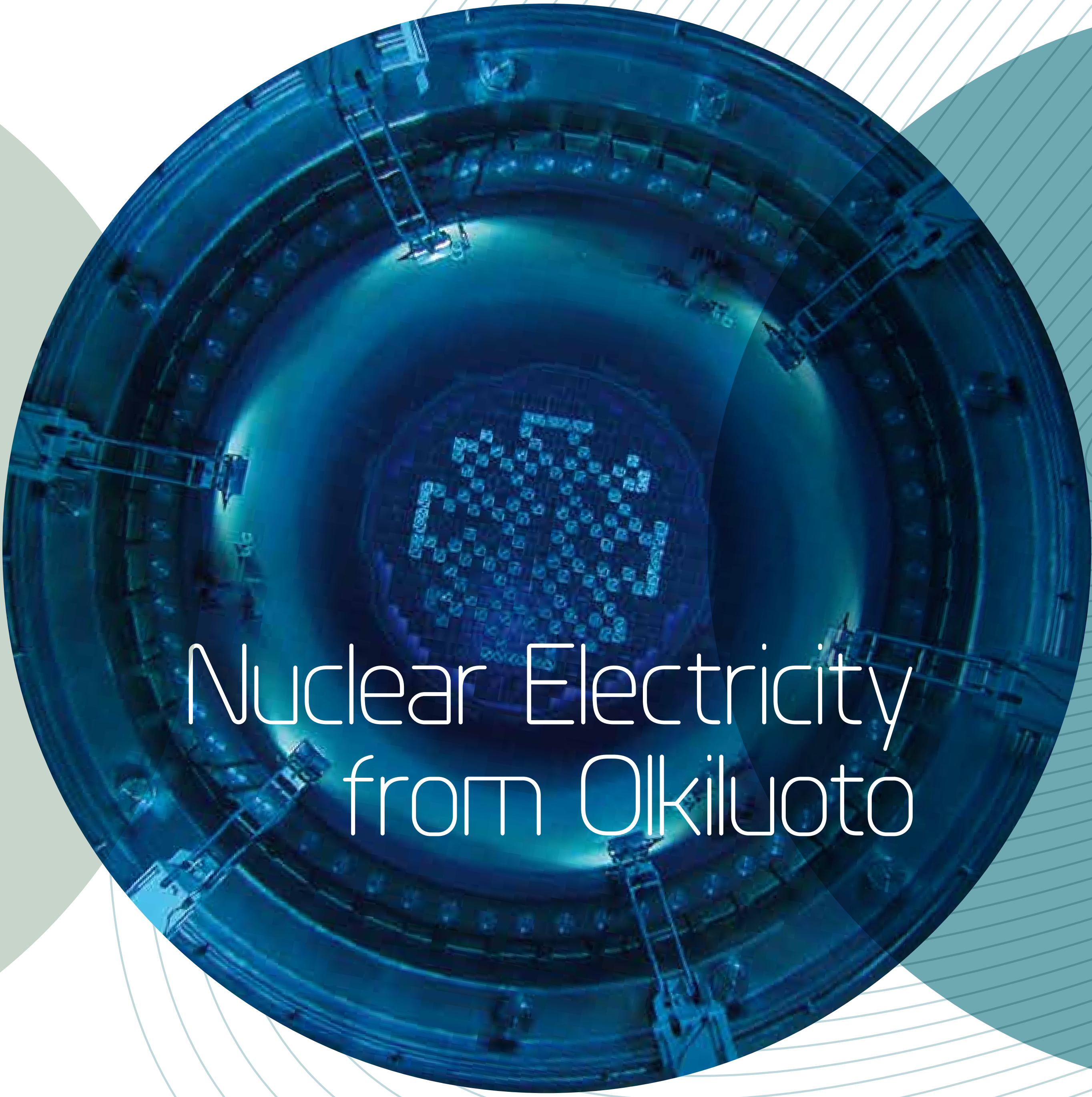
TVO



Nuclear Electricity from Olkiluoto

Teollisuuden Voima Oyj – Well-being with nuclear electricity

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Finland needs climate-friendly electricity

Electricity is a vital element of society. Most daily human activities, industrial production, and actually the entire operation of society relies on electricity.

Finland consumes 80–90 terawatt hours (TWh) of electricity per year, of which 25% is consumed by forest industry and 25% by other industries. The remaining 50% is divided up between housing, agriculture, services and construction. Forecasts say that electricity consumption will increase over the next few decades. Many functions which were previously based on fossil fuels are replaced with electricity due to, among other things, stricter carbon and sulphur dioxide emission requirements. It is important to be able to produce electricity in Finland in a reliable and competitive manner, with no unnecessary carbon dioxide emissions to the environment.

Finland's main sources of electricity production are nuclear power, hydropower, coal, natural gas, wood fuels and peat. Nuclear power amounts to about 30% (2011) of Finnish electricity production.

Nuclear power does not contribute to the greenhouse effect

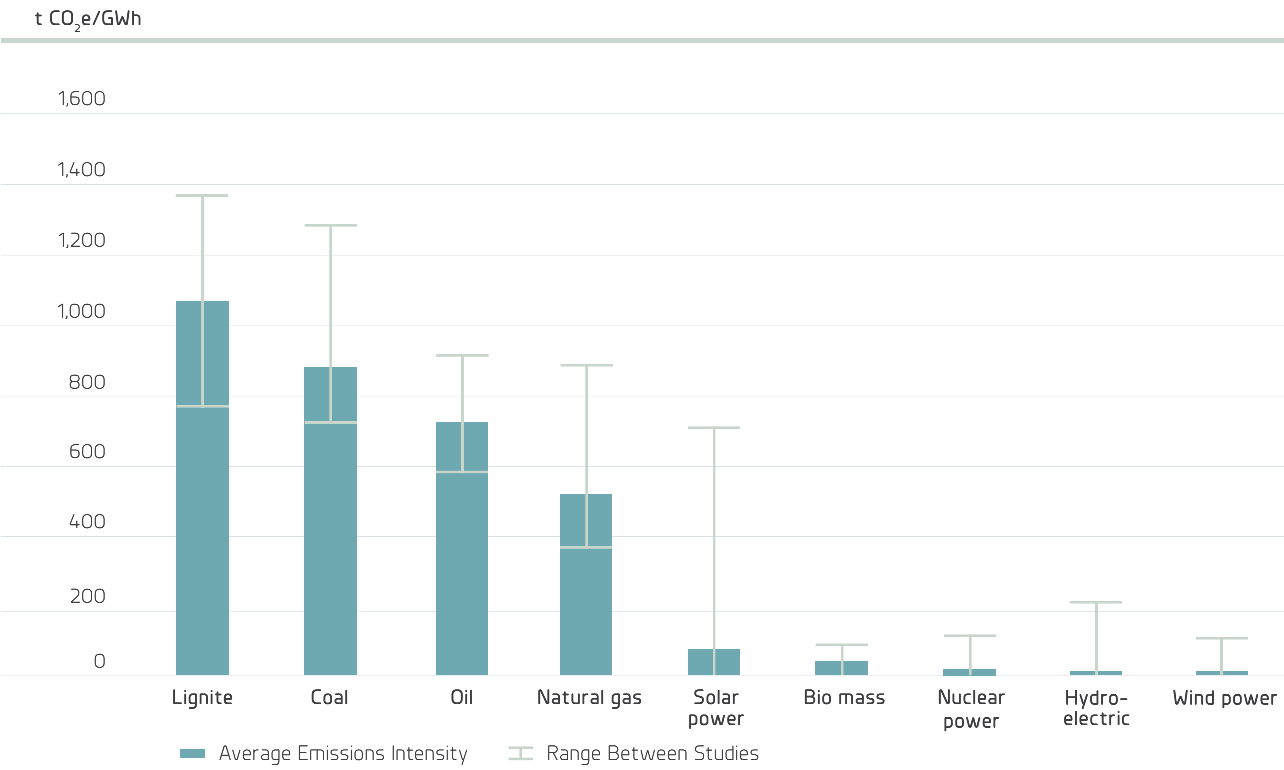
Energy production causes about 25% of Finland's annual greenhouse gases. Carbon dioxide emissions are increased by the combustion of coal, oil and natural gas, to mention a few. Wind, nuclear, hydro and solar power cause the least emissions during their life cycle.

Nuclear power-based electricity does not contribute to the greenhouse effect and does not emit particles that would increase acidification or decrease the quality of air. In Finland, the most extensive environmental impact of nuclear power plants is that the sea water warms up by a few degrees in the vicinity of the power plants.

