Reliable solutions for decarbonized LNG operations

Emission free. Efficient. Low maintenance.

Building a world that works

GE is your partner of choice for turnkey low carbon LNG projects

LNG is the industry's most volume-intensive process, with success hinging on a balance of critical aspects – both technological and organizational. With over 25 years of proven experience in this field, GE continues developing innovative solutions that help customers achieve their objectives at many of the largest processing facilities in the world.

1 GW+
Total power installed in the world on LNG projects

75 MW
World's largest synchronous motor for eLNG project

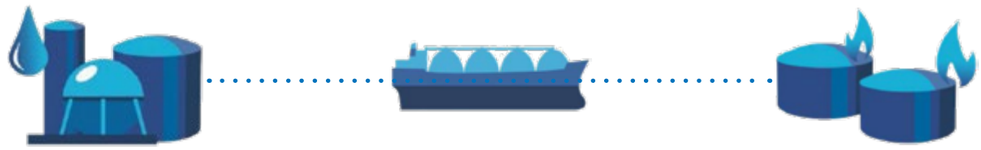
675 MW
Total power installed on world's largest eLNG plant

61 MW
World largest VSI + synchronous motor system

80 MW
World's largest 2-pole induction motor

Experts in LNG electrification

Complete scope of supply



With our considerable expertise in electrification, exhaustive knowledge of LNG processes, and strong capabilities in high-power systems, GE is leading the LNG electrification process with the largest worldwide full electric refrigeration compression systems (600 MW+ installed power) operating since 2019.

Systems expertise

Technology leadership

Stable operations since 2005

One stop shop

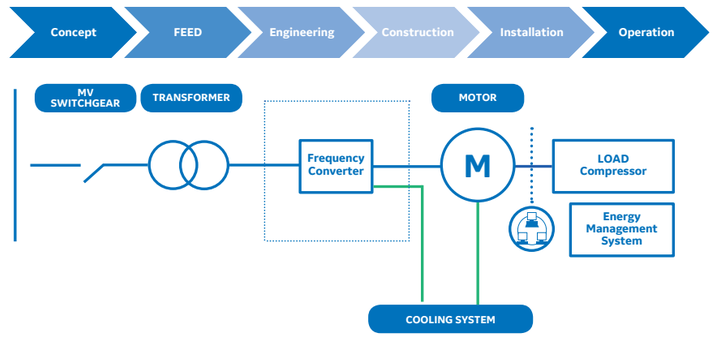
Zero emission electrical solutions

Our integrated solutions are designed and manufactured to operate efficiently, with no emissions and CO_2 free associated with their use, in a technologically complex and regulated environment where reliability, availability, and ease of maintenance are critical. Our engineering expertise, and understanding of the complete process, complimented by our grid integration studies and overall process knowledge, means that you can benefit from an overall enhanced, total system for compressor train processes enabling larger speed ranges delivered by smaller, less power-hungry compressors.

Our extended electrical package for LNG operations includes medium voltage fixed or variable speed motors (up to 100 MW), generators, HV distribution, switchgear, transformers, UPS, MCC, harmonic filters, Energy Management Systems, Active VAR compensator, e-house and power cables.

As your preferred LNG supplier, we offer:

- The experience of a worldwide leader for electrified LNG
- The convenience of one point of contact
- Direct, easy access to both electrical and mechanical expertise
- Tailor-made support to reduce complexity and optimize solutions
- Simpler, faster integration
- Proven, trusted systems – fully tested in demanding environments
- Reduced risk – adding more value to your operations



Flexible offering for LNG operations

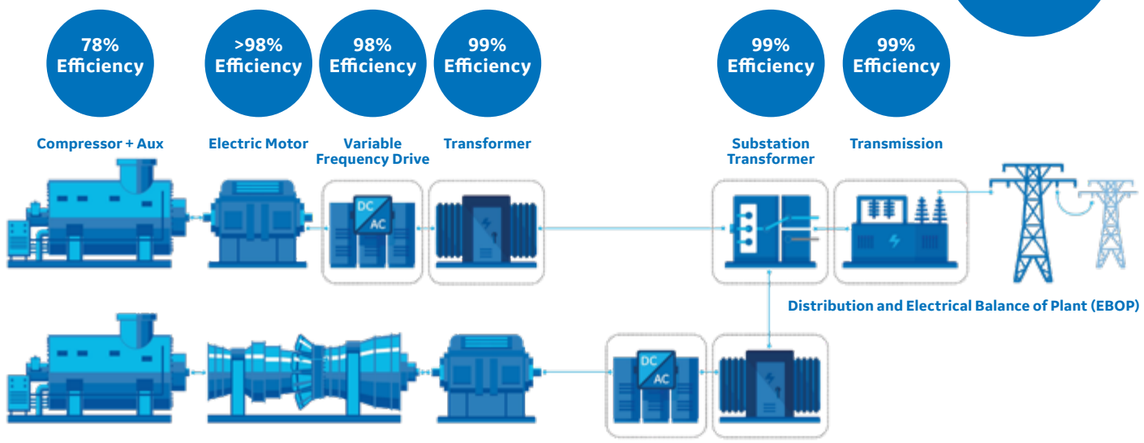
Innovative technology to help maximize LNG production and optimize life cycle costs while reducing carbon emissions

