

GT13E2 GAS TURBINES



Our world has an ever-growing appetite for energy – balanced by an increasing concern for the environment. **Alstom delivers the clean power and clear solutions that power producers and industries need to meet these increasing challenges.**

From gas turbines or entire turnkey power plants to industrial solutions, our **versatile** technology is proven to **lower energy costs, reduce emissions** and provide unmatched operational **reliability and flexibility.**

For more than 70 years, Alstom has established a track record of quality, safety and responsiveness to versatile market needs. Alstom's more than 1,500 gas power plant experts are committed to meet any gas power plant operator's need – whether it's designing and installing a plant from the ground up or retrofitting an existing facility.

Key facts

- 70 years of innovation
- 90 locations
- 200 turnkey power plants
- 1,500 gas turbine R&D professionals





Accumulating more than 8.7 million fired hours, the Alstom GT13E2 has proven its class leading position as the most reliable heavy-duty gas turbine for the 50 Hz market.

Class leading efficiency and operational flexibility

Utilities and operators of industrial plants using gas-fired turbines face a difficult challenge: to meet fluctuating demands for electricity, cleanly and affordably.

Alstom created its gas turbine and component products to meet three key business imperatives of global power producers:

- the need to reduce the cost of electricity;
- the desire to minimise each plant's environmental footprint; and
- the need for superior reliability and flexibility.

These three business imperatives drive the ongoing evolution of the GT13E2.

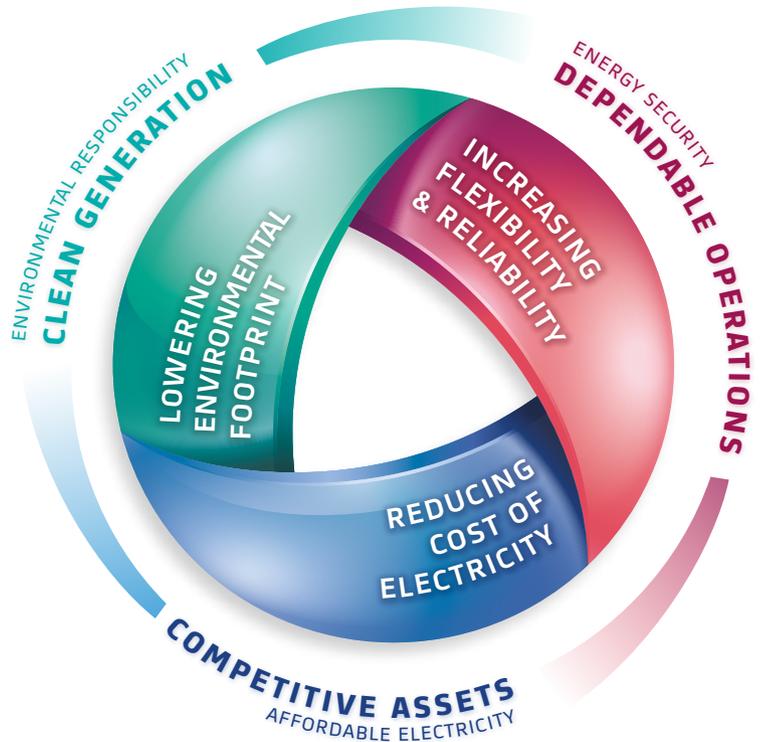
Today, the GT13E2 has delivered reliable performance across more than 8 million fired hours, prompting industry experts to name it the most powerful and efficient gas turbine in its class. With recent upgrades to every major performance area, the GT13E2 can reach more than 200 MW output, with an improved efficiency of above 38% across the entire load range while reducing NO_x emissions by 40%.

With its versatile offering, the GT13E2 is positioned at best to meet power producers' need for flexible, low-cost, clean power generation.

Clean Power, How Alstom is helping you

CLEAN POWER CLEAR SOLUTIONS™

Our Power generation offering is based on a deep understanding of power markets and our customers' needs. It is organised around three levers to maximise the return of assets over their entire lifecycle.



REDUCING COST OF ELECTRICITY

It takes competitive assets to keep electricity affordable. We enable power companies to compete successfully in the marketplace and provide affordable electricity to consumers. We help you reduce the cost of electricity through:

- Efficiency improvements
- CAPEX reduction / scaling up
- Capacity Factor increase (renewable)
- Lead time reduction
- Competitive O&M
- Competitive financing



LOWERING ENVIRONMENTAL FOOTPRINT

Clean generation is one way of demonstrating environmental responsibility. Another is lowering resource usage, visual impact and noise pollution. In both cases, we can help you meet or exceed regulations and environmental standards. That is why Alstom innovates in the following areas:

- Renewable portfolio
- Natural resource optimisation
- Pollutants control (SO_x, NO_x, PM, mercury)
- CO₂ emission reduction & CCS
- Land use, visual impact and noise
- Water intensity reduction & recyclability



