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Johanna Marttila (ed.)

Regulatory oversight of nuclear safety in Finland

Annual report 2023

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Contents

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Introduction

This report is the Radiation and Nuclear Safety Authority's (STUK) account to the Ministry of Economic Affairs and Employment (MEAE) of regulatory oversight in the field of nuclear energy, to be supplied once a year under Section 121 of the Nuclear Energy Decree (161/1988). The report is also provided to the Ministry of Social Affairs and Health, the Ministry of the Environment, the Finnish Environment Institute and the environmental authorities of the municipalities where the relevant nuclear facilities are located.

The report is an overview of the regulatory oversight of nuclear safety carried out by STUK, and of the results of this oversight, in 2023. The nuclear safety oversight by STUK discussed in this report covers the essential oversight data that relate to design, construction, commissioning preparation, operation and decommissioning planning with regard to nuclear facilities. Additionally, the report covers the equivalent data on other use of nuclear energy, including nuclear waste management and nuclear materials. In addition to the actual oversight of safety, the report describes, among other topics, how the regulations that govern the use of nuclear energy were developed and implemented during the year, as well as discussing the main characteristics of the safety research programmes in Finland that deal with nuclear safety and nuclear waste management. As required by the Nuclear Energy Decree, the report is accompanied by a summary of the licences that STUK granted in 2023 under the Nuclear Energy Act.

Based on the oversight undertaken by STUK, the use of nuclear energy in 2023 did not pose a risk to the population, society, the environment or future generations.

Management's view

The regulatory oversight of nuclear facilities and safety assessments carried out by STUK play a key role in society's decision-making and the implementation of nuclear safety. The objective of the regulatory oversight of nuclear facilities is to ensure the safe use of nuclear energy in such a way that the operation of nuclear facilities or their possible accidents do not pose a danger to society and the environment.

There were a great deal of familiar aspects to the Radiation and Nuclear Safety Authority's oversight of nuclear energy use and the safety of nuclear waste management, but we were also faced with new things in some areas of oversight. We oversaw the safety of operating nuclear facilities and ensured that the waste management of nuclear power plants met the applicable safety requirements. We also oversaw nuclear safeguards according to the national oversight plan and supervised the first decommissioning of a nuclear facility in Finland – VTT's FiR 1 research reactor.

What were the things that particularly stuck in our minds from 2023? Certainly, one of the most significant events in the nuclear energy sector was Olkiluoto 3 becoming Finland's fifth operating nuclear power plant unit in the spring. STUK oversaw the power tests of the plant unit's commissioning phase and the first operating cycle. From the perspective of nuclear safety, the commissioning tests were successful overall, and no significant discrepancies were found in terms of operational safety.

Another long-term project also progressed: the operating licence for the world's first encapsulation and final disposal facility for spent nuclear fuel was processed and the preparation of the relevant safety assessment was continued in 2023. The process of reviewing the extensive documentation was not yet completed, but good progress has been made. At the same time, STUK has made sure that the Olkiluoto final disposal facility has been built safely and the commissioning and operational preparations adhere to the safety requirements.

At the beginning of 2023, STUK's statements and safety assessments were completed on the continued operation of the Loviisa nuclear power plant units until the end of 2050 and the continued operation of the final disposal facility for low- and intermediate-level waste until the end of 2090. In STUK's assessment, Fortum has the required capabilities, procedures, competences and resources to continue safe operation. The final disposal facility for low- and intermediate-level waste in Olkiluoto was also assessed in 2023. According to STUK's periodic safety assessment, the operation of the Olkiluoto final disposal facility can be safely continued in its current form.

In addition to traditional nuclear safety oversight, year 2023 involved discussions around new kinds of small modular reactors with designers and other operators. The most significant of these were the regular meetings with Fortum on the study, which involves Fortum examining the preconditions for constructing new nuclear power in Finland and Sweden and exploring questions related to various reactor options, and the participation in the assessment of the French Nuward reactor with French and Czech nuclear safety authorities. We did not yet

receive any applications or documents for processing with regard to small modular reactors in 2023, but we are looking forward to the coming years with great interest.

The renewal of the nuclear safety regulations, which was initiated in STUK in 2022, was continued by working on the regulations and their justifications and drafting the regulatory structure. The aims of the renewal are to emphasise operator responsibility, to correctly dimension the requirements in terms of safety significance and to enable effective focusing of oversight based on risk significance. The aims are related to STUK's efforts to develop oversight in accordance with its strategy. Renewing the nuclear safety regulations will be among the most important work efforts of our experts in the current decade.

Tapani Virolainen
Director, Nuclear Reactor Regulation

Jaakko Leino
Director, Nuclear Waste Regulation and Safeguards

1 Results of the regulatory oversight of nuclear facilities

In accordance with its fundamental purpose, STUK has taken care of the implementation of the regulatory oversight of radiation and nuclear safety, safety assessments and the development of its regulatory activities and participated as an expert in the social debate in its field in 2022. The regulatory oversight of nuclear facilities and safety assessments carried out by STUK play a key role in social decision-making and the implementation of nuclear safety. The objective of the regulatory oversight of nuclear facilities is to ensure the safe use of nuclear energy in such a way that the operation of nuclear facilities or their possible accidents do not pose a danger to society and the environment. The oversight assesses the design, construction and operation of nuclear facilities and the safety analyses demonstrating the safety of operation of nuclear facilities, as well as the activities of the licensee's organisation and its subcontracting chain, for example suppliers manufacturing equipment for the facilities.

The majority of STUK's oversight is based on document reviews. STUK has developed new procedures for assessing the depth of inspection of documents that better take into account the safety significance of handling the matter. STUK has also developed its other means of oversight: in addition to the traditional inspections, lightweight inspections have been carried out at the oversight targets and more use has been made of the self-monitoring of facilities.

STUK oversaw the safety of the operating nuclear facilities and, in January 2023, issued the MEAE with its statement on the continued operation of the Loviisa nuclear power plant units until 2050. According to STUK's safety assessment, Fortum has the necessary preconditions, expertise and resources to continue the safe use of the plant units and manage the ageing of the facility.

STUK continued the regulatory oversight of the OL3 commissioning phase power tests in 2023. Overall, the commissioning tests conducted on the plant succeeded well in terms of nuclear safety. The commissioning of OL3 ended in April 2023, after which regular electricity production was started at the plant.

The periodic safety assessment regarding the Olkiluoto operational waste was completed in September 2023.

In 2023, STUK prepared for the project initiated by TVO, which involves TVO exploring the possibility of elevating the reactor power of the OL1 and OL2 plant units and continuing the operation life further than 2038. TVO will supply a conceptual plan related to the power increase in early 2024.

Finland is the first country in the world to start the final disposal of spent fuel, with its facility at Olkiluoto. STUK oversaw the construction of Posiva's encapsulation and final disposal facility, focusing its oversight on the design, construction, manufacture and installation of the facility as well as on demonstrating the long-term safety of the final disposal of spent fuel. STUK continued the assessment of the operating licence application documentation, which was initiated in 2022.

In early 2023, STUK supervised VTT's preparation for the dismantling phase of the FiR 1 research reactor and confirmed the preparedness for the commencement of the dismantling phase with an inspection in 2023. During the dismantling phase, which began in the summer, STUK supervised the implementation of the dismantling work and the processing and packaging of the resulting waste by means of documentation inspections and site supervision.

1.1 Loviisa nuclear power plant

STUK oversaw the safety of units Loviisa 1 (LO1) and Loviisa 2 (LO2) and power plant waste management at the Loviisa nuclear power plant and assessed the operating organisation in different areas by reviewing materials provided by the licensee, carrying out inspections in line with the periodic inspection programme and the YVL Guides and overseeing operations at the plant. The descriptions of the annual outages and the most significant events are presented in Section 1.1.1, and the summaries of the inspections in accordance with the periodic inspection programme (KTO) are presented in Section 1.1.5.

On the basis of this regulatory oversight, STUK stated that, as regards radiation exposure, the activities of the Loviisa nuclear power plant were safe for the employees, the population and the environment.

On 16 February 2023, the Government granted an operating licence pursuant to the Nuclear Energy Act (990/1987) to Fortum Power and Heat Oy's Loviisa 1 and Loviisa 2 power plant units. By virtue of the operating licence, the nuclear power plant units can be used for energy production up to the end of 2050. The new permit also means that Fortum needs to begin modernisation projects to ensure the continuation of the plant's safe operation life from 2030 to 2050. For example, this work includes modifications aiming for the modernisation of the plant and increasing the capacity of the interim storage for spent fuel. STUK will continue to monitor the management and progress of the modifications in Loviisa closely in 2024.

The Government also granted Fortum permission to use the buildings and storages necessary for the management of nuclear fuel and nuclear waste, including the necessary expansions, until the end of 2090.

FIGURE 1. Loviisa nuclear power plant.

1.1.1 Safe operation of the plant

Radiation safety of the plant, personnel and environment

The radiation doses of the Loviisa power plant remained low. In 2023, the total radiation dose of the nuclear power plant was 0.277 manSv. The collective occupational radiation dose of the employees in 2023 was 0.140 manSv at LO2 and 0.137 manSv at LO2. Most of the doses accumulated from work completed during the annual outage of the plant (0.100 manSv at LO1 and 0.125 manSv at LO2).

The radiation doses of the Loviisa power plant's personnel have decreased in the 2000s through the development of working methods and improvement of systems, for example, and because the amount of high activated substances in components connected to the primary circuit has been significantly reduced in accordance with the ALARA principle. The radiation doses are higher in even years, which is when an extensive annual outage is carried out at one plant unit – in 2023, both units went through short annual outage procedures.

According to the Government Decree on Ionising Radiation (1034/2018), the effective radiation dose for persons engaged in radiation work must not exceed 20 mSv per year. The actual individual radiation doses remained clearly below this limit. The highest personal dose received at the Loviisa power plant in 2023 was 4.83 mSv and resulted from cleaning work.

Radioactive releases into the air and sea remained clearly below the set limits, despite the small discharges in the primary circuit. The calculated radiation dose of the most exposed individual in the vicinity of the plant was less than 1% of the limit of 0.1 mSv set in the Nuclear Energy Decree (161/1988).

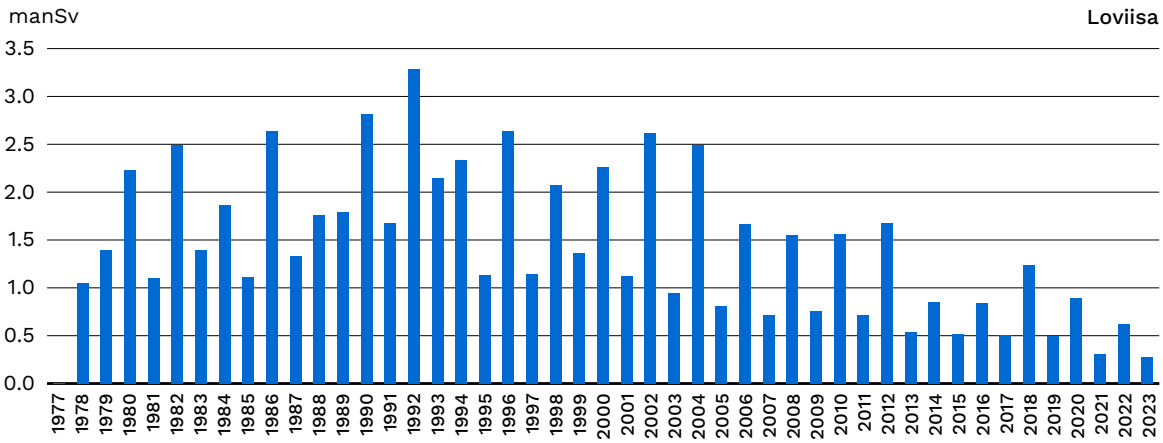

FIGURE 2. Collective occupational doses since the start of operation of the Loviisa nuclear power plant.

A total of approximately 410 samples were collected and analysed from the land and marine environment surrounding the Loviisa power plant in 2023. The measured concentrations were so low that they are insignificant in terms of the radiation safety of the environment or people. The exposure to radioactivity of residents in the vicinity of the nuclear power plant was also measured. No radioactive substances originating from the Loviisa power plant were detected in the measured persons.

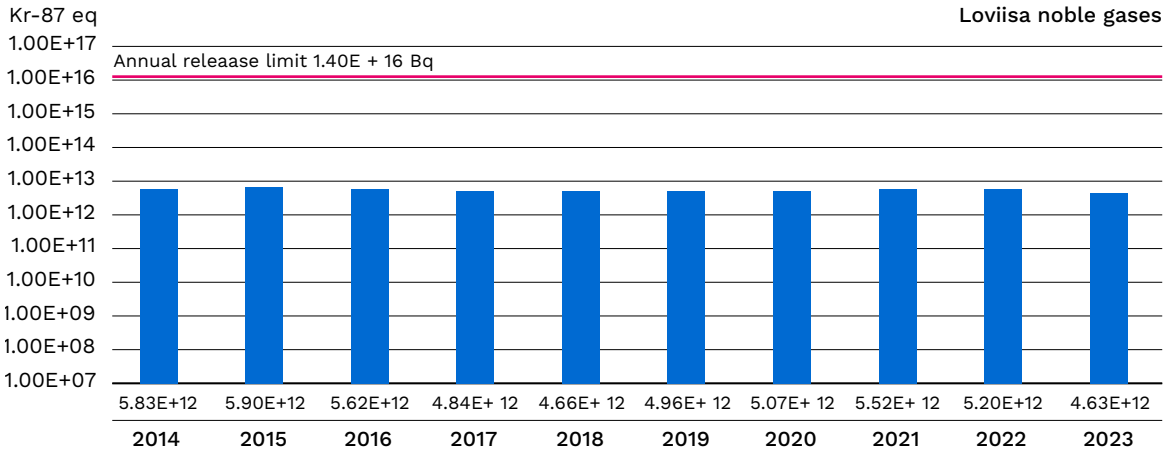

FIGURE 3. Noble gas releases to the atmosphere (Kr-87 eq), Loviisa.

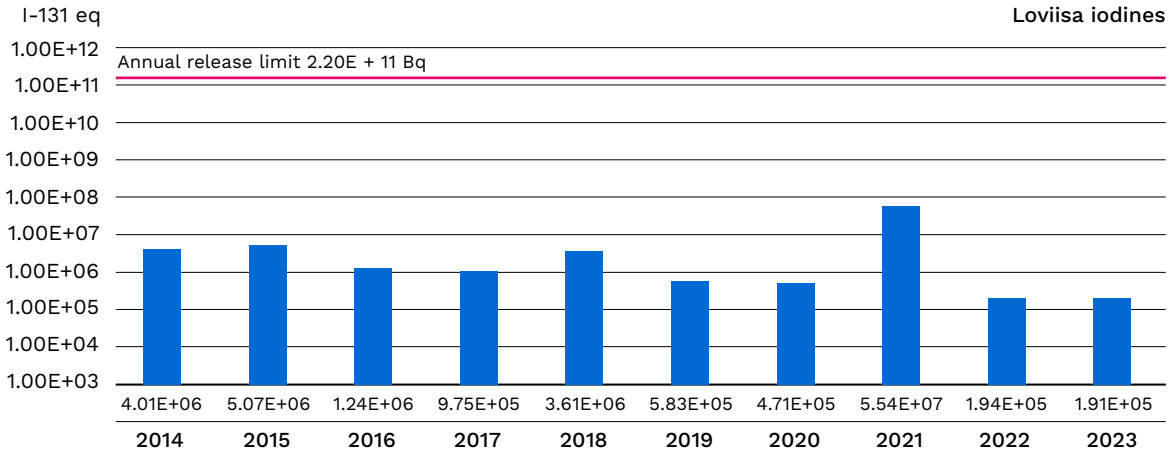

FIGURE 4. Iodine isotope releases to the atmosphere (I-131 eq), Loviisa.

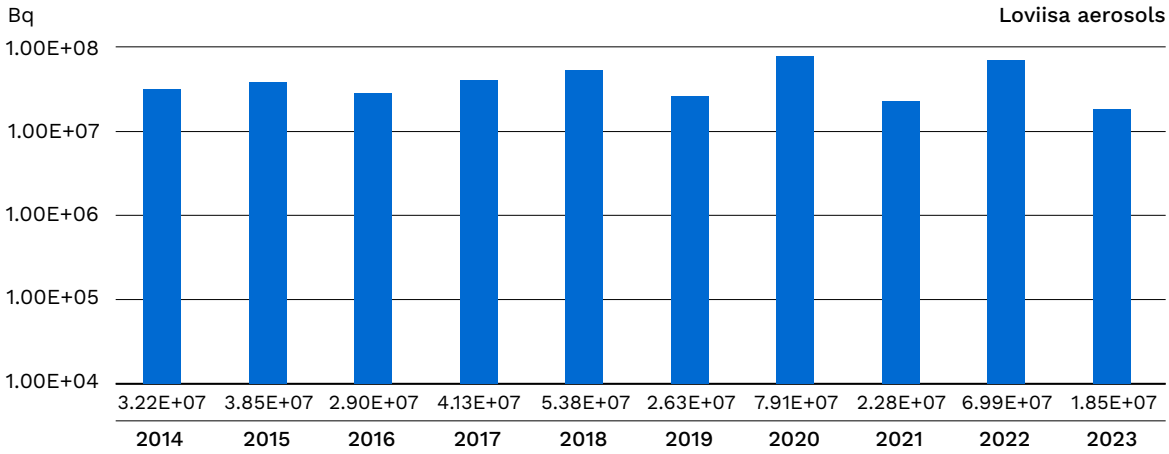

FIGURE 5. Aerosol releases to the atmosphere (Bq), Loviisa.

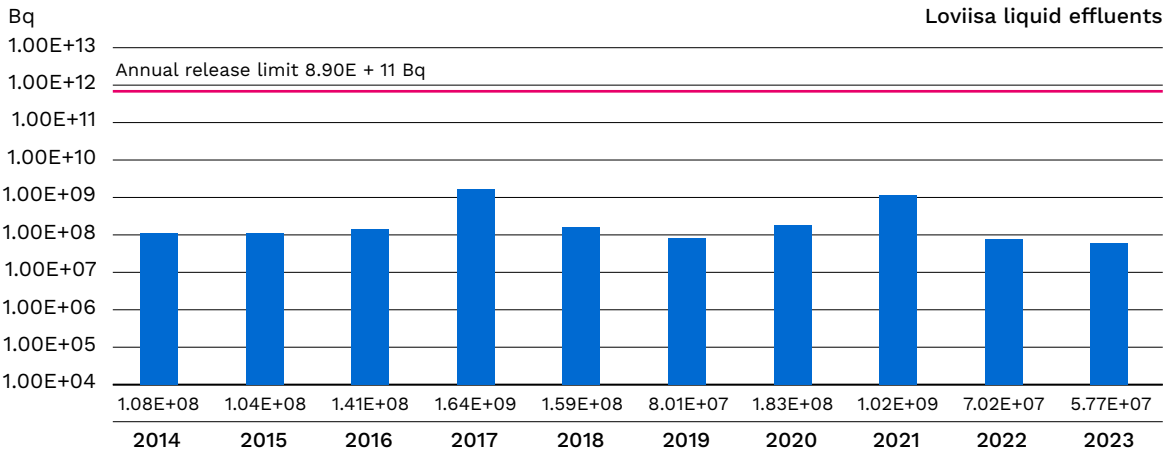

FIGURE 6. Gamma activity of the liquid effluents (Bq), Loviisa.

Operational events and operating experience feedback

STUK received notification from Fortum of 20 events that occurred or were observed at the Loviisa plant units in 2023. The events revealed areas for improvement in the organisation's activities. In five of the events, deficiencies in managing the separations of the equipment caused the plant unit to end up in a situation that was in violation of the Operational Limits and Conditions (OLC). Separation management ensures that the devices to be maintained are separated from the systems electrically or physically for the duration of maintenance. Fortum has earlier recognised shortcomings in the management of separations, which result in a variety of consequences, such as events. Fortum analysed the overall arrangement and initiated improvements through a generic investigation, which was completed in the spring of 2023. Fortum is currently assessing what the four events after this say about the progression and success of the improvements.

By reviewing the results of the event investigations, STUK verified that Fortum has investigated the underlying causes of the events and initiated the actions to correct technical faults and deficiencies in its organisation's performance and to prevent the reoccurrence of the events. STUK also utilises the results of the event investigations to discern the overall status of the various controlled areas and focus its control measures.

In its oversight measures in recent years, STUK has paid attention to the recurrence of events of the same type and some deficiencies generate several different events. In 2017, STUK required Fortum to determine why operating experience procedures (such as event investigations) sometimes fail to identify or rectify deficiencies in technology, operations and culture. As part of its oversight activities, STUK has checked that Fortum's development activities are progressing. The independent and active investigation of the separation management described above indicates that Fortum desires change at various levels of the organisation.

In its oversight, STUK paid attention to the fact that there have been several changes of personnel in the organisation unit that handles Fortum's operating experience activities in recent years. The repeated changes have impacted the workloads of the personnel and caused temporary drops in the joint level of competence.

Most significant events

Storage of contaminated pallets outside the controlled area, INES 1

During the annual outage on 15 September 2023, it was observed when moving pallets in the unclassified radiation area of the LO1 unit auxiliary building that two of them were contaminated. Fortum immediately set out to determine the origin and extent of the contamination. Based on the investigation, it was determined that the level of contamination was very low (total activity 156 kBq and maximum dose rate 35 µSv/h), which was not significant in terms of safety. In other words, contamination of this scope would not have compromised safety even in the worst-case scenario.

The event was due either to taking material across the boundary door of the controlled area without radiation measurements or to deficient radiation measurements in connection to the outgoing measurements at the boundary door of the controlled area. These are affected by deficiencies in structural obstacles and the contamination management of transport activities through the controlled area. One of the problems related to this at the boundary door of the controlled area is that the cargo should sometimes be unloaded for sufficiently thorough radiation measurements, but the large number of transports may not provide enough time for this.

The investigation found that the instructions have been observed more generally but that individual activities in violation of the instructions cannot be ruled out entirely. Since contaminations were found in a space determined to be clean and in which contaminations are not expected to occur (potential risk in procedures), the event was classified as INES 1. The INES classification i.e. the International Nuclear and Radiological Event Scale is described here: https://stuk.fi/en/the-international-nuclear-and-radiological-event-scale-ines.

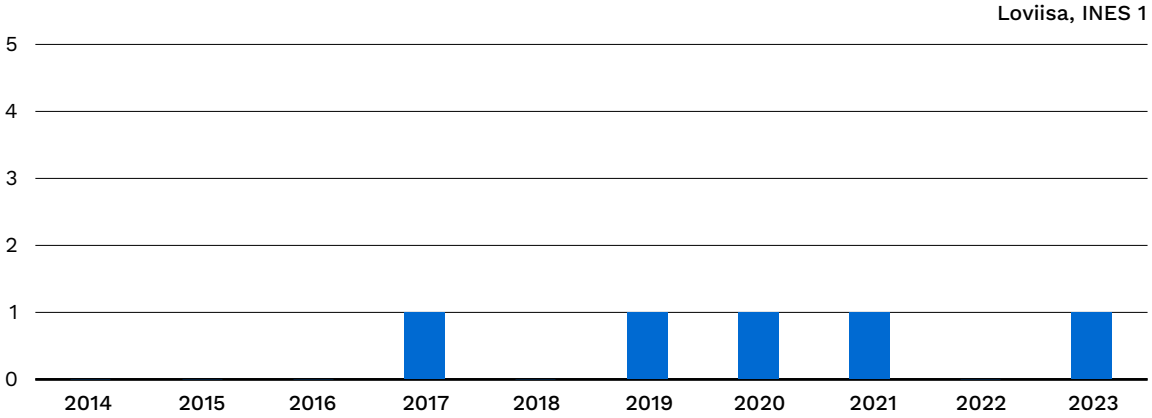

FIGURE 7. INES classified events at the Loviisa plant (INES Level 1).

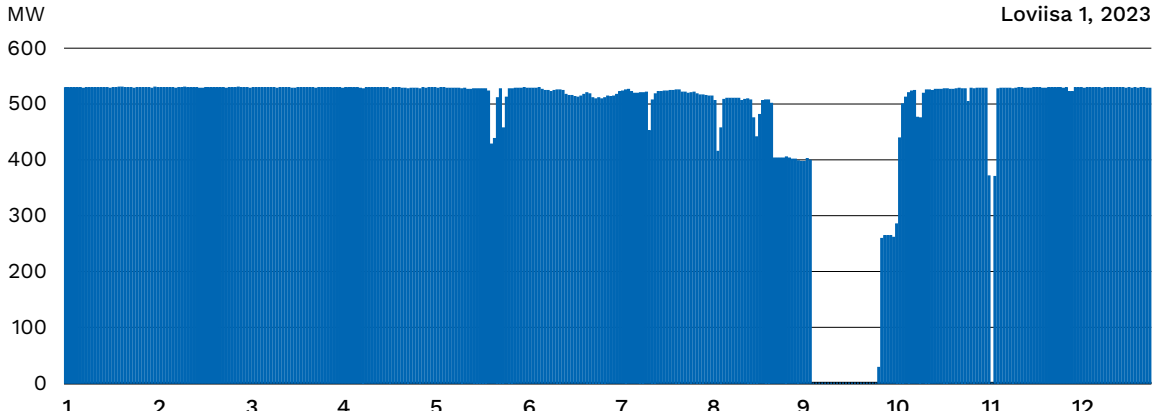

FIGURE 8. Daily average gross electrical power of the Loviisa 1 plant unit in 2023.

