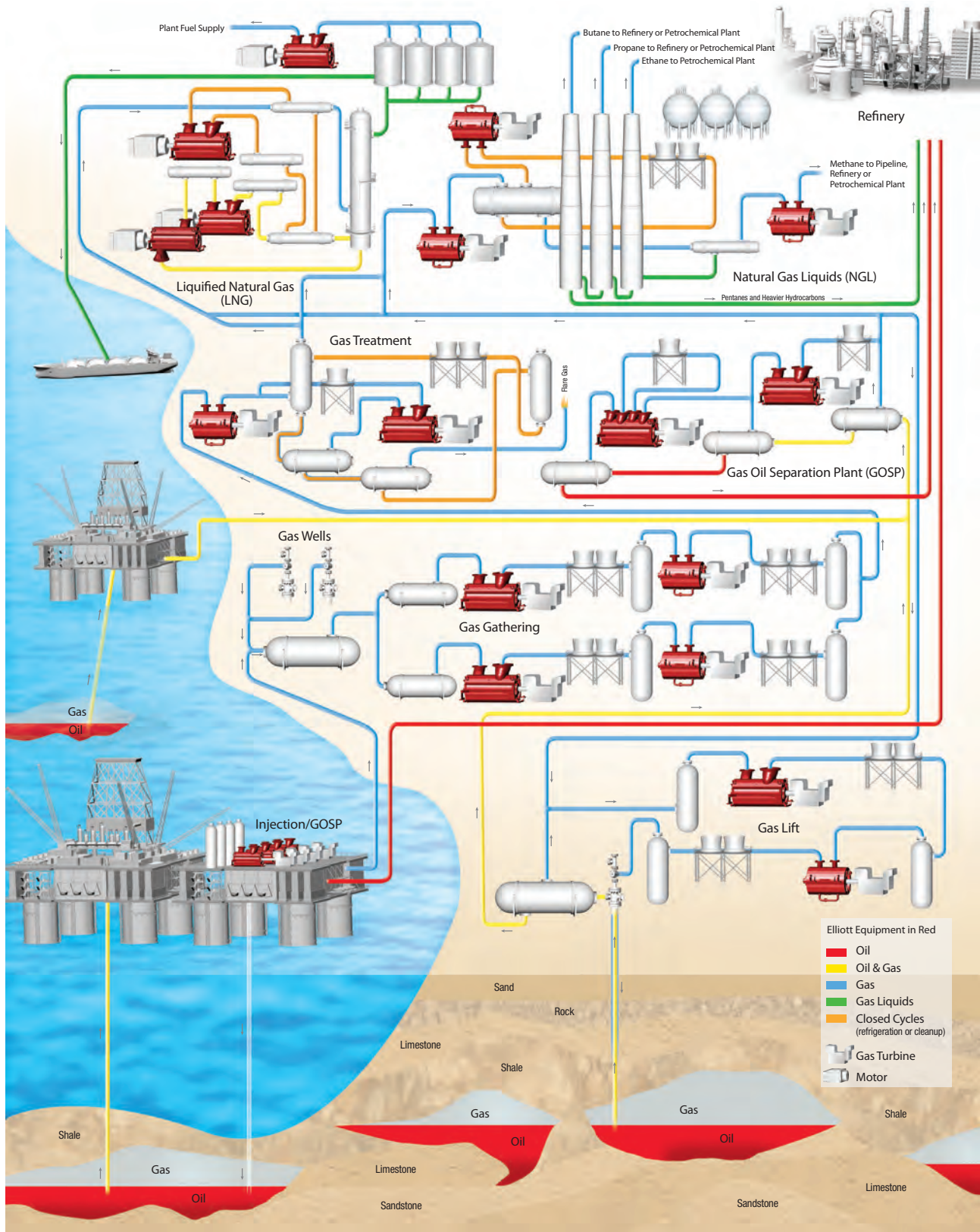


Elliott Upstream Solutions for Oil and Gas



ELLIOTT IN OIL AND GAS PRODUCTION



MEETING THE CHALLENGES IN OIL AND GAS

The oil and gas industry holds many challenges for producers and companies that supply equipment and services. The high risk and high costs of exploration and production demand a high return – maintaining high production levels is critical to success. As existing oil and gas fields are depleted, and commercial and consumer demand continues to grow, the challenges become ever greater, driving producers to seek new oil and gas resources in remote onshore and ultra deep water offshore locations.