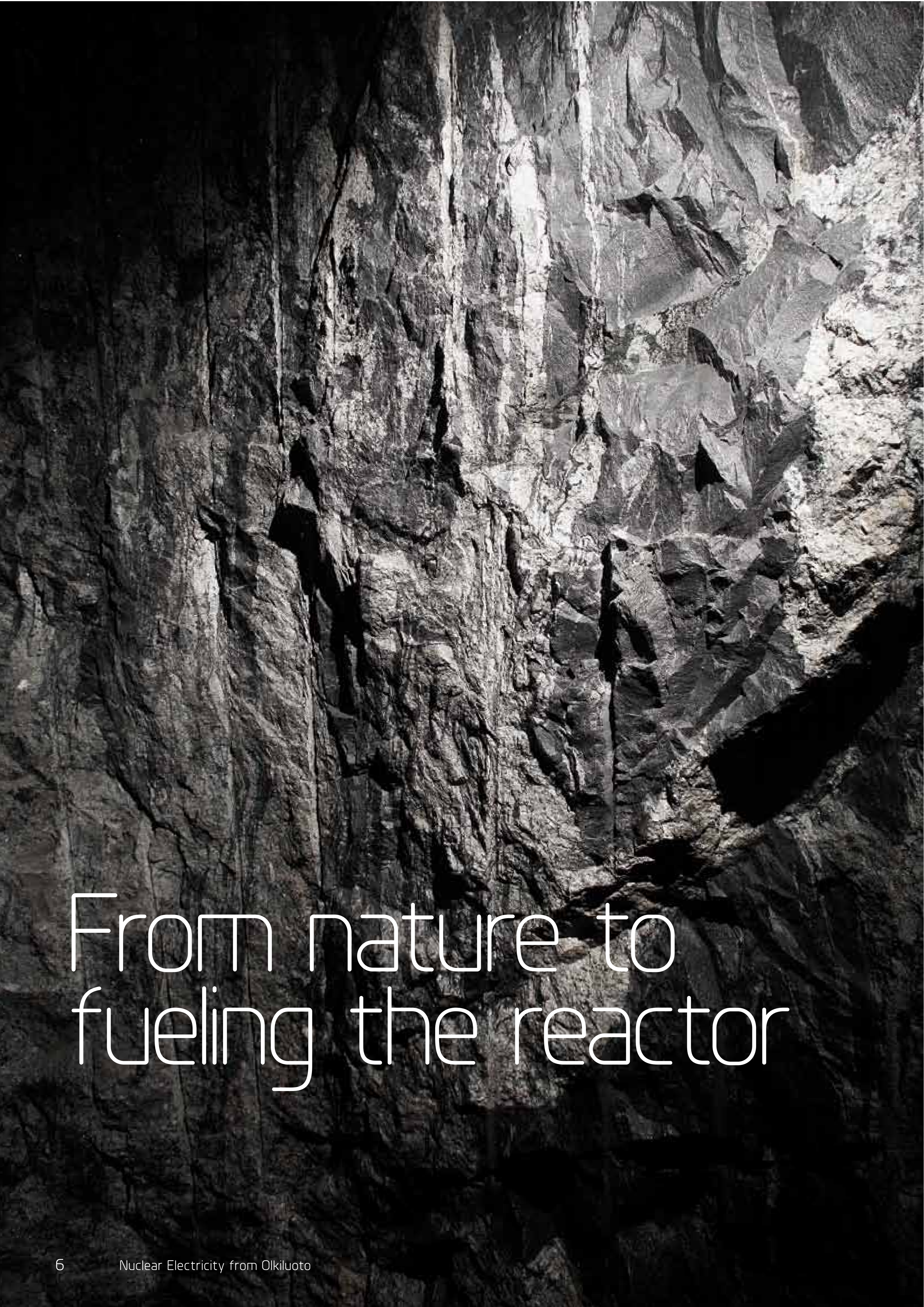
The goals: self-sufficiency, low emissions and reliable delivery

Currently, a critical factor of Finnish energy supply is its reliance on electricity imported from abroad. Finnish society is also dependent on having a sufficient amount of electricity available at all times and in all conditions. Finland's national goal is to produce electricity self-sufficiently in the winter's peak demand situation. Another goal is to adopt a low-emission society where greenhouse gas emissions will be decreased by 80% from the level of 2007 by 2050. Nuclear electricity is pivotal in meeting these goals, which is why TVO is involved in realising the goals by investing in the future of nuclear power.

GREENHOUSE GAS EMISSIONS



Source: World Nuclear Association, gathered from studies of independent research institutes.



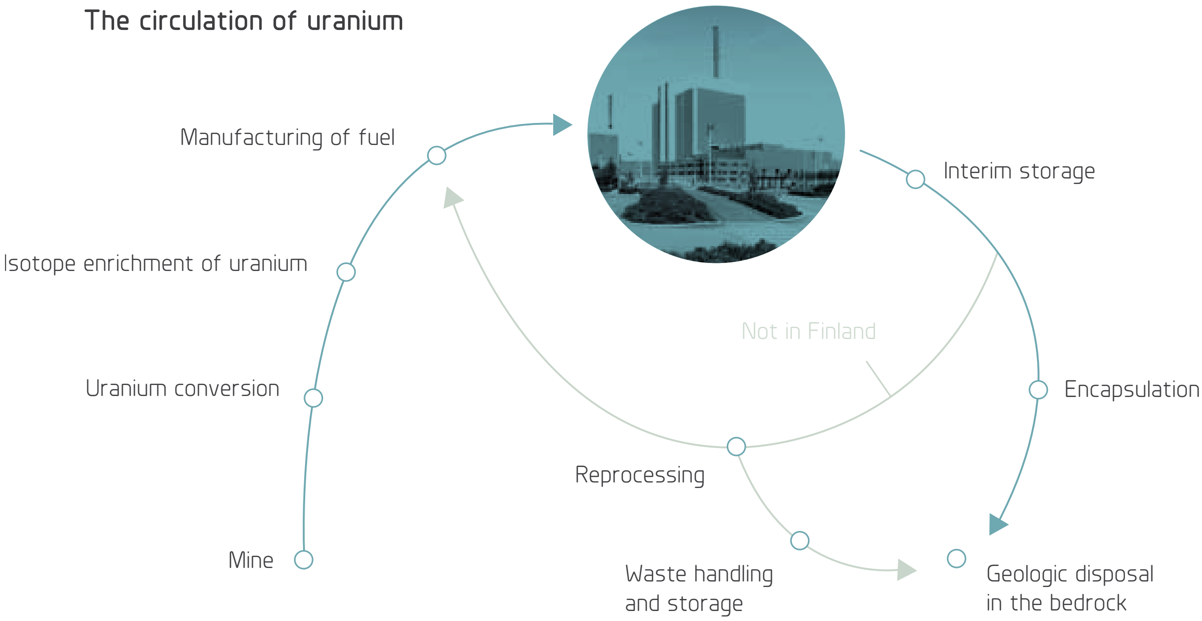
From nature to fueling the reactor

The fuel in nuclear power plants is made of uranium. Uranium (U) is a slightly radioactive, common element, which has a low radiation level in its natural form. The earth's crust has an average of about four grams of uranium per ton. The uranium found in the nature is mainly in a form of U-238 isotope.

TVO's plant units Olkiluoto 1 and Olkiluoto 2 annually need a total of about 40 tons of low-enriched uranium for fuel. TVO obtains its fuel through a decentralised supply chain and there are several suppliers for each stage of the chain. TVO has long-term contracts with leading uranium suppliers which TVO monitors and assesses on a continuous basis. Uranium is only acquired from suppliers who meet the strict requirements specified by TVO.

Leading uranium suppliers have mining operations in many countries. Kazakhstan, Canada, Australia and Namibia are the states that produce the largest amount of uranium.

The circulation of uranium



Uranium production process

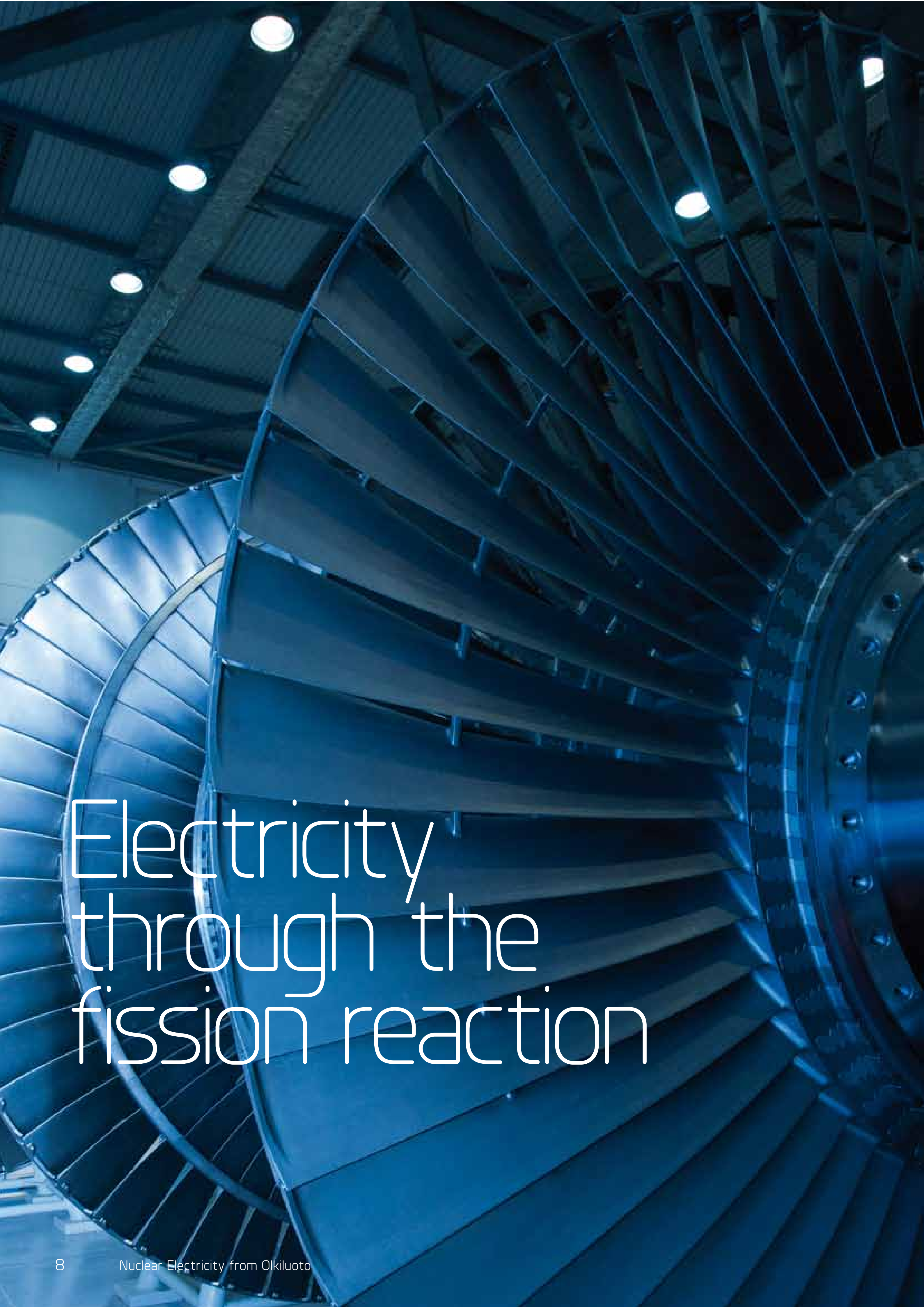
Underground mines and open pits produce about 50% of the world's uranium by using conventional mining technology. Slightly less than 50% of uranium is leached from the soil. A small share of uranium is obtained as a by-product of other minerals.

Regular stages of the uranium mining process are ore quarrying, crushing and grinding. An ore enrichment plant, usually located close, or in connection to the mine, separates rock and foreign minerals from the uranium compound and refines the uranium into uranium concentrate.

