Leveraging offshore potential

Rotating and electrical solutions for offshore exploration, production and transportation

Answers for energy.
Advanced offshore solutions

Global energy demand is expected to rise by 50 percent by 2030. Oil and gas exploration and production is moving to increasingly hostile environments, including polar latitudes and ultra-deep waters. Complementing their diversification of portfolios, major players in the oil and gas industry are developing strategic partnerships and reevaluating existing technologies.

Enter Siemens. With a unique portfolio of rotating and electrical equipment, power generation, transmission and distribution systems, water management, process automation, instrumentation and life-cycle services, Siemens provides a host of solutions designed to ensure ultimate performance in all mission-critical applications and meet all of tomorrow's challenges, technical, economic and environmental. Moreover, through its global manufacturing and service network, Siemens ensures maximum customer proximity and local content.

Innovative design, excellence in engineering and project management, maximum value over asset lifetime, and uncompromising compliance with health, safety, environmental and industry standards are common denominators for all components, products, systems and services in the Siemens offshore portfolio.

Combining our competence and strengths with yours, we can together chart new territory and optimize the efficiency and economics of your offshore operations.

Compression and pumping
A portfolio of field-proven compressors, gas-turbine and electric drives and their associated control systems, including instrumentation for virtually all production, transportation and process applications in the oil and gas industry.

Power generation and distribution
A comprehensive range of power solutions, including planning, finance, engineering and optimization of power grids; gas- and steam-turbine-based power plants, generators, transformers; high-, medium- and low-voltage switchgear; substation automation, energy management and network design.

Water management
Encompassing a complete range of solutions for production water processing, including water treatment for injection, produced-water treatment, reverse osmosis systems, flowback and pipeline services, support equipment and services.

Automation and control
A unique array of integrated automation and electric-drive related products, systems and solutions for field, operation and management. Designed to maximize productivity, while substantially reducing costs.

Industrial IT

Life-cycle services
A portfolio of life-cycle services, from feasibility, front-end engineering design and network studies through to preventive and corrective maintenance, performance enhancement programs, service agreements and training.
One of Siemens’ answers to challenges in the oil and gas industry: STC-ECO, a sealless, fully integrated motor/compressor unit designed for dirty-gas and subsea applications. Its concept and credibility has been proved in more than 20 months of field operation on an actual plant with dirty process gas in modulating mode and routine asset control.
From challenge to solution

Remote locations, harsh environments, extreme climates, weight and size constraints. These are but a few of the characteristics typical of offshore oil and gas operations around the globe. Extreme robustness, high reliability and availability as well as compact, modular designs of solutions are of paramount importance.

Moreover, as project scopes widen, sourcing a vast share of products, solutions and services from a single supplier offers a variety of benefits to engineering, procurement and construction companies (EPC) and end-clients alike. Reduction of CAPEX and project management complexity can be realized, which can improve project scheduling, leading to earlier first oil.

At Siemens, the single-source supply concept is based on a customer-focused design and management system, integrating a multitude of technologies and processes tailored to deliver ultimate quality in every respect.

Comprehensive testing before shipping
Upon customer request, major equipment packages are functionally tested and load-tested prior to shipment to reduce the risk of delays due to non-conforming or non-performing equipment. The latest extension of Siemens’ testing facilities, the Mega Test Center in Duisburg, Germany, greatly enhances the scope of testing capabilities by volume and versatility, enabling:

- assembly and testing of up to six compressor trains in parallel;
- full-load closed-loop testing of compressor trains of up to 100 MW;
- part-load open-loop testing of mega-scale air compressors;
- testing of compressors with electric motors of up to 100 MW, with steam turbines of up to 35 MW, and with gas turbines of up to 160 MW.

Speeding up installation
When there are weight and size limitations for shipping, offshore subsystems are constructed in a modular form with pre-installed and pre-commissioned equipment. Siemens’ vast experience and a structured project-management process including a detailed logistic and installation execution plan, have allowed much shorter project lead times compared to the market average.