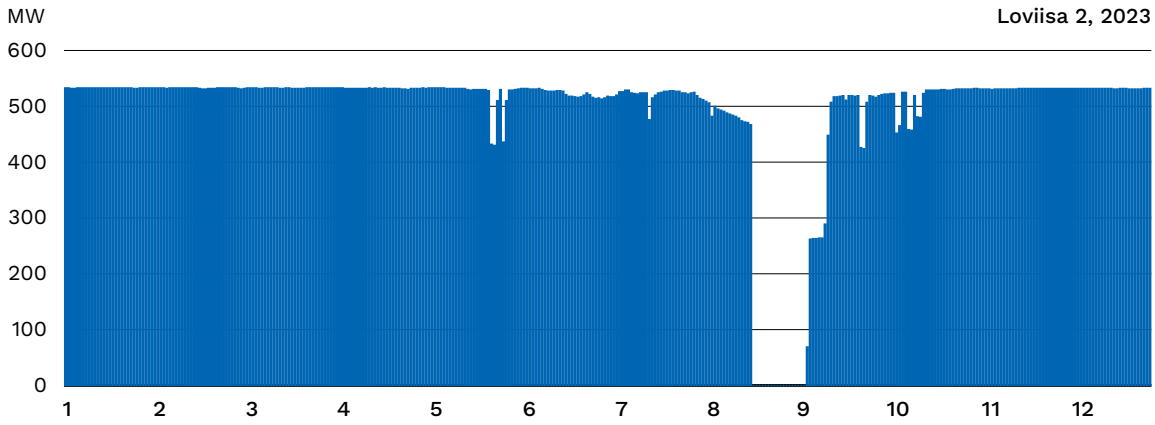

FIGURE 9. Daily average gross electrical power of the Loviisa 2 plant unit in 2023.

Annual outages and maintenance operations

The annual outages of the power plant were implemented as planned in terms of nuclear and radiation safety and very well in terms of the radiation doses of employees. The total radiation dose of Loviisa 2 was the lowest in plant history, and the collective dose of the Loviisa 1 annual outage was also very low, which means that the total result was the lowest in plant history (doses at the start of this section). In addition to this, the number of contamination alarms was very low.

The Loviisa annual outages began on 20 August 2023 with the maintenance of the LO2 unit and ended when the LO1 unit began electricity production after the outage on 1 October 2023. Fortum conducted a brief annual outage on both units according to the original plans. Fortum replaced some of the reactor fuel with fresh fuel, handled the necessary repairs, inspections and maintenance and continued the management of plant ageing and modifications aimed at improving safety. Fortum also rectified very small primary circuit drips inside the containment, which were observed at the end of 2022 during operation and were then monitored continuously. The leaks were not significant in terms of safety.

An important measure related to the continued operating licence granted to the nuclear power plant at the start of 2023 and ageing management was the installation of 12 additional protection elements installed at the edge positions of the LO1 reactor. Their purpose was to reduce the radiation inside the reactor pressure vessel and thereby contribute to ensuring that the safety margins remain sufficient until the end of the current operating licence. Corresponding elements were installed in the second reactor during last year's annual outage. During the loading of new fuel, Fortum also loaded into the LO2 reactor a test fuel bundle provided by a potential new fuel supplier, Westinghouse, which did not include uranium fuel. The purpose of this is to test the flow properties of the new bundle, among other things.

As a more extensive maintenance measure, Fortum replaced a total of seven internal cover seals of the main control pumps of both units during the annual outages of both units. Minor but higher than normal leakage was observed in them during the previous operating period. The main circulation pumps are located inside the containment building and they always feature two cover seals – the inner and outer seal. A minor leak in the inner seal alone does not have safety significance. In connection with replacing the seals, Fortum also installed more

extensive leak pressure monitoring. However, after the annual outage as the power operation of the plant continued, the minor leaks in the cover seals resumed, which means that the matter will require further monitoring and measures in 2024.

In connection with annual maintenance, STUK checked and approved the plans prepared by Fortum, monitored the performance of the work and approved the end result. A summary of the inspection conducted by STUK according to the inspection programme is presented in Section 1.1.5 Periodic inspections.

In terms of maintenance, the general operations have aligned with the requirements: the periodic inspections have been carried out according to requirements and the relevant Periodic Inspection Programme (KTO) inspections have found Fortum's inspection activities to be good.

Nuclear safeguards

In 2023, STUK granted Fortum two import licences concerning nuclear use items (Appendix 1). STUK approved Fortum's new international nuclear safeguards manual for the transfer of nuclear materials. In the manual, Fortum determines the accounting and oversight procedures for international nuclear material transfers. In addition to this, STUK approved a new deputy for the person in charge of nuclear safeguards. Fortum submitted the nuclear safeguards reports and notifications it was responsible for in time, and they were consistent with the observations made during inspections.

In 2023, a total of nine nuclear safeguards inspections were conducted at the Loviisa power plant. STUK performed an inspection pertaining to the physical inventory verification of nuclear materials together with the IAEA and the European Commission, both before and after the annual outages. Furthermore, STUK inspected the positions of the fuel assemblies in the reactor cores of both reactors prior to the closing of the reactor covers. The IAEA and the Commission carried out one inspection at short notice in the material balance area at the Loviisa power plant. The oversight and inspections by STUK indicated that the Loviisa plant fulfilled its nuclear safeguards obligations in 2023.

Nuclear security arrangements

In 2023, STUK carried out two KTO inspections regarding nuclear security. One covered the nuclear power plant's physical nuclear security system and the other addressed information security. The inspection of the physical security arrangements covered modifications, the human resources and competence of the security arrangements, and the training and exercise activities, among other things. The inspection of data security covered the data security of the process computer environment and data security testing in general. The summaries of the inspections are provided in Section 1.1.5.

According to STUK's assessment, the nuclear security system (including information security) at the Loviisa power plant is up to date, has been purposefully developed and Fortum has sufficient plans to ensure safety.

Fire safety

In 2023, STUK oversaw the fire safety of the power plant by means of site visits and by reviewing reports submitted by Fortum. Site visits were carried out to verify the fire protection system during annual outages. The annual outage oversight focused on the operation of Fortum's

fire protection organisation. The activities monitored included the plant fire brigades shifts, hot work supervision and the officers of the plant fire brigade. Fire safety at the Loviisa power plant is at a good level.

1.1.2 Technical condition of the plant and preparing for exceptional events

The Loviisa power plant is undergoing a number of modernisation projects to improve the plant's safety and ensure safe operation in accordance with the new operating licence. STUK is monitoring the progress of projects that are important to safety, checks and approved plans related to changes and approves the end result. In 2023, Fortum renewed the final automation system of the LO1 emergency diesel generators. The project was carried out one machine unit at a time, starting from the annual outage of 2020. Fortum is planning the implementation of a corresponding change for LO2 as well.

In addition to the automation, the cooling piping of the first emergency diesel generator was also replaced at LO1. A project concerning the cooling water piping of LO1 was initiated in 2020. For LO2, equivalent replacements were carried out in 2018–2021.

During the annual outages, Fortum also modernized the radiation measurements during accidents of plant unit vent stacks in relation to the management of their ageing: in this instance, one of the two measurements was replaced at both plant units. For example, the measurements are used to determine the quality and quantity of emissions released through the ventilation stack during and after accidents.

Among the other most significant modifications conducted by Fortum were modernising the roof of the LO2 reactor building – this was done for LO1 in 2022 – and the final phase measures of the extensive modernisation of the chemical systems.

Reports and analyses

Fortum has furthered the measures to ensure the plant's earthquake resistance and, during 2023, provided STUK with updated building durability assessments and estimated the impact on of the new design earthquake determined in 2021 on the estimated resistances of the building and structures.

In the 2023 risk analysis, Fortum continued to update the seismic risk assessment of the Loviisa power plant based on new and specified hazard and sustainability assessments. Based on the 2023 results, the seismic risks for the plant accounts for about 30% (previously about 20%) of the estimated reactor core damage as per a probability-based risk assessment (PRA). The increase in seismic risk is primarily due to the fact that Fortum has also included other estimates of the seismic resistance of equipment. The process is a long-term equipment resistance assessment that considers uncertainties related to seismic hazard and equipment durability in a more conservatively than before. Investigations related to earthquakes are still under way, and the distribution of risk across the various devices will be specified as analyses are updated. After this, Fortum will determine the possible corrective measures to reduce the earthquake risk.

A minor leak in the spent fuel storage pools was also investigated more extensively in 2023. Since 2022, one of the storage pools of the Loviisa power plant's interim storage for spent fuel has had a minor and unchanging leak which Fortum has not been able to fully

locate and repair. Based on the investigations conducted by Fortum in 2023, the leak does not endanger plant safety or the environment. Fortum has monitored the amount of the leak regularly with the leakage monitoring system of the pools. Minor leaks have also been detected in other storage pools previously, but the leak points have been found and repaired. STUK has also required Fortum to provide a wider report on the matter by the end of April 2024, so that it can more accurately estimate Fortum's plans and schedules regarding future measures in order to determine, among other things, the root cause of the leaks and the ways in which these types of events have been taken into account in the context of storage capacity expansions related to the operating licence (cf. Section 1.1.6).

Emergency response arrangements

STUK oversaw the ability of the Loviisa power plant emergency response organisation to act under exceptional conditions by making inspection visits and reviewing reports and emergency response plan updates submitted by Fortum. A periodic inspection was also prepared on emergency activities, the summary of which is presented in Section 1.1.5. No events requiring emergency response actions took place at the Loviisa power plant in 2022.

An extensive cooperation exercise was held in December in which the Loviisa power plant was at the centre of the scenario. The exercise served as the power plant's annual emergency response exercise. More than 20 organisations, mainly from public administration, participated in the exercise. STUK's emergency response organisation practised emergency activities at STUK's security control centre. STUK took part in the efforts of the exercise planning group and assessed the activities of Fortum's emergency organisation in the context of the exercise.

In STUK's opinion, Fortum has systematically developed the emergency response activities of the Loviisa plant and the plant's emergency arrangements meet the relevant requirements.

1.1.3 Operation of the organisations

STUK oversaw the operations of the Loviisa power plant in 2023, which included the supervision of safety culture and management, competence and resources, and the validity of the management system. The oversight has been conducted through KTO inspections, topic-specific meetings, annual outage oversight and the processing of operating events. A summary of the KTO inspections on the organisation's operations is provided in Section 1.1.5 Periodic inspections.

The focus of STUK's oversight has been on verifying the licensee's capability to critically assess development targets in its own operating culture and manage the necessary changes in operating practices in a goal-oriented manner. Through its oversight, STUK has particularly monitored the achievement of the development targets identified by Fortum in its safety assessment. The development targets related to the organisation's operations and culture are being worked on as planned. Based on the availability investigation, Fortum has initiated measures which STUK will monitor through its oversight.

By Fortum's application, STUK has approved the head of the Nuclear Fuel and Waste Management unit as the deputy of the responsible manager for the operation of the final disposal facility for low- and intermediate-level waste.

In June 2023, Fortum carried out an organisational change at the Loviisa power plant, which divided the maintenance technology unit's operations to the maintenance unit and technology and investments unit. In connection with the change, a group that is responsible for maintaining and developing the investments and project management processes in Loviisa was connected to the unit. Through the organisational change, Fortum is preparing for the modernisation projects required by extending the operating licence. STUK has also targeted more resources at the oversight of the Fortum's project management.

1.1.4 Operational waste

The processing, storage and disposal of low- and intermediate-level waste (operational waste) at the Loviisa power plant were carried out as planned. The volume and activity of operational waste in relation to reactor power remained low compared with most other countries. Fortum has continued to carry out development tasks related to power plant waste management, such as the development of the solidification process for liquid waste and the reassessment of the final disposal concept. At the end of 2023, Fortum made an investment decision on updating the final disposal concept, and the update efforts will be initiated in 2024. The update of the final disposal concept aims to ensure the safe operation of the final disposal facility all the way to the end of the operating licence period, i.e. the year 2090. More generally, the goal of the development projects is to increase operational efficiency and reduce the quantity of waste requiring final disposal.

Over the course of 2023, Fortum updated its safety analysis report regarding the final disposal facility and the instructions on the decommissioning waste generated by the dismantling of the FiR 1 research reactor to enable receipt. In addition to this, Fortum updated the safety justifications regarding the final disposal of the dismantling waste and delivered it to STUK for review. The waste generated by the dismantling of the research reactor is intended to be transported to Loviisa in 2024.

STUK examined the functionality of the Loviisa power plant waste management procedures as part of the annual outage inspection. The inspection did not reveal any deficiencies in Fortum's operations. In 2023, STUK also conducted a KTO inspection on the final disposal facility for low- and intermediate-level waste – a summary is provided in Section 1.1.5.

The oversight and inspections by STUK indicate that power plant waste management at the Loviisa plant has been developed in a goal-oriented manner and the total arrangement meets the requirements.

1.1.5 Periodic inspections

In 2023, STUK conducted 16 inspections at the Loviisa nuclear power plant under the periodic inspection programme. Inspections were carried at the plant site as combinations of remote and on-site inspections, i.e. hybrid inspections. Based on the inspections, it can be stated that Fortum's operations comply with the requirements and take safety into account well.

The inspections included in the periodic inspection programme focus on safety management, the main operational processes and procedures, and the technical acceptability of systems. These inspections verify that the operation, maintenance, safety assessment and

protection activities of the relevant facility comply with the requirements laid down in the nuclear safety regulations.

Security arrangements – physical protection, 25–26 April 2023

The inspection focused on the security arrangements of the facility, which are considered to include structural, technical, operational and organisational arrangements to detect, delay and prevent unlawful or unauthorized activities.

As a conclusion to the inspection, STUK states that, in the security arrangements, the licensee's human resources, competence, training and exercise activities and the timeliness of the instructions are appropriate and sufficient at the Loviisa nuclear power plant. A number of good practices were detected during the inspection. STUK monitors the progress of matters recorded as observations as part of its normal supervision.

The licensee also has adequate plans for the continuous improvement of security arrangements to ensure the safety of the Loviisa power plant. Modifications and other development areas aimed at this are proceeding systematically. STUK continuously monitors these matters as part of its normal supervision.

No requirements were made on the basis of the inspection.

Radiation protection, 25–27 April 2023

One of the main topics of the radiation protection inspection was learning from operating experiences in the radiation protection area of responsibility. Information was also obtained on the functionality of Fortum's operating experience procedures. With the help of operating experiences, it has been possible to improve, for example, contamination management. On the other hand, scheduling pressures have somewhat reduced the effectiveness of learning from operating experiences.

The inspection also addressed the resource situation of radiation protection and timeliness of instructions, implementation of the ALARA action plan, alpha radiation measurement programme, formal self-assessment of radiation protection and other topical issues as well as the status of measures in ongoing development areas.

As a conclusion to the inspection, STUK states that Fortum is investing in the development of radiation safety and operations in accordance with the ALARA principles. In the audit, STUK required Fortum to provide a summary of the fulfilment of the requirements of the YVL Guides for the rooms below the spent fuel storage building (so-called sand rooms) after the ongoing leakage control line improvements as well as information on the activity measurements of the filters of the air-conditioning machines in the chemical laboratory.

Safety functions, 2–3 May 2023

The topic of the 2023 Safety functions inspection was fuel and reactor. In connection with these, the criticality safety assessment procedures and monitoring during use of the reactor from instrumentation to simulation and the status of related systems were inspected. In addition, the number and competence of personnel and the status of guidelines were reviewed.

Fortum has developed the reactor monitoring system as part of its own research and development activities, such as studying the impact that updates to the reactor performance calculations have on the calculation results. The status of the automation systems related to reactor monitoring was good: Significant defects, spare part deficiencies or major new devel-

opment needs were not identified. In accident analyses and investigations related to criticality safety, Fortum relies heavily on subcontractors. As such, the company's own expertise in this area could be improved, if possible.

There have been positive changes in fuel transfers since the organisational change in 2018. Based on the inspection, the persons involved in fuel handling have a sufficient understanding of criticality safety in the event of accidents. There has been recent turnover in the group responsible for the use of fuel, and new employees are being recruited, which poses a need to ensure the development of in-house expertise in this area.

On the basis of the inspection, STUK did not make any requirements. Based on the inspection, this area meets requirements. STUK monitors the development of the resourcing and competence of the group responsible for the use of fuel in connection with other supervision.

Security arrangements – information security, 2–5 May 2023

The inspection concerned the information security of the plant in accordance with the focus areas of the inspection. As a conclusion to the inspection, STUK states that, in the field of information security, the licensee's project management, human resources, competence, training and exercise activities are appropriate and sufficient at the Loviisa nuclear power plant. Good practices were identified in the inspection.

The licensee has plans for the continuous improvement of information security in order to develop the overall safety of the Loviisa power plant, and information security is also taken into account in other development projects at the plant. Modifications and other development targets related to information security of the Loviisa power plant are proceeding according to schedule. STUK monitors these as part of its normal supervision.

No requirements were made on the basis of the inspection.

Chemistry, 9–10 May 2023

The inspection covered the licensee's procedures related to the maintenance of the primary and secondary circuit's water chemistry, monitoring the radiochemical conditions of the circuits and the water chemistry and radiochemistry of the fuel pool as well as the quality control of laboratory operations. The inspection dealt with human resources from the point of view of adequacy and competence. In addition, the inspection covered the up-to-dateness of guidelines and equipment management of continuous analysers, as well as the use of the analysis results in managing water chemistry and radiochemistry.

Based on the inspection, the number of qualifications managed by the Usage Chemistry organisation has been maintained at a good level, despite a lot of recent turnover in the organisation. The organisation's resources have been increased to ensure Fortum's own expertise in areas such as waste analytics.

The quality management of the chemical laboratory is at a good level. The water chemistry of the primary and secondary circuit and monitoring of the status of water chemistry are at a good level. Changes in activity levels have remained moderate. It is important to further deepen the competence of the people responsible for performing activity monitoring by putting into practice the lessons learned from training. On the basis of the inspection, STUK required Fortum to evaluate and, if necessary, supplement the nuclides presented in the annual report from the perspective of verifying the monitoring of radiochemical phenomena.

Safety planning, 22–25 May 2023

The inspection focused on deterministic safety analyses of the Loviisa power plant. The inspection addressed the existing procedures and their development needs related to the validation of computer programs, the development of calculation models, the definition of analysis cases and the processing of analysis results. On the basis of the inspection, STUK did not present any requirements. Fortum has strong expertise in process analysis and the number of experts is sufficient. Procedures for conducting deterministic safety analyses are systematic and well-established.

Annual maintenance, 20 August – 26 September 2023

The inspection on Loviisa plant's annual maintenance assessed and validated the activities related to the safe implementation of the annual maintenance of the plant units. Several technical inspectors participated in the inspection, carrying out site tours, monitoring the activities, interviewing personnel and monitoring progress of the planned work. The site tours performed during annual maintenance paid particular attention to the management of bulk parts. The targets of this year's inspection included:

Corrective actions determined on the basis of operational events related to annual maintenance

- Supervising the performance of NDTs
- Preparation and application of electrical schedules in annual maintenance
- Radiation protection procedures during annual maintenance
- Industrial radiography imaging at the Loviisa power plant
- Utilization of PRA and downtime risk assessments in annual maintenance
- Periodic inspections on structural technology
- General tidiness and order related to earthquake resistance (seismic housekeeping)
- Preventive maintenance of reserve emergency feed water system during annual maintenance
- Fire protection
- Waste management
- Management of bulk parts.

During the annual maintenance, no deviations were found in Fortum's operations that would have required immediate intervention from STUK. On the basis of the inspection, it can be concluded that Fortum's annual maintenance activities comply with the requirements. Based on the inspection, STUK presented a number of observations and requirements for the further development of operations and for ensuring safety also in future annual maintenances. The requirements were related, among others, to the supervision of the performance of NDTs, preventive maintenance of the reserve emergency feed water system, general tidiness and order related to earthquake resistance as well as the implementation of corrective measures determined on the basis of operational events.

Final waste disposal facilities, 4–5 October 2023

The inspection allowed to STUK to assesses whether the final disposal facilities (VLJ cave) for power plant waste of the Loviisa plants and their use comply with the general safety principles and regulatory requirements for nuclear waste management. The 2023 inspection focused es-

pecially on monitoring the characteristics of the rock surrounding the final disposal facilities for power plant waste and their stability. Other topics reviewed were the personnel resources and competence of the waste management team, the up-to-datedness of the instructions and the priority of safety in the operations in general.

Based on the inspection, the waste management team displays a solution-oriented approach in its operations and knows how to prioritise tasks sensibly. The fundamentals of the group (e.g. instructions and the need to update them, as well as increasing the competence of the staff) are in order. The waste management team has recently also acquired expertise in concrete technology, and training within the group has been started in this regard.

Measures taken to prevent the previously observed damage to metal drums containing absorbed solidified waste from the maintenance waste facilities 1 and 2 have progressed and the damaged drums in maintenance waste facility 2 have been packed in concrete crates during 2020–2021. Fortum has, for example, developed a new solidification formula for resins and dregs, as well as for scintillators. The development of the formulas will continue in 2024.

The operation life of the VLJ cave is about to be extended until the 2090s with a new operating licence, which has been taken into account in ongoing studies and ageing management. Fortum has, for example, mapped the condition of shotcrete surfaces widely and planned to change the final disposal concept with regard to the packaging of the drums in service waste facilities HJT1 and HJT2.

When it comes to rock mechanics, Fortum has investigated the adequacy of the monitoring network that monitors the rock mechanics at the VLJ cave. Fortum is also developing a visualization program for the results output by the measuring devices measuring rock mechanics, enabling the results to be monitored in real time.

The training and equipment related to fire protection in the VLJ cave were in order.

STUK did not present any requirements inspection and considers that the inspected items comply with the requirements. In STUK's view, however, it is important for Fortum to invest in the development of timely monitoring of hydrological measurements in the VLJ cave.

Structures and buildings, 17–18 October 2023

The inspection focused on the use, condition monitoring, maintenance and ageing management of structures and buildings, as well as seawater ducts and tunnels. The inspection assessed the licensee's procedures and operations and reviewed the results of inspections carried out by the power company and the modifications made.

STUK did not present any requirements, but some observations were recorded in order to monitor their development in the future. Positive observations concerned the introduction of competence requirements in the target organisation, the completion of the roof renewal projects of the reactor building and Fortum's active participation in concrete technology research on the management of ageing and operation life extension (LTO). Other observations concerned the need for STUK to process earthquake-classified, EYT (non-nuclear safety classified) equipment and support structures as part of the nuclear power plant's protection against external threats, and the development of the current way of assessing the operating condition of plant components to it better suited for power plant buildings.

The Loviisa power plant's periodic inspections and repairs of structural technology as well as modifications have been carried out as planned. In STUK's view, the use, condition monitoring, maintenance and ageing management of structures and buildings is at a sufficient level.

Automation technology, 31 October – 1 November 2023

The inspection focused on Fortum's automation technology systems, organisation and instructions. As a special topic, we reviewed the types of circuit board repairs performed by Fortum's Automation Maintenance and how the suitability of the components used in the repairs is assessed. We also reviewed the management of automation documents in modification projects, for example.

The instructions for automation technology are up-to-date. In order to ensure that the plant documentation concerning automation is up-to-date, Fortum has carried out development work, which will continue with the digitalization of the automation archive, among other tasks. Procedures for project documentation will also be developed. Automated testing equipment has been developed for circuit board repairs carried out by Automation Maintenance, enabling the functionality of the board to be tested in a more traceable and harmonious manner in the future. STUK supervises the progress of Fortum's development measures as part of normal operational supervision.

The QC functions of automation are largely dependent on one person, which is why STUK required Fortum to assess and carry out an analysis of the situation. Otherwise, there were no comments concerning the resources.

As a conclusion of the inspection, STUK states that, with regard to automation technology, the operations are in accordance with the regulations.

Safeguards of nuclear materials, 6–7 November 2023

The inspection focused on safeguards procedures, accounting, and the methods of maintaining the expertise and adequate resources for the safeguards. On the basis of the inspection, it can be concluded that the safeguards procedures at the Loviisa power plant are appropriate. The amount of resources and the competence of the persons responsible is at a good level. Minor deficiencies were found in the accounting of nuclear safeguards and, as a result, a total of three requirements were presented to remedy them. The requirements concerned advance notifications associated with the safeguards, inventory reports and improving the associated guidance.

Emergency response arrangements, 7–8 November 2023

The inspection covers the nuclear power plant's emergency response arrangements, instructions, facilities and training. The inspection reviewed the past year's experiences gained from emergency response activities, as well as experiences and feedback from emergency response exercises. The inspection also covered automatic environmental radiation monitoring, meteorological measurements and the forecasting of the spreading of emissions.