For process equipment manufacturers, the inherent unpredictability and variability in raw oil and gas resources pose unique design challenges. Elliott Group understands these challenges. As a supplier of technically advanced centrifugal compressors and related turbomachinery for more than a century, Elliott has provided hundreds of compressor systems that provide the superior performance, flexibility, availability and reliability that oil and gas producers demand. Our upstream compression solutions include:

- ♦ Offshore
- ♦ Well Head/Booster Stations
- ♦ Enhanced Oil Recovery – Gas Lift, Injection & Reinjection
- ♦ Gas Gathering
- ♦ Gas/Oil Separation
- ♦ Gas Treatment and Processing
- ♦ Coal Bed Methane
- ♦ LNG

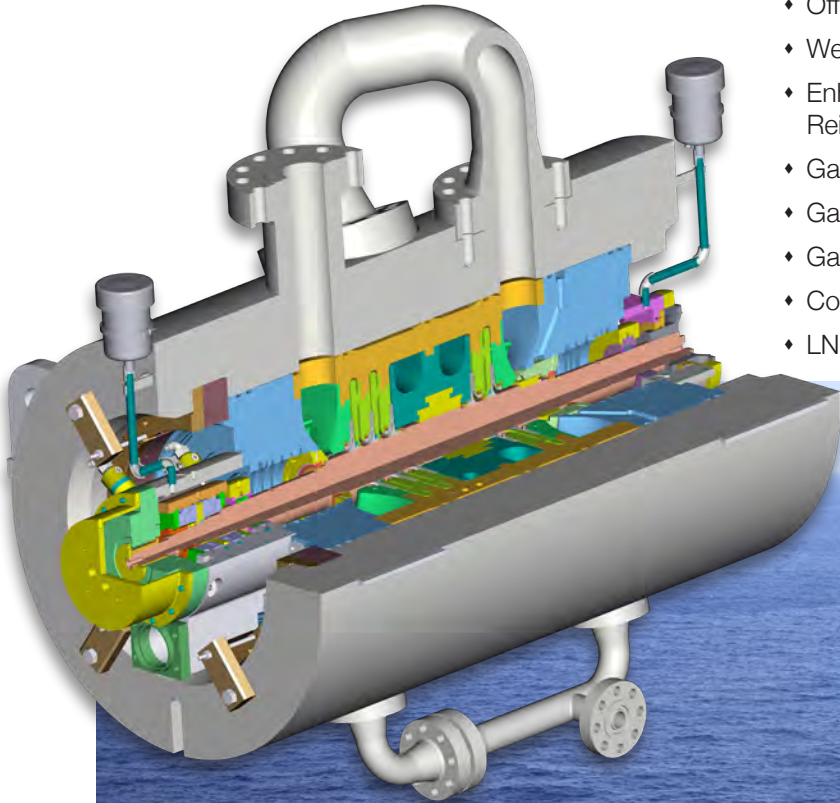


Photo courtesy of Woodside Energy Ltd.