INCREASING FLEXIBILITY & RELIABILITY

Intermittent power generation is a growing challenge of energy security, as is maintaining an aging installed base and adapting it to changing market conditions. We help you tackle both issues so that you can enjoy dependable operations with:

- Maintainability and outage time reduction
- Operational and fuel flexibility
- Designs and service for improved availability and reliability
- Climate packages
- Energy storage

Clear Solutions™

meet the challenges of energy sustainability



Our commitment to customers

Alstom's gas-fired solutions are designed to deliver maximum performance to meet today's challenging requirements and ultimate flexibility to address tomorrow's needs. We know that success in today's dynamic energy markets requires maintaining a delicate balance among the three clean power levers.

That's why Alstom engineers focus on providing solutions that are state-of-the-art in both performance and efficiency. Our solutions offer you the highest levels of operational flexibility, quality and reliability and help you to meet your local market requirements for clean power at a cost efficient price.

REDUCING
COST OF ELECTRICITY



>38%
efficiency in simple-cycle

LOWERING
ENVIRONMENTAL FOOTPRINT



-40%
less NO_x emissions over a wide
load range down to 15 vppm*

INCREASING
FLEXIBILITY & RELIABILITY



+50%
interval extension between
scheduled inspections due to unique
switchable operation mode

* Compared to previous ratings.

Evolving technology.

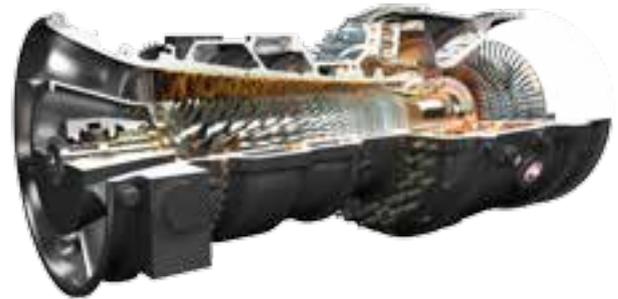
A versatile offering

The **GT13E2 gas turbine portfolio** gives power producers the **flexibility** to select the gas turbine that best meets their unique requirements.

All three GT13E2 configurations feature outstanding fuel flexibility, enabling the gas turbine to burn nearly every natural gas composition in the world.

The solid welded rotors never need to be de-stacked, optimising maintenance costs and the proven compressor design ensures high blading efficiency.

By offering an improved turn-down capability and the versatility to operate either in the performance optimised mode or in the maintenance optimised mode, power providers can react to changing power demands.



GT13E2 2005

The maintenance-friendly nature of this highly reliable gas turbine makes it the ideal choice for applications with limited physical space. A five-stage turbine with annular combustion technology and EnVironmental dry low NO_x burners, the GT13E2's 2005 configuration delivers combined-cycle power of 517 MW at an efficiency rating of 53.8% (KA13E2-2 configuration) and a GT power of 185 MW at 37.8% efficiency.

KEY FEATURES

- Use in the power optimised mode and set maintenance intervals at 24,000 Equivalent Operating Hours (EOH), or utilise maintenance cost optimised mode to push service out to 36,000 EOH
- EnVironmental burner do not require separate combustor inspections between hot gas path inspections
- Also available with optional AEV burners to accommodate wide fluctuations in fuel gas composition, and increase operational flexibility

Expanded solutions.

based on our proven GT13E2 family



GT13E2 MXL2

The GT13E2 MXL2, which is well suited to specialised applications found in baseload combined-cycle power plants, aluminium smelters and industrial operations, provides significantly improved compressor, turbine and combustion performance. Its enhanced components, which have been added to the GT13E2's proven architecture, enable the MXL2 configuration to deliver combined-cycle power of 535 MW at 55.8% efficiency (KA13E2-2 configuration) and GT power of 188 MW at 38.6% efficiency in single-cycle operation. It is available for both new plant installations as well as upgrades.

KEY FEATURES

- The GT13E2 MXL2's Controlled Diffusion Airfoil (CDA) compressor blade profiles optimise efficiency and improve its surge margin
- The GT13E2 MXL2's turbine blades feature optimised sealing, improved aerodynamic efficiency and advanced cooling technology
- Extend inspection intervals and reduce maintenance costs: Inspection intervals of 32,000 Equivalent Operating Hours (EOH) in the power optimised mode and 48,000 EOH in the maintenance cost optimised mode



GT13E2 2012

Output optimisation characterises the GT13E2 2012, which offers up to 565 MW performance at 53.8% efficiency in combined-cycle use (KA13E2-2 configuration) and 202 MW performance at 38% efficiency. By using the proven compressor from Alstom's advanced class GT26 gas turbine, the GT13E2 2012 delivers a 10% massflow increase, better turndown and better part load performance. To quickly respond to cycling, seasonality and peaks, the GT13E2 2012 achieves start-up times of 15 minutes from initiation with turn-down capability of 50%.