LNG: Carbon neutral value chain

- **Upstream and liquefaction: 13% to 20%**
- **Shipping: 1% to 4%**
- **Regasification: 0% to 3%**
- **End use: 75% to 85%**

Electrification in combination with renewable power generation or high efficiency power generation (i.e. combined cycle) strongly reduce the upstream CO_2 emission portion.

Up to **700 k$** per Mtpy savings on **CO_2** tax reduction



Fully integrated electromechanical systems

Starter helper function – The use of electric motors to start or help the main turbine power supply allows the gas turbine to always perform at its optimal operating point. This in turn allows for optimal energy balance, continuous operation and stability of the whole system in possibly any situation.

Full electric solution for refrigerant compression: "eLNG" – electrified LNG – is the liquefied natural gas supply chain enabled through full electric motor driven compression technology in the processing, transport and distribution network for LNG. This is an alternative process to traditional mechanically driven devices, powered by gas itself or other fossil fuels. We offer a complete solution to drive the main refrigerant compressors using electrical motors (synchronous or induction) powered by high-power drives based on thyristor technology (for LCI) or IGBT technology (for VSI).

- 5+ years operation – low maintenance
- 99%+ availability + reliability
- 97% efficiency
- NOx/CO_2 free

Auxillary services: Fixed-speed motor or variable-speed drive systems (VSDS) to drive compressors for use in:

- Gas treatment plants
- CO_2 reinjection
- Boil Off Gas (BOG)
- End Flash Gas (EFG)
- Booster or Fuel Gas
- Conventional and high-speed solutions for pipeline applications

LNG process: a systems approach

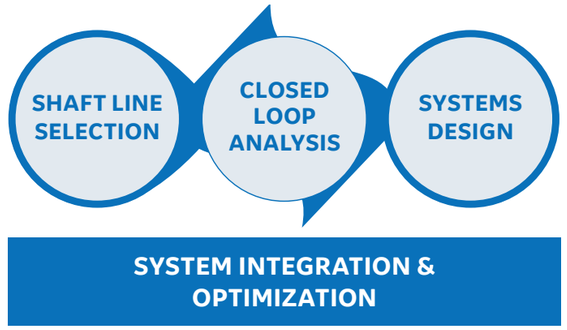
Optimized from grid connection to the compressor flow

Systems expertise

Managing technical risk and ensuring a proper balance between different technical solutions for LNG operations can be tough and a big pain point for LNG projects – and by not mitigating these risks, there can be a big impact in terms of project timings and costs. The critical relationships of the mechanical and electrical equipment are complex involving multi-dimensional harmonics, rotor dynamics, fluid dynamics on the compressor side which can feed back to the driver, engineering to avoid surge risks, etc.

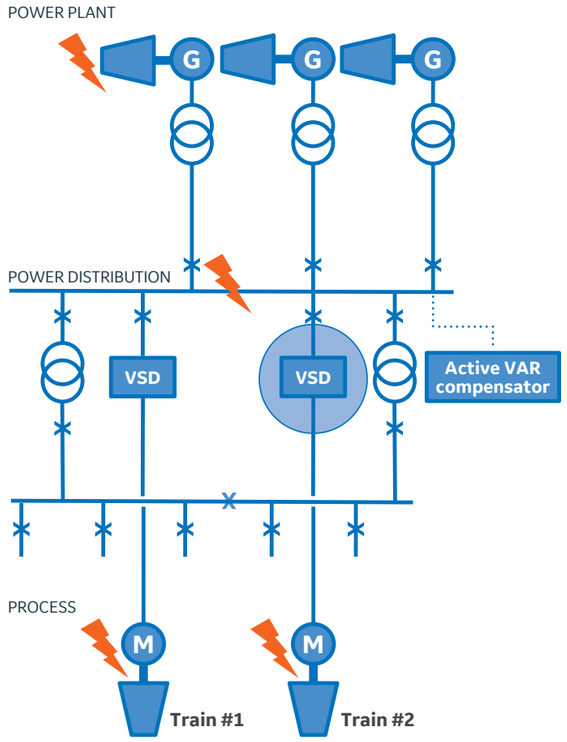
Addressing all these pain points is where GE's expertise and detailed knowledge of LNG operations enables us to offer the right solution. We have expertise in LNG. We can tailor our solutions by partnering with our customers early in the project (FEED/Pre-FEED) and at the very beginning of the process, evaluating the complete system and completing the network analysis to help deliver better solutions.

