
RINGHALS
– The largest Nordic power plant
Electricity – a vital
part of our daily lives

Electricity is to be found everywhere. Industries, hospitals and a lot else in our daily lives need a constant supply of electricity. At Ringhals, the largest Nordic nuclear power plant, we produce nearly 20 per cent of the electricity consumed in Sweden.

Ringhals is focusing on the future, on the environment as well as on a secure and reliable supply of energy for all consumers. This is why we are committed to continuous research and development. Ringhals also participates in the international exchange of information and experiences with other nuclear power plants. We have to meet exacting demands, but the question is whether we are not ourselves making the highest possible demands. For us it is of the utmost importance that our operations are always conducted in a secure and controlled way.

An important company in the region

In 2010 Ringhals produced app. 24 TWh. Ringhals is one of the few nuclear power plants in the world to operate both boiling water (BWR) and pressurized water (PWR) reactors. Ringhals is situated on Sweden's west coast, about 60 km south of Gothenburg, in the municipality of Varberg. The company is a member of the Vattenfall Group, one of Europe's largest energy corporations

Ringhals has an annual turnover of just over SEK 6 billion (approximately EURO 520 million) and employs 1,500 people.

We have accumulated a unique fund of competencies in the fields of electricity generation, technology and development. At the same time, Ringhals acts as an important player in the Varberg region, something that benefits a large number of firms here.

Ringhals invests for the future

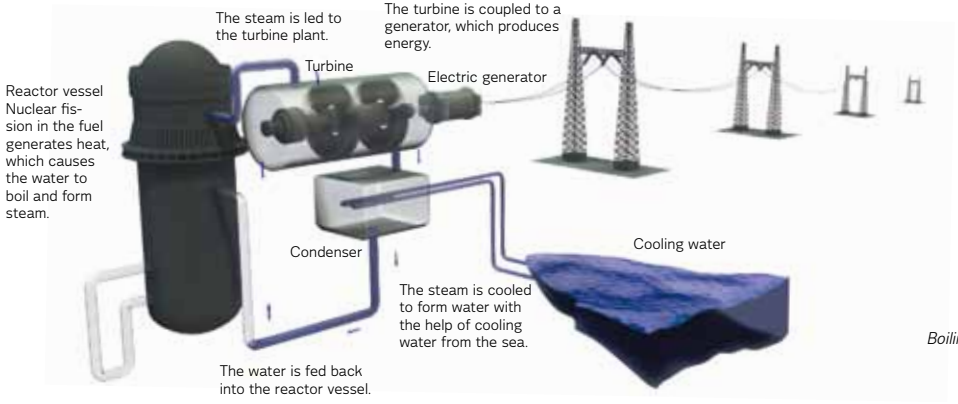
We will continue to consume large amounts of electricity also in the future. At Ringhals we are investing to ensure a safe and secure supply of electricity for many years to come. Nearly SEK 7 million (EURO 0.5 million) per day, or 2.5 billion per year up to 2015, will be invested to enable us to produce more electricity and meet our exacting demands and those of the community relating to safety, the environment and availability. We are introducing state-of-the-art technology in over 300 projects in our plants, for example, replacing turbines and generators and introducing new, advanced IT technology in our control systems. In order to manage our major investment programme, we intend to recruit many new employees during the years to come.

Focus on our employees

Our employees are our most important resource. At Ringhals people go hand in glove with technology. In order to manage the major investment programme that is now in full swing and, at the same time, maintain a high availability, it is important that all those employed here are satisfied with their jobs. Ringhals is working actively to become one of Sweden's healthiest companies. Both Ringhals and Vattenfall offer the employees a large number of benefits, ranging from holiday homes, discounts for aerobics centres to home PCs, cars and home services. Working at Ringhals gives the employees great opportunities to develop their skills and advance their careers. By being a part of the Vattenfall Group, one of Europe's leading energy companies with 38,000 employees and operations in the Nordic countries, Germany and Holland there are many career paths, both nationally and internationally.