KEY FEATURES

- The GT13E2 2012 advanced low-pressure compressor, proven through more than 1.2 million operating hours
- Achieve 40% lower emissions across the entire spectrum of load ranges and fuel types, reaching 15 vppm at 100% load on gas and 25 vppm on fuel oil
- Operation down to 50% load while remaining within emissions limits of 25 vppm on fuel gas and 42 vppm on fuel oil
- The GT13E2 2012 can start at -30 °C without an air pre-heater and operate down to -50 °C if a pre-heater is in use

Meeting a wide range of customer applications,
Alstom's expanded range of GT13E2 gas turbines
can produce reliable, competitively-priced electricity.

GT13E2: Continual

Delivering the ultimate in

Alstom's GT13E2: The most reliable and best performing gas turbine in its class

Performance and reliability

Meeting customer needs for superior performance across the widest range of applications, the GT13E2 can be configured to provide best-in-class performance whatever the specific application demands. From simple- and combined-cycle power plants to co-generation and industrial applications, the GT13E2 offers the right solution.

Accumulating more than 8.7 million fired hours and 66,000 starts of operating performance across an operating fleet of over 160 units, the GT13E2 has achieved a five-year availability, reliability and maintenance rating far exceeding class averages, with reliability reaching 99.5%.

Improved efficiency

The Alstom conventional class GT13E2 turbine portfolio continues to offer class-leading efficiency to help power producers deal with rising fuel costs and increasing demands. The 2012 configuration improves on the 2005 configuration's gas turbine efficiency of 37.8% with a gas turbine efficiency rating of 38% and maintains combined-cycle efficiency of 53.8%.

The MXL2 efficiency rating reaches gas turbine efficiency of 38.6% and combined-cycle efficiency of 55.8%.

Extended inspection interval

Reducing turbine maintenance is a key factor in reducing long-term power costs. To meet increasing cost containment needs, Alstom gas turbines offer extended inspection intervals across the GT13E2 configurations that reduce maintenance time. The GT13E2 2005 and 2012 configurations feature inspection intervals of 36,000 operating EOH and the MXL2, with the improved turbine blading, can offer extended inspection intervals reaching 48,000 EOH for higher availability and reduced costs.

Unmatched flexibility

Today's GT13E2 offers power producers an unprecedented level of operational flexibility. Not only can plant operators select a turbine configuration that matches site-specific output needs, they can switch online between two operating modes – one optimising performance, the other substantially extending standard inspection intervals. This unique capability offers the potential for financial savings, by enabling plant operators to react quickly to fluctuating power demands, while keeping costs in line.

The GT13E2 portfolio also offers superior fuel versatility, allowing for a wide range of fuel compositions without hardware changes and feature best-in-class Wobbe Index and C2+ tolerance. And the introduction of three rows of Variable Guide Vanes (VGV) in the GT13E2 2012 configuration has enabled superior part-load efficiency and widest operating range in terms of ambient conditions.

To respond quickly to changing power demand the GT13E2 2012 offers 15-minute start-up times from initiation and features turn-down capability down to 50% load.

In addition, the GT13E2 can burn fuel oil if there is a fuel gas shortage and the switchover can be accomplished while the turbine continues its operation.

CLEAN POWER
CLEAR SOLUTIONS™

INCREASING
FLEXIBILITY & RELIABILITY



>99.5%

The most reliable gas turbine
in its class according to
ORAP (Operational Reliability
Analysis Programme)