Scalable operation and maintenance services
Siemens has a tradition of going way beyond the conventional meaning of service. The scope of services spans from initial concept development and screening, concept selection to front-end engineering and project execution through the entire lifecycle. Supported by comprehensive diagnostic and logistic functions from service centers, factories and headquarters, Siemens’ local and regional organizations deliver a full range of services, from on-call support through all-inclusive operation and maintenance. Availability guarantees can be included as optional parts of long-term operation and maintenance contracts.

Optimizing asset service and availability
Fast response times from a team of dedicated specialists ensure minimized downtime and higher profitability. The centralized and specialized support center offers wide-ranging support services tailored to meet the needs of the individual long-term operation plan.

Major components of Siemens equipment and systems can be connected to one of two Global Service and Diagnostic Centers for permanent online performance monitoring. The scheme allows the development of condition-monitoring based maintenance strategies, and comparative fault analyses of Siemens’ entire fleet for the whole lifecycle.

Tailored training measures
Comprehensive training of customer personnel complements every contract. Programs include training on real-time simulators, duplicating essential parts of the information and control system, and allowing hands-on training without interfering with the actual operation, plus the proactive development of standard operating practices and emergency procedures.
Parallel to the further development of existing reserves, current energy demand projections imply a major surge in hydrocarbon exploration — on a global scale and in territory so far uncharted. Exploration is of singular importance to ensuring future production levels will meet demand. It is also the part of the value chain that contains the highest risk.

Siemens solutions for offshore drilling and field development all work towards the common goal of achieving maximum efficiency, reliability and availability of operations, and keeping potential losses at a minimum. They provide a sophisticated answer to the quest for risk reduction in areas ranging from conceptual development and decision-making to the technology deployed.

**Drilling**
Power generation and distribution solutions • Variable speed drives for azimuthing thrusters, drilling and winch applications • Motor control centers with intelligent starters • Uninterruptible power supply and battery banks • Marine automation: power management • Safety systems, ballast and cargo control • Telecom and navigation systems

**Field development**
Benchmarking, technology selection, economic analysis and risk assessment for oil and gas developments • Program for concept selection and field development planning • Program for pressure-relief system design and analysis • Platform positioning and navigation • Computational fluid dynamics (CFD) analysis of toxic-gas dispersion • Pipeline simulation • Evaluation of energy efficiency and carbon footprint of a field development
**Drilling**
The Stena Don, a semi-submersible drilling and intervention rig, currently operates off the coast of Norway. Siemens scope of supply: integrated control and safety system; vessel management including dynamic positioning systems; electrical systems; power generation and distribution; auxiliary and AC drilling drives; uninterruptible power supplies; communication and navigation systems; basic and detailed engineering and layout of electrical, instrumentation and telecom systems.

**Drilling**
The five drill ships in Transocean's new Enterprise class. Siemens scope of supply: integrated fault-tolerant electrical drives and distribution system, jointly developed by Transocean and Siemens; generators and motors; SIPLINK™ thruster and drilling drives; MV-Distribution panels and transformers; uninterruptible power supply, auxiliaries; water-cooled breaking resistors.

**Drilling**
The DSME-GVA7500 semi-submersible deep-sea drilling rig, owned and operated by Odfjell Drilling. Siemens scope of supply: Generators (6144 kVA); 11-kV switchboard; thruster drives, 8x3.8 MW/4.16 kV; distribution transformers 11 kV/690 V; AC drilling drive system (active heave); low-voltage switchgears, MCCs; uninterruptible power supply; system studies.

**Drilling**
The Sea Dragon CS50 Mk II #1, a semi-submersible drilling owned and operated by SeaDragon Offshore Ltd. Siemens scope of supply: Generators; 11-kV switchboard; thruster drives, 8x4MW, 4.16 kV; distribution transformers, 11 kV/690 V; AC drilling drive system (active heave); low-voltage switchgears, MCCs; uninterruptible power supply; system studies.

**Drilling**
The DSME-GVA7500 semi-submersible deep-sea drilling rig, owned and operated by Odfjell Drilling. Siemens scope of supply: Generators (6144 kVA); 11-kV switchboard; thruster drives, 8x4MW, 4.16 kV; distribution transformers, 11 kV/690 V; AC drilling drive system (active heave); low-voltage switchgears, MCCs; uninterruptible power supply; system studies.