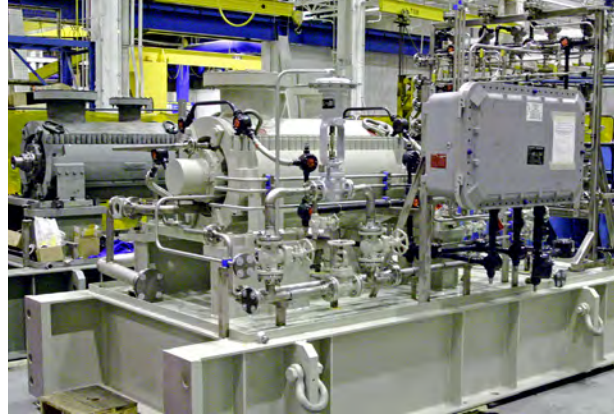
■ FLEXIBILITY, AVAILABILITY, RELIABILITY

During the development phase of oil and gas fields, it is difficult to determine the exact properties of associated gas and raw natural gas. Because of this inherent unpredictability, process engineers must design for a wide range of gas compositions, flow rates and pressures, particularly for the initial process steps of oil and gas production, such as gas / oil separation (GOSP) and gas gathering.

Elliott Group is uniquely qualified to meet these design challenges. Our industry-leading EDGE® compressor technology anchors a product line that offers a large operating window within a single casing. This technical advantage is enhanced by Elliott's extensive range of compressor frames and impeller families.

Besides the inherent uncertainty of oil and gas properties during field development, depletion of oil and gas fields impacts operating conditions with

continual changes. Elliott's experience and expertise are critical both at the beginning of field development and throughout the life of the field. Elliott helps customers plan for future operating requirements by designing for compressor rerateability from the outset of the project.



■ OPTIMIZING PRODUCTION

Optimizing oil field production for enhanced oil recovery relies on high pressure gas lift or reinjection compression. Elliott's large, global installed base of compressors in high-pressure service includes the ground breaking work on the first centrifugal compressors put into operation in the North Sea in the 1970s for extreme high-pressure (9200 psig, 634 barg) gas reinjection. Elliott's expertise in gas mixture properties at high pressures assures a robust, reliable compression solution for these difficult services.

While operating conditions at natural gas processing plants are more controlled, variation in gas compositions and flow rates still require operational flexibility in the compressor design. Elliott's wide operating range provides distinct advantages in plant design, in some cases allowing for fewer compressor bodies relative to other compressor OEMs. Elliott's EDGE technology is key to achieving the high efficiencies required to maximize cost-efficient operations.

Elliott's expertise in gas properties, metallurgy and material science is also critical in designing equipment for the varying levels of corrosive gases commonly associated with raw natural gas. In the 1960s, Elliott pioneered refrigeration compression. With hundreds of process refrigeration systems in service, Elliott brings an unrivaled expertise in refrigeration compression commonly used in natural gas liquids (NGL) recovery processes.



■ ANSWERS FOR CHALLENGING APPLICATIONS

Elliott application and design engineers employ a variety of advanced interactive design and prediction tools to model and optimize compressor performance. Computational fluid dynamic (CFD) analysis, finite element analysis (FEA) and solids modeling provide full 3-dimensional analyses of the aerodynamic flow path and the structural mechanics. Compressor selection viability is evaluated through compressor performance modeling, advanced rotor dynamic analysis and dynamic simulation programs. In addition, Elliott's proprietary EDSCAN program can be employed to simulate compressor train performance under various customer and factory process conditions such as start-up, controlled and emergency shutdowns, alternate gas operations and anti-surge valve selection confirmation.

Elliott's proprietary compressor selection program incorporates data from single stage design verification tests and actual factory performance tests, and is used to accurately model compressor performance. Recent enhancements enable application engineers to immediately model the rotor dynamics for a particular selection for faster decisions and adjustments.

Elliott's regionally located application engineers have the tools and expertise to support process engineers in evaluating the wide range of compression operating conditions in advance of, as well as during, the quotation process.

