Our environment 2016

2016 LOVIISA POWER PLANT

Join the change

fortum

40 years of carbon dioxide free electricity from Fortum's Loviisa power plant

In 2016, the power plant generated a total of 8.33 terawatt hours of power, corresponding to about 13% of the total energy generation in Finland.

For Fortum, excellence in safety is the foundation of our business and safe performance is a sign of professionalism. The safety condition of the power plant remained good, and both the production and equipment availability was on a very high level. We strive to be a safe workplace for our employees and for the contractors and service providers who work for us. We believe that all work injuries are preventable when competence and the right attitude prevails, when potential risks are addressed and when measures are taken to safeguard against them.

As a producer of clean energy, the Loviisa power plant and carbon-free nuclear power play a significant role in mitigating climate change. The greenhouse gas emissions during nuclear power's lifecycle are as low as those for wind, hydro and solar power. Electricity production at the Loviisa nuclear power plant results to approximately 6 million tonnes less carbon dioxide emissions in the atmosphere compared to the equivalent amount produced with fossil fuels. If the electricity generated by the Loviisa power plant over the course of its operating lifetime would have been generated in a coal condensing plant, about 230 million tonnes of carbon dioxide would have been released into the atmosphere.

In 2016 we stayed within all permit limits in terms of environmental impacts. Long-term development efforts to reduce the radiation doses workers are exposed to during annual outages have brought significant results. The collective radiation dose of personnel was record low in both units compared to years when the annual maintenance work was carried out to a similar extent.

Radiation safety

The collective radiation dose of the Loviisa power plant's personnel was record low compared to years when similar outages have taken place. As in previous years, the four-year moving average for radiation dose continued its downward curve. Replacing the seals on the primary circulation pumps to antimony-free seals has reduced radiation levels caused by antimony nuclides around the primary circuit. Long-term development efforts to lower the dosage of radiation workers during annual outages have produced significant results at both plant units.

Emissions of radioactive materials into the environment in 2016 were, as in previous years, significantly lower than the limits set for nuclear power plant emissions. Based on emissions and meteorological data, the estimated radiation dosage to the surrounding population was about 0.2% of the set dosage limit and about one ten-thousandth of the normal annual radiation dosage Finns are exposed to for other reasons.

The radiation monitoring programme carried out in the surroundings of the power plant occasionally detected radionuclides originating from the plant, but the concentrations detected were very small. Radioactive substances from the power plant's emissions appeared mainly in the indicator organisms in the marine environment and in samples of materials and sludge from sediment at the bottom of the sea.

Waste management

Waste management at the Loviisa power plant is comprised of two separate areas: waste management for the non-controlled area and waste management for the controlled area. All waste generated in the controlled area is treated as radioactive. Waste generated outside the controlled area can be treated as waste from a conventional industrial plant.

The goal of conventional waste management is to prevent the production of waste and to reduce the amount of landfill waste through effective sorting.

In 2016, a total of 730 tonnes of waste was transported out from the power plant area. Of this, 10% was landfilled, 82% was recycled and the remaining 8% was treated as hazardous waste.

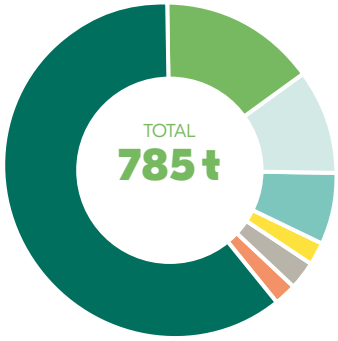
In February, the solidification plant for liquid radioactive waste started its full operation - a significant step forward in the power plant's waste management.

Waste generated in the controlled area is divided into three categories: Low-level waste (maintenance waste), intermediate-level waste (liquid waste), and high-level waste (spent fuel). Maintenance waste is either cleared as non-active and treated as conventional waste, or disposed of in the final repository located in a depth of 110 metres in the power plant area. Liquid waste is treated and conducted into the sea or stored and solidified in concrete. Spent fuel is stored to await final disposal at Posiva Oy's facilities in Olkiluoto, Eurajoki.

Environmental balance sheet 2016

The environmental work of the Loviisa power plant is managed according to an ISO 14001 certified environmental management system.

Total amount of waste handled at the Loviisa power plant in 2016



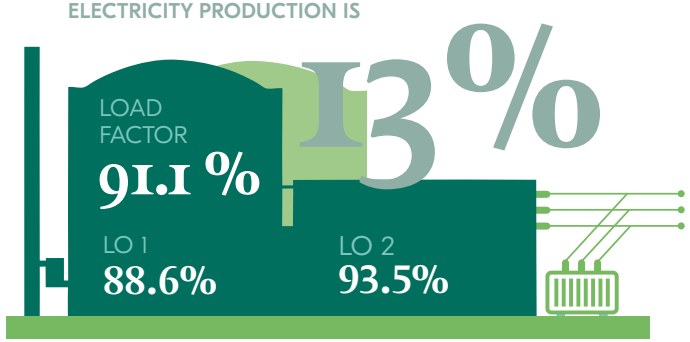
- **Waste to recycling 76%**
- - as material (of which 75% metal) 61%
- - as energy 15%
- **Waste to landfill 10%**
- **Hazardous waste 7%**
- **Radioactive maintenance waste to final repository 2%**
- **Radioactive liquid waste for solidification 3%**
- **Spent fuel 2%**

The annual waste intake depends on the length of the annual outage and particularly the deconstruction works carried out during that time.

