Nuclear Energy: Koeberg Power Station

Nuclear energy currently provides approximately 16% of the world's electricity needs and has the potential to deliver clean, sustainable, economically competitive energy to complement coal-generated, hydro-electric and other forms of renewable energy.

Eskom's Koeberg Nuclear Power Station supplies about 5% of South Africa's total electricity needs and powers most of the Western Cape.

Construction of Koeberg began shortly after the contract with a French consortium was signed in 1976, and Koeberg has been generating electricity for more than 26 years. The power station is located 30km north of Cape Town to cater for increased demand for electricity due to the economic and industrial development of the surrounding area.

The reason for the choice of location is that the Duynefontein area, which houses Koeberg, is geologically stable, Eskom's national grid is easily accessible, and the cold water of the Atlantic Ocean is ideal for cooling. Koeberg also ensures that Cape Town is less dependent on the Mpumalanga power stations, which are 1 500 km away.

Koeberg showcases South Africa's successful history of nuclear operations. It is the only nuclear power station on the African continent and only one of three in the southern hemisphere. It has been operating since 1984 and holds the record for the longest continuous operating Eskom unit: 454 days without an interruption.

Eskom is a founder member of the World Association of Nuclear Operators (WANO), which sets standards for, and reviews nuclear utilities.

How is electricity generated by a nuclear power station?

A nuclear reactor is essentially a heat source. Heat is generated through the nuclear fission process, making use of uranium which is slightly enriched in the isotope uranium-235. The heat is transferred by the primary coolant (water in the case of Koeberg) to the steam generators where water from a secondary loop is turned into steam. This steam drives the turbine which is connected to a generator. The electrical generator then uses this rotational energy to generate electricity.

Koeberg operates on three separate water systems (primary, secondary and tertiary circuits), which work as the coolant, with seawater as the ultimate heat sink (tertiary circuit). The fact that the three systems are separate is important because it means that the water in the reactor, which is radioactive but is in a closed system, does not come into contact with the other two systems and therefore does not contaminate the water in these systems. The primary system is kept under pressure by a pressuriser to prevent boiling of the primary coolant, hence the name Pressurised Water Reactor (PWR).

Nuclear waste

Depending on its level of radioactivity, waste at a nuclear power station is divided into three types: low, intermediate and high level waste.

Low level waste contains low traces of radioactive contamination, and typically consists of day-to-day refuse, such as paper and plastics. At Koeberg, these items are compressed into sealed, clearly marked steel drums and stored on site until they are transported by road to the designated waste disposal site at Vaalputs. On average 500 steel drums and 100 concrete drums are shipped to Vaalputs every year. Vaalputs is the national nuclear waste disposal site for low and intermediate-level waste and is situated approximately 600km north of Cape Town.

Intermediate level waste consists of purification sludge, radioactive resins, spent filter cartridges and irradiated scrap metal pieces from normal maintenance work. It is mixed in a very specific way with a sand/cement mixture, poured into sealed and appropriately marked concrete drums, and then transported to the waste disposal site at Vaalputs.

Spent fuel is fuel that has been used in the fission process and contains high levels of radioactivity. The volume of spent fuel generated by Koeberg is small by industrial standards and must be housed safely so that it does not constitute a health risk to humanity. At Koeberg, the spent fuel assemblies are stored under water in storage racks with sufficient capacity to contain these assemblies formore than 30 years. Water cools the fuel assemblies and serves as an effective shield to protect workers in the fuel storage building from radiation. A limited number of fuel assemblies are also stored on site in dry storage casks.

Radiation starts decreasing immediately after the fission reaction has stopped and within approximately 10 years will have decreased by more than 95%. Spent fuel will either be sent to a reprocessing facility when uranium and plutonium extraction becomes economically viable, or it will be disposed of at an approved repository. Both options are currently available to Koeberg.

Vaalputs

Vaalputs, which is managed by NECSA (National Energy Corporation of South Africa), is currently the only disposal site for nuclear waste in South Africa and is situated in Namaqualand where annual evaporation exceeds annual rainfall, ensuring that even if radioactivity should escape, it could not contaminate ground water which may find its way to the surface. The waste is stored in trenches 10m deep and radiation at the surface is almost at natural levels and does not constitute a health hazard. However, for safety reasons, the site is fenced off, monitored, and access is restricted.

For more information on Eskom related topics see the Eskom website (www.eskom.co.za).
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