Are you ready for the next service level?

ROTEX – Plug-in Exchange Solution for Gas Turbines

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www.siemens.com/rotex
Discover ROTEX – Gas turbine rotor exchange

ROTEX – Plug-in Exchange Solution

Our Rotor Exchange Program ROTEX increases power plant availability and reliability by transforming rotor life decisions into an adaptable asset management strategy.

Please enjoy our interactive presentation and contact us to get further information.

- **Higher availability**
  - Record major outage: 11 days outage duration for one F-Class

- **Improved inventory management**
  - Up to 35% savings on spare parts

- **More predictable outage duration**
  - Reduced risk for outage time extension
  - Up to 40% lower probability of outage extension

- **Mods enabler**
  - Facilitates modernizations and upgrades
  - Up to >40 MW more power output

- **SGT-2000E series**
  - Standard major outage time reduction: up to 30%

- **SGT-4000F series**
  - Outage time reduction: up to 50%

**Decrease of outage time**

**Increased value** through flexibility & higher availability

Product offering also available for other frames, including SGT6-5000F.
Swap your power plant equipment for higher availability and reliability

ROTEX - Plug-in Exchange Solution

Customers can benefit from improved cash flow, cost reduction and continued modernization when providing us with the flexibility of effectively managing their rotors.

At each outage, a just-in-time Siemens-qualified rotor according to Siemens' latest standards / recommendations is put into operation, while your existing rotor is sent to a Siemens facility to be updated and included in the rotor pool.

This proactive program can eliminate the rotor as a life-limiting component and enhance your possibility to optimize your assets with latest technology.

### Budget is tight
- Budget must be reliable
- Additional investments e.g. for upgrades should be reasonable and provide good ROI
- Cost deviations should be avoided
- Get the most of of the investment

![Siemens-qualified plug in rotor]

### No surprises, please
- Minimize potential for delays
- Minimize potential for unplanned costs
- Minimize potential for unexpected findings

![Siemens-qualified plug in rotor]

It is all about Availability

- Reduced scheduled outage duration
- Avoid potential for extended outages
- Generate more revenue from higher availability

![Siemens-qualified plug in rotor]

Help me with my Inventory

- Reduce inventory costs while maintaining availability
- Reduced number of spares
- Less on-site space occupied by rotor work

![Rotor built from customer’s inventory]
Rethink!

Service exchange for major components to improve availability, to minimize risks, and to reduce inventory

Regular service is required for smooth and reliable operation of power plants. An outage is also the best time for implementation of Modernizations or Upgrades to increase the power plants performance.

With ROTEX it is possible to reduce the time and financial impact of scheduled service. Rethink your service to enhance your performance.

Frame specifics for Rotor Exchange:
- SGT-2000E series Frame Specifics
- SGT-4000F series Frame Specifics

Plus upgrades:
- SGT-2000E series Frame Upgrades
- SGT-4000F series Frame Upgrades

SGT-2000E series: Frame Specifications for Rotor Exchange

ROTEX can be customized according to project specifics
If you prefer a new rotor, refurbished rotor, or want to extend the life of your existing rotor, ROTEX portfolio has solutions to meet this specific business needs, e.g. ROTEX for one unit, ROTEX for multiple units or our ROTEX fast track solution.

Scenario: One unit
- OEM new-built or refurbished rotor delivered to customer site prior to event start
- Service-run rotor transferred to Siemens pooling

Frame specifics
- Fitting of inner casing with rotor

Rotor Exchange beneficial if
- Rotor destack is required
- Upgrades and Modifications apply
- Remote Outage or other on-site repairs apply, specifically
  - Compressor recoating
  - Turbine rings (repair)
  - Replacement of damping cones

Configuration levels
- Limited / no crane and laydown area available
- “Plug and Play” rotor (incl. new set of compressor blades, high-speed balancing and blade grinding)
- Inner casing (new or refurbished)
- Mixing chambers (if required)
- Turbine vane carrier (if required)

Blade tip grinding
- Yes
- Ansaldo Frames have to be clarified project-specific (impact on outage duration, no significant cost impact expected)
Recalculate!

ROTEX - Plug-in Exchange Solution

Nothing is more persuasive than figures. ROTEX can pay off in every respect – from emissions, energy consumption, availability and reliability to reduced costs and maintenance-related downtime. Recalculate your service to maximize your availability.

SGT-2000E lifetime extension

The comparison is based on Siemens standard calculations.
Site calculations and savings may differ based on site conditions and scope considered.
Would you like to save outage time and reduce potential outage extensions during your next outage? You can rely on ROTEX – our Plug-in Exchange Solution. We provide everything from a single source – from an initial ROI estimate to the feasibility study to project execution; and from providing all components to installation, assembly, and commissioning, including documentation and service by our Field Service Experts. Replan your service to maximize availability and reliability.

**What**

**General scope of supply**

You can rely on us. We will provide everything from a single source – that is, from an initial ROI estimate through the feasibility study to project execution; and providing all components for installation, assembly, and commissioning, including documentation and service by our Field Service experts.