Based on the inspection, the headcount and competence of Fortum's personnel involved in emergency response arrangements is sufficient and the instructions are up-to-date. The general development of emergency response arrangements has continued. The development projects are progressing as planned and many have already been completed.

For example, Fortum is revising the structure and content of the support material for radiation experts. Another area of development is the co-operation between STUK and the plant's radiation experts. The roles of the emergency response organisation have also been developed, resulting in a more evenly distributed workload in the future.

The further specifications to the passageways to be used in a radiation situation have been completed and training is about to start at the end of 2023.

The inspection concluded that Fortum's emergency response arrangements are at the required level.

Plant maintenance, 7–8 November 2023

The objective of the plant maintenance inspection is to verify that the licensee takes care of the operability of the systems, structures and equipment in the short and long term.

The inspection assessed the sufficiency of resources for condition monitoring, mechanical maintenance and ageing management in all plant units, the training situation and the update of the associated guidelines.

Fortum presented the organisational change implemented in the summer of 2023 from the perspective of operation life management and maintenance operations. In STUK's view, the change will promote the performance of maintenance and operation life management tasks.

In recent years, Fortum has worked effectively to procure the missing spare parts that are necessary during long-term disturbances and accidents (requirement 724 of Guide YVL A.8), and the situation has improved considerably. With the exception of two systems, all device data of the systems have been exported to the database (LOAM) developed for the ageing management of the plant. On the basis of the inspection, STUK required Fortum to export the missing devices of the two systems into LOAM and to update the time-limited analyses in accordance with the plan announced by Fortum. STUK will verify the results in the 2024 inspection. STUK is of the opinion that LOAM developed by Fortum is a good tool and only needs a few finishing touches.

Based on the inspection, it can be concluded that the inspected entity is at a good level.

Using a PRA, 14 November 2023

The inspection focused on the preparation of a probabilistic risk analysis (PRA) for the nuclear power plant, the procedures related to its application, as well as the use of the PRA in the safety management of the plant. The inspection reviewed the status of the PRA models and applications of Loviisa 1 and 2 nuclear power plant units and the spent fuel storage, the extensions and updates in preparation, and their schedules. The most significant ongoing update is related to the seismic risk assessment, and the update work will continue in the coming years. The inspection also assessed the organisation's guidelines and activities related to the preparation and application of the PRA.

No requirements were made on the basis of the inspection. On the basis of the inspection, it can be concluded that the PRA guidelines are up to date, the PRA has been developed as planned and the PRA is used in a variety of ways to support safety management. No material change has occurred in the PRA resources, and there are no comments on the management of the personnel's skills.

Electrotechnics, 29–30 November 2023

The inspection focused on the electrical maintenance organisation, the condition monitoring of safety-classified battery banks, the timeliness and maintenance of the electrotechnical plant documentation, the verification of the suitability of replacement spare parts when selecting components, and the ageing and condition monitoring of the cables in the evaporator space.

In 2024, the successors have been recruited well in advance for the retiring electrical maintenance supervisors, and the new supervisors will be able to familiarize themselves with their work alongside their predecessors.

The condition monitoring methods of the safety-classified battery banks are appropriately described in Fortum's internal maintenance instructions for the battery banks, so there was nothing to comment on them.

A detailed assessment of the suitability of replacement electrotechnical spare parts is carried out as part of the preparation of installation plans. When repairing electrical equipment, no separate suitability assessment will be made for the replacement electrical components. Instead, Fortum will carry out an internal spare part investigation for these components.

The investigation of the replacement of the LOCA-qualified cable in the evaporator space of the plant units has begun. Fortum's measurements carried out in 2005 and 2016 in connection with the ageing of the cables revealed elevated temperatures in the cable shelves of the evaporator rooms. A further inquiry found that the measurement methods used in those years were unusual compared to the measurement methods used in other years and therefore the results are not comparable. Thus, the temperatures in the evaporator space have remained practically stable over the years, so there is no need to make a change to the qualified lifespan of the cables in the evaporator spaces based on the measurements made.

In STUK's opinion, the situation in the inspected electrotechnical subject areas was appropriate. No requirements were made on the basis of the inspection.

Operation of the organisation, 29 November – 1 December 2023

This year's inspection focused on management and managerial work. The topic was approached from the perspective of setting goals and expectations, assessing and measuring operations, and developing them.

On the basis of the inspection, STUK concludes that the plant's objectives have been defined and their attainment is monitored regularly. The operations of the Loviisa organisation are characterised by trust in supervisors and a permissive attitude towards variance in operating methods of the different organisational units, which is appreciated, but which might also slow down the implementation of changes related to operating methods or the detection of local challenges in the organisation.

The success of supervisors' activities has begun to be evaluated, and supervisors are provided with support from HR and training, taking into account the needs of the industry where safety is paramount.

The power plant and the licensee's operations meet the requirements of the regulations within the topic of the inspection. In STUK's view, communicating and implementing uniform expectations throughout the organisation still requires investment at the Loviisa plant, but Fortum has measures in place in this regard.

1.1.6 New operating licence – separate licences for the Loviisa power plant and waste final disposal facility

On 16 February 2023, the Government granted an operating licence pursuant to the Nuclear Energy Act (990/1987) to Fortum Power and Heat Oy's Loviisa 1 and Loviisa 2 power plant units. By virtue of the operating licence, the nuclear power plant units can be used for energy

production up to the end of 2050. Loviisa's previous operating licences were effective until 31 December 2027 (LO1) and 31 December 2030 (LO2). The plant unit also received an operating licence for preparations for decommissioning no later than by the end of 2055. For buildings and storages required for nuclear fuel and nuclear waste management, including any requisite expansions, an operating licence was granted until the end of 2090.

In its safety assessment concerning the operating licence of the nuclear power plant, STUK stated that Fortum has the necessary preconditions, expertise and resources to continue the safe use of the plant units and manage the ageing of the facility. However, managing phenomena related to the ageing of the facilities will require measures, monitoring and safeguards to ensure safe operation until 2050. An important effort completed in relation to the extended operating licence and ageing management of the facilities is the installation of 12 additional protection elements at the reactor edge positions of both units (LO1 in 2023, LO2 in 2022). Their purpose was to reduce the radiation inside the reactor pressure vessel and thereby contribute to ensuring that the safety margins remain sufficient until the end of the operating licence. Fortum will analyse and confirm the impacts of the changes by the next period safety assessment before 2030.

In 2023, Fortum advanced the fuel licensing process of the new fuel supplier (Westinghouse), which will continue in 2024. The deployment of the new fuel is a multiyear project, and STUK must also approve the related documentation. With a new fuel supplier, Fortum has ensured fuel management after 2027 and 2030 when the current supply agreement with the Russian TVEL ends. Fortum provided the relevant report to the Ministry of Economic Affairs and Employment (MEAE) in late 2023, as required by the operating licence.

Fortum has an extensive modernisation programme (Loviisa long-term operation program, LTOP), which includes more than 100 investment projects and covers modernisation projects that are significant for safety improvements and ageing management in order to ensure the safe operation of the facility until the end of the operating licence. Fortum has made preparations for the project since 2017, and it currently covers the measures specified in the periodic safety assessment conducted in connection with the operating licence.

Over the course of 2023, Fortum has also prepared a corresponding programme related to the storage (KPA facility), processing and final disposal of spent nuclear fuel as well as waste management. Alongside the management of ageing, a particular aim is to ensure that the facility will have sufficient storage space for the nuclear fuel throughout its operation life and the capabilities to transfer the nuclear fuel to the final disposal facility.

STUK will oversee the timely and compliant implementation of Fortum's safety-improving methods. STUK also ensures that Fortum's plans and procedures regarding the management of ageing are sufficient. The safety of nuclear power plants is assessed comprehensively every ten years, as required by the Nuclear Energy Act. Fortum will conduct the next periodic safety assessment and submit it to STUK for assessment as planned in 2030.

TABLE 1. Periodic inspection programme of nuclear power plants.

Basic programme	Inspections in 2023	
	Loviisa 1 and 2	Olkiluoto 1, 2 and 3
I&C technology	x	x
Disposal facilities	x	x
Chemistry	x	x
Mechanical technology		
Interim storage of spent nuclear fuel		x
Operating experience feedback		x
Operation		x
Plant maintenance	x	x
Organisational factors (former Human resources and competence, Management and safety culture, Management system)	x	x
Fire protection		x
Utilisation of the PRA	x	x
Structures and buildings	x	
Electrical technology	x	
Radiation protection	x	x
Nuclear security	x	x
Safety design	x	x
Safety functions	x	x
Emergency response arrangements	x	x
Power plant waste		x
Annual outage	x	x
Nuclear safeguards	x	
Special subjects		
Decontamination		x
Readiness for the Provisional Take Over		x

1.2 Olkiluoto nuclear power plant

STUK oversaw the safety of units Olkiluoto 1 (OL1), Olkiluoto 2 (OL2) and Olkiluoto 3 (OL3) and power plant waste management at the Olkiluoto nuclear power plant and assessed the operating organisation in different areas by reviewing materials provided by the licensee, carrying out inspections in line with the periodic inspection programme and the YVL Guides and overseeing operations at the plant.

On the basis of this regulatory oversight, STUK states that, as regards radiation exposure, the activities of the plant are safe for the employees, the population and the environment.

1.2.1 Finishing the commissioning of the Olkiluoto 3 unit

The nuclear commissioning of the OL3 unit was under way at the beginning of 2023. In January 2023, a repair and maintenance outage was initiated as planned at the OL3 plant to inspect the feed water pumps. Based on the inspection, new more durable impellers were installed in all four feed water pumps. During the repair outage, TVO and the plant supplier also conducted other necessary repair, maintenance and inspection measures. During the plant ramp-up following the outage, normal functional tests were carried out on the pressuriser safety valve stations. The task of the pressuriser safety valves is to provide the primary i.e. reactor circuit with overpressure protection during operation and in operational occurrence and accident conditions. Acceptable results were not achieved in the tests, and TVO decided to service the valve stations. For the maintenance, TVO decided to run the plant back to a cold state on 11 February 2023.

STUK monitored the activities during the maintenance outage at Olkiluoto and performed inspections on the pressuriser safety valve stations, for example. STUK required TVO to provide specifications on the pressuriser safety valves before starting the plant and on the operability of some measurement connectors that are essential to safety. The specifications were requested because TVO had noticed deficiencies in the connectors in its own inspections. Based on the

FIGURE 10. Olkiluoto nuclear power plant.

findings, TVO had conducted additional inspections and corrective measures to ensure operating condition. STUK did not have comments on the specifications and reports.

The pressuriser's safety valve stations were maintained in February–March, and their operation was ensured with functional tests in connection with plant ramp-up. The functional tests were completed in an acceptable manner, which enabled the continuation of the commissioning tests. The commissioning tests entailed a performance tests, which was included in the full-power tests, as well as test runs by the plant supplier and TVO in relation to an uninterrupted operating cycle and power adjustment tests. The tests were completed successfully, and the commissioning of the plant unit ended on 16 April 2023, after which commercial use, i.e. regular electricity production, was initiated at OL3. This transferred the total responsibility for OL3's operation and maintenance from the plant supplier to TVO. Overall, the commissioning tests conducted on the plant succeeded well in terms of nuclear safety.

TVO did not require a special licence from STUK to begin commercial use, but STUK monitored the preparation for the commercial use as part of its monitoring and conducted a separate inspection to review readiness in March 2023. As a conclusion of the inspection, STUK required TVO to determine measures that will, during the following operating cycles, ensure that any faults that may impact nuclear safety are rectified without unnecessary delays. TVO presented the procedures for the guarantee period to STUK in April and responded to and presented measures for open requirements previously laid down by STUK.

1.2.2 Safe operation of the plants

The operation of the Olkiluoto plant units has been safe in 2023. For the OL1 plant unit, the year did not involve significant faults that would have affected production or safety. Moreover, the refuelling outage in April was carried out successfully.

During 2023, the OL2 plant unit had to be shut down twice for an outage to repair observed faults. On 27 January, the plant unit was shut down for an outage to service a steam line isolation valve that closed too slowly during a periodic test. The fast closure of the isolation valve is important to prevent the discharge of reactor coolant and radioactive substances from the containment, if the need arises. For this reason, criteria for the closure time have been set in the Operational Limits and Conditions. On 18 August, the plant unit was shut down for an outage due to a leak detected in the generator cooling system. During the repair outage, a damaged generator rotor was replaced with a spare part rotor. The failure had no effect on nuclear or radiation safety. The annual outage of the OL2 plant unit was carried out successfully in May.

The regular power production of the OL3 plant unit began in April 2023. After this, electricity production had to be interrupted twice, with the reactor power being lowered to partial power: On 19 November, the plant unit experienced a turbine trip as a result of a failure in the plant generator's temperature measurement and, on 29 November, a turbine trip occurred at the plant unit as a result of a fault test.

Regular power adjustments of electricity production were carried out at all Olkiluoto plant units due to the situation of the electricity market. For the OL1 and OL2 plant units, this is a significant change in terms of running the plants, as the operation of the plants has traditionally involved consistent baseload power generation at full power. The OL3 plant unit is better equipped for power adjustment because the matter has been accounted for in the

design more extensively than in the two older units. At this point, there is limited experience regarding any long-term impacts that power adjustment may cause to the plants, for example the wear of equipment, systems and structures. The power adjustment also strains the plant operating personnel more than consistent power operation. STUK monitors the implementation of the power adjustment as part of its normal oversight activities. Furthermore, STUK's inspection programme for 2024 involves a special inspection regarding the impacts of power adjustment on the safe operation of the plants.

Planned reactor power uprate and service life extension of the OL1 and OL2 plant units

TVO has initiated a project to explore possible uprate of the reactor power and extend the operation life of the OL1 and OL2 plant units. The planned power uprate would raise the thermal power of the reactors from the current 2,500 MW by 10% to 2,750 MW. In the context of the power uprate, TVO will investigate the possibility of extending the service life of the plant units beyond the year 2038 stated in the current operating licence. TVO's analysis will assess extending the service life until 2048 or 2058.

TVO will submit a conceptual plan for the power uprate project to STUK during the first half of 2024. STUK will review the safety specifications and analyses related to power uprate, in which TVO must indicate that the power uprate will not reduce nuclear and radiation safety and that the plant will continue to meet the Finnish safety requirements. As part of the project, TVO has also initiated an environmental impact assessment procedure (EIA). TVO submitted the EIA programme to the Ministry of Economic Affairs and Employment (MEAE) on 5 January 2024.

TVO will make the decision on the implementation of the power uprate and operation life extension after STUK's processing of the conceptual plan and the completion of the EIA. Should TVO decide to proceed with the project, it must apply for a new operating licence for the OL1 and OL2 plant units from the Government. STUK will assess the licence application and the safety of the power uprate before the Government issues a decision.

The power uprate planned by TVO has been under STUK's oversight since the autumn of 2022. At the time, TVO provided STUK with a preliminary conceptual project plan in which the company leveraged preliminary analyses to assess the impacts of a power uprate on the operation and safety of the plants. While reviewing the materials, STUK did not come across any issues that would, based on the information available, prevent the reactor power uprate. TVO's plan regarding the implementation method, organisation and schedule of the project indicated that it is possible to implement the power uprate according to the safety requirements.

Uprating the nuclear power plant's reactor power affects the normal operation of the plant and its operation in the event of possible operational occurrences and accidents. In terms of safety, significant matters to take into account include ensuring sufficient emergency cooling, overpressure protection and residue heat removal capacity. The impacts that an increase in steam and main coolant flows may have on the plant's structures, systems and equipment must also be assessed. The impacts must also be assessed as regards the activities of the plant operating personnel. In the preliminary documentation it has provided to STUK, TVO has presented planned plant modifications and safety improvements that will compensate for the effects of increased power. STUK will assess the sufficiency of the measures in connection with the processing of the conceptual plan.

In addition to processing documents related to the power increase, STUK will, over the course of the project, oversee the operations of TVO and the organisations carrying out the project and conduct necessary inspections at the plant site and on equipment supplier premises. To support its work, STUK will commission comparative analyses from experts that are independent of the authority and TVO.

Radiation safety of the plant, personnel and environment

In 2023, the total accumulated radiation dose of the Olkiluoto nuclear power plant personnel was 0.598 manSv, of which 0.176 manSv was attributable to OL1, 0.416 manSv to OL2 and 0.006 manSv to OL3. The majority of the OL1 and OL2 doses were accumulated from work carried out during annual outages. 0.104 manSv at OL1 and 0.376 manSv at OL2. The first annual outage of the OL3 unit will take place in 2024.

According to the Government Decree on Ionising Radiation (1034/2018), the effective radiation dose to persons engaged in radiation work must not exceed 20 mSv per year. The actual individual radiation doses remained clearly below this limit. The largest annual dose at the Olkiluoto nuclear power plant was 5.58 mSv caused by plant maintenance work.

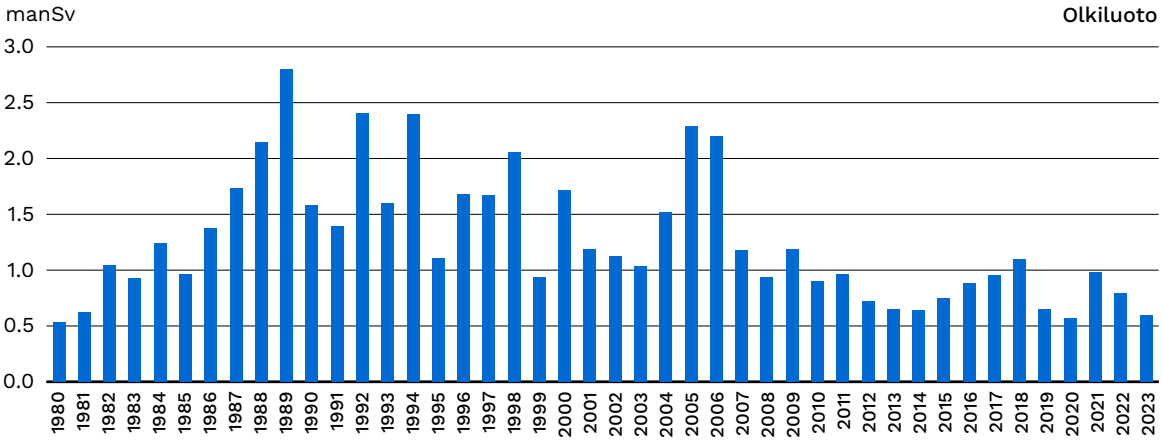

FIGURE 11. Collective occupational doses since the start of operation of the Olkiluoto nuclear power plant.

Radioactive releases into the air and sea remained clearly below the set limits. The calculated radiation dose of the most exposed individual in the vicinity of the plant was less than 1% of the limit of 0.1 mSv set in the Nuclear Energy Decree (161/1988).

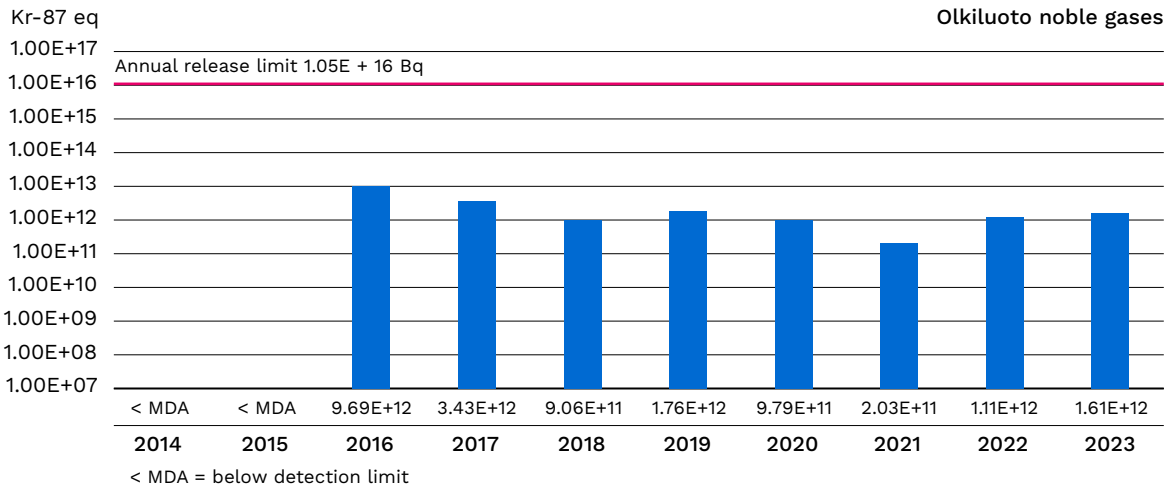

FIGURE 12. Noble gas releases to the atmosphere (Kr-87 eq), Olkiluoto.

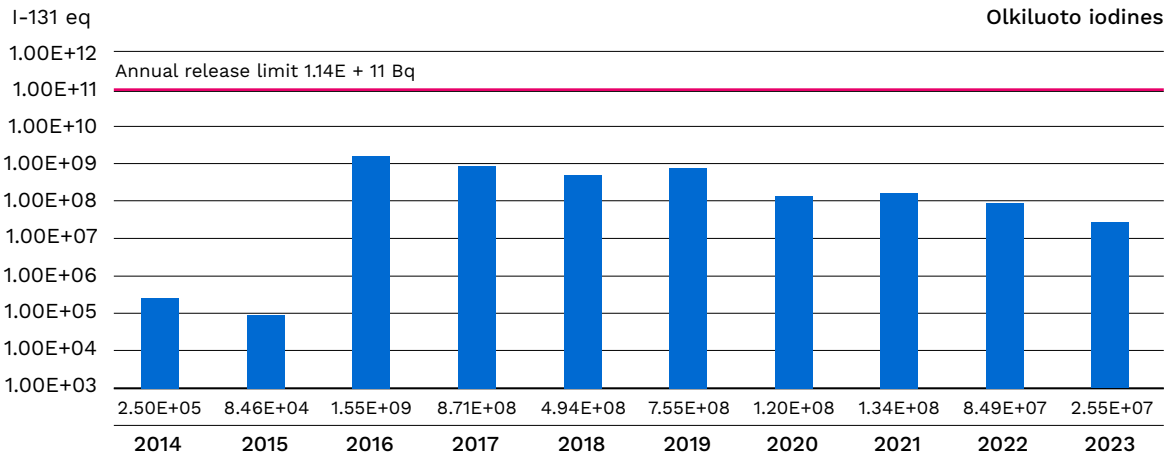

FIGURE 13. Iodine isotope releases to the atmosphere (I-131), Olkiluoto.

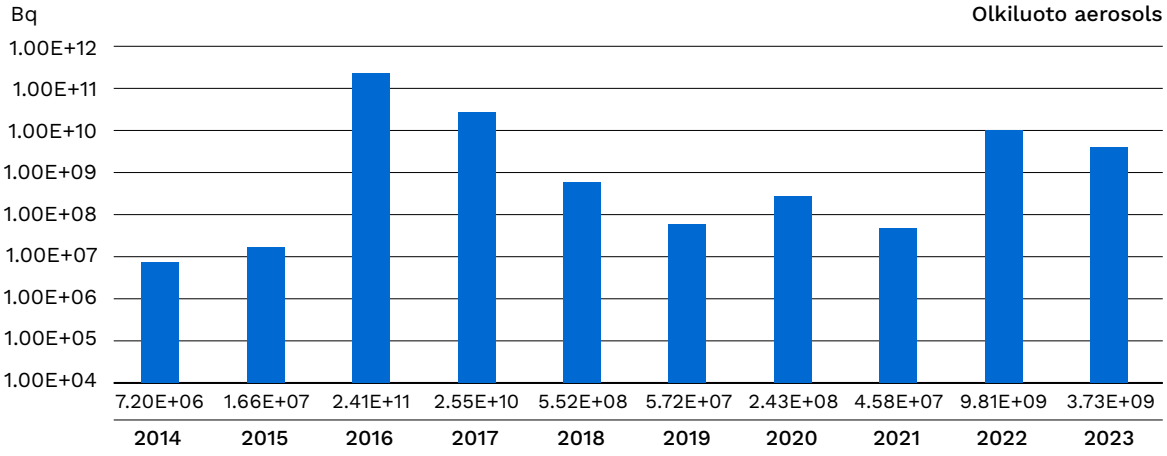

FIGURE 14. Aerosol releases to the atmosphere (Bq), Olkiluoto.

