuracy, precision machining and consistent quality. Each product is inspected, assembled and tested prior to shipment. Computer tracking systems are used to schedule and monitor each customer’s order during the manufacturing process. This attention to detail ensures product quality and on-time delivery.

SERVICE
In order to ensure vital support to the offshore industry, Dril-Quip field service technicians are rigorously trained and tested in the proper use, handling and repair of Dril-Quip products. Only the most qualified and knowledgeable personnel are employed by Dril-Quip for field service. These technicians are then posted at strategically located Dril-Quip facilities throughout the world, readily available to our customers on a 24-hour basis.

TRAINING
The Dril-Quip Training Department offers to the industry training courses in the installation, operation and maintenance of offshore drilling and production equipment. These courses utilize computer-assisted training tools, models and actual equipment to enhance the participants’ knowledge of offshore operations. Dril-Quip’s Training Department offers custom courses tailored toward specific projects and customer requirements.
Spars and Tension Leg Platforms (TLPs) are floating production vessels that serve as host platforms for the production subsea wells. These vessels can feature top-tensioning drilling and/or production riser systems that are attached to subsea wellheads directly beneath the vessel on the ocean floor. Each well is completed at the surface with a surface production tree.

Spars and TLPs can also serve as host platforms for ocean floor field developments that are tied back to the floating production vessel with flow lines. Each well, in this case, is completed at the ocean floor with a subsea tree, and then funneled through a manifold to the floating production platform.
DRY TREE COMPLETION SYSTEM

Dril-Quip’s field-proven Dry Tree Completion Systems are designed and crafted to all applicable API industry standards and customer specifications in accordance with Dril-Quip’s ISO Quality System.

DRY TREE COMPLETION SYSTEMS COMPONENTS

DH and DHS Series Block Valve Production Tree

Dril-Quip’s Dry Tree Completion System incorporates a block valve design. Block valves are a popular choice for offshore platforms where reducing weight and conserving space are high priorities.

SU-90° Tubing Hanger System and Tubing Head

Dril-Quip’s Tubing Hanger System features high load and high bending capacity with metal-to-metal sealing technology throughout. Dril-Quip’s Tubing Hanger and Tubing Spool come with all necessary support equipment.

PRODUCTION RISER SYSTEMS

Top Tensioning Joint

Dril-Quip’s Top Tensioning Production Riser Joint features adjustable tensioning rings that help ensure proper tension on the production riser string.

Type PR™ Production Riser Connector

Dril-Quip’s Type PR Production Riser Connector features a proprietary thread that is stronger than the pipe and incorporates a full-root radius for higher fatigue capacities. A metal-to-metal pin nose seal engages on a straight diameter box seal surface.

DX® Tie-Back Connector

The Dril-Quip DX Tie-Back Connector is ideally suited for use with tie-back applications to a floating production platform. The DX Tie-Back Connector is designed to provide high bending, high tensile, and high pressure capacity, while remaining simple to operate and easy to install with ROV assistance.
**SU-902™ UNITIZED WELLHEAD**

Dril-Quip’s SU-902 Unitized Wellhead is a new-generation surface wellhead that incorporates subsea wellhead technology. This unique approach in surface wellhead design provides benefits that are not available in current surface wellhead systems.

**SYSTEM FEATURES**

- Compact wellhead design saves space
- System flexibility allows adaptation to most casing programs
- Fewer connections reduce possible leak paths and save BOP nipple-up/nipple-down time
- Mandrel-type casing hangers simplify installation process
- The 13 3/4” wellhead can be run through the 20 1/4” or 21 1/4” BOP stack
- Field-proven dual metal-to-metal sealing with backup resilient seals
- Available for standard or H₂S service
- Accessories allow for adjustment in height and tension
- Available with slip-type hangers for stuck casing situations
- Field-proven for drilling and production applications
SURFACE PRODUCTION SYSTEMS

STACKED VALVE PRODUCTION TREE

Dril-Quip offers surface production trees utilizing a stacked valve configuration for land or platform completion systems. The systems are designed and assembled to meet customer specifications. Both valves and components are manufactured to meet API specifications.

