

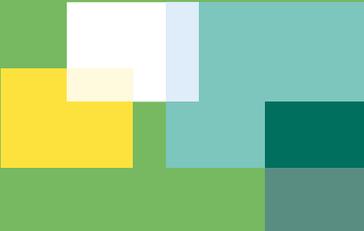


Our environment

2018 Loviisa power plant

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Loviisa power plant – producer of clean energy

In 2018, the Loviisa power plant generated a total of 7.79 TWh (net) of carbon-free power, corresponding to more than ten per cent of the energy generation in Finland. 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 over nuclear power's lifecycle are equivalent to those of wind, hydro and solar power.

As a result of the Loviisa nuclear power plant's electricity production, Finland emits about 6 million tonnes less carbon dioxide emissions compared to the equivalent amount of fossil fuel-based electricity.

The safety condition of the power

plant remained good, and both the production and equipment availability was at a very high level. Excellence in plant safety is an absolute prerequisite of safe and efficient operations for employees and the environment, and it is a sign of professionalism.

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.

In 2018 we stayed within all permit limits in terms of environmental impacts.

Radiation safety

The annual collective radiation dose of the Loviisa power plant's personnel was higher than the previous year due to the significantly longer annual outages. However, the cumulated dose during the outage period was significantly lower than in previous, similar outage periods. This shows, that long-term development efforts to lower the dose to radiation workers have produced good results.

One example of the measures taken to lower the radiation levels near the primary circuit is a project that started in the beginning of 2010 to replace the sealing material of the main circulation pumps.

Emissions of radioactive effluents into the environment in 2018 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 dose to the surrounding population was about 0.2% of the set dose limit. Regarding environmental radiation safety, it can be noted also for 2018 that the radiation dose to the surrounding population from radioactive substances originating from the Loviisa power plant accounted for only a minor increase compared to the radioactive dose from other sources.

The radiation monitoring programme carried out in the power plant surroundings 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 sedimented materials, sediments and sludge from 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 2018, a total of 879 tonnes of waste was transported from the power plant area. Of this, 14% was landfilled, 75% was reused as materials or energy

and 11% was treated as hazardous waste.

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. Thanks to efficient sorting and packaging, the amount of maintenance waste for final disposal in 2018 was at a record low. Liquid waste is purified and conducted into the sea or stored and solidified in concrete. Spent fuel is stored to await final disposal in Eurajoki.

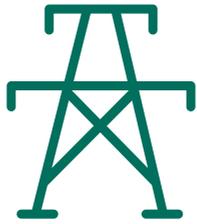
Environmental balance sheet 2018

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

IN 2018, LOVIISA NUCLEAR POWER PLANT GENERATED

7.8 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 Helsinki, Espoo and Vantaa.



Load factor

88.4%

Loviisa 1
90.9%

Loviisa 2
85.9%

Occupational safety

OCCUPATIONAL INCIDENTS

Loviisa power plant, own personnel

2018 **0** 2017 **1**



Loviisa power plant, external personnel

2018 **4** 2017 **5**

Observation reports

2018 **1052** 2017 **665**

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.

Emissions into air

	2018	2017	Permitted annual emissions
Noble gases, TBq (Kr-87 equivalent)	4.7	4.8	14 000
Iodine, TBq (I-131 equivalent)	0.000004	0.000001	0.22

Emissions into water

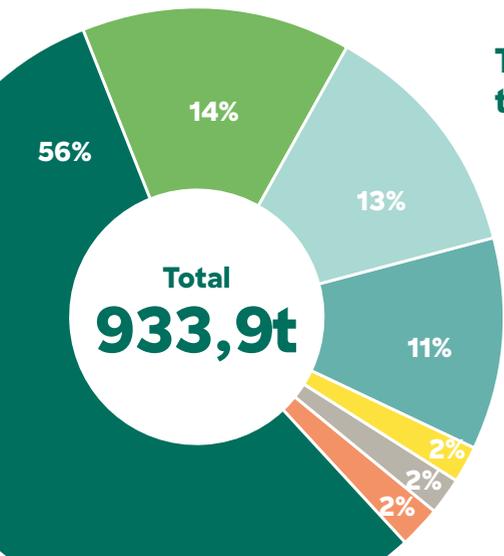
	2018	2017	Permitted annual emissions
Cooling water, million m ³	1 304	1 372	1 800
Thermal load into the sea, TJ	54 916	57 651	60 000
Tritium, TBq	15.2	14.7	150
Other radioactive nuclides, TBq	0.000159	0.00164	0.89