- ROI estimate
- Data capturing
- Feasibility study
- Project management
- Delivery of equipment
- Installation and commissioning
- Documentation
- Services

**How**

- NDT inspection results
- Detailed risk evaluation
- Repair/replace
- Lifetime extension
- Proposed rework evaluation
- Full life evaluation
- Technical review
- Release component for operation

**Who**

- Reassemble unit rotor, runouts and balance
- Pack and ship rotor
- Component balancing and runouts
- Component evaluation
- Individual component cleaning
- Split compressor/turbine and disassembly of rotors
- Incoming inspections, runouts, and balance
Reconsider!

ROTEX - Plug-in Exchange Solution

ROTEX is already being used successfully in plants all over the world with many satisfied customers. Rethink your service to secure your competitiveness.

Reference Projects

Click the icons on the map to see more information

The Rotor Exchange Program (ROTEX) is an integrated service solution so that we can jointly manage the challenges (staying in budget, saving time, improving availability) of our customers' complete value chain everywhere.

Vinod Philip, CEO of Siemens Power Generation

As near as we can, we want to return to the efficiency levels the plant achieved when it was built. The rotor exchange concept was very attractive to our customer.

Tony Thomas, Project Manager Peterhead
Combined ROTEX and other swap solutions can deliver increased power plant availability and reliability. Customers can benefit even more from improved cash flow, cost reduction and continued modernization when entrusting us with the management of their major components, e.g. valves, combustion chamber, turbine vane carrier.

Leasing and financing options of major components can be a huge benefit to our customers.

Gas turbine exchange

Apart from the turbine rotor, further components can be offered. For SGT-4000F series, complete combustion chambers and associated burner combinations as well as the guide vane carriers can be exchanged. The provision of SGT-2000E series inner and mixing casings can further reduce the outage lead time.
Life Time Extension project at Peterhead, Scotland

Read the article:
Peterhead power station is the first in the UK to opt for a gas turbine rotor exchange, thereby cutting the typical outage duration by a third.
In April this year a Life Time Extension project began at Peterhead, the largest thermal power station in Scotland, to improve its efficiency and extend the asset life. To keep downtime to a minimum, SSE opted for a gas turbine rotor exchange solution which enables Siemens to cut 15 days from a standard outage.

“The rotor exchange concept was very attractive to SSE. We wanted to trial it”

Tony Thomas has a clear ambition for Peterhead power plant, the site he has managed since 2011 and his seventh station in a 40-year career. “As near as we can, we want to return to the efficiency levels the plant achieved when it was built. That’s very important for SSE. And we’re looking for the same reliability and performance that we’ve had for the last 100,000 hours.”

The Life Time Extension now underway at Peterhead is originally scheduled for 2014. Plans were put on the back burner when difficult market conditions saw the station’s operating hours drop significantly, making the investment uneconomic. But in late 2017 market conditions were favourable once more, and the station has been running at full capacity ever since.

“Two years ago it wouldn’t have greatly mattered how long the outage took,” says Tony. “But in the current climate upturn is really important. The standard 44 day outage for an LTE was unacceptable, but the 29 day proposal was much more customer-focused in recent years. ‘SSE is looking at solutions from the customer’s point of view. They ask us what was important and it was our emphasis on safety, a reduced outage period and efficiency gains that led to this solution. ‘It’s in both our interests to run Peterhead as effectively as we can,” he adds, “and that can only happen if Siemens has a close understanding of our challenges. I feel they’ve shown a genuine interest.’

He looks back to a project Siemens undertook at Peterhead in 2016: the upgrade of the Siemens distributed control system for the three gas turbines and boilers, and the migration of the balance of plant control system from an obsolete Schneider system to the Siemens S3000. “We’ve built up a good relationship. It’s not just a contractual arrangement; it works as a partnership.”

Reducing risks

‘It’s a sensible concept and it worked for us. Part of the appeal is that it reduces risk because there are no issues of emergent work, and since the outage durations are shorter there is less safety risk too,” explains Tony. SSE’s Kevin Beaumont, lead mechanical asset engineer at Peterhead, agrees. “Another bonus for Peterhead is that the gas turbine rotor which Siemens shipped here to replace the first of our three is a later model, so we’re benefitting from some technology upgrades that may deliver additional power. Plus, Siemens has provided new thermal insulation for the GT that will result in efficiency gains. That’s a real positive for us too.”

Tony believes Siemens has become much more customer-focused in recent years. “Siemens is looking at solutions from the customer’s point of view. They asked us what was important and it was our emphasis on safety, a reduced outage period and efficiency gains that led to this solution.”

Safety lessons

Throughout the project there were two safety incidents. For the first rotor exchange, the generator rotor exchange and with the first two GT rotor outages, he’s very disappointed by the safety record. During the de-stack of the first GT rotor there were two safety incidents within 24 hours.