Our planning, design and engineering experience spans the entire LNG value chain – and so does our portfolio of equipment and support capabilities. Since every LNG facility has unique characteristics and operational objectives, we are committed to solutions that are customized and configured to each customer's specific needs.



First level risk mitigation

- Pre-existing network interaction and local generation
- Sub-synchronous torsional interactions evaluation and risk mitigation
- Prevention of future external grid configuration change by adding intelligent filtering and compensator
- Plant management and stability over the different operating conditions
- Harmonics and Inter-harmonics: n*|f_grid - f_motor| effects evaluation and mitigation by best technology application
- Torque ripple and torsional resonant conditions prevention and mitigation
- System performances studies (Power vs Speed/Torque vs. speed)
- Torque pulsations on the load machine due to switching inverter characteristics
- Data for shaft line torsional analysis are given to the OEM
- Insulation coordination studies
- Rotor dynamic analysis



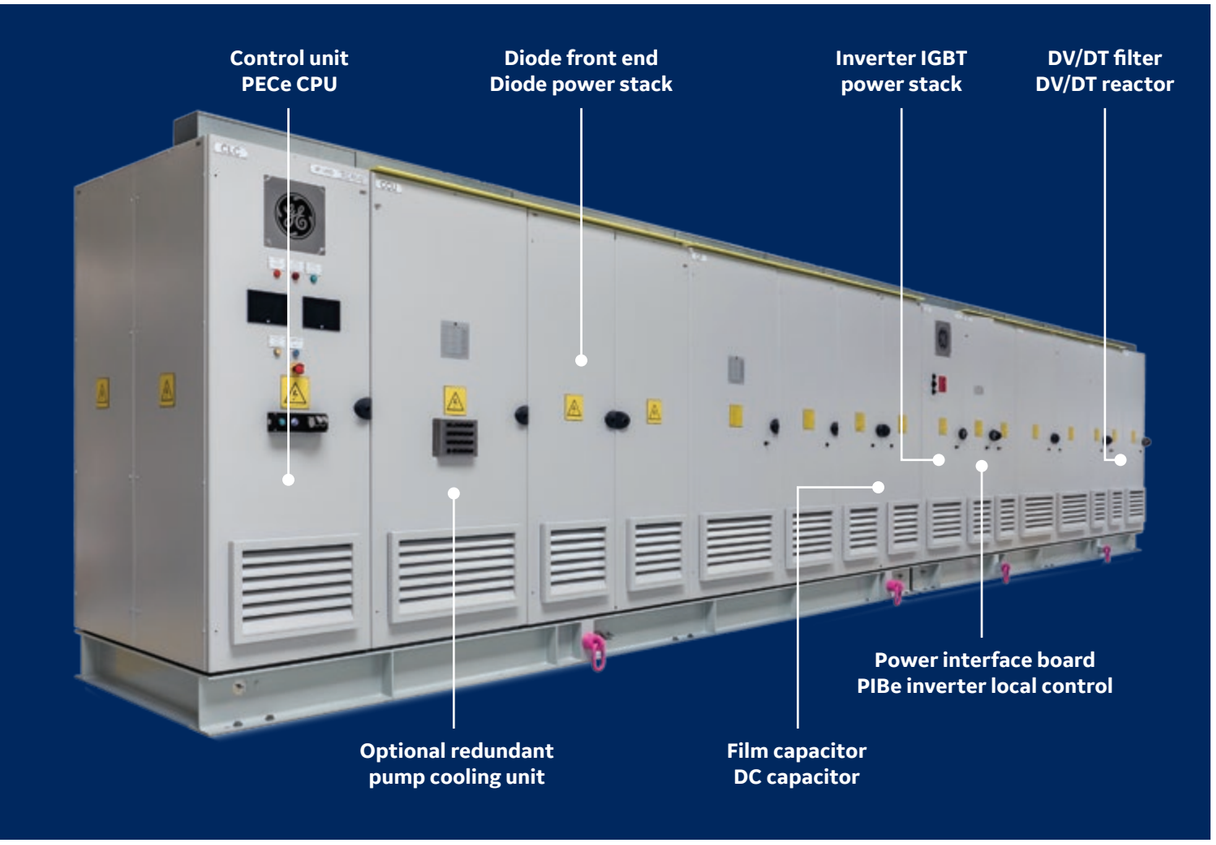
Medium voltage variable speed drive systems

