Renewable energy: Hydroelectric power stations

Eskom provides 95% of South Africa's electricity and is among the largest producers of electricity in the world.

However, water resources are at a premium in the country and Eskom's two power stations on the Orange River are the only conventional hydroelectric schemes of significance in the country.

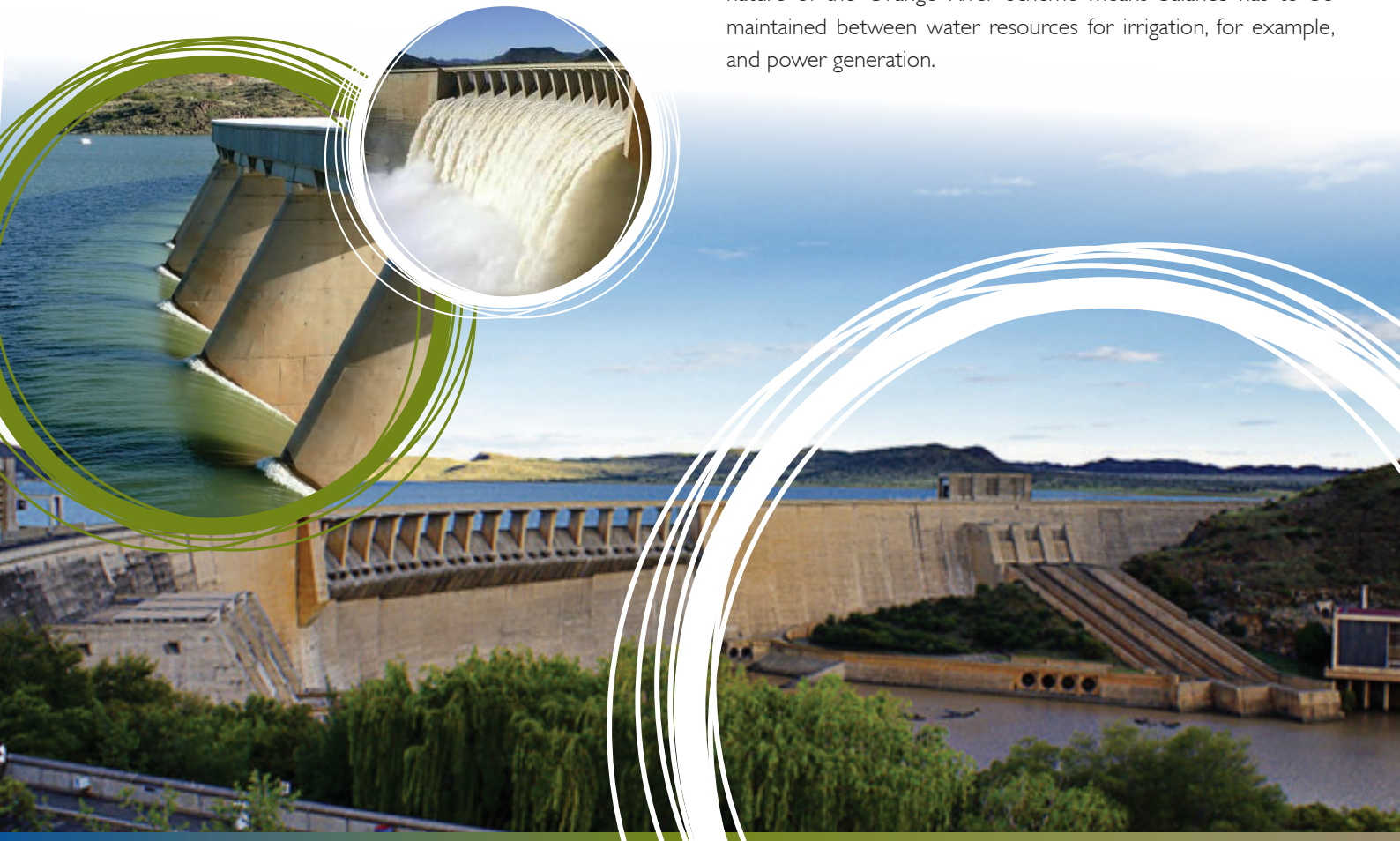
Gariep and Vanderkloof Power Stations are situated on the border of the Eastern Cape and Free State; and the Northern Cape provinces respectively; and built adjacent to the Gariep and Vanderkloof Dams in the country's summer rainfall region. Their electricity feeds into the Eskom national grid to supply power for peak and emergency demand periods, as well as base load energy when excess water poses a flood risk.

The Dams

The Gariep and Vanderkloof Dams, owned and operated by the Department of Water and Environmental Affairs (DW&EA), are the largest and second largest water reservoirs in South Africa, with Vanderkloof 130 km downstream of Gariep Dam. They, together with the Eskom hydro power stations, are integral components of the Orange River Water Scheme.

