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Implementing nuclear non-proliferation in Finland

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

Annual report 2011

Olli Okko (ed)

Säteilyturvakeskus
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Executive summary

The regulatory control of nuclear materials (i.e. nuclear safeguards) is a prerequisite for the peaceful use of nuclear energy in Finland. Safeguards are required for Finland to comply with international agreements on nuclear non-proliferation – mainly the Non-Proliferation Treaty (NPT). This regulatory control is exercised by the Nuclear Materials Section of the Finnish Radiation and Nuclear Safety Authority (STUK).

The results of STUK's nuclear safeguards inspection activities in 2011 continued to demonstrate that the 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 licence holders' declarations. STUK remarked on the nuclear safeguards systems of one of the stakeholders in 2011, setting required actions to comply with procedures.

Safeguards are applied to nuclear materials and activities that can lead to the proliferation of nuclear weapons or sensitive nuclear technology. These safeguards include nuclear materials accountancy, control, security and 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 “license holders” or “operators” – and the state authority. A license holder shall take good care of its nuclear materials and the state authority shall provide the regulatory control to ensure that the license holder fulfils the requirements. Also the control of non-nuclear technology holders and suppliers, to ensure the non-proliferation of sensitive technology, is a growing global challenge for all stakeholders. In the Finnish legislation all these stakeholders are dealt with as users of nuclear energy.

Finland has a significant nuclear power production, but the related nuclear industry is rather limited. Most of the declared nuclear materials (uranium, plutonium) in Finland reside at the nuclear power plants in Olkiluoto and Loviisa. Additionally, there are the VTT research reactor in Espoo and a dozen minor nuclear material holders in Finland. Nuclear dual-use items and instrumentation for the third reactor under construction at Olkiluoto are being imported and installed. The import licenses are reviewed as applicable to ensure the peaceful use of the technology. The International Atomic Energy Agency (IAEA) and the European Commission made their site visits to the construction site prior to the installation of safeguards instrumentation and fuel delivery.

The construction of the fourth reactor at the Olkiluoto nuclear power plant, a new nuclear power plant site at Hanhikivi in Pyhäjoki, and the expansion of the geological repository at Olkiluoto to suffice for also the volume applied for the spent fuel from the new Olkiluoto four reactor were all authorised in 2010. The safeguards systems for these new facilities shall be designed concurrently and in coordination with facility design. In order to familiarise the operators’ safeguards staff with the safeguards obligations, a first

general course was arranged in June 2011. The course also started the dialogue between the operators, STUK, the Commission and the IAEA to expedite and promote safeguards approaches at the facilities.

The first inspections at the two new material balance areas in the front end of the nuclear fuel cycle were carried out in 2011. Uranium may be economically extracted at the Talvivaara mine as one of the by-products of nickel because of the bioheapleaching technique developed for large nickel deposits makes the extraction of other metals from low grade ore economically viable. The Harjavalta nickel refinery applied for a licence to refine the Talvivaara nickel products. Currently, uranium residuals are extracted from the nickel at Harjavalta. Industrial scale mineral processing may start in 2012 after nuclear licensing of the Talvivaara mine.

STUK maintains a central national nuclear materials accountancy system and verifies that nuclear activities in Finland are carried out according to the Finnish Nuclear Energy Act and Decree, the European Union's legislation and international agreements. These tasks are performed to guarantee 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 number of the routine inspection days of these international inspectorates has been reduced significantly owing to the state-level integrated safeguards approach for Finland, which is in force since 2008. The number of their inspection days is approximately 20 days in a year. In 2011, neither the IAEA nor the Commission made any remarks nor did they present any required actions based on their inspections. By their nuclear materials accountancy and control systems, all licence holders enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards. STUK continues with 40 annual inspections and more than 60 inspection days.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is one of the elements of the global nuclear non-proliferation effort. STUK has two roles in relation to the CTBT: STUK operates the Finnish National Data Centre (FiNDC) and one of the radionuclide laboratories designated in the CTBT. The main task of the FiNDC is to inspect data received from the International Monitoring System and to inform the national authority, the Ministry for Foreign Affairs, about any indications of a nuclear weapons test. The FiNDC falls under the non-proliferation process in STUK's organisation, together with the regulatory control of nuclear materials.

A major goal of all current 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 make a clandestine nuclear test without getting detected. 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.

The human resources development at the Nuclear Materials Section during 2011 was focused on nuclear materials control, in particular in the front end of the fuel cycle. This was partly due to the need to regulate the new stakeholders at Harjavalta and Talvivaara. In addition, two fellowship visitors from the Czech Republic could contribute to human resources development also at STUK. During the year, uranium exploration, mining and milling premises were visited in the Czech Republic, Canada and Zambia. STUK and the Finnish Customs continued the joint multi-year border monitoring development project. The project covers updating technical equipment and operational procedures, and customs officers training.