Electricity generation process

The reactor vessel accommodates the fuel in the form of enriched uranium clad in metal tubes. The tubes are arranged in bundles placed in fuel assemblies. The reactor core comprises a large number of such fuel assemblies surrounded by water. When the uranium atoms are split, this releases large amounts of energy that heats the water circulating through the reactor system. In a reactor of BWR type the water is converted into steam, as its name indicates. The steam passes direct to the turbine plant and makes the turbines rotate. In a reactor of PWR type the pressure is so high that the water, despite its temperature of several hundred degrees, does not boil. The hot water is pumped through tubes in large heat exchangers, so-called steam generators, where the water, which has not been in contact with the reactor core, is converted into steam. After this, the process is similar to that of the BWR. The steam is led to the turbines, whose shaft is coupled to the generator for the production of electricity. From the turbines, the steam passes down through the condensers. Seawater is pumped through a large number of tubes in the condensers. When the steam meets the cold tubes, it is converted back again into water. Pumps then return the water to the reactor vessel and steam generators, respectively. Each year the process consumes 60–70 tonnes of uranium. During operation at full power, 170 m^3 of seawater per second pass through the plant.



Boiling water rector (BWR)

Safety at Ringhals

Safety efforts at Ringhals are intended to prevent malfunctions, counteract the development of a malfunction into a breakdown and alleviate the consequences of any possible breakdown. Despite the high standards laid down, things break and human beings make mistakes. Consequently, the installation has several safety systems to detect such faults. One example is the safety filters.
A nuclear power plant must be so designed that radioactive substances cannot escape in an uncontrollable manner. Even in the event of a major breakdown, the reactor containment must remain intact and the damaged core kept cooled and covered with water. There are several barriers to prevent the spread of radioactive material into the surroundings.

In order to cope with operational malfunctions and unforeseen events, the Ringhals operating staff undergo an extensive training program adapted to their duties and official requirements. Theoretical studies are alternated with know-how tests and training on simulators.

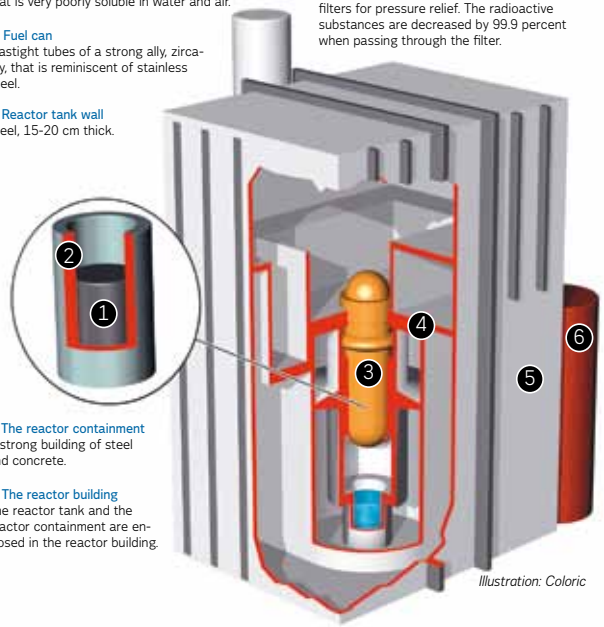
SSM – The Swedish Radiation Safety Authority supervises that the nuclear power plants are conducted in a safe manner by issuing regulations as well as following up on and checking nuclear safety related activities. SSM also ensures that personnel and the environment are exposed to as little radiation as possible.

Ringhals saftey system

1. Fuel
The uranium dioxide fuel is a chemical substance that is very poorly soluble in water and air.

2. Fuel can
Gastight tubes of a strong ally, zircaloy, that is reminiscent of stainless steel.

3. Reactor tank wall
Steel, 15-20 cm thick.



4. The reactor containment
A strong building of steel and concrete.

5. The reactor building
The reactor tank and the reactor containment are enclosed in the reactor building.

6. Safety filter
Ringhals reactors are fitted with saftey filters for pressure relief. The radioactive substances are decreased by 99.9 percent when passing through the filter.

Illustration: Coloric

Active environmental work

From the environmental point of view nuclear power is a good way to generate electricity. This applies to the complete process, from the mining of uranium ore to waste management. The Swedish nuclear power plants, for example, have extremely low emissions of greenhouse gases and environmental pollutants.

