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Olli Okko (ed.)

Implementing nuclear non-proliferation in Finland

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

Annual report 2019

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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 Finland. 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), have their roles in safeguards. During 2019, STUK together with the ministries continued and further strengthened national cooperation in the areas of non-proliferation, export control and nuclear disarmament.

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 shut-down research reactor in Espoo with nuclear fuel still at the site, as well as a dozen minor nuclear material holders in Finland.

A new category of nuclear material holder was initiated in 2018 owing to the decision of the MEAE that all production source material grade uranium in the metal industry must be licensed according to Finnish nuclear energy legislation. STUK therefore granted operating licences to the Boliden Group's Zinc and Copper production units at Kokkola and Harjavalta, owing to the uranium-rich intermediate copper product. These operations and materials are not considered by the European Commission and are excluded from the EU Safeguards Regulation owing to the non-nuclear use of the source material. In 2019, Dragon Mining Oy was licensed for its uranium-rich gold concentrates.

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 Regulation 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 inspection activities in 2019 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 stakeholders' declarations.

The number of international inspection days per year is approximately 25. According to the statements on inspection results and the conclusion of safeguards implementation provided by the IAEA and the Commission, neither the IAEA nor the Commission made any remarks or required any actions in 2019. At the end of 2018, however, there was an unresolved request for clarification concerning findings in environmental sampling carried out by the IAEA in April 2018. The clarification was consequently prepared and provided to the IAEA in early 2019. In addition, there were a few other follow-ups pending owing to equipment maintenance needs that were resolved in the beginning of 2019. By means of their nuclear materials accountancy and control systems, the stakeholders enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards. In safeguards, STUK is continuing with 40 annual inspections and 60 inspection days.

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 Finnish National Data Centre for the CTBT (FiNDC) is committed to its own role in the common endeavour, so that the verification system of the CTBTO can accomplish its detection task.

Human resources development at the Nuclear Materials Section during 2019 was focused on comprehensive competence development taking into account the risk assessment of certain areas of expertise and the ability of personnel to cope at work. The objective is to ensure the necessary human resources now and in the future, and to develop the work and work flows to fulfil STUK's strategy for 2018–2022. 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.

In addition, STUK contributed to educational workshops and training courses for authorities that represent nuclear newcomers: countries that aim at uranium production or nuclear power in cooperation with the IAEA. STUK also contributed to EU-funded projects to promote safeguards and regulators in Tanzania and Vietnam.

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.

In this current setting, Chapter 1 presents the Finnish system and the relevant stakeholders to new readers in a concise way. Chapter 2 presents the safeguards activities at the operators and other stakeholders. Development work and other activities are dealt with later in the report. STUK's activities concerning the Comprehensive Nuclear-Test-Ban Treaty and nuclear disarmament are included in report.

The report is compiled by the staff members of the Safeguards Section of STUK. The inspectors in the office have specific oversight tasks and duties towards individual operators and stakeholders, so all staff members contribute to the reporting. In the Safeguards Section, there are a Section Head and seven inspectors as responsible officers for all facilities, installations and other NM or nuclear related activities. Inspectors work in pairs to ensure duplicate knowledge and appropriate response time. This arrangement also makes it easier for all individuals to handle their workload. In addition, one researcher who is developing measuring methods in the GOSSER project has been hired by the Section.

The Section Head is Marko Hämäläinen and the responsible officers for nuclear material holders in 2019 were Henri Niittymäki for Loviisa NPP, the Technical Research Centre of Finland (VTT) and minor NM holders, Timo Ansaranta for Olkiluoto NPP, Tapani Honkamaa for the new Olkiluoto 3 unit and the FV Hanhikivi NPP project, Mikael Moring and Olli Okko for the encapsulation plant and geological repository for spent nuclear fuel at Olkiluoto. Mr Moring acted as responsible officer for STUK as a nuclear material holder and Olli Okko for nuclear material producers and nuclear materials at the universities of Helsinki and Jyväskylä. Mr Okko was also responsible for nuclear fuel-cycle related R&D activities under the Additional Protocol.

In addition, there are several additional tasks related to safeguards and nuclear non-proliferation, which are taken care of by various experts of STUK. In particular, the Support Programme to the IAEA safeguards contributes to the R&D work for international safeguards. Mr Honkamaa acts as support programme coordinator, prepares its annual report and draws attention to the highlights in this report. Mr Moring is responsible to the CTBTO for the Finnish National Data Centre and, of STUK's other departments, Kari Peräjärvi contributes to the GICNT and IPNDV activities included in this report. It is important to highlight that Elina Martikka is continuing to contribute strongly to non-proliferation and safeguards issues in her current position as an international co-operation manager in the recently established Department for Expert Services. Ms Martikka works in close co-operation with the Safeguards Section and leads the working group of NPT partners at STUK. The contents of this annual report can be expected to reflect these changes in the future. Comments and suggestions are welcome to improve the content and normativity of the report.

The Editor

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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. In order 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 facilities that use nuclear materials, often referred to as 'licence holders' or '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 stakeholders 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 a dozen 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 of 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.

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 also 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 was 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 Guide YVL 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 stakeholders 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 stakeholders. Undistributed responsibility for the safety, security and safeguards of the use of nuclear energy rests with the stakeholder. It is the responsibility of STUK as the state regulatory authority to ensure that the licence holders and all other stakeholders 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. 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

As per the Finnish nuclear legislation, STUK is responsible for maintaining the national nuclear safeguards system in order to prevent the proliferation of nuclear weapons. STUK regulates the stakeholders' 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 is in charge of Finland's approval and consultation process for inspectors from the IAEA and the European Commission.

Nuclear safeguards by the Nuclear Materials Section of STUK cover all typical measures of the State System of Accounting for and Control of Nuclear Materials (SSAC), together with many other activities. STUK reviews the stakeholders' 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 the 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 the different duty areas is presented in Figure 2. Most of the working days are invoiced to the stakeholders. As seen in Figure 2, the duty areas are divided into those of 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 Foreign Affairs or the European Union. However, the state budgetary funding constitutes only about 5% of the total funding of the Nuclear Materials Safeguards Section.

Nuclear non-proliferation is, by its nature, an international domain. STUK therefore actively participates in international nuclear safeguards-related cooperation and development efforts, and also participates in the European Safeguards Research and Development Association ESARDA's working groups, executive board and steering committee. The practices adopted in the current nuclear construction projects have emphasised the need to bring in the safeguards requirements at an early stage of facility design. The experience has been shared with the IAEA, in several international fora and also in bilateral cooperation with several countries.

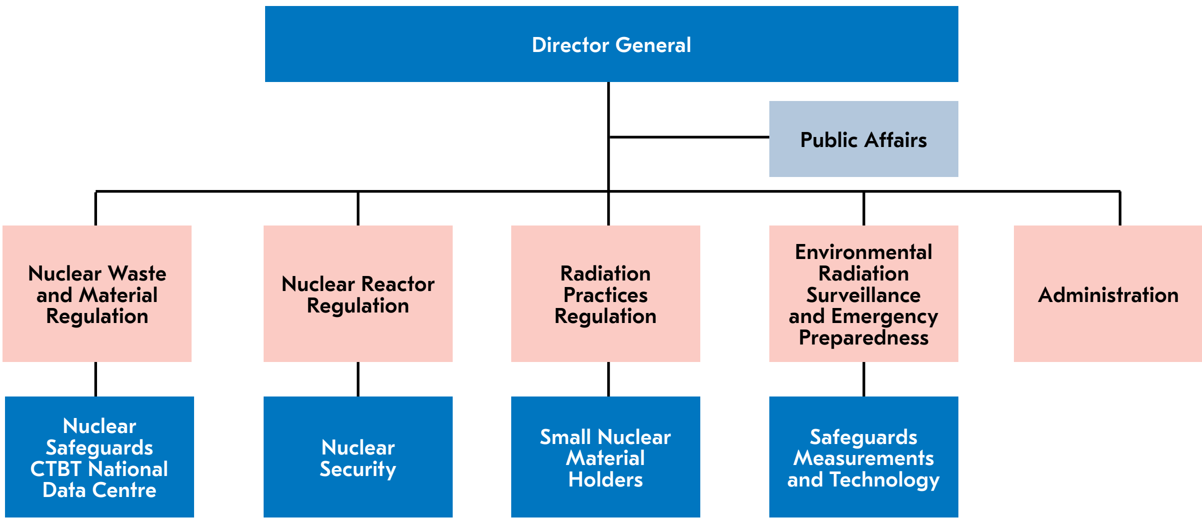


FIGURE 1. Framework to implement nuclear non-proliferation within STUK's organisation.

