
# Nuclear energy: Koeberg Power Station

Nuclear energy currently provides approximately 13% of the world's electricity needs (IEA: World Energy Outlook 2011), delivering clean, sustainable and economically competitive energy to complement coal and gas, hydro and renewable energy generated electricity.

Eskom's Koeberg Nuclear Power Station supplies about 5% of South Africa's total electricity needs and approximately 50% of the electricity demand of the Western Cape.

Construction of Koeberg began shortly after the contract with a French consortium was signed in 1976, with the first of its two units starting commercial operation in April 1984. Koeberg has thus been generating electricity safely for more than 27 years. The power station is located approximately 30 km north of Cape Town.

In the 1960s, electricity planners identified the need to locate a power station in the Western Cape, one of the fast growing electricity demand centres, to reduce the regions dependence on the supply of electricity from coal-fired power stations in the Mpumalanga Province, 1 500 km away. The Duynefontein site, where Koeberg is located, was chosen for a variety of reasons, not least the ability to connect to the national transmission network and the availability of cold sea water for cooling the steam that drives the massive turbines.

Koeberg showcases South Africa's successful history of nuclear operations. It is the only commercial nuclear power station on the African continent and only one of four 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.

Koeberg operates under a Nuclear Installation Licence issued, and closely monitored by the National Nuclear Regulator. Eskom regularly invites independent international peer reviews of Koeberg's operations and management by organisations such as the World Association of Nuclear Operators (WANO) and the International Atomic Energy Agency.

## 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 and independent water systems (primary, secondary and tertiary circuits). 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 those 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). The secondary system is also closed. Water is pumped into the steam generator where it boils and forms steam, which then drives the turbines. Once the steam has driven the turbines it flows to the condensers where it is cooled and condensed back into water and then pumped back to the steam generator. The tertiary cooling system uses sea water to cool the steam that has driven the turbines and condense it back to water. Once it has cooled the steam, the sea water (now slightly warmer) is returned to the sea.

## 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.

Intermediate level waste consists of purification sludge, radioactive resins, spent filter cartridges and irradiated scrap metal pieces from normal maintenance work. It is mixed with a sand/cement mixture, poured into and solidifies in concrete drums, and then transported to the 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. Vaalputs is managed by the South African National Energy Corporation (Necsa) on behalf of the State.

Used fuel is fuel that has been used in the fission process and is highly of radioactive. The volume of spent fuel generated by Koeberg is small by industrial standards, but nevertheless and must be managed and handled safely so that it does not constitute a health risk to people or the environment. At Koeberg, the used fuel assemblies are stored under water in storage racks. Water cools the fuel assemblies and also 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.

Levels of radioactivity starts decreasing immediately after the fission reaction has stopped and within approximately 10 years will have decreased by more than 95%. Used fuel will either be sent to a reprocessing facility when uranium and plutonium extraction becomes economically viable, or it will be disposed of directly as high level waste at an approved repository. If the used fuel is reprocessed, a much smaller volume of high level radioactive waste must be disposed of in an approved facility.

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