performance innovations

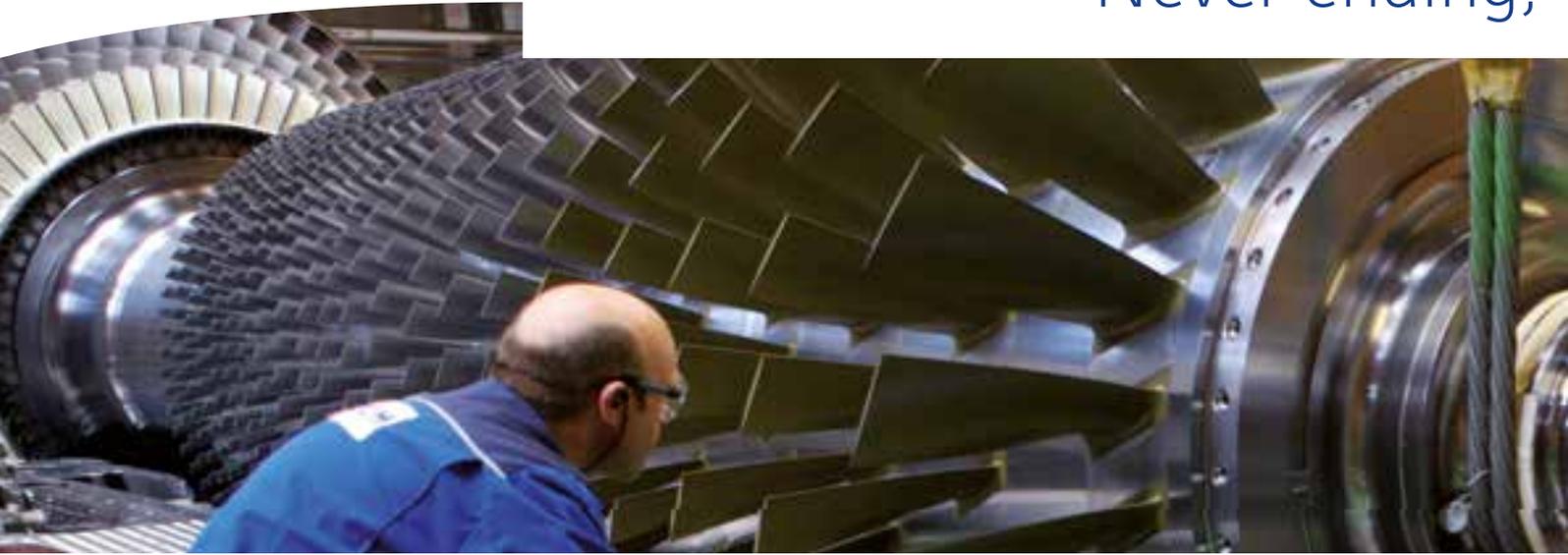
operational flexibility

Alstom's evolutionary approach to technology advances has resulted in **unprecedented improvements to an already class-leading solution** to delivering clean, reliable energy.



Alstom's

Never ending,



Superior efficiency and availability

By upgrading every area of turbine performance, Alstom is assuring customers the highest efficiency, versatility, emission performance and cost effectiveness available in a conventional class gas turbine.

Maintenance-free welded rotors

Alstom's welded rotors, which have been powering gas and steam turbines since they were introduced in 1929, ensure high stiffness with two-bearing support. Welded from forged discs, the rotors eliminate the need for de-stacking and re-stacking rotors common during routine inspections and overhauls. Lower maintenance costs and more uptime result from this unique approach to rotor design.

Advanced burner design lowers emissions

Upgrades to Alstom's dry low NO_x Advanced EnVironmental burners assure better performance and lower emissions, down to 50% gas turbine load with 25 vppm NO_x on fuel gas and 42 vppm NO_x on fuel oil. These results occur in ambient temperatures ranging from -10 °C without an air heater and -30 °C with an air heater in operation.

To achieve maximum blading efficiency and superior surge margins, Alstom applied Controlled Diffusion Airfoil (CDA) profiles for the GT13E2 2012 and MXL2 of compressors.