Advanced power electronics technology for LNG applications

GE Power Conversion combines cutting-edge power electronics technology and decades of process expertise in its Medium Voltage (MV) drives portfolio, which is composed of Load Commutated Inverters (LCI) and Voltage Source Inverters (VSI).

Our Variable-Speed Drives Systems (VSDS) offer a wide power range covering many industrial applications –notably where energy efficiency, reliability and safety are key – and are optimized for LNG industry requirements. Whatever our customers' industry setting and needs, we provide solutions engineered to meet the most demanding expectations.

SD7000 – LCI drives	MV7000 – VSI drives
Voltage: 1.5 – 15 kV Frequency: up to 100 Hz Power: 3 – 100 MW Motor: Synchronous	Voltage: 3.3 – 13.8 kV Frequency: up to 300 Hz Power: 6 – 100 MW Motor: Induction or Synchronous
• Proven technology (30+ years' experience) • Flexible design adaptable to any rating, frequency and cooling configuration, for new installations or retrofit of existing ones • High efficiency: Up to 98.5% performance • N+1 redundancy for increased reliability and availability	• Energy optimization: PWM active front end enables regeneration of the energy to the network • High efficiency: Up to 99% performance • Reliability: With press-pack IGBT technology, fuseless protection and a low component count, MV7000 offers longer life expectancy – even under load cycling • Redundancy: Secured continuous conduction of the IGBT in failure mode



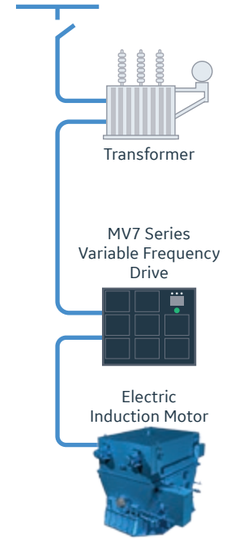
MV7 for LNG train optimization

Increased power density with fewer components and smaller footprint

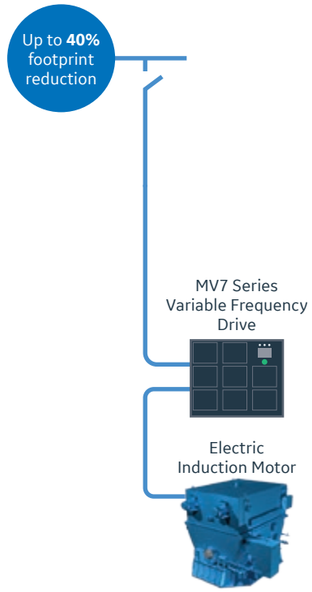
Up to 100 MW/13.8 kV: low part count for high reliability

The Variable Frequency Drive (VFD) is a core component in an electrical driven train. GE uses multi-level technology to dramatically reduce the scope of required associated equipment.

- **Increased efficiency:** Reducing current harmonic content in the motor with up to 30% lower harmonic losses
- **Increased availability:**
  - — Lower maintenance requirements, extended operation
  - — Built-in N+1 redundancy



