

Pumped Storage Schemes: Drakensberg and Palmiet

Water resources are at a premium in South Africa and the Drakensberg and Palmiet Pumped Storage Schemes play an unusual dual role in making optimum use of this scarce resource.

The two pumped storage schemes are joint ventures between Eskom and the Department of Water and Environmental Affairs (DW&EA). Not only do they generate hydroelectric peaking power for the Eskom national grid, their reversible pump/turbines are components of inter-catchment water transfers as well.

Both schemes have received several accolades, including the 2003 International Hydropower Association's (IHA) Blue Planet Prize for the Palmiet Pumped Storage Scheme. In particular, the scheme was noted for its contribution to the protection and management of the Cape Floral Kingdom, which includes the unique fynbos flora.

Conventional hydroelectric power stations

In conventional hydroelectric power stations, the potential energy of water stored in a dam or river is converted into electrical energy. Water is conveyed through waterways to hydro-turbines. The water flowing through the turbine runner spins the turbine shaft, thus driving the rotor to which it is coupled. The electricity generated is fed onto the transmission lines that link up with the electricity grid. Once the water has run through the turbines it is discharged back into the river below the power station to continue its course.

In countries where water resources are plentiful, hydroelectric power stations can be run continuously to provide 24-hour base load electricity. Electricity generated by conventional hydroelectric power stations is cheaper than that produced by coal-fired power stations. In addition, where the latter consume the coal used in electricity generation, the former do not consume water, but merely utilise its energy. Running costs are consequently much lower.



Hydroelectric power stations also have the advantage of being able to start up very quickly and are thus frequently used as peaking power stations. Their quick reaction time enables them to respond swiftly to sudden changes in consumer demand and emergencies. They also lend themselves to automation and can be operated by remote control. For example, the hydroelectric power stations on the Orange River are operated by remote control from Eskom's National Control Centre in Germiston.

However, because of South Africa's limited water resources and erratic rainfall it is not feasible to make greater use of conventional hydroelectricity.

Pumped storage power stations

In water-scarce areas, pumped storage schemes are used as an alternative to conventional hydroelectric power stations to provide the power needed during peak periods. Instead of the water being discharged, it is retained in the system and re-used.

A pumped storage scheme consists of lower and upper reservoirs with a power station/pumping plant between the two. During off-peak periods, when customer demand for electricity has decreased, the reversible pump/turbines use electricity from the national grid to pump water from the lower to the upper reservoir. During periods of emergency or peak demand, this water is allowed to run back into the lower reservoir through the turbines to generate electricity. In this way, the potential energy of water stored in the upper reservoir is released and converted into electricity when needed.



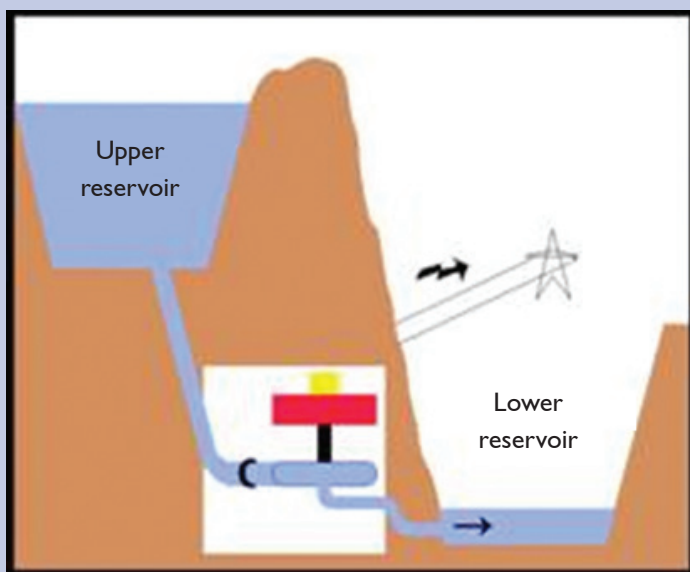
Because it is necessary to pump the water back after use, pumped storage power stations can only provide energy for limited periods of time. In addition they are more expensive to operate than conventional hydroelectric power stations because of the pumping costs.

These disadvantages are offset by their quick re-action to changes in electricity demand which play a major part in maintaining the stability of the Eskom national grid.

