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STUK-B 265 / MAY 2021

Ville Peri (ed.)

Implementing nuclear non-proliferation in Finland

Regulatory control, international cooperation and the Comprehensive Nuclear-Test-Ban Treaty

Annual report 2020

ISBN 978-952-309-504-5 (print) PunaMusta Oy
ISBN 978-952-309-505-2 (pdf)
ISSN 0781-1713 (print)
ISSN 2243-1896 (pdf)

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PERI Ville (ed.). Implementing nuclear non-proliferation in Finland. Regulatory control, international cooperation and the Comprehensive Nuclear-Test-Ban Treaty. Annual report 2020. STUK-B 265, Helsinki 2021, 63 p.

KEYWORDS: nuclear safeguards, regulatory control, comprehensive nuclear-test-ban treaty, verification

Abstract

The regulatory control of nuclear materials, nuclear safeguards, is a prerequisite for the peaceful use of nuclear energy. In order to maintain the Finnish part of the international agreements on nuclear non-proliferation – mainly the Non-Proliferation Treaty (NPT) – this regulatory control is implemented mainly by the Nuclear Materials Safeguards section of the Finnish Radiation and Nuclear Safety Authority (STUK). In addition, the Ministry for Foreign Affairs (MFA) and Ministry of Economic Affairs and Employment (MEAE) play a central role in the state system of accounting for and control of nuclear material (SSAC). STUK cooperates nationally with the ministries, customs, border control and other domestic stakeholders in the areas of non-proliferation, export control and nuclear disarmament.

Core stakeholders in the SSAC are the operators and licence holders who have the ultimate responsibility for their nuclear materials and related activities. Finland has quite significant nuclear power production, but the related nuclear industry is rather limited. Most of the declared nuclear materials (uranium, plutonium and thorium) in Finland reside at the nuclear power plants at Olkiluoto and Loviisa. In addition, there is a shutdown research reactor in Espoo with fresh nuclear fuel still at the site. Other Finnish operators include STUK itself, the University of Helsinki and VTT's Centre for Nuclear Safety as mid-sized holders, holders of nuclear materials generated as concentrates or by-products in the mineral processing industry and 13 minor nuclear material holders.

STUK maintains a national nuclear materials accountancy system and verifies that nuclear activities in Finland are carried out in accordance with the Finnish Nuclear Energy Act and Decree, European Union safeguards regulations, and international agreements. These tasks are performed to verify that Finland can assure itself and the international community of the absence of undeclared nuclear activities and materials. In addition to this, the IAEA evaluates the success of the state safeguards system, and the European Commission participates in safeguarding the materials under its jurisdiction.

The results of STUK's nuclear safeguards accounting and verification activities in 2020 continued to demonstrate that Finnish licence holders take good care of their nuclear materials. There were no indications of undeclared nuclear materials or activities, and the inspected materials and activities were in accordance with the operators' declarations. The operators' own nuclear materials accountancy and control systems enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards.

In 2020, STUK and other stakeholders faced unforeseen circumstances caused by the global COVID-19 pandemic. Travel and gathering restrictions particularly impacted international events, but also presented a challenge for STUK to continue safeguards inspection activities uninterrupted. STUK adapted to the circumstances by postponing non-urgent field activities, cooperating with the operators to ensure that health and safety precautions were taken, and performing remote inspections. STUK finished the year with 39 inspections and 89 inspection days, both of which are just below and above average. The number of international inspections and inspection days were also close to the average. According to the statements on inspection results and the conclusion of safeguards implementation provided by the IAEA and the Commission in 2020, the IAEA issued a total of two notices for and required two actions from operators in Finland. The notices were responded to and the actions were completed satisfactorily by the end of 2020.

The Nuclear Materials section saw two new employees joining in early 2020: one researcher to work on the passive gamma emission tomography methods and one safeguards inspector. Inspector responsibilities were rearranged from responsible officer and deputy to responsible officer pairs with the aim of strengthening teamwork and promoting job rotation. Special arrangements with inspections and working from home due to COVID-19 restrictions delayed training of new inspectors and resulted in the cancellation of events but also allowed old and new inspectors to focus on the development of their own expertise and internal procedures. As a continuation of technical development work, due to the need to regulate the construction of the disposal facility for spent nuclear fuel at the Olkiluoto repository site, safeguards instrumentation was under development, in particular passive gamma emission tomography and passive neutron albedo reactivity measurement for the verification of spent fuel.

A major goal of all current Comprehensive Nuclear-Test-Ban Treaty (CTBT)-related activities is the entry into force of the CTBT itself. An important prerequisite for such positive political action is that the verification system of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is functioning and able to provide assurance to all parties that it is impossible to carry out a clandestine nuclear test without detection. The FiNDC is committed to its own role in this common endeavour, so that the verification system of the CTBTO can accomplish its detection task.

Preface

Every year, STUK prepares the report on Implementing Nuclear Non-Proliferation in Finland. The main function of the report is to inform and share experiences with colleagues and interested parties on safeguards implementation, nuclear non-proliferation measures and to inform the Finnish National Data Centre on CTBTO activities in Finland.

In addition to myself, we have seven SG inspectors and one researcher in the Safeguards section. They all are important contributors to maintaining and developing the national safeguards system and the SSAC. Their work is vital for the legislative objectives of all use of nuclear energy in Finland, i.e. ensuring that the use of nuclear energy does not promote the proliferation of nuclear weapons. This work cannot be done without co-operation and collaboration with operators, the users of nuclear energy, so we have appointed responsible officers in the safeguards section facility who pair up to take care of communication with the operators, the planning and implementation of national safeguards measures towards the operators and their operations, and the evaluation and assessment of the results, findings and conclusions by the international organisations, the IAEA and EC.

The highlights of 2020 have been many:

- First, we managed to ensure that our safeguards objectives were met during this special year of Covid-19.
- Second, we made much progress in preparing for the supervision of the disposal of spent nuclear fuel, and we (STUK) did this in close co-operation with the operator Posiva, the IAEA and the European Commission.
- Third, we made much progress in developing the expertise of personnel and transferring knowledge and experiences both internally and externally.

The inspectors in the office have specific oversight tasks and duties towards individual operators and stakeholders. They work in pairs to ensure duplicate knowledge and appropriate response time. This arrangement also makes it easier for all individuals to handle their workload. I am proud to present my team:

- Mr Tapani Honkamaa, Principal Advisor
- Mr Mikael Moring, Senior Inspector
- Dr Olli Okko, Senior Inspector
- Mr Timo Ansaranta, Senior Inspector
- Mr Henri Niittymäki, Senior Inspector
- Mr Ville Peri, Inspector
- Mr Topi Tupasela, Inspector
- Ms Riina Virta, Researcher

This report is compiled by all the staff members of the Safeguards section of STUK. The report is structured to enable the reader to understand the complete picture of the Finnish nuclear safeguards system and to find out about recent events and latest developments in Finnish safeguards. Thank you, Ville and Olli, for the good work in compiling and editing this report.

I would also like to thank other experts at STUK who take care of several additional tasks related to safeguards and nuclear non-proliferation and are contributing to this report, especially Ms Elina Martikka who actively continues to contribute strongly to non-proliferation and safeguards issues in her current position as an international cooperation manager in the recently established Department for Expert Services. Ms Martikka works in close cooperation with the Safeguards section and leads the working group of NPT partners at STUK. I would also like to underline the importance of the work Mr Kari Peräjärvi is doing while contributing to the GICNT and IPNDV activities that are also included in this report.

Comments and suggestions are welcome to improve the content and normativity of the report. I wish you all good and rewarding moments with the report. Stay safe and well!

Marko Hämäläinen,
Safeguards Section Head

Contents

1 Implementation of nuclear non-proliferation in Finland

The regulatory control of nuclear materials, nuclear safeguards, is a prerequisite for the peaceful use of nuclear energy in Finland. For Finland to have a nuclear industry, most of which consists of nuclear energy production, it must be ensured that nuclear materials, equipment and technology are used only for their declared peaceful purposes. The basis of nuclear safeguards is the national system for the regulatory control of nuclear materials and activities. Nuclear safeguards represent an integral part of nuclear safety and nuclear security and are applied to both large- and medium-sized nuclear industry and to small-scale nuclear material activities. Along with the safeguards, the regulatory process for nuclear non-proliferation includes transport control, export control, border control, international cooperation and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

Safeguards are applied to nuclear materials and activities that can lead to the proliferation of nuclear weapons. These safeguards include nuclear materials accountancy, control, security and the reporting of nuclear fuel cycle-related activities. The main parties involved in a state nuclear safeguards system are the users of nuclear materials, often referred to as 'licence holders' or more broadly as 'operators' and the state authority, STUK. A licence holder must take good care of its nuclear materials and the state authority must provide the regulatory control to ensure that the licence holder fulfils the requirements. The control of nuclear expert organisations, technology holders and suppliers, to ensure the non-proliferation of sensitive technology, is also a growing global challenge for all stakeholders. In Finnish legislation, all these operators are dealt with as users of nuclear energy.

Finland has quite significant nuclear power production, but the related nuclear industry is rather limited. Most of the declared nuclear materials (uranium, plutonium and thorium) in Finland reside at the nuclear power plants at Olkiluoto and Loviisa. Additionally, there is the research reactor in Espoo with nuclear materials, as well as 13 minor nuclear material holders in Finland. Most of the applied nuclear research and development activities are carried out to improve the maintenance and safety of the nuclear power plants.

1.1 International safeguards agreements and national legislation

Nuclear safeguards are based on international agreements, the most important and extensive of which is the Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT). The Treaty Establishing the European Atomic Energy Community (Euratom Treaty) is the basis for the nuclear safeguards system of the European Union (EU). Finland is bound by both these treaties, and also has several bilateral agreements in the area of the peaceful use of nuclear energy. When Finland joined the EU, the bilateral agreements with Australia, Canada and the USA were partly replaced by the corresponding Euratom agreements (see Appendix 3 for the relevant legislation).

Finland was the first state where an INFCIRC/153-type comprehensive Safeguards Agreement with the IAEA entered into force (INFCIRC/155, 9 February 1972). When Finland joined the EU (1 January 1995), this agreement was suspended and subsequently the Safeguards Agreement between the non-nuclear weapon Member States of the EU, the Euratom and the IAEA (INFCIRC/193) entered into force in Finland on 1 October 1995. Finland signed the Additional Protocol (AP) to the INFCIRC/193 in Vienna on 22 September 1998 with the other EU Member States and ratified it on 8 August 2000. The Additional Protocol entered into force on 30 April 2004, once all the EU Member States had ratified it. The scope and mandate for Euratom safeguards are defined in the European Commission Regulation No. 302/2005.

The year 2020 marked the 50th anniversary of the NPT entering into force internationally and in Finland, which was one of its early signatories. Much of the history of nuclear non-proliferation can be studied through Finland's part in it, as Finland and Finnish diplomats and experts have played a strong role in international non-proliferation and safeguards activities throughout the decades. This role and other details of Finland's implementation of the NPT are described in the recent study *Finland and nuclear non-proliferation. Fifty years of implementing The Nuclear Non-Proliferation Treaty*[1]. The report showcases the accomplishments of Finnish experts in promoting nuclear non-proliferation, developing a national safeguards system and supporting IAEA safeguards.

After Finland joined the EU as a Member State and thereby subjected itself to the Euratom safeguards, a comprehensive national safeguards system continued to be maintained and further developed. The basic motivation for this is the responsibility assumed by Finland for its safeguards and security under the obligations of the NPT, and to ensure fulfilment of the Euratom requirements.

The national safeguards derive their mandate and scope from the Finnish Nuclear Energy Act and Decree. The operator's obligation to have a nuclear material accountancy system and the right of STUK to oversee the planning and generation of design information for new facilities were introduced from STUK requirements into the Nuclear Energy Decree.

In 2015, the Nuclear Energy Act was amended in such a way that the government decrees on nuclear safety, nuclear waste management, emergency preparedness and nuclear security were replaced by new STUK regulations. In addition, the new STUK regulation on the Safety of Mining and Milling Operations Aimed at Producing Uranium or Thorium also entered into force on 1 January 2016.

As stipulated by the act, STUK issues detailed requirements (the YVL Guides) on safety, security and safeguards that apply to the use of nuclear energy. STUK's safeguards requirements for all users of nuclear energy during all phases of the nuclear fuel cycle are set in

1 Paju, Petri. Finland and nuclear non-proliferation. Fifty years of implementing the Nuclear Non-Proliferation Treaty. STUK-TR 34, Helsinki 2020. 90 p.

YVL Guide D.1 Regulatory Control of Nuclear Safeguards issued in 2013. The guide was updated in 2018, and a new version was published in 2019. Areas covered in the new comprehensive guide include the obligations and measures stemming from the Additional Protocol for the Safeguards Agreement and from recent developments. All operators must describe their own safeguards system in written form (as a nuclear materials handbook or safeguards manual), in order to facilitate their task of fulfilling their obligations and to guarantee the effective and comprehensive operation of the national safeguards system. In the new guide, there are also specific national requirements for the disposal of spent nuclear fuel in a geological repository.

In general, nuclear safeguards control applies to:

- nuclear material (special fissionable material and source material)
- nuclear dual-use items (non-nuclear materials, components, equipment and technology suitable for producing nuclear energy or nuclear weapons as specified in INFCIRC/254, Part 1)
- licence holders' activities, expertise, preparedness and competence including information security
- R&D and other activities related to the nuclear fuel cycle as defined in the Additional Protocol
- the design and construction of new nuclear facilities.

1.2 Parties of the Finnish safeguards system

The main parties involved in the Finnish safeguards system are the authorities and operators. Undistributed responsibility for the safety, security and safeguards of the use of nuclear energy rests with the operator. It is the responsibility of STUK as the state regulatory authority to ensure that the licence holders and all other operators in the nuclear field comply with the requirements of the law and the nuclear safeguards agreements. To complement the national effort, international control is necessary in order to demonstrate credibility and the proper functioning of the national safeguards system.