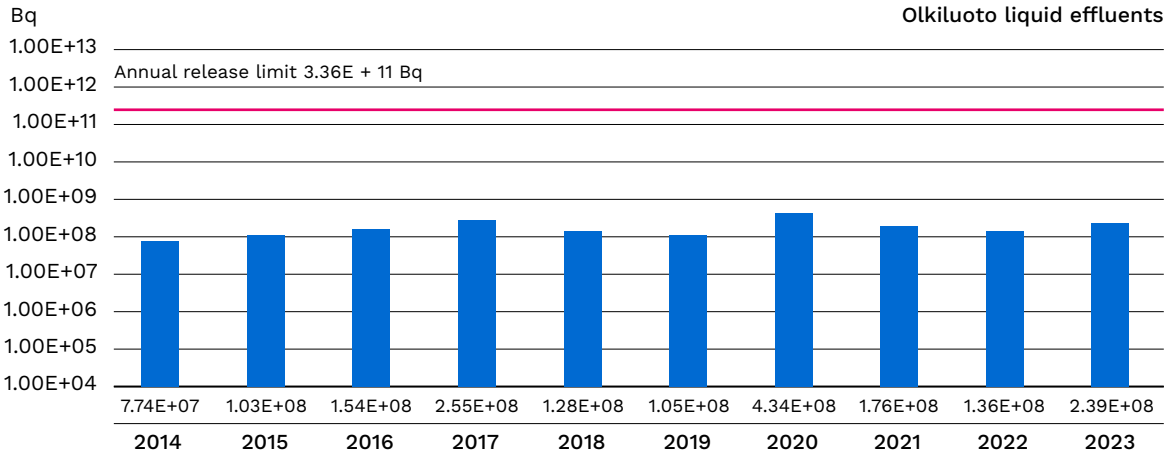

FIGURE 15. Gamma activity of the liquid effluents (Bq), Olkiluoto.

A total of approximately 410 samples were collected and analysed from the land and marine environment surrounding the Olkiluoto power plant in 2023. Small amounts of radioactive substances originating from the plant were observed in some of the analysed environmental samples. The measured concentrations were so low that they are insignificant in terms of the radiation safety of the environment or people. The exposure to radioactivity of residents in the vicinity of the nuclear power plant was also measured. No radioactive substances originating from the Olkiluoto power plant were detected in them.

Operational events and operating experience feedback

TVO notified STUK of eight events at OL1 and OL2 and 13 events at OL3 that occurred or were observed in 2023. Most of the events revealed needs for improvement in the organisation's operations. In eight of the events, the result was the plant unit ending up in a situation that was in violation of the Operational Limits and Conditions (OLCs).

In addition to this, TVO initiated three large-scale investigations, which will be completed in 2024. For all three plant units, analyses will be carried out on spare part deficiencies regarding systems that are important to safety and on the conservativeness of decision-making related to the operating line. The third investigation will examine the impact of penetrations on the structural integrity of the OL1 and OL2 reactor buildings.

By reviewing the results of the event investigations, STUK verified that TVO has investigated the underlying causes of the events and initiated the actions to correct technical faults and deficiencies in its organisation's performance and to prevent the reoccurrence of the events. STUK also utilises the results of the event investigations to discern the status of the various controlled areas and focus its control measures.

TVO has discovered that people do not always learn from their own events. STUK has required that TVO investigate why the operating experience feedback procedures (such as event investigations) do not always identify or correct deficiencies in technology, operations and culture, but rather the same deficiencies create new events of the same type or several different events. STUK is monitoring that TVO's development is progressing.

In its oversight activities, STUK has observed that there have been several changes in the personnel handling TVO's nuclear safety oversight (incl. investigations) in recent years. The repeated changes have impacted the workloads of the personnel and caused temporary drops in the joint level of competence.

Most significant events

Two significant events took place at OL3 in 2023. The first occurred in the spring of 2023 when TVO observed and the rectified faults and deficiencies in the seals of some plant I&C measurement connectors. The seals in question are needed in the event of an accident. Were the seals to be missing, the measurements required to handle an accident might not work, which could affect the plant's safety functions. Since the event involved deficient instructions and the fault appearing in multiple locations, STUK categorised the event in class 1 on the Nuclear and Radiological Event Scale (INES). In other words, this was an anomaly that significantly affected safety. One seal being missing is not a significant issue in terms of safety, but the recurrence of the fault elevated the significance of the event on the evaluation scale.

The second significant event at the OL3 unit took place in June 2023. OL3 deviated from the minimum personnel requirement of the control room for slightly less than two hours. The

control room's minimum personnel requirement has been a basis for plant design, and it has been specified in TVO's administrative instructions and the Operational Limits and Conditions (OLCs). The event did not have an immediate impact on nuclear safety. However, the operational capability of the control room personnel had decreased, which could have affected the measures conducted in the control room and, by extension, plant safety. TVO submitted a report on the event to STUK on 3 August 2023. After the event, TVO has made efforts to prevent corresponding events by carrying out corrective measures on its operating method instructions, for example. Since the event involved intentional deviation from the administrative requirements of the Operational Limits and Conditions, STUK categorised the event in class 1 on the Nuclear and Radiological Event Scale (INES).

The OL1 and OL2 plant units did not experience INES 1 or higher-level events in 2023.

In August and September 2023, three similar failures occurred in the UPS equipment of the battery backed-up 380 V AC system that is important for safety. The first failure occurred when Olkiluoto 2 was in a cold shutdown state. The latest three faults were observed during Olkiluoto 2's power operation. Due to the UPS equipment fault, the power supply of the battery backed-up 380 V AC system would not have switched to battery supply without interruption in the event of a possible normal failure of the AC system. Instead, there would have been a voltage interruption during the start-up and loading of the emergency diesel generators. To prevent the voltage interruption, TVO activated an emergency diesel generator beforehand to supply the diesel backed-up power rail as a precautionary measure. According to the Operational Limits and Conditions, these measures enabled continuing plant operation for seven days. The identified cause of the fault was the stopping of the UPS equipment inverters as a result of outlet side undervoltage detected by internal voltage monitoring. However, these signals were unnecessary. The erroneous signals were due to failures in the electronic cards. As a corrective measure, the electronic cards were replaced. Faults were detected in two parallel subsystems (four subsystems in total). For this reason, TVO examined the possibility of a common-cause failure resulting from the same factor. According to TVO's investigation, there was no common-cause failure, since the instances of inoperability were due to inverter stoppages caused by various card faults. TVO identified equipment ageing as the root cause of the event. Based on the event, TVO decided to replace the UPS devices in question earlier than planned. STUK categorised the event in class 0 on the Nuclear and Radiological Event Scale (INES).

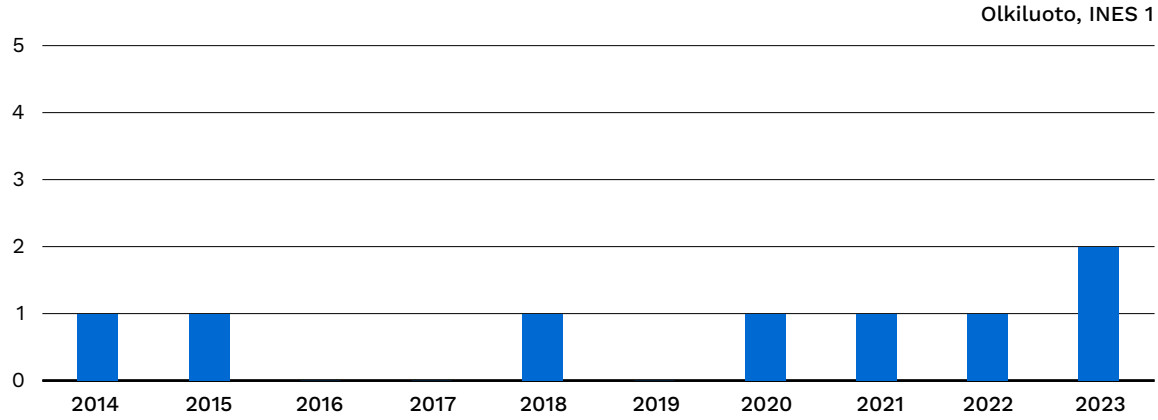

FIGURE 16. INES classified events at the Olkiluoto plant (INES Level 1).

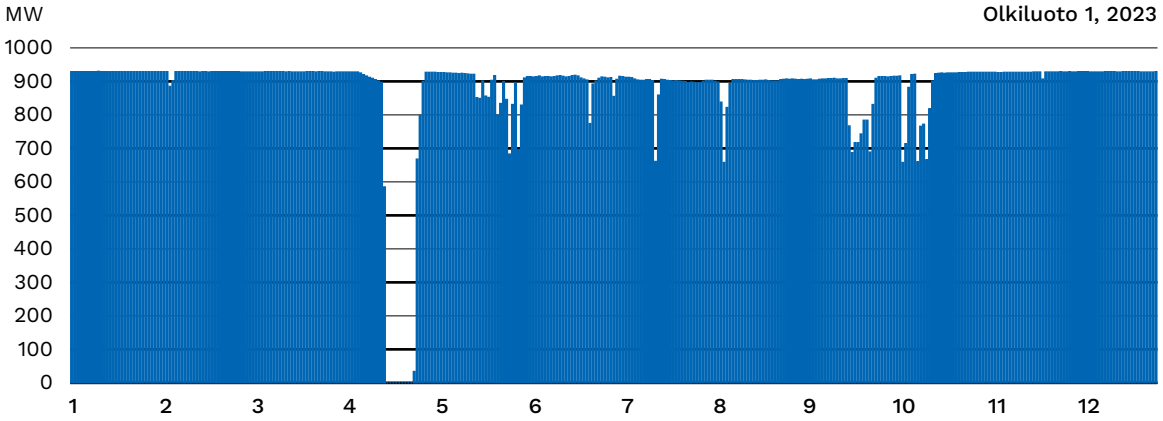

FIGURE 17. Daily average gross electrical power of the Olkiluoto 1 plant unit in 2023.

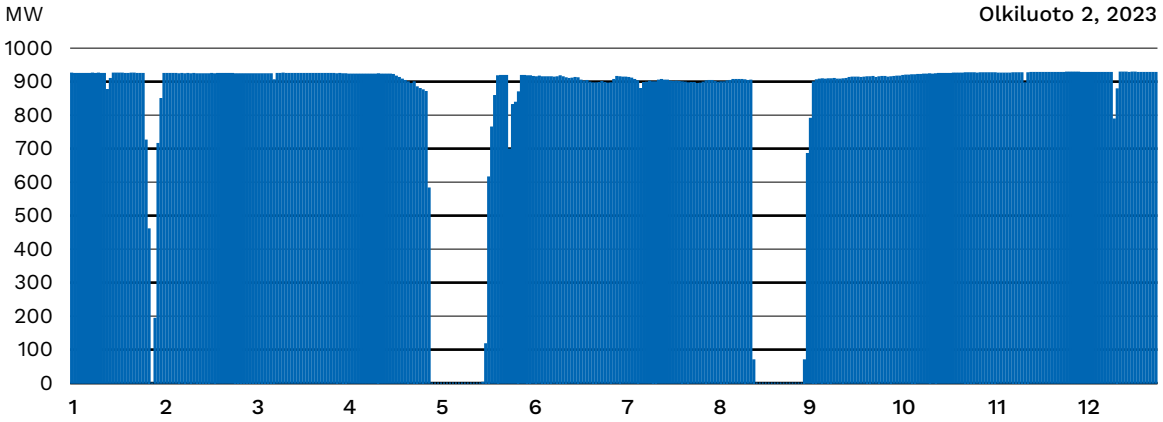

FIGURE 18. Daily average gross electrical power of the Olkiluoto 2 plant unit in 2023.

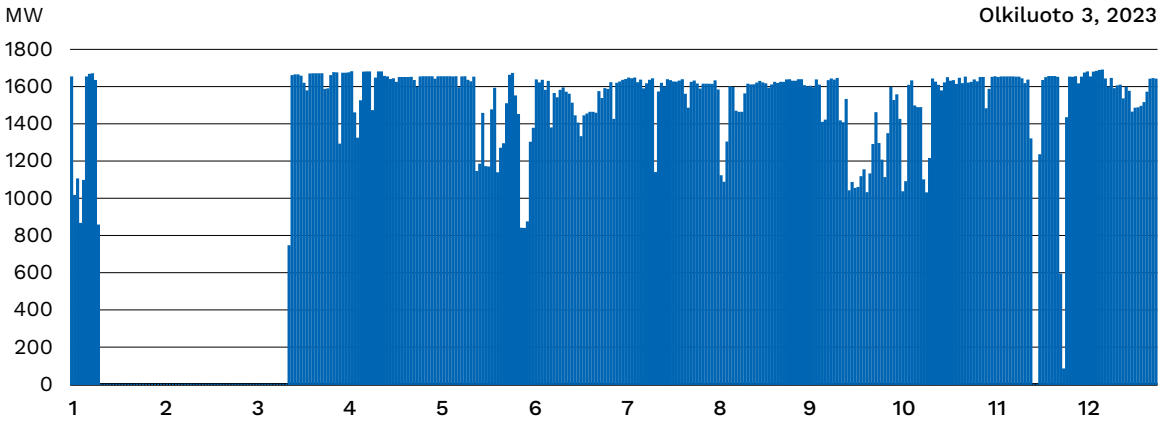

FIGURE 19. Daily average gross electrical power of the Olkiluoto 3 plant unit in 2023.

Annual outages and maintenance measures of the OL1 and OL2 units

In terms of nuclear and radiation safety, the annual outages of the OL1 and OL2 plant units were implemented as planned. The 2023 schedule included a refuelling outage at OL1 and a maintenance outage at OL2.

During the OL1 refuelling outage, the status of the crack found in the reactor's steam separator in 2022 was checked. In the event of growth in the crack, TVO had prepared to repair the damaged steam separator pipe by plugging it. The inspection found that the crack had remained unchanged and that there was no need for the repair. TVO has planned to replace the steam separators of both plant units by 2028.

Significant work tasks during the maintenance outage of the OL2 plant unit were replacing the turbine automation and the reactor building ventilation systems. The safety of the plant unit was improved by installing the bypass switches of the reactor surface measurement, which was done for OL1 during the 2022 annual outage.

A reactor trip occurred during the start-up following the OL2 plant unit's maintenance outage on 19 May. The reason for this was a small leak in the turbine condenser. The plant's safety functions operated as planned and the event did not impact safety. TVO conducted the repairs and inspections required by the situation before continuing the start-up.

STUK oversaw the annual outages from the time of their design to the start-up of the plant units. During the annual maintenance, STUK conducted the mechanical equipment inspections prescribed in the YVL Guides normally at the plant site. STUK's control activities focused on targets identified as significant in terms of safety. According to STUK's findings, the annual outages were performed safely.

TVO also carried out a large number of repairs, inspections and maintenance measures during each annual outage to ensure the safe and reliable operation of the power plant. Non-destructive in-service inspections of pressure equipment were implemented in compliance with an in-service inspection programme approved by STUK. During the annual outage, STUK carried out a KTO inspection of annual outages. The relevant inspection summary is provided in Section 1.2.6.

In its oversight activities, STUK has paid attention to the spare parts situation of the OL1 and OL2 units. TVO has requested more time from STUK with regard to the spare part inventory for prolonged operational occurrences and accidents necessitated by Requirement 724 of Guide YVL A.8. The spare parts in question are required so that the systems that are important to safety can be maintained, if necessary, in the context of prolonged operational occurrences or accidents. These spare parts or typically wearing spare parts of devices, such as bearings and seals. STUK granted a time extension for fulfilling the requirement until the end of 2024. In addition, the spare parts required by Guide YVL A.8, TVO has had difficulties with the spare parts needed for the preventive maintenance of safety systems. Due to the spare part deficiencies, it has been necessary to postpone some areas of the work covered by the preventive maintenance programme. As a result of the difficulties with spare parts, TVO has initiated an internal theme investigation, which will be completed in spring 2024. STUK will intensify the oversight of the development of the spare parts situation of the OL1 and OL2 units in 2024.

Nuclear safeguards

STUK granted TVO seven licences concerning nuclear use items for the Olkiluoto nuclear power plant (see Appendix 1).

TVO submitted the nuclear safeguards reports and notifications it was responsible for in time, and they were consistent with the observations made during inspections. TVO also responded to STUK's open requirements related to nuclear safeguards on time.

STUK carried out a total of 18 nuclear safeguards inspections of the material balance areas of TVO's operating plant units and the spent fuel storage facility's material balance area, including inspections of the entire plant site. STUK, the IAEA and the European Commission conducted inspections on the physical inventory of nuclear materials at OL1 and OL2 plant units before the annual outages and on the inventory and the spent nuclear fuel storage after the outages. In the latter context, STUK, the IAEA and the European Commission also carried out an inspection on the physical inventory of nuclear materials at the OL3 plant unit. Furthermore, STUK inspected the positions of the fuel assemblies in the reactor cores of OL1 and OL2 after the annual outage prior to the closing of the reactor covers. STUK performed interim inspections of nuclear safeguards at all plant units and at the spent fuel storage facility and also participated in inspections carried out by the IAEA and the European Commission at short notice. In addition to this, STUK, the IAEA and the European Commission carried out preparatory work for the control of the disposal of spent nuclear fuel at the spent nuclear fuel storage facility, including a spent fuel measurement campaign.

The oversight and inspections by STUK indicated that the operating Olkiluoto nuclear power plant fulfilled their nuclear safeguards obligations.

Nuclear security arrangements

In 2023, STUK conducted two security arrangement inspections pursuant to the periodic inspection programme on site at Olkiluoto. STUK also processed an update to the security standing order for the Olkiluoto nuclear facilities. According to Section 7(5) of the Nuclear Energy Act (990/1987), STUK will request statements on the security standing order from the Ministry of the Interior and Advisory Commission on Nuclear Security.

As part of its oversight activities, STUK monitored TVO's handling of the assessment group recommendations and suggestions provided in the 2022 international and independent peer review of the security arrangements of nuclear energy use (International Physical Protection Advisory Service, IPPAS) at the OL3 plant unit. The review was commissioned by the Ministry of Economic Affairs and Employment and coordinated by the IAEA. The assessment group had also identified good practices at the facility.

In 2023, a wide-ranging independent assessment was arranged at the Olkiluoto nuclear power plant, which was conducted by an assessment group of authorities belonging to the Advisory Committee on Nuclear Security. STUK's oversight activities also involve monitoring the processing of the recommendations provided by this assessment group as part of the development of the Olkiluoto nuclear power plant's security arrangements. Measures related to the implementation decision of the updated security arrangement guide YVL A.11 are still under way at the OL3 plant unit, for example.

The nuclear security system of the power plant comprises an extensive package of administrative, technical and operational arrangements for securing a nuclear facility from unlawful or other activities endangering nuclear or radiation safety. The aim has been to collect the de-

velopment measures together under a development project intended to maintain and improve physical protections and data security procedures.

Fire safety

In 2023, STUK oversaw the fire safety of the Olkiluoto power plant during annual maintenance inspections, document inspections and a periodic inspection.

As a result of the KTO inspection of fire safety, STUK found that TVO has been able to improve the resource situation of the plant fire brigade. In addition to this, development measures related to the plant fire brigade were verified in the follow-up meeting of the previous year's additional KTO inspection.

An ignition occurred during hot work at the replacement worksite of the Olkiluoto 1 and 2 emergency diesel generators in January 2023. The ignition quickly died down on its own, and the event did not threaten nuclear safety. The report prepared on the event revealed shortcomings in subcontractor activities. In the KTO inspection of fire safety, TVO's measures to remove deficiencies were found to be sufficient.

Overall, fire safety at the Olkiluoto power plant is at an acceptable level.

1.2.3 Technical condition of the plant and preparing for exceptional events

Safety development

Olkiluoto 1 and Olkiluoto 2

The project to update the emergency diesel generators of OL1 and OL2 continued in 2023. The project will involve updating all eight of the plant units' original diesel generators (four per plant unit). In addition to this, an additional ninth emergency diesel generator was deployed in 2020 to enable diesel generator replacements during the power operation of the plants. By the end of 2023, three diesel generators had been replaced at OL1 and two diesel generators at OL2. The remaining diesel generators will be installed and commissioned one by one by the spring of 2025. The new diesel generators can be cooled with seawater and air. The current ones can be cooled only with seawater. The new diesel generators are also more effective than the old ones, and they account for the possible reactor power increase of the OL1 and OL2 units, which will increase the need for emergency power as a result of the increase in residual heat power. STUK oversaw the upgrade, inspected related design documents and commissioning reports over the course of 2023 and performed inspections at the suppliers' premises. At the plant site, STUK oversaw technical construction and mechanical work and the diesel generator test runs.

STUK has required TVO to equip the reactor water level measurement, which is essential in accident situations, with an alternative solution that is based on a different operating principle in order to ensure the operability of the essential safety systems in the event of a common cause failure in normal level measurement. In 2021 and 2022, TVO suggested to STUK two different safety improvements for implementation. The first will improve plant safety in the event of a reactor surge, where the operation of the emergency cooling of the reactor is prevented by an unintentional maximum level limit trip. The update would involve installing manual switches in the control room for bypassing the unintentional high-level signal and

thus enable the operation of the emergency cooling of the reactor. New alarms and measurements to support failure detection in level measurement would also be added to the control room. The safety improvement was implemented for OL1 during the annual maintenance in 2022 and for OL2 during the annual maintenance in 2023.

With the second planned safety improvement, a new surface monitoring system will be installed in the reactor, which can be used to detect the low surface of the reactor in the event of a normal surface measurement failure and automatically start safety functions. The new surface monitoring system will utilise the current surface measurements but is independent of the problematic reference vessel in case of turbulence and is thus different in principle from the current surface measurement. STUK approved the conceptual plan for the surface monitoring system in October 2023. The intention is to start the test operation of the new system during the annual maintenance of 2024. During the test operation, the automatic functions enabled by the system will not yet be deployed.

The planning of the replacement of the plant units' nuclear fuel loading machines and their manufacture proceeded in 2023. The performance of the factory tests was initiated in January 2024. The modification involves the renewal of the mechanical devices and electrical and I&C system of the refuelling machines. The reason for this modification is the reduced availability of the existing refuelling machines, the difficult availability of spare parts and challenging maintenance. The new refuelling machines are more reliable, reducing interruptions during annual outages due to disturbances in them. STUK will oversee the design, construction, installations and commissioning of the new refuelling machines.

The project schedule has been delayed due to the delay in starting the factory tests. According to the previous plan, the installation work of the OL1 unit's refuelling machine would have been conducted early in 2024. According to the updated schedule, the installation work at the OL2 plant unit will begin in the autumn of 2024. The update is expected to be completed during 2026, once the installations have been completed at OL1. The delay in the project has no safety significance because the current refuelling machines are in operating condition and regular maintenance and condition monitoring measures are conducted on them.

TVO has launched a new large-scale project to renew the I&C systems of OL1 and OL2 in order to extend the service life of the I&C systems. The project will replace the analogue components (relays, automation cards, circuit breakers) and measuring cabinets of I&C systems with new products similar to the original. In addition, the project will replace the digital main regulators, the neutron flux measurement system and the control room process computer system. The main installations are planned to be carried out in 2025 and 2026, but work on the I&C components that are to be updated with corresponding new equipment was already started during the 2021 annual outage. STUK oversees the planning and implementation of the project and the deployment of the changes.

Olkiluoto 3

After the completion of the OL3 project and the beginning of commercial use, guarantee-period repairs and modifications have been carried on the plant. STUK has inspected the safety-significant changes that, since the commencement of regular electricity production, have been mainly targeted at I&C functions

The fatigue analyses of primary circuit equipment were reassessed in 2023 due the false assumptions that were observed. The specified fatigue analyses of the pressuriser yielded an

acceptable result. However, STUK required periodic inspections of the pressuriser support since the assumed load was significantly optimised in the fatigue calculation. TVO provided specifications on the stresses caused by the local heat treatment of the steam generators and pressuriser. The processing of the specifications will be continued in 2024.

STUK monitored the reporting on the stress corrosion cracks observed at French facilities. STUK had required TVO to provide an account of the possibility of corresponding faults at the Olkiluoto 3 plant unit. TVO provided the account of matters related to the stress corrosion of the primary circuit piping and the measures to reduce the stress corrosion risk in May 2023. STUK assessed TVO's account and requested an action plan on the measures to eliminate the stress corrosion risk by the end of 2023. TVO's account was in processing by STUK at the start of 2024.

In January 2023, maintenance measures were carried out at the pressuriser safety valve stations (PSRV). In the periodic test conducted upon plant start-up at the beginning of February, the electric control valve of the PSRV1 station did not pass. The plant was ramped down again and all main valves of the safety valve stations and the electric control valves were maintained. A tightness test was also performed on the mechanical control valves. The periodic tests were redone for the electric control valves and mechanical control valves. Temporary surface temperature measurements were installed in the main valve and mechanical control valve discharge lines in order to assess possible leaks. TVO provided an account of the electric control valve failure at the end of November 2023. The account is in processing by STUK.

EPR reactors of the same type have previously been found to exhibit neutron flux fluctuation that is higher than expected. The fluctuation has been found to be caused by the lateral movement of the fuel assemblies due to reactor coolant flow, which slows down neutron movement in the reactor. In this regard, OL3 has already carried out changes in previous years, but the monitoring of the phenomenon and situation has been continued. STUK processed the matter in a KTO inspection (OL3 safety functions) late in the year, among other contexts. Neutron flux fluctuation for the same reason has also been observed at OL3 during the first operating period. The fluctuation is monitored with regular measurements and it is taken into account in limit values regarding use. The upcoming annual maintenance in November 2024 will involve extensive fuel inspections to assess the effects of the phenomenon.