When a rotor is de-stacked during a Life Time Extension outage, the compressor blades have to be destructively removed. The UK Field Service team typically uses a 14 lb hammer to remove the blades, having found it to be the most effective method. But the Peterhead rotor’s compressor blades had been blasted and re-coated in 2007, making the removal extremely difficult.

“Although it’s an operation that’s been carried out for years, it’s clear with hindsight that we shouldn’t still have been doing it this way,” says Dave. “We need to constantly challenge our processes to ensure they’re as safe as possible and I should have more carefully considered the safety risks. I feel I’ve personally failed the team and it’s a lesson I’ll certainly never forget.”

Immediately after the incidents, the team sat down to agree a new approach. They devised various improvements to the process including the development of a doily to sit the blade upon so that a second team member no longer needed to stand close to the operation. The team also looked to reduce the potential fatigue risk by limiting the operators’ time and a safe zone was established to restrict access. As they approached the second de-stack, they consulted the wider Siemens network and undertook some further brainstorming. Two further options were trialled, including the use of a tool supplied from Germany. Since this was only successful on three rows of blades, a new technique involving a jackhammer was developed. The effectiveness of this method surprised everyone.

“Sometimes it feels as if there’s only one way to do a job, but clearly...”
Peterhead power station is the first in the UK to opt for a gas turbine rotor exchange, thereby cutting the typical outage duration by a third.

Whilst the traditional approach to refurbishing a GT rotor can take 45 days, the rotor exchange concept developed by Siemens cuts it to under 30.

It’s an option which customers find increasingly attractive in a competitive marketplace. “This solution is all about availability and cost effectiveness,” says Siemens project manager Gary Robson.

In essence, Siemens identifies an existing, spare, used rotor from another station which it has already refurbished. Revaluated and effectively as good as new, the rotor can be shipped to any plant in the UK or Ireland, as and when it is required during an outage. The time that would have been spent refurbishing the rotor at the station or at a Siemens plant is gained.

Although a gas turbine rotor exchange is new to the UK (Seabank opted for a generator rotor exchange in 2014), the idea has been successfully deployed elsewhere in the world. Siemens technical field advisor Johann von Thun and others within the Peterhead team gained first-hand experience of it in Egypt.

“The事实 is Ged was in direct contact with the back office team in Newcastle as well as with colleagues in Germany helped to speed up the responses to queries, which meant an accelerated decision-making process on site.”

Reflecting on the success of the Peterhead rotor exchanges and others, Dave sees a value in developing the concept further. “The same principle could be applied to diaphragms, pumps, valves and other components. The principle is just the same: having refurbished spares from other stations ready and waiting to install, in order to minimise downtime and reduce costs.”

Peterhead Fact File

- Owned by SSE and situated in Aberdeenshire, Peterhead is a CGGT plant that began operating in 1982.
- In 2000, the station completed a major repowering project to increase its efficiency and capacity. Siemens won a £180m contract to install three gas turbines which were used in an innovative manner to provide steam to one of the original steam turbines. It increased the station’s efficiency by 50 per cent.
- In June 2018, SSE submitted a planning application to install a ‘black start’ facility at Peterhead.

Gary agrees. “Everyone needs to stay flexible. Dave gets the team round the table at 7:30 every morning to talk through the coming day, but we also constantly challenge people to think four or five days ahead and to prepare for what could happen.”

“Face-to-face is the best form of communication,” adds Dave. “We will discuss together what’s worked and what could be better.”

After the first outage, completed a day early in 28 days, the team looked at lessons learned in readiness for the second, which was completed four days sooner. “As we begin the third outage all the preparation work will have been done as far as parts and transport is concerned, and of course the rotor will already have been re-built,” says Gary. “The lads have done such a good job on the first two GT outages – a phenomenal amount of work in the time given – that we’re as well prepared for the third as we can be.”

It’s the first time that Siemens has run a Life Time Extension with a global project manager, who is responsible for work undertaken in both the UK and Germany, in a desire to operate more as ‘One Siemens’.

“We feel it works better for our customers to have a single point of contact during an outage,” says Gary. Having an engineer on site who also acted as a focal point for all technical queries was seen at a bonus by SSE too. The role of Ged Thewlis, solely for the duration of the outage, was to explain to the customer any technical findings and recommend courses of action.

“Peterhead is a unique project and people really want to make it work.”

Tony is open about his disappointment too. “Safety is our number one value at SSE and we want everyone to get home safely, so to have two incidents happening close together was especially frustrating. Fatigue can set in when time constraints, and that’s when unexpected happens you have to find ways of work,” says Tony. “Fatigue can set in when time constraints, and that’s when unexpected happens you have to find a quick resolution.”

Gary agrees. “Everyone needs to stay flexible. Dave gets the team round the table at 7:30 every morning to talk through the coming day, but we also constantly challenge people to think four or five days ahead and to prepare for what could happen.”

“Face-to-face is the best form of communication,” adds Dave. “We will discuss together what’s worked and what could be better.”