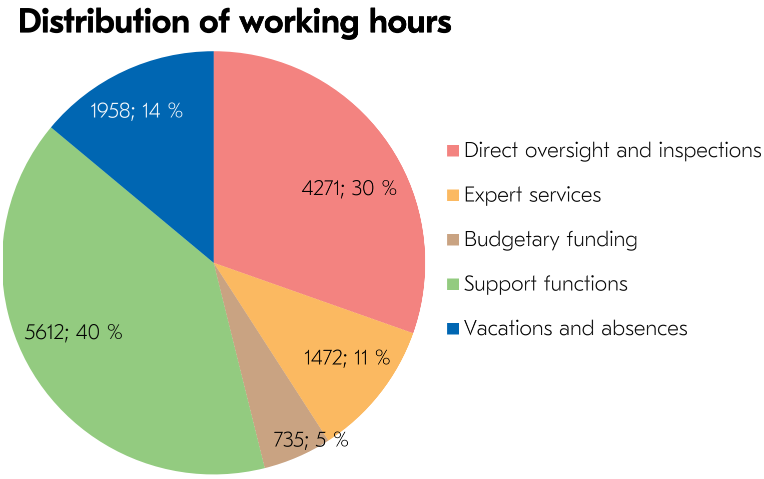


FIGURE 2. The distribution of the working hours of the Nuclear Materials Safeguards Section in the various duty areas.

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 and other stakeholders. In Finnish legislation, the term 'use of nuclear energy' comprises a wide range of nuclear-related activities, such as those defined in the Additional Protocol. These stakeholders, 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 the Additional Protocol are integrated into the handbook to facilitate implementation of safeguards at the site, including the material balance areas. Other stakeholders 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 stakeholders 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 1990–2019 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: the Technical Research Centre of Finland, the Radiation and Nuclear Safety Authority and the Laboratory of Radiochemistry at the University of Helsinki.

With the basic technical characteristics (BTC) submitted by a licence holder or by other stakeholder 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 2019.

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	15.5.2017	SSFLOV1, 8.7.2004	Yes, 4.5.1998	No	Operating, LO1 until 31.12.2027 LO2 until 31.12.2030	27.11.2019
WOL1, Olkiluoto	22.8.2018	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	19.9.2019
WOL2, Olkiluoto	22.8.2018	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	19.9.2019
WOLS, Olkiluoto	17.4.2019	SSFOLKI, 8.7.2004	Yes, 7.6.2007	No	Operating, until 31.12.2038	19.9.2019
WOL3, Olkiluoto	3.1.2019	SSFOLKI, 8.7.2004	No	No	Operating, until 31.12.2038	19.9.2019
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, 1.7.2010	4.7.2014
WRRF, Espoo	31.12.2014	SSFVTTI, 8.7.2004	Yes, 9.7.1998	No	Operating, until 31.12.2023	12.4.2017
WNSC, Espoo	12.9.2019	Included 2017 to SSF VTT1	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)	17.2.2017
WHEL, Helsinki	4.4.2019	SSFHYRL, 8.7.2004	No	No	Operating, until 31.12.2027	3.9.2019
WKKO, Kokkola	30.5.2013	No	No	No	Operating, until 31.12.2024	18.6.2015
WNNH, Harjavalta	16.1.2018	No	No	No	Operating, until 31.12.2029	15.11.2019
WTAL, Terrafame	25.5.2019	No	No	No	Operating (pilot test) until 30.6.2023	6.11.2017
WDPJ, Jyväskylä	10.3.2017	No	No	No	Operating, until 31.12.2024	24.9.2018

Finnish material balance areas and their status as 31.12.2019. 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, date of Parliament approval, in force 5 years).

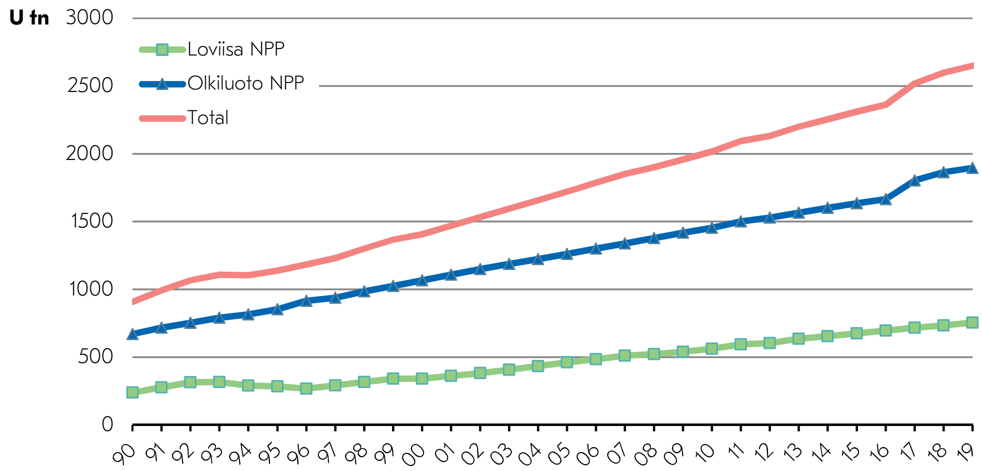


FIGURE 3. Uranium accumulation in Finland in 1990–2019.

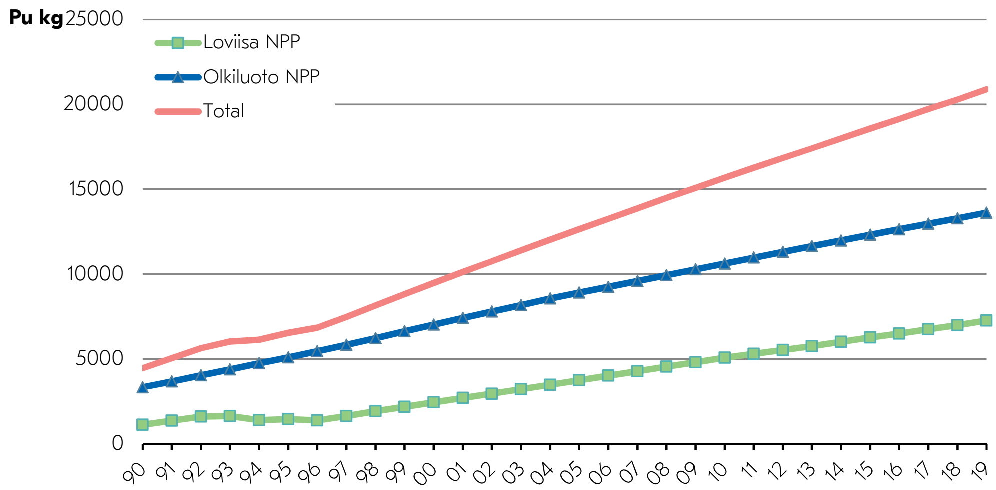


FIGURE 4. Plutonium in spent nuclear fuel in Finland in 1990–2019.

Fortum (MBA WLOV)

The nuclear power plant operated by Fortum Power and Heat Oy is located on Hästholmen Island in Loviisa on the southeast 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.