Emergency response arrangements

STUK oversaw the ability of the Olkiluoto power plant emergency response organisation to act under exceptional conditions by making inspection visits and reviewing reports and emergency response plan updates submitted by TVO. STUK approved TVO's proposal on a new person to handle emergency response arrangements in May 2023. TVO deployed a new auxiliary response centre in Rauma and presented it to STUK in August 2023. A KTO inspection was conducted on emergency response activities in September 2023.

The Rescue Act (379/2011) requires the rescue department to test the functionality of Olkiluoto's external rescue plan through a cooperation exercise organised very three years. The OLKI23 emergency response exercise held in Olkiluoto in December 2023 served as this cooperation exercise and involved municipalities in the region and several central government organisations. The scenario of the exercise was a serious reactor accident at two plant units (OL3 and OL1). As is normal practice, STUK's emergency response organisation took part

in the exercise. STUK also took part in the efforts of the exercise planning group and assessed the activities of the TVO's emergency response organisation during the exercise on site.

No events requiring emergency response actions took place at the operating plant units of the Olkiluoto power plant in 2023.

Emergency preparedness arrangements at the Olkiluoto nuclear power plant have been constantly developed, and the power plant's emergency preparedness arrangements comply with the set requirements.

1.2.4 Operation of the organisations

Based on STUK's oversight, TVO operates in a responsible manner, is committed to safety and appropriately considers the safety-related views of experts in its decision-making. TVO takes seriously all observations indicating that the priority of safety may have been compromised. All cases are investigated and operating methods are developed based on them. Especially at the OL3 unit, there are still plenty of plant situations that the personnel have not become accustomed to before the start of operation. In its oversight, STUK has paid attention to the state of the safety culture by checking TVO's interpretations from the perspective of the organisation's operations and monitoring daily activities at the plant site, for example. Based on this, no shortcomings in the organisation's activities have been observed.

TVO has a developed management system that meets the requirements for nuclear sector management systems and, based on STUK's oversight, TVO complies well with the management system. STUK has reviewed documents related to TVO's operations as an organisation, which TVO has updated in the context of commencing OL3's operations. The management systems of OL1, OL2 and Ol3 were harmonised based on these updates. The updated documents include TVO's operating system, organisation manual and TVO's administrative rules. STUK annually goes through TVO's assessments of its own operations such as reports related to the safety culture and competence development. Maintaining a situational picture enables continuous operational improvements.

The inspection STUK carried out on the OL3 unit early in the year sought to confirm the readiness of the plant organisation and operations to transition from the test operation phase to the commercial operation phase. The inspection covered management measures related to the change in responsibility relationships, identifying risks related to the organisation's operations, the organisation's level of competence and the readiness of the management system. Based on the inspection, TVO had considered these perspectives in the phase of operational changes, but some measures were still under way. A summary of the inspection is provided in Section 1.2.6.

The inspection of the organisation's operations, which STUK carried out late in the year, covered topics related to management and the handling of safety matters. The inspection examined TVO's way of taking safety matters into account in its strategy and the ways in which they affect operations planning. "A high level of safety" is one of TVO's three strategic objectives. STUK emphasised that it is important not to take the understanding of the significance of nuclear and radiation safety for granted and instead highlight it clearly in communications regarding goals and priorities. Based on the inspection, it was identified that the safety significance of certain operational challenges requires further clarification. The activities of TVO's

safety group have been developed and, according to STUK, it is important to assess the effects of the changes. The relevant inspection summary is provided in Section 1.2.6.

In terms of all plant units, STUK has found the human resources and competence to be at a good level. That said, high turnover slows down the accumulation of competence in certain activities. In STUK's opinion, there are still resource and competence deficiencies in certain maintenance functions. This may affect preventive maintenance and repairs as well as corrective measures regarding the spent fuel storage. However, new people are being recruited for maintenance. TVO's training activities are diverse with regard to both operational and general training. Among other things, TVO has developed an extensive Nuclear Professional Leader (NPL) supervisor training programme to ensure that supervisors have the requisite knowledge and skills to guide operations and people under their responsibility towards activities according to expectations and goals.

1.2.5 Operational waste

The processing, storage and disposal of low- and intermediate-level waste (operational waste) at the Olkiluoto power plant were mainly carried out as planned. The power plant pays attention to keeping the amount of waste generated as low as possible by tightly packing the waste and releasing from control waste with such a low level of radioactivity that no special measures are needed. In recent years, TVO has developed waste sorting guidelines for its own staff and contractors in order to separate non-radioactive waste more efficiently. From the waste stream, TVO separates very low-level waste, which in the future is intended to be disposed of in a near-surface disposal facility instead of the repository of low- and intermediate-level waste.

For now, TVO has waived the planning of a shared waste solidification process for all three plant units and is focusing on OL3 waste in the planning of the solidification plant. The conceptual plan regarding the solidification method was delivered to STUK for approval at the end of 2023. TVO has also continued the preparation of the underground final disposal of very low-level waste. According to TVO, the application for the underground final disposal facility will be delivered to STUK for approval in 2024.

In 2023, the KTO inspection concerning the operational waste of the Olkiluoto plant units focused on OL3's waste processing systems and procedures. For example, topic-specific meetings have been held on the development of a solidification method for liquid waste and the possible transfer of liquid waste from OL3 for processing at the OL1 and OL2 plant units. In addition to this, the functionality of waste management practices was examined as part of a broader annual outage inspection.

The periodic safety assessment regarding the Olkiluoto operational waste was completed in September 2023. As a summary of the periodic safety assessment, STUK stated that the state of the final disposal facility for the Olkiluoto operational waste is good in terms of operational and long-term safety, and that the licensee has the necessary procedures and resources to continue safe operation. The decision regarding the safety assessment presented three requirements on the safety development plan with regard to the solidification method and ageing management of the final disposal facility and updating the instructions in terms of the management of possible active water. A KTO inspection was not conducted on the final disposal facility of Olkiluoto operational waste in 2023.

The development of the tritium concentrations found earlier in water samples of the disposal facility for operational waste and in the indoor air of rooms continued to be monitored in 2023. According to the measurement results, tritium concentrations and emissions have remained quite low and have not compromised the radiation safety of workers, the environment or the surrounding population. During 2023, it was found that the tritium released into the final disposal facility most likely originates from small waste that is the state's responsibility and that is stored and ultimately disposed of in the Olkiluoto final disposal facility for operational waste. STUK and TVO have initiated additional measures to investigate the matter. Before the completion of the investigations and corrective measures, new small waste for which the state is responsible cannot be taken into the final disposal facility for operational waste.

The oversight and inspections by STUK indicate that power plant waste management at the OL1 and OL2 has been developed in a goal-oriented manner and the total arrangement meets the requirements – regardless of the aforementioned tritium observation.

1.2.6 Periodic inspections

In 2023, STUK conducted 20 inspections at the Olkiluoto nuclear power plant under the periodic inspection programme. Inspections were carried at the plant site as combinations of remote and on-site inspections, i.e. hybrid inspections.

The inspections included in the periodic inspection programme focus on safety management, the main operational processes and procedures, and the technical acceptability of systems. These inspections verify that the operation, maintenance, safety assessment and protection activities of the relevant facility comply with the requirements laid down in the nuclear safety regulations.

PTO readiness verification, 2–3 March 2023

The inspection of the plant unit OL3 verified the readiness of the plant's organization and operations to move from the commissioning test phase to the commercial use phase (so-called PTO phase). The objective of the inspection was to verify the readiness of TVO's organization to take the OL3 plant over from the plant provider in its entirety. The inspection dealt with the actions of TVO's management in relation to the change of responsibilities, the identification of risks related to the organization's operations, the level of the organization's competence and the readiness of the management system. In addition, the ability of TVO to manage the plant and the situation regarding the closure of cases that are still pending were reviewed.

On the basis of the inspection, the readiness for commercial use could not be fully verified, as many issues were still pending. For example, the agreement on the guarantee organization and procedures between the plant provider and TVO was still pending. However, progress had been made in many areas in recent months and TVO was found to have comprehensive procedures in place to monitor the progress of preparedness.

During the inspection, attention was paid to TVO's maintenance resources, for which there were still deficiencies in terms of both the number of personnel and the familiarity of the personnel, including systems that are important from the point of view of safety, in relation to the target state set by TVO. STUK considered it important that co-operation agreements with the plant provider and other subcontractors compensate for the situation.

On the basis of the inspection, STUK did not make any requirements. STUK will continue to monitor the activities of TVO's organization as part of its normal supervision.

Fire protection, 25–26 April 2023

The fire protection inspection assessed the effectiveness of TVO's fire protection arrangements. The inspection focused in particular on the resources of the plant fire brigade and the induction of new employees, which were identified as challenging areas in previous inspections and other STUK supervision. A plant tour was carried out for the OL3 plant unit in connection with the inspection.

Based on the inspection, TVO has solved the worst resource shortage of the plant fire brigade.

New employees have been recruited and the induction has progressed so that the new employees are now working in shifts. There is still a shortage of two employees and recruitment is still ongoing. The induction arrangements have been well implemented. Positive feedback has been received especially about the fire simulator used in the training.

The report on the ignition at the OL1 emergency diesel generator replacement site in January 2023 was discussed during the inspection. The ignition extinguished spontaneously and there was no threat to nuclear safety. The report revealed shortcomings in the operations of the subcontractors, for which TVO correctly identified corrective measures.

During the plant tour, shortcomings were found in the marking of storage areas and in the earthquake fastenings of movable property. Otherwise, the cleanliness level of the plant was high and no additional fire load was observed.

TVO's fire protection arrangements, which were verified by the inspection, comply with the set regulations. On the basis of the inspection, one requirement was made regarding the shortcomings found in the earthquake fastenings at OL3. STUK will monitor the development of the resource situation of TVO's fire brigade as part of its normal supervision.

Operations (OL1/Ol2), 23–24 March 2023

The inspection focused on the operations of the plant units OL1 and OL2 verified the resource situation of the operating unit, operating unit's indicators, processing of deviations, development proposals and safety observations and the preparations for unavailability of the digital user interfaces in the control room. During the inspection, a plant tour was carried out to the control rooms of the plant units.

Based on the inspection, the resource situation of the operating unit is good. For future needs, new instructor training groups have been set up at regular intervals. The operating unit was found to have systematic procedures for processing deviations, development proposals and safety observations and for monitoring measures. The operating unit uses several indicators that include both safety and usability issues. The indicators are used to monitor, for example, issues that increase the load of operators and the number and situation of faults affecting the operation.

The plant tour targeted at the main control rooms of the plant units OL1 and OL2 verified that the operating shifts know the procedures and instructions in the event of faults in the digital user interfaces. In addition, it was investigated how well the operating shifts are familiar with the updated instructions in the event of a reactor surface measurement fault, where the measurement shows an unnecessarily high reactor surface. Based on the inspection,

appropriate instructions were available for the aforementioned fault situations, and the operating shifts were well familiar with the relevant procedures.

The operating procedures of TVO, verified by the inspection, comply with the set regulations. On the basis of the inspection, STUK did not make any requirements.

Power plant waste, 28–29 March 2023

The inspection of the power plant waste was primarily focused on the waste management arrangements of plant unit OL3. In addition, the planning of nuclear waste management measures as a whole, the adequacy and competence of nuclear waste management personnel and the timeliness of the guidelines were reviewed. The inspection covered the findings of the previous inspection as well as developments and significant events since the previous inspection. The condition of the waste treatment and storage facilities, the radiation levels of the facilities and the classifications and markings were verified during the plant tour that was included in the inspection.

Based on the inspection, TVO has sufficient resources at its disposal to manage the waste of the power plants. The responsibilities and powers of the clerical workers had been clarified and the deputies for different tasks had been defined. TVO did not present a summary of the status of the OL3 guidelines and the final safety analysis report during the inspection. Communication with TVO's radiochemistry laboratory had improved compared to the time of the previous inspection. Since the commissioning of OL3 waste management systems, there have been faults which have been repaired. According to TVO, the detected faults have been small, with the exception of faults that occurred in the evaporator in autumn 2022. Repairing faults has sometimes taken a long time due to, for example, the long delivery times of spare parts. At the time of inspection, the systems were operational.

Based on the inspection, the management of power plant waste complies with the set regulations. On the basis of the inspection, STUK did not make any requirements.

Radiation protection, 7–9 March 2023

The radiation protection inspection was targeted at learning from operating experiences in the radiation protection area of responsibility. In addition, the coverage of the radiation protection instructions and the measurement results obtained from alpha measurements were reviewed. Other topical issues in radiation protection were also discussed.

In TVO's radiation protection organization, the handling of operating experiences is appropriate. However, there is no systematic procedure for processing operating experience data from different areas of responsibility as a whole. A common situational picture of operating experiences and potential problem areas is formed through informal discussions, which TVO has found to be a functional procedure in practice.

The test runs of Olkiluoto 3 have progressed as planned with regard to radiation protection. During the plant tour, radiation measurement arrangements were examined in the Olkiluoto storage buildings.

Based on the inspection, TVO's radiation protection procedures comply as a whole with the regulations. On the basis of the inspection findings, three requirements were made for TVO to take action in certain areas. The requirements concerned the development plan related to the use of a Radiation Safety Expert, the completion of the ALARA action plan and the targeting and updating of the radiation protection guidelines.

Fire protection, 25–26 April 2023

The fire protection inspection assessed the effectiveness of TVO's fire protection arrangements. The inspection focused in particular on the resources of the plant fire brigade and the induction of new employees, which were identified as challenging areas in previous inspections and other STUK supervision. A plant tour was carried out for the OL3 plant unit in connection with the inspection. Based on the inspection, TVO has solved the worst resource shortage of the plant fire brigade.

New employees have been recruited and the induction has progressed so that the new employees are now working in shifts. There is still a shortage of two employees and recruitment is still ongoing. The induction arrangements have been well implemented. Positive feedback has been received especially about the fire simulator used in the training.

The report on the ignition at the OL1 emergency diesel generator replacement site in January 2023 was discussed during the inspection. The ignition extinguished spontaneously and there was no threat to nuclear safety. The report revealed shortcomings in the operations of the subcontractors, for which TVO correctly identified corrective measures.

During the plant tour, shortcomings were found in the marking of storage areas and in the earthquake fastenings of movable property. Otherwise, the cleanliness level of the plant was high and no additional fire load was observed.

TVO's fire protection arrangements, which were verified by the inspection, comply with the set regulations. On the basis of the inspection, one requirement was made regarding the shortcomings found in the earthquake fastenings at OL3. STUK will monitor the development of the resource situation of TVO's fire brigade as part of its normal supervision.

Security arrangements, 25–28 April 2023

The topics of the security arrangement inspection were recent developments and other topical issues, information security, including supply chain management, the final disposal repositories for power plant waste, practical operations and operating experiences, which were verified during the plant visit. An information security inspection related to annual maintenance was carried out in connection with the inspection.

TVO is currently carrying out a comprehensive security arrangement assessment and development project. In addition, projects to improve and update security control systems as well as individual immediate actions are underway.

The inspection made a number of positive observation and two requirements.

Annual maintenance, 16 April–19 May 2023

The annual maintenance inspection assessed and validated the activities related to the implementation of the annual maintenance of the plant units OL1 and OL2. Several technical inspectors participated in the inspection, monitoring the activities, carrying out site tours, interviewing employees and monitoring progress of the planned work. During the annual maintenance, particular attention was paid to the procedures for the management of bulk parts and the use of safety-classified supplies (TLTA) at work sites.

During the annual maintenance, no deviations were found in TVO's operations that would have required immediate intervention from STUK. On the basis of the inspection, it can be concluded that TVO's annual maintenance activities are in accordance with the requirements and have succeeded well – safely and in accordance with the plans drawn up in advance.

On the basis of the inspection, STUK presented one requirement. In accordance with TVO's instructions, a TLTA class 4 chemical or consumable material requires case-specific instructions for use. During the plant tours carried out by STUK, it was not possible to verify the instructions or suitability of the use of the consumable material or chemical in use at the work sites. The requirement posed required TVO to develop its procedures regarding the guidelines for the use of a TLTA class 4 substance or chemical.

Safety functions (OL1/OL2), 29–30 May 2023

The Safety functions inspection of the plant units OL1/OL2 assessed the procedures by which TVO ensures the validity of the design principles of the systems used to implement the safety functions and the compliancy of the systems. The target area of the 2023 inspection was "Fuel and reactor", with special focus on reactor control systems and criticality safety assessment procedures. In addition, the human resources and competence management procedures of TVO's reactor control were validated.

Based on the inspection, TVO has sufficient and professionally competent resources and clear procedures at its disposal in reactor control and criticality safety. Based on the inspection, the operation complies with the set regulations. On the basis of the inspection, STUK did not make any requirements.

OL3 maintenance work management system, 7–9 June 2023

STUK carried out an additional inspection regarding the use of the OL3 plant unit's maintenance work management system (KUPI) and ensuring that it is up to date. During the inspection, the procedures and situation related to the use of the system was surveyed using separate examples. The inspection was carried out unannounced, but TVO was informed about the inspection two days in advance in order for them to be able to reserve sufficient resources for the inspection.

The KUPI system has been in use for a long time at OL1/2 plant units. TVO is harmonising procedures and introducing the same system at OL3. The system has only been in use for a short time, but based on the inspection, its implementation and use has generally gone well. Establishing common operating methods still requires work and enhanced monitoring. With regard to separation plans, several entries have been created in TVO's deviation and safety observation monitoring system. STUK monitors the status of corrective measures as part of its normal supervision.

On the basis of the inspection, STUK presented two requirements. The requirements required TVO to develop procedures for monitoring the overall situation of urgent malfunctions, as well as the availability of the current status of the work management system. During the Operational activity inspection of OL3 to be held in the autumn of 2023, STUK will verify that the measures to comply with the above requirements have been carried out.

Automation technology, 14–15 June 2023

The automation technology inspection focused on the automation technology systems, organization and instructions of all three Olkiluoto plant units. The inspection was focused especially on the development of automation technology configuration management and automation-related topics arising from the operational event reports processed by STUK. The inspection also dealt with matters related to the automation technology design organization and resources.

In the previous automation technology inspection in 2020, STUK drew attention to the configuration management of the plant units OL1/OL2. Based on the inspection, progress had been made. The findings of the 2020 inspection are described in the "Regulatory oversight of nuclear safety in Finland" annual reportLink to an external website, Opens in a new tab.

The automation technology measures for correcting errors reported in the operational event reports were relevant and the instructions were up to date. Resourcing of TVO's automation technology has improved, but upcoming recruitments are needed due to factors such as retirements, and the availability of some experts remains challenging. Based on the inspection, TVO's automation technology procedures comply with the set regulations regarding the inspected subject areas.

No requirements were made on the basis of the inspection.

Operating experience activities, 31 August 2023, 27–28 September 2023

The inspection focused on in-house operating experience activities, i.e. learning from the operating experience of the Olkiluoto nuclear power plant.

In the inspection, STUK investigated how TVO's management monitors the success of activities related to in-house operating experience and reacts to shortcomings. In addition, the inspection examined the significance of the events at the plant units in 2023 from the perspective of safety as a whole and how the operating experiences are reflected in the everyday life of the line organization (maintenance). Based on the information received in the inspection, STUK closed its requirements that were based on the previous inspections.

STUK did not make any requirements on the basis of the inspection.

Plant maintenance, 12–13 September 2023

The inspection assessed the adequacy of the resources, instructions, functions and tasks related to the condition monitoring and maintenance of the plant units OL1, OL2 and OL3 to ensure safe operation. Among the topics verified in the inspection were the human resources of structural engineering and maintenance, the situation of the instructions concerning the preventive maintenance and annual maintenance of OL3, the management of spare part items and the situation of OL3 spare parts that are needed in case of long-term disturbances and accidents (Guide YVL A.8 requirement 724).

Regarding human resources, TVO has created procedures for the transfer of knowledge from more experienced experts to younger experts in connection with the management of expert resources in structural engineering. The human resources status in maintenance was found to be at a good level. OL3's resources are largely managed with the help of maintenance agreements at least until the end of 2025.

The instructions required for the preventive maintenance and annual maintenance of OL3 were found to be in a good state of preparation. The majority of the instructions consist of operating, maintenance and periodic inspection instructions prepared by the equipment manufacturers and they form the framework for instructions on maintenance operations.

The classification principles of fault reports were examined from the perspective of identifying ageing phenomena. In the classification of faults, a specific aging mechanism has been identified in about 1.5% of cases. The options presented as potential failure mechanisms are based on expert assessments made by TVO's ageing management.

In order to promote the management of spare part items, the modification management program will be equipped in late 2023 with a feature that enables the users to see which equipment locations will be affected by the modification. When it comes to spare parts that must be kept available in case of long-term disturbances and accidents at OL3, it was found that the procurement of certain items is still ongoing, but the overall situation is good.

No requirements were made on the basis of the inspection.

Emergency response arrangements, 12–13 September 2023

The inspection of emergency response arrangements covered the nuclear power plant's emergency response arrangements, instructions, facilities and training. It reviewed the experiences gained during the past year from emergency response activities, as well as experiences and feedback from emergency response exercises. The inspection also covered automatic environmental radiation monitoring, meteorological measurements and the forecasting of the spreading of emissions. The inspection covered TVO Group's preparedness activities as a whole, including Posiva's preparedness activities.

Based on the inspection, TVO's emergency response arrangements are at the required level. Training activities and development work have been active and their monitoring has been in accordance with the plans. Some changes have been made to the emergency plan during the inspection period. Development work related to Olkiluoto's emergency response arrangements has been active.

Safety planning, 13–14 September 2023

The inspection focused in particular on deterministic safety analyses of the Olkiluoto 1 and 2 nuclear power plant units (operational occurrences and accidents, including severe reactor accidents). The inspection also paid some attention to the Olkiluoto 3 plant unit. The inspection addressed the existing procedures and their development needs related to the validation of computer software, the development of calculation models, the definition of analysis cases and the processing of analysis results.

TVO has developed its expertise and procedures in the area of deterministic safety analyses. TVO's goal is still to moderately increase its own ability to carry out analyses. The procedures for conducting and procuring deterministic safety analyses are systematic and the necessary instructions exist.

No requirements were made on the basis of the inspection.

Intermediate storage of spent nuclear fuel, 14–15 September 2023

The inspection focused on the operation of the intermediate storage of spent nuclear fuel (KPA storage). The inspection reviewed the operations of TVO's organization, which manages the operation of the KPA storage, security and the progress of the modifications also from the point of view of the KPA storage as a whole. The inspection covered TVO's operating methods and responsibilities, resources, instructions, as well as the status of the modifications and planned modifications to the KPA storage. In addition, STUK and TVO discussed the effects the operations of OL3 and Posiva's nuclear facilities will have on the operation of the KPA storage and how TVO has prepared for them. The inspection included the monitoring of fuel transfers at the KPA storage.

In the course of the inspection, TVO stated that it had noticed a need to improve the organization's operations regarding the KPA storage, and TVO has started the necessary development effort as a result. The previous problems in the interaction between different organizations seem to have improved after the launch of the new usage planning group, but not much experience of the group's operation has been gained yet, and there is still room for improvement in the interaction. TVO's spent fuel management team (SNF), which has been operating for less than two years, seems to have acted in accordance with its defined tasks. SNF has been strongly involved in developing the management of the KPA storage as a whole towards a more functional direction.

Based on the inspection, TVO is prepared for the changes in the operations of the KPA storage that have been caused by the operations of Posiva and OL3. The necessary additional recruitment of new people has been initiated and the future modifications and their schedules have been technically considered. TVO still has work to do in preparing and updating instructions and documents, as well as in training before Posiva's operations begin, but there is not much time for this if TVO intends to use the schedules presented in the inspection. The instructions and documents do not need to be ready until the Posiva cooperation test (YTK test), but the schedules of the YTK test have recently been postponed.

No requirements were made on the basis of the inspection.

Operations (OL3), 3 October 2023

The inspection focused on the operation of the Olkiluoto 3 plant unit (OL3). The objective of the inspection was to investigate and verify, among other things, the procedures related to temporary changes and the situation of the OL3 operating division now that the commercial use of the plant has started.

On the basis of the inspection, the situation of the OL3 operating unit is at an acceptable level. The indicators used by the OL3 operating unit support the formation of a situational picture well, and the dashboard is developed continuously. The resources and organization of the operating unit also seem appropriate. STUK considers it important that TVO has paid attention to issues that put a strain on the operators. Excessive workload can lead to human errors and increase the likelihood of incorrect actions.

Based on the inspection, TVO's procedures and instructions for managing temporary changes require further development. During the inspection, STUK drew attention to the fact that no periods of validity were stated for temporary changes. STUK considers it important that temporary changes are managed in accordance with the YVL Guides and that the period of validity of the temporary changes is defined and monitored. STUK presented a requirement that TVO must develop the management of temporary changes so that the period of validity of the changes can be determined and monitored.