During the isotope enrichment process, the concentration of the fissionable U-235 isotope in natural uranium is increased from 0.7% to 3–5%. After enrichment, the uranium is transported to the fuel manufacturing plant in special cylinders and protective packaging.

In the fuel manufacturing process, the uranium dioxide powder is compressed into small pellets and the pellets are condensed by sintering, i.e. heating them to about 1,700 degrees. After this, the fuel pellets, about 1 cm in diameter, are stacked into fuel rods which are then complied into fuel elements.

Electricity through the fission reaction



Controlled chain reaction

The energy production of a nuclear power plant is based on the uranium fuel fission and controlled chain reaction. In the fission, a neutron collides with the nucleus of isotope U-235 and splits it. This fission reaction releases two or three new neutrons and fission products. Some of the released neutrons continue the chain reaction. Every fission reaction releases a lot of energy. This means that very small amounts of uranium fuel can be used to produce large quantities of heat.

Fission products created in the fission reaction are radio-active, i.e. they decay into other elements. In radioactive decay the nuclei emit radiation. The radiation of radio-active fission products causes decay heat in the fuel. The removal of decay heat must be ensured at all stages of fuel handling.

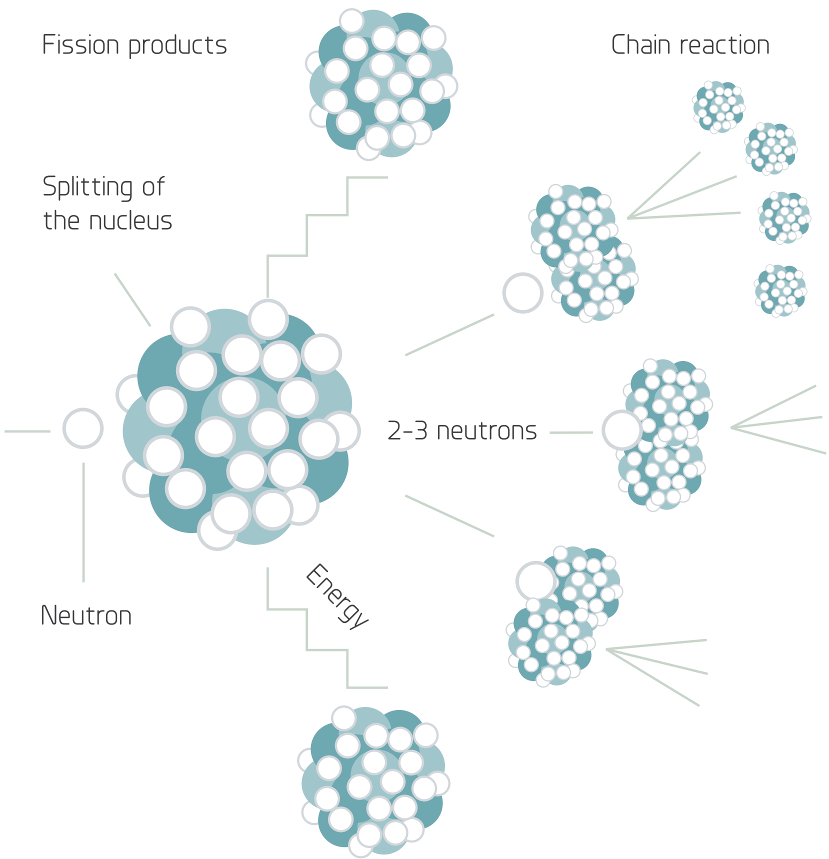
The released neutrons travel at about 20,000 km per second. In the reactor, the movement of neutrons is slowed down to a few thousand metres per second, which multiplies the probability of the uranium fission reaction. Demineralised water is used as the moderator at Olkiluoto 1 and 2, and Olkiluoto 3 uses a water/boron solution.

Chain reaction controlled with control rods

The chain reaction and the power distribution of the reactor core are regulated with the control rods and water flow. The control rods contain, for example, boron or cadmium, which effectively absorb neutrons and thus weaken the chain reaction. In a scram, the chain reaction can be stopped with the control rods in a few seconds.

The control rod length of Olkiluoto 1 and 2 plant units is four metres and there are 121 control rods in each plant unit's reactor core. The control rods used in the Olkiluoto 3 plant unit are control rod assemblies. One control rod assembly contains 24 finger rods. The length of an Olki-luoto 3 control rod is five metres, and there is a total of 89 control rod assemblies.

In addition to the control rods, the Olkiluoto 3 plant unit regulates the chain reaction with boron contained in the reactor water, and the concentration of the water is regulated with a designated system. This results in a slow change in the chain reaction to even out the fuel burnup.



The energy production of a nuclear power plant is based on the fission and controlled chain reaction.

The operating of the nuclear power plant

The operating principle of a nuclear power plant is to convert the fission heat energy through the turbine and generator to electricity. With the fission reaction heat, the water is vaporized in the reactor or with separate steam generators. After this, the steam is conducted to the turbines in the plant pipes. The turbines are used to gradually decrease the steam pressure, which means that the steam swells thousandfold. The swollen steam pushes the turbine wings ahead of it, and the turbine starts to rotate. The turbine rotates the generator connected onto the same shaft. The generator produces electricity to the Finnish national grid.

Olkiluoto fuel elements

Olkiluoto 1 and 2

Olkiluoto 3

Once the steam has given up all its usable energy, it is conducted to a condenser where it is condensed into water by using seawater. Finally, the cooled process water is pumped back to its original rotation and the cycle begins again.

The most common nuclear power plant types

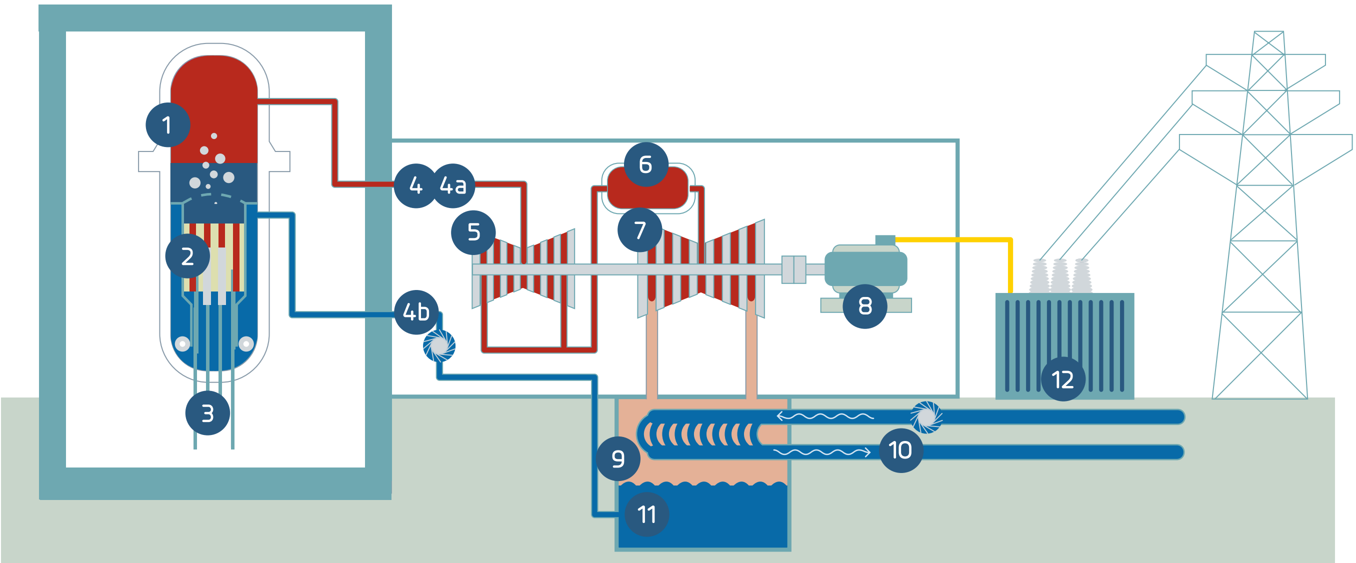
Most nuclear power plants are boiling or pressurised water reactor plants. The main difference is in steam formation. In boiling water reactors, water boils in the reactor core. The pressurised steam from the water is transferred along pipes directly to the turbines.

In a pressurized water reactor, the reactor water, at about 300 degrees, is kept from boiling through high pressure. After this, the hot water travels as liquid to separate steam generators where it boils the water on the other side of the pipes into steam. The resulting steam is conducted to turbines.

TVO's Olkiluoto 1 and Olkiluoto 2 in operation are boiling water reactor plants. Olkiluoto 3 is a pressurised water reactor plant.

The fuel elements are placed in the reactor core. Olkiluoto 1 and Olkiluoto 2 plant unit reactors have 500 fuel elements each. Olkiluoto 3 has 241 fuel elements.