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. 1,600 (net)	Pressurised water reactor (PWR), Areva NP

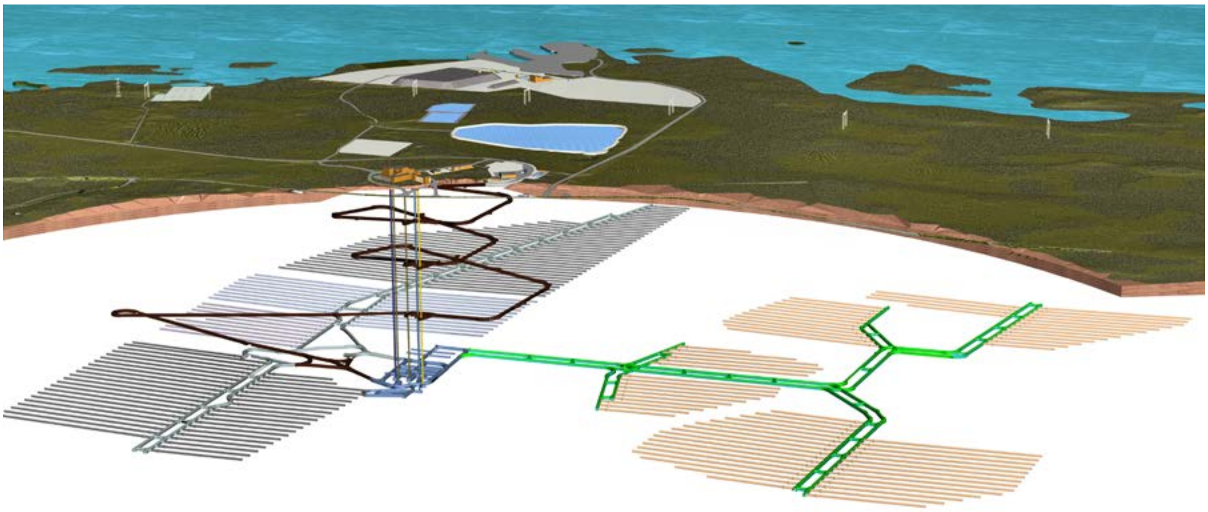
Teollisuuden Voima Oyj owns the Olkiluoto 1 and 2 plant units located in Olkiluoto, Eurajoki, and the Olkiluoto 3 plant unit under commissioning.

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–zirkonium hybrid combination: 8% uranium, 91% zirkonium 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.

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 nuclear power reactor units and an interim spent fuel storage. Olkiluoto 1 was connected to the electricity grid in 1978 and Olkiluoto 2 in 1980. There are three active material balance areas (MBA codes WOL1, WOL2, WOLS) at the Olkiluoto NPP.

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 in the EU, and the fuel assemblies are manufactured in Germany and Sweden.

The Finnish Government granted a licence to construct a new nuclear reactor, Olkiluoto 3 in 2005. As a part of the licensing process, TVO's plan for arranging the necessary measures to prevent the proliferation of nuclear weapons was approved by STUK. The European Commission has assigned the MBA code WOL3 for Olkiluoto 3. TVO submitted the operating licence application to the Government in April 2016 and, consequently, the operating licence was granted on 7 March 2019. In the meanwhile, the first fresh fuel for the first loading was received to OL3 in October 2017 and the initial inventory was verified in February 2018. The current estimate for the beginning of energy production is in early 2021.

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 the Olkiluoto NPP have been in force since 2007. The 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 expects the construction licence to be granted 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 to launch the decommissioning process. The reactor was shut down and made subcritical in 2015.

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

In contrast to this, 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 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 FiR1 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.

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 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 at a different department of STUK to the regulatory Nuclear Materials 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 facility's 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 facility is located at Kokkola on the west coast of Finland.

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.

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 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 Talvivaara. 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 but the use of the extraction plant needs the operating licence to be granted by the Government. The application was submitted to the Government at 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 62a§. 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 about ten 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 fulfils the definition of nuclear material. These metal products that 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 harmful waste among other extracts. According to the definitions in Finnish nuclear energy legislation, the production and possession of source material has been licensed by STUK since 2018 after the interpretation and decision of MEAE in summer 2018. Earlier, these kinds of stakeholders 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 at its Sastamala mill.

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 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 for the encapsulation plant and the geological repository and submitted to the Commission in 2013. The MBA codes assigned to the future facilities are WOLE for the encapsulation plant and WOLF for the geological repository. The construction of the geological repository (GR) commenced officially in 2016 and the encapsulation plant (EP) 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. 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.

The installation without nuclear materials but with the two BTCs for the Material Balance Areas under construction constitutes a site according to the Additional Protocol. The Posiva site (SSFPOS1) covers the fenced area around the buildings supporting the construction of the facilities.

Other stakeholders

Nuclear expert organisations, technology holders and suppliers that serve the nuclear and other industry 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 not involving 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 stakeholders, universities, research organisations or companies that have activities defined in the Additional Protocol are under reporting requirements and export control. These stakeholders (the Technical Research Centre 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 safeguard 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 as per INFCIRC/193, and safeguards activities in accordance with the Additional Protocol, integrated together. While this should not lead to an increase in inspections, it should enable the IAEA to assure itself of the absence of undeclared nuclear activities in a state. In practice, the number of IAEA routine interim inspections is decreasing. In contrast to this, the IAEA additionally performs 1–3 short-notice inspections per year in a state that has a number and type of nuclear installations similar to the situation in Finland. The IAEA has annually drawn conclusions confirming its confidence that all nuclear activities and materials are accounted for and are in peaceful use in Finland.

The number of IAEA and Euratom routine inspections decreased significantly in 2009, as defined in the state-level safeguards approach for Finland, which was negotiated during 2007 and 2008. 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 infobox). At reactors, the physical inventory verification includes both pre- and post-PIV inspections. In 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.

According to the Finnish Nuclear Energy Act, STUK must participate when the IAEA and Euratom are having 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.

IAEA/EU 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-h notification (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-h 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)

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.

1.5 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.

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

As per 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 was last amended in 2019 (Commission-delegated regulation (EU) 2019/2199). 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.

1.7 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.

1.8 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 deterrence, detection and delay of and response to nuclear security events. On the other hand, nuclear material accountancy and detection measures may supplement security measures through a deterrence effect.

2 Safeguards activities in 2019

2.1 The regulatory control of nuclear materials

In 2019, as in the past, STUK continued with national safeguards measures and activities with 66 inspection days and 42 inspections of material balance areas. The stakeholders' activities were licensed and inspected as appropriate, and inventory reports and accountancies were verified systematically. 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 2019 are shown in Tables A2 and A3 in Appendix 1.

The implementation of the IAEA's integrated safeguards since 2008 reduces the total number of annual routine inspections days of the international inspectorates, but includes short-notice random inspections. Since 2010, the number of IAEA and European Commission inspections annually has been close to 20 with approximately 25 inspection days. The fluctuation is mainly due to the different design information verification activities at the disposal site during each of the years. In October 2019, there was an extensive campaign at construction site resulting in a high number of inspections days in Finland. In 2019, the IAEA launched more short-notice inspections in Finland than ever before, three short-notice random inspections (SNRI) at Olkiluoto, one at Loviisa, and one complementary access (CA) at Olkiluoto. The development of inspections and inspection person-days at material balance areas is presented in Figures 5 and 6. Inspections by STUK, the International Atomic Energy Agency (IAEA) and the European Commission in 2019 are presented in Appendix 2.