The nuclear accident at the Fukushima nuclear power plant in Japan on 11 March 2011 affected the nuclear community worldwide. At STUK, immediate emergency preparedness actions took place in order to analyse the situation in Japan and to promptly serve the Finnish citizens, the general public and the media. Because several of STUK staff members are assigned also to the emergency preparedness system and media service of STUK, the event had a major effect on STUK's human resources including the safeguards staff and the analysis system for the Nuclear-Test-Ban Treaty. The radionuclide network provided reliable measurement data of the dispersion of radionuclides throughout the northern hemisphere. The data was analysed as it arrived, and the results were provided to the STUK Emergency Preparedness.

Contents

1 Nuclear non-proliferation implementation in Finland

Nuclear non-proliferation is a prerequisite for the peaceful use of nuclear materials and nuclear energy, globally. 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 for nuclear safeguards is the national system for the regulatory control of nuclear materials and activities. Nuclear safeguards are an integral part of nuclear safety and nuclear security, and they are applied both to large and to medium-size nuclear industry and to small-scale nuclear material activities. Along with safeguards, the regulatory process for nuclear non-proliferation includes transport control, export control, border control, international cooperation and conventions, and monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

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 (the 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 peaceful use of nuclear energy. Upon joining the EU, Finland's bilateral agreements with Australia, Canada and the USA were partly substituted by the corresponding Euratom agreements (see Appendix 3 for the relevant legislation).

Finland was the first state where an INFCIRC[1]/153-type nuclear 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 in April 30, 2004, when all the EU Member States had ratified it. The scope and mandate for Euratom nuclear safeguards are defined in the European Commission Regulation No. 302/2005.

After Finland joined EU as a Member State, and therefore joined the Euratom nuclear safeguards, a comprehensive national safeguards system was maintained, even improved. The basic motivation for this is the responsibility assumed by Finland for its nuclear safeguards and nuclear security under the obligations of the NPT.

The national nuclear safeguards derive their mandate and scope from the Finnish Nuclear Energy Act and Decree. These were amended during 2008 as a result of the general constitution-based renewal of the Finnish nuclear legislation system. The operator's obligation to have a nuclear material accountancy system and the right of STUK to oversee the planning of and generation of design information for new facilities was introduced from STUK regulations to the Decree.

[1] INFCIRC = IAEA Information Circulars

As stipulated by the Act, STUK issues detailed regulations on safety and security (the YVL Guides) that apply to the use of nuclear energy. The YVL Guides most relevant to nuclear safeguards are:

- Control of nuclear fuel and other nuclear materials required in the operation of nuclear power plants (Guide YVL 6.1)
- The national system of accounting for and control of nuclear materials (Guide YVL 6.9)
- Reports to be submitted on nuclear materials (Guide YVL 6.10).

All STUK YVL Guides are under renovation. The guides relevant to safeguards will be merged into one joint new guide. The draft version has already been communicated to the stakeholders. The new guides will be issued by the end of 2012. Nuclear materials control applies to:

- nuclear material (special fissionable material and source material)
- nuclear dual-use items (non-nuclear materials, components, equipment and data suitable for producing nuclear energy or nuclear weapons as specified in INFCIRC/254, Part 1)
- licence holders' activities, expertise, preparedness and competence
- R&D activities related to the nuclear fuel cycle
- nuclear security, and
- safeguards for the final disposal of spent nuclear fuel.

1.2 The parties of the Finnish nuclear safeguards system

The main parties involved in the Finnish nuclear safeguards system are the authorities and the licence holders. Undistributed responsibility for the safety, security and safeguards of the use of nuclear energy is on the licence holder. It is the responsibility of STUK as the competent state authority to ensure that the license holders comply with the requirements of the law and the nuclear safeguards agreements. To complement the national effort, international control is necessary 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 licensing of nuclear materials and other nuclear dual-use items including sensitive nuclear technology. The MFA promotes nuclear safety and safeguards in the neighbouring region, and also finances the inter-institutional cooperation between government authorities.

The Ministry of Employment and the Economy (MEE) is the highest authority for the management and control of nuclear energy. MEE is responsible for legislation related to nuclear energy and it is also the competent authority mentioned in the Euratom Treaty. Also other ministries, such as the Ministry of the Interior and the Ministry of Defence contribute to the efficient functioning of the national nuclear safeguards system. In governance, STUK belongs to the administration of the Ministry of Social Affairs and Health.

1.2.2 STUK

According to the Finnish nuclear legislation, STUK is responsible for maintaining the national nuclear safeguards system in order to prevent proliferation of nuclear weapons. STUK regulates the license holders' 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 material and nuclear dual-use items. STUK is in charge of Finland's approval and consultation process for IAEA and European Commission inspectors. STUK approves an inspector as long as there are no such issues related to the person in question that might adversely affect nuclear safety or security at Finnish facilities or the non-proliferation of nuclear weapons. The new inspector requests are sent for comments to the operators that hold construction or operating licenses for nuclear facilities. If STUK cannot approve an inspector, it assigns the approval process to the Ministry of Employment and the Economy.