However, a nuclear power plant, which is a large industry, naturally impacts the environment in different ways. Nuclear power is consequently carefully monitored and must meet stringent environmental demands. At Ringhals we are continuously working on reducing the environmental impact of nuclear power. We want to create a good environment in our neighbourhood and live up to the demands of the authorities and the community. In our operations we take into account the safety and the environment in different ways. We use, for example, recycling and take care of waste products in an environmentally correct way. We select suppliers who also care for the environment and regularly assess and improve our safety and environmental work.

Priority is given to the environmental work at Ringhals, which is characterized by an approach where the total environmental impact of the operations is taken into account.

Electricity production at Ringhals has received a certified Environmental Product Declaration (EPD). The EPD is based on a life cycle analysis and openly reports the environmental impact of our electricity production.

History

1969: Construction of Ringhals on Värö peninsula starts. At the beginning of the 1970s Ringhals is one of Europe's biggest building sites, where a total of 2,700 people are working.

1975: On 1 May Ringhals 2 enters into commercial operation. This event is celebrated with a big inaugural ceremony. Ringhals 1 is commissioned on 1 January, **1976**.
1977: Ringhals 3 is ready for the start-up, but this is postponed due to the Nuclear Power Plant Act, which requires an agreement for the reprocessing and storage of spent nuclear fuel or the reporting of secure final storage of non-reprocessed fuel.
1979: An investigation shows that there exists suitable bedrock for the final storage of radioactive waste and on 27 March SKI recommends the start-up of Ringhals 3. The Harrisburg incident occurs on the following day. It is decided to hold a referendum on the nuclear power issue and also stated that no reactors are to be allowed to start up prior to the referendum.

1980: The referendum takes place on 23 March and the two YES alternatives receive 58.1 per cent of the votes and the NO alternative 38.6 per cent. Ringhals 3 is started up and synchronized to the grid on 7 September.
1984: All four units reach full power at the beginning of the year. Ringhals is now Sweden's largest power plant with its output of 3,380 MW.
1989: The steam generators of Ringhals 2 are replaced and its output is increased by 70 MW. The output of Ringhals 1 is raised from 730 to 750 MW in the following year.

1996: A record year for Ringhals. The total production amounts to 25.3 billion kWh, the highest annual figure since the start-up in 1976. The unit capability factor, i.e., the ability to generate electricity expressed as a percentage, is 90 per cent.

2002: Ringhals receives a certified EPD, which means that the company can report exactly the environmental impact of each produced kWh. An environmental assessment of the operations according to the new Environmental Code is started.
2004: Ringhals achieves its hitherto best production results: 28 TWh.
2008: Ringhals 3 and 4 achive their best year of operation of all time. Two billion invested in modern technology, even greater safety and better environmental performance.
2009: From analog to digital - installation of new control room and I&C equipment at Ringhals 2.

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Vattenfall

Vattenfall's vision is to create a strong and diversified European energy portfolio with sustainable and increased profits, significant growth options and will be among the leaders in developing environmentally sustainable energy production.
The geographic focus is our core markets Sweden, Germany and the Netherlands, the three main products are electricity, heat and gas.

Ringhals

Ringhals nuclear power plant is the largest power plant in Scandinavia. We are situated on the west coast of Sweden, 60 kilometres south of Gothenburg.
Ringhals has four reactors - three pressurised water reactors and one boiling water reactor. In a normal year, Ringhals generates some 28 billion kilowatt-hours of electricity. This is approximately one fifth of Sweden's total electrical energy consumption, sufficient to supply six cities the size of Gothenburg with electricity. The total power output is approximately 3701 MW. Ringhals AB has around 1,500 employees and an annual turnover of just over SEK 6 billion.

Barsebäck Kraft AB is a wholly-owned subsidiary of Ringhals AB, which in turn is owned by Vattenfall (70.4%) and E.ON (29.6%).

For more information please visit:

www.vattenfall.com/ringhals

Ringhals AB 432 85 Väröbacka
Tel 0340-66 70 00 Telefax 0340-66 51 84

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