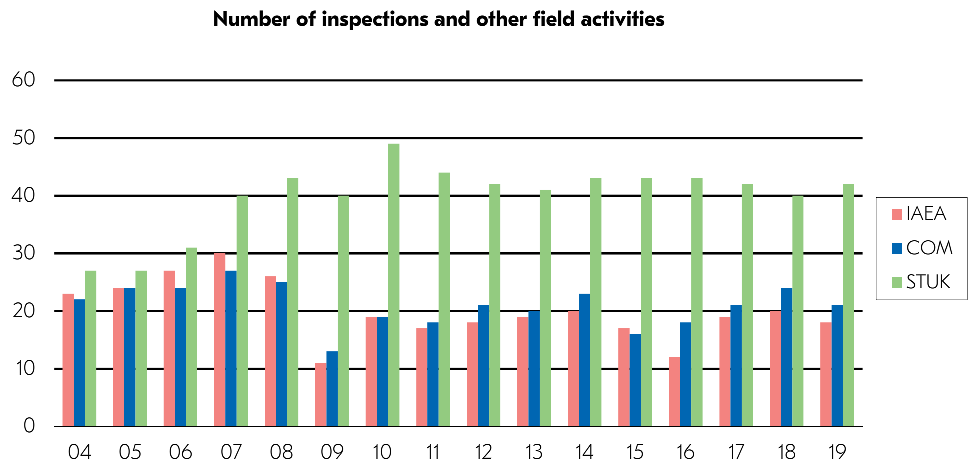


FIGURE 5. The number of inspections from 2004 to 2019.

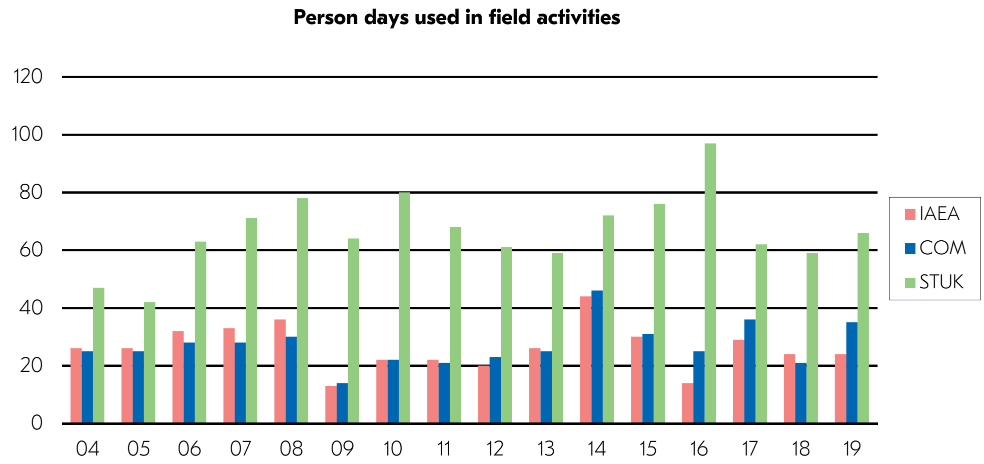


FIGURE 6. Inspection person days from 2004 to 2019.

The implementation of safeguards in Finland was addressed at several meetings with the IAEA and the European Commission. During the IAEA General Conference in September 2019, a trilateral meeting was organised in Vienna. A trilateral meeting at least once a year and usually supplemented by a smaller trilateral meeting in spring is a useful informal forum for every organisation to discuss, share information and clarify state declarations. In addition, STUK experts met IAEA officials to discuss actual topics like implementing the State-Level Concept at Finnish facilities in connection with other meetings or occasions in Vienna. Similarly, in addition to the inspection routines, STUK continued with two annual safeguards meetings with each of the NPP operator's staff members responsible for safeguards.

2.2 General safeguards activities

2.2.1 Additional Protocol declarations

In 2019, 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 28 March 2019, and the declarations according to articles 2.a.(i), 2.a.(iv), 2.a.(x) and 2.b.(i) on 13 May 2019. Furthermore, STUK submitted the quarterly declarations on exports that are due in February, May, August and November.

On 21 January 2019, STUK submitted to the IAEA a declaration with a clarification upon request by the IAEA according to Article 2.c. In a statement dated 14 March 2019, the IAEA concluded that the response provided by STUK was acceptable and that the IAEA had no further questions on the matter.

2.2.2. Approvals of new international inspectors

In 2019, a total of 33 IAEA and 14 Commission inspectors, newly appointed, were approved to perform inspections at nuclear facilities in Finland.

2.2.3 Nuclear dual-use items, export licences

In 2019, the Ministry for Foreign Affairs issued 26 export licences for NSG Part 1 items:

- three for export of equipment for nuclear power plant to France and two to Sweden;
- nine for exporting nuclear technology (nuclear information) to EU countries, four to the USA and one to the Russian Federation;
- three to export software and training to China;
- two to export non-nuclear materials to China;
- one for exporting a fresh fuel assembly to the Russian Federation; and
- one licence for exporting of zirconium tubes (of two fresh fuel assemblies to be returned to the manufacturer for reparation) to Sweden.

2.2.4 Transport of nuclear materials

In 2019, 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 one transport plan and two transport packaging designs. STUK inspected fresh nuclear fuel consignments with two inspection being carried out in 2019.

2.2.5 International transfers of nuclear material

In 2019, TVO reported to STUK about its international fuel contracts, fuel transfers and fuel shipments. Based on the document inspection findings and on two audits of TVO's international nuclear material transfer accountancy and control carried out on 10 January and 4 December 2019, 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 stakeholders

2.3.1 Loviisa nuclear power plant

In 2019, STUK granted two licences for the import of nuclear dual-use items. In total, STUK performed eight safeguards inspections and one inspection of the safeguards system at the Loviisa NPP in 2019. A follow-up from a 2018 safeguards inspection was carried out together with the IAEA and European Commission, followed by work on camera installations on 22-24 January 2019. A site inspection was performed on the 19 March 2019. In June 2019, one random interim inspection was carried out by the IAEA and Commission together. The refuelling outage at the Loviisa 2 reactor unit took place during the period 18 August – 13 September 2019 and the outage at the Loviisa 1 reactor unit during the period 7–27 September 2019. STUK, the IAEA and the Commission performed a Physical Inventory Taking (pre-PIT) inspection before the outages, on 31 July 2019. This inspection was carried out effectively within one working day, as was proven to be good practice the previous years. The Physical Inventory Verification (PIV) was carried out after the outage, on 9–10 October 2019. 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 26 August 2019 and the Loviisa 1 core on 15 September 2019. A system inspection of the NPPs safeguards system was performed by STUK on 30–31 October 2019.

On the basis of its own assessment, that of the IAEA and of the Commission inspection results, STUK concluded that Fortum's Loviisa NPP complied with its nuclear safeguards obligations in 2019.

2.3.2 Olkiluoto nuclear power plant

In 2019 STUK granted TVO four import licences for fresh nuclear fuel for the two operating units, seven licences to import non-fuel items and one licence for possessing items, and one licence for export of dismantled plant components to Studsvik, Sweden, for disposing and recycling purposes. TVO updated its nuclear materials handbooks, and the updates were approved by STUK.

The operating reactor units Olkiluoto 1 and 2 and the spent fuel storage of the TVO Olkiluoto power plant were subject to 18 safeguards inspections. In addition, the accountancy of the uranium batches in TVO possession abroad was inspected. 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 16–17 April and 18–19 June, respectively. STUK performed the core verification inspection of both reactor units before the reactor core lid was closed.

STUK took part in the complementary access to the Olkiluoto site as well as in random interim inspections at the Olkiluoto 1 unit and the spent fuel storage, all initiated by the IAEA, together with the European Commission. Furthermore, the IAEA, EC and STUK performed physical inventory verification in the spent fuel storage. STUK performed a further interim safeguards inspection in the reactor unit 2 and a site declaration update verification inspection.

At the Olkiluoto 3 unit, the design information verification inspection together with the physical inventory verification inspection was carried out by the IAEA, EC and STUK on 19 November.

On the basis of its own assessment and that of the IAEA and of the Commission inspection results, STUK concluded that TVO's Olkiluoto NPP complied with its nuclear safeguards obligations in 2019.