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

>10%

Total amount of waste handled at the Loviisa power plant in 2018

- as material
- as energy
- Waste to recycling **70%**
- Waste to landfill
- Hazardous waste (e.g. chemicals and solvents)
- Radioactive maintenance waste (to final repository)
- Radioactive liquid waste for solidification
- Spent fuel



Personnel

Own personnel

84%

16%

Men

424

Women

82

= 506 temporary employees **17**

External personnel

Technical support in Espoo **170**

Permanent contractors approx. **100**

Summer workers **73**

During annual outages approx. **1100**

Annual load caused by domestic water

	2018	2017
Biological oxygen demand, kg	91	174
Chemical oxygen demand, kg	300	580
Phosphorus, kg	4.5	9.3
Nitrogen, kg	1 018	1 164
Solids, kg	242	505
Domestic water volume, m ³	17 658	25 835

Annual load caused by process waste water

	2018	2017
Phosphorus, kg	2.8	9.9
Nitrogen, kg	188	1 796
Solid matter, kg	0.07	68
Process waste water amount, m ³	164 206	164 590

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. In practice, two-thirds 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.

Summer 2018 was exceptionally warm throughout Finland, and the temperature of the seawater on the northern coast of the Gulf of Finland was elevated. These conditions prompted measures at the Loviisa power plant to keep the temperature of the cooling water discharged into the sea within the environmental permit conditions.

The temperature of the cooling water discharged into the sea continuously exceeded +32 °C for a period of just under two weeks in summer 2018. Because of this, the plant drafted a separate report about the impacts that exceeding the temperature limit have on the status of the sea area. The

report was submitted to the environmental authority in line with the permit conditions. However, the hourly average of the cooling water didn't exceed the maximum limit of +34 °C set by the permit, so the Loviisa plant remained within the limits of the permit conditions also in 2018. Since exceeding the temperature limit was short in duration and the thermal impact caused by it was local, exceeding the temperature limit is estimated to not have significant adverse impacts on the status of the sea area.

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 2018, the power plant used a total of about 1,304 million m³ of sea water for cooling, and the thermal load on the sea totalled 54,916 terajoules.

In accordance with the environmental permit, the amount of cooling water released into the sea should not exceed 1,800 million m³ per year or 56 m³/s. The cooling water's thermal load on the sea may not exceed 60 000 terajoules annually. The limits set by the permit were not exceeded in 2018.

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.

The total volume of water withdrawn from Lake Lappominjärvi in 2018 was about 179,100 m³. According to the service water withdrawal permit, the power plant can withdraw up to 180 m³/h of water from the lake for a short period of time and a maximum of 150 m³/h per quarter.

Wastewater

The domestic wastewater generated is treated at the power plant area's biological-chemical wastewater treatment plant, to which about 17,658 m³ of wastewater was piped in 2018.

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 the total phosphorus concentration does not exceed 0.7 mg/l, calculated 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 per-

mit: the biological oxygen demand of treated wastewater in 2018 was 5.13 mg/l on average and total phosphorus concentration 0.26 mg/l.

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 2018 was 2.8 kg of phosphorus, 188 kg of nitrogen and 0.07 kg of solids. In 2018, the power plant's share of the total load in the Hästholmen sea area was 1% phosphorus and 6% nitrogen.

Environmental incidents

No permit limits were exceeded at the Loviisa power plant in 2018 nor were there any breaches of permit conditions.

A total of two chemical and oil leaks were reported. One of the incidents was an overflow of the wastewater tank caused by a leaking toilet in the office space of the power plant's final repository. This resulted in a small amount of wastewater ending up in the sea through a

floor drain.

The second incident was related to a leak in the oil bearing of a feedwater pump and resulted in a small amount of oil being discharged into the sea, bypassing the oil trap well.

The other leaks consisted of refrigerant leaks from air conditioning systems (a total of 97 kg) as a result of various equipment malfunctions. All the leaks were less than 100 litres/kg 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. Nuclear Services business is built upon this strong competence base, and our customers are in the centre of the solutions we provide.