design excellence

ever powerful, proven effective

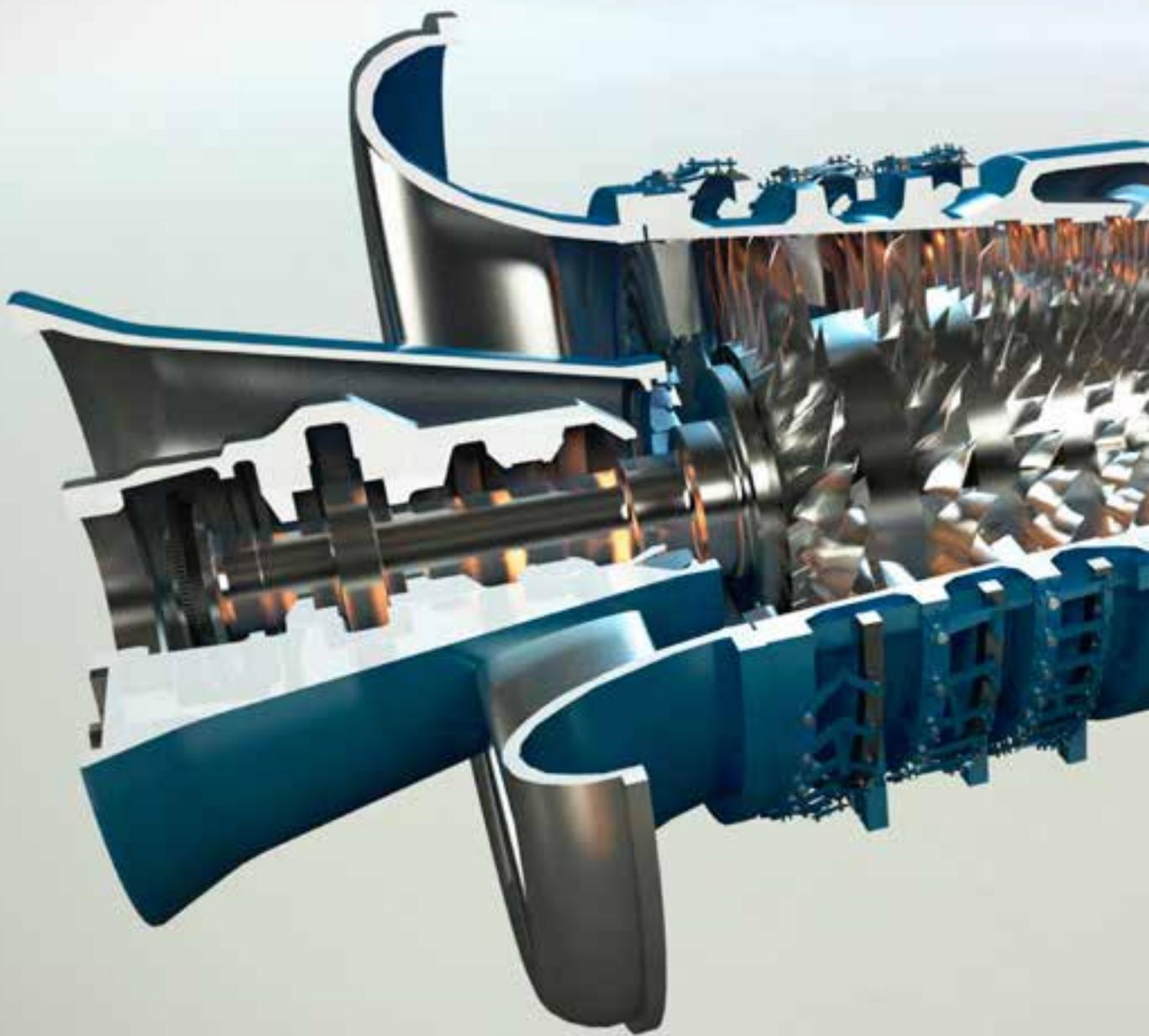
Alstom never stops working to ensure optimal component design to meet high industry demands and **deliver maximum return for customers.**