1.2.1 Ministries

The Ministry for Foreign Affairs (MFA) is responsible for national non-proliferation policy and international agreements. The MFA is responsible for the export control of nuclear materials and other nuclear dual-use items, including sensitive nuclear technology. The Ministry of Economic Affairs and Employment (MEAE) is responsible for the supreme command and control of nuclear matters. The MEAE is responsible for the legislation related to nuclear energy and is also the competent authority mentioned in the Euratom Treaty. Other ministries, such as the Ministry of the Interior and the Ministry of Defence, also contribute to the efficient functioning of the national nuclear safeguards system.

1.2.2 STUK

According to Finnish nuclear legislation, STUK is responsible for maintaining the national nuclear safeguards system to prevent the proliferation of nuclear weapons. STUK regulates the operators' activities and ensures that the obligations of international agreements concerning the peaceful use of nuclear materials are met. Regulatory control by STUK includes the possession, use, production, transfer (national and international), handling, storage, transport, export and import of nuclear materials and nuclear dual-use items. STUK oversees Finland's approval and consultation process for inspectors from the IAEA and the European Commission.

The nuclear safeguards work of STUK, executed by its Nuclear Materials Safeguards section, covers most typical measures of the national authority in the state system of accounting for and control of nuclear material (SSAC), together with many other activities. STUK reviews the operators' reports (operational notifications, inventory reports), inspects their accountancy, facilities and transport arrangements on site, and performs system audits. STUK runs a verification programme for nuclear activities to assess the completeness and correctness of the declarations by the licence holders. STUK acts proactively in order to avoid or solve in advance any foreseeable issues that may be raised by the international inspectorates. Nuclear safeguards on a national level are closely linked to other functions of nuclear materials control and non-proliferation: licensing, export control, border control, transport control, combating illicit trafficking, physical protection of nuclear materials, monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and the Global Initiative to Combat Nuclear Terrorism (GICNT). Nuclear safety and particularly nuclear security objectives are closely complemented by safeguards objectives. For this reason, the research and regulatory units in the fields of safety, security and safeguards at STUK cooperate within the non-proliferation framework. The scope of non-proliferation work is linked to many organisational units of STUK (Fig. 1).

The distribution of the working hours of the Nuclear Materials Safeguards section in 2020 in the different duty areas is presented in Figure 2. Most of the working hours are invoiced to the operators. The duty areas are divided into direct oversight and inspections (basic operations), support functions including maintenance, development work for the regulatory functions and consultancy, including international cooperation financed by the Ministry for

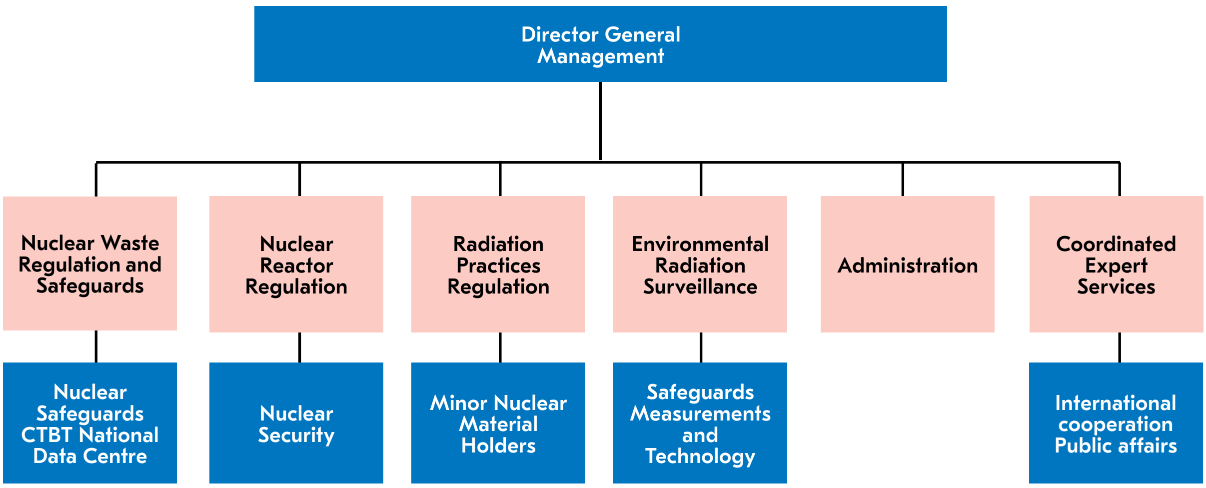


FIGURE 1. Framework to implement nuclear non-proliferation within STUK's organisation.

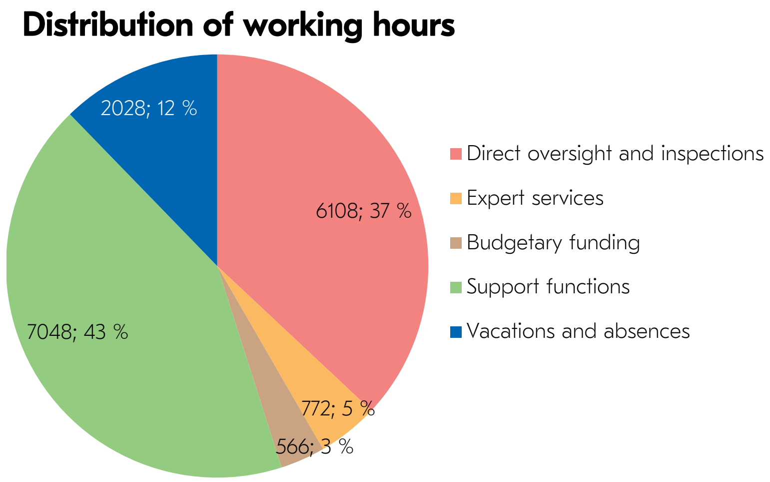


FIGURE 2. The distribution of the working hours of the Nuclear Materials Safeguards section in the various duty areas.

Foreign Affairs or the European Union. State budgetary funding usually constitutes about 5% and in 2020 just 3% of the total funding of the section. It is worthwhile mentioning that the working hours in 2020 do not represent an average year. The unusual circumstances of the global pandemic and subsequent postponement of especially international activities reduced hours dedicated to expert services. Additionally, as the staff worked mostly from home, the section lost fewer days to sick leave, thus reducing the share of absences. These hours were directed at development and oversight work.

Nuclear non-proliferation is by nature an international domain. STUK therefore actively participates in international nuclear safeguards-related cooperation and development efforts. STUK takes part in the European Safeguards Research and Development Association ESARDA's working groups, executive board and steering committee. Current nuclear new-build projects including the final disposal facility have emphasised the need to introduce safeguards requirements at an early stage of facility design. These experiences, among others, are actively shared by STUK with the IAEA, in several international fora, and in bilateral cooperation with several countries.

1.2.3 Licence holders and other users of nuclear energy

The essential parts of the national safeguards system are the licence holders and other users of nuclear energy – in nuclear terminology, often called the operators. In the Finnish legislation, the term 'use of nuclear energy' encompasses a wide range of nuclear-related activities such as those defined in the Additional Protocol. These operators, in particular the licence holders, perform key functions in the national safeguards system: control of the authentic source data of their nuclear materials in addition to accountancy for nuclear materials at the facility level for each of their material balance areas (MBA). Each licence holder or other user of nuclear energy must operate its safeguards system in accordance with its own nuclear materials handbook or safeguards manual. The requirements of Finnish nuclear energy legislation, the Comprehensive Safeguards Agreement and the Additional Protocol are integrated into the handbook to facilitate implementation of safeguards at the site, including the material balance areas. Other operators too, as users of nuclear energy, are required to have a safeguards manual to facilitate safeguards implementation. The nuclear materials handbook or safeguards manual is part of the operator's quality system and is reviewed and approved by STUK.

In Finland, there are about 30 operators responsible for nuclear material accountancy and control. The major material balance areas are listed in Table 1 and described in greater detail below. Most of the nuclear materials in Finland reside at the nuclear power plants at Loviisa and Olkiluoto. The amounts of nuclear materials (uranium, plutonium) in Finland in 1990–2020 are presented in Figures 3 and 4. Currently there are six sites as referred to in the Additional Protocol: the two nuclear power plant sites, the geological repository site in Olkiluoto, and three minor sites: VTT Technical Research Centre of Finland, the Radiation and Nuclear Safety Authority STUK and the Laboratory of Radiochemistry at the University of Helsinki.

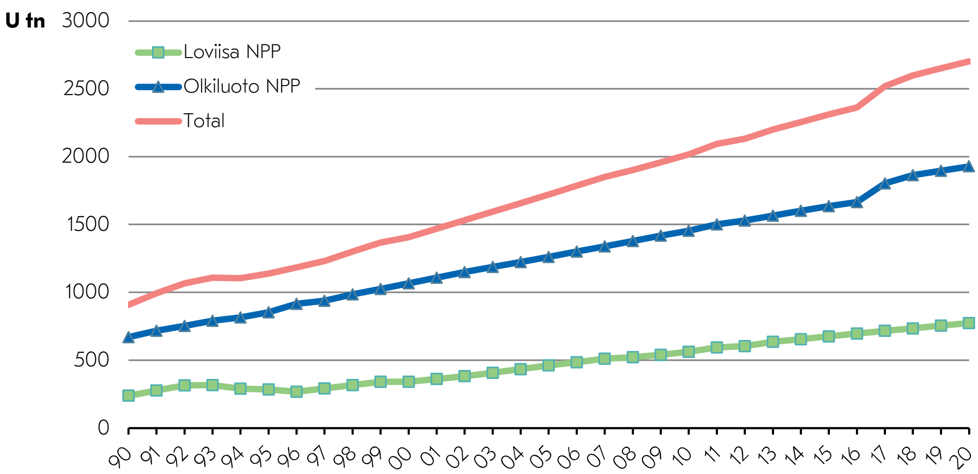


FIGURE 3. Uranium accumulation in Finland in 1990–2020.

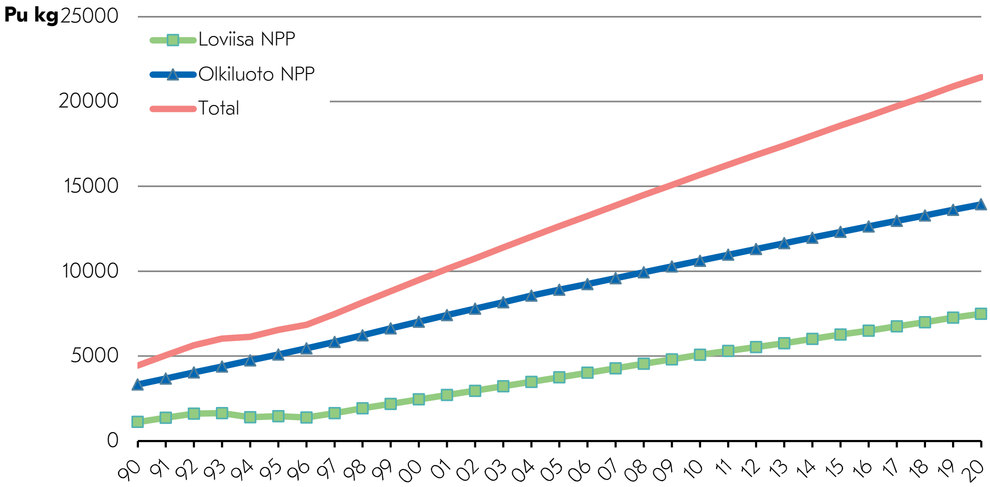


FIGURE 4. Plutonium in spent nuclear fuel in Finland in 1990–2020.

With the basic technical characteristics (BTC) submitted by a licence holder or by other operator as groundwork, the European Commission adopts particular safeguards provisions (PSP) for that licence holder. PSPs are drawn taking operational and technical constraints into account in close consultation with both the person or undertaking concerned and the relevant member state. Until PSPs are adopted, the person or undertaking must apply the general provisions of Commission Regulation No. 302/2005. A facility attachment (FA) is prepared in cooperation with the IAEA for each facility to describe arrangements specific to that facility. The status of the regulatory documents for the Finnish material balance areas is shown in Table 1.

TABLE 1. Status of regulatory documents for material balance areas in Finland at the end of 2020.

MBA, location	BTC, last upd.	Site (AP), founded	PSP, in force	FA, in force	Licence/DiP, in force (from/until)	SG Manual, approved update
WLOV, Loviisa	20.3.2020	SSFLOVI, 8.7.2004	Yes, 4.5.1998	No	Operating, LO1 until 31.12.2027, LO2 until 31.12.2030	19.5.2020
WOL1, Olkiluoto	9.12.2020	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	4.12.2020
WOL2, Olkiluoto	9.12.2020	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	4.12.2020
WOLS, Olkiluoto	9.12.2020	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	4.12.2020
WOL3, Olkiluoto	9.12.2020	SSFOLKI, 8.7.2004	Yes, 17.12.2019	No	Operating, until 31.12.2038	4.12.2020
WOLE, Olkiluoto	24.6.2019	SSFPOSI, 31.3.2010	No	No	Construction, 12.11.2015	No, included in WOLF manual
WOLF, Olkiluoto	9.12.2019	SSFPOSI, 31.3.2010	No	No	Construction, 12.11.2015	22.8.2019
WFV1, Pyhäjoki	3.2.2017	No	No	No	DiP, initial 1.7.2010, supplement 5.12.2014	20.4.2018
WRRF, Espoo	12.5.2017	SSFVTTI, 8.7.2004	Yes, 9.7.1998	No	Operating, until 31.12.2023	13.4.2017
WNSC, Espoo	26.10.2020	Included 2017 to SSFVTTI	No	No	Operating, until 31.12.2026	11.11.2019
WFRS, Helsinki	15.2.2019	SSFSTUK, 8.7.2004	No	No	Not required (as an authority)	11.11.2019
WHEL, Helsinki	4.4.2019	SSFHYRL, 8.7.2004	No	No	Operating, until 31.12.2027	3.9.2019
WKKO, Kokkola	13.2.2020	No	No	No	Operating, until 31.12.2024	17.12.2020
WNNH, Harjavalta	16.1.2018	No	No	No	Operating, until 31.12.2029	15.11.2019
WTAL, Terrafame	20.5.2019	No	No	No	Operating (legal force pending), until 31.12.2050	19.7.2018
WDPJ, Jyväskylä	10.3.2017	No	No	No	Operating, until 31.12.2024	24.9.2018

Finnish material balance areas and their status on 31.12.2020. MBA (material balance area code), BTC (Basic Technical Characteristics, i.e. Design Information), AP (the Additional Protocol), PSP (Particular Safeguards Provisions set by the European Commission), FA (Facility Attachment prepared by the IAEA), DiP (Decision-in-Principle).