Security arrangements, 3–5 October 2023

The inspection of the security arrangements at Olkiluoto covered the open issues remaining in the implementation decision of Guide YVL A.11, as well as the results and measures of external IPPAS and Advisory Committee on Nuclear Security (TJNK) assessments, as well as the procedures and results of internal audits. The inspection also verified information security topics, such as the planning of exercises.

The open issues in the implementing decisions of Guide YVL A.11 and the status of the results of the IPPAS assessment and the related plans were reviewed. The development project of the security arrangements is in the "analysis and goal definition" phase. The project will proceed in accordance with the management's decisions. STUK sees the development goals of the project as positive. Two new experts had been recruited for corporate security. Device managers have been trained to manage the workload of the enterprise security system specialist and to expand their expertise.

No new requirements were made on the basis of the inspection.

Operation of the organization, 4–5 October 2023

The inspection focused on management practices and the handling of safety issues. The inspection reviewed TVO's operations as a licensee in the management of three plants and in supporting Posiva, as well as the prioritization of operations. The inspection looked at the identification, monitoring and processing of safety issues. Other topics covered by the inspection were the development of supervisors' activities, the results of the personnel survey, the operation of independent self-monitoring and the indicators used in safety monitoring.

Based on the inspection, it can be concluded that TVO's management sets goals and creates action plans comprehensively on the basis of both the operating environment and the challenges faced by the facility over the long term and in its operations. Safety is included in the strategy and goals. In supervisors' activities and their development, TVO actively strives to ensure that supervisors have the knowledge and skills to guide the function and people under their responsibility towards the expectations and goals. The personnel survey is very useful in identifying the local strengths and challenges of the various functions and personnel groups of the organization.

On the basis of the inspection, STUK presented two requirements. TVO's management did not have a uniform understanding of the safety significance of the spare part defects of the plants. This is why STUK presented a requirement for TVO to clarify the mechanisms through which spare part defects can affect safety. The second requirement concerned the operations of TVO's security team. TVO's safety group was found to have undergone significant changes in its operations, so STUK presented a requirement for TVO to investigate the changes in the safety group's operations and what effects the changes have on the operations of the other groups and the instructions of the management system.

Decontamination, 10–11 October 2023

The inspection focused on the decontamination of equipment, structures and rooms located in the controlled and supervised areas of Olkiluoto plant units 1, 2 and 3, as well as the organizations performing it and the premises, systems, instructions and methods in use. The inspection focused in particular on the situation of the decontamination functions of the OL3 plant unit and how the preparation for the 2024 annual maintenance has started.

Based on the inspection, TVO has appropriate and regulatory decontamination procedures in place. One requirement was made on the basis of the inspection. TVO shall submit to STUK a report on how TVO controls and monitors the use of work methods and chemicals used for cleaning, and what procedures are in place to ensure that the cleaning tasks do not cause harm to safety.

OL3 safety functions, 27–28 November 2023

The inspection focused on the criticality safety systems and reactor control systems of the Olkiluoto 3 nuclear power plant unit. In addition, measurement results and actions related to the monitoring of neutron flux oscillation were included as a separate topic.

Based on the inspection, TVO has sufficient and professionally competent resources as well as clear procedures at its disposal for reactor control and criticality safety. The systems have worked mainly without problems and the number of faults has been low. Appropriate measures and studies have been carried out to eliminate the faults and assess their significance to safety. OL3 has been found to have a similar neutron flux oscillation as its EPR sister plant. The oscillation is monitored with regular measurements and it is taken into account in the limit values for operation. TVO is interested in monitoring the phenomenon and gaining a better understanding of it.

The inspection did not result in any requirements presented by STUK.

1.3 Otaniemi research reactor

On 17 June 2021, the Government granted a permit, pursuant to Section 20 of the Nuclear Energy Act (990/1987), to VTT Technical Research Centre of Finland for dismantling the FiR 1 research reactor. VTT has continued the detailed planning of the dismantling of the research reactor and, in early 2023, STUK processed documents such as an updated decommissioning plan, an application for the transfer of nuclear waste, a conceptual plan for the buffer storage of decommissioning waste, and heavily updated worksite documentation before the commencement of the actual dismantling work.

The preparatory phase of the FiR 1 research reactor's dismantling worksite was primarily completed in early 2023. During it, STUK conducted inspections according to the inspection plan regarding emergency response arrangements and fire protection, radiation protection and safety arrangements, and a commissioning inspection on the controlled area of the dismantling site. In May 2023, STUK also conducted a binding inspection pursuant to the oversight plan on VTT's readiness to transition to the dismantling phase. Based on the inspection, STUK found VTT to be ready to initiate the dismantling work.

VTT transitioned to the reactor dismantling phase on 13 June 2023. In addition to the document inspections in the dismantling phase, STUK also carried out worksite supervision roughly once a week and took part in the weekly worksite meetings and the initial and final meetings of various work phases. Once the dismantling work had progressed to the dismantling of the concrete biological shield of the research reactor, STUK conducted the binding inspection pursuant to the supervision plan on 3 October 2023. Based on the inspection, STUK found that VTT can progress to the cutting of the biological shield.

Based on the worksite supervision and inspections, STUK did not have significant comments on the operations of VTT and the subcontractor Fortum. Nuclear and radiation safety had been sufficiently ensured at the dismantling worksite. The necessary plan changes had been carried out in a controlled manner, and safety has been a priority in their execution.

In June 2023, VTT provided information on the research reactor's financial preparation for nuclear waste management to the MEAE (Ministry of Economic Affairs and Employment), which requested a statement from STUK. According to STUK's view, the uncertainties related to the total cost estimate had continued to decrease due to the dismantling work progressing

as planned. The risk of the project being prolonged and the costs increasing is also reduced by the new operating licence granted to the Loviisa VLJ repository in 2023, which enables the final disposal of the operational and decommissioning waste of the FiR 1 research reactor in the VLJ repository. VTT and Fortum submitted an application to the MEAE for the transition of the obligation to manage the FiR 1 research reactor's operational and decommissioning waste from VTT to Fortum according to Section 30 of the Nuclear Energy Act (990/1987). STUK issued a statement to the MEAE on the application to transfer the waste management obligation. At the same time, VTT applied from STUK for permission to transfer nuclear waste to Fortum pursuant to Section 21 (990/1987) of the Nuclear Energy Act and in the manner set forth in Section 81 of the Nuclear Energy Decree (161/1988). Both applications were resolved at the same time according to Section 82 of the Nuclear Energy decree (161/1988): STUK granted VTT permission to transfer nuclear waste to Fortum and the MEAE permitted the transfer of the waste management obligation from VTT to Fortum.

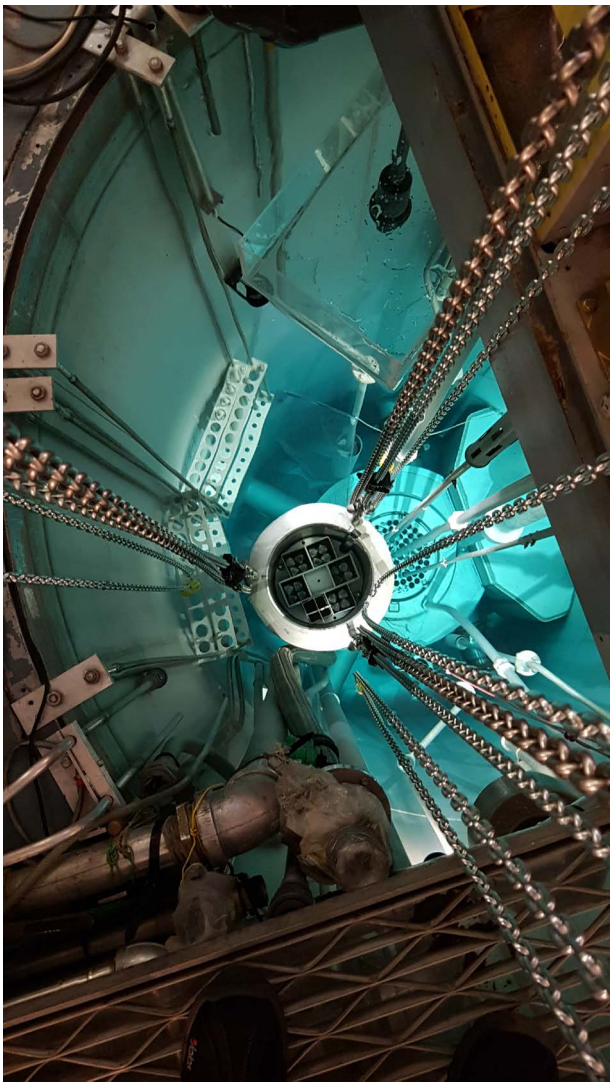

FIGURE 20. FiR 1 research reactor.

Concerning nuclear safeguards, the material balance area of VTT's research reactor includes nuclear materials in the Otakaari 3 building and their related activities. VTT's plant site, which is compliant with the Additional Protocol of the Safeguards Agreement, includes the buildings in the material balance areas of both the research reactor and the Centre for Nuclear Safety. In the spring of 2023, STUK approved VTT's overall plan on the management of other nuclear materials in the research reactor dismantling phase and removal from VTT's nuclear material accounting. Since STUK had approved the procedures presented before the transition to the dismantling phase, STUK could focus on inspecting the notifications pursuant to VTT's overall plan. The control of nuclear materials will continue unchanged in the dismantling phase. In 2023, STUK worked with the European Commission to conduct an inspection related to the nuclear material storage specification in the VTT research reactor's material balance area. In the same context, STUK checked the accounting related to the use of the nuclear materials and their removal from the accounting, the practices and the situation at the plant. The oversight and inspections by STUK indicated that the material balance area of VTT's research reactor fulfilled its nuclear safeguards obligations in 2023.

1.4 Spent nuclear fuel encapsulation plant and final disposal facility

Posiva continued the construction of the encapsulation plant and final disposal facility at the Olkiluoto site in 2023. The installation and construction of the systems and structures needed for the tunnels have been continued at the underground final disposal facility. The installation work of the internal structures and systems have progressed in the encapsulation plant. Over the course of 2023, Posiva also continued manufacture of the lifting and transfer equipment and the capsule parts.

The regulatory oversight carried out during the construction stage of the spent nuclear fuel encapsulation plant and final disposal facility concerned the design, manufacture, construction, installation and erection of the nuclear waste facility and its safety-classified systems, structures and components, as well as focusing on the demonstration of long-term safety. STUK oversaw the commissioning of the Posiva facilities by means of inspecting the relevant system test operation plans, and by performing commissioning inspections on components, structures and systems.

1.4.1 Construction of the encapsulation and final disposal facility

In 2023 in the tunnels that were completed, STUK carried out rock engineering inspections and processed the final disposal hole-related rock engineering plans that Posiva had submitted.

STUK processed a number of construction and fire protection related materials pertaining to the encapsulation plant as documentation related to the plant. Over the course of 2023, a large volume of lifting and transfer equipment construction plans was submitted to STUK for processing, some of which concerned materials that had been updated based on the requirements that STUK issued previously. An inspection body was employed to assist with the review of these lifting and transfer equipment construction plans, to balance STUK's workload. The qualification of the capsule production has progressed, and the procedure tests have begun. STUK has processed planning documents and procedure test plans, and supervised the performance of the procedure tests.

FIGURE 21. The encapsulation facility of Posiva (Posiva Oy).

1.4.2 Operating licence application of Posiva's encapsulation plant and final disposal facility

At the end of 2021, Posiva submitted an operating licence application to the Government. In the same connection, Posiva submitted to STUK the operating licence materials required under Section 36 of the Nuclear Energy Decree (161/1988). In February 2023, the MEAE requested STUK to provide a statement on the safety of Posiva's operating licence application. The MEAE required STUK's statement to be provided by the end of 2023. However, STUK's inspection efforts were not complete at the end of 2023, so STUK applied for more time to issue the statement until the end of 2024. The MEAE approved STUK's application for a time extension.

During 2023, STUK processed documentation related to the operating licence application and prepared necessary clarification requests to obtain more information. As regards the operating licence documentation, STUK's efforts in 2023 consisted of processing and approving the administrative rules for the encapsulation and final disposal facility, a clarification on safety management and culture, and operational quality management plan. Alongside processing the operating licence documentation, STUK has worked to prepare the safety assessment to be submitted to MEAE as an annex to the statement, to the extent that the processing has progressed sufficiently far.

1.4.3 Preparation for the operating licence phase

STUK has been overseeing Posiva's preparation for the commissioning phase of the facility. This oversight has focused on examining Posiva's organisation, resources, training, guides, instructions and related procedures.

STUK launched planning of the oversight to be carried during Posiva's operation phase. STUK will test the oversight practices during Posiva's joint operation test which, according to the current schedule, will be conducted in 2024. STUK will also prepare a plan for oversight to be conducted during the joint operation test.

1.4.4 Operation of the organisation

STUK has been overseeing the activities of Posiva's organisation by means of the inspections included in the construction inspection programme (RTO). The purpose of the inspections was to assess Posiva's operating instructions and their management process, operator training and the management of human factors, the management of project-related and organisational changes for the operating activities, security arrangements, management and competence management, and radiation protection arrangements.

Based on the inspections, it can be stated that Posiva's procedures in the various areas are largely at a good level. However, the procedures were found to need some specification and, where necessary, requirements were issued concerning that during the inspections.

STUK has continued to oversee Posiva's auditing activities, participating in a small number of auditing events as an observer. STUK commissioned an analysis of Posiva's safety culture from VTT. Based on the analysis, the various aspects of Posiva's safety culture are good or fairly good in terms of the life cycle phase of a nuclear facility preparing for the operation phase. From STUK's perspective, the recommendations presented in VTT's analysis were appropriate and corresponded well with the observations made during STUK's oversight activities. Based on STUK's oversight, Posiva should still work on developing competence in the management of human factors and practices related to safety.

1.4.5 Nuclear safeguards

With regard to final disposal, STUK carried out nuclear safeguards related activities in compliance with the national safeguards plan. Posiva submitted the nuclear safeguards reports and notifications for which it is responsible in sufficient scope. On the basis of the oversight and inspections carried out by STUK, Posiva has in 2023 fulfilled the applicable nuclear safeguards obligations.

STUK continued its close cooperation with the IAEA and the European Commission, with the aim of ensuring that the plans to carry out the international nuclear safeguards-related activities for the encapsulation plant and final disposal facility will proceed in line with the design and construction of the facility while also meeting the applicable national requirements. Regular technical meetings were held with Posiva, the European Commission and the IAEA in 2023 almost on a monthly basis. The IAEA installed some of the first control devices in the encapsulation facility in February and July, and STUK inspected the viability of the

installations. The equipment installations of the IAEA and European Commission continued in early 2024.

The nuclear safeguards projects of Finland and Sweden that concern final disposal are coordinated in the framework of the EPGR forum, set up between the IAEA, the European Commission, the Swedish and Finnish nuclear safety authorities (SSM and STUK) and the relevant operators (SKB and Posiva), which in 2023 convened once, as well as meeting twice with a more concise composition without the Swedish parties.

Nuclear fuel that has been placed in final disposal can no longer be inspected or verified by any known means. It is therefore important for nuclear safeguards purposes that fuel be verified before encapsulation and final disposal and that this verification be documented using methods that leave no doubt as to the accuracy and completeness of the data reported. STUK's project to develop the verification methods and equipment for spent nuclear fuel to be disposed of progressed well during the year. The project is currently investigating the integration of two complementary methods, PGET (Passive Gamma Emission Tomography) and PNAR (Passive Neutron Albedo Reactivity), into one and the same modular equipment. Both devices were used to conduct fuel measurements at Olkiluoto in October, and the PGET device was used at Loviisa in November 2023. The measurements with both methods succeeded well. In the case of the PGET method, development continued also on the software side: the analysis algorithm was developed in cooperation with the University of Helsinki, Helsinki Institute of Physics and VTT Technical Research Centre of Finland, and a doctoral thesis is about to be completed on it. A database program is also about to be completed for storing measurement data and information regarding nuclear safeguards related to the final disposal.

1.4.6 Inspections during construction

The licensing and construction oversight project (PORA) for Posiva's spent nuclear fuel final disposal project in 2022 continued the inspections laid down in the construction inspection programme.

The inspections had as their aim to assess the functioning of Posiva's management system, the adequacy and appropriateness of the relevant procedures for carrying out and controlling the construction of the plant, as well as for taking account of the relevant safety requirements.

Management of project-related and organisational changes for operating activities, 20–23 March 2023

Based on the inspections, Posiva's change management practices appear appropriate and mainly fulfil the safety requirements concerning them. The organisational change related to the operating phase is significant in terms of safety, and Posiva will prepare an assessment on the impacts of the organisational change on safety. The requirement issued by STUK in the context of its inspection concerns the assessment procedures of the upcoming organisational change.

Operating instructions and their management process and the training of operators and management of human factors, 18–19 April 2023

The inspection of the construction inspection plan covered Posiva's nuclear facility operating instructions, facility operator training and the management of human factors. In the inspection, it was found that Posiva is still in the process of preparing the operating instructions for the nuclear facility and the procedures to manage them.

The inspection found that the approval procedures for the operators of the Posiva nuclear power plant are not fully complete. STUK will oversee the development and completion of the approval procedures. The inspection covered the management of human factors in planning and the improvement and monitoring of the reliability of human activities. It was found that Posiva's plan for integrated system validation does not sufficiently cover operational occurrences and emergencies. In its inspection, STUK presented a requirement to rectify the matter.

Security arrangements, 25–27 September 2023

The inspection targeted Posiva's security arrangements in the construction and operating licence phase of the encapsulation and final disposal facilities. In addition to physical protections, the security arrangements are considered to include data security and the documentation of these areas. The inspection covered topical security arrangement matters and data security at Posiva's nuclear facilities. The inspection also included a facility visit, which covered the sufficiency of the security arrangements, with due consideration for preparations for the operation phase. Posiva fulfilled the security arrangement requirements concerning the current service life of the nuclear facilities, with the exception of two requirements.

Management and competence management, 18–19 October 2023

In its inspections, STUK has paid attention to the ways in which Posiva's management monitors the readiness of the organisation to commence the operation of the nuclear facility. STUK requires Posiva to make the indicators for organisational readiness and monitoring more transparent and clear. Furthermore, STUK has required Posiva to more comprehensively utilise the information generated by the licensee's own operations to develop the organisation's activities. STUK has verified that the resource planning of Posiva's key activities is progressing as planned for the production phase.

Radiation protection arrangements, 29–30 November 2023

STUK assessed the state of the radiation protection arrangements and the readiness in terms of in-service operations of the facilities. The inspections gave STUK a positive impression of the state of Posiva's radiation protection arrangements. In terms of radiation protection arrangements, the commissioning of Posiva's nuclear facilities has progressed far.

1.5 Other objects of regulatory oversight

In accordance with Section 2 of the Nuclear Energy Act (990/1987), the regulatory oversight of the use of nuclear energy covers the nuclear facilities and those in possession of small quantities of nuclear materials. This oversight also covers nuclear devices, equipment and information, as well as nuclear fuel cycle-related research and development activities and the

transport of nuclear materials and nuclear waste. The regulatory oversight of the use of nuclear energy also covers mining and milling operations aimed at producing uranium or thorium. Uranium-bearing semi-finished products from the metal-working industry fall within the scope of the regulatory control of the use of nuclear energy when the concentration that is defined for nuclear material is exceeded in an industrial process or product.

STUK oversees that the users of nuclear energy (operators in the field) meet the set requirements, the most essential of which are competent organisation and up-to-date internal instructions. In line with the respective applications, STUK approves the responsible managers or deputies. For international nuclear safeguards, operators must also adhere to the European Commission's nuclear safeguards regulation (Euratom No. 302/2005), which requires the plant's Basic Technical Characteristics (BTC), contact information and the nuclear material inventory to be up to date. The IAEA oversees Finland as a state pursuant to the Safeguards Agreement (INFCIRC/193) and its Additional Protocol. This extends the IAEA's oversight activities to also cover areas such as the research and development of nuclear fuel circulation, equipment production and export control.

All operators submitted the nuclear safeguards reports and notifications required of them. As regards companies that collect and hold uranium in the metal industry, STUK inspected the reports and notifications provided by the metal works of Umicore Finland Oy in Kokkola, Norilsk Nickel Oy in Harjavalta and Terrafame Oy in Sotkamo, and the ore processing plant of Dragon Mining Oy in Sastamala. There were no significant changes in the activities of these operators in 2023. Umicore provided a special report on the high uranium content of the enriched cobalt at the Kokkola works and returned the cargo with excessive impurities to the sender. The IEAE conducted a supplementary inspection visit to Metso Oyj's research facility in Pori in March 2023. In December, the IAEA confirmed that it had received appropriate and sufficient responses and clarifications to its questions regarding the ore processing procedure of Metso (Outotec).

Among the operators that submit monthly reports to the Commission, the IAEA, the Commission and STUK inspected VTT's nuclear material inventories in the material balance areas of both the Centre for Nuclear Safety and the research reactor in June 2023. In June, the Commission and STUK also inspected the nuclear material inventory of STUK. STUK inspected the nuclear material inventory of the University of Helsinki's Department of Chemistry by participating in the annual inventory specification on 31 May and approved a new deputy for the responsible manager. The University of Helsinki's Department of Physics was granted a new permit to hold nuclear materials at its X-ray and accelerator laboratories. The joint material balance area code for holders of small quantities, which the Department of Physics had previously had for reports to the Commission, was reactivated.

The Finnish bodies in possession of small quantities of nuclear materials, of which there are currently 12, fulfilled the nuclear safeguards obligations and submitted annual reports on time. Over the course of the year, two operators discontinued their nuclear material activities and their licences were revoked.

STUK inspected the annual reports on nuclear fuel cycle-related research and development activities and produced an annual report on their basis for the IAEA.

In 2023, STUK granted two new licences for the possession and processing of data materials requiring a licence (see Appendix 1). These cover the continued possession and disclosure of data materials requiring a licence following the end of the Fennovoima project. In addition,

STUK approved an update to the manual and the change of one person in charge. In 2023, STUK approved a total of eight nuclear safeguards manual updates related to these activities outside nuclear facilities.

Terrafame Oy began the monthly reporting on nuclear materials generated by pilot tests, pursuant to the nuclear safeguards procedures, to STUK and the European Commission in the summer of 2019. The Government granted permission for extensive uranium extraction in February 2020, and the licence became legally valid in the summer of 2021. According to the licence, Terrafame must commence the relevant collection activities in summer 2024. Terrafame provided an update to the safety report in October 2023 and supplemented it in December 2023 and at the beginning of January 2024. The review of the updates is under way. The collection activities cannot be commenced until the report updates have been approved and STUK has confirmed the safety of the collection activities through inspections. As regards the nuclear material generated through pilot tests, Terrafame has fulfilled the nuclear safeguards obligations in 2023.

On the basis of the inspections, as well as the reports and notifications submitted, STUK has satisfied itself that operations classified as the use of nuclear energy in Finland have been implemented in compliance with the safety obligations.

2 Oversight of nuclear facilities in figures

2.1 Examination of matters

In 2023, a total of 2,263 matters were submitted to STUK for examination, 253 of which concerned the spent nuclear fuel final disposal facility. The processing of 2,352 matters in total was completed. This figure includes the matters submitted in 2023 and earlier, as well as the licences granted by STUK under the Nuclear Energy Act, which are listed in Appendix 1. The average time taken to examine matters was 85 days. The number of matters and their average examination times in 2019–2023 are illustrated in Figure 22.

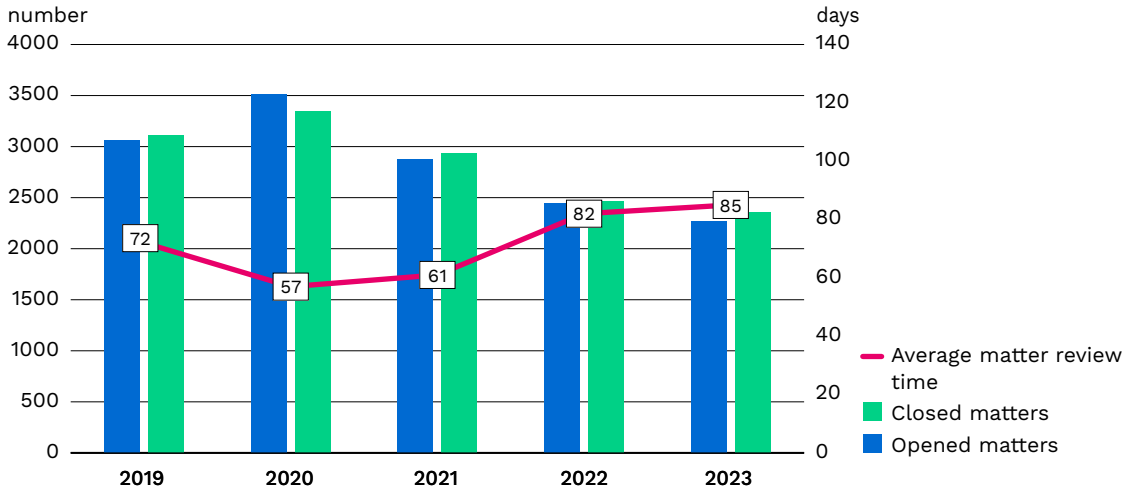

FIGURE 22. Average review time of opened and closed matters.