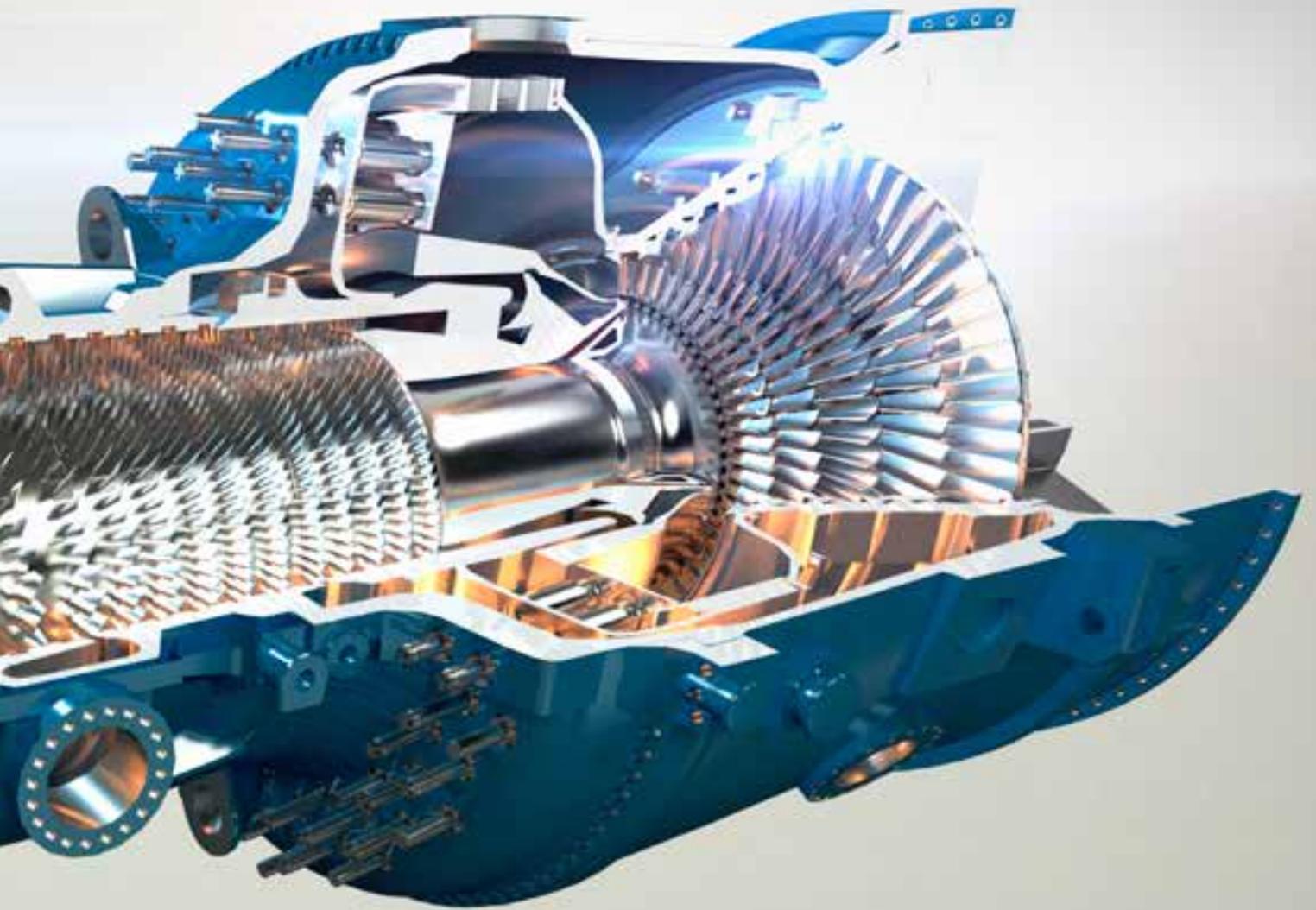
Optimised turbine blades

To ensure optimised efficiency and longer blade lifecycle, which results in lower cost, Alstom improved the turbine blades using its own F-Class technology. The GT13E2 MXL2 configuration uses turbine blades that feature advanced shrouds for improved sealing on stages 2 to 5, and an improved cooling configuration to achieve extended lifetime. They also provide better aerodynamic efficiency.

As with all Alstom innovations, these design features are based on proven technology.







Alstom helps power producers maximise their return on investment in today's rapidly changing power markets with dramatically improved NO_x emission performance, greater efficiency and best-in-class fuel versatility.

Seamlessly integrated

power trains



Efficient multi-shaft arrangement

From base load to daily start and stop, Alstom's power train experience spans a variety of sizes of multishaft arrangements containing four key components: steam turbine, turbogenerator, gas turbine and Heat Recovery Steam Generators.

1 Steam turbine

Key features

- A high-pressure turbine shrink ring design for fast start-up and ongoing efficiency
- Welded rotors for low maintenance
- Single-bearings to minimise the physical footprint
- Cost-effective single axial or lateral exhaust to accommodate lower foundations

2 Turbogenerator

Key features

- High efficiency and reliability
- Low maintenance requirements
- Multi-chamber Totally Enclosed Water-to-Air Cooled (TEWAC) system for high efficiency
- Self-retightening stator end windings for low maintenance

3 Gas turbine

Key features

- A variety of configurations to honour site-specific needs and performance objectives

4 Heat Recovery Steam Generators (HRSG)

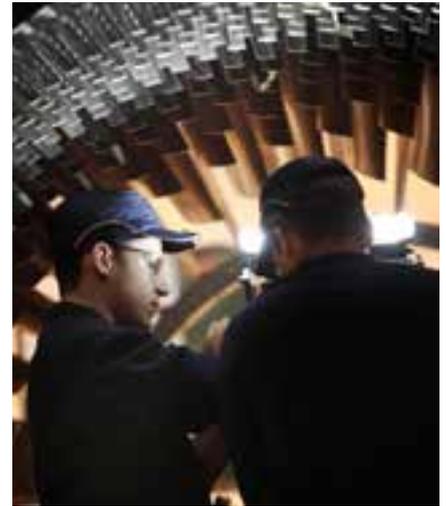
Key features

- Drum type and once-through technology
- Optimised hot and cold end performance for maximum combined-cycle efficiency
- Fast start-up from high thermal flexibility
- Rapid installation from a modularised design

Alstom engineers have optimised our power trains for both hot and cold end performance, **creating maximum combined-cycle efficiency and versatility.**

Customer-centred

Research and Development



Alstom's never-ending innovation

Advanced products from powerful people

Power solutions from Alstom allow leading utilities and industrial concerns to generate reliable, competitively priced and eco-friendly power. Producing these advanced power generation solutions requires the commitment of nearly 1,500 experienced research and development professionals in nearly 90 countries.

In addition, Alstom maintains working relationships with more than 30 universities around the world, including Oxford, Massachusetts Institute of Technology (MIT), Lausanne and engineering institutes in China, India and Russia.

The combination of resources enables Alstom to deliver products featuring leading edge design and unmatched performance, and a complete set of services that enhance plant performance, reduce life-cycle costs, and minimise environmental impact.

The Alstom power plant

Customers benefit from Alstom's real-world validation and development facility in Birr, Switzerland.