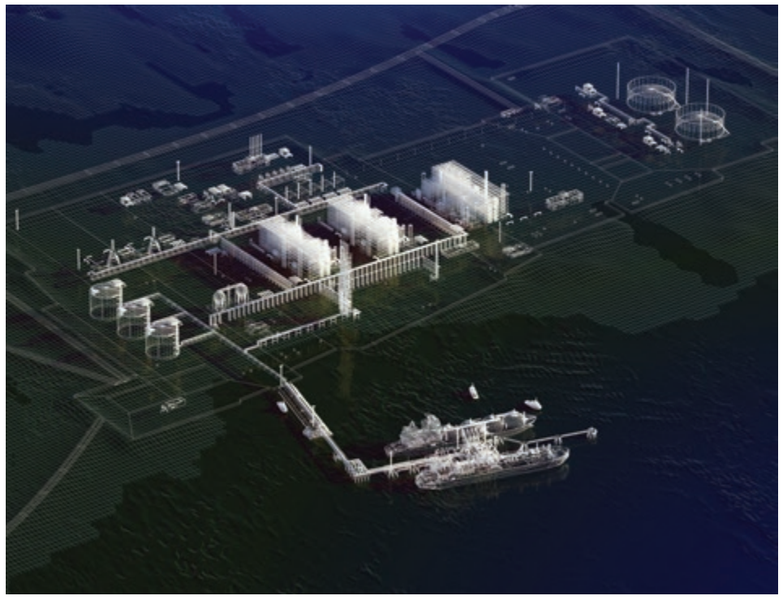
AFE transformer-less solution



Saving space with transformer-less design

This development in variable frequency drive technology allows the removal of the transformer for voltage up to 13.8 kV. This has added benefits for offshore operations by minimizing footprint requirements and allowing easier maintenance. It also enables better power output by ensuring a clean energy supply and high-power quality grid performance.

- **Reduce size and weight:** Minimizing the associated CAPEX expenditure for installation. Up to 40% footprint reduction allowing valuable space savings.
- **Increase uptime:** Availability up to 99.9% with offshore solution based on proven technology. Removal of the transformer allows significant reduction in meantime to repair.

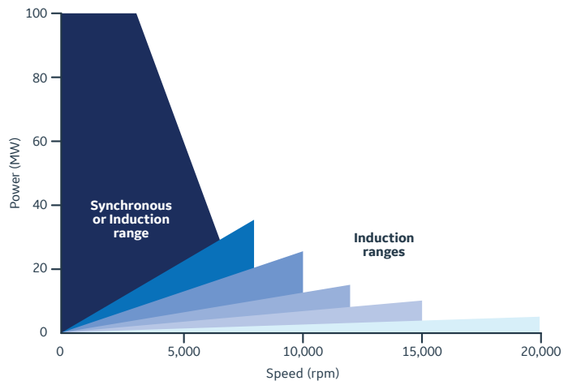


Experts in rotating machines

Reliable innovation for over 125 years

We continue to innovate with product quality

GE has been setting the standard in manufacturing rotating machines for over 125 years. GE manufactured motors for some of the first commercial and industrial electrical applications. We continue to deliver innovative mechanical power solutions to the world. Motors are designed and manufactured to operate efficiently and reliably in challenging applications and severe environments where reliability and ease of maintenance are critical.



Induction motor technology

Smaller, lighter, more reliable

High power induction motor range

Voltage	13.8 kV
Power	20 – 100 MW
Speed	3,600 – 4,000 rpm

High-speed machines

With over 120 machines in our reference list, GE is one of the leading suppliers of high-speed motors. We have 20 years of experience with high-speed machine designs and are constantly improving it to ensure reliable performance for this demanding application.

Our third generation MGV induction range is based on a reliable stiff shaft design. Available with a Class H insulation system, sleeve, tiling pad or active magnetic bearings, we offer a flexible design suitable for a broad range of applications.

Synchronous motors

Stator frame and magnetic core

- Low loss core design
- Easy access for routine maintenance
- Low vibration long life
- Pin Vent technology reduces hot spot compared to I-beams technology

Insulation system

- Vacuum Pressure Impregnation (VPI) process for added protection and rigidity
- Thermal capability and high dielectric strength

Rotor

- The shaft is single piece, solid forging
- All rotors are carefully balanced to comply with standards requirements

Up to 48% increased uptime*

- Delivers greater reliability and efficiency primarily by reducing the rotor's parts by X 10
- Leaner, low-maintenance motor that delivers extended maintenance periods and longer periods of uninterrupted operation. 5+ years of operation

Up to 36% lower overall footprint*

- Induction + VSI allows to operate at higher speed, then optimizing the entire train for smaller and lighter compressor design
- Fewer components allow for lower overall installation costs (civil works, foundations, associated equipment, etc.)

Increased system efficiency for lower power consumption

- Increased operational flexibility and efficiency
- Up to 98.1% operational efficiency
- OPEX savings when combined with VSI drive (~+1.25%** increased overall system efficiency/lower power consumption)

* Comparison based on equivalent power GE synchronous motor and average maintenance cycles. Source: GE study.
**Estimate from comparison between global system efficiency of largest eLNG project – induction vs synchronous.