2.3.3 The Hanhikivi nuclear power plant project

The Government granted a decision-in-principle in 2010 for the new operator Fennovoima to construct a new nuclear power plant at a new site. STUK initiated negotiations with the operators and the European Commission as well as with the IAEA in 2011 to prepare for the implementation of safeguards in good time simultaneously with the facility development. As a consequence, the company could request the vendor organisations to facilitate safeguards implementation, for example to improve proliferation resistance and facilitate nuclear material verification and surveillance at the future plant. In the meantime, Fennovoima created an organisation for safeguards and prepared for the implementation of safeguards.

Based on the meetings on the implementation of safeguards and the control of nuclear technology with Fennovoima's staff, STUK concludes that awareness and preparedness for safeguards procedures are at an adequate level in the new organisation preparing for the new NPP project and that Fennovoima fulfilled its current safeguards obligations in 2019.

2.3.4 VTT

At the Technical Research of Finland (VTT), the preparations for licensing the decommissioning of the research reactor and associated activities continued together with the initiation of new research activities at the Centre for Nuclear Safety where operations started in 2017 by moving the small amounts of nuclear material used in the laboratories located in the reactor building. Both buildings with separate material balance areas (MBA) were included in the updated site declaration in 2017. The BTC of the Centre for Nuclear Safety was updated in September 2019 as a result of the deputy director being changed.

STUK and the Commission verified the nuclear material inventories of both of VTT's MBAs on 4 and 5 June 2019.

On the basis of its assessment and inspection results, STUK concluded that VTT complied with its nuclear safeguards obligations in 2019.

2.3.5 STUK

STUK's Nuclear Materials Safeguards Section made a nuclear material inspection at the operating unit at STUK on 18 December 2019. The operator needs to focus on following their written procedures for nuclear material bookkeeping and reporting. During 2020 special care should be taken to send the NM reports to the EC on time. 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 safeguards inspection together with the European Commission on 6 June and verified the inventory of the University of Helsinki. The record keeping was addressed by the Commission and STUK. As a result of the inspection, the operator was requested to update its nuclear materials manual. The updated manual was approved by STUK in September 2019.

On the basis of its assessment and inspection results, STUK concluded that the University of Helsinki complied with its nuclear safeguards obligations in 2019.

2.3.7 Minor nuclear material holders

In 2019, 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 Guide YVL D.1. In total, two handbooks prepared by the minor holders were approved in 2019.

On the basis of its assessment, STUK concluded that the minor nuclear material holders complied with their nuclear safeguards obligations in 2019.

2.3.8 Front-end fuel cycle operators

The operators at Harjavalta and Kokkola nickel and cobalt factories report monthly to the European Commission and STUK. The extraction of uranium from industrial purification processes is considered to be a pre-safeguard activity so not subject to IAEA safeguards. In 2016, STUK and the Commission inspected the inventories and accountancy practices at both of the operators. During 2019, at Kokkola the ownership changed and, at Harjavalta, the operating licence was renewed, but the responsible personnel remained in place and the operators reported about their planned activities and monthly inventories according to safeguards requirements. On the basis of its assessment, STUK concluded that these operators complied with their nuclear safeguards obligations in 2019.

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 of Boliden company reported processed 853 kg of natural uranium originating from zinc concentrates in 2019. The uranium ends up in the waste streams during the processing. Dragon Mining reported an amount of 12 kg of uranium in its gold production originating mainly from its 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 2019.

In June 2017, Terrafame Ltd applied for an operating licence to carry out pilot tests to analyse the processing techniques to be applied in the uranium production within the company's uranium extraction plant built in the mineral processing plant that currently produces nickel and zinc. The pilot tests were licensed by STUK just as for other minor holders possessing small amounts of natural uranium in December 2017. The nuclear safeguards manual and responsible persons for nuclear materials accountancy were therefore approved by STUK before granting the licence. During 2018, the first pilot test was carried out. The uranium remained in liquid form, but reached the grade of source material. The material balance area initiated monthly reporting in 2019. STUK concluded that this operator complied with its nuclear safeguards obligations in 2019.

The licence application for the operation of Terrafame's uranium extraction plan was submitted by the operator to the government in October 2017. The Ministry of Economic Affairs and Employment launched the process to evaluate the application within the desired timeline in June 2018. Within this process, STUK's Safeguards Section approved Terrafame's 'Plan for arranging the safeguards control that is necessary to prevent the proliferation of nuclear weapons' that was submitted according to the Nuclear Energy Decree for STUK's approval. STUK gave its statement on nuclear safety to the ministry in June 2019 after assessing the safety documentation. In this context, the proposed update of Terrafame's safeguards manual was postponed in order to include the foreseen needs from the IAEA and the Commission. The manual must be updated before the uranium extraction operations begin.

2.3.9 The disposal facility for spent nuclear fuel

The operator Posiva applied for a nuclear construction licence for the disposal facility in 2012. STUK assessed the application during 2013–2015 together with the Commission and the IAEA in order to clarify and facilitate safeguards measures for the permanent disposal of spent nuclear fuel. The requirement document for the IAEA/EC equipment to be installed in the encapsulation plant was jointly prepared by the IAEA and EC in 2014. This requirement document was referenced in the STUK assessment of the licence application.

In 2019, Posiva updated the BTCs both for the encapsulation plant and the geological repository. In particular, the layout of the encapsulation plant was updated in June 2019. As a consequence, the plans for the safeguards equipment to be installed at the encapsulation plant was updated by the IAEA and the Commission. The changes in the layout and their influence on the details of the equipment selection, emplacement and connections were discussed jointly at several meetings, and at a site visit carried out at Olkiluoto in June 2019. This 'Safeguards-by-Design' process can be expected to continue during the construction of the facility.

The underground construction for the non-nuclear technical servicing parts such as parking halls, personnel shafts, etc. continued during 2019. In addition, the construction of nuclear parts where nuclear material will be stored or transferred in the installation began simultaneously by excavating an access tunnel to the canister shaft, canister transfer tunnels, canister storage, etc. There were more than 10 active concurrent construction locations underground, challenging the timing of a design information verification campaign in 2018 and 2019. At ground level, the foundation work for the encapsulation plant continued, the construction of the plant began in June 2019, and its foundation stone was laid at a festive ceremony in September.

In October 2019 the IAEA and the Commission carried out an extensive design information verification campaign to verify the underground premises constructed since the previous inspection in 2017. 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. Posiva updated the BTC for the underground installation to include the above-ground buildings in December. STUK carried out an inspection of the Posiva site on 14 February 2019 and a DIV inspection of the MBAs WOLF and WOLE on 9 December 2019.

On the basis of its assessment and inspection results, STUK concluded that Posiva complied with its nuclear safeguards obligations in 2019.

2.3.10 Other stakeholders

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 2019

3.1 Development of working practices

STUK started a new strategy period in 2018. The new strategy aims at a change involving the entire philosophy. In the new strategy period 2018–2022, the activities of STUK will be guided by effectiveness. Methods for achieving effectiveness include risk-oriented commensurable oversight and flexible and efficient working methods. Increased emphasis on operator responsibility forms the basis of this strategy. To meet the objectives of the new strategy, STUK needs to invest in the competence and well-being of its personnel. In the nuclear safeguards section, these have been taken into account, for example in developing job rotation inside the section, encouraging pair- and teamwork, seeking opportunities in training and competence building and in sharing knowledge. Part of this approach is a contribution to the international multidisciplinary tasks supporting safeguards, safety and security.

The change in oversight and increased emphasis on operators' responsibility aim 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. Another objective is to have a critical look at STUK's requirements for operators. With regard to safeguards, STUK's regulatory guide D.1 for nuclear material holders and other stakeholders was updated in 2018 and the new version issued in 2019 to highlight the responsibilities of operators to better meet these strategic objectives.

Nuclear materials safeguards implemented by the Nuclear Materials Safeguards Section of STUK cover all typical measures of the State System of Accounting for and Control of Nuclear Materials (SSAC), and many other activities besides. Nuclear safeguards on the national level are closely linked with the other functions of nuclear materials control and non-proliferation: licensing, export control, border control, transport control, combating illicit trafficking, the physical protection of nuclear materials, and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The continuous analysis of the developments in the involved fields of both technology and politics is a daily, multidisciplinary task in the STUK Nuclear Materials Safeguards Section.