SOLID BLOCK VALVE PRODUCTION TREE

Dril-Quip’s solid block valves are popular for offshore platform completions where conserving space and minimizing leak paths are important. Dril-Quip block valves are manufactured to API specifications.

SYSTEM FEATURES

- Offered in a wide range of sizes, pressure ratings and trims
- Production tree-to-wellhead connection available with flange, clamp hub, Dril-Quip Quik-Clamp™ or Radial Bolt Connector
- Production system components offered with standard API connections or customer-specified connections
- Component selection consistent with well service specifications

GATE VALVES

SERIES DH, DHS AND DL GATE VALVES

The Dril-Quip Series DH, DHS and DL Gate Valves are bidirectional sealing gate valves designed to offer maximum reliability and provide extended service in the field. This has been accomplished by incorporating field-proven gate-to-seat and seat-to-body, metal-to-metal sealing technology and a non-elastomeric stem packing design. The gate valves are available with the following end connections: clamp, flanged and threaded. All Dril-Quip gate valves comply with API specifications 6A, 14D and 17D and are licensed with the API monogram.

DHF SERIES FIRE-RESISTANT GATE VALVES

API 6FC DESIGN

This gate valve is made so the stem-to-bonnet, metal-to-metal backseat will engage in a fire. This is done to eliminate the possibility of the packing burning out and creating a new fuel source for the fire. All other components are made to withstand the half-hour burn and cooldown without leaking. After the valve cools down, the stem packing is replaced and the valve stroked. The pressurized valve must not show any significant leakage during the test. The metal-to-metal DX Bonnet Seal is pressure energized and will not leak due to high temperatures. A nut shroud is added to protect the bonnet bolting from direct flame.

API 6FA DESIGN

Components of the pressurized valve can withstand a half-hour burn and cooldown and one-time operation without significant leakage. The stem packing is made up of a high-temperature “Teflon” and metal backup ring that can withstand the heat of a half-hour burn.

*Teflon® is a registered trademark of DuPont
**Production/Drilling Riser Systems**

**Production Riser**

Dril-Quip’s PR-80™ and FRC™ Production Riser Connectors, along with the Company’s subsea wellhead system, wellhead tie-back connector and surface production tree product lines, have enabled Dril-Quip to offer the entire production riser string for Spar and TLP vessels.

**System Features**

- Complete drilling and production risers available
- Available with universal riser spider to run all production riser, sales riser and drilling riser joints
- Dual-use riser strings available for drilling and production riser applications

**Production Riser Features**

- Field-proven performance
- Uses Dril-Quip’s high-strength DX Tie-Back Connector and tapered stress joint
- Unique keel joint and transition joints to accommodate point loading at Spar keel
- Incorporates tension monitoring joint standard
- Uses Dril-Quip’s high fatigue life PR-80 Riser Connector and Dril-Quip’s FRC Flanged Riser Connector

**PR-80 Production Riser and Connectors**

The PR-80 Production Riser Connector features high tensile, high bending and high fatigue life characteristics while maintaining easy operational features. The connector incorporates a metal-to-metal seal with an elastomeric backup.
**Drilling Riser**

**Drilling Riser Features**
- Easy operation
- Includes syntactic foam buoyancy for lighter riser string
- Includes telescopic joint and diverter joint
- Field-proven performance
- Available with Dril-Quip’s PR-80 or FRC Riser Connectors

**FRC Riser Connectors**

Dril-Quip’s FRC Flanged Riser Connectors are preloaded connections suitable for use in TLP or Spar high pressure drilling riser and production riser applications. Forged heavy-duty bolts are used to make up each connection and incorporate rings to retain the bolts in the “up” position during handling. A metal-to-metal sealing ring gasket provides a gas-tight connection.
Dril-Quip’s DX Subsea Connectors are designed for deep water, high wellhead pressure, deep wells and long drilling times. They are available in a variety of designs and configurations and can be modified to meet specific customer requirements. The DX-10 Connector is pressure rated to 10,000 psi, and the DX-15 is pressure rated to 15,000 psi.