■ COMPLETE COMPRESSION TRAIN PACKAGES

Elliott provides complete compression train packages including:

- ◆ Drivers
- ◆ Gears
- ◆ Lube oil systems
- ◆ Dry gas seal buffer systems
- ◆ Control systems
- ◆ Anti-surge valves
- ◆ Baseplates
- ◆ On-skid piping & wiring for ease of installation and connections

Lube oil and buffer systems are individually engineered to meet the specific requirements and environmental considerations of each application. They can be designed to supply the compressor requirements only or the entire train requirements including gears and drivers. Oil consoles can be supplied on an individual baseplate, or integral with the compressor baseplate in applications where real estate is at a premium. Dry gas seal buffer panels can be supplied as stand-alone units or compactly mounted on the compressor baseplate.

Global sourcing means Elliott can offer complete flexibility in selecting driver types:

- ◆ Steam turbines
- ◆ Gas turbines (including starter motors as needed)
- ◆ Induction and synchronous motors (including VFDs as needed)

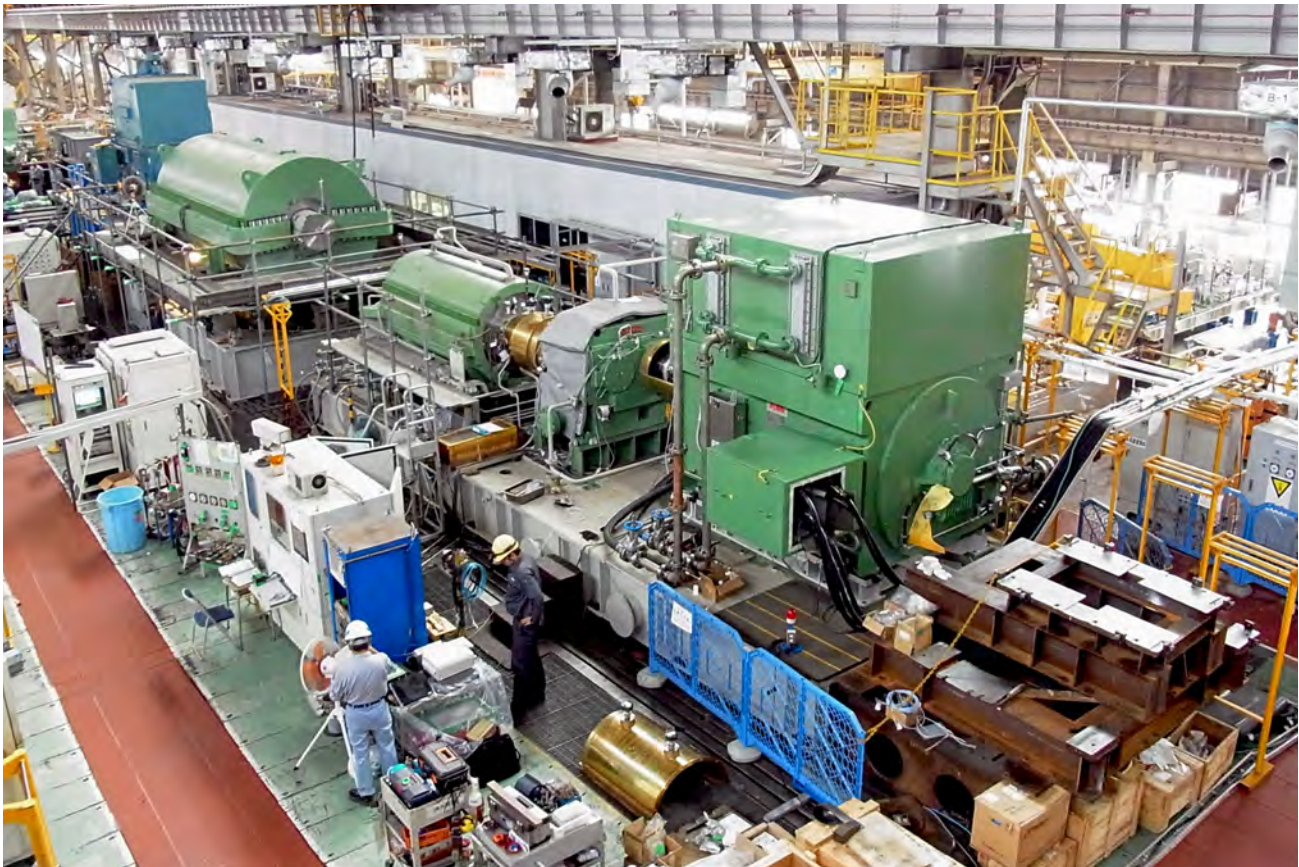


■ WORLD CLASS MANUFACTURING AND TESTING

Elliott's manufacturing centers are located in Jeannette, Pennsylvania, USA and Sodegaura, Chiba, Japan and are fully equipped with the latest machine tools and state-of-the-art test facilities. Both test facilities can accommodate multiple equipment strings simultaneously as well as complete string tests with any driver arrangement.

Elliott provides comprehensive testing capabilities for:

- ◆ API 612 (steam turbines)
- ◆ API 614 (lube, control and seal oil systems)
- ◆ API 617 (axial and centrifugal compressors)
- ◆ ASME Power Test Code (PTC-10 Type II)
- ◆ High-speed rotor balancing
- ◆ Full variable frequency drive motors
- ◆ Permanent gas turbine test pad incorporating all required utilities and auxiliary equipment
- ◆ Partial-load and full-load string tests
- ◆ String tests with job auxiliary systems



■ GLOBAL SERVICE AND SUPPORT

From installation, commissioning and startup, through maintenance, overhauls and repairs, Elliott offers a complete range of turbomachinery service and support for Elliott and non-Elliott equipment.



Repair Services

Elliott has a global network of service centers that are registered to ISO 9001 or have structured quality management systems. They provide comprehensive service for Elliott and non-Elliott rotating equipment. Service teams consist of experienced, dedicated engineers, metallurgists, technicians, welders, machinists and mechanics. We offer rotor balance and storage, and we repair and remanufacture all rotating and stationary components including blades, impellers, diaphragms, casings, shafts, seals, and bearings.