In the Safeguards Section, there are a Section Head and seven inspectors who are responsible officers for all facilities, installations and other nuclear material or nuclear-related activities. Inspectors work in pairs to ensure duplicate knowledge and appropriate response time. This arrangement also makes it easier for all individuals to handle their workload.

As the licensed construction of the disposal facility began in 2016, the preparatory work at the authority focused on timely implementation of safeguards, in particular the equipment infrastructure to be fitted to the encapsulation and disposal process. The development of passive gamma emission tomography continued in cooperation with national experts at the Helsinki Institute of Physics and, also within the support programme to the IAEA. Within this context, Master's thesis work was successfully finalised in 2019.

In Finland, the Ministry for Foreign Affairs (MFA) and Ministry of Economic Affairs and Employment (MEAE) play a role in safeguards. The Ministry for Foreign Affairs is responsible for the international aspects of Finland's non-proliferation policy in collaboration with other authorities. The export control of nuclear products also falls within the ambit of the MFA. The Ministry of Economic Affairs and Employment (MEAE) is responsible for the supreme command and control of nuclear matters. STUK together with the ministries strengthened cooperation in the area of non-proliferation, export control and disarmament. As a joint activity, STUK experts participate in Nuclear Suppliers' Group's Technical Expert Group meetings.

3.2 Support programme to the IAEA safeguards

The Finnish Support Programme to 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 2019. The annual review meeting was held on 26 April 2019 and semi-annual review meeting on 22 October, both in Vienna. At the end of 2019, FINSP had 15 active tasks and one stand-by task.

The FINSP prepares a separate annual report to the ministry. Some highlights of the 2019 activities are provided in the following text.

Performance Evaluation and Implementation Support of Gamma Emission Tomography for Spent-Fuel Verification

Passive Gamma Emission Tomography is a method which can detect individual missing pins even from the inner parts of a spent fuel assembly. The IAEA approved the method in 2017 and is in the process of procuring verification instruments. FINSP provides support to the IAEA in putting the new method into practice. This includes organising access to spent fuel ponds in order to perform the needed testing. In addition, the MSSP participates in the tests as observers in order to provide feedback from regulatory and operations perspectives and expert support in that regard. Campaigns were arranged in 2018 at Loviisa and Olkiluoto. The task was completed on 25 April 2019 but work continues in the task JNT A 2414 FIN "Support for the testing of PGET new functionalities in attended, remote and unattended modes". In the new task a test campaign at Olkiluoto spent fuel storage was arranged in July 2019. The campaign was the first opportunity to verify spent BWR fuel with long (almost 40-year) cooling times. PGET was used in the modular verification system together with another novel method - PNAR (Passive Neutron Albedo Reactivity). PNAR test campaign results were reported to the IAEA in November 2019 at the EPGR LLLC (Encapsulation Plant Geological Repository Low-Level Liaison Committee) meeting.

FINSP also arranged a meeting in Finland to assist the IAEA in the delivery of new commercial PGET instruments. The first commercial PGET unit was delivered to the IAEA in 2019.

FIGURE 7. Setting up the measurement campaign with PGET and PNAR at Olkiluoto spent fuel storage, July 2019.

In 2019 the IAEA arranged a challenge where it sought submissions from the public to enhance the software used to analyse PGET data. FINSP sponsored Rasmus Backholm to participate in the challenge. The software used and developed by Mr Backholm was initially written by the Helsinki Institute of Physics and later developed in STUK. Mr Backholm won the 2nd prize in the challenge and gave a presentation at the award ceremony in Vienna on 30 September 2019.

Disposal programmes for spent nuclear fuel and the ASTOR group

The programmes for a geological repository for spent nuclear fuel in Sweden and Finland have reached the licensing phase, and the safeguards measures must be agreed on by all parties: facility designers, operators and inspectorates. The implementation of safeguards measures has been discussed in several fora. The Experts' Group Application of Safeguards to Geological Repositories (ASTOR) provided the IAEA with a draft report mainly on potential methods that can be applied to safeguard geological repositories. The report (STR-384) was published by the IAEA in August 2017. This task of SAGOR/ASTOR, which had been in effect for 30 years, was formally closed after the report. However, the IAEA created a new task to consolidate the earlier reports and findings of the Experts' Group. The purpose of the task was not to create any new information but to consolidate existing information. The document is written in the form of questions and answers based on more than 90 reports published over 30 years.

At the end of April, the IAEA organised a workshop where most of the consolidation work was accomplished. The workshop was attended by experts from Finland, Sweden, the USA, Belgium, Germany and the European Commission. When reviewing and consolidating the reports from the 1990s, the Additional Protocol and its terminology and measures were not properly incorporated into the report and future guidance. FINSP concern about final disposal is that the application of safeguards will become too resource-intensive for both inspectorates and operators. The optimisation of traditional and integrated safeguards measures should have been addressed more deeply in the group. One of the purposes of the task is to take care of knowledge management at the IAEA. This is achieved by collecting and assessing the selected references in the documents placed on the ASTOR group's internal website. The final report of the task is not a recommendation and does not express any official position of the IAEA or participating MSSPs.

Unfortunately, the ASTOR group was too slow and bureaucratic to assist in the practical implementation of safeguards within the timelines for the construction of the disposal facility at Olkiluoto so, in 2012, the IAEA-EC Lower Level Liaison Committee Meeting recommended that a Task Force be formed, which would coordinate the activities of the EPGR (Encapsulation Plant and Geological Repository) project and include representatives from the IAEA, EC, Sweden and Finland. In 2019, the European Commission hosted the 7th EPGR meeting in February in Luxembourg and the IAEA organised the 8th meeting in November in Vienna. ASTOR remained at the generic level whereas the EPGR group has access to the facility-specific design information and applies and develops the current safeguards approaches to the Finnish project.

Development of safeguards guideline for facilities under decommissioning and post-accident facilities

Two consultancy meetings were held in 2019 to improve the revision of existing DIQ templates for facilities under decommissioning. For Finland, and especially considering the VTT Research Reactor currently under decommissioning, these considerations such as those regarding essential equipment were beneficial. A major goal for the next consultancy meeting will be to establish and review an adequate DIQ example for spent fuel encapsulation plant and geological repository. The task continues in 2020.

New task: Safeguards-by-Design for Small Modular Reactors (SMR)

There is much interest in small modular reactors (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 the Technical Research Centre of Finland (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.

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 must be properly implemented at 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.

According to the national safeguards concept prepared, it is proposed that all fuel be verified in a comprehensive manner and with the available system comprising a PGET and PNAR (Passive Neutron Albedo Reactivity) verifier. The NDA system should be an instrument in joint use between the IAEA, EC and STUK. On the other hand, on the C/S-side STUK can rely on technical surveillance and the safeguards conclusions of the international inspectorates. For STUK's independent conclusions STUK can also make use of the information collected by its resident inspectors, inspection programme and environmental monitoring networks.

International inspectors do not plan to routinely follow nuclear material at the disposal depth. STUK has a different position here. In terms of safety, security and safeguards (3S), STUK will check that Posiva performs underground activities according to approved plans and STUK will utilise the same inspection effort to collect relevant information for all 3Ss. Examples of information most relevant to safeguards are data proving that the canisters are placed undamaged in the correct positions as declared to STUK and data showing that backfilling and sealing have been done in the approved manner. How this is efficiently and effectively arranged is under discussion.

The GOSSER project will now continue to the second phase. The programme is planned for the period 2019–2022. The plan is now going into greater details and includes the development of technologies and refining the national safeguards approach.

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 IAEA 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 cyberattacks. Through hashing and data encryption, SLAFKA's DLT-based platform fortifies these systems from cyberattacks 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 study SLAFKA was launched in March 2020.