Major nuclear installations in Finland

Loviisa nuclear power plant

Plant unit	Start-up	National grid	Nominal electric power (gross/net, MW)	Type, supplier
Loviisa 1	8 Feb 1977	9 May 1977	531/507	Pressurised water reactor (PWR), Atomenergoexport
Loviisa 2	4 Nov 1980	5 Jan 1981	531/507	Pressurised water reactor (PWR), Atomenergoexport

Fortum Power and Heat Oy owns the Loviisa 1 and 2 plant units located in Loviisa.

Olkiluoto nuclear power plant

Plant unit	Start-up	National grid	Nominal electric power (gross/net, MW)	Type, supplier
Olkiluoto 1	2 Sep 1978	10 Oct 1979	920/890	Boiling water reactor (BWR), Asea Atom
Olkiluoto 2	18 Feb 1980	1 Jul 1982	920/890	Boiling water reactor (BWR), Asea Atom
Olkiluoto 3	Operating licence granted 7 Mar 2019		Approx. 1600 (net)	Pressurised water reactor (PWR), Areva NP

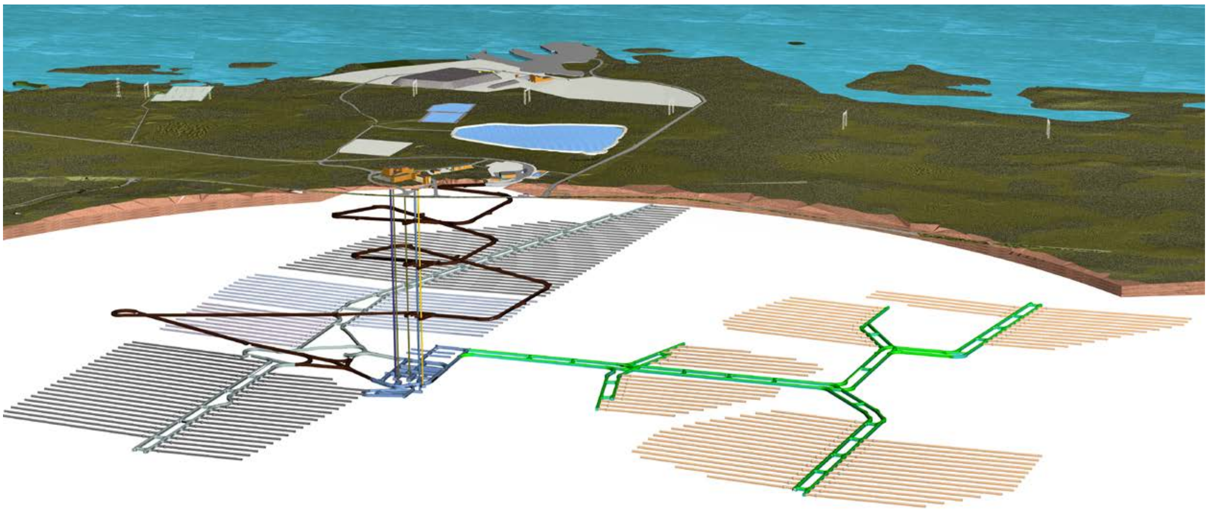
Teollisuuden Voima Oyj owns the Olkiluoto 1 and 2 plant units located in Olkiluoto, Eurajoki, and the Olkiluoto 3 plant unit under commissioning.

Hanhikivi nuclear facility project

Plant unit	Supplemented Decision-In-Principle approved	Nominal electric power, net (MW)	Type, supplier
Hanhikivi 1	5 Dec 2014	Approx. 1200	Pressurised Water Reactor (PWR), ROSATOM

Hanhikivi nuclear power plant FH1 is a power plant project of Fennovoima.

Olkiluoto encapsulation plant and geological repository



The planned facility under construction will consist of a surface facility for the encapsulation of spent nuclear fuel and a geological repository for disposal of the fuel at a depth of appr. 420 metres.

FiR 1 research reactor

Facility	Thermal power	In operation	Fuel	Triga fuel type
TRIGA Mark II research reactor	250 kW	March 1962 – June 2015	Reactor core consists of 80 fuel rods which contain 15 kg of uranium	Uranium–zirconium hydride combination: 8% uranium, 91% zirconium and 1% hydrogen

The FiR 1 research reactor, operated by VTT Technical Research Centre of Finland, was commissioned in March 1962. VTT stopped using the reactor in June 2015 and placed it in permanent shutdown. VTT submitted the operating licence application for the decommissioning phase to the Government in June 2017.

Fortum (MBA WLOV)

The nuclear power plant operated by Fortum Power and Heat Oy is located on Hästholmen Island in Loviisa on the south-east coast of Finland. This first NPP was built in Finland in the 1970s to host two VVER-440-type power reactor units. These two units share common fresh and spent fuel storages. For nuclear safeguards accountancy purposes, the entire NPP is counted as one material balance area (MBA code WLOV).

Most of the fuel for the Loviisa NPP is imported from the Soviet Union/Russian Federation. The spent fuel of the Loviisa NPP was returned to the Soviet Union/Russian Federation until 1996 and since then has been stored in the interim storage due to a change in Finnish nuclear legislation, which forbids the import and export of nuclear waste in general, including spent fuel.

As per the requirements of the Additional Protocol, the Loviisa NPP site (SSFLOVI) comprises Hästholmen Island as a whole and extends to the main gate on the mainland. Particular Safeguards Provisions for the Loviisa NPP, which define the European Commission's nuclear safeguards procedures for the facility, have been in force since 1998. The Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared by the IAEA for the Loviisa NPP.

Teollisuuden Voima (MBAs WOL1, WOL2, WOLS, and WOL3)

Teollisuuden Voima Oyj (TVO) owns and operates a nuclear power plant on Olkiluoto Island in Eurajoki on the west coast of Finland. The Olkiluoto NPP consists of two operational reactor units, one unit under commissioning, and an interim spent fuel storage. There are four active material balance areas (MBA codes WOL1, WOL2, WOLS, WOL3) at the Olkiluoto NPP. Olkiluoto 1 was connected to the electricity grid in 1978 and Olkiluoto 2 in 1980. The Finnish Government granted a licence to construct a new nuclear reactor, Olkiluoto 3, in 2005. An operating licence for the new unit was granted to TVO on 7 March 2019. At the end of 2020, TVO was finalising preparations for loading the reactor core with nuclear fuel. Permission for fuel loading is granted by STUK. The current estimate for the beginning of commercial energy production is in early 2022.

Presently, the uranium in TVO's nuclear fuel is mainly of Australian, Canadian and Russian origin. This uranium is enriched in the Russian Federation or EU, and the fuel assemblies are manufactured in the EU. Spent fuel is stored in the interim storage at the site until final disposal in the Olkiluoto repository.

TVO owns most of the area of Olkiluoto Island, but the NPP site (SSFOLKI) as per the requirements of the Additional Protocol currently comprises the fenced areas around the reactor units, the spent fuel storage and the storage for low- and intermediate-level waste, and the Olkiluoto 3 construction site. Particular Safeguards Provisions for Olkiluoto 1, 2 and the spent fuel storage have been in force since 2007 and for Olkiluoto 3 since 2019. A Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared by the IAEA for the Olkiluoto NPP.

Fennovoima (MBA WFV1)

Fennovoima was founded in 2007 as a new nuclear power operator in Finland. The government approved a Decision-in-Principle in 2010 for the new operator Fennovoima to construct a new nuclear power plant at a new site. The preliminary Basic Technical Characteristics (BTC) were submitted to the European Commission in summer 2013, and the MBA code WFV1 was assigned to the future material balance area once the selection of the future Hanhikivi site at Pyhäjoki was decided upon. Fennovoima submitted the construction licence application to the government in June 2015. Provision of the necessary information to STUK, required for a construction licence as per Section 35 of the Nuclear Energy Decree, has been delayed. Fennovoima's goal is to receive the construction licence in 2021. The first Hanhikivi site declaration (according to the Additional Protocol) will be submitted once the construction licence has been granted.

VTT (MBAs WRRF and WNSC)

Small amounts of nuclear materials are located at facilities other than nuclear power plants. The most significant of these facilities is the VTT (Technical Research Centre of Finland) research reactor FiR1 (MBA code WRRF), located in Otaniemi, Espoo. The research reactor was the first nuclear reactor built in Finland. In 2012, the Ministry of Employment and the Economy and VTT announced the plan to close down the reactor and launch the decommissioning process. The reactor was shut down and made subcritical in 2015. Irradiated fuel from the reactor was shipped to the United States in December 2020 to be used at the research reactor at the U.S. Geological Survey in Denver.

Particular Safeguards Provisions that define the European Commission's nuclear safeguards procedures for the facility have been in force for VTT FiR1 since 1998. A Facility Attachment of the Safeguards Agreement INFCIRC/193 has not been prepared by the IAEA for the research reactor.

A new building, the VTT Centre for Nuclear Safety, for experimental nuclear research was built at the Espoo premises of VTT. The preliminary BTC for the new building was submitted to the Commission at the end of 2014, and the MBA code WNSC was subsequently assigned to the future material balance area in 2015. STUK granted the operating licence in 2016 for the VTT Centre for Nuclear Safety, and the first nuclear materials were moved to the new building in 2017. Both these decisions for future decommissioning and construction will have long-lasting effects, due to the need for licences, permits, contracts and environmental impact assessment. This also affects safeguards, as the nuclear materials must be kept under the control of competent personnel in both material balance areas.

The VTT site (SSFVTTI), as per the requirements of the Additional Protocol, currently consists of the whole building around the research reactor, although there are non-nuclear companies and university premises in the same building, and the Centre for Nuclear Safety building.

STUK (MBA WFRS)

According to the nuclear energy decree, the Radiation and Nuclear Safety Authority (STUK) needs no licence as referred to in the Nuclear Energy Act for operations performed in its capacity as an authority, but STUK's Nuclear Materials Safeguards section follows all the regulations and reporting practices in its capacity as nuclear material holder. The function of handling and possessing nuclear materials is set in a different department of STUK to the regulatory Nuclear Materials Safeguards section, which also provides oversight for this function. Small quantities of nuclear materials are stored by STUK, mainly materials no longer in use and hence taken into STUK's custody. STUK was founded in 1958 and has been located at its current premises in Roihupelto, Helsinki, since 1994. The STUK MBA (WFRS) consists of the STUK headquarters and the 'Central interim storage for small-user radioactive waste' at the Olkiluoto NPP site.

The STUK site (SSFSTUK), as per the requirements of the Additional Protocol, consists of the premises of STUK's headquarters located in Helsinki. The storage at Olkiluoto is included in the NPP's site declaration.

The University of Helsinki (MBA WHEL)

The Laboratory of Radiochemistry at the University of Helsinki (HYRL) uses small amounts of nuclear materials. The laboratory is located on the Kumpula university campus in Helsinki. The University's internal structure was reorganised in 2017, and the current licence holder is the Department of Chemistry.

The HYRL site (SSFHYRL), as per the requirements of the Additional Protocol, comprises the whole building housing the laboratory.

Umicore Finland Oy (MBA WKKO)

The by-products of Kokkola Chemicals cobalt purification process contain uranium, which qualifies these by-products as nuclear material. Kokkola Chemicals has an operating licence to produce, store and handle nuclear material. In 2013, Freeport-McMoRan Copper & Gold Inc. acquired the ownership of the OM Group. The current operator since December 2019 is Umicore Finland Oy, and the factory is located at Kokkola on the west coast of Finland. The extraction of uranium from industrial purification processes involves so-called pre-safeguarded materials, which are not yet suitable for fuel fabrication or isotopic enrichment and are thus not subject to conventional IAEA safeguards. The operator reports monthly to the European Commission and STUK.

Norilsk Nickel Harjavalta Oy (MBA WNNH)

Norilsk Nickel Harjavalta Oy operates the nickel refining plant at Harjavalta in western Finland. The plant was commissioned in 1959, expanded in 1995 and again in 2002. The refinery of Norilsk Nickel Harjavalta employs the technique of the sulphuric acid leaching of nickel products. Uranium residuals are extracted from the nickel products and currently stored at the site. The Norilsk Nickel Harjavalta company submitted the basic technical characteristics (BTC) to the European Commission in 2010. In 2010, STUK granted a licence to extract and store less than 10 tonnes of uranium per year. The licence was renewed at the end of 2019 for a new 10-year period. The materials in Harjavalta are also pre-safeguarded and reported monthly to STUK and the European Commission.

Terrafame Oy (MBA WTAL)

In 2010, the Talvivaara Sotkamo Ltd mining company announced its interest in investigating the recovery of uranium as a separate product from its sulphide ore body at Talvivaara located in Sotkamo in eastern Finland. The Basic Technical Characteristics (BTC) were submitted to the European Commission in 2010, and the MBA code WTAL is assigned to the future uranium extraction plant that has been constructed as a separate part of the mineral processing plant. During 2015, the state-owned company Terrafame took over the mining and milling operations. At the end of 2016, the use of the uranium extraction plant was again included in the mining and mineral processing planning. STUK granted a licence for the small-scale pilot testing of the mineral processing techniques in December 2017. The licencing process included the approval of Terrafame's nuclear safeguards manual and responsible persons. The application for a full operating licence for the extraction plant was submitted to the government at the end of October 2017 and was processed by the Ministry of Economic Affairs and Employment. STUK delivered its statement on the safety of the uranium extraction plant to the ministry on 11 June 2019 based on the information required for construction licence as per Nuclear Energy Degree 62 a §. The licence was granted by the government on 6 February 2020 with a period for complaints. The MBA code WTAL is kept available for the nuclear material accountancy that was initiated with the pilot tests.