Emissions into air	2016	2015	Permitted annual emissions
Noble gases, TBq (Kr-87 equivalent)	5.6	5.9	14 000
Iodine, TBq (I-131 equivalent)	0,000001	0,000005	0.22

Emissions into water	2016	2015	Permitted annual emissions
Cooling water, million m^3	1 340	1 403	1 800
Thermal load into the sea, TJ	56 210	57 879	60 000
Tritium, TBq	13.4	16.4	150
Other radioactive nuclides, TBq	0.0001	0.0001	0.89

LOVIISA NUCLEAR POWER PLANT'S SHARE OF FINLAND'S TOTAL ELECTRICITY PRODUCTION IS



IN 2016, LOVIISA NUCLEAR POWER PLANT GENERATED

8.33 TWh ELECTRICITY

without carbon dioxide emissions

THE AMOUNT OF ELECTRICITY GENERATED AT THE LOVIISA POWER PLANT IS ALMOST EQUIVALENT TO THE TOTAL ELECTRICITY CONSUMPTION OF THE CITIES OF HELSINKI, ESPOO AND VANTAA.

Annual load caused by domestic water	2016	2015
Biological oxygen demand, kg	118	90
Chemical oxygen demand, kg	319	313
Phosphorus, kg	5.4	3.1
Nitrogen, kg	1 021	894
Solids, kg	451	290
Domestic water volume, m^3	23 155	19 189

Annual load caused by process waste water	2016	2015
Phosphorus, kg	2.1	1.7
Nitrogen, kg	96	103
Solid matter, kg	64	59
Process waste water amount, m^3	71 387	40 097

Occupational safety

OCCUPATIONAL INCIDENTS

Loviisa power plant, own personnal

2016 1 incident 2015 0 incident

Loviisa power plant, external personnel

2016 4 incidents 2015 5 incidents

Observation reports

2016 502 2015 402

The power plant makes use of an observation report procedure, collecting information to be used at the power plant and for safety-related statistics. Accident reports are also made for "near miss" incidents and possibly hazardous incidents.

Personnel

Temporary employees 8

Technical support 170

Permanent contractors approx. 100

Annual outage approx. 950

Cooling water

The power plant's most significant environmental impact is the thermal load on the sea caused by the cooling water, which heats up by about 10 degrees as it passes through the plant. The highest temperature of the cooling water discharged into the sea was 31.6 °C in the summer and the limits set for the temperature were not exceeded.

In practice, 2/3 of the thermal energy produced by the reactor ends up in the sea with the cooling water. According to temperature measurements, the discharged water raises the temperature of the sea water during the growing season by about 1-2.5 degrees within a 1-2 kilometre range from the discharge point.

The cooling water discharge area remains unfrozen throughout the winter. The size of the open water and thin ice area depends on winter temperatures.

In 2016 the power plant used a total of about 1,377 million m^3 of sea water for cooling, and the thermal load on the sea totalled 56,741 TJ. In accordance with the environmental permit, the amount of cooling water should not exceed 1,800 million m^3 or 56 m^3/s. The amount of thermal load on to the sea may not exceed 60 000 J annually. The limits set by the permit were not exceeded.

Wastewater

The domestic wastewater generated is treated at the power plant area's biological-chemical wastewater treatment plant, to which about 23,155 m^3 of wastewater was piped in 2016.

In accordance with the environmental permit, domestic wastewater must be treated so that the biological oxygen demand (BOD7atu) of wastewater discharged into the sea does not exceed 15 mg/l and total phosphorus concentration 0.7 mg/l as annual averages. The efficiency of the treatment process must be at least 90% for both variables.

According to the monitoring results, the treatment plant reached results compliant with the conditions of the permit: the biological oxygen demand of treated wastewater was 5 mg/l on average and total phosphorus concentration 0.2 mg/l in 2016.

The environmental permit of the power plant does not set any limits for the process wastewater load. However, the nutrient load caused by the process wastewater is monitored through samples taken in accordance with the monitoring programme. The load caused by process wastewater in 2016 was 2.1 kg of phosphorus, 96 kg of nitrogen and 64 kg of solids.

Service water

The process and domestic water required by the power plant is sourced from Lake Lappominjärvi, which is located about 5 kilometres north of the power plant.

The water is purified before use at the water plant and the water used as process water is additionally treated at the demineralisation plant.

In 2016 the total volume of water withdrawn from Lake Lappominjärvi was about 181,067 m^3. According to the service water withdrawal permit, the power plant can withdraw up to 180 m^3/h of water from the lake for a short period of time and a maximum of 150 m^3/h per quarter.

Environmental incidents

No permit limits were exceeded at the Loviisa power plant in 2016, nor were there any breaches of permit conditions.

A total of 6 chemical and oil leaks were reported. One of the incidents was the breakdown of a sweeping machine for outdoor maintenance, from which a small amount of hydraulic oil leaked into the pavement. Another incident was when a few litres of sodium hydroxide poured into the yard when the chemical tank was filled with a tank truck hose. The other leaks consisted of refrigerant leaks from air conditioning systems as a result of various equipment malfunctions. All the leaks were less than 100 litres in volume.

The most important task of our nuclear power operations is to produce electricity safely, reliably and competitively, in the short term and long term, while complying with the principles of nuclear and radiation safety, waste management safety, and nuclear material control.

Our operations are based on a high-level safety culture and quality and on continuous improvement.

Our own world-class expertise is a prerequisite for safety and competitiveness.

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