3.5 International cooperation for Nuclear Non-Proliferation

The state's regulatory authority plays an important role in implementing safeguards at a national level, and also in contributing to and participating in the 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 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 in the ESARDA Executive Board. A STUK expert is Vice Chair of the Implementation of Safeguards Working Group. Two STUK experts participated in the ESARDA Reflection Group that is reviewing the ESARDA administrative practices and formulating new short- and long-term strategies for ESARDA. These were presented at the ESARDA 50th Anniversary Symposium in May 2019 by organising a Word Café introduction and presentation of the new strategy. The aim is to continuously follow the needs of the ESARDA members. STUK experts also made a few presentations and other contributions at the Institute of Nuclear Materials Management (INMM) annual meeting in July 2019 in Palm Springs, USA. The outcome of the ESARDA strategy work was also presented at the INMM meeting by the Reflection Group members.

The 9th INMM/ESARDA/INMMJ Joint Workshop Future Challenges for the Enhancement of International Safeguards and Nuclear Security was held in Tokyo, Japan in October 2019. STUK was contributing by chairing the session on effective and efficient safeguards for facility decommissioning and long-term waste management.

The back-end of the fuel cycle was also focused on by the ESARDA Reflection Group, and a new ESARDA WG for final disposal was established in 2019. The first meeting was held at the beginning of 2020 in connection with ESARDA administrative meetings.

Services for authorities abroad

STUK continued supporting NRRC's (the regulatory authority of the Kingdom of Saudi Arabia) safeguards functions. In 2019, STUK provided assistance in the procurement process of nuclear material bookkeeping software.

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 is scheduled to continue for at least 2–3 years. In 2019, the EU-funded project to support the nuclear regulator in Vietnam

(VARANS) was finalised. In the 3-year project, STUK was the single contributor to the task on nuclear safeguards. During 2019, the nuclear regulator of Tanzania (TAEC) published its safeguards regulation among other regulations to enhance the regulatory framework in Tanzania. In 2019, STUK contributed to a new EU-funded project that covers the security and border control of radioactive and nuclear materials in several African countries.

NPT Preparatory Committee

The Non-Proliferation Treaty entered into force in 1970. The Treaty includes more than 190 countries around the world. The Treaty Review Conference is held every five years, the previous one in 2015 and the next in 2020. Before the Review Conference, preparatory meetings will be held. STUK's expert, together with Ministry for Foreign Affairs, Ministry of Economic Affairs and Employment, Ministry of Defence and other organisations, attended a preparatory meeting in May 2019 in New York.

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 by the Ministry for Foreign Affairs in the NSG forum. STUK's experts attended to the NSG Technical Expert Group meetings in 2019.

GICNT – Global Initiative to Combat Nuclear Terrorism

Nuclear Security activities often include cooperation between multiple authorities. Nuclear Security also has a strong international linkage. 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. The Finnish Ministry for Foreign Affairs coordinated the work of GICNT until the summer of 2019. Since then, Finland has continued in the GICNT Leadership Team with Special Advisor status. STUK continues to serve 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 IPNDV develops methods and procedures for the verification of nuclear disarmament. The second phase of IPNDV finished at the end of 2019. During the second phase, the scope was expanded to cover all steps of nuclear disarmament, i.e., unlike phase 1 it not only concentrated on verification of the dismantlement of a nuclear weapon. During the second phase, the work also become more concrete through exercises and measurements. The IPNDV is a US initiative and the other participants come from both nuclear and non-nuclear weapon states. Finland has been participating in the IPNDV from the beginning. 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 all nuclear explosions in any environment. This ban is aimed at constraining the development and the qualitative improvement of nuclear weapons, including the development of advanced new 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 IMS is almost 90% ready and the CTBTO certified its 300th monitoring station out of a total of 337 in December 2019. The worldwide station network provides data to more than 1,200 organisations in more than 120 countries. In addition to monitoring compliance with the treaty, the data from the IMS is used in disaster mitigation. The Comprehensive Nuclear-Test-Ban Treaty Organization (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 support in radionuclide analyses and in quality control of the radionuclide station network.

Comprehensive Nuclear-Test-Ban Treaty (CTBT) Status (31 December 2019)

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

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 analysis of waveform IMS data.

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. However, until it does, it lacks full power. After the Nyonoksa (Archangel) radiation accident in northwest Russia in August 2019, IMS radionuclide stations in Russia paused delivery of data to the network, referring to, for example, the preparatory status of the CTBT and thus the voluntary status of upholding the IMS stations. This effectively hindered detection in the network of any radionuclides from the accident, as the winds blew any possible activity released into the atmosphere towards south and southeast, making it practically undetectable outside Russia. That this could be done without significant pushback from the international community is one more indication of the importance of implementing the CTBT.

In 2019, the Finnish National Data Centre (FiNDC) participated in workshops and meetings of the Working Group B (WGB) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). 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 is a well-established daily routine

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 generate 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 detected at some particulate stations.

5 Summary

STUK continued its nuclear regulatory authority role in 2019 by licensing and inspecting the national stakeholders. STUK maintained the national safeguards system including the SSAC (State System of Accounting and Control) of nuclear materials, regulated the stakeholders' 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 comprises reviewing stakeholder applications, reports and notifications, but also periodical and ad hoc inspection are carried out for safeguards purposes. STUK prepared the national reports according to the safeguards agreement and its additional protocol. This report summarises these activities, but there are continuously parallel development activities and international cooperation in the fields of safeguards and non-proliferation described in this report.

In the field, STUK continued with national safeguards measures and activities in 66 inspection days and 42 inspections. Since 2010, the number of annual IAEA and European Commission inspections has been around 20. The implementation of the IAEA integrated safeguards since 2008 in force in Finland reduces the total number of annual routine inspections days of the international inspectorates but includes short-notice random inspections. In order to be present at all the short-notice IAEA inspections, STUK has had a daily on-call inspector.

In 2019, STUK performed 27 safeguards inspections on the material balance areas of the Finnish nuclear power plants (NPP), eight at Loviisa NPP and 19 at Olkiluoto NPP. According to the IAEA state-level approach for Finland, five short-notice inspections were carried out, three short-notice random inspections (SNRI) at Olkiluoto, one at Loviisa, and one complementary access (CA) at Olkiluoto. This was the highest number of IAEA short-notice activities in Finland so far. STUK performed one non-destructive assay measurement campaign at Olkiluoto NPP. These, in particular the passive gamma emission tomography (PGET) tests, were followed and performed by the IAEA and European Commission staff members, increasing the number of inspection days. At other facilities, the Commission took part in accountancy inspections and physical inventory verifications at the VTT Research Reactor and Centre for Nuclear Safety and at the University of Helsinki. The total number of safeguards inspections in 2019 was 42 for STUK, 21 for the Commission and 18 for the IAEA. The IAEA sent its safeguards statements to the Commission, which amended them with its own conclusions and remarks, and forwarded them to STUK. The conclusions by the Commission were in line with the IAEA's findings and conclusions as well as with STUK's own findings; there were no outstanding questions from the IAEA or the Commission at the end of 2019, which could not be answered and clarified.

The results of STUK's nuclear safeguards inspection activities continued to demonstrate that the Finnish licence holders take good care of their nuclear materials. There were no indications of undeclared materials or activities, and the inspected materials and activities were in accordance with the stakeholders' declarations. Neither the IAEA nor the European Commission made any remarks, nor did they present any required actions based on their inspections. By means of their nuclear materials accountancy and control systems, the stakeholders enabled Finland to fulfil its own obligations under the international agreements relevant to nuclear safeguards and non-proliferation.

STUK safeguards development work continued in 2019. The main development project is the GOSSER project, which proceeded to the second phase. In this phase, the development of the practical safeguards implementation of the national safeguards concept for the spent fuel disposal is the ultimate target. The GOSSER II project plan has been prepared for the period 2019–2022. Other important development work started in 2019 includes legislation-related functions such as to review and update Finnish nuclear energy legislation and to prepare for future challenges in bookkeeping and reporting with distributed ledger and blockchain techniques. More emphasis on ensuring competence and workload control in the Safeguards Section now and in the future was also started.