**Features**

- High bending and tension capacity
- High load capacity before hub separation
- Top connection can be a clamp, flange or studded connection
- Tight load path through the upper body, latch segments and wellhead
- Annular piston/cam ring design maximizes locking force within a smaller dimensional envelope
- Special seal design and stainless steel surfaces extend seal life
- Self-locking taper on latch segments offer greater locking reliability
- Quick unlatching time; meets all international regulatory requirements
- Primary unlocking force 25% greater than locking force
- Emergency secondary unlocking force 88% greater than primary locking force
- Latching segments are automatically retracted on disconnect
- Design includes primary metal-to-metal seal profile with backup metal-to-metal profile for emergency use
- Seals on the independent secondary release system are not used during normal connector operation
- Design is compatible with existing blowout preventor hydraulic control systems
- Design offers trouble-free, easy operation
- Performance is field-proven

**Ideal for Subsea Completion**

For completion wells, the metal sealing profile on the DX Connector ensures a metal-to-metal seal throughout the long drilling, testing and production program. Even if the primary metal-to-metal seal is damaged during drilling, the DX Connector has an emergency backup metal-to-metal sealing profile. This ensures a pressure-tight, trouble-free connection between the completion tree and the wellhead.
Because of the dynamic forces imparted to a subsea wellhead from a production vessel that is constantly in motion, the pressure integrity and fatigue life of the well equipment becomes an important issue. The Dril-Quip Tie-Back System for Spar and TLP applications incorporates the following:

**Features**

- DX Wellhead Connectors for high preloaded wellhead connection
- Easy stab and make-up at high misalignment angles
- High bending and tension load capacity
- High pressure capacity
- All metal-to-metal seals with resilient backup
- Easily adapted to accommodate most production riser programs
- Available with mechanical or hydraulic locking systems
- Tie-back can be pressure tested
- Stab seal is field replaceable
- DX Wellhead Gasket can be preinstalled by ROV prior to tie-back for rig time savings
- Dual metal-to-metal sealing profile on Tie-Back Connector Gasket
- Computer analyzed and gas tested
- Field-proven performance
QUICK-THREAD® CONNECTORS

Quik-Thread Connectors offer fast make-up, reliable sealing and versatility to excel in a variety of drilling applications. Their rugged thread form and automatic self-aligning profiles allow for quick and easy installation in the field. Quik-Thread Connectors can be outfitted with anti-rotation keys for added security in harsh drilling environments. Metal-to-metal sealing is also an option.

Quik-Thread Connectors make up in 2 1/2 turns and cannot be cross-threaded.

Recommended Applications
- For casing run from any floating rig where rig movement and deepwater current may be encountered
- For casing run from a dual-activity floating rig
- For “lost circulation” hole sections
- For riser casing strings in mudline suspension system wells
- For long-term fatigue life (H and HC-type)

FEATURES: Quik-Thread and Multi-Thread

- Easy stabbing
- Self-aligning
- No cross-threading
- Fast make-up
- Low torque
- Visual indication of make-up
- High strength
- High-pressure sealing
- Driveable
- Anti-rotation devices available
- Reusable
- Fully tested
- Field-proven technology
- Easily weldable

MULTI-THREAD™ CONNECTORS

The Multi-Thread Connector is a member of the Quik-Thread line of connectors. It maintains the field-proven performance of the Quik-Thread design with the advantage of making up in only 5/8 of a turn, and also cannot be cross-threaded.