This working gas power plant, which is connected to the Swiss power grid, gives Alstom the opportunity to validate technologies and components in a working environment, under real service conditions. The result is an assurance that customers receive the highest quality, most innovative, versatile and reliable products proven in real-world conditions.

Alstom performance

Customers around



F'KIRINA (ALGERIA) **Constructed in record time**

From contract signing to the first unit's commercial operation, Sonelgaz' base load simple-cycle power plant, which is located 120 km South-East of Constantine was built in record time. The plant's layout design will accommodate additional units and a conversion to combined-cycle – without disturbing operations.



RAS ABU FONTAS B & B1 (QATAR) **Leveraging turbine fuel flexibility**

Using natural gas from 14 different sources, Ras Abu Fontas is Qatar's largest and most important power and water production plant. Adding three GT13E2 gas turbines increased the plant's capacity by 377 MW. A single, air-conditioned building now houses all eight turbines. Operating with a wide range of gas compositions and without any hardware changes, the power plant demonstrates exceptional fuel versatility.



KUALA LANGAT (MALAYSIA) **Using a flexible operating mode**

This co-generation plant was the first of several independent power projects featuring the GT13E2 in Malaysia. Owned by Genting Sanyen Power and completed in only 24 months, it generates 667 MW and supplies 57 tons/hour of process steam to an adjacent paper mill. Upgrading all the gas turbines offers the operator an opportunity to select either from two operational modes – higher output or extended lifetime – online in real time.



SOUTH HUMBER BANK (UK) **GT13E2 MXL2 upgrade implemented**

South Humber Bank's combined-cycle power station achieved a 1% efficiency increase in combined-cycle mode and 10 MW additional output per GT in XL mode following its upgrade with three out of five GT13E2 gas turbines. Today, the plant reports an extended service interval, greatly reduced lifecycle costs and lower CO₂ emissions. Alstom supports the GT13E2 turbines with an extended parts-and-services contract.



ALBA (BAHRAIN) **Continuously upgraded**

With an installed production capacity of more than 800,000 tonnes per year, Aluminium Bahrain (Alba) is currently one of the world's largest modern aluminium smelter. Power stations 3 & 4, which were installed by Alstom, supply 75% of Alba's power generation capacity. The gas turbines have been continuously upgraded, increasing their performance, extending inspection intervals, lengthening the plant's lifetime and improving overall availability.



PELICAN POINT (AUSTRALIA) **Built on a fast-track basis**

A 500 MW combined-cycle power project developed on a fast track by National Power, Pelican Point utilises two GT13E2 gas turbines equipped with advanced high-efficiency, low-emission burner technology to help meet the country's strict environmental requirements. Alstom also supplied the overall power plant control system, plant engineering, and associated installation and commissioning.

delivered

the globe have trusted Alstom



LUMUT EXTENSION (MALAYSIA)

Efficient installation

When Alstom installed a turbine block on this GT13E2-based, 1,400 MW combined-cycle power plant, the developers invested in a bypass stack. This stack allowed open-cycle operations, while Alstom converted the plant to combined-cycle. Alstom supplied three 165 MW GT13E2 gas turbines, a steam turbine, three HRSGs, electrical generators, the auxiliary system, a control system and interconnection facility. Alstom also supervised the plant's erection and commissioning.



VAIRES-SUR-MARNES (FRANCE)

Efficient power

Alstom installed three GT13E2 gas turbines into the Vaires-sur-Marnes power plant, bringing the facility up to 555 MW production. This increased output helps meet France's rising energy demands.



PHU MY (VIETNAM)

Vietnam's largest power complex

The Phu My combined-cycle power plant's capacity of over 3,800 MW makes it the largest power-generating complex in Vietnam. Alstom's plants in the complex include:

- Phu My 2.1 – 300 MW, 1997
- Phu My 2.1 – Add-on 160 MW, 2003
- Phu My 4 – 450 MW, 2004
- Phu My 2.1 Ext. – 160 MW add-on, 2006



MUARA TAWAR (INDONESIA)

Increased efficiency

The Muara Tawar combined-cycle gas power located near Jakarta, West Java now has 14 units and a capacity of 2,158 MW. Alstom has provided one KA13E2-3, one SC13E2-2-1 and one KA13E2-1.



RUWAIS (UNITED ARAB EMIRATES)

Consistent high service

Alstom supplied four GT13E2 gas turbines and generators, along with the associated HRSGs for the Ruwais power and desalination plant in Abu Dhabi. Alstom also provided the plant control system, the BoP equipment and engineering, installation and commissioning work.



MINSK (BELARUS)

Reduced emissions

Operated by RUE Minskenergo, the Minsk gas power plant was originally opened as a single simple-cycle unit. Alstom designed, manufactured and installed a second unit which converted the facility into a combined-cycle co-generation plant. As a result of this expansion, the plant now produces an increased amount of energy with higher efficiency and less of an environmental impact.