Other nuclear material holders

There are 13 minor nuclear material holders in Finland. One of them is an actual material balance area: the University of Jyväskylä, Department of Physics (JYFL, MBA code WDPJ), but in fact the nuclear material at JYFL has been derogated and exempted by the European Commission and the IAEA. Other minor nuclear material holders are members of a Catch-All-MBA (CAM), for the purposes of international nuclear safeguards. Most of these have depleted uranium as radiation-shielding material.

Uranium may be concentrated in the mineral processing industry in intermediate or metal products with uranium concentration that fulfil the definition of nuclear material. These metal products that are typical when, for example, processing sulphide ores with low uranium content, do not need to be included in the Euratom reporting because of their non-nuclear use. In the process industry, the annual quantities of processed natural uranium are in the order of several kilogrammes or even tonnes. Typically, uranium is extracted from the main products and considered as industrial waste among other extracts. According to the definitions in Finnish nuclear energy legislation, the production and possession of source material have been licensed by STUK since 2018 after the interpretation and decision of MEAE in the summer of 2018. Earlier, these kinds of operators were not licensed by STUK, but a few gold companies, for example, have reported their uranium-rich gold production to STUK. Current licence holders are Boliden Kokkola Oy and Boliden Harjavalta Oy for the production and possession of uranium-rich copper cement originating from zinc concentrates, and Dragon Mining Oy for the production of uranium-rich gold concentrates.

Posiva (MBAs WOLE and WOLF)

Posiva Oy is the company responsible for the disposal of spent nuclear fuel in Finland. It was founded in 1995 and is owned by the nuclear power plant operators TVO and Fortum. Posiva will dispose of the spent nuclear fuel produced by its owners 400 meters deep in the crystalline bedrock, using the KBS-3 concept. The concept was initially developed by the Swedish Nuclear Fuel and Waste Management company SKB and has been further jointly developed by Posiva and SKB. Posiva was granted a licence by the government in November 2015 to construct a disposal facility. Based on the drawings presented in the application, the preliminary BTCs were prepared for the encapsulation plant (EP) and geological repository (GR) separately and submitted to the European Commission in 2013. The MBA codes assigned to the facilities are WOLE for the encapsulation plant and WOLF for the geological repository. The construction of the geological repository commenced officially in 2016 and the encapsulation plant construction in 2019. From 2003 to 2016, Posiva was building an underground rock characterisation facility called ONKALO® in Olkiluoto, and thus preparing for the construction of the disposal facility. Posiva has since started using the name ONKALO® for the whole disposal facility. The rock characterisation facility is now a part of the geological repository and constitutes the vehicle access ramp, three shafts and the technical support premises. In the IAEA safeguards approaches, it has been suggested that the geological formation should be under safeguards during the whole lifetime of the underground facility, beginning from the pre-operational phase. For this reason, long before becoming a nuclear material holder, Posiva was already required to develop a non-proliferation handbook, such as a nuclear materials handbook, to describe its safeguards procedures and reporting system.

Posiva is planning to submit an operating licence application by the end of 2021 and, according to plans, the first canisters with spent nuclear fuel will be deposited in the mid-2020s. Cold tests of the disposal procedures are planned to start in 2023. Normal verification inspections of nuclear materials cannot be performed once the materials have been permanently disposed, so procedures related to verification inspections must be clear and necessary safeguards equipment should be installed and operational before the initiation of final disposal.

The installation, still without nuclear materials, constitutes a site according to the Additional Protocol. The Posiva site (SSFPOSI) covers the fenced area around the buildings supporting the construction of the facilities.

Other operators

Nuclear expert organisations, technology holders and suppliers that serve the nuclear and other industries are obliged to ensure that non-proliferation-sensitive technology does not get into the hands of unauthorised parties and thereby contribute to nuclear proliferation. The introduction of the Additional Protocol extended the scope of safeguards to the non-proliferation control of nuclear programmes and fuel cycle-related activities. These also include research and development activities, which do not involve nuclear materials but are related to the process or system development of fuel cycle aspects defined in the protocol. Additionally, the United Nations Security Council Resolution 1540 requires every state to ensure that export controls, border controls, material accountancy and physical protection are efficiently addressed, and calls on all states to develop appropriate ways to work with and inform industry and the public of their obligations. The control of nuclear expert organisations to ensure the non-proliferation and peaceful use of sensitive technology and dual-use items is a growing global challenge for all stakeholders.

Nuclear safeguards are commonly seen as the traditional nuclear material accountancy and reporting system, the main stakeholders of which are the international, regional and local authorities and the operators. In accordance with the extended non-proliferation regime and the amendments to the Finnish legislation, the operators, universities, research organisations or companies that have activities defined in the Additional Protocol are under reporting requirements and export control. These operators (VTT Technical Research Centre of Finland and a few universities) as users of nuclear energy are required to prepare a nuclear safeguards manual and to nominate persons responsible for nuclear safeguards arrangements.

1.3 IAEA and Euratom Safeguards in Finland

The IAEA and the European Commission (Euratom safeguards) both have independent mandates to operate in Finland. These two international inspectorates have agreed on cooperation, which aims to reduce undue duplication of effort. The operators report to the Commission as required by Commission Safeguards Regulation No 302/2005. It is the Commission's task to control the licence holders' accounting and reporting systems. The Commission must draw up the particular safeguards provisions (PSP) to agree on the means of safeguards implementation, taking account of the operational and technical constraints of the licence holder.

The IAEA safeguards include traditional nuclear safeguards according to safeguards agreement INFCIRC/193, and safeguards activities in accordance with the Additional Protocol, integrated together. While this should not lead to an increase in the number of inspections, it should enable the IAEA to assure itself of the absence of undeclared nuclear activities in a state. In Finland, the integrated safeguards (IS) approach has reduced the rate of IAEA routine interim inspections. The reduction was first seen in 2009 and was a result of the state-level safeguards approach for Finland, which was negotiated during 2007 and 2008. In contrast to the reduction in routine inspections, the IAEA additionally performs 1–3 short-notice inspections per year in a state with a similar set of nuclear installations as Finland. Since 2010, the number of annual IAEA and European Commission inspections has been close to 20 with approximately 25 inspection days. The fluctuation is mainly due to the different design information verification (DIV) activities at the final disposal site during each of the years.

At the trilateral meeting (IAEA/EC/STUK) in September 2013, it was agreed that no unannounced inspections with two hours' notice time would be performed in Finland after the beginning of 2014. Thus, currently all short-notice inspections are expected to take place with 48 hours' advance notice (see info box). At reactors, the physical inventory verification includes both pre- and post-PIV inspections. At Loviisa, cask shipments are verified when the core is open. STUK continues with annual routines consisting of approximately 40 field inspections, which enables the effective safeguards implementation of the international inspectorates.

IAEA regular inspections:

Facilities and spent fuel storages at nuclear power plants (NPPs):

- **Physical Inventory Verification (PIV)/Design Information Verification (DIV) 1/year**
- **Random Interim Inspection (RII) at 48 hours' notice (at least 1/year for Finland)**

Research reactor and locations outside facilities (LOF)

- **PIV/DIV 1/4–6 years**

New reactors, under construction

- **DIV and PIV later, as at the NPPs**

Repository under construction

- **PIV/DIV most likely 1/year**

Complementary access at 2/24-hour notification to verify declared activities or to detect undeclared activities.

Euratom carries out additional inspections of the research reactor and MBAs at locations outside facilities (LOFs)

According to the Finnish Nuclear Energy Act, STUK must participate in IAEA and Euratom inspections at Finnish facilities, so STUK has increased preparedness for short-notice and unannounced inspections and complementary access (abbreviated SNUICA). Every working day, one of STUK's inspectors is prepared to attend a possible IAEA or Euratom inspection.

The IAEA sends its statements on inspection results and the conclusion of safeguards implementation according to INFCIRC/193 and the Additional Protocol to the Commission, which amends them with its own conclusions and remarks, and forwards them to STUK. STUK sends the statements and conclusions to the operator in question for information and any required action. The IAEA annually draws conclusions confirming its confidence that all nuclear activities and materials are accounted for and are in peaceful use in Finland.

A state's declarations on its nuclear materials and activities are the basis for state evaluation by the IAEA under the obligations of the Additional Protocol. In Finland, the state has delegated its responsibility for these declarations to STUK. STUK has been nominated as a site representative, as per European Commission Regulation No. 302/2005. STUK collects, inspects and reviews the relevant information and then submits the compiled declarations in a timely fashion to the Commission and the IAEA.

Technical analysis methods are one tool for a state nuclear safeguards system to ensure that nuclear materials and activities within the state are in accordance with the licence holders' declarations, and that there are no undeclared activities. Such methods can provide information on the identity of the nuclear materials and confirm that licence holders' declarations are correct and complete with respect to, for example, the enrichment of uranium and the burn-up and cooling time of nuclear fuel. The technical analysis methods in use are non-destructive assay (NDA), environmental sampling and satellite imagery.

The declarations, inspections and other details on cooperation between the Finnish SSAC, the IAEA and the European Commission are discussed regularly. A trilateral meeting is a useful informal forum for every organisation to discuss, share information and clarify state declarations. A meeting is held at least once a year and is usually supplemented by a smaller trilateral meeting. STUK maintains active informal communication between the operators, itself, the IAEA and the Commission in day-to-day safeguards matters such as inspection arrangements.

1.4 Control of uranium and thorium production

Mining and mineral processing operations aiming to produce uranium or thorium are also under regulatory control. In order to carry out these activities, a licence and accounting system to keep track of the amounts of uranium and thorium are required. A national licence is also required to export and import uranium or thorium ore and ore concentrates. These activities are also controlled by the Euratom Supply Agency and the European Commission. Mining and milling activities and the production of uranium and thorium must be reported to STUK, the Commission and the IAEA.

1.5 Licensing and export/import control of dual-use goods

In accordance with the Finnish Nuclear Energy Act, other nuclear fuel cycle-related activities in addition to nuclear materials are under regulatory control. A licence is required for the possession, transfer and import of non-nuclear materials, components, equipment and technology suitable for producing nuclear energy (nuclear dual-use items). The list of these other items is based on the Nuclear Suppliers' Group (NSG) Guidelines (INFCIRC/254 Part 1). The licensing authority is STUK. The Ministry for Foreign Affairs is responsible for granting NSG Government-to-Government Assurances (GTGA) when necessary. The ministry usually consults with STUK before giving the assurances. The licence holder is required to provide STUK with a list of the above-mentioned items annually. Moreover, the export, import and transfer of such items must be confirmed to STUK after the action.

Finland's export control system is based on EU Council Regulation (EC) No. 428/2009 of 5 May 2009, which sets up a Community regime for the control of exports, transfer, brokering and transit of dual-use items. This regulation is amended annually, the latest in 2020 with Commission Delegated Regulation (EU) 2020/1749. The export of Nuclear Suppliers' Group (NSG) Part 1 and Part 2 items is regulated by the Finnish Act on the Control of Exports of Dual-use Goods. Authorisation is required to export dual-use items outside the European Union as well as for the EU internal transfers of NSG Part 1 items, excluding non-sensitive nuclear materials. The licensing authority is the Ministry for Foreign Affairs. Before granting an export licence, it also takes care of NSG Government-to-Government Assurances. The ministry asks STUK's opinion on all applications concerning NSG Part 1 items.

1.6 Control of nuclear material transport

The requirements for the transport of radioactive material are set in the Finnish regulations on the transport of dangerous goods. The requirements are based on the IAEA Safety Standard Regulations for the Safe Transport of Radioactive Material, SSR-6, and their purpose is to protect people, the environment and property from the harmful effects of radiation during the transport of radioactive material. Based on these regulations, STUK is the competent national authority for the regulatory control of the transport of radioactive material.

In addition to the dangerous goods transport regulations, the Finnish Nuclear Energy Act sets specific requirements for the transport of nuclear material and nuclear waste. Generally, a licence granted by STUK is needed for such a transport. Usually, the transport licences are granted for a fixed period, typically a few years. A transport plan and a transport security plan approved by STUK are mandatory for each consignment of nuclear material or nuclear waste. A certificate of nuclear liability insurance must also be delivered to STUK before transportation. Furthermore, a package may be used for the transport of fissile nuclear material only after the package design has been validated by STUK.

1.7 Nuclear safeguards and security strengthen each other

STUK is the national authority for the regulatory control of radiation and nuclear safety, security and safeguards (3S). All these three regimes have a common objective: the protection of people, society, the environment and future generations from the harmful effects of ionising radiation. As nuclear security aims to protect nuclear facilities' sensitive or classified information, nuclear material and other radioactive material from unlawful activities, it is clear that the majority of the activities that aim at the non-proliferation of nuclear weapons, nuclear materials and sensitive nuclear technology contribute to nuclear security. Physical and information security measures at nuclear facilities and for nuclear materials including technology, sensitive information and knowledge also contribute to non-proliferation by providing the deterrence, detection and delay of and response to nuclear security events. At the same time, nuclear material accountancy and detection measures may supplement security measures through a deterrence effect.

2 Safeguards activities in 2020

2.1 The regulatory control of nuclear materials

For the world, 2020 ended very differently than how it had started, as the COVID-19 pandemic spread around the globe during the year. For the Finnish safeguards system, however, very little changed in light of activities and their results. In his letter to all member states on 17 March 2020, IAEA Director General Grossi confirmed the continuation of IAEA and national safeguards under the COVID-19 emergency and emphasised that the safeguards agreements do not allow for unilateral suspension of safeguards activities under any circumstance. In 2020, it was imperative for STUK and other parties of the Finnish safeguards system to sustain their activities under the difficult situation and to continue fulfilling the requirements of safeguards agreements and Finnish nuclear legislation.