Recommended Applications
- Recommended for applications where casing will be run directly into the hole
- Available with metal-to-metal sealing
- Available with long-term high fatigue capacities

Multi-Thread Connectors and protectors have an identifying groove that easily distinguishes them from Quik-Thread Connectors.
**QUIK-STAB™ Connectors**

Quik-Stab Connectors provide for fast, reliable weight-set connections of large-diameter tubulars. Their design allows for high-angle stabbing and self-aligning and automatic locking of pin and box. Quik-Stab Connectors are an excellent choice for applications that require fast make-up without rotation.

**Features:**
- High-angle stab
- Self-aligning
- Automatic positive lock
- Mechanical release
- Requires no rotation
- Rugged, high-strength design
- Reliable high-pressure sealing
- Reusable
- Easily weldable
- Driveable
- Anti-rotation features
- Field-proven technology

**Pipe and Fabrication**

All Dril-Quip manufacturing facilities are equipped to fabricate connectors to casing joints in accordance with customer specifications, using qualified procedures that conform to industry standards.

Dril-Quip stocks pipe of various sizes and grades to fabricate casing joints quickly upon customer request. Pipe stocks are kept in every Dril-Quip manufacturing facility for fast delivery worldwide. Mill certificates are available for all pipe in stock to ensure quality and traceability. Dril-Quip supplies connectors, pipe and fabrication for turnkey casing joints of consistent and verifiable high quality. This translates into timely deliveries and cost savings for the customer.
SUBSEA EQUIPMENT

SUBSEA WELLHEAD SYSTEMS

Dril-Quip’s SS Series Subsea Wellhead Systems are 10,000 and 15,000 psi systems that feature weight-set metal-to-metal annulus seals. Subsea wellhead system components include the guide base, conductor wellhead, primary 18 ¾” wellhead, primary casing programs designed to fit your application, supplemental casing programs (optional), and all associated seal assemblies, wear bushings, bore protectors and running tools.

GENERAL FEATURES

• Simple, reliable, trouble-free operation
• Fewer trips required
• Weight-set seal assemblies provide true dual metal-to-metal seals with elastomeric backup
• Same seal assembly fits all hangers 14” and smaller
• Seal assemblies are locked down to hangers
• Seal assemblies are retrieved by vertical pull, with no rotation required
• One running tool runs all casing hangers with seal assemblies
• All casing hangers are automatically centralized in the wellhead
• Large flow-by areas around casing hangers
• Casing hangers can be locked down to 18 ¾” wellhead housing
• High pressure and high load carrying capacity due to a unique landing shoulder at the bottom of the 18 ¾” wellhead housing
• High bending load capacity between the 30” and 18 ¾” housing (on SS-15 Systems)
• BOP stack can be tested with wear bushings installed
• Tubing hanger profile standard on all wellheads
• Subsea tie-back profile standard on all casing hangers that land in the wellhead

Configurations of the Dril-Quip line of SS Series Subsea Wellhead Systems for TLP/Spar applications include the following (the systems may be adapted to meet customer requirements):

SS-15ES™ SUBSEA WELLHEAD SYSTEM

This version of the SS-15 Subsea Wellhead System is specially designed for deepwater use where higher bending and tensile capacities are required.

SS-15 TLP/Spar SUBSEA WELLHEAD SYSTEM

These systems are adapted to meet stringent strength requirements imposed on a subsea wellhead system when it is tied back to a TLP or Spar.

SS-15 BigBore II™ SUBSEA WELLHEAD SYSTEM

The BigBore II Wellhead Systems accommodate drilling and running large-bore diameter casing string through pressurized water sands with complete BOP control and with all returns back to the drilling vessel.
**Dual Bore Production System**

Dril-Quip’s field-proven Dual Bore Production System is designed to provide direct overhead access (via completion riser) to the production and annulus bores. This allows the setting of wireline plugs in the tubing hanger to secure the well prior to removing the BOP stack. The Dual Bore System is available in pressure ratings of up to 15,000 psi. Metal-to-metal sealing and high-performance gate valves and subsea actuators are utilized. Dril-Quip’s integral field-proven DX Wellhead Connector is standard. Dril-Quip’s Dual Bore System is easily adapted to accommodate most production tubing programs and is adaptable to a variety of flowline and control system connections.