Boiling Water Reactor operating principle



1. Reactor
2. Core
3. Control rods
4. Primary circuit

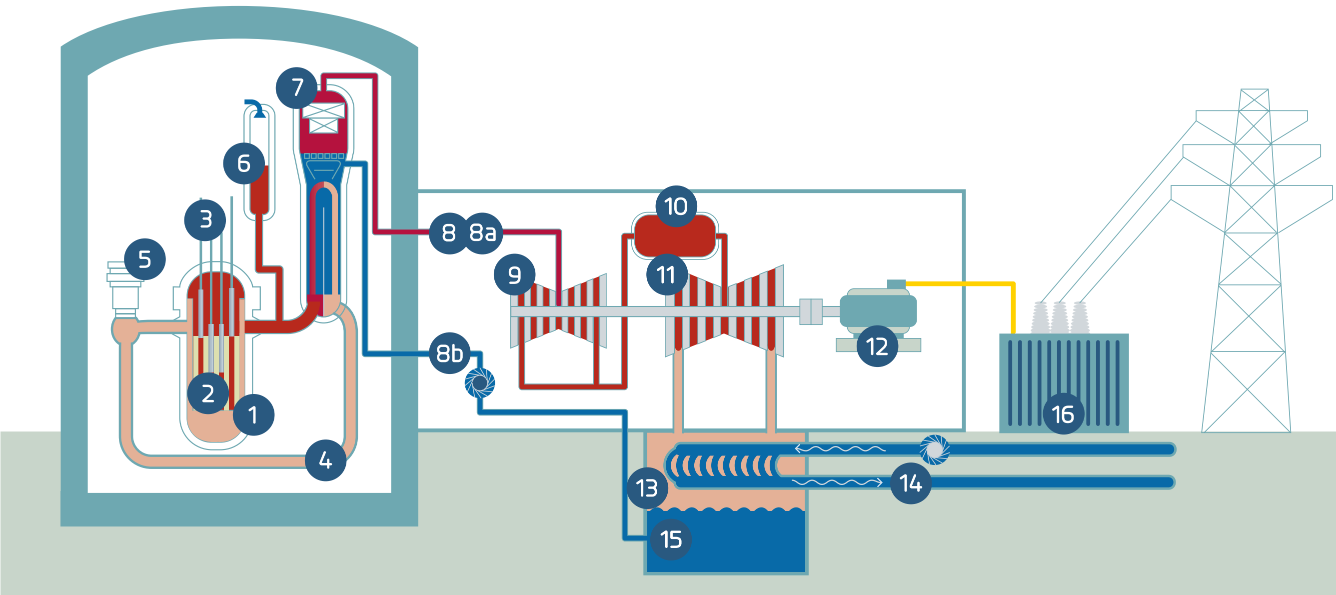
4a. Steam to the turbine

4b. Feed water to the reactor

5. High-pressure turbine
6. Reheater
7. Low-pressure turbines
8. Generator
9. Condenser
10. Seawater circuit
11. Condensate
12. Transformer

Pressurized Water Reactor operating principle

TVO's plant units Olkiluoto 1 and Olkiluoto 2 are boiling water reactor plants. Olkiluoto 3 is a pressurised water reactor plant.



1. Reactor
2. Core
3. Control rods
4. Primary circuit (water circulation)
5. Reactor coolant pump
6. Pressuriser
7. Steam generator
8. Secondary circuit

8a. Steam to the turbine

8b. Feed water to the steam generators

9. High-pressure turbine
10. Reheater
11. Low-pressure turbines
12. Generator
13. Condenser
14. Seawater circuit
15. Condensate
16. Transformer

Responsible handling of nuclear waste

Responsible nuclear waste management is an important part of the whole of nuclear electricity production. TVO has an environmental management system which, in addition to the nuclear energy legislation, specifies instructions for waste handling and recycling.

The production of nuclear electricity creates radioactive waste, which means that special attention must be paid to waste management. Waste must be separated from living nature for a long enough time fort its radioactivity to decrease to a hazard-free level. TVO's goal is to always keep emissions well below both the limits set by the authorities and the even more stringent ones set by TVO itself.

All nuclear waste is processed

The waste produced at the Olkiluoto nuclear power plant is classified as waste cleared after monitoring, low and medium level operating waste, high level waste (spent fuel), and decommissioning waste. The classification is based on the radioactivity level of the waste.

Low level waste includes protective plastic, tools, protective clothing and towels from maintenance work. Medium level waste includes process ion-exchange resins, for example. Low and medium level waste is packed in barrels in concrete boxes or directly into concrete boxes. After packing, the boxes are disposed of in the final repository for low and medium level waste excavated in the plant area's bedrock.

Waste exempted from control contains such a small amount of radioactive substances, or none at all, so that the waste can be utilized by recycling or disposed of at the Olkiluoto landfill site.

Decommissioning waste is created when the plant units are dismantled after they are no longer used. Space has already been reserved in Olkiluoto for the final disposal of this waste.

Spent fuel is placed in interim storage

The fuel in the reactor becomes highly active during use. Nuclear fuel is used in the Olkiluoto power plant unit reactors for an average of four years. Some of the fuel is replaced annually. After removing spent fuel from the reactor, it is stored in the reactor hall water pools for a few years and then transferred to the interim storage for spent nuclear fuel, located in the power plant area.

Spent fuel is stored in the interim storage for about 40 years before final disposal. Over the course of 40 years, the radioactivity and heat generation of the fuel decrease to less than one-thousandth of the original level. This means that it is easier to transport and process the spent fuel for final disposal.

Spent fuel is stored in interim storage in water pools.

Geologic disposal of spent nuclear fuel

The principle of geological disposal is to isolate the spent fuel in the old and steady bedrock of Olkiluoto so that the disposed uranium fuel will not harm nature organisms in any conditions.

When geological disposal begins, the fuel is transferred from the interim storage pools to the encapsulation plant in a shock-proof transport container which provides radiation protection and prevents damage to the fuel elements during transfer. Then the spent fuel elements are sealed in a massive protective canisters made of cast iron and copper.

The canister's sturdy cast iron insert provides the required strength and protects the fuel from mechanical stress and pressure. The outer part's pure copper retains its characteristics well in the oxygen-free conditions in the bedrock which means that the canister will remain intact. The spent fuel will be disposed of in the bedrock, in disposal facilities located at a depth of about 420 m.

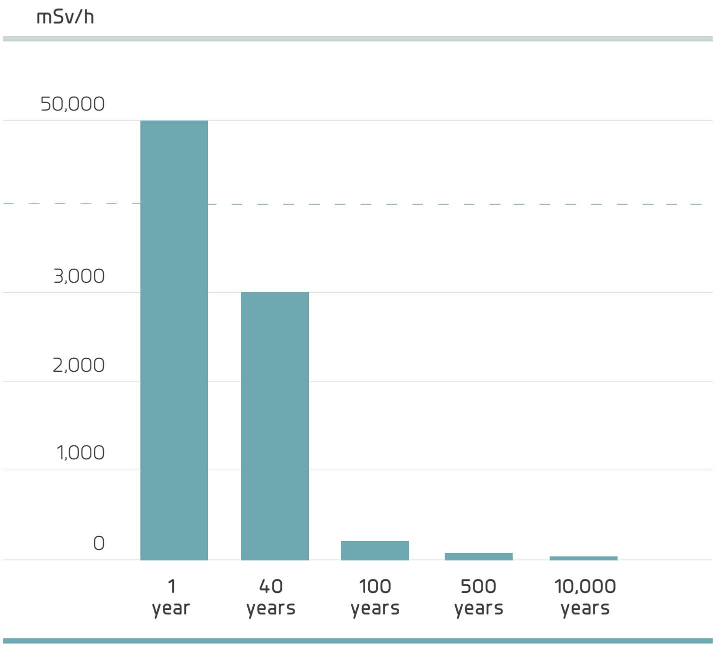
Multiple barriers stop radiation

Spent fuel is placed inside the rock, hundreds of meters down, but already a two-metre thick layer of the insulation methods used in disposal would prevent the disposed fuel from radiating around it.

Protective canisters are placed into deposition holes deep in the bedrock tunnels. The canister is isolated from the rock with compacted but flexible bentonite clay which isolates water, prevents groundwater from accessing the canister surface and protects the bentonite buffer and canister from possible rock movement. After this, the tunnels are filled with clay blocks and pellets which keep the canisters in place and prevent the flow of groundwater. Finally, the tunnels are carefully sealed.

TVO already started the research of the disposal of spent fuel in the late 1970s. In 1995, TVO and Fortum established Posiva to manage the disposal of its founding companies' spent fuel. The disposal activities are scheduled to begin in about 2020.

THE RADIATION LEVEL OF SPENT NUCLEAR FUEL WITHOUT SHIELD CANISTER, MEASURED ONE METER AWAY FROM THE FUEL ASSEMBLY SURFACE



1 YEAR / 50,000 mSv/h:
The radioactivity of a removed fuel assembly decreases to approximately one hundredth in one year

40 YEARS / 3,000 mSv/h:
An acute exposure to 1,000 mSv will cause radiation sickness; acute exposure to 8,000 mSv will cause death

100 YEARS / 70 mSv/h:
In radiation work, a worker's five-year dose limit is 100 mSv

500 YEARS / 4 mSv/h:
The average radiation dose incurred by a Finn in one year is approximately 4 mSv

10,000 YEARS / 0.3 mSv/h:
The radiation dose caused by a mammography X-ray examinations is approximately 0.3 mSv

Safety in all conditions

The main principle of nuclear safety is that radioactive substances must not end up in the environment under any circumstances. Therefore, all nuclear power plant operations are based on safety, and they rely on multi-level safety thinking. Safety is ensured through systems which are multiple, mutually independent, physically separated from each other and operate with different principles.

Many different and overlapping safety systems reduce the possibility of accidents. Olkiluoto has fourfold safety systems, which means that if one system fails, there are many other systems available. A user error or several equipment failure cannot alone cause a serious accident.

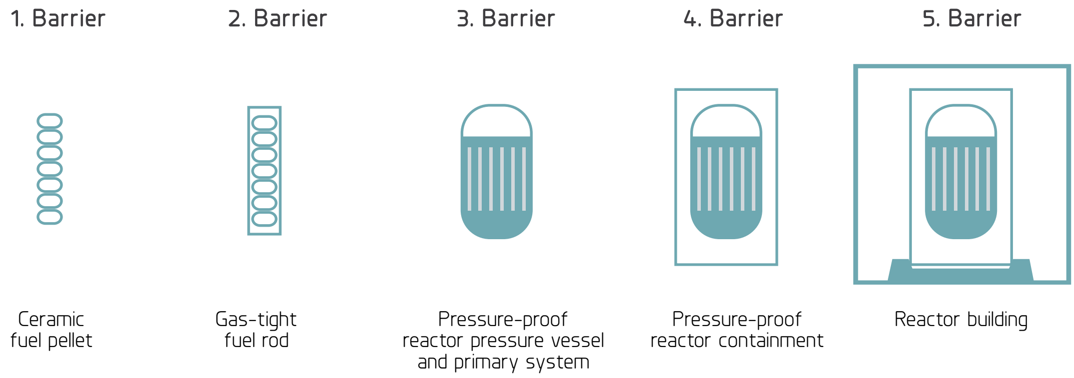
For example, the radioactive uranium fuel in the reactor has five multiple release barriers. These include the ceramic fuel pellet, the gas-tight fuel rod, the pressure-proof reactor pressure vessel, the pressure-proof reactor containment building and the reactor building.