Figures 23–26 illustrate the distribution of the examination times of the matters pertaining to the various plant units for which approval processing was initiated, and to Posiva.

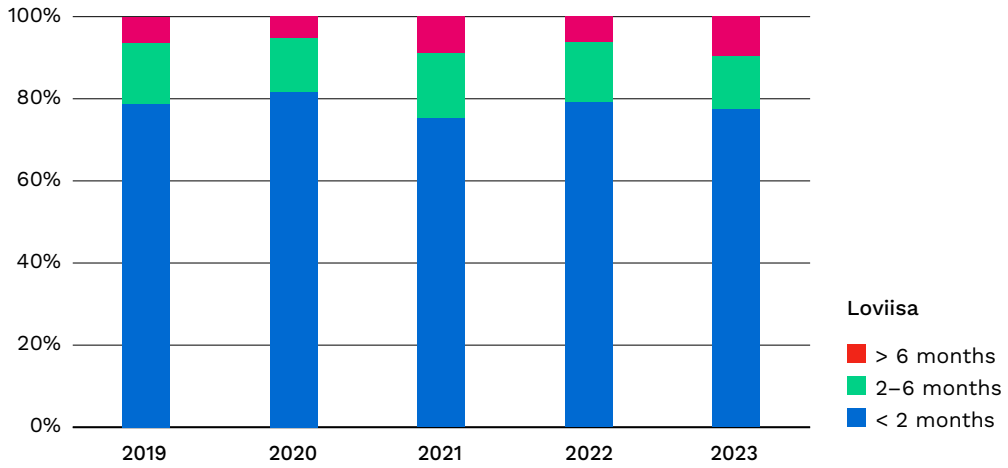

FIGURE 23. Distribution of time spent on preparing decisions on the Loviisa plant.

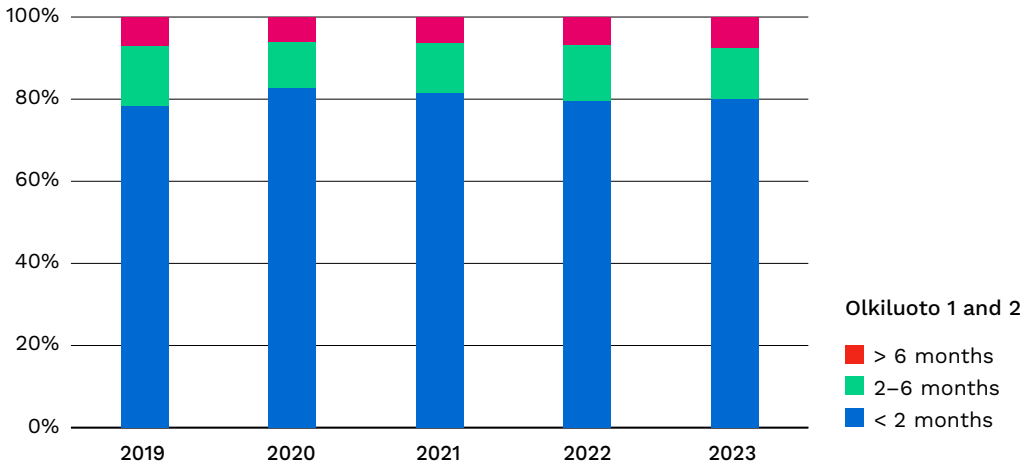

FIGURE 24. Distribution of time spent on preparing decisions on the operating plant units of Olkiluoto.

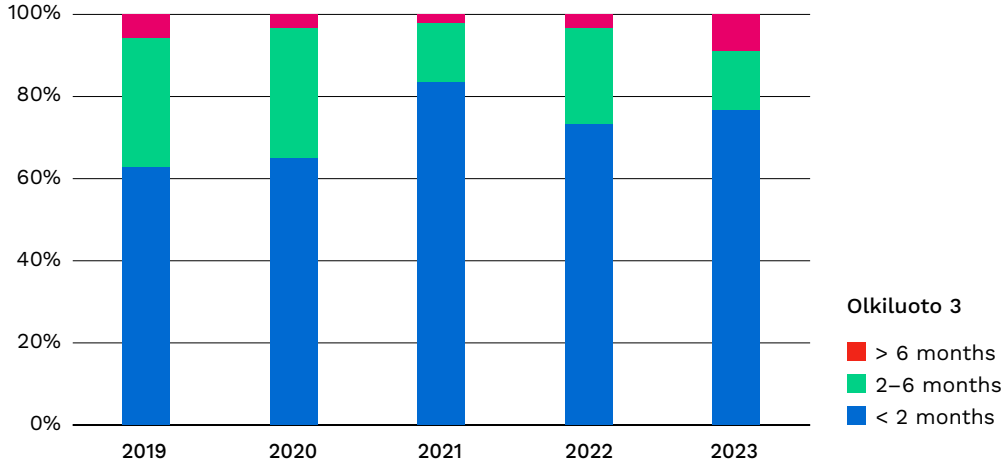

FIGURE 25. Distribution of time spent on preparing decisions on Olkiluoto plant unit 3.

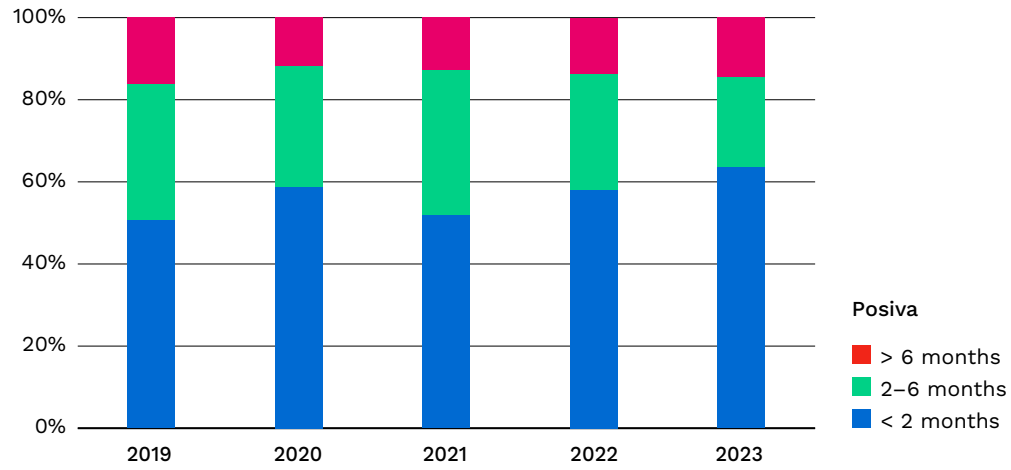

FIGURE 26. Distribution of time spent on preparing decisions on Posiva.

2.2 Inspections

Inspection programmes

Under the 2023 periodic inspection programme a total 16 inspections were carried out for the Loviisa nuclear power plant, and 20 inspections for the Olkiluoto plant.. During 2023, there were a total of five inspections carried out under the construction inspection programme of the encapsulation plant and final disposal facility. The most important observations of the inspections are presented in Section 1 on oversight.

Other inspections at plant sites

The year 2023 saw a total of 1,189 inspection protocols completed at the plant site or on supplier premises (for inspections other than the above inspections conducted under the inspection programmes and other than the nuclear safeguards inspections, which are discussed separately). Of these inspections, 369 were part of Olkiluoto 3 oversight and 775 of oversight focused on other operating plants. The oversight of the construction of Posiva's final disposal facility included 20 inspections.

The numbers of on-site inspection days in 2019–2023 are illustrated in Figure 27.

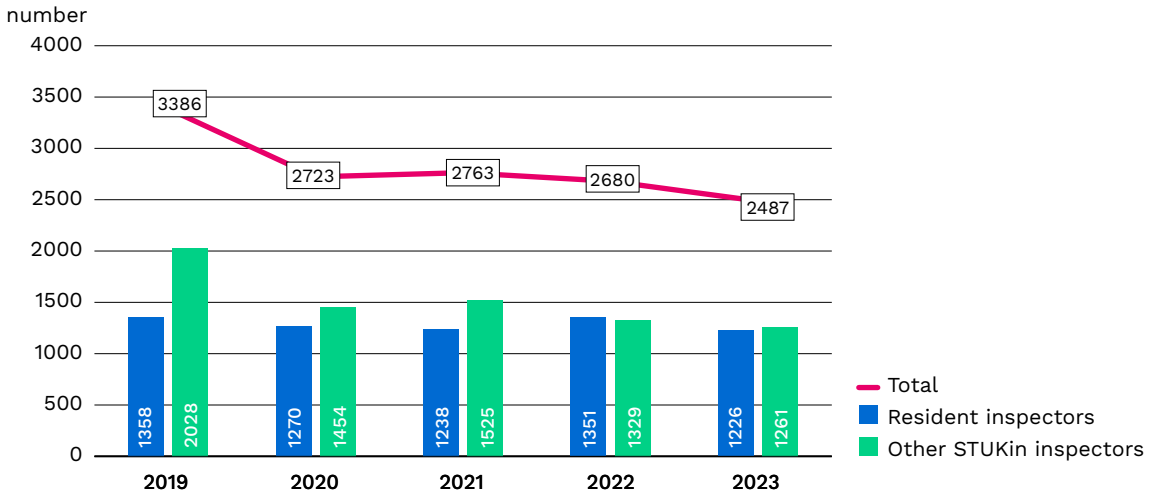

FIGURE 27. Number of inspection days onsite and at component manufacturers' premises.

2.3 Finances and resources

The performance area of regulatory oversight of nuclear safety conducts carried out both paid and free-of-charge routine operations. The paid routine operations mainly consist of the regulatory oversight of nuclear facilities, with the related costs charged to those subject to this oversight. The free-of-charge routine operations encompass international and domestic cooperation, participation in legislative development, emergency response activity, and communications. The free-of-charge routine operations are publicly funded. The costs arising from the development of regulations and from support functions (for example, administration, oversight development, competence development, reporting, and participation in nuclear safety research) is shifted to the paid and free-of-charge routine operations, as well as to service activity, in relation to the number of the working hours spent on each function.

Consequently, the cost correlation of the regulatory oversight of nuclear safety was 100%. Achievement of the oversight cost price is ensured by adjusting, after the annual cost accounting, the invoicing by way of a settlement bill to reflect the actual costs incurred. The income and costs from the paid regulatory oversight of the use of nuclear energy were EUR 18.2 million. This figure includes the environmental radiological monitoring of nuclear facilities, which was changed from a service operation to regulatory oversight in 2015. The total costs of the regulatory oversight of the use of nuclear energy came to EUR 20.2 million. This figure includes the costs from the paid and the free-of-charge regulatory oversight of the use of nuclear energy. The paid operations accounted for 90% of the total costs. Figure 28 illustrates the annual costs of the regulatory oversight of the use of nuclear energy in 2019–2023.

14.9 staff-years were spent on oversight of the Loviisa nuclear power plant, equal to 11.2% of the total working time of the personnel carrying out regulatory oversight of the use of nu-

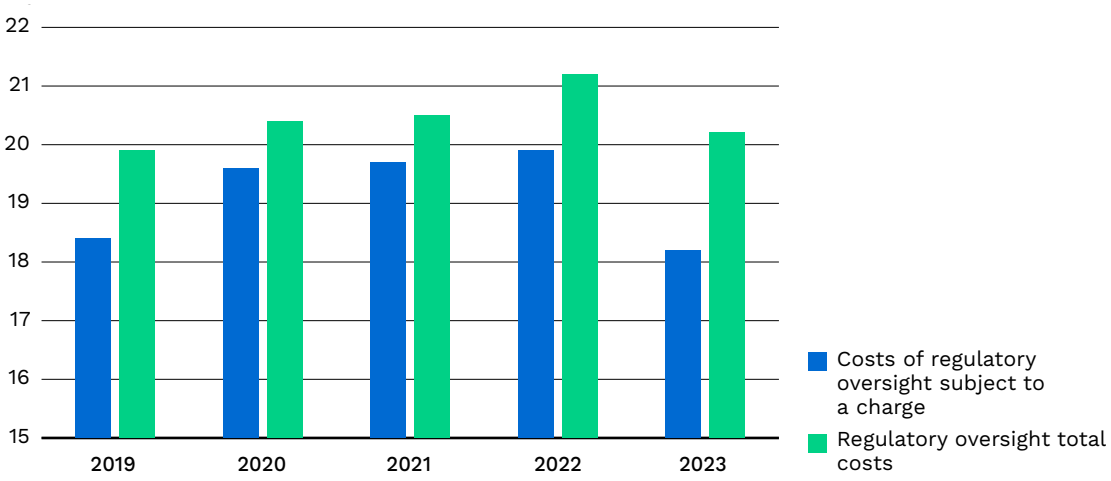

FIGURE 28. Income and costs of nuclear safety regulation.

clear energy. 17.7 staff-years were spent on oversight of the Olkiluoto 1 and 2 plant units, equal to 13.3% of the total working time. In addition to oversight of the operation of nuclear power plants, these figures include the time allocated to nuclear safeguards. 12.5 staff-years, or 9.4% of the total working time, were spent on overseeing Olkiluoto 3. The working time spent on overseeing Posiva was 11.8 staff-years, or 8.9% of the total working time. The time spent on the inspection and review of the FiR 1 research reactor was 1.1 staff-years. Figure 29 shows the distribution of the working hours (expressed in staff-years) of the personnel carrying out regulatory oversight of the use of nuclear energy, itemised by overseen entity, in 2017–2023.

Where necessary, STUK commissions independent assessments and analyses to support its oversight efforts. Figure 30 illustrates procurement costs in 2019–2023. The procurements in 2023 were mainly related to the modernisation of the refuelling machines of the OL1 and OL2 plant units, assessing the maturity of TVO's management system and safety culture, assessing the safety of Posiva's final disposal project for spent nuclear fuel, the inspection of the construction plans for the lifting and transfer equipment of the encapsulation and final disposal facility, production oversight and structural inspections.

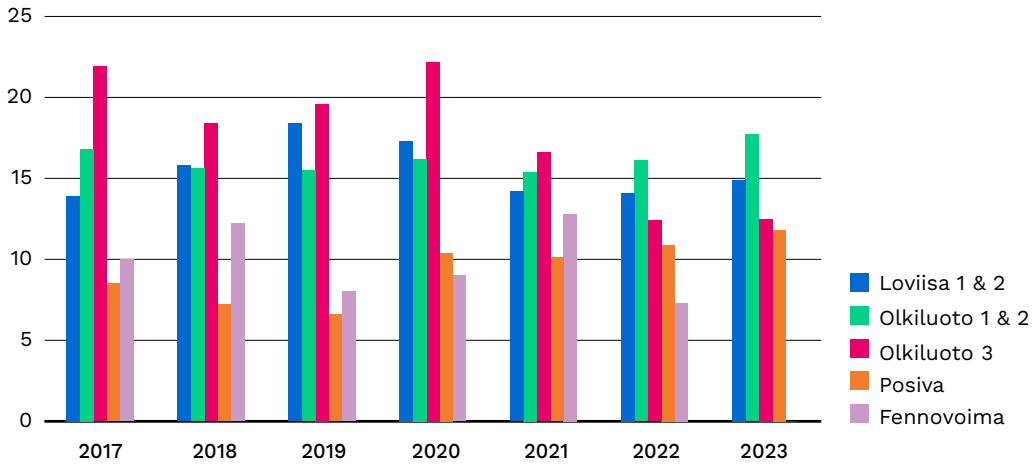

FIGURE 29. Distribution of working hours (person-years) of the regulatory personnel by subject of oversight in 2017–2023.

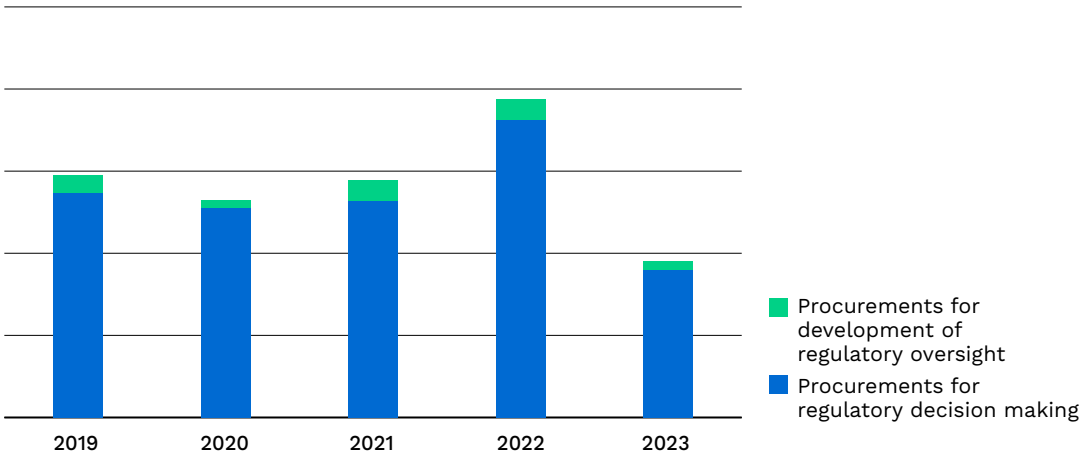

FIGURE 30. The acquisition costs of assessments and analyses.

Table 2 shows the distribution of the annual working time of the personnel carrying out regulatory oversight of the use of nuclear energy across the various performance areas. The figures do not include the work volumes of environmental radiation monitoring.

TABLE 2. Distribution of working time (person-years) of the regulatory personnel in each duty area.

Duty area	2019	2020	2021	2023	2023
Basic operations subject to a charge	68.7	75.8	71.9	63.3	58.3
Basic operations not subject to a charge	6.3	4.0	3.0	4.1	7.1
Service activities	1.1	0.5	0.7	1.4	1.6
Regulation work and support functions	45.2	44.7	42.6	43.2	42.5
Holidays and absences	26.0	23.3	23.7	23.4	23.4
Total	147.4	148.3	142.0	135.4	132.9

3 Development of oversight

There were several development projects regarding nuclear safety oversight under way at STUK in 2023. The oversight development efforts have taken into account the oversight expectations derived from STUK's strategy and the possibilities of leveraging risk informed methods to target oversight activities to ensure the fulfilment of the Graded Approach. The aim is to focus oversight increasingly on matters that are the most important for safety and consider the ability and responsibility of the licences in the choice of oversight measures and the amount of oversight. In order to support this objective, digital tools and systems have also been developed for various processes.

Development of oversight processes

Assessment of overall safety

STUK introduced an assessment model for overall safety in 2017. The assessment of overall safety creates and maintains an overall picture of the safety of the nuclear facility and the licensee's efforts to ensure its safety. Decisions on targeting oversight activities can be made based on the overall safety assessment. The model consists of more than 30 regularly assessed areas, which are based on STUK's current regulation structure. The on-going comprehensive update of the Nuclear Energy Act also creates a need to review the current overall safety assessment model.

Oversight programmes for operating nuclear power plants

Various areas of the oversight of operating plants have been developed over the years. The key oversight tasks were integrated into the plant-specific oversight programmes in 2023. In addition to the inspections of the inspection programme, the oversight programme includes other preplanned oversight tasks. The oversight programme provides sufficient time and comprehensive information for maintaining a situational picture of the situation of the facility and the basic activities of the licensee. The oversight activities conducted provide input for the overall safety assessment process. The oversight programme ensures that STUK's oversight is even more planned and systematic than before.

Oversight of organisational factors

Focusing the oversight related to organisational factors based on safety significance has been identified as one of the development targets. In 2022–2023, the development efforts identified safety-significant licensee organisational functions and roles and worked to develop a tool to support oversight. The development will be continued in 2024, with the goal of integrating the work into the assessment of overall safety.

Development of risk informed oversight tools

In recent years, STUK has worked to develop and implement tools to support the focusing of inspections and reviews, and the assessment of safety significance. The tools are based on plant-specific probabilistic risk assessment (PRA), which is why they can be used in the processing of matters related to the incidents, systems and equipment of nuclear facilities.

A new electronic inspection protocol system was implemented at STUK in 2020. In recent years, the system has been developed further based on user experiences and needs. The inspection protocol system utilises data in STUK's other information systems, which is why it can be used to steer the performance of inspections towards considering the safety significance of the inspected target alongside possible experiences, for example.

As regards the oversight of mechanical equipment, a risk informed oversight model was introduced in 2022, which covers the inspections and other oversight measures carried out by STUK during the entire lifecycle of equipment.

In 2023, STUK introduced a risk information system, which was developed to improve the risk awareness of STUK's inspectors based on PRA results. The information system includes key PRA results in graphical format, a simple description of the most significant initiating events, the development of the main results over the past decade, and a general description of the PRA content and applications. The information system supports inspectors in utilising risk information in their work and decision-making.

FIGURE 31. Developing regulatory oversight.

4 Nuclear safety regulation

STUK oversees compliance with the Radiation Act (859/2018) and Nuclear Energy Act (990/1987) and the provisions and regulations issued under them. STUK also takes part in the preparation of statutes and issues statements on the preparations of statutes regarding its field.

In 2023, a significant part of the work efforts was focused on the renewal of the Nuclear Energy Act under the leadership of the MEAE (Ministry of Economic Affairs and Employment), the overall revision of STUK's nuclear safety regulation and the updating of STUK's Regulation on the emergency arrangements of nuclear power plant.

Renewal of STUK's nuclear safety regulation

In October 2020, STUK made the decision to begin the structural and substantive renewal of its nuclear safety regulation. The regulation renewal, for which STUK is responsible, is part of the overall reform of the Nuclear Energy Act, as initiated by the MEAE. The structural reform entails an examination of the regulatory levels pursuant to Section 80 of the Constitution of Finland, which involves the positioning of the requirements in relation to the act, decree and STUK's regulations. In addition, the binding requirements and the advisory content, such as recommendations and justifications, will be separated more clearly. In the content-related reform the starting point is to maintain the requisite safety level and upper-level principles as they are. After the reform, the phrasing and language of the safety requirements are intended to be as technology-neutral as possible and less detailed in order to ensure that the requirements do not unnecessarily limit different solutions.

Based on prior preparatory work, STUK initiated an overall reform of its nuclear safety regulations in 2022 (SYTYKE project, 2022–2027). The key aims of STUK's regulatory reform is to emphasise operator responsibility, to correctly dimension the requirements in terms of safety significance and to enable effective focusing of oversight based on risk significance. The aims are related to STUK's efforts to develop oversight in accordance with its strategy. In 2023, STUK continued the efforts started in the previous year by working on matters to be included in the regulations, as well as their justifications, and by drafting the regulation structure. An important part of the regulatory reform was also conducting a comparison between the preparations for the SYTYKE project and the regulatory requirements of other domestic and international authorities and organisations (IAEA, WENRA). Furthermore, the content-related goals, structure and presentation method of the new nuclear safety regulations were planned. The preparation of STUK's regulations will continue in 2024, at which point the goal will be to prepare a first draft of all regulations.

STUK will present questions of principle, new matters and the most significant changes related to the reform to the ministries, current licensees, Advisory Committee on Nuclear Safety and other stakeholders for discussion. The smooth and scheduled implementation of the reform requires going through the content-related matters with the key stakeholders on a front-loaded basis. The purpose of the stakeholder cooperation is to ensure that no major questions of principle are expected to be presented for resolution or reassessment in the reg-

ulatory statement phase. STUK and the MEAE arranged two expanded stakeholder events in 2023, which covered the reform of the Nuclear Energy Act and STUK's nuclear safety regulations. STUK and the MEAE also organised topic-specific workshops in cooperation with the licensees of the current nuclear facilities. In addition to these, STUK initiated support group meetings with the current licensees to cover technical regulation-level matters related to various areas.

STUK's work to update the nuclear safety regulations as well as its schedule is closely connected to the comprehensive reform of the Nuclear Energy Act because the Nuclear Energy Act and the STUK regulations based on it are linked. In terms of the act, achieving the goals set for the regulatory reform and the development of STUK's regulatory activities requires basic regulations as well as precise and clearly delineated authorities to issue regulations based on which safety requirements can be set and regulatory oversight can be implemented. In the course of 2023, STUK participated in the preparations for the comprehensive reform of the Nuclear Energy Act (990/1987), which is the responsibility of the MEAE. The MEAE worked with STUK's experts and lawyers to organise meetings that covered various topics in which STUK used its expertise to support the MEAE in preparing drafts for the Nuclear Energy Act and decrees and drawing up background analyses.

STUK's regulations and the YVL Guides

By virtue of Section 7 q of the Nuclear Energy Act (990/1987), STUK is authorised to issue more specific regulations on the technical details of the principles and requirements laid down in Chapter 2a of the Nuclear Energy Act. Under this authorisation, STUK has issued regulations on the safety of a nuclear power plant (STUK Y/1/2018), the emergency arrangements of a nuclear power plant (STUK Y/2/2018), the security in the use of nuclear energy (STUK Y/3/2020), the safety of disposal of nuclear waste (STUK Y/4/2018) and the safety of mining and milling operations aimed at producing uranium or thorium (STUK Y/5/2016).