The system accommodates tubing sizes up to 5” with 2” annulus access, with weight-set metal-to-metal seals, and standard industry tools and procedures are used for orienting the tubing hanger during installation. The tubing hanger easily accommodates electrical, hydraulic and chemical injection downhole functions. An Orientation Pin and Orientation Elevation Check Tool are included to confirm proper installation.
**Production Control Systems**

**Master Control Station**
Dril-Quip’s Master Control Station (MCS) allows the operator to control and monitor the subsea completion and surface equipment in the Production Control System.

The station’s open architecture is compatible with the latest industry technology, using high-bandwidth Ethernet communications to achieve the highest throughput of data. Additional computers are used for third-party sensor control monitoring.

Dril-Quip’s design offers the customer a highly reliable, flexible, and high-speed field-proven solution.

**Hydraulic Power Unit**
Dril-Quip’s Hydraulic Power Unit (HPU) is designed using computerized hydraulic analysis to meet project specification. Standard designs for differing environmental requirements are available employing Delta V Controllers.

**Third Party Unit**
Dril-Quip’s Third Party Unit (TPU) can be custom configured with computers to monitor a variety of third party sensors. The Third Party Unit can also be configured to include a data historian with remote access capabilities.

**Topside Umbilical Termination Unit**
Dril-Quip’s termination unit provides an electrical, hydraulic and optical interface to the umbilical. Each unit is configured to meet customer specifications and industry standards as well as zone and environmental requirements.

**Multiplex Control System**
Dril-Quip’s Multiplex Control System is a key component of the subsea completion system. With Dril-Quip’s system, users have real-time access to sensors monitoring well-reservoir performance and tree equipment status.

The system’s open architecture allows for control and monitoring of over 50 wells and the collection of all data within five seconds. MODBUS protocol allows customers to easily link to the platform control system.

A single control module can operate 36 functions and monitor 12 sensors. A flexible design allows Dril-Quip engineers to create a system for clients’ applications employing standard equipment modules. Dril-Quip can package this system for shallow or deepwater applications up to a 10,000-foot depth.

Dril-Quip’s innovative fiber-optic-based communications system is the only system on the market that provides four independent channels. Reliable noise-free communications allows each channel to operate at 115K baud for a total of 460K baud. Dril-Quip’s Multiplex Control System uses single-mode fiber-optic technology that provides reliable communications over 100-plus miles of fiber-optic cable.
**Subsea Electronics Module**

Dril-Quip’s Subsea Electronics Module is microprocessor-based (16-bit) for an optimum combination of capability, reliability and simplicity. Dril-Quip’s design incorporates downloadable software allowing for reprogramming, changing operation, configuration management or diagnosis without requiring retrieval of the module.

One communications channel is dedicated to module operation and the remaining three channels are available for digital sensors with RS-485 interfaces, such as downhole pressure temperature sensors, intelligent well sensors and flow sensors. The module is designed for low power consumption, minimizing the size, weight and cost of the umbilical. The Subsea Electronics Module is capable of operating with either single or three-phase power.

**Software Support**

Dril-Quip’s Control System software runs on a Delta V platform for control and monitoring of the production equipment.

All software programs necessary for reliable operation of the system and to meet each customer’s functional requirements are included.

Dril-Quip’s screen illustrations are user-friendly graphics that model equipment architecture and operation.

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**Shallow and Deepwater Subsea Control Modules**

Dril-Quip’s Shallow and Deepwater Subsea Control Modules offer operators advanced multiplex electro-hydraulic systems designed to control and monitor the subsea completion system.