A sound safety culture is key

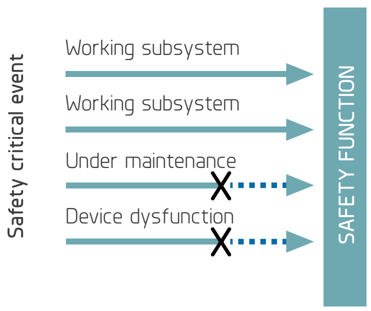
Good nuclear safety is not only created through technology but the plant personnel's commitment to the high morale and correct methods required by the sector are crucial. Commitment is called safety culture and it is part of ensuring plant safety. TVO also requires its subcontractors to have this commitment.

> Good nuclear safety is not only about technology – personnel's commitment is also crucial.

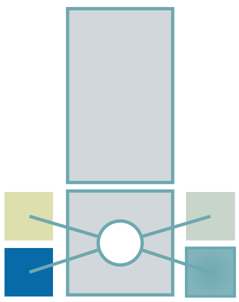
Multiple release barriers of a boiling water reactor plant



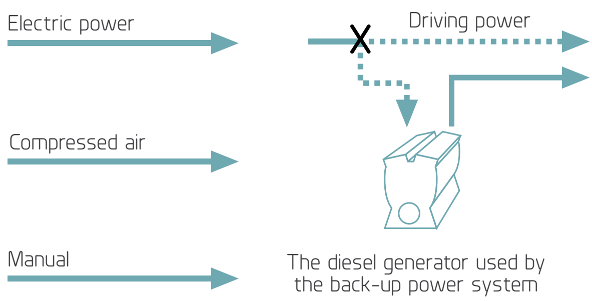
Redundancy



Separation



Diversity



Preparing for accidents

Different preventive steps in a nuclear power plant prepare for plant malfunctions. For possible accidents, there are comprehensive protection and control systems and established procedures. Through consequence mitigation measures, radioactive substances are isolated from the environment, thus preventing permanent harmful effects in exceptional and unlikely accidents.

Reactor safety is ensured in many ways

In all conditions, reactor safety requires that the chain reaction and its power is managed, fuel is cooled and radioactive substances are isolated from their environment. In case of severe accidents, the plant units are equipped with off-gas systems which have filters and which minimise the spreading of radioactive substances into the environment. The filter line is designed to take the pressure and temperature of severe accidents.

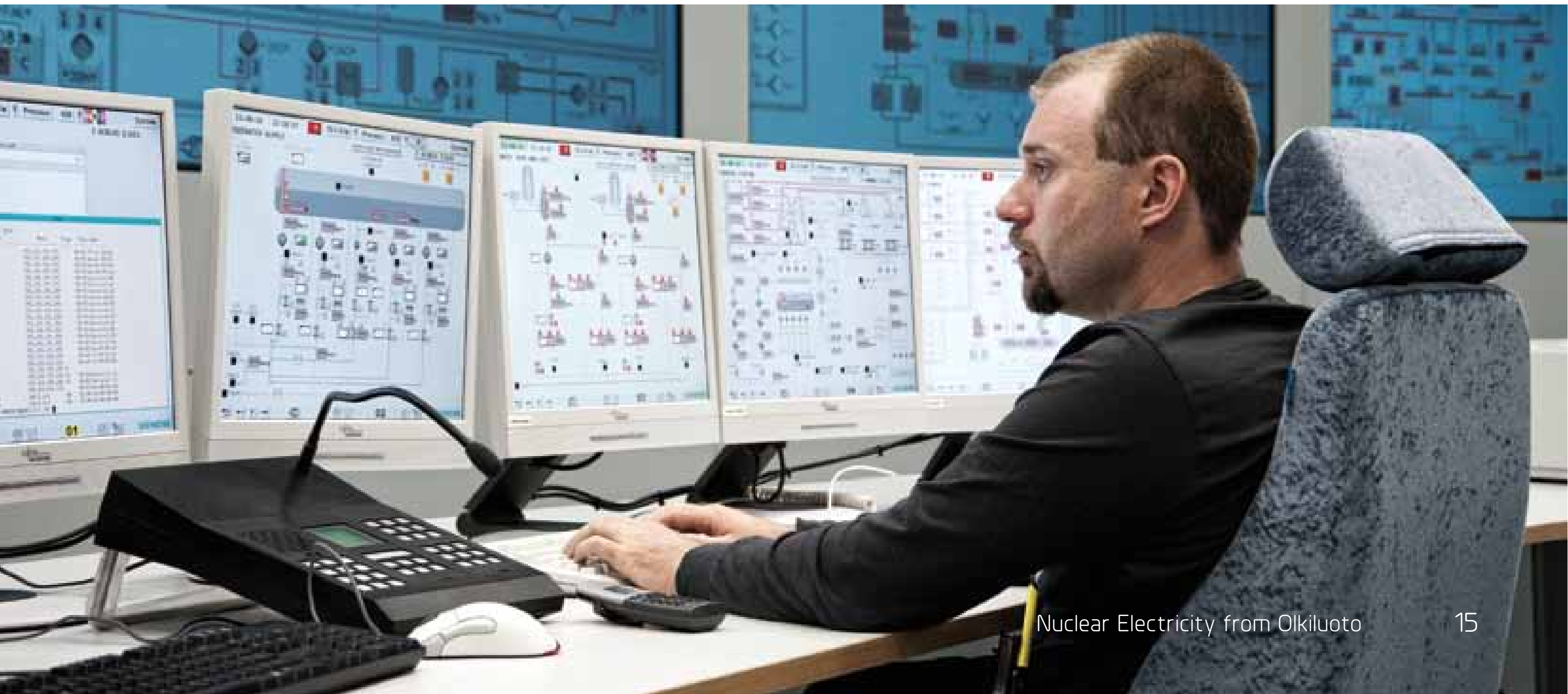
The safety and possible risk factors of Olkiluoto nuclear power plant units have been analysed in many different ways. One of the methods is probabilistic risk analysis that can help identify and evaluate accidents (and their probability) which may cause serious damage to the reactor core. The design, development and construction of safety systems accounts for the worst possible hazards that threaten Olkiluoto. TVO has analysed about 50 different natural phenomena related to land, sea and air, and their combinations, and has also prepared for them. Threats include storms, floods, freezing, fire and earthquakes.

The reactor will be shut down within a few seconds if necessary

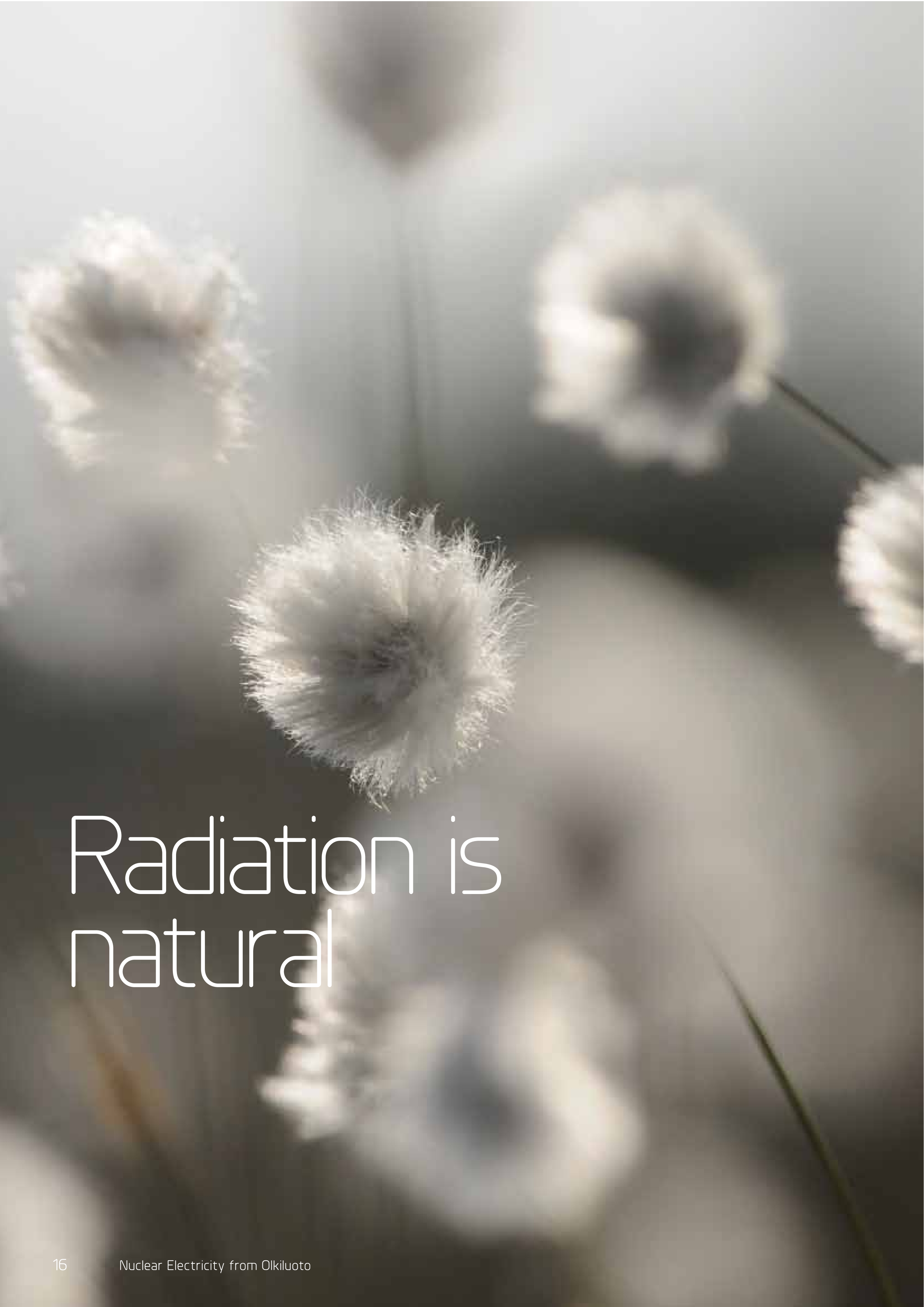
The operating principle of Olkiluoto nuclear power plant unit reactors in operation involves what is known as negative feedback which helps prevent the reactor from overheating. As the reactor temperature increases, its power automatically decreases because the reactor water boiling into steam produces fewer slow neutrons required in the chain reaction.