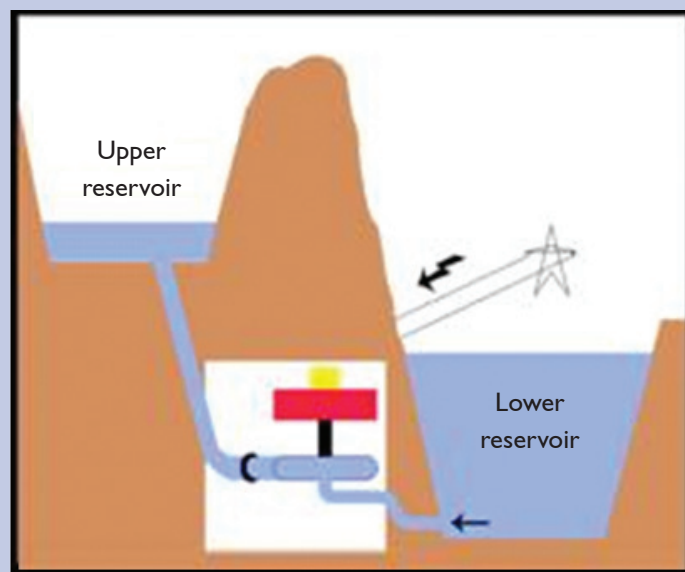
Hydroelectric and pumped storage, rather than coal-fired power stations, are preferred as 'peaking' power stations. They can be brought on-stream within three minutes, whereas coal-fired power stations require several hours from cold start before they can start generating power.

Pumped storage operation

Generation cycle



Pumping cycle



Inter-catchment water transfer

A water transfer scheme diverts water from one river system to another. It is undertaken when the potential use of water in one system is insufficiently developed or not required. In such cases the water would flow unused to the sea and in practical terms, be lost. Transferred to another river system however, this water can be used for irrigation, domestic and industrial water supplies and power generation.

Joint ventures between DW&EA and Eskom resulted in the construction and operation of the Drakensberg and Palmiet Pumped Storage Schemes. In both cases, the powerful pump/turbines installed in the power station are used to pump water up to an elevation from which it can be transferred into a different river catchment.

Eskom's pumped storage schemes

The Drakensberg Pumped Storage Scheme generates electricity during peak periods, but also functions as a pump station in the Thukela-Vaal Water Transfer Scheme. Water is pumped from the Thukela River, over the Drakensberg escarpment into the Wilge River, a tributary of the Vaal. The scheme was commissioned in 1982 and has a generating capability of 1 000 MW.

The Palmiet Pumped Storage Scheme, near Grabouw in the Western Cape, transfers water from the Palmiet River catchment into the Steenbras Dam to supplement Cape Town's water supply. The power station can generate 400 MW during peak demand periods and began commercial operation in 1988.



The Palmiet Pumped Storage Scheme and the environment

Palmiet Pumped Storage Scheme has consistently demonstrated Eskom's commitment to excellence in environmental disciplines. It was awarded the International Hydropower Association's (IHA) 2003 Blue Planet Prize, together with the Brazilian Salto Caxias Hydropower Plant.

The prize is awarded by IHA every two years, with evaluation support by UNESCO's International Hydrological Programme. Its aim is to increase awareness of hydropower's contribution to sustainable development and to promote good practice in the use of the world's hydropower resources.

The Prize recognises good practice and sound management in the development and operation of a hydropower scheme, on the basis of technical, economic, social and environmental criteria and excellence in one or more of these aspects.

The Palmiet Pumped Storage Scheme was found to demonstrate excellence in relation to all the above criteria and was praised for its contribution to the protection and management of the Cape Floral Kingdom, which includes the unique fynbos flora. Fynbos grows mainly on the mountains and plains of the southern and southwestern parts of the Western Cape. Almost 70% of fynbos plant species are not found naturally anywhere else on earth.





During the implementation phase, extraordinary procedures were applied to minimise the impact of the construction work.

The uniqueness and biodiversity of the Kogelberg – heart of the fynbos plant kingdom – was recognised in 1998 when UNESCO registered the area as a biosphere reserve under its MAB (Man and the Biosphere) Programme. Eskom was one of the signatories to the application for biosphere status submitted to UNESCO and is committed to upholding its objectives.

According to the IHA Blue Planet inspection team, the fact that the area, including that of the Palmiet scheme, has subsequently been designated as a UNESCO biosphere, the Kogelberg Biosphere

Reserve, is testament to the positive role hydropower can play even within environmentally sensitive zones.

Other environmental awards for Palmiet include:

- 1998: the award from the Environmental Planning Professions Inter-disciplinary Committee (EPPIC) for integrated environmental planning and management
- 1997: the Conserva Award from the South African Minister of Environmental Affairs and Tourism for outstanding achievement in effective conservation and sustainable utilisation of the environment to ensure a better quality of living for all South Africans

For further information on the Drakensberg and Palmiet Pumped Storage Schemes, consult our technical brochures available on the Eskom website – www.eskom.co.za