**Drilling**
Transocean, Sedco 702 and 706 upgrades to DP-2 semi-submersible drilling platforms. Siemens scope of supply: integrated, fault tolerant electrical drives and distribution system, jointly developed by Transocean and Siemens; SIPLINK™ thruster and drilling drives; low- and medium-voltage distribution panels and transformers.

**Drilling**
The Sevan Deepsea Driller, operated by Petrobras America Inc. and Sevan Drilling Pte. Ltd. Siemens scope of supply: switchgear and motor control centers (MCCs); transformers; 230-V switchgear; uninterruptible power supply (UPS); DC system; thruster drives; diesel generators; vessel control; emergency shutdown system (ESD); fire- and gas-detection system (F&G); power-management system (PMS); thruster control; dynamic positioning system (DP-3); telecommunication systems.
Recent developments in offshore production technology in a broader sense focus on three major goals. Considerable resources are invested in finding ways to advance field development and extend field life in order to maintain or even increase production levels. Much of this relates to smart-well solutions, field-integration technologies, reduction of downtime and predictive maintenance schemes.

Secondly, new approaches and solutions have been developed in order to optimize the efficiency of established operations. Land-borne high-efficiency power generation feeding offshore facilities through HVDC networks, as well as new driver concepts, offer ample scope for improvement, both in terms of flexibility and greenhouse gas emissions. Moreover, flare elimination through gas gathering and export or re-injection enables better use of resources and reduces environmental impact.

At the same time, technology is under development, some just tested and ready, for deployment at new discoveries, including deepwater reserves, and other unconventional resources.

Siemens research and development is active in all of these areas, the most recent and much acclaimed proof of innovation being a hermetically sealed electric motor-compressor unit designed for real-gas compression on- and offshore as well as subsea. After two years of field operation, the prototype has proven the credibility of its concept and design. It is also proof, that innovation is not a result of mere incremental improvement, but at times requires a radically new approach.

**Compression and pumping**
Gas lift • Gas/oil separation • Gas processing • Well depletion • Export gas compression • Gas injection • Gas boosting • Recompression • Refrigeration • Compression of associated acid gas for direct injection into reservoirs • Totally canned motor/compressor modules without shaft seals • Mechanical and electric drivers for all compression and pumping applications, including seawater injection and seawater lift pumps

**Power generation and distribution**
Power generation • High-voltage DC power transmission from onshore • Medium-voltage DC links • Power distribution solutions • Utilities (power, steam, instrument air) • Medium-power seaborne power generation • Decentralized power supply • Field shelters

**Water management**
Electrochlorination • Coarse filters for particle removal • Fine filtration using media filters, cartridge filters and ultrafiltration • Deaerators (vacuum and gas stripping) • Membrane sulphate removal • Chemical injection • Feed and main injection pumps • Liquid/liquid hydrocyclones • Solid/liquid hydrocyclones • Dissolved gas flotation (DGF) • Induced gas flotation (IGF) • Retrofit DFG pumps • Walnut shell, media and adsorption filters • Chemical injection • Pump systems • Turnkey systems

**Automation and control**
Remote terminal units (RTU) • Field data acquisition • Analyzers • Subsea well enhancer • Deep-water entrusted automation and power systems • Well control unit • Instrumentation and control packages for gas/oil separation • Integrated control and safety systems (ICSS), incorporating distributed control systems (DCS), process-control systems (PCS), fire-and-gas detection systems (F&G), emergency shutdown systems (ESD), process-shutdown systems (PSD), supervisory control and data acquisition (SCADA), management information systems (MIS) • Remote operation and control • Export (inventory and scheduling) management • Ballast control systems • Thruster control • Crude oil storage instrumentation and control solutions
Platforms
Maersk Oil Qatar AS, Al Shaheen Block 5 Field Development Project. Siemens scope of supply: five SGT-700 gas-turbine driven compressor sets for export-gas compression, installed on three different platforms; one spare SGT-700 core engine. Complete automation system (SCADA, ESD, F&G) for 15 fixed platforms (32,000 I/O signals).