STUK adapted to the circumstances and carried on with uninterrupted nuclear safeguards. The Director General's message was forwarded to the Finnish operators and other stakeholders. STUK and the stakeholders maintained and strengthened their active communication from previous years to organise inspections and other activities effectively and safely. In the

FIGURE 5. IAEA inspectors examining an electronic control device in Olkiluoto in May 2020 to check if the reactor lid had remained closed since the last inspection. Photo: TVO.

initial phase, on-site inspections were limited to critical installations such as nuclear power plants. Health authorities' guidelines on avoiding close contact and wearing face masks were implemented rigorously during inspections. STUK cooperated with the Finnish border guard and provided details on arriving international inspectors and their itineraries to enable a smooth entry into Finland. The new procedures were first put to the test in an inventory verification inspection with IAEA inspectors in Olkiluoto in May. With proper planning and precautions, the inspection, along with all those that followed, was performed successfully.

After transferring to fully working from home and rescheduling some field work and inspections in the spring, STUK later caught up with its slightly delayed inspection plan and finished the year with 89 inspection days and 39 inspections of material balance areas. The number of inspection days was the second highest in the past 10 years. This was in part caused by the training of new inspectors. The number of inspections fell just short of the generally achieved level of 40 inspections per year. Like the number of inspections, neither was their content compromised. Some inspections were held remotely with very good results.

The licensing of operators' activities and verification of inventory reports and accountancies were not interrupted during the year. Inventory reports and the following verification confirmed that nuclear materials remained in their intended peaceful use and under safeguards control even in the middle of a global health crisis. The accumulation of nuclear material at the facilities is shown in Figures 3 and 4 and the verified nuclear material inventories at the end of 2020 are shown in Tables A2 and A3 in Appendix 1.

The implementation of the IAEA's integrated safeguards since 2008 reduces the rate of routine inspections of the international inspectorates but includes short-notice random inspections. In 2020, the postponement of some inspections, especially by the Commission, resulted in a reduced number of international inspections. However, another extensive DIV campaign at the disposal construction site in October raised the number of inspection days above average. In 2020, the IAEA launched just two short-notice inspections in Finland, one short-notice random inspection (SNRI) each at Olkiluoto and at Loviisa. The development of inspections and inspection person-days at material balance areas is presented in Figures 6 and 7. Inspections by STUK, the IAEA and the European Commission in 2020 are presented in Appendix 2.

The IAEA and the Commission provided STUK with statements on inspection results and conclusions of safeguards implementation in 2020. In total, the statements included two notices for and two required actions from operators in Finland. The notices were responded to and the actions were completed satisfactorily. There were no outstanding questions from the IAEA or the Commission at the end of 2020. There were no indications of undeclared materials or activities, and the inspected materials and activities were in accordance with the operators' declarations.

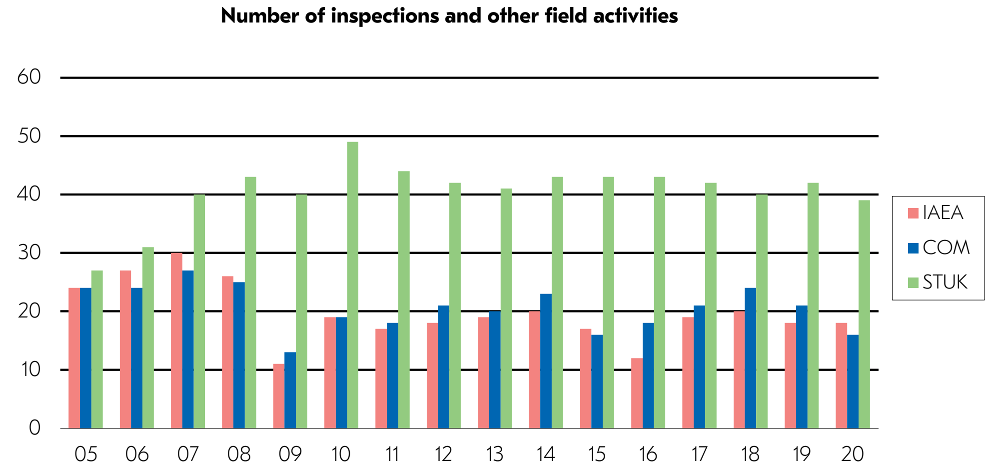


FIGURE 6. The number of inspections from 2005 to 2020.

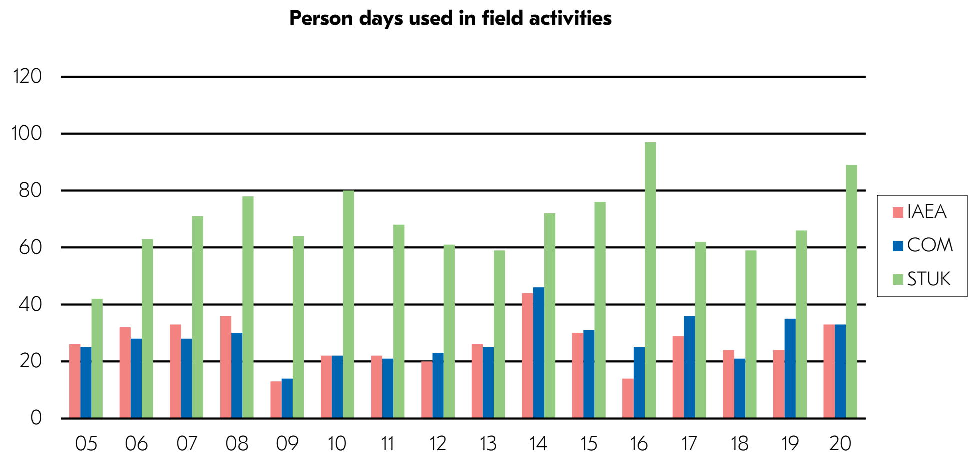


FIGURE 7. Inspection person days from 2005 to 2020.

A significant effect of the pandemic and the following travel restrictions was the postponement, cancellation and virtualisation of meetings, conferences and other venues of discussion. The implementation of safeguards in Finland was nevertheless addressed at live and virtual meetings with the IAEA and the European Commission. A live trilateral meeting with representatives from the IAEA, the European Commission, STUK and other parties to the Finnish safeguards system was held in Helsinki in March only days before most unnecessary travel was halted. During the IAEA General Conference in September 2020, Finnish delegates met with the IAEA Director General and deputies in Vienna. In October, the annual trilateral meeting with the IAEA, EC and STUK was organised virtually. In addition to the inspection routines, STUK continued with two annual safeguards meetings with the major nuclear materials holders' safeguards' responsible staff.

In November 2020, STUK notified the authorities in charge of radiation safety in the countries that have supplied the Finnish nuclear power plants with uranium of Finland's intention to begin the final disposal of spent nuclear fuel in the mid-2020s. Normal verification inspections of nuclear materials cannot be performed once the materials have been finally disposed of, and so procedures related to such inspections must be specified before the initiation of final disposal. By notifying the countries supplying uranium fuel and the IAEA and the European Commission, STUK ensures that all parties remain assured that the uranium delivered to Finland continues to be used for peaceful purposes.

2.2 General safeguards activities

2.2.1 Additional Protocol declarations

In 2020, STUK compiled licence holders' reports using the PR3 software provided by the IAEA, and submitted the annual updates for national declarations according to articles 2.a.(iii) and 2.a.(viii) on 2 April 2020, and the declarations according to articles 2.a.(i), 2.a.(iv), 2.a.(x) and 2.b.(i) on 13 May 2020. Furthermore, STUK submitted the quarterly declarations on exports that are due in February, May, August and December.

On 5 October 2020, STUK submitted to the IAEA a clarification upon request by the IAEA according to Article 4.d.

2.2.2 Approvals of new international inspectors

In 2020, a total of 23 IAEA and 7 Commission inspectors, newly appointed, were approved to perform inspections at nuclear facilities in Finland.

2.2.3 Nuclear dual-use items, export licences

In 2020, the Ministry for Foreign Affairs issued 19 export licences for NSG Part 1 items:

- five for exporting nuclear technology (technical data and training, category 0E001) to France (2), USA (2) and Japan (1).
- 14 licences to export software and relevant training (category 0D001) to Sweden (4), Czech Republic (2), Slovenia (1), China (3), Republic of Korea (2), USA (1) and Japan (1).

2.2.4 Transport of nuclear materials

In 2020, fresh nuclear fuel was imported to Finland from Germany, Sweden and the Russian Federation (Appendix 1, Table A1). In relation to these imports, STUK approved three transport plans and one transport packaging design. STUK inspected one fresh nuclear fuel consignment in 2020.

2.2.5 International transfers of nuclear material

In 2020, TVO reported to STUK about its international fuel contracts, fuel transfers and fuel shipments. Based on the document inspection findings and on an audit of TVO's international nuclear material transfer accountancy and control carried out on 22 January 2021, STUK concluded that TVO had complied with its safeguards obligations when purchasing the nuclear fuel and managing its international nuclear material transfers. Other operators purchase fuel as an end-product, so their accountancy does not need to cover the purchase chain abroad.

2.3 Safeguards implementation at the operators

2.3.1 Loviisa nuclear power plant

In 2020, STUK granted one licence for the import of nuclear dual-use items. In total, STUK performed 11 safeguards inspections at the Loviisa NPP in 2020. An NDA inspection with a PGET instrument was performed in June. The outage at the Loviisa 2 reactor unit took place during the period 2–28 August and the outage at the Loviisa 1 reactor unit during the period 29 August–22 October. STUK, the IAEA and the Commission performed an inventory verification inspection prior to the physical inventory taking (pre-PIT), accompanied with camera replacement work, before the outages, on 21–23 July. The physical inventory verification after the outage (post-PIT) together with a design information verification (DIV) was carried out on 20–21 October. STUK identified the fuel assemblies in the reactor cores and item-counted the fuel assemblies in the loading ponds. The Loviisa 2 core was inspected on 11 August and the Loviisa 1 core on 30 September. Two fuel transfer cask inspections were carried out in September. A joint interim and site safeguards inspection was performed on 12 November 2020. In December 2020, one random interim inspection was carried out by the IAEA and Commission together.

On the basis of its own assessment and on the IAEA and Commission inspection results, STUK concluded that Fortum's Loviisa NPP complied with its nuclear safeguards obligations in 2020.

2.3.2 Olkiluoto nuclear power plant

In 2020, STUK granted TVO four import licences for fresh nuclear fuel for the two operating units and six licences to import non-fuel items. STUK approved updates to TVO's nuclear materials handbooks.

The operating reactor units Olkiluoto 1 and 2 and the spent fuel storage of the Olkiluoto power plant were subject to 15 safeguards inspections in 2020, including inspections of the whole Olkiluoto site and system inspections. In addition, the accountancy of the uranium batches in TVO possession abroad was inspected early in 2021. In cooperation with the European Commission and the IAEA, STUK performed the inspections that comprise the physical inventory verification of the reactor units and the spent fuel storage, both before and after the annual outages, on 6–7 May and 25–26 June, respectively. The latter also included a site survey inspection of preparations for final disposal at the spent fuel storage. STUK performed a core verification inspection of both reactor units before the reactor core lid was closed. The on-site work of the core verification was carried out exceptionally by STUK's local inspector. Inspectors from the Nuclear Materials section took care of organising the inspection and filled out the paperwork. This was done to avoid unnecessary travel from the Uusimaa region to Olkiluoto and to help TVO minimise the number of personnel entering the plant during the outages.

STUK took part in one random interim inspection at the Olkiluoto 1 unit initiated by the IAEA. STUK performed an interim safeguards inspection at both units and the spent fuel storage and a site declaration update verification inspection. STUK also carried out an NDA campaign with the PNAR equipment in October. In December, STUK inspected TVO's nuclear materials accountancy and control system.

At the Olkiluoto 3 unit, a design information verification inspection together with a physical inventory verification inspection was carried out by the IAEA, EC and STUK on 1–2 December. The inspection included surveillance camera replacement work.

Based on its own assessment and on the IAEA and Commission inspection results, STUK concluded that TVO's Olkiluoto NPP complied with its nuclear safeguards obligations in 2020.

2.3.2 The Hanhikivi nuclear power plant project

Currently, Fennovoima is an operator possessing nuclear information purported by Finnish nuclear energy legislation. STUK performed an inspection in Fennovoima in November 2020. The purpose of the inspection was to check how Fennovoima fulfils its duties. As a result of the inspection, STUK made five requirements, related to Fennovoima's organisation and management system. At the end of 2020, STUK's approval of Fennovoima's nuclear materials responsible person and Nuclear Materials Manual is under way.

Fennovoima's project involves also a few other Finnish companies possessing nuclear information. The Finnish branch of the plant supplier, RAOS Project Oy, is the most important of these and participates in most of the meetings STUK has with Fennovoima's nuclear materials responsible persons.

In 2020, STUK granted a total of six licences for the import, possession or transfer of nuclear information related to Hanhikivi NPP project to different companies. Based on its assessment, STUK concluded that Fennovoima and other companies possessing nuclear information in the Hanhikivi NPP project complied with their nuclear safeguards obligations in 2020.

2.3.4 VTT

At VTT Technical Research Centre of Finland, the preparations for decommissioning of the research reactor FiR1 and associated activities continued together with research activities at the Centre for Nuclear Safety where operations had started in 2017 by moving small amounts of nuclear material used in the laboratories located in the reactor building. In 2020, another batch of samples containing nuclear materials was transported from the laboratories to the centre. The BTC of the Centre for Nuclear Safety was updated in October 2020 as a result of changes in responsible persons.

Irradiated fuel from the FiR1 reactor was shipped to USA in the final days of 2020. Still being usable, the fuel was sent to Denver, Colorado, to be used at the U.S. Geological Survey's research reactor. At the end of operation, USA will take care of the fuel. Exporting nuclear waste from a research reactor is a special case allowed by the Finnish Nuclear Energy Decree. In general, nuclear waste generated through use of nuclear energy in Finland shall be disposed of in Finland.

The Commission postponed its nuclear material inventory verification inspections of both of VTT's MBAs. STUK carried out its own inspection of the inventory at WRRF in December. The inspection was performed especially in preparation for VTT transporting its spent fuel to the USA. STUK postponed its inspection of WNSC until early 2021.