When necessary, the reactor can be shut down in a few seconds by either pumping a boron solution or pushing the control rods into the reactor core. The automatic functions of the nuclear power plant will automatically shut down the reactor in case of malfunction.

The OL3 plant unit simulator is a full-scale, plant-identical training simulator. The simulator is used for training different operation and malfunction situations at the plant unit.



Radiation is natural



People are exposed to radiation in the housing and living environment. Examples include light, thermal radiation, radiowaves, X-radiation and radiation emitted by radioactive substances. Different substances radiate differently.

Radioactivity is everywhere

Radioactive substances end up in the body through food, beverages and the air we breathe. Radon is the most significant substance with regard to the radiation exposure of Finns in their homes. Other sources of radiation include the cosmic radiation in space, gamma radiation emitted by radioactive substances in natural minerals and the human body, the pharmaceutical use of radiation, and radiation caused by industry. In Finland, the average radiation dose is about 4 millisieverts (mSv) per year.

Radiation is either ionizing or non-ionizing based on how it affects the substance it encounters. Particle radiation (alpha, beta, proton and neutron radiation) and gamma and X-radiation can remove electrons from atoms in their sphere of influence, which means that the target atoms become positively charged, i.e. ionized atoms. Therefore, the radiation types above are called ionizing radiation.

Ionizing radiation is harmful

The ionized atom is chemically very reactive with the surrounding atoms and molecules. In living cells, ionized atoms discharge and create new chemical binds which are not necessarily favourable for the cell operations. In fact, the ionizing capability is a harmful characteristic of radiation.

Nuclear power-related radiation usually refers to ionizing radiation. The fission reaction always creates radiation but effective protection against it can be achieved through careful planning and accurate work.

The energy of non-ionizing radiation, such as light, is not enough to ionize the atom and cause an electrical charge in it. Non-ionizing radiation, such as sunlight, has different harmful mechanisms.

/ The average radiation dose in Finland is about 4 mSv per year. /

Units related to radiation

Activity is a variable which indicates the number of decays in radioactive matter per time unit. The unit of radioactivity, the becquerel (Bq), equals one disintegration per second. Upon the decay, radiation is emitted from the matter.

All radioactive matter has its own specific half-life, during which the activity of the matter decreases by 50%. Half-life varies from the fragments of a second to billions of years.

Radiation doses are measured in sieverts

Radiation dose often refers to the effective dose. Its unit is the sievert (Sv). The unit describes the latent harm to people caused in practice by radiation.

Practical work also uses the dose rate unit, sievert per hour in one-thousands or one-millionths (mSv/h and μSv/h). Dose rate can be used to determine the necessary radiation protection measures to minimise radiation doses.

RADIATION DOSES (mSv) TO FINNS FROM DIFFERENT SOURCES PER YEAR

	mSv
Radon in indoor air	2.0
Natural radioactivity in the body	0.36
External radiation from the soil	0.45
Cosmic radiation from space	0.33
Medical X-ray examinations	0.5
Medical radioisotope examinations	0.03
Nuclear weapon tests and the Chernobyl fallout	0.02
Total	3.69

Source: The Finnish Radiation and Nuclear Safety Authority (STUK) www.stuk.fi.

Radiation safety

Radiation is measured continuously in Olkiluoto and its surroundings in many ways. Radiation control at TVO is guided by legislations, official instructions, international recommendations and the principles of TVO's safety culture.

Radiation measurements for the personnel and environment

The Olkiluoto nuclear power plant is divided into a control and monitoring area as per radiation measurement, and to an area outside them, not classified with regard to radiation protection. The radiation dose of everyone working in the control area in Olkiluoto is monitored and measured with dosage meters. In addition, STUK performs full-body measurement on radiation employees and residents in the neighbourhood.

TVO also measures radiation in the air, water, soil and organisms. Measurement results indicate that the Olkiluoto nuclear power plant has not caused any harmful radiation exposure to people or the environment.

Diverse protection

In the nuclear power plant, radiating matter is separated from the environment and careful protection is taken against radiation. Radiation protection generally adheres to the principle according to which unnecessary exposure to radiation must be avoided and radiation doses must be kept to the minimum by taking reasonable action.

There are different ways to find protection against radiation in the nuclear power plant. The main factors of protection are time, protective covering and distance. Radiation doses are effectively decreased by minimising the time exposed to radiation, by isolating the source of radiation with separately installed shields and by keeping sufficient distance to the source of radiation. In addition, it must always be ensured that radioactive substances cannot enter the body for example through respiration.

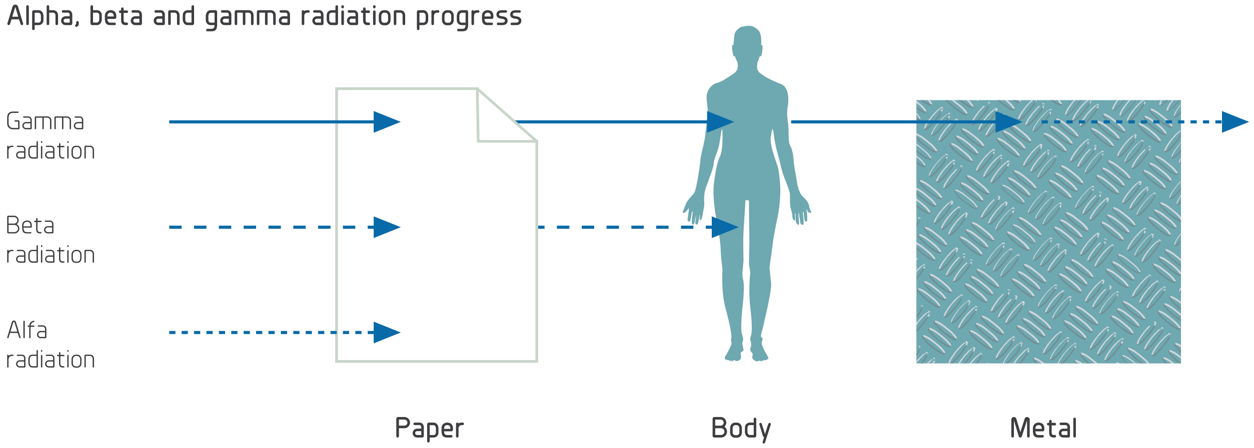
Radiation activity is regulated

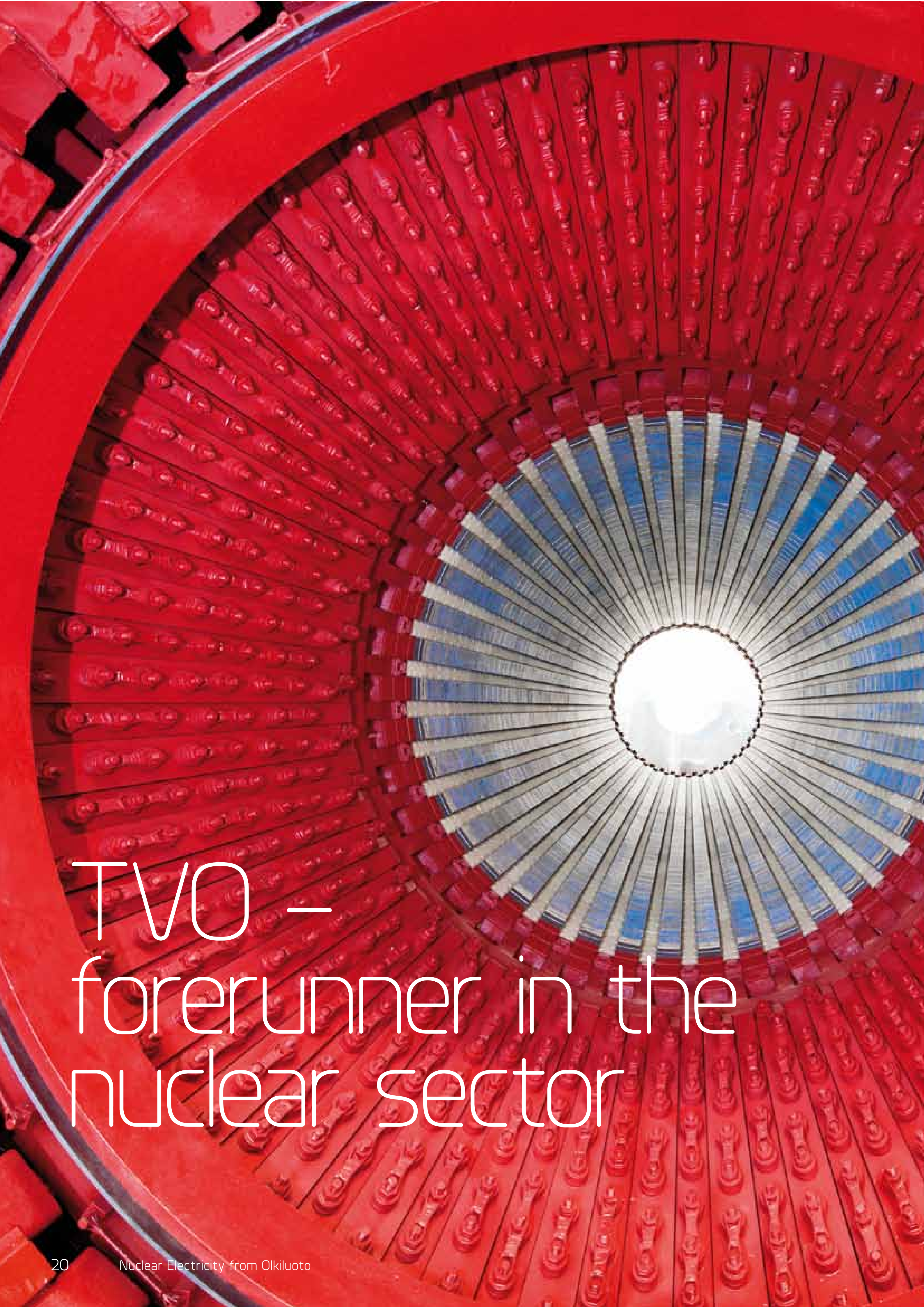
Radiation activity is regulated by radiation, nuclear energy and occupational health laws and the radiation decree. STUK provides radiation safety and nuclear power plant instructions for nuclear power plants. In addition, TVO has its own instructions for implementing radiation protection in practice in the plant units.