STUK's Nuclear Materials Safeguards Section cooperates closely with the IAEA to share experiences and train authorities' staff in countries aiming at nuclear programmes such as uranium production or nuclear energy. This context was enlarged and in 2019 focused on Tanzania and Vietnam in EU-financed projects. The cooperation with Saudi Arabia continued in 2019.

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 2019 is that implementation of nuclear non-proliferation in Finland has achieved its objectives.

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7 Abbreviations and acronyms

ADR
European Agreement concerning the International Carriage of Dangerous Goods by Road

AP
Additional Protocol to the Safeguards Agreement

AQG
Atomic Questions Group of the Council of the European Union

ASTOR
Application of Safeguards to Geological Repositories

BTC
Basic Technical Characteristics

CA
Complementary Access

CBRN
Chemical, biological, radiological and nuclear (such as in 'protective measures taken against CBRN weapons or hazards')

CdZnTe
Cadmium zinc telluride

CTBT
Comprehensive Nuclear-Test-Ban Treaty

CTBTO
Comprehensive Nuclear-Test-Ban Treaty Organization

DIQ
Design Information Questionnaire

DIV
Design Information Verification

DU
Depleted uranium

eFORK
Enhanced FORK with a CdZnTe-gamma spectrometer (see FORK)

EPGR
Encapsulation Plant and Geological Repository

ES
Environmental Sampling

ESARDA
European Safeguards Research and Development Association

EU
European Union

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

FORK

Spent fuel verifier with gross gamma and neutron detection

GBUV

Gamma Burnup Verifier

GICNT

Global Initiative for Combating Nuclear Terrorism

HEU

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

HPGe

High-Purity Germanium

IAEA

International Atomic Energy Agency

IMS

International Monitoring System of the CTBTO

ITU

Institute of Transuranium Elements in Karlsruhe

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

IPPAS

International Physical Protection Advisory Service

IS

Integrated Safeguards

ISSAS

International SSAC Advisory Service

ITWG

International Technical Working Group for combating illicit trafficking of nuclear and other radioactive materials

JRC

The Joint Research Centre

KMP

Key Measurement Point

LEU

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

LUT

Lappeenranta-Lahti University of Technology

LINSSI

An SQL database for gamma-ray spectrometry

MBA

Material Balance Area

MEAE

Ministry of Economic Affairs and Employment

MFA

Ministry for Foreign Affairs

MSSP

Member State Support Programme (to the IAEA)

NDA

Non-Destructive Assay

NM

Nuclear Material

NPP

Nuclear Power Plant

NPT

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

NSG

Nuclear Suppliers' Group

NRC

U.S. Nuclear Regulatory Commission

NRRC

KSA Nuclear and Radiological Regulatory Commission

OECD/NEA

Organisation for Economic Co-operation and Development /Nuclear Energy Agency

Onkalo

Underground rock characterisation facility (for the disposal of spent nuclear fuel)

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

RL07

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

SA

Subsidiary Arrangements

SFAT

Spent Fuel Attribute Tester

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

SSM

Swedish Radiation Safety Authority

Th

Thorium

U

Uranium

UI

Unannounced Inspection

UNSC

United Nations Security Council

VTT

Technical Research Centre of Finland

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 2019

TABLE A1. Summary of fresh nuclear fuel receipts in 2019.

To	From	FA	LEU (kg)
Olkiluoto 1, WOL1	Germany	100	17 657
Olkiluoto 2, WOL2	Sweden	98	17 216
Olkiluoto 3, WOL3	No imports	0	0
Loviisa NPP, WLOV	Russian Federation	169	21 167

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

TABLE A2. Fuel assemblies at 31 December 2019

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
Olkiluoto 1, WOL1	1 159/579	197 334	936
Olkiluoto 2, WOL2	1 285/717	215 845	1 121
Olkiluoto 3, WOL3	245/0	130 784	0
Olkiluoto, spent fuel storage, WOLS	8 032/8 032	1 352 198	11 562
Loviisa NPP, WLOV	6 471/5 713	753 752	7 261

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 and Olkiluoto NPP 500 FAs per reactor in units 1 and 2)

TABLE A3. Total amounts of nuclear materials at 31 December 2019

MBA	Natural U (kg)	Enriched U* (kg)	Depleted U (kg)	Plutonium (kg)	Thorium (kg)
WOL1	–	197 391	–	937	–
WOL2	–	215 891	–	1 121	–
WOL3	–	130 784	10.5	–	–
WOLS	–	1 352 198	–	11 562	–
WLOV	–	753 753	–	7 261	–
WRRF	92.8	27.6	0.001	< 0.001	–
WNSC	0.282	2.22	-	< 0.001	0.044
WHEL	10.8	0.284	0.005	0.002	1.08
WFRS	34.9	0.537	208	<0.001	2.89
WTAL	1.36	–	–	–	–
WKKO	2 915	–	–	–	–
WNNH	3 588	–	–	–	–
Minor holders	0.989	–	1 093	–	0.249

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 = Freeport Cobalt Oy, in Kokkola, WNNH = Norilsk Nickel Harjavalta, U = uranium. *) Less than 150 g total of high-enriched uranium, mainly used in detectors.

APPENDIX 2
Safeguards field activities in 2019

			Inspections			Inspection person days		
MBA/operator	**Date**	**Inspection type**	**IAEA**	**COM**	**STUK**	**IAEA**	**COM**	**STUK**
TVO	10.1.	International NM transfers			1			1
WL0V	22.1.	Follow up inspection	1	1	1	1	1	1
WL0V	23.–24.1.	Camera installations LO1/LO2	1	1	1	2	2	2
SSFPOSI	4.2.	Site			1			2
Dragon Mining	5.2.	System inspection (U in milling)			1			2
S SF VTT	22.2.	STUK CA			1			2
W0LS, S SSFOLKI	13.3.	PIV (Cover installation), site	1	1	2	1	1	2
SF0459CA	14.3.	PIV			1			1
WL0V	19.3.	Site			1			2
W0L1, W0L2, W0LS	16.–17.4.	Pre-PIT OL1/OL2, seals W0LS	3	3	3	3	3	3
WTAL	17.4.	DIV, PIV			2			2
W0L2	24.5.	OL2 CV			1			1
WRRF	4.6.	PIV		1	1		1	1
WNSC	5.6.	PIV		1	1		1	1
WHEL	6.6.	PIV		1	1		1	1
W0L1	9.6.	OL1 CV			1			1
W0L1, W0L2, W0LS	18.–19.6.	Post-PIT+PIV: W0L1, W0L2, W0LS	3	3	3	3	3	3
WL0V	24.6.	RII	1	1	1	1	1	1
W0LS	22.–26.7.	NDA (PNAR+PGET)			1			11
WL0V	31.7.	Pre-PIT	1	1	1	1	1	1
WL0V	26.8.	LO2 CV			1			1
W0LS	29.8.	RII	1	1	1	1	1	1
WL0V	15.9.	LO1 CV			1			1
WL0V	9.–10.10.	Post-PIT	1	1	1	1	1	1
W0LF, W0LE	14.–17.10.	W0LF DIV, W0LE DIV	2	2	2	7	15	4
SSFOLKI	17.10.	CA	1	1	1	1	1	1
WL0V	30.–31.10.	System inspection			1			6
W0L3	19.11.	PIV	1	1	1	1	1	1
W0L1	20.11.	RII	1	1	1	1	1	1
TVO	4.12.	International NM transfers			1			1
W0LE, W0LF	9.12.	Interim			2			2
W0LE, W0LF	10.12.	Closing of requirements			1			1
W0L2	10.12.	Interim			1			1
WFRS	18.12.	PIV			1			3
Total			18	21	42	24	35	66

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 November1976 (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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