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Az Zour: 1000 MWe of Workhorse Power Help Kuwait Beat the Heat

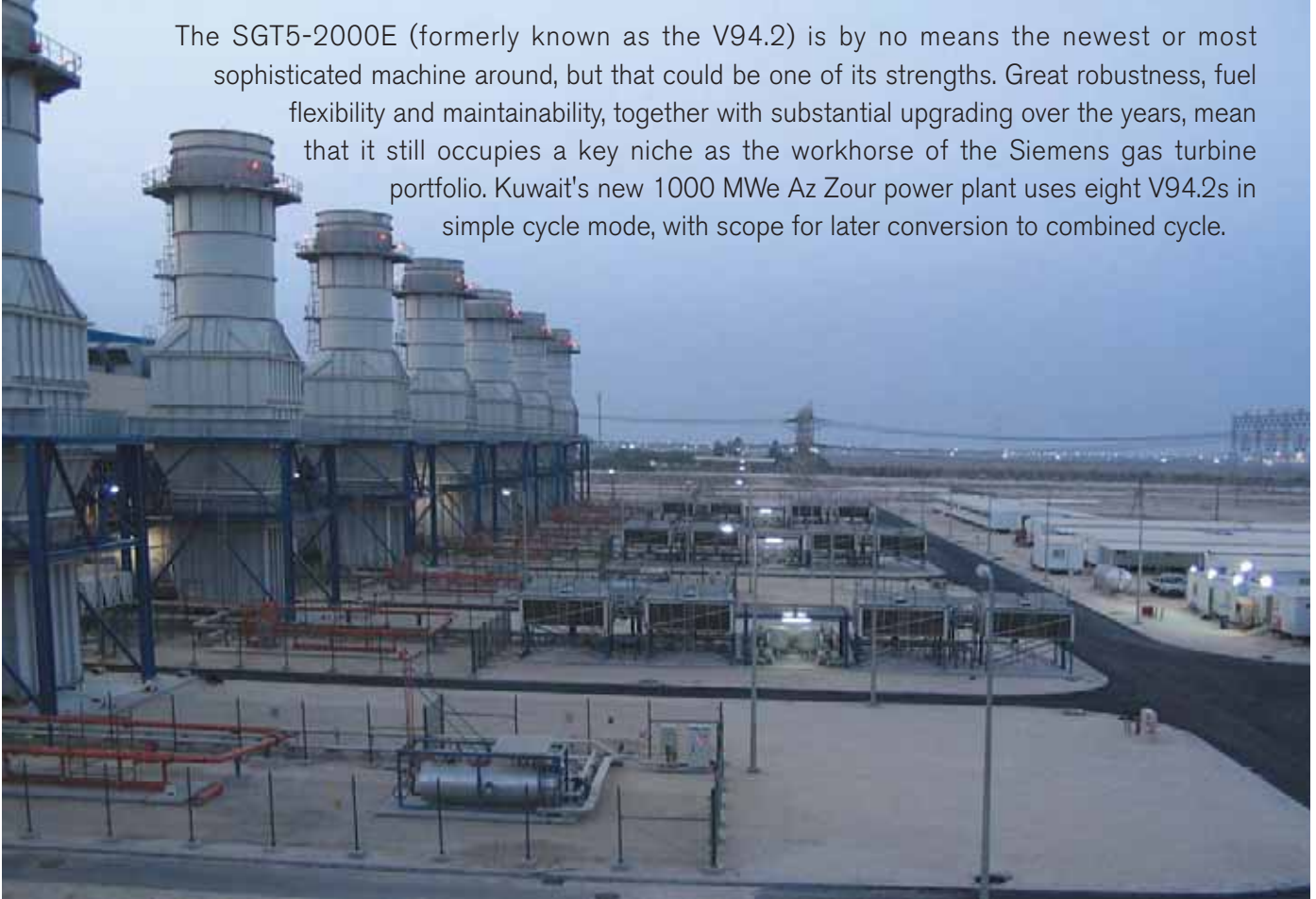
Power Generation

SIEMENS

Power Plants



Az Zour: 1 000 MWe of workhorse power help Kuwait beat the heat



The SGT5-2000E (formerly known as the V94.2) is by no means the newest or most sophisticated machine around, but that could be one of its strengths. Great robustness, fuel flexibility and maintainability, together with substantial upgrading over the years, mean that it still occupies a key niche as the workhorse of the Siemens gas turbine portfolio. Kuwait's new 1000 MWe Az Zour power plant uses eight V94.2s in simple cycle mode, with scope for later conversion to combined cycle.