In 2023, STUK began the process of updating the Regulation on the emergency arrangements of nuclear power plant (STUK Y/2/2018), which entered into force on 15 December 2018. The update concerned the regulation's definitions and requirements related to a nuclear power plant's precautionary action zone and emergency planning zone, and its essential goal was to change the definitions of the zones to be case-specific instead of fixed kilometre limits. The preparation of the change was justified to ensure that the requirements imposed on nuclear facilities are correctly proportioned in terms of their risk significance. The draft regulation was circulated for external statements through the statement service in June–August, after which the preparation of the regulation was continued at STUK. The regulation's publication and entry into force will take place early in 2024.

Section 7r of the Nuclear Energy Act (990/1987) provides that STUK has the power to issue detailed safety requirements concerning the implementation of the safety level in accordance with the Nuclear Energy Act. STUK's nuclear safety guides (YVL Guides) are considered binding just as regulations are, but unlike regulations, the possibility of deviating from the requirements is provided for. The YVL guides were not updated in 2023.

5 Safety research

Publicly funded safety research on the use of nuclear energy has a key role in the development and maintenance of nuclear technology expertise in Finland. Without a national safety research programme, developing the expertise needed in the nuclear sector to support the authorities in ensuring safety would not be possible in Finland. According to the Nuclear Energy Act (990/1987), research funded by the Finnish State Nuclear Waste Management Fund (VYR) aims at ensuring that the authorities have access to sufficient expertise and methods at their immediate disposal if it is necessary to assess the safety significance of new issues that may emerge. The two national research programmes funded by VYR on nuclear safety research and nuclear waste management were combined under a single programme (SAFER2028) at the beginning of 2023. Both STUK and the licensees have hired several people who have obtained their training for expert positions in the field of nuclear energy use and oversight in these and previous publicly funded research programmes. The safety research programmes also have an important role in the training of organisations that provide STUK with technical support services, such as the VTT Technical Research Centre of Finland, University of Helsinki, Aalto University, Finnish Meteorological Institute, Geological Survey of Finland and Lappeenranta-Lahti University of Technology (LUT University). The importance of research programme is also emphasised by the fact that there is little other funding for research institutes in Finland to develop and maintain their expertise in the field.

The year 2023 was the first year of operations for the six-year SAFER2028 programme. STUK has contributed to ensuring that the research is steered towards projects that align with the goals of the framework plan prepared for the project in 2022. This has been ensured through active participation in the administrative groups of the programme. Overall, roughly 40 STUK experts took part in the programme in these groups in 2023. More information on the programme is available at https://safer2028.fi.

In May 2022, the MEAE appointed the SAFER2028 programme management group of end users of the research. The programme organisation is presented in Figure 32. In addition to

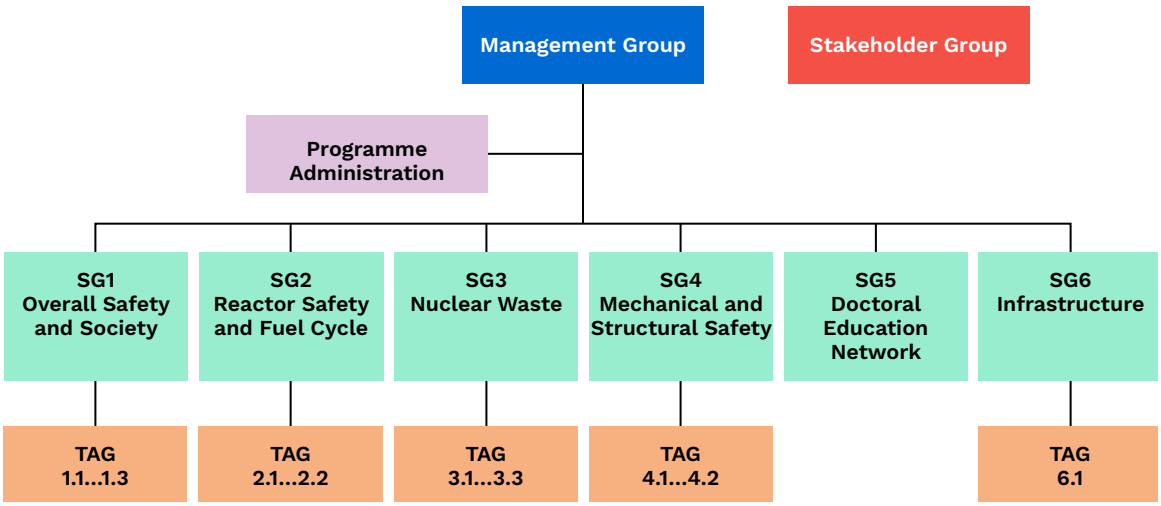

FIGURE 32. The administrative structure of SAFER2028 research programme.

holding the position of chair, STUK has two members in the management group, one of whom serves as the deputy chair. The programme involves four thematic areas: 1) Overall safety and society, 2) Reactor safety and fuel cycle, 3) Nuclear waste management, final disposal and decommissioning and 4) Mechanical and structural safety of NPPs. In addition to this, the programme features separate areas for a network of doctoral students (DENSE) and projects that support infrastructure.

In order to steer the research in these six areas and prepare annual funding proposals, each area has its own steering group (SG). STUK holds the position of chair in the first four areas and has a member in the infrastructure area. STUK does not have a member in the doctoral training network, because the research in the area is guided by research facilities and universities. That said, a representative of STUK can take part in the steering group meeting if they so desire. The steering groups process project proposals and present to the management group which projects are to be funded in the coming year and the sums of funding. Based on the steering group proposals, the management group presents to VYR an overall arrangement of the projects to be funded. The distribution of research funding between the aforementioned areas in 2023 is illustrated in Figure 33. The steering group of the doctoral training network does not issue a funding proposal. It only evaluates the scientific merits of the project proposals. This arrangement ensures that those conducting the research cannot influence the funding proposals. In order to strengthen the interaction between the SAFER2028 management group and research organisations, a stakeholder group consisting of representatives of research institutes has been established in the programme to engage in a dialogue on research challenges with the management group.

The research projects also have Technical Advisory Groups (TAG), which help steer the research according to the funding decisions. The Technical Advisopry Groups enable end user representatives to discuss project results with the researchers and provide the necessary guidance for implementing the projects. The doctoral training network does not have a Technical Advisopry Group, but, the networking of the doctoral students has been organised as a separate project within the programme. STUK has comprehensive representation in each Technical Advisopry Group.

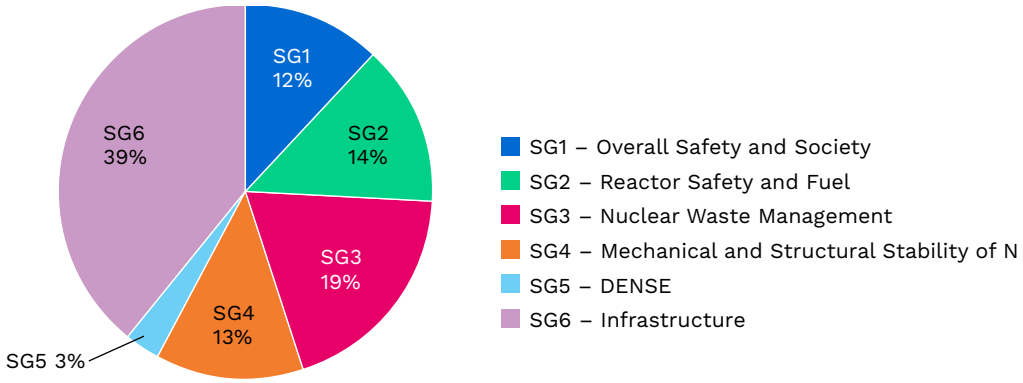

FIGURE 33. Research areas of SAFER2028 programme and their shares of the total funding in 2023.

6 International cooperation

STUK oversees and develops radiation and nuclear safety in cooperation with its foreign partners. In its international cooperation, STUK seeks to impact and develop procedures to improve nuclear safety on a global scale.

One of STUK's important partners is the International Atomic Energy Agency IAEA. Cooperation forums that are important to STUK also include the Nuclear Energy Agency (NEA) of the OECD countries and the Western European Nuclear Regulators' Association WENRA. In addition to this, STUK is actively involved in the regulatory and nuclear safety cooperation carried under the European Union and European Commission, and in the Nordic cooperation with corresponding authorities.

In 2023, challenges for international cooperation were presented by Russia's activities in Ukraine and the concerns of their possible impacts on Ukrainian nuclear power plants. The war resulted in tensions especially in meetings concerning international conventions.

6.1 International conventions

Non-Proliferation Treaty

The Non-Proliferation Treaty (NPT) took effect in 1970. It involves 191 countries throughout the world. The three main objectives of the treaty are the peaceful use of energy, the non-proliferation of nuclear weapons and nuclear disarmament. According to the Non-Proliferation Treaty, nations must enter into a Safeguards Agreement with the International Atomic Energy Agency (IAEA). The first Comprehensive Safeguards Agreement (INFCIRC 155) between Finland and the IAEA entered into force on 9 February 1972. When Finland joined the EU, the agreement was replaced by the tripartite Safeguards Agreement between the countries not in possession of nuclear weapons within the European Union, the European Atomic Energy Community and the IAEA in 1995. The Additional Protocol to the Safeguards Agreement, which strengthened IAEA's oversight, entered into force in the EU in 2004.

In 2023, nine bilateral international nuclear cooperation agreements agreed by the EU were in force (Australia, Canada, Japan, Kazakhstan, South Africa, Ukraine, the United Kingdom, USA, Uzbekistan). In addition, three nuclear cooperation agreements agreed by the State of Finland are in force (Russia, Saudi Arabia, South Korea). These bilateral agreements cause additional obligations for operators concerning the use of nuclear energy and reporting on it.

Treaty establishing the European Atomic Energy Community

Two establishing treaties were signed in Rome on 25 March 1957: the treaty to establish the European Economic Community (EEC) and the treaty to establish the European Atomic Energy Community (EAEC or Euratom). Among the most important goals of the Euratom Treaty were to promote research related to the use of nuclear energy and disseminate information, but the treaty also sought to ensure that nuclear materials intended for civilian use are not transferred

to other applications, and that all member states of the treaty have access to sufficient nuclear materials.

Convention on Nuclear Safety

The Convention on Nuclear Safety requires the presentation of a report to be prepared every three years on the fulfilment of its obligations. Since 1999, every three years Finland has been producing national reports, which are compliant with the Convention on Nuclear Safety, the latest report of which was produced in 2022. The fulfilment and reporting of the obligations of the convention will be assessed at an international review meeting between the contracting parties, which is held every three years. An assessment meeting was held in March 2023 and covered the two latest reporting periods, as the 2020 assessment meeting was cancelled due to the COVID-19 pandemic. At the meeting, Finland's challenges were found to include the ongoing regulatory update, in terms of resources and content, and the extension of the service life of facilities, especially with regard to retaining and acquiring the requisite competence. Many areas of good performance were found: for example, the KELPO project aiming for use of industrial serially manufactured equipment at nuclear facilities, in which STUK took part as an observer, the establishment of the volunteer group for radiation measurement and the national nuclear safety research programme (SAFIR/SAFER).

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

The latest assessment meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (JC) was held in the summer of 2022. The COVID-19 pandemic resulted in the postponement of the meeting from 2021. The meeting reflected the war in Ukraine and the tensions between Russia and its allies and Ukraine. Several countries made statements in their national presentations condemning Russia's actions in Ukraine. A summary report of the review meeting will be published, the content of which must be agreed upon by all participating countries during the meeting. This time, there was no agreement on the content of the report: the disagreements concerned how the Russian invasion of Ukraine and its impact on the safety of nuclear waste would be expressed.

The national report required by the joint convention is compiled every three years, and the process of compiling the next national report was initiated towards the end of 2023. The report presents the matters related to Finland's nuclear waste management required by the convention. The current national report to be prepared will be submitted to the IAEA in the autumn of 2024, and the next assessment meeting will be held in spring 2025.

International peer reviews

In 2022, three peer reviews coordinated by the IAEA were conducted in Finland in 2022: Integrated Regulatory Review Service (IRRS) peer review of the use of nuclear energy and radiation, peer review of the management of nuclear waste and radioactive waste (ARTEMIS), peer review of physical protections (IPPAS). Based on the recommendations gained through the reviews, STUK has worked together with the Ministry of Social Affairs and Health and the Ministry of Economic Affairs and Employment to prepare action plans that contain the necessary measures to develop operations according to the recommendations.

6.2 International cooperation groups

The **IAEA** continued to develop its safety standards on nuclear safety and security in 2023. STUK had a representative on the Commission on Safety Standards (CSS) managing the preparation of the standards as well as in the committees dealing with the content of the standards, i.e. the Nuclear Safety Standards Committee (**NUSSC**), the Waste Safety Standards Committee (**WASSC**), the Radiation Safety Standards Committee (**RASSC**), the Transport Safety Standards Committee (**TRANSSC**), the Emergency Preparedness Committee **EPReSC** and the Nuclear Security Guidance Committee (**NSGC**). STUK issued statements on the IAEA safety standards under preparation.

The Nuclear Energy Agency of the **OECD** (**NEA**) coordinates international cooperation in the field of safety research in particular. The organisation also provides an opportunity for cooperation between regulatory authorities. STUK was represented on all main committees of the organisation dealing with radiation and nuclear safety issues. The main committees' fields of activity are nuclear safety regulation (**CNRA**, Committee on Nuclear Regulatory Activities), safety research (**CSNI**, Committee on the Safety of Nuclear Installations), radiation safety (**CRPPH**, Committee on Radiation Protection and Public Health), nuclear waste management (**RWMC**, Radioactive Waste Management Committee) and the decommissioning of nuclear facilities (**CDLM**, Committee on Decommissioning of Nuclear Installation and Legacy Management).

The Reactor Harmonisation Working Group (**RHWG**) of **WENRA** (Western European Regulator's Association) convened three times in 2023, and STUK hosted the spring meeting. The key tasks of the working group during the year included finalising an assessment report on the implementation of reference-level operations at European nuclear power plants and the promotion of shared safety views with regard to SMRs. STUK was actively involved in the efforts and the RHWG subgroups.

WENRA's Working Group on Waste and Decommissioning (**WGWD**) convened once in person in Cologne and once virtually over the course of 2023. Self-assessments and peer reviews of reference levels associated with disposal were continued during the year, as were self-assessments and peer reviews of the reference level report on nuclear waste processing facilities. STUK was actively involved in the group's efforts.

The **SRL Steering Group**, which discusses the harmonisation of WENRA's reference levels, remotely convened four times in 2023. The efforts to consolidate the reference levels of WENRA's various working groups were initiated in 2023, based on earlier analyses. The work will continue in the coming years.

STUK participated in the activities of the European Nuclear Safety Regulators Group (**ENSREG**) and three of its subgroups (nuclear safety, nuclear waste management and communication).

ENSREG's nuclear safety group continued its efforts according to the Nuclear Safety Directive to complete the topic-specific peer review, which is conducted every four years. The topic of the second assessment, which was initiated in 2022, was fire protection and the national assessment reports were completed 2023. The actual peer review phase will take place once the reports are complete. The nuclear safety group continued to work together with the nuclear waste management group to develop the IRRS and ARTEMIS peer reviews and discussed its work and results so far in the experience exchange seminar for IRRS and ARTEMIS peer

reviews, which was organised in October 2023. Development work is carried out in close cooperation with the IAEA, which is responsible for the execution of the peer reviews.

The ENSREG nuclear waste management group initiated investigations on the decommissioning permissions of member state nuclear facilities and the practices of managing radioactive waste generated outside the use of nuclear energy in the member states. The group approved the investigation reports. In addition to this, the group approved a technical report on key performance indicators of waste management programmes, which had been under preparation for a long time. The key topics identified for the upcoming term were the collection and analysis of experiences related to the reporting and peer reviews required by the Nuclear Waste Directive and the further examination of the operational practices of the management of radioactive waste generated outside nuclear energy production. The third important topic for the coming period is the Commission's analysis on the viability of the member states' joint final disposal projects, which is already under preparation.

The **Deep geological repository regulators forum (DGRRF)** is a cooperative forum for six nuclear and radiation safety authorities (USA, Canada, Sweden, France, Switzerland and Finland) where disposal projects for spent nuclear fuel and high-level nuclear waste are discussed from the perspective of public authorities. In May 2023, STUK organised the fifth workshop to discuss the authority's approaches to and expectations for final disposal demonstrations. The second collection of topics covered the processing of rare events after the closure of the final disposal facility, the assessment of the repercussions and the acceptability from the perspective of authorities and legislation.

The **VVER Regulators' Forum** is a cooperative group for authorities operating Russian VVER pressurised water-type nuclear facilities, mainly concentrating on developing oversight activities of plants operating in its member countries. Finland will not participate in the operations of the cooperative group for the time being. Fortum's annual meeting and the majority of the working group meetings were not arranged due to the war between Russia and Ukraine.

Multilateral meeting is a new cooperative body formed by authorities of Slovakia, Czechia, Hungary and Finland with the aim of updating the cooperation between the countries on a European basis, especially now that the VVER Regulators' Forum, which has served as the main channel for cooperation, is not convening due to the geopolitical situation. STUK took part in the group's meeting for the first time in June 2023. The meeting covered the general situation of the participating countries and matters related to their facilities, and considered cooperation opportunities in various areas. One special topic was the nuclear fuel diversification of VVER facilities in the countries, which concerns not being dependent on a Russian fuel supplier.

The European Nuclear Security Regulators Association (ENSRA), which develops nuclear security systems through information exchange and working groups, convened twice in 2022. A representative of STUK attended the meetings.

6.3 International cooperation regarding small modular reactors

STUK continued participating in the activities of the SMR (small modular reactor) Regulators' Forum, which is supported by the IAEA. The forum convened twice in 2023. The third phase of the forum ended in the autumn of 2023, and the reports created during the phase were pub-

lished. The reports covered the containment function, production oversight and 3S perspectives (safety-security-safeguards). Preparations for the next phase of the cooperation began in the autumn of 2023.

In 2022, the IAEA started an initiative to promote SMRs (NHSI – Nuclear Harmonisation and Standardisation Initiative). There are separate tracks for the work of industry and regulators. Since the start, STUK has participated in the working groups of the track for authorities, which develop procedures for the safety assessments conducted together with the regulators of different countries and the utilisation of the work of other regulators. In addition to this, STUK engages in bilateral and multilateral cooperation with the nuclear safety regulators of other countries. STUK has, together with French and Czech regulators, for example, taken part in the joint assessment of the French Nuward reactor, which was initiated in 2022 and involves evaluating the reactor concept against its own set of regulations. Late in 2023, efforts were started to plan the continuation of the work and include Swedish, Dutch and Polish regulators in the next phase.

In the autumn of 2023, STUK had the opportunity to examine a British regulator's assessment of a Rolls-Royce small reactor together Swedish, Dutch, Polish and Czech nuclear safety regulators. Participation in projects like those described above helps STUK to examine design solutions of SMRs, possible special characteristics and new approaches to their operation. The involvement is also valuable in terms of the ongoing regulatory reform. In addition to this, discussions have been started on possible cooperation with the Swedish nuclear safety regulator with regard to the processing of safety questions concerning SMRs and the positioning of the facilities.

6.4 Bilateral cooperation between authorities on nuclear safeguards

STUK continued bilateral cooperation in the field of nuclear safeguards, for example with the Belgian authority (FANC). In 2023, a workshop was arranged on the topic of taking the design requirements of nuclear safeguards into account in legislation, regulatory guidelines and preparation. The feedback gained through the workshop on the role of nuclear safeguards in Finnish legislation and regulatory guidelines and the resulting conclusions are useful for the comprehensive reform of nuclear energy legislation and STUK's nuclear safety regulations. The results of the SBD cooperation have also been utilised in the Commission's proposal to update Commission Regulation 302/2005, which was released in December.

STUK and the Swedish authority SSM hold a cooperative meeting on nuclear safeguards in alternating years, which covers topical questions related to the safeguards and especially questions about which the parties would like to hear each other's experiences and views concerning the best ways of developing the safeguard arrangements and regulations. The 2023 meeting was held in Stockholm.

The Norwegian nuclear safety authority DSA hosted the Nordic Society on Nuclear Non-Proliferation and Safeguards Issues meeting in Oslo in October, and STUK took part in it.

6.5 Cooperation for the prevention of the proliferation of nuclear weapons

STUK took part at a preparatory committee meeting of the NPT Review Conference, which is held every five years, in Vienna between July and August 2023. The next review conference will be held in 2026.

The Nuclear Suppliers Group (NSG) forms a multinational control system that aims to prevent the proliferation of nuclear weapons by controlling the export of materials, equipment and technology used in the manufacture of nuclear weapons. The group consists of 48 countries, and Finland is represented in the group by the Ministry for Foreign Affairs, which STUK supports by attending the meetings of the Technical Experts Group (TEG) on request.

The Finnish Support Programme to the IAEA Safeguards (FINSP) is funded by the Ministry for Foreign Affairs and coordinated by STUK. The objective of the programme is to provide support to the IAEA in tasks related to the development of oversight methods, the preparation of oversight plans and the training of the IAEA inspectors. In 2023, the support programme had 13 ongoing projects. The Finnish support programme had a review meeting with the IAEA in November 2023.

There are STUK's experts in ESARDA's (European Safeguards Research and Development Association) committees, working groups and editorial committee. STUK is also a member of ESARDA's Steering Committee and Executive Board. In 2023, STUK's experts served as chairpersons of the Implementation of Safeguards (IS WG) working group and Export Control (EXC WG) and as members of the Executive Board of ESARDA. STUK attended an extensive meeting held with ESARDA and INMM (Institute of Nuclear Materials Management) in May 2023. In addition to this, most ESARDA working groups convened towards the end of the year. The objective is to continuously oversee and respond to the needs of ESARDA's members and further the nuclear safeguards goals on a national and international level.

A meeting of the EPGR cooperative group (Encapsulation Plant and Geological Repository) of the IAEA, the European Commission and representatives of Sweden and Finland took place in February 2022. The main topics of the meeting included the plans for the safeguards-by-design oversight of Posiva's encapsulation plant and the underground disposal facility and the preparations for implementation (required monitoring equipment and their installation planning). In 2023, this meeting was not held but instead a tripartite meeting (Finland, EC and IAEA) was held on the oversight of the final disposal facility and the technical consensus on the organisation of oversight, as were several technical meetings on the detailed plans for the technical oversight of the encapsulation plant.

Appendix 1
– Licences granted by STUK under the Nuclear Energy Act

Teollisuuden Voima Oy

- STUK 1/C42214/2023, 30 May 2023: OL1 and OL2 – Import licence application for fuel transfer machines, date of expiry 31 December 2026.
- STUK 2/C42214/2023, 30 May 2023: OL1 e 46 ”S” – Import licence application, date of expiry 31 December 2024.
- STUK 1/D42214/2023, 1 September 2023: OL2 e 44A ”P” – Import licence application, date of expiry 31 December 2024.
- STUK 2/D42214/2023, 4 September 2023: OL2 e 44B ”P” – Import licence application, date of expiry 31 December 2024.
- STUK 1/G42214/2023, 14 September 2023: OL2 e 02D ”P” – Import licence application, date of expiry 31 December 2024.
- STUK 3/G42214/2023, 21 December 2023: OL3 – Import licence amendment application STUK 2/G42214/2022, date of expiry 31 December 2025.
- STUK 4/G42214/2023, 20 December 2023: OL3 – Import licence amendment application STUK 3/G42214/2022, date of expiry 31 December 2024.

Fortum Power and Heat Oy

- STUK 1/A42214/2023, 31 May 2023: Import licence for neutron flux sensors. Date of expiry 31 July 2023
- STUK 2/A42214/2023, 19 June 2023: Import licence application, import of an optimised uranium-free test assembly from Sweden. Date of expiry 31 December 2023.
- STUK 3/A42214/2023, 28 September 2023: Export licence – Application for a shipment licence of radioactive waste samples for analysis to Denmark. The date of expiry of the export licence is 31 December 2025.
- STUK 9/Y42214/2023, 20 December 2023: Data material licence, date of expiry 31 December 2028.

VTT

- STUK 1/F42214/2023, 5 April 2023: VTT Technical Research Centre of Finland’s application for the transfer of nuclear waste. The licence is valid until 31 December 2030.

Other

- STUK 5/Y42214/2023, 7 December 2023: University of Helsinki Department of Physics – Nuclear material licence, date of expiry 31 December 2033.
- STUK 1/J42214/2023, 13 December 2023: Fennovoima – Data material licence, date of expiry 31 December 2028.
- STUK 25/Y46201/2023, 13 December 2023: DMS s.r.o. – Transport licence for fuel to Hungary via Finnish territory, date of expiry 31 December 2026.
- STUK 10/Y42214/2023, 20 December 2023: RAOS OY – Data material licence, date of expiry 31 December 2026.

List of figures

Figures are freely available with notification "Figure: STUK", unless otherwise stated.

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