Each module includes a Subsea Electronics Module (single or dual configuration), up to 36 hydraulically latched pilot control valves with pressure transducers, metal-sealing hydraulic couplers, electrical/optic connectors, hydraulic fluid filters and accumulators.

**The Shallow Water Control Module** is attached to the tree with a simple diver-assisted latch mechanism. It is designed for subsea operations in water depths up to 700 feet. The module provides control and monitoring of 12 hydraulic functions and is expandable. It also monitors up to 12 electrical sensors.

**The Deepwater Control Module** installs into a mounting base that provides guidance, soft landing, coupler make-up and module lock. Dril-Quip’s base and funnel are designed to easily mount to subsea trees, manifolds and distribution units. The deepwater module is designed for subsea operations of up to 10,000 feet and provides control and monitoring of 24 hydraulic functions (also expandable). Monitoring of 24 or more electrical sensors is provided.

Both control modules communicate via high speed (115K baud) Fiber-Optic or Signal-On Power (9.6K baud). The modules employ dual modems and power supplies in the Subsea Electronics Module. Each module has a design life of 20 years and is designed to meet or exceed ISO industry standards.
Dril-Quip’s LS-15 Liner Hanger System is available with all of Dril-Quip’s Wellhead Systems. The LS-15 Liner Hanger products are built to perform under a wide range of conditions, and are ideally suited for long reach, high angle, horizontal and ultra-heavy liner completions. This premium liner hookup incorporates many innovative tool designs, ensuring reliable operation and service in many of today’s most demanding wells.

**LS-15 System Features**

The LS-15 Liner Hanger System features field-proven technology that incorporates the following:

- High strength, high pressure, high load-carrying capacity
- Metal-to-metal Annulus Packer Seal for high pressure service
- No hydraulic or mechanical devices on the hanger body, minimizing leak paths
- Large slip area and controlled friction minimizes stress in the supporting casing
- All hangers are automatically centralized when C-Ring Slip is set
- Bypass flow area is the same after setting the liner hanger slip as in the running-in position
- Maximizes circulating flow-by areas for efficient cementing operations
- The LS-15 Liner Hanger System can be sized and configured to customer specifications

**LS-15 Packer Seal Features**

- Integral, one-trip metal-to-metal sealing design
- Anti-swab design for faster running speeds and higher circulating rates, and resists mechanical damage while running
- Standard service for many sizes is 10,000 psi at 400°F. Higher pressures are achievable and are only limited by the capacity of the packer mandrel and casing

**Rotational Option**

With the addition of a rotating bearing assembly, the LS-15 Liner Hanger can be rotated with the slips in the set position during the cementing operation. This feature can assist in completing a successful cement job.
The LS-15 System Incorporates a Unique Hanger Slip Design

Dril-Quip’s proprietary one-piece C-Ring Hang-Off Slip has been developed to greatly reduce the amount of hoop stress placed on the supporting casing by the liner load. Dril-Quip’s circumferential slip design distributes the liner load much more evenly around the casing than conventional multi-slip segment hanger systems. The C-Ring Slip also incorporates a method of controlling the friction between the slip and the hanger body. This “controlled friction” design redirects hoop load into axial load, drastically reducing the collapsing load on the hanger body and burst pressure on the casing. This combination of stress loading permits the LS-15 Liner Hanger System to hang longer and much heavier liners than possible with conventional technology.

1. The liner hanger is run to total depth with the slip in the retracted, running position.
2. When released from its locked-down running-in position, the slip will spring open and come into contact with the ID of the supporting casing.
3. The hanger body is then slacked off onto the slip. The sharp teeth on the slip will secure the liner hanger to the supporting casing. At light loading, the dull inner slip teeth will not yet grab the cone as it slides behind the slip.
4. As the loading increases and travel progresses, the inner teeth begin to form small shoulders on the liner hanger slip cone. As the shoulders increase in size, the downward travel of the liner hanger is stopped before loading gets high enough to collapse the liner hanger body or burst the supporting casing.