Subsea
Snorre A, subsea production system, Statoil. Siemens scope of supply: subsea control system, including topside controllers; add-on subsea control and monitoring system, including topside controller for add-on well instruments, OPC interface and PC test tool, event-driven communication on power lines, new powerful multi-task subsea controller, redundant communication utilizing Profibus; complete independent control system, including subsea canisters, modems and electronics, well supervision and down-hole and X-tree monitoring, system designed for upgrading all SPS wells.

Floating Production System (FPS)
Deep Producer I. FPSOcean, Norway. The first DP-operated FPSO powered by gas turbines. Siemens scope of supply: two SGT-500 17-MW gas turbines; thruster drives; medium- and low-voltage switchgear; transformers; uninterruptable power supply (UPS); DC system; integrated control and safety systems (ICSS); process control system (PCS); emergency shutdown system (ESD); fire- and gas-detection system (F&G); power management system (PMS); CCTV, video-conference, entertainment and admin network; radio and satellite communication; telephone, paging, announcements; navigational aids.

Floating Production System (FPS)
Petrobras’ P43 and P48 produce crude oil from the Barracuda and Caratinga fields off the coast of Brazil. Siemens scope of supply: designing and manufacturing of six process-gas packages each comprising compression trains with variable speed drive systems (VSDS), coolers, scrubbers, separators, integrated control and safety systems, process control systems (PCS), emergency shutdown systems, fire- and gas-detection system (F&G), vessel management and information management system.

Floating Production System (FPS)
Petrobras’ SSP Piranema. Customer: Sevan Marine, Norway. Siemens scope of supply: switchgear and motor control centers (MCCs); transformers; 230-V switchgear; uninterruptable power supply (UPS); DC system; process control; emergency shutdown system; fire- and gas-detection system (F&G); power management system (PMS); information management system; training simulator; communications solutions.

Floating Production System (FPS)
The P-45 Bijupira & Salema, operated by Modec International/Shell Oil, off the coast of Brazil. Siemens scope of supply: Complete single-story 50 ft x 70 ft E-house/electrical gear solution, including medium-voltage switchgear/medium-voltage control gear (MVS/MVC), low-voltage switchgear/low-voltage control gear (LVS/LVC), medium-voltage soft starters, power-management system and uninterruptible power supply; four 4,500-HP gas-compression motors; two 450-HP flash-gas compressor motors; telecom system.
Transportation

Ship operators must meet extremely tight receiving and delivery schedules along with increasingly stringent safety and security regulations and guidelines at loading terminals. Moreover, ships have to match an increasing number of environmental regulations and guidelines, affecting, for instance, power generation when moored.

Based on its medium-voltage coupling system, Siemens has developed a solution which enables ships berthed in port to be connected to the medium-voltage network of local power utilities and supplied with electrical power. On-board diesel generating-sets, notorious for their exhaust gases, soot, fine dust and noise, can be completely shut down, reducing CO₂ and NOₓ emissions, an environmental problem of increasing concern. Compared with conventional ship-board power generation, this solution also results in savings in electricity costs.

Siemens' portfolios for seagoing vessels further integrate all products and services needed for sustained maximization of ship performance, ranging from state-of-the-art solutions for integrated power generation and drive systems with dual-fuel 2-stroke diesel-electric or COGES schemes, to a host of process peripherals such as boil-off-gas compression. Dedicated ship-automation solutions are available covering all technological aspects of carriers, such as the cargo, bilge, ballast, and other machinery systems, ensuring lower operating costs and greater efficiency for shipyard, ship owner, trading partners and crew alike.

Compression
Cryogenic-temperature LNG boil-off gas (BOG) compressors and drives
- End-flash gas compressors and drives
- Field-proven standardized barrel-type compressor for refrigerant compression, and associated control systems
- Variable-speed drive system (VSDS), including synchronous motor, frequency converter, and associated control systems

Power generation and distribution
COGES plants with dual-fuel gas turbines
- Medium-voltage generators
- Medium-voltage switchgear
- Propulsion transformers
- Medium-voltage converters
- Electric propulsion motors
- Drive control and safety systems
- Protection and power management system
- Induction and synchronous motors
- Ship-to-shore power supply