Based on its assessment and inspection results, STUK concluded that VTT complied with its nuclear safeguards obligations in 2020.

2.3.5 STUK

STUK's Nuclear Materials Safeguards section made a nuclear material inspection together with the IAEA and European Commission at the operating unit at STUK on 22 October 2020. The operator has improved its reporting timeliness but still needs to restructure its bookkeeping (General Ledger) and correct minor errors. However, it can be concluded that the operating unit at STUK fulfils the requirements for national safeguards arrangements.

2.3.6 University of Helsinki

STUK carried out a remote safeguards inspection at the University of Helsinki on 17 December. The physical inventory was verified by identifying the nuclear materials remotely. The operator's bookkeeping practices had been improved since the previous inspection in 2019. However, technical details in reporting were still clarified with the Commission after the inspection.

On the basis of its assessment and inspection results, STUK concluded that the University of Helsinki complied with its nuclear safeguards obligations in 2020.

2.3.7 Minor nuclear material holders

In 2020, STUK inspected the reports from the minor nuclear material holders. The minor holders are requested to prepare their nuclear materials handbooks as required in the new STUK requirements, i.e. in YVL Guide D.1. In total, one handbook prepared by a minor holder was approved in 2020.

On the basis of its assessment, STUK concluded that the minor nuclear material holders complied with their nuclear safeguards obligations in 2020.

2.3.8 Front-end fuel cycle operators

2020 was the first year after an ownership change to Umicore Finland Oy by the Kokkola plant. At Norilsk Nickel Harjavalta Oy's plant in Harjavalta, the operating licence was renewed. At both installations, the responsible personnel remained in place, and the operators reported on their planned activities and monthly inventories according to safeguards requirements. During 2020, STUK inspected safeguards practices at Umicore in Kokkola and approved the updated nuclear materials handbook. On the basis of its assessment, STUK concluded that these operators complied with their nuclear safeguards obligations in 2020.

The metal processing industry was requested to be licensed for its uranium-rich intermediate products in 2017 as described in Chapter 1.2, so the zinc and copper production unit of the Boliden company reported that it had processed 949 kg of natural uranium originating from zinc concentrates in 2020. The uranium ends up in waste streams during the processing. Dragon Mining reported 10.6 kg of uranium in its gold production at its Sastamala mineral processing unit originating mainly from the Jokisivu mine. The uranium, of source material grade, is not used in industrial processes. STUK concluded that these operators complied with their nuclear safeguards obligations in 2020.

In 2020, STUK approved the responsible manager and his deputy for Terrafame's planned uranium extraction plant. Terrafame continued its monthly reporting, which had been initiated in 2019 after storing the first uranium extracts. STUK concluded that Terrafame complied with its nuclear safeguards obligations in 2020.

2.3.9 The disposal facility for spent nuclear fuel

The construction of the encapsulation plant by Posiva has been proceeding according to plan and, by the end of the year, the walls had reached the second floor. At the geological repository, it was mainly the excavation of the central tunnels of the deposition area that had continued. The rock suitability studies continued by analysing the pilot hole information from the planned disposal tunnel locations. The construction works for the infrastructure of the technical premises involved a large workforce underground, even limiting daytime access for visitors. The construction areas were segregated to avoid or limit possible COVID-19 infections.

In 2020, several technical meetings between the IAEA, the EC, STUK and Posiva were held remotely to finalise the technical details of the equipment selection, emplacement and connections of safeguards equipment at the EP. This work is almost finished and Posiva has implemented the equipment infrastructure requirements (EIR) in its construction drawings. The EIR for the GR are still ongoing, and several meetings were also held on this issue. IAEA's DDG Aparo and safeguards staff visited the construction site in December in order to familiarise themselves with the disposal facility and the planned operations after the November visit of DG Grossi. The IAEA's planned safeguards approaches will provide assurance of no spent fuel assembly leaving or being processed within the GR at any time.

This Safeguards-by-Design process can be expected to continue during the construction of the facility.

In October 2020, the IAEA and Commission carried out an extensive design information verification campaign to verify the underground premises constructed since the previous inspection in 2019. In addition, the status of the construction of the encapsulation plant was verified and the hoist and ventilations buildings with shaft connections underground were visited. Ground-penetrating radar equipment was deployed by the IAEA during the inspection of the geological repository. The radar revealed fractured rock at short distances as expected, but the detectability of a nearby tunnel was not obvious. STUK carried out an inspection of the Posiva site on 5 March 2020 and a system inspection (RTO) of Posiva's nuclear accountancy system, which is still under development, on 1–2 December 2020.

On the basis of its assessment and inspection results, STUK concluded that Posiva complied with its nuclear safeguards obligations in 2020.

2.3.10 Other operators

Research organisations and universities provided STUK with their annual declarations on research and development work. After its review, STUK prepared the annual declaration based on the Additional Protocol to the IAEA within the time limit of 15 May.

3 Development work in 2020

3.1 Development of working practices

In STUK's current strategy period, which extends from 2018 to 2022, its activities as a regulator and expert organisation are guided by effectiveness. Methods for achieving this include risk-oriented commensurable oversight and flexible and efficient working methods. Increased emphasis on operator responsibility forms the basis of this strategy. The competence and well-being of STUK's personnel is seen as the foundation for reaching these objectives. In 2020, the middle year of the strategy period, the Nuclear Materials Safeguards section of STUK pursued the strategic goals by developing the competencies of the inspectors and empowering the operators and licence holders to better take responsibility for their own safeguards control.

The section consists of a section head, one researcher and seven inspectors who are responsible officers for the facilities, installations and other nuclear material or nuclear-related activities. Measures in inspector development in 2020 included continuing job rotation and better handling workload by pivoting from a system based on responsible officers and deputies towards responsible officer pairs for facilities. The section has continued, even in the extraordinary circumstances of a global pandemic, to take advantage of opportunities to learn from and teach national and international institutions and experts in webinars, trainings and conferences. Part of this approach is a contribution to the international multidisciplinary tasks supporting safeguards, safety and security. The section takes every chance to teach as a chance to learn.

In early 2020, one new inspector joined the section and, along with another inspector, started undergoing a new training and mentoring programme to become responsible officers. Special arrangements with inspections and working from home due to COVID-19 restrictions delayed the inspector training. At the same time, the situation allowed new inspectors more time to strengthen their knowledge of the national nuclear legislation, international agreements and timely development projects. Senior employees of the section were also able to work on projects such as developing STUK's internal nuclear material database SAFKA. Shared daily coffee breaks, section meetings every two weeks and virtual face-to-face discussions helped integrate new members into the section and keep the team spirit in the section at high levels.

The change in oversight and increased emphasis on operators' responsibility are aiming for increased trust and a culture in which operators accept the responsibility for safety and find and propose viable solutions for ensuring and improving safety. An up-to-date nuclear materials handbook as an integral part of the operator's quality management system, ensuring the availability of competent safeguards personnel in the operator's organisation, and understanding the benefits of efficient safeguards are key elements of success. STUK has encouraged the operators to find and implement best practices by, for example, taking an active part in international safeguards seminars and working groups. The major licence holders such as nuclear power plants with mature and well-functioning safeguards systems are motivated to keep improving even the smallest details and to take care of the continuity of know-how and competence of personnel. The safeguards meetings with the licence holders play a significant role in maintaining a working relationship between STUK and the licence holder and discussing ideas. Points of improvement and best practices are actively brought up by STUK during inspections.

3.2 Support programme for the IAEA safeguards

The Finnish Support Programme for the IAEA Safeguards (FINSP) is financed by the Ministry for Foreign Affairs and coordinated by STUK. The objective of FINSP is to provide the IAEA with support in well-managed tasks related to the development of safeguards verification methods, safeguards concepts and IAEA inspector training. FINSP held two review meetings with the IAEA in 2020. The annual review meeting was held online on 22 October. At the end of 2020, FINSP had 14 active tasks and one stand-by task. Some of these tasks are presented here. For more details, please see the FINSP annual report, which is available online at https://www.julkari.fi/handle/10024/140911.

A new task on Safeguards by Design for small modular reactors (SMR) was started with a kick-off meeting in December. There is much interest in SMRs in Finland. Active Finnish SMR practitioners are Lappeenranta-Lahti University of Technology (LUT) which has proposed a SMR design for district heating, Fortum and VTT. STUK is an active member of the SMR regulators forum. This task will identify the key technical challenges for safeguards implementation involving SMRs, and steps that can be taken to support incorporating Safeguards by Design principles into SMR designs and IAEA safety guidance.

In November, STUK held a virtual Training and Mentoring workshop for six trainees from a scholarship programme at the IAEA. The objective of the training was firstly to share best practices from the Finnish SSAC with newcomers and secondly to offer mentoring opportunities to trainees. The training was held within the scope of the Support Programme. STUK expects to continue this kind of support in the future.

3.3 Spent fuel disposal and GOSSER R&D project

The disposal of spent fuel requires that safety, data security and other security arrangements and the safeguards required to prevent the proliferation of nuclear weapons be properly implemented on a national level. For this purpose, STUK launched GOSSER (Geological Disposal Safeguards and Security) to finalise the Finnish concept for safeguarding the geological disposal of spent nuclear fuel in 2016. The first project period ended in 2018 and the final report was prepared to describe the national safeguards concept for spent fuel disposal in Finland. The continuation project covers the years 2019–2022.

According to the national safeguards concept prepared, it is proposed that all fuel be verified in a comprehensive manner with the available system comprising a PGET and PNAR (Passive Neutron Albedo Reactivity) verifier. The NDA concept and ownership are discussed with the EC and the IAEA. A principal agreement exists that the measurement data will be shared with all parties.

R&D of PGET and PNAR were conducted in 2020. Two measurement campaigns were arranged in 2020. In Loviisa, June 2020 measurements were done with the IAEA and EC using the new commercial version of the PGET device. In October 2020, STUK performed a PNAR measurement campaign in Olkiluoto spent fuel storage. Both campaigns were successful. Multiple papers relating to NDA development were also published (Virta et al., 2020, Virta et al., 2020, Tupasela et al., 2020, Litichevskyi et al., 2020).

In terms of safety, security and safeguards (3S), STUK will verify that Posiva performs underground activities according to approved plans and STUK will utilise the same inspection effort to collect relevant information for all three S's. STUK is developing its internal processes in this regard. For its independent conclusions, STUK will make use of the information collected by its resident inspectors, the inspection programme and the operator's environmental and geoscientific monitoring networks. Examples of information most relevant to safeguards are data proving that the canisters have been placed undamaged in the correct positions as declared to STUK and data showing that backfilling and sealing have been done in the approved manner. In 2020, STUK also commissioned studies on the use of geophysical methods applied to site characterisation for safeguards purposes. The study will be published in 2021.

FIGURE 8. STUK and EC inspectors studying measurement data during PNAR campaign in Olkiluoto spent fuel storage. Photo: TVO.

3.4 Pilot Blockchain-based system for nuclear material accounting and control

STUK in cooperation with the Henry L. Stimson Center and University of New South Wales have prepared the world's first pilot system for blockchain-based nuclear material accounting and control, SLAFKA, in Finland. Based on the internal STUK database SAFKA, SLAFKA is a prototype distributed ledger technology (DLT) platform that offers great potential to significantly strengthen nuclear material accountancy by ensuring data immutability, improving the efficiency of materials tracking, and engendering a greater sense of participation among different parties. DLT is the use of replicated, synchronised data shared across multiple 'nodes' to track the transaction of assets. Emerging from the IAEA's and non-proliferation stakeholders' interests in enhancing nuclear safeguards through technological advancements, SLAFKA arose from interest in testing applications of DLT to nuclear safeguards. In the case of placing spent fuel in geological repositories, the significance of data integrity is immense. SLAFKA offers assurance of the integrity of accounting records and measurements when physical verification is impossible. Additionally, as new cyber threats emerge every day, STUK and Euratom's current systems become increasingly vulnerable to cyber-attacks. Through hashing and data encryption, SLAFKA's DLT-based platform fortifies these systems from cyber-attacks and any fraudulent data modification. Strengthening security not only benefits regulators, but also increases incentives for reporting, so SLAFKA has the potential to benefit all participants in safeguards reporting.

The small-scale SLAFKA study was launched in March 2020 with a press release and event in Helsinki. COVID-19 restrictions caused the postponement of further release events, but in November the Stimson Center released a Blockchain in Practice report on SLAFKA and the potential of DLT in nuclear safeguards. The report is available online at https://www.stimson.org/2020/slafka/. The SLAFKA study was presented at several occasions, including the INMM Annual Meeting.

3.5 International cooperation for Nuclear Non-Proliferation

The state's regulatory authority plays an important role in implementing safeguards on a national level and in contributing to and participating in international fora to share experiences and interact with other parties. Participating in international events with a suitable contribution is also the best training for safeguards inspectors. Resources are limited so the selection of the events is important.

International cooperation and events were badly affected by the COVID-19 pandemic in 2020. Following the restriction of international travel that started in March, many events, conferences and meetings were either virtualised, postponed or cancelled. Especially in the case of bilateral and smaller-scale cooperation, meetings were successfully held virtually in videoconferencing.

International organisations ESARDA and INMM

STUK is a member of the European Safeguards Research and Development Association (ESARDA) and has appointed experts to its committees and most of the working groups. STUK is a board member of the ESARDA Executive Board. A STUK expert is Vice Chair of the Implementation of Safeguards Working Group. ESARDA's annual meeting was originally planned to be held at IRSN in France but was organised virtually over the same dates; 16–19 November 2020. STUK's experts contributed to the meeting with several presentations.

STUK experts also made a presentation and other contributions at the Institute of Nuclear Materials Management (INMM) annual meeting in July 2020 held for first time in remote mode as an International Virtual Experience instead of gathering in person to Baltimore. The recorded presentations and contributions are available at the INMM website. After the total pandemic lockdown in spring 2020, the INMM launched short virtual working group meetings and webinars that were easy to attend from home offices after European working hours. These new practices will make international cooperation more interactive in the future and reduce the need for travel.