Partnership throughout the plant's lifecycle

In-depth service portfolio combined with broad experience

In today's power generation and industrial markets, plant owners and operators seek to establish long-term cooperation with major Original Equipment Manufacturers (OEM). They look for partners who are willing and able to develop flexible solutions that will increase production efficiency and reduce emissions throughout the lifetime of their equipment.

As part of Alstom's commitment to providing complete plant services for optimal performance, we are dedicated to supporting you to cost-effectively maintain your gas turbine and combined-cycle (GT/CC) power plants.

Our flexible and customised expert services cover solutions at all stages of the plant lifecycle or if requested simply on single components including:

- Parts
- Reconditioning & repairs
- Technical expertise & operational support
- Field service
- Performance improvements
- Service contracts
- Services on other OEM gas turbines

Service contracts

Alstom's service contracts are tailored to meet all your operational, maintenance and support requirements. Whether you prefer a Long Term Agreement (LTA) or an Operation & Maintenance (O&M) contract, with Alstom's comprehensive, yet flexible agreements, you can be sure of a win-win situation.

Partnerships for performance

Long-term agreements are based on framework contracts that define prices and conditions in advance. Besides offering preferential conditions for high quality parts and services, the LTA reduces administrative efforts and simplifies planning. The scope of services and equipment covered, as well as the contract duration and risk sharing, can be adapted perfectly to your needs.

LTAs offer many immediate advantages:

- Fixed preferential prices for parts and services
- Flexible scope to suit operative strategy
- Extendable scope to include almost any aspect of plant operations

Alstom's operation and maintenance contracts let plant owners devise completely new management strategies by outsourcing risks and responsibilities.

Alstom's **O&M contracts** are fee-based agreements that:

- Mitigate risks
- Leverage Alstom's extensive experience in plant asset management
- Can be adapted to suit your business strategy

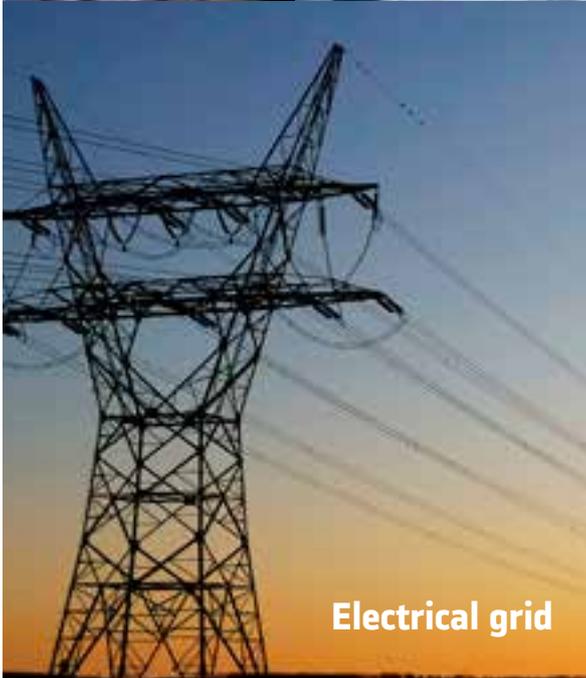
Plant Support Center™ – Expert support around-the-clock

Alstom's Plant Support Center™ (PSC) offers fast and comprehensive technical support solutions to keep plants competitive. Besides remote monitoring and diagnostic services, the PSC provides 24/7 operation support and direct access to a global network of technical experts who assist in troubleshooting, assessment and re-commissioning and analyse equipment trends.

Besides practical experience, our plant operation experts rely on comprehensive and proprietary knowledge management tools. If required, they can also call in Alstom experts with specific engineering know-how and fleet-wide experience to assist with operational support or more detailed investigations.



Power generation



Electrical grid



Rail transport

Alstom

Alstom is a global leader in the world of power generation, power transmission and rail infrastructure and sets the benchmark for innovative and environmentally friendly technologies.

Alstom builds the fastest train and the highest capacity automated metro in the world, provides turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal, wind, solar thermal, geothermal and ocean energies. Alstom offers a wide range of solutions for power transmission, with a focus on smart grids.

Power generation

Alstom Power offers solutions which allow their customers to generate reliable, competitive and eco-friendly power.

Alstom has the industry's most comprehensive portfolio of thermal technologies – coal, gas, oil and nuclear – and holds leading positions in turnkey power plants, power generation services and air quality control systems. It is also a pioneer in carbon capture technologies.

Alstom offers the most comprehensive range of renewable power generation solutions today: hydro power, wind power, geothermal, biomass and solar. With ocean energies, we are developing solutions for tomorrow. Alstom is one of the world leaders in hydro power, the largest source of renewable energy on the planet.

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