Energy Management System (EMS)

Electrical power resilience for off-grid, process-critical and electro-intensive facilities

GE Power Conversion's Energy Management System (EMS) is an advanced automation solution designed to ensure electrical power availability and quality for energy-critical industrial plants and maritime vessels by enabling permanent load balancing between the energy produced and the energy consumed, ensuring the global energy efficiency of the plant. GE Power Conversion's EMS is ideal to enable energy surety and efficiency for microgrid installations to support integration of a mix of cleaner energy sources and energy-intensive loads.

Based on the same core control structure as our power electronics technology (converter, inverter, STATCOM), the EMS natively interacts with converters to simultaneously help to guarantee the overall facilities' power quality and availability. The EMS is particularly valuable in helping to mitigate the effects of bringing in increased renewable energy sources to a facility's energy mix (harmonics mitigation, reactive power compensation).

Permanent load balancing between local energy sources (renewable or fossil fuel) and consuming loads

> Helps ensure operational delivery and increase safety by significantly reducing or even eliminating blackout

Maximum energy efficiency and minimum GHG emission

> By directly acting at lower tasks level of sources' primary control converters (solar, wind, battery, H_2...)

Productivity improvement

> Thanks to its embedded analytics and digital tools, like Asset Performance Management (APM), simulation software, unified supervision automation and power electronics and open ending to customers' prosuming approach

With more than 15 years' operational experience in the oil and gas segment, Power Conversion's EMS is fully involved in LNG production, both Upstream and Downstream, with key references:

- Interconnected gas compressing platform – the world's largest column-stabilized- and FPSO, producing 9.6 MTPA LNG, 1.6 MTPA LPG and 100 kbd condensate powered at 150 MW by six gas turbine generators.
- e-LNG 10 MTPA liquefaction facility powered at 720 MW by five gas turbine generators in combined-cycle.

EMS functions

- **Power Management System (PMS):** the primary function of the EMS is to coordinate power generation on site: it manages sharing of power delivered by all heterogeneous sources between all equipment, in accordance with their respective acceptance/rejection capabilities and real time health status.
- **Power Distribution and Control System (PDCS)**
  - Dynamic load shedding to contextually adapt the distributed power to real-time capacities of available power sources
  - Live busbars synchronizing, Automatic Transfer Switch (ATS), etc.
- **Monitoring and Supervision System:** The EMS incorporates SCADA software for supervision, data acquisition and logging (1 ms time stamping accuracy for key events' postmortem analysis, e.g. efficiency, MTTR, etc.)
- **Central electrical gateway:** Dual networks for data flux segregation and cyber protection
  - Reactivity and safety of hardware critical data
  - Standard protocols, e.g. IEC 61850, MB, etc. for long term sustainability and smooth interfacing between heterogeneous devices, from several manufacturers and ranges
- **Connectivity with complementary Digital Suite tools** for key electrical apparatus, including Asset Performance Management, Energy Optimizer, etc.

Grid Integration and Energy Consulting

Grid integration analysis, power systems operation and planning

For over a century, the electrical grid has served its purpose, delivering power when and where it is needed. In recent years, several factors have converged that have heightened attention on the reliability and functionality of electric grids.

Utilizing the power of software, power systems, machine learning, and other advanced analytics and next-generation design and visualization techniques, GE is using its extensive knowledge of the grid to develop new solutions that will help utilities predict and prevent potential failures before they happen. GE's portfolio of power-grid-based technologies enables the use of real-time information to improve the operation of the grid.

Our dedicated group of engineers and business experts is specialized in complete power system analysis and simulation. Our teams work to analyze and help to ensure the compliance of power plant integration to the grid, keeping GE and its customers ahead of grid interconnection challenges.