Matthias Wink, *Siemens Power Generation, Offenbach, Germany*

Electrical supply has become a critical issue for Kuwait, in particular during the hot summer months when net capacity utilisation can exceed 95% due to air conditioning requirements. Power demand in summer is roughly three times the peak load demand during winter.

The growth in construction and support industries in Kuwait has contributed to a steady 5% annual growth rate in electricity demand in recent years, which is projected to continue. It is to meet this growth in demand that the Az Zour South gas turbine plant has been built for the Ministry of Energy.

The plant was officially opened by Federal Chancellor Gerhard Schröder on 28 February 2005 as part of his state visit to Kuwait. Installed as a turnkey project by Siemens Power Generation (with Alghanim

International acting as local partner), it is the first new Siemens power plant in Kuwait in nearly three decades. The owner's engineer and technical advisor is PB Power.

The Az Zour plant comprises eight Siemens Econopacs, each of which includes the gas turbine and generator, fin fan coolers for generator and oil cooling, plant control system, electrical equipment, air intake and filter house, exhaust diffuser and stack.

The design features of the plant have been carefully considered in an attempt to reach an optimum balance between capital cost, plant performance and operation and maintenance requirements. Plant exhaust emissions are minimised through the use of Siemens hybrid burners, which allow for operation on both gas and oil.

The eight gas turbines are located in a single 275 m long turbine hall, with capacity for later

conversion to combined cycle and have been designed to operate with dual-fuel firing by using both gas oil (with dry low-NO_x burners) as well as gas.

The Az Zour South Gas Turbine Project is located around 80 km south of Kuwait City within the premises of an existing oil fired thermal power station. The 1000 MW installed capacity of the new plant supplements the existing 2400 MW conventional thermal plant nearby.

The architecture of the power plant uses materials, textures and colours very carefully, reducing its visual impact and adapting it to the environment.

Local materials and methods of construction have been used wherever possible, thereby providing a link between the new plant and the existing architecture of the region.

Site planning has ensured that the opera-



tional areas are well separated from the residential and service facilities, while detailed attention to landscaping has further lessened the impact upon the environment.

The gas turbine units

The SGT5-2000E (formerly known as the V94.2) is a long-proven gas turbine over all load ranges - particularly peak load operation. The machine is of a robust design capable of burning a variety of fuels - from gas and/or liquid fuels of widely varying calorific values to treated heavy oil. The SGT5-2000E fleet consists of more than 140 units, with over 75 000 starts and a total of 6 900 000 operating hours.

Six years ago market requirements prompted an upgrade of the product, which has been rewarded by orders from both the modernisation and new build market. Consequently the SGT5-2000E remains a key member of the Siemens heavy duty gas turbine portfolio. Its most important features can be summarised as follows:

- 16-stage compressor, adjustable inlet guide vanes (IGVs), optionally fast-acting for grid frequency stabilisation;
- two large external silo-type combustors equipped with 2x8 hybrid burners for premix and diffusion mode operation with natural gas, fuel oil and special fuels, such as heavy oil and refinery residues;
- hot casings weld-fabricated from Ni-based material, designed with single shell for elbow-shaped mixing casings or double shell for inner casing;
- four-stage turbine with conventionally cast blading made of Ni-based material, stages 1 and 2 having conventional cooling providing fuel flexibility (including ash-forming fuels, that cannot be burnt when film-cooled blading is used);
- built-up disc rotor with a self-centring radial Hirth serrations and one central tie rod;
- two bearing design;
- generator drive at cold end;
- axial exhaust design;
- fast starting capability, a major advantage for peaking and black start applications;
- compressor and turbine blades and vanes exchangeable with rotor in place;
- high availability due to long maintenance intervals; and
- capability for hot-gas-path to be inspected without cover lift thanks to the walk-in combustion chambers.

I&C equipment

The Az Zour power plant has a central control



room equipped with a Teleperm XP process and control system.

The operating and monitoring of the Az Zour Power Plant is carried out via plant diagrams, which can be displayed by simply opening individual operation buttons on the computer screen.

The diagram element is a dynamic unit, which represents the current system status via changes in colour, form or position. More detailed information for the operator can be provided in the standard plant diagrams by clicking the operation buttons of individual objects.

