

PORT REX AND ACACIA GAS TURBINE STATIONS

Port Rex and Acacia Gas Turbine Power Stations – “parcels of power”

Introduction

Port Rex and Acacia are gas turbine stations owned by Eskom and are part of Eskom’s Peaking Generation group of power stations. Port Rex is situated in East London and Acacia on the outskirts of the City of Cape Town. These two gas turbine stations are identical.

Port Rex

Despite the station being so small, Port Rex is critical for system voltage stability in the Eastern Cape, due to its location at the end of a long transmission line. Long transmission lines have the effect of causing phase changes between the voltage and the current being transported, hence the longer the lines, the more voltage instability occurs. Port Rex has the capability of regulating this voltage instability via an operating mode called synchronous condenser operation.

Acacia

Situated at the southern end of the Eskom National Grid, Acacia also operates predominantly in the synchronous condenser mode to regulate voltage. In addition, it provides an off-site electrical supply to Koeberg Nuclear Power Station as per the National Nuclear Regulator licensing requirement.

Modular industrial gas turbines, such as Port Rex and Acacia, produce up to 40 000 horsepower and are equipped to burn a variety of fuels, ranging from oil to gas. The advantage of the modular design compared to conventional gas turbine design is that routine and planned maintenance is done considerably faster, resulting in higher continuous availability.

Role:

- Improving the security of local power supply is not the only role played by Port Rex and Acacia power stations. The operating flexibility of the gas turbine generating sets, particularly their very rapid run-up capability, makes them ideal for meeting relatively short peaks in load demand. They are also useful as stand-by plant to supplement reserve generating capacity on the national system, and can be employed as synchronous condensers for voltage regulation.
- An important feature of these stations is their black-start capability. In the event of a catastrophic incident on the electricity system resulting in a loss of all generators, these stations can be used to re-energise the network due to their ability to re-start without power from the network.

Plant description:

Port Rex and Acacia each have three gas turbine generators, which are driven by engines similar to those of a Boeing 707 aircraft. They were commissioned in 1976. Each unit is capable of a base load output of 57,1 MW and a peak output of 60,8 MW at the design atmospheric condition. The peak load output can only be sustained for three hours. The total installed capacity of each station is 171MW.

The TP4 “Twin Pacs”, as the sets are called, consist of three primary units:

- the gas turbine unit
- the generation unit
- the control unit.

The turbine and generator units comprise two gas turbines/engines connected through self-shifting clutches to an electric generator with a through-drive connected brushless exciter. The control unit is located adjacent to the turbine/generator enclosure and contains all of the controls and instruments necessary to operate the generating plant.

Both the turbine-generator and control units are housed in all-weather painted steel enclosures which include heating, lighting and fire protection equipment. The air start equipment is also housed in similar modular units. The inlet silencers have an all-weather painted steel exterior while the exhaust stack has an aluminium exterior. The entire unit occupies approximately 48.9m x 12.2m of space with the turbine-generator module erected on a common 37.25m x 7.23m reinforced concrete pad.

Operation and performance:

- The units can be started by means of a signal from either the local or remote control centre.
- Sequencing is automatic and the units are synchronised to the system approximately 190 seconds after initiation of the start signal. The units are then driven to full load in 5 minutes if the “normal” loading rate is selected or in approximately 15 to 20 seconds if the “fast” loading rate is selected.
- The clutches between the free turbines and the generator facilitate single engine operation and also synchronous condenser operation.
- The stations are designed to be unmanned, i.e. they can be controlled from Eskom’s National Control Centre in Germiston, as well as Regional control in Bellville.
- The gas turbines run on kerosene and each unit consumes 5,7 litre/second at a base load of 57MW.
- Fuel is pumped to the site from bulk storage tanks through pipelines.
- The overall thermal efficiency of the unit is 28.8%.

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