There is close liaison and cooperation between DW&EA and Eskom on these projects, with Eskom contributing to the cost of raising the walls of both Gariep and Vanderkloof Dams to substantially increase their hydro power potential.

The partnership cooperation agreement ensures provision is made for irrigation, urban water supplies, recreation and electricity generation in a water-scarce South Africa, as the multi-purpose nature of the Orange River Scheme means balance has to be maintained between water resources for irrigation, for example, and power generation.



Operation and maintenance of the Power Stations

First-rate operating and maintenance processes have resulted in decades of excellent plant performance. Proactive plans for current maintenance, future refurbishment and capacity upgrades, as well as a focus on long-term plant health, will ensure that these environmentally-friendly hydro plants continue to deliver electricity for decades to come.

Resource use

South Africa is affected by wet and dry climatic cycles. These affect the river flow to the dams, which in turn influences the availability of water to the power plant. Eskom and DW&EA have developed a sophisticated operating model, for both power generation and water supply, to ensure optimum management of this precious resource.

Set control curves are used to maximise electricity generation without violating the rights of downstream users. The stations produce base load energy during times of flood risk to prevent the dams from spilling water and to take advantage of the opportunity for low-cost energy production. The innovation of running a Gariep unit for one hour every three hours allows water release for downstream users, while deriving energy that would otherwise have been wasted.

Energy system benefits

The hydro power plants are peaking power stations and provide swift response to the needs of the South African energy market. Ancillary services are also provided, such as governing (frequency control) and synchronous condenser operation to control network stability and voltage. The units are able to come on-line within three minutes and can thus be relied upon for rapid reaction to emergency demand, contributing to grid stability.

Cost benefits and economic performance

The electricity produced by the Orange River hydro stations would otherwise have to be sourced from Eskom's thermal power stations, at double the cost.

Environmental aspects

Environmental aspects were carefully considered during the planning and construction phases of the power stations and these continue to be monitored during the operational phase. Ongoing management reviews ensure compliance with international, company and national legislative requirements and include water quality, erosion and social aspects of the sites' operations.

Both power stations are fully compliant with the ISO 14001 Standard for Environmental Management Systems and all relevant national environmental and water management legislative requirements. In line with international agreements, the South African government is committed to meeting 4% of estimated electricity demand by renewable energy resources, such as the Orange River hydros, by 2013.

The hydros displace a portion of electricity which would otherwise have to be generated by Eskom's fossil stations. The approximately 700 GWh generated annually by the hydros results in about 200 000 fewer kilograms of particulate matter being emitted into the air.

Safety

The safety of personnel, the public and plant is of paramount importance and a culture of safety awareness has been inculcated into every activity on these sites. Gariep and Vanderkloof comply with Eskom's stringent health and safety policies as well as the National Occupational Health and Safety Act. External and internal audits are carried out on an ongoing basis.

Technical Data

Dams	Gariep	Vanderkloof
Type	Double curvature concrete arch	Double curvature concrete arch
Maximum Height Above Foundations	90.5m	108m
Crest Length	947.9m	770m
Volume Excavation	2.1 million m3	2.43 million m3
Volume of Concrete Placed	1.73 million m3	1.116 million m3
Storage Volume	5 670 million m3	3 236 million m3

Power Stations	Gariep	Vanderkloof
Type	Surface	Underground
Number of Machines	4	2
Full Load Capacity Per Machine	90 MW	120 MW
Full Load Station Capacity	360 MW	240 MW
Hydraulic Turbine		
Type	Vertical Francis	Vertical Francis
Design Net Head	55 m	61 m
Rated Speed	136.4 rpm	125 rpm
Maximum Water Consumption	220 m^3/s	217 m^3/s
Runner Diameter	4.88 m	5.30 m
Runner Mass	53 tons	53.7 tons
Runner Material	Cast Stainless Steel	Cast Stainless Steel
Inlet Diameter of Spiral Casing	5.5 m	7.0 m
Generator		
Type	Umbrella	Umbrella
Rated Output	100 MVA at 0.9 Power Factor	133 MVA at 0.9 Power Factor
Rotor Diameter	8.9 m	9.5 m
Mass of Rotor	380 tons	436 tons
Nominal Voltage	13.2 kV	11 kV
Thrust-Bearing Load	9 MN	14 MN
Transformer voltage	13.2 kV/132 kV	11 kV/220 kV
Construction Commenced	December 1967	January 1973
Commissioning		
Set 1	September 1971	December 1976
Set 2	November 1971	February 1977
Set 3	January 1976	-
Set 4	February 1977	-