Field Service

Elliott's experienced on-site project management and skilled field service crews provide emergency repairs and scheduled turnarounds at job sites around the world. Compressors can be modified and rerated in the field to increase reliability, efficiency and capacity. Elliott Rerate Services enhance the performance and extend the life of critical rotating equipment from any manufacturer. Service programs range from routine preventative maintenance and emergency assistance, to performance audits and comprehensive long-term service agreements.

Technical Services

Elliott's regionally-based engineering teams assist customers daily with technical questions and troubleshooting, root cause failure analysis, material analysis, finite element and rotor dynamics analyses, vibration analysis, and field performance testing. We also provide customer training classes at any Elliott facility or at customer sites.

Service Parts Network

Elliott's ISO 9001 registered Service Parts organization delivers the quality OEM parts and rapid turnaround necessary to maintain equipment performance and reliability. Knowledgeable customer care representatives are available 24/7 to support customers with:

- ♦ Parts and service for Elliott and non-Elliott rotating equipment
- ♦ Parts management programs and customer inventories
- ♦ Quick action machining center to produce urgently needed parts
- ♦ Regional parts depots with same-day shipping on most stock items
- ♦ Technical manuals and comprehensive engineering files on every unit we manufacture





Elliott Group is a global leader in the design, manufacture, and service of technically advanced centrifugal compressors, steam turbines, power recovery expanders, cryogenic pumps and expanders, and axial compressors used in the petrochemical, refining, oil & gas, liquefied gas, and process industries, as well as in power applications.

Elliott Group is a wholly owned subsidiary of Ebara Corporation, a major industrial conglomerate headquartered in Tokyo, Japan.



901 North Fourth Street
Jeannette, PA 15644-1473
Telephone: 724-527-2811
Fax: 724-600-8442

Email: info@elliott-turbo.com
www.elliott-turbo.com

T H E W O R L D T U R N S T O E L L I O T T



COMPRESSORS ■ TURBINES ■ CRYODYNAMICS ■ GLOBAL SERVICE