Automation and control
Automation platform for machinery and cargo based on a uniform hard- and software solution
- Advanced operations control solutions
- Integrated data visualization software enabling informed decisions regarding utilization of assets and their operating efficiency
- Energy management and control system (EMCS)
- Field instrumentation and sensors for machinery and LNG cargo systems
- Field instrumentation and analytics
- Integrated distributed control system (DCS) for VSDS and compressor automation, including associated instrumentation

Cargo handling
Tank storage monitoring and control
- Cargo transfer
- Vessel-to-vessel telemetry system
- Cargo pump drives
Tomorrow’s challenges

The quest for higher efficiencies and availability, better flexibility and minimizing of environmental impact affects each and every step of offshore operations. At the same time, the classical thinking in clear-cut categories of upstream and midstream operations is challenged by radically new types of offshore installations.

Floating LNG (F-LNG)
A whole new type of seaborne facility, F-LNG vessels enable the commercially viable exploitation of stranded-gas reserves of a mere 1 trillion cubic feet or less. Mounted on converted tankers or custom-designed hulls, these floating liquefaction plants have to meet intrinsically different requirements compared to land-borne plants. Major issues include footprint, availability, and maintainability of liquefaction trains under rough sea conditions, as well as a number of special safety regulations.

Backed by vast offshore expertise in compression, drive and power-generation technologies, Siemens developed a range of solutions perfectly suited for on-board installation. From steam- and gas-turbine driven solutions to small-footprint all-electric E-LNG schemes, they are engineered to ensure high availability and high reliability, while allowing operators to optimise efficiency, CAPEX and OPEX. What’s more, Siemens’ all-electric E-LNG concept takes maximum advantage of the operational flexibility of variable-speed drive systems (VSDS), the high availability of motors, and the possibility of five years of continuous operation of compressor-string components; in addition, superior maintainability is ensured even under bad weather conditions.

Compression and drives
Field-proven standardized barrel-type compressor for refrigerant compression • End-flash gas compressors • Boil-off gas compressors, single and tandem casing • Variable-speed drive system (VSDS) • Load-commutated inverter (LCI) and pulse-width modulation (PWM) frequency converters • Associated control systems

Field instrumentation and analytics
Pressure transmitters • Temperature transmitters • Flow meters • Level measuring instruments • Gas analysers • Remote terminal units • Level measurement in LNG storage tanks and for pump control • Level switches for detection of minimum and maximum level in tanks • Valve positioner for valve control • Chromatograph for determination of gas composition and quality; measuring of calorific value • Moisture and dew-point measurement in natural gas

Automation
Integrated distributed control system (DCS) for VSDS and compressor automation, including associated instrumentation • Advanced operations control solutions • Integrated data visualization software enabling informed decisions regarding utilization of assets and their operating efficiency • Energy management and control system (EMCS)

Power generation, transmission and distribution
Combined gas turbine electric and steam systems (COGES) • Simple, combined and triple-cycle schemes with gas and steam turbines including generators and auxiliaries • Heat recovery steam generators • Water steam cycle solutions • Electrical and controls for supplied equipment • Network planning and consulting services, including harmonic studies • High-, medium- and low-voltage switchgear • High-current switchgear • Bus ducts • Power, distribution and special transformers • Substation automation and protection systems • Energy management • Motor control center • Emergency diesel generator sets • Uninterruptible power-supply systems • Station batteries • Power quality and power correction • Auxiliaries • All services for substations • Cranes and heat, ventilation and air conditioning (HVAC) for turbine building • Cooling water systems

Gas To Wire (GTW)
Generating electrical power from locally produced gas, GTW is another example of a formerly land-borne type of facility moving to gas-production sites on sea. Massive power plants on dedicated floating installations will be linked via transmission lines to platform clusters and shore, allowing bi-directional energy transfer via sea cable and de-bottlenecking the energy balance of onshore grids.

From marinized gas- and steam-turbine generator sets to advanced high-voltage DC link technology, Siemens offers a vast range of efficiency-boosting solutions for seaborne power generation, transmission and distribution.

Power generation, transmission and distribution
Gas turbines with ratings between 5 and 45 MW • Steam turbines • Generators • Heat-recovery steam generators (HRSG) • High-voltage DC power-transmission solutions • Associated control systems

Compression
Compressors and drives for CO₂ re-injection