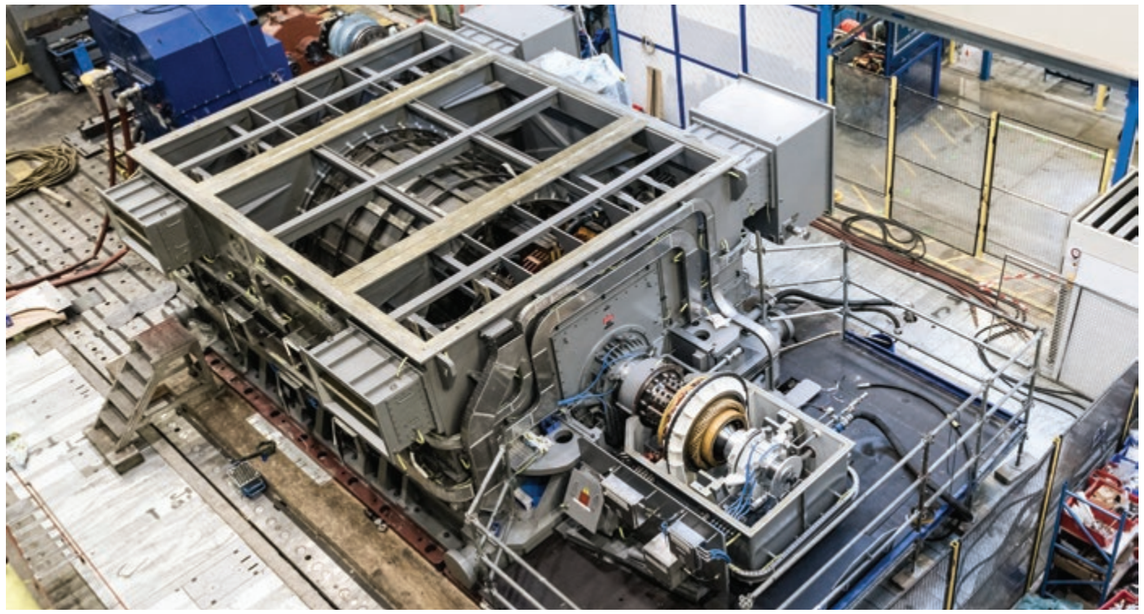
We can help you with:

- Power integration and application issues
- Grid code testing of power generation equipment
- Sub-synchronous torsional interaction analysis
- Risk mitigation

Additionally, we have expertise in power system stabilizer application issues as well as utility IT and grid modernization projects.

Technology validation

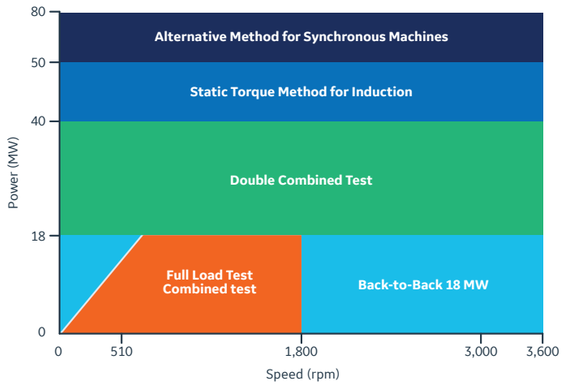
Reducing risk through full load, and back-to-back testing facilities



40 MW full load capability

Full load capability for frequency from 5 Hz up to 300 Hz, and a 40 MW loading induction machine, capable of an alternative method on induction forced cooled motors up to 50 MW. The test bench is capable of a full load combined test up to 40 MW on a back-to-back configuration comprising transformer, drive and motor.

- Ensure machine quality with full load test validation of electrical and mechanical parameters
- Complete system set-up with project transformer and drive
- Commissioning lead time reduction on site due to equipment fittings and fine-tuning during test



Real time application simulation software designed to help maximize system uptime

Integrated electrical and gas process dynamics simulations allow for technology and equipment validation prior to project execution and help with overall system optimization.

- Job-specific software validation
- Risk management on new solutions
- Application and technology validation
- System tuning
- Certifications
- Fast commissioning

Project management

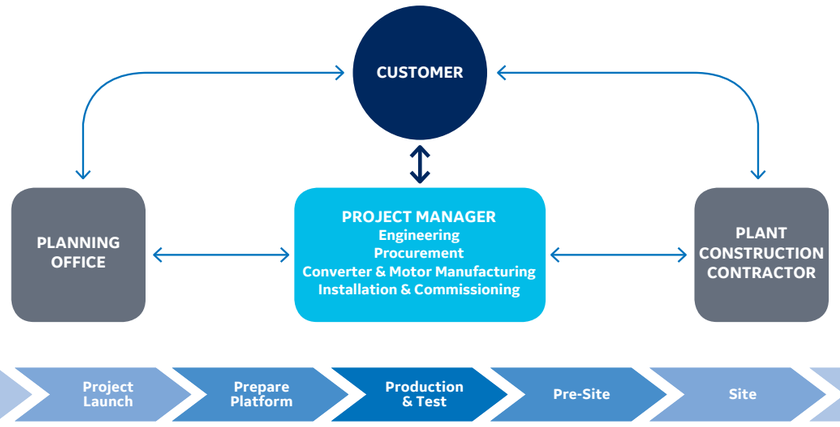
And supply chain management support

GE Power Conversion's offers cover each step of the project: from conceptual design assistance during initial needs definition upstream proposal phase to engineering, procurement, manufacturing, equipment transportation and support to commissioning of the equipment and overall plant.