The annunciation part is integrated into the operating and monitoring system. The current alarms and messages are indicated in the alarm sequence display.

Additionally a back-up mimic panel exists, where all crucial trip and alarm signals as well as important analogue indicators are shown.

The data exchange between the operations management level and the automation level is realized via a redundant data highway.

The operator terminals for Az Zour are connected to an overall multimedia bus and human-machine interface to the plant bus.

The SINEC H1 FO is a bus system for high data transmission data rates. The advantages of fibre optic cables over coaxial cables are higher availability, electrical isolation and insensitivity to electromagnetic interference.

The data exchange between the automation level and the process level is realised with process-bus lines. The L2 bus lines consist of fibre optic cables in order to avoid high voltage influences.

The process values of the single-cycle power plant are converted to analogue or binary transmitter signals at the process level. These signals are digitised in the input/output modules of the peripheral cabinets (ET200), which are installed around the plant rather than centrally. The input/output modules transmit the switching and positioning signals for controlling

the motors, actuators and servo drives.

The electrical concept

The gas turbine generators feed into the 132 kV and 275 kV grid via the unit transformers. Two generators each are connected via one three winding unit transformer. Four unit auxiliary transformers provide the plant auxiliary power supply from the generator leads to the 6.6 kV unit switchgear. Each unit auxiliary transformer supplies the auxiliary power for a pair of two gas turbines.

In the event of a grid failure, the 1600 kVA emergency diesel generator sets provide power to the most essential loads of the gas turbine generator sets.

The 6.6 kV switchgear via low voltage distribution transformers supplies the various 400 V AC switchgears.

Battery-backed 220 V DC systems are fed from the 400 V unit and common switchgear via rectifiers. Static converters are used in order to step the 220 V DC down to a 24 V DC voltage level for the control and instrumentation loads.

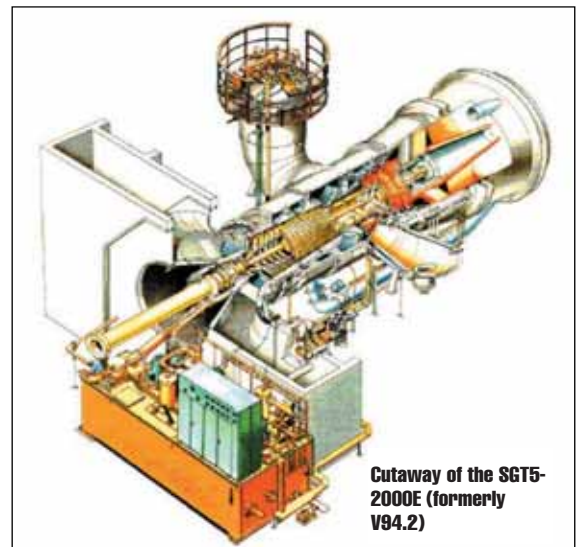
The gas turbines are started via start-up frequency converters, which accelerate the turbines by motoring the generators. During start-up and also during standstill periods of the entire power plant, the plant auxiliary power is supplied to the 6.6 kV unit switchgear via the 132kV (275 kV) grid via the unit and unit auxiliary transformers with the generator circuit breakers open.

Tight schedule

Timescales are always a key factor in any construction project. Az Zour South is no exception. With an already ambitious schedule of 16 months being reduced before the works had even started, the challenge of meeting the planned completion date was one that was met with a "will to win" attitude.

The tight time schedule called for considerable efforts to be made in terms of logistics: in January 2004, over 30 000 freight tons had to be brought ashore within two weeks and to be installed in the shortest possible time.

Four of the eight SGT5-2000E gas turbines were available for commercial operation to help meet the high summer demand of 2004, surpassing expectations.



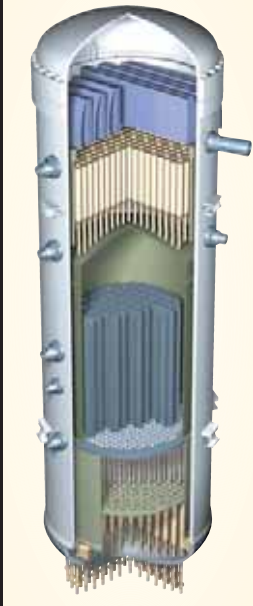
Cutaway of the SGT5-2000E (formerly V94.2)

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