Services for authorities abroad

Two EU-funded projects were launched in 2016 to support the nuclear regulators in Vietnam and Tanzania as these countries are aiming at nuclear power and uranium mining, respectively. The kick-off meetings were held in 2016 and the cooperation was scheduled to continue for at least 2~~3~~ years. The project to support the regulator in Vietnam was finalised in 2019. After the nuclear regulator of Tanzania (TAEC) published its safeguards regulation in 2019, the safeguards-related tasks of that project were finalised at the beginning of 2020 before the pandemic lockdown. The remaining issues concerning the licensing of uranium production and transport were raised at the end of 2020 and the objectives of the project are to be specified in a remote workshop in 2021.

NPT Preparatory Committee

The Non-Proliferation Treaty entered into force in 1970. The NPT Treaty includes more than 190 countries around the world. The Treaty Review Conference is held every five years, the previous one in 2015. The next conference was planned to be held in 2020 but was postponed to 2021 due to the COVID-19 pandemic. Before the Review Conference, preparatory meetings will be held. Preparations for a strong Finnish presence at the conference and its side events are well under way.

NSG – Nuclear Suppliers Group

The Nuclear Suppliers Group (NSG) is a multilateral export control regime and a group of nuclear supplier countries that seek to prevent nuclear proliferation by controlling the export of materials, equipment and technology that can be used to manufacture nuclear weapons. It has 48 participating governments. Finland is represented in the NSG forum by the Ministry for Foreign Affairs. NSG meetings in April and November were cancelled due to the pandemic. In November, the NSG working group chairs arranged a videoconference, which was attended by STUK.

GICNT – Global Initiative to Combat Nuclear Terrorism

Nuclear security activities often include cooperation between multiple authorities. Nuclear security also has a strong international aspect. The Global Initiative to Combat Nuclear Terrorism, GICNT, established in 2006, is one of the most important international fora for nuclear security. Currently 89 states and six international organisations participate in the work of GICNT. Member states' nuclear security capabilities and cooperation are developed, for example, by organising exercises. In 2020 Finland acted as interim chair of the GICNT's Nuclear Detection Working Group. The Finnish Ministry for Foreign Affairs coordinated Finland's GICNT activities and STUK served as the ministry's technical advisor.

IPNDV – International Partnership for Nuclear Disarmament Verification

The International Partnership for Nuclear Disarmament Verification (IPNDV) was established on the initiative of the United States in 2014. The other participants of IPNDV come from both nuclear and non-nuclear weapon states. A third phase of IPNDV started at the beginning of 2020. The IPNDV develops methods and procedures for the verification of nuclear disarmament. Finland has been participating in the IPNDV since its inception. STUK's tasks in IPNDV have always been connected to the development of technological verification methods.

4 National Data Centre for the Comprehensive Nuclear-Test-Ban Treaty (FiNDC)

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an important part of the international regime for the non-proliferation of nuclear weapons. The CTBT bans any nuclear test explosions in any environment. This ban is aimed at constraining the development and the qualitative improvement of nuclear weapons, including the development of new advanced types of nuclear weapons.

The CTBT was adopted by the United Nations General Assembly and was opened for signature in New York on 24 September 1996. It will enter into force after it has been ratified by the 44 states listed in its Annex 2. These 44 states participated in the 1996 session of the Conference on Disarmament and possess nuclear power or research reactors.

A global verification regime is being established in order to monitor compliance with the CTBT. The verification regime consists of the following elements: the International Monitoring System (IMS), a consultation and clarification process, on-site inspections and confidence-building measures. The Provisional Technical Secretariat (PTS) of the CTBT Organisation (CTBTO) is co-located with the IAEA in the Vienna International Centre (VIC). The IMS is more than 90% ready with 311 out of 337 stations installed at the end of 2020. The worldwide station network provides data to more than 1,200 organisations in more than 120 countries through the International Data Centre (IDC) run by the PTS in Vienna. In addition to monitoring compliance with the treaty, the data from the IMS is used in disaster mitigation. The CTBTO actively provides data to the global Tsunami Warning System and, since 2012, the CTBTO has been a member of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) and a co-sponsor of the Joint Radiation Emergency Management Plan of the International Organisations (JPLAN) led by the IAEA. Within this framework, the CTBTO is responsible for gathering and providing close-to-real-time radionuclide monitoring data to the IAEA and other participating organisations.

Finland signed the CTBT on its inaugural day in 1996 and ratified it less than three years later. In addition to complying with the basic requirement of the CTBT of not carrying out any nuclear weapons tests, Finland actively takes part in the development of the verification regime.

In the CTBT framework, the Finnish national authority is the Ministry for Foreign Affairs. STUK has two roles: it operates the Finnish National Data Centre (FiNDC) and one of the 16 radionuclide laboratories in the IMS (RL07). The most important task of the FiNDC is to inspect data received from IMS and inform the national authority about any indications of a nuclear test explosion. The radionuclide laboratory contributes to the IMS by providing

Comprehensive Nuclear-Test-Ban Treaty (CTBT) Status (31 December 2020). In 2020, no new countries signed or ratified the treaty

- **CTBT Member States 184**
- **Total Ratifications 168**
- **Annex 2 Ratifications 36**

support in radionuclide analyses and in quality control of the radionuclide station network. The third major national collaborator is the Institute of Seismology at the University of Helsinki, which runs an IMS seismology station (PS17 in Sysmä) and provides interpretation of waveform events in the IMS system..

4.1 International cooperation the foundation of CTBT verification

Before the opening of the CTBT in 1996, the world had seen more than 2,000 nuclear tests. In the more than 20 years since then, there have been only eight, six of which were by the DPRK. Since 2017, no activities pointing to clandestine nuclear testing have been detected by the network or otherwise. This is a strong indicator of the de facto strength of the treaty that has yet to come into force.

Because of COVID-19, 2020 was an exceptional year for any international cooperation. At the end of February, the Finnish National Data Centre (FiNDC) attended the meeting of the Working Group B (WGB) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization in Vienna. The second meeting of WGB in August-September was shortened and fully remote, with attendance limited to two full participants per country (one from FiNDC). In the autumn, the CTBT arranged several successful remote workshops where FiNDC also participated actively. It was something of a surprise how well a workshop can be conducted fully remotely, even with more than 100 participants. WGB is a policy-making organ for the technical development of the verification regime. By participating in the work of WGB and its subsidiaries (workshops and expert groups), the FiNDC can provide technical expertise to the CTBTO, while also attending to Finnish national interests.

4.2 The analysis pipeline a well-established daily routine

Due to the COVID-19 restrictions in Vienna and worldwide, the PTS had to work in remote mode for extensive periods of time, and so did FiNDC. Visits to IMS stations by PTS staff have also been limited during 2020. Even working remotely, however, the data flow from the IMS to the FiNDC has been steady. The FiNDC routinely analyses all radionuclide measurement data generated at IMS radionuclide stations across the world. The analysis pipeline for the air filter monitoring data is linked to the LINSSI database and equipped with an automated alarm system to enable efficient and fully automated screening of the data. Radioxenon measurements are especially important for CTBT verification because xenon, as a noble gas, may also leak from underground tests, which seldom release particulate matter. The operational stations generated more than 1,000 gamma and beta-gamma spectra per day for the FiNDC analysis pipeline to handle. The pipeline is well-established and has been running stably for many years.

Xenon radioisotopes released from medical isotope production facilities and NPPs are regularly measured all around the globe. Anthropogenic nuclides with CTBT relevance, mainly ^{99}Tc, ^{131}I from medical isotope production and ^{137}Cs from the Chernobyl and Fukushima fallouts, are regularly measured at some particulate stations.

5 Summary

In 2020, STUK continued its regulatory authority role in the Finnish SSAC. It supervised the national safeguards of nuclear materials, regulated the operators' activities and ensured that the obligations of international agreements concerning the peaceful use of nuclear materials and activities were met. Most of the practical work comprised reviewing operator applications, reports and notifications, but also carrying out periodical and ad hoc inspections for safeguards purposes. STUK prepared the national reports according to the safeguards agreement and its additional protocol. These activities, alongside continuously parallel development activities and international cooperation in the fields of safeguards and non-proliferation, are described in this report.

2020 was characterised by the COVID-19 pandemic, which halted most international travel, cancelled or postponed events and forced STUK's personnel to work from home. Responsible for nuclear safeguards control and accounting, the Nuclear Materials Safeguards section of STUK cooperated with the IAEA, European Commission and Finnish stakeholders and other government institutions to enable continuation of effective nuclear safeguards in Finland. Special arrangements included strengthened communication with the Finnish border guard to facilitate a swift entry into Finland for international inspectors, holding meetings and even some inspections virtually, and redirecting efforts from rescheduled international conferences and meetings to development projects. The section addressed challenges related to remote work with regular virtual video meetings. As a result, office work, including reviewing reports and issuing licences, was affected very little by the circumstances.

In the field, STUK continued with national safeguards measures and activities on 89 inspection days and in 39 inspections. Since 2010, the number of annual IAEA and European Commission inspections has been around 20. Postponement of some inspections and active preparations for final disposal balanced out the number of international inspections for 2020, bringing the total number of inspections and inspection days close to the short-term average. The implementation of the IAEA integrated safeguards since 2008 in force in Finland reduces the total number of annual routine inspections of the international inspectorates but includes short-notice random inspections. The Nuclear Materials section has an inspector on duty for short-notice inspections.

As usual, the majority of safeguards inspections in 2020 were carried out on the material balance areas of the Finnish nuclear power plants (NPP), 11 at Loviisa NPP and 17 at Olkiluoto NPP. According to the IAEA state-level approach for Finland, two short-notice inspections were carried out, one short-notice random inspection at Olkiluoto and one at Loviisa. STUK performed one non-destructive assay measurement campaign at both NPPs. Given that final disposal of nuclear fuel is one of the most pressing issues in safeguards and will continue to be in the near future, inspection activity at Posiva in Olkiluoto was high with four inspections and 17 inspection days. The accountancy inspections and physical inventory verifications at the VTT Research Reactor FiR1 and Centre for Nuclear Safety were postponed to 2021, although STUK carried out an inventory verification inspection at FiR1 just before irradiated fuel was shipped to the USA in the last days of 2020. The accountancy inspection at the University of Helsinki was carried out remotely with very good results.

The results of STUK's nuclear safeguards inspection activities continued to demonstrate that the Finnish licence holders take good care of their nuclear materials, even in the middle of a global health crisis. There were no indications of undeclared materials or activities, and the inspected materials and activities were in accordance with the operators' declarations. In their statements on inspection results and the conclusion of safeguards implementation in 2020, the IAEA and European Commission issued a total of two notices and required two actions from operators in Finland. These notices were responded to, and the actions were completed satisfactorily by the end of 2020. By means of their nuclear materials accountancy and control systems, the operators enabled Finland to fulfil its own obligations under the international agreements relevant to nuclear safeguards and non-proliferation.

STUK safeguards development work continued in 2020. The main development project is the GOSSER project whose current and second phase will continue until 2022. In the current phase of the project, the development of the practical safeguards implementation of the national safeguards concept for the spent fuel disposal is the ultimate target. Even though the pandemic delayed some activities, the project continued with successful measurement campaigns and other R&D work. The competence and workload of the staff in the Nuclear Materials section was also in focus as new inspectors were trained, and a system based on responsible and deputy officers was transformed into one based on officer pairs. Restrictions postponed on-site training and international events, so old and new inspectors focused on the development of their own expertise and on internal procedures.

A major goal of all current Comprehensive Nuclear-Test-Ban Treaty (CTBT)-related activities is the entry into force of the CTBT itself. To reach this goal, major steps must be taken in the political arena, and an important prerequisite for positive political action is for the verification system of the CTBTO to be functioning and able to assure all parties that it is impossible to carry out a clandestine nuclear test without detection. The FiNDC is committed to its own role in the common endeavour so that the verification system of the CTBTO can accomplish its detection task. While still incomplete, the verification system has clearly demonstrated its ability to detect nuclear tests.

The outcome of the supervision and activities carried out in 2020 is that implementation of nuclear non-proliferation in Finland has achieved its objectives.

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7 Abbreviations and acronyms

AP
: Additional Protocol to the Safeguards Agreement

BTC
: Basic Technical Characteristics

CA
: Complementary Access

CTBT
: Comprehensive Nuclear-Test-Ban Treaty

CTBTO
: Comprehensive Nuclear-Test-Ban Treaty Organization

CV
: Verification of fuel in the reactor core

DiP
: Decision-in-Principle

DIV
: Design Information Verification

DPRK
: Democratic People's Republic of Korea

DU
: Depleted uranium

EC
: European Commission

EIR
: Equipment Infrastructure Requirements

EP
: Encapsulation Plant

ESARDA
: European Safeguards Research and Development Association

EU
: European Union

Euratom
: European Atomic Energy Community

FA
: (1) Facility Attachment according to the Safeguards Agreement (INFCIRC/193), (2) Fuel Assembly

FiNDC
: Finnish National Data Centre for the CTBT

FINSP
: Finnish Support Programme to the IAEA Safeguards

FiR1
: Shutdown TRIGA Mark II type research reactor under the responsibility of VTT in Espoo, Finland

GICNT

Global Initiative for Combating Nuclear Terrorism

GR

Geological Repository

HEU

High-enriched uranium, 20% or more of U-235

IAEA

International Atomic Energy Agency

IMS

International Monitoring System of the CTBTO

INFCIRC

Information Circular (IAEA document type, e.g. INFCIRC/193, Safeguards Agreement, or INFCIRC/140, the Non-Proliferation Treaty)

INMM

Institute of Nuclear Materials Management

IPNDV

International Partnership for Nuclear Disarmament Verification

IS

Integrated Safeguards

KTO

STUK's periodic inspection programme for facilities in operation

LEU

Low-enriched uranium, less than 20 % of U-235

LINSSI

An SQL database for gamma-ray spectrometry

LOF

Location Outside Facilities

LUT

Lappeenranta-Lahti University of Technology

MBA

Material Balance Area

MEAE

Ministry of Economic Affairs and Employment

MFA

Ministry for Foreign Affairs

NDA

Non-Destructive Assay

NPP

Nuclear Power Plant

NPT

The Treaty on the Non-proliferation of Nuclear Weapons (INFCIRC/140, "Non-Proliferation Treaty")

NSG

Nuclear Suppliers' Group

OECD

Organisation for Economic Co-operation and Development

ONKALO®

Originally underground rock characterisation facility (for the disposal of spent nuclear fuel), now officially the whole underground final disposal facility

PGET

Passive Gamma Emission Tomography

PIT

Physical Inventory Taking

PIV

Physical Inventory Verification

PNAR

Passive Neutron Albedo Reactivity

PSP

Particular Safeguards Provisions

PTS

Provisional Technical Secretariat (to the Preparatory Commission of the CTBT)

Pu

Plutonium

RII

Random Interim Inspection

RKT

STUK's inspection programme relating to the review of the construction licence application

RL07

Radionuclide Laboratory in the CTBT IMS network hosted by STUK (FIL07)

RTO

STUK's construction inspection programme (CIP)

SA

Subsidiary Arrangements

SAFKA

STUK's internal nuclear material database

SMR

Small Modular Reactor

SNRI

Short Notice Random Inspection

SNUICA

Short notice, unannounced inspection, complementary access, on-call inspector

SSAC

State System of Accounting for and Control of Nuclear Materials

Th

Thorium

TVO

Teollisuuden Voima Oyj

U

Uranium

UI

Unannounced Inspection

VTT

VTT Technical Research Centre of Finland Ltd

WGB

Working Group B (of the CTBTO)

YVL Guide

Regulatory Guide on Nuclear Safety (STUK requirements on safety, security and safeguards, in Finnish Ydinvoimalaitosohje)

APPENDIX 1
Nuclear materials in Finland 2020

TABLE A1. Summary of fresh nuclear fuel receipts in 2020.