Our team of experienced professionals will guide you toward the best solution during the sales and proposal stages and will offer you best in class transparent project management up to the handover of the commissioned plant. GE can capitalize on a large variety of experiences in LNG that can help enable a straightforward and proven design. Our rigor and experience will help you secure the overall plant schedule.

From our perspective, experienced project managers as a single point of contact are key to success – collaborating with the individual contractors, to help predict potential challenges and manage them in a structured and well-organized manner.

Project managers are key to a successful project by coordinating the individual stakeholders



Services

Optimizing maintenance operations

GE has developed a wide range of services, partnering with our customers to provide the high level of reliability and availability needed in the LNG world, ranging from specific maintenance methodologies that shorten planned maintenance site activities, through to taking full responsibility for the ongoing performance and availability of the equipment under Contractual Service Agreements.

By injecting our latest technologies into existing installations, we are able to extend maintenance intervals and component life. We also provide advanced machine monitoring and diagnostics –with a variety of on-site and remote system options– ensuring that each piece of equipment is running to its potential and making the necessary contribution to plant performance.

Thanks to our service model close to our customers, we are able to propose upgrades based on operational feedbacks to improve equipment performance and reliability or adapt to the site development.

Meeting the needs of your operational model

GE offers customized services to meet the needs of customers' individual operational and maintenance models (from daily operation, routine and scheduled maintenance, to outage services) comprising:

- Remote monitoring and diagnostics
- Maintenance
- Spare parts and obsolescence management
- Warranty extensions
- Response time guarantees
- Availability guarantees as risk sharing mechanisms
- Dedicated resident engineer

Fleet data analytics and predictive maintenance

Through advanced digital platforms, we deliver expert onsite and remote 24/7 support, emergency interventions and all customized to meet unique customer requirements.

Long term and local support

With a strong network of regional field service engineers and local repair workshops, supported by global engineering experts, GE Power Conversion has the organization to support customers wherever they may be in the world.

Enhancing energy harvest across project life cycle

GE's services help to increase equipment availability and support continuous plant operation, giving higher energy yield and therefore higher return on investment across life cycle.

Reducing risk, enhancing productivity

GE offers services that address a broad range of activities that are necessary for LNG operators to protect assets, keep critical processes running, to help decrease risk and enhance productivity.

Key differentiators at a glance

Adding value to LNG operations

Extended system focus for best technology selection	Reliable, proven technology	Overall system analysis and optimization
Variable speed drive customized solutions • Conventional speed and medium power applications • High speed applications up to 20,000 rpm • High power applications up to 100 MW • Transformer-less solutions	**Advanced technology bringing value to operations** • Integrated and optimized equipment packages and reference designs lower overall project cost and risk • Design and delivery of full electrical drive train and electrical management solutions	**Proven motors portfolio** • 30% OPEX savings compared to gas turbine driver • Up to 36% more power density at same footprint • Synchronous and induction machines portfolio • Higher reliability through lower part count • Extensive test facilities
Customized life cycle services • Extended global footprint and service capabilities with customized offerings • Cloud based diagnostics, prognostics and predictive maintenance based on GE's Digital Suite solutions	**Stabilizing power to the grid** • Proven grid integration capability • Meeting grid codes under harsh conditions • Advisory Services for grid integration • Advanced grid integration studies and modelling • Active VAR compensator (MMC based) for large existing plants' voltage stabilization and external harmonics effects mitigation	**Global partner** • Worldwide manufacturing locations to meet lead time, cost, local content requirements • Extensive network of engineers, scientists, and researchers

For more information on GE Power Conversion's LNG Solutions, please contact your local sales representative.

About GE Power Conversion

GE Power Conversion applies the science and systems of power conversion to help drive the electrification of the world's energy infrastructure by designing and delivering advanced motor, drive and control technologies that evolve today's industrial processes for a cleaner, more productive future. Serving specialized sectors such as energy, marine, oil and gas, renewable and industry, through customized solutions and advanced technologies, GE Power Conversion partners with customers to maximize efficiency.

www.gepowerconversion.com

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