The radiation legislation and decree specifies the maximum limits for those whose work involves exposure to radiation. The maximum allowed dose of a radiation employee in five years is 100 mSv and the dose in an individual year must not exceed 50 mSv.

The annual radiation dose limit arising from the operation of a nuclear power plant has been set at 0.1 mSv in Finland. The radioactive emissions of the Olkiluoto power plant are up to a few per mille of the allowed amounts and are therefore clearly within the official limits. STUK monitors and controls the operations of the Olkiluoto nuclear power plant for example through a local inspector.

Alpha, beta and gamma radiation progress





TVO – forerunner in the nuclear sector

Teollisuuden Voima Oyj (TVO) is a non-listed public company founded in 1969. Its mission is to produce electricity for its owners at cost price.

The company owns and operates two nuclear power plant units, Olkiluoto 1 and Olkiluoto 2, and is building a new Olkiluoto 3 plant unit in Olkiluoto in Eurajoki. TVO is also a shareholder of the Meri-Pori coal-fired power plant. In July 2010, Parliament ratified the Government's favourable decision in principle concerning the construction of the fourth nuclear power plant unit, Olkiluoto 4.

The Olkiluoto nuclear power plant units have already operated reliably and safely for more than 30 years. The capacity factors of both plant units in operation have been at an internationally high level throughout almost their entire operations. The current net production output of both plant units is 880 megawatts (MW). In 2011, TVO produced 20% of the electricity produced in Finland, i.e. more than 14 TWh. Electricity produced by TVO is consumed in almost all of Finland in about 140 municipalities – in homes, industry, agriculture and services.

TVO is a major employer in the Eurajoki municipality and its neighbouring areas. Once Olkiluoto 3 has been completed, the company will provide new permanent jobs for about 150–200 people. In addition to TVO employees, the power plant's annual maintenance and other subcontracting annually employ about one thousand people. TVO is also known as a good summer job and trainee location.

CAPACITY FACTORS

	2011	2010	2009	2008	2007
Olkiluoto 1	94.8	91.8	97.0	93.7	97.5
Olkiluoto 2	90.9	95.2	95.1	96.9	93.7
Total capacity factors	92.8	93.5	96.0	95.3	95.6

1. Olkiluoto 1
2. Olkiluoto 2
3. Olkiluoto 3
4. Olkiluoto 4
5. Final repository for low and medium level waste (VLJ)
6. Interim storage for spent nuclear fuel (KPA)
7. Underground research facility for the geologic disposal of spent nuclear fuel (ONKALO)

Continuous development of operations

TVO has produced electricity for the Finnish society for more than three decades. Over the years, Olkiluoto nuclear power plant units have been modernised in many ways and their safety has been improved. Examples of the safety improvements are the improvement of the earthquake resistance and fireproofing, improvements made in the reactor pressure reduction systems and reinforcing the structures of the interim storage for spent nuclear fuel. In addition, a separate gas turbine plant has been built in the plant area, from which electricity can be fed to the plant units' safety systems and the national grid when necessary.

Regular and careful maintenance

The Olkiluoto nuclear power plant is continuously modernised through the plant units' alternating refueling and maintenance outages. The annual maintenance, which takes place in Olkiluoto each spring, starts with a refueling outage of about one week, which exchanges the uranium fuel and carries out the necessary fault repair and maintenance, and the possible preparation work for the plant unit's maintenance outage next year.

The annual maintenance continues with the other plant unit's maintenance outage where major maintenance and modification work is carried out in addition to refueling. The maintenance outage usually takes two or three weeks. Both outages require careful planning to ensure that the work progresses in an excellent way.

Ensuring competence

A safe nuclear power plant needs up-to-date technology and competent personnel. Competence ensures that the tasks are taken care of in the correct way in all conditions.

TVO continuously arranges training to maintain the competence and know-how of its staff. Most of the training deals with TVO's operations, particularly plant and operating technology.

Plant units are always kept in such a condition that they can be used for the next 40 years.

Carefully regulated operations

Nuclear energy production is carefully regulated and subject to a licence, so that it serves the overall interests of society. Energy production must not cause any damage to people, the environment, or property. Safety and anything affecting it is always put before financial objectives.

Everything is based on the Nuclear Energy Act

The Nuclear Energy Decree and five government decisions on the use of nuclear energy have been issued as per the Nuclear Energy Act. The decisions concern nuclear plant safety, security arrangements, emergency arrangements and the final disposal of low and medium level waste and spent nuclear fuel.

The nuclear power plant licence holder must ensure the safety of nuclear energy use, of nuclear waste created through the operations, and of all nuclear waste management costs. For decades now, nuclear waste management costs have been prepared for by collecting a nuclear waste reservation fee in the price of nuclear electricity to be funded to the State Nuclear Waste Management Fund.

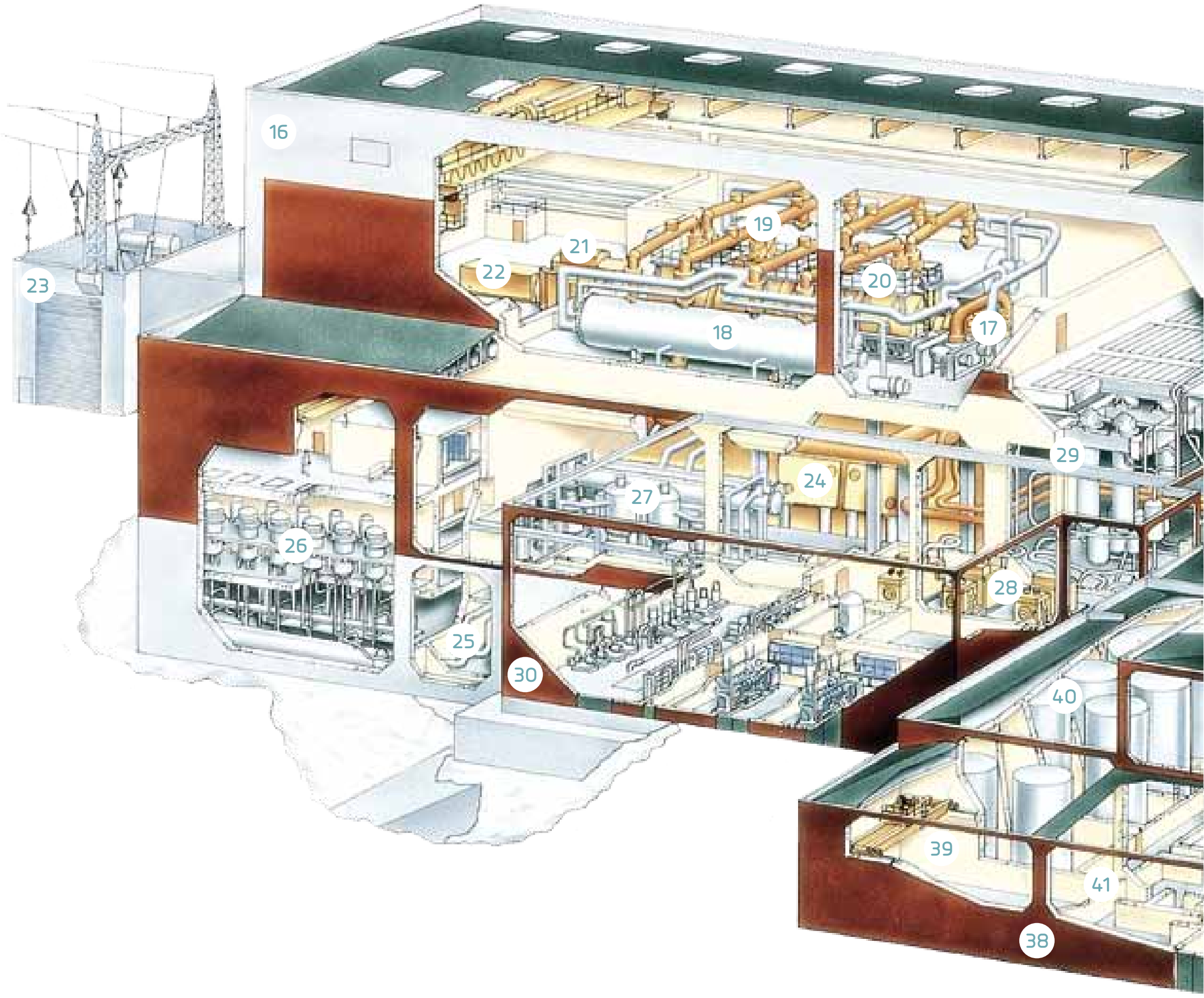
The Radiation and Nuclear Safety Authority (STUK) is the supervisory authority for the Finnish nuclear power plants. TVO provides regular reports of its operations to the Radiation and Nuclear Safety Authority. Nuclear fuel is also controlled by the International Atomic Energy Agency (IAEA) and the European Atomic Energy Community (Euratom).