To	From	FA	LEU (kg)
Olkiluoto 1, WOL1	Spain	96	17 337
Olkiluoto 2, WOL2	Sweden	100	17 499
Olkiluoto 3, WOL3	No imports	0	0
Loviisa NPP, WLOV	Russian Federation	168	21 059

FA = fuel assembly; LEU = low-enriched uranium.

TABLE A2. Fuel assemblies at 31 December 2020

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
Olkiluoto 1, WOL1	1 259/673	214 361	1 093
Olkiluoto 2, WOL2	1 256/696	211 165	1 091
Olkiluoto 3, WOL3	245/0	130 784	0
Olkiluoto, spent fuel storage, WOLS	8 155/8 155	1 372 253	11 757
Loviisa NPP, WLOV	6 639/5 869	773 571	7 493

MBA = material balance area, FA = fuel assembly, SFA = spent fuel assembly
*) Fuel assemblies (FA) in the core are accounted as fresh fuel assemblies
(Loviisa NPP 313 FAs per reactor and Olkiluoto NPP 500 FAs per reactor in units 1 and 2 and 241 FAs in unit 3)

TABLE A3. Total amounts of nuclear materials at 31 December 2020

MBA	Natural U (kg)	Enriched U* (kg)	Depleted U (kg)	Plutonium (kg)	Thorium (kg)
WOL1	–	214 421	–	1 094	–
WOL2	–	211 218	–	1 091	–
WOL3	–	130 784	10.5	–	–
WOLS	–	1 372 253	–	11 757	–
WLOV	–	773 572	–	7 493	–
WRRF	92.8	6.27	–	< 0.001	–
WNSC	0.406	2.23	0.019	< 0.001	0.044
WHEL	2.34	0.295	0.006	0.002	1.08
WFRS	346	0.537	208	<0.001	2.89
WTAL	1.36	–	–	–	–
WKKO	2 915	–	–	–	–
WNNH	3 588	–	–	–	–
Minor holders	1.08	< 0.001	631	–	0.481

MBA = material balance area, WRRF = VTT Research Reactor, WNSC = VTT Centre for Nuclear Safety, WHEL = University of Helsinki, WFRS = STUK, WTAL = Terrafame Oy in Sotkamo, WKKO = Umicore Finland Oy in Kokkola, WNNH = Norilsk Nickel Harjavalta Oy, U = uranium. *) Less than 150 g total of high-enriched uranium, mainly used in detectors.

APPENDIX 2
Safeguards field activities in 2020

			Inspections			Inspection person days		
MBA/operator	**Date**	**Inspection type**	**IAEA**	**COM**	**STUK**	**IAEA**	**COM**	**STUK**
SSFOLKI	5.3.	Site			1			3
SSFPOSI	5.3.	Site			1			3
WOL1, WOL2	6.–7.5.	Pre-PIT PIV	2		2	4		2
WOL2	17.5.	OL2 CV			1			2
WOL1	5.6.	OL1 CV			1			2
WLOV	9.–10.6.	NDA (PGET)		1	1		2	4
WOL1, WOL2, WOLS	25.–26.6.	Post-PIT PIV, DIV, WOLS Site Survey	4	3	4	4	3	7
WLOV	21.–23.7.	Pre-PIT PIV, Tech activity	2	2	2	3	3	3
WLOV	11.8.	LO2 CV			1			2
WLOV	4.9. and 6.9.	Cask verification	1	1	1	2	2	3
Boliden Kokkola	17.9.	System inspection			1			1
WKKO	17.9.	PIV, System Inspection			2			2
WLOV	27.9.	Cask verification	1	1	1	1	1	1
WLOV	30.9.	LO1 CV			1			2
WOLE, WOLF	6.–8.10.	DIV	2	2	2	12	12	6
WLOV	20.–21.10.	Post-PIT PIV, DIV	1	1	1	2	2	4
WFRS	22.10.	PIV	1	1	1	1	1	2
WOLS	26.–29.10.	NDA (PNAR)		1	1		4	7
WOL1, WOL2, WOLS	30.10.	Interim			3			3
WFV1	9.11. and 13.11.	System inspection (RKT)			1			6
WOL1	11.11.	RII	1		1	1		1
WLOV, SSFLOVI	12.11.	Interim, Site			2			4
WOL3	1.–2.12.	PIV, DIV, Tech activity	2	2	2	2	2	2
WOLE, WOLF	1.–2.12.	System inspection (RTO)			1			8
WOL1, WOL2, WOL3, WOLS	7.–8.12.	System inspection (KTO)			1			5
WLOV	16.12.	RII	1	1	1	1	1	1
WHEL	17.12.	Interim (Remote)			1			2
WRRF	17.12.	PIV			1			1
Total			18	16	39	33	33	89

APPENDIX 3
International agreements relevant to nuclear safeguards in Finland

Valid legislation, treaties and agreements concerning safeguards of nuclear materials and other nuclear items in Finland (Finnish Treaty Series, FTS):

Treaties and international organisations to which Finland is a party:

Treaty on the Non-proliferation of Nuclear Weapons; adopted in London, Moscow and Washington on 1 July 1968 (1970), INFCIRC/140 (FTS 11/70).

The Treaty establishing the European Atomic Energy Community (Euratom Treaty), 25 March 1957:
- Regulation No 5, amendment of the list in Attachment VI, 22 December 1958
- Regulation No 9, article 197, point 4 of the Euratom Treaty, on determining concentrations of ores, 2 February 1960.

The Comprehensive Nuclear-Test-Ban Treaty (FTS 15/2001). This treaty was ratified by Finland on January 15, 1999 but will not enter into force before it is ratified by all 44 states listed in Annex II of the Treaty.

International Atomic Energy Agency (since 1958).

Nuclear Energy Agency of the OECD (since 1976).

International Energy Agency (since 1992).

Safeguards Agreements based on Non-Proliferation Treaty:

The Agreement with the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, the Republic of Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of Netherlands, the European Atomic Energy Community and the International Atomic Energy Agency in Implementation of Article III, (1) and (4) of the Treaty on Non-Proliferation of Nuclear Weapons (INFCIRC/193), 14 September 1973. Valid for Finland from 1 October 1995.

The Protocol Additional to the Agreement between the Republic of Austria, the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, the Hellenic Republic, the Republic of Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of Netherlands, the Portuguese Republic, the Kingdom of Spain, the Kingdom of Sweden, the European Atomic Energy Community and the International Atomic Energy Agency in Implementation of Article iii, (1) and (4) of the Treaty on Non-Proliferation of Nuclear Weapons, 22 September 1998. Entered into force on 30 April 2004.

Finland is a party to the following international conventions among others (the year when the convention entered into force for Finland is given in brackets):

Convention on the Physical Protection of Nuclear Material; opened for signature in Vienna and New York on 3 March 1980 (1989).

Amendment to the Convention on the Physical Protection of Nuclear Material; as amended on 8 July 2005 (2016).

Convention on Early Notification of a Nuclear Accident; opened for signature in Vienna on 26 September 1986 (1987).

Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; opened for signature in Vienna on 26 September 1986 (1990).

Convention on Third Party Liability in the Field of Nuclear Energy; adopted in Paris on 29 July 1960 (1972).

Convention Supplementary to the Paris Convention of 29 July 1960 on Third Party Liability in the Field of Nuclear Energy; adopted in Brussels on 31 January 1963 (1977).

Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material; adopted in Brussels on 17 December 1971 (1991).

The 1988 Joint Protocol Relating to the Application of the Paris Convention and the Vienna Convention; adopted in Vienna on 21 September 1988 (1995).

Convention on Nuclear Safety; opened for signature in Vienna on 20 September 1994 (1996).

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, adopted on 29 September 1997 in Vienna (2001).

Nordic Mutual Emergency Assistance Agreement in Connection with Radiation Accidents; adopted in Vienna on 17 October 1963 (1965) Agreement on common Nordic guidelines on communications concerning the siting of nuclear installations in border areas; adopted on 15 November 1976 (1976).

The Agreement between Finland and Sweden on the guidelines to be followed while exporting nuclear material, technology or equipment, 4 March 1983 (FTS 20/1983).

Agreements relating to early notification of nuclear events and exchange of information on safety of nuclear facilities with Denmark (1987), Norway (1987), Sweden (1987), Germany (1993), the Russian Federation (1996) and Ukraine (1996).

Convention on Environmental Impact Assessments in a Transboundary Context (Espoo, 1991)

As of 1 January 1995, Finland has been a member of the European Atomic Energy Community (EAEC or Euratom). Consequently, the following agreements are applied in Finland:

The Agreement between the Government of Republic of Finland and the Government of Canada and Canada concerning the uses of nuclear materials, equipment, facilities and information transferred between Finland and Canada (FTS 43/76). Substituted to the appropriate extent by the Agreement with the Government of Canada and the European Atomic Energy Community (Euratom) in the peaceful Uses of Atomic Energy, 6 October 1959, as amended.

The Agreement between the Government of Republic of Finland and the Government of Australia concerning the transfer of nuclear material between Finland and Australia (FTS2/80). Substituted to the appropriate extent by the Agreement between the Government of Australia and the European Atomic Energy Community ty concerning transfer of nuclear material from Australia to the European Atomic Energy Community, 21 September 1981.

The Agreement for Cooperation with the Government of the Republic of Finland and the Government of the United States concerning Peaceful Uses of Nuclear Energy (FTS 37/92). Substituted to the appropriate extent by the Agreement for Cooperation in the Peaceful Uses of Nuclear Energy with European Atomic Energy Community and the USA, 12 April 1996.

The Agreement for Cooperation in the Peaceful Uses of Nuclear Energy Between the European Atomic Energy Community and the Government of Japan, 27 February 2006.

The Agreement Between the European Atomic Energy Community and the Cabinet of Ministers of Ukraine for Cooperation in the Peaceful Uses of Nuclear Energy, 28 April 2005.

The Agreement for Cooperation in the Peaceful Uses of Nuclear Energy Between the European Atomic Energy Community and the Government of the Republic of Kazakhstan, 4 December 2006.

The Agreement for cooperation in the peaceful uses of nuclear energy between the European Atomic Energy Community (Euratom) and the Government of the Republic of Uzbekistan, 21.10.2003

The Agreement for cooperation in the peaceful uses of nuclear energy between the European Atomic Energy Community (Euratom) and the Government of the Argentine Republic, 30.10.1997

The Agreement between the Government of the Republic of South Africa and the European Atomic Energy Community (Euratom) for Cooperation in the Peaceful Uses of Nuclear Energy, 31.7.2013

The Agreement between the European Atomic Energy Community (Euratom) and the Government of the United States of Brazil for cooperation concerning the peaceful uses of atomic energy, 24.6.1965

Bilateral Safeguards Agreements made by Finland:

The Agreement between the Government of the Republic of Korea and the Government of the Republic of Finland for Cooperation in the Peaceful Uses of Atomic Energy, entered into force on 1.1.2015 (FTS 5/2015).

The Agreement with the Government of the Russian Federation and the Government of the Republic of Finland for Cooperation in the Peaceful Uses of Atomic Energy, entered into force on 6.4.2015 (FTS 32/2015).

The Agreement on Cooperation in the Field of Peaceful Uses of Atomic Energy Between the Government of the Kingdom of Saudi Arabia and the Government of the Republic of Finland, entered into force on 3.6.2017 (FTS 48/2017).

The Agreement with the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy (FTS 16/69). Articles I, II, III and X expired on 20 February 1999.

The Agreement with the Government of the Russian Federation (the Soviet Union signed) and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy (FTS 39/69). Articles 1, 2, 3 and 11 expired on 1.12.2004.

The Agreement between the Government of the Kingdom of Sweden and the Government of the Republic of Finland for Co-operation in the Peaceful Uses of Atomic Energy 580/70 (FTS 41/70). Articles 1, 2 and 3 expired on 5.9.2000.

The Agreement on implementation of the Agreement with Finland and Canada concerning the uses of nuclear materials, equipment, facilities and information transferred between Finland and Canada (FTS 43/84).

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ISBN 978-952-309-504-5 (print) PunaMusta Oy
ISBN 978-952-309-505-2 (pdf)
ISSN 0781-1713 (print)
ISSN 2243-1896 (pdf)

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