The operating system ensures safety

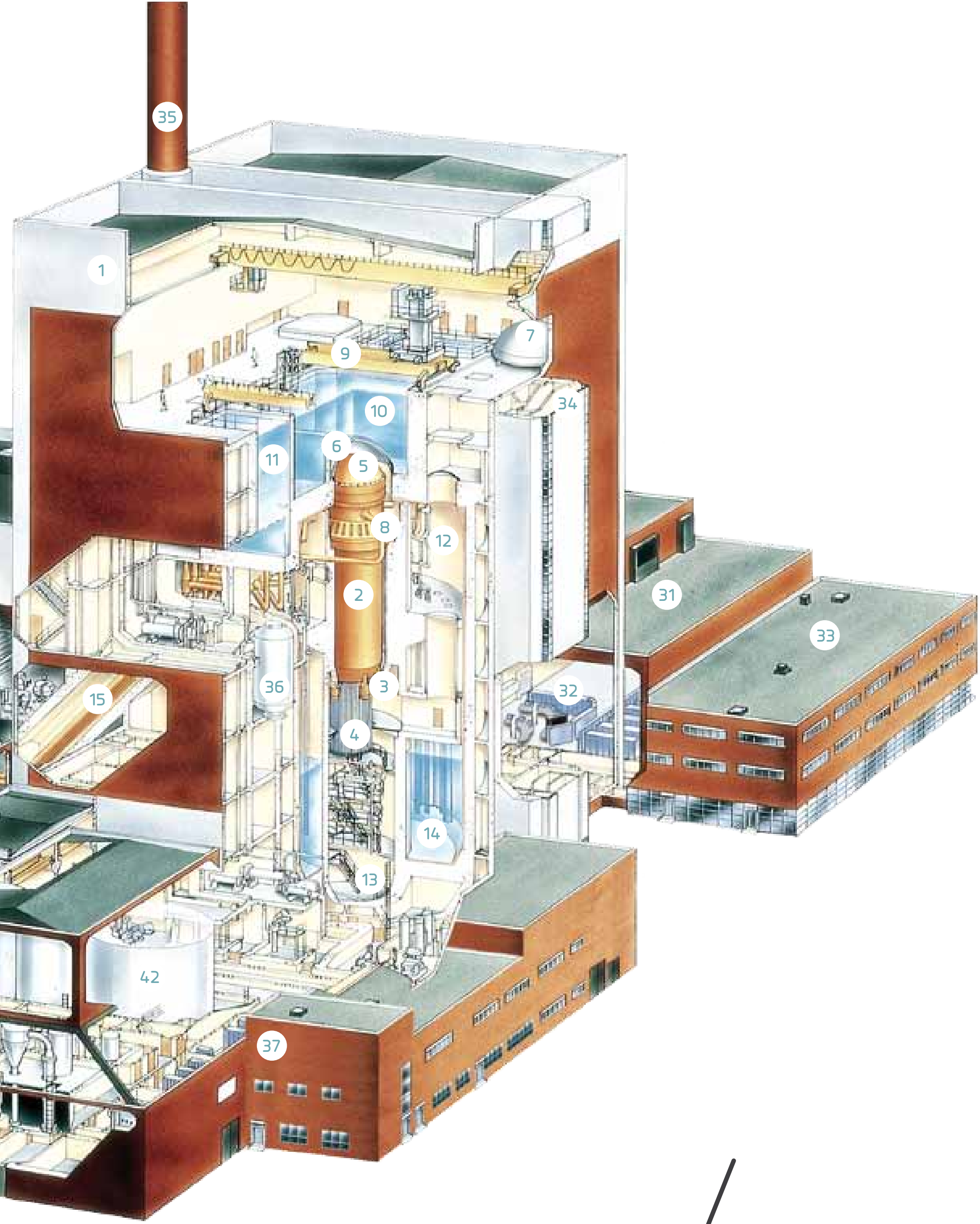
TVO has an operating system based on the requirements specified in Finnish legislation and STUK's nuclear power plant instructions. The system describes the procedures according to the business concept, the values, and the policies which guide the work of all TVO employees and partners at Olkiluoto. The system provides the procedures for ensuring safe, competitive, high-quality, and environmentally sound electricity production.

TVO adheres to international quality management, environment and occupational health and industrial safety standards. STUK and an external certification body annually check that TVO follows the regulations and standards.

Olkiluoto 1 and 2 cross-section



1 Reactor building
2 Reactor pressure vessel
3 Recirculation pumps
4 Control rod drives
5 Reactor pressure vessel cover
6 Containment cover
7 Containment cover lifted off (during annual outages)
8 Main steam lines
9 Reactor service bridge
10 Reactor pool
11 Fuel pool
12 Upper dry-well of containment
13 Lower dry-well of containment
14 Condensation pool of containment
15 Main steam lines
16 Turbine building
17 High pressure turbine
18 Reheater
19 Cross-over pipes
20 Low pressure turbines
21 Generator
22 Exciter
23 Main transformer
24 Condenser
25 Condensate line
26 Condensate purification system
27 Low pressure preheaters
28 Feedwater pumps
29 High pressure preheaters
30 Auxiliary systems building

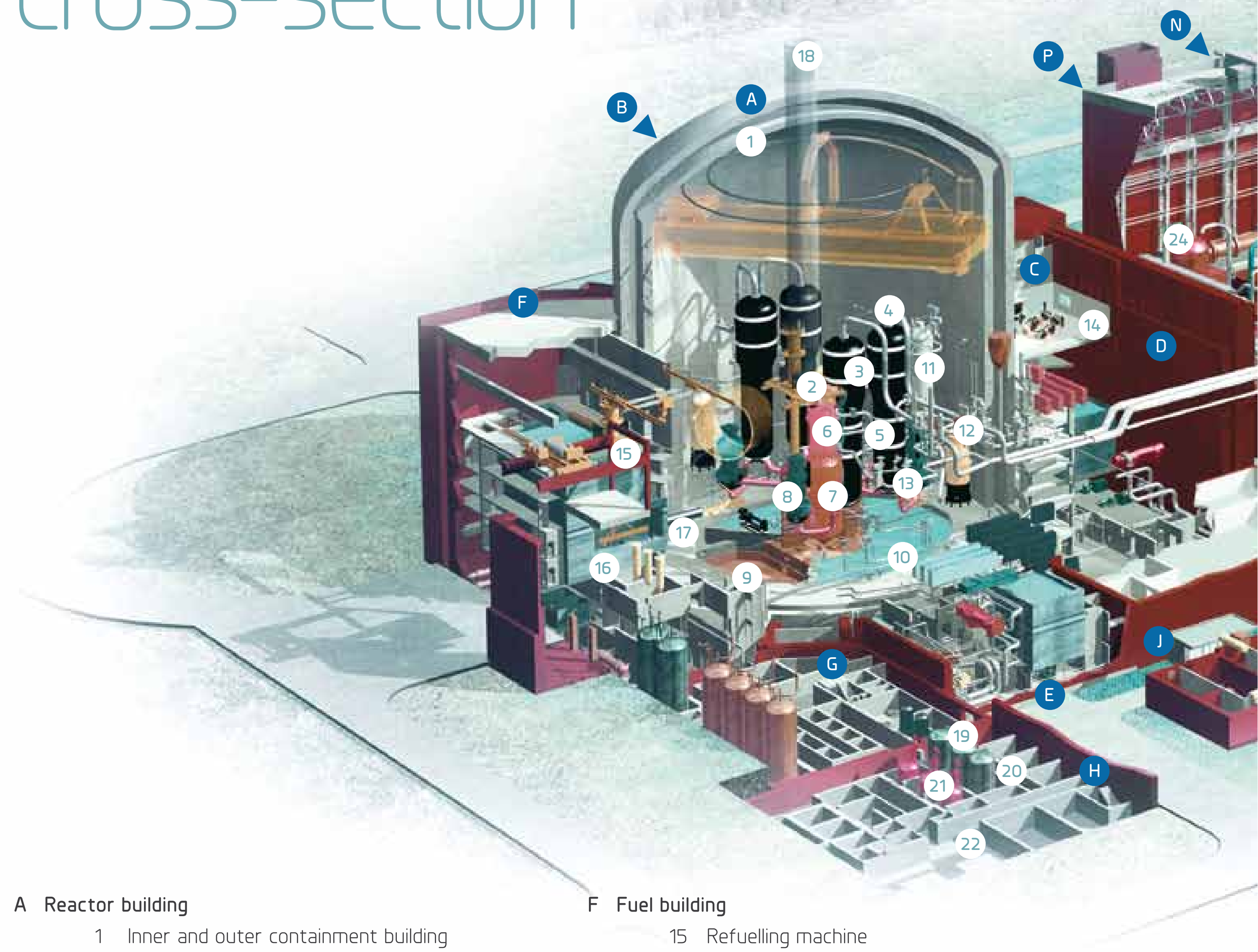


31 Control building
32 Main control room
33 Entrance-/office building
34 Lift
35 Ventilation stack
36 SAM scrubber (filtered venting system of the containment)
37 Active workshop/laboratory building (Only OL1)
38 Radioactive waste building
39 Low and medium-level radioactive waste storage
40 Liquid waste storage tanks
41 Liquid waste management
42 Make-up water tank

OLKILUOTO 1 AND OLKILUOTO 2 – TECHNICAL INFORMATION

Reactor thermal power	2,500 MW
Net electrical power	880 MW
Reactor pressure	70 bar
Steam temperature	286 °C
Number of fuel elements	500
Number of control rods	121
Turbine island	
Apparent power	910 MW
Rated speed	3,000 rpm
Cooling water flow	38 m^3/s

Olkiluoto 3 cross-section



A Reactor building
- 1 Inner and outer containment building
- 2 Refueling machine
- 3 Steam generator
- 4 Main steam pipelines
- 5 Main feedwater lines
- 6 Reactor control rod drives
- 7 Reactor pressure vessel
- 8 Primary circuit reactor coolant pump
- 9 Core melt spreading area
- 10 Emergency cooling water storage
- 11 Primary circuit pressurizer
- 12 Main steam valves
- 13 Feedwater valves

B Safeguard building division 1

C Safeguard building devision 2
- 14 Main control room

D Safeguard building devision 3

E Safeguard building devision 4

F Fuel building
- 15 Refuelling machine
- 16 Fuel pools
- 17 Fuel transfer tube

G Reactor plant auxiliary building
- 18 Ventilation stack

H Radioactive waste processing building
- 19 Liquid waste collecting tank
- 20 Monitoring tanks
- 21 Concentrate tanks
- 22 Drum storage area

I Emergency power generating building/Diesel building
- 23 Emergency diesel generators

J Access building

K Office building

L Turbine building
- 24 Moisture separator
- 25 High-pressure feedwater preheaters
- 26 High-pressure turbine

27 Low-pressure turbine
28 Condensers
29 Generator
30 Exciter
31 Feedwater tank
32 Low-pressure feedwater preheater
33 Feedwater pumps
34 Low-pressure feedwater preheater

M Switchgear building

35 Transformer boxes

N Circulating water pump building

O Essential service water pump building

P Anti-icing pumps

Q Auxiliary boiler building

36 Demineralized water storage tanks
37 Auxiliary stand-by transformer
38 Unit transformers
39 Auxiliary normal transformers
40 Switchyard
41 High-voltage lines

OLKILUOTO 3 - TECHNICAL INFORMATION

Reactor thermal power	4,300 MW
Net electrical power	ca. 1,600 MW
Reactor pressure	155 bar
Steam temperature	291 °C
Number of fuel elements	241
Number of control rods	89
Turbine island	
Apparent power	1,720 MW
Rated speed	1,500 rpm
Cooling water flow	53 m^3/s

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