Nuclear safeguards by the Nuclear Materials Section of STUK (see Figure 1 for the organisational chart and Figure 11 for the staff) cover all typical measures of a State System of Accounting for and Control of Nuclear Materials (SSAC), and many other activities besides. STUK reviews the license holders' reports (operational notifications, inventory reports), inspects their accountancy, facilities and transport arrangements on site, and performs system audits. Office work constitutes 90% of the inspection effort. STUK runs a verification programme for nuclear activities to assess the completeness and correctness of the declarations by the licence holders. Nuclear safeguards on the national level are closely linked with 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) – all duties of the STUK Nuclear Materials Section. Nuclear safety and particularly nuclear security objectives are closely complemented by safeguards objectives. Therefore, the research, development and regulatory units in the fields of safety, security and safeguards at STUK cooperate under the non-proliferation framework.

1.2.3 License holders

Essential parts of the national nuclear safeguards system are the licence holders, in nuclear terminology often called the operators. They perform key functions of the national safeguards system: control of the authentic source data of their nuclear materials and accountancy of nuclear material at the facility level for each of their material balance areas (MBA). Each license holder has to operate its safeguards system according to its own nuclear materials handbook. The handbook is a part of the facility's quality system and is reviewed and approved by STUK.

With the basic technical characteristics (BTC) submitted by a license holder as groundwork,

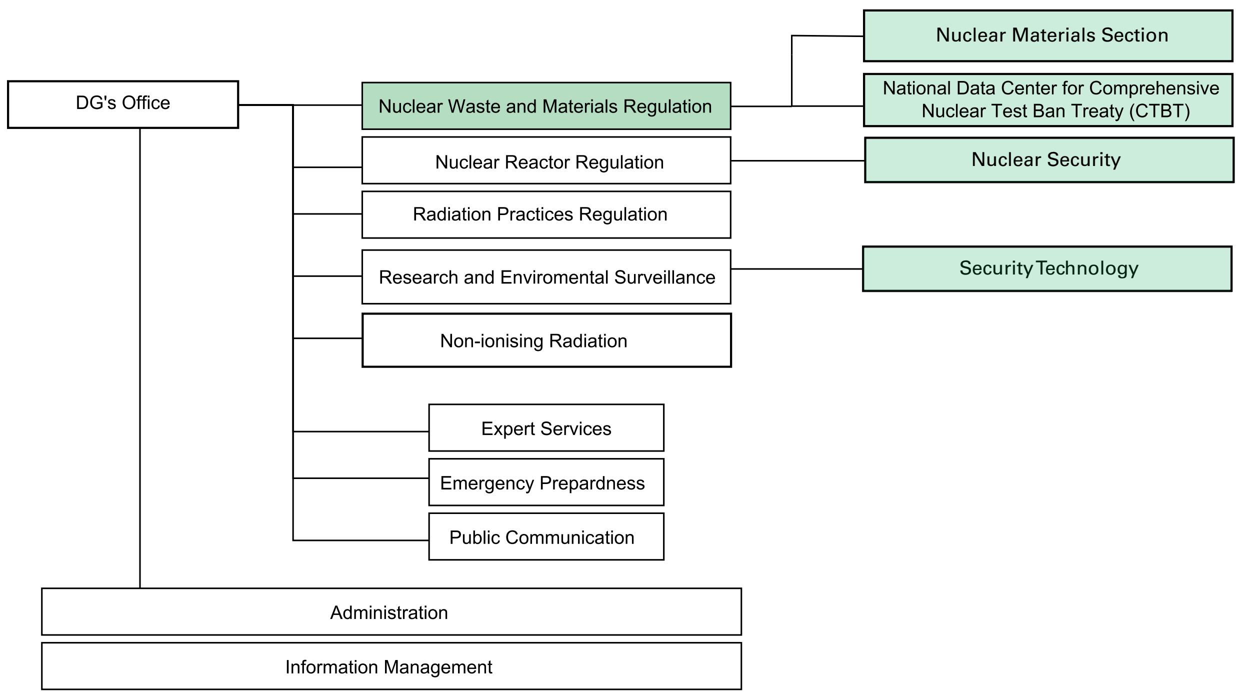

Figure 1. Several departments and independent units of STUK cooperate under the non-proliferation framework.

the European Commission shall adopt particular safeguards provisions (PSP) for that license holder. PSP are to be drawn taking into account operational and technical constraints and in close consultation with both the person or undertaking concerned and the relevant member state. Until PSP are adopted, the person or undertaking shall apply the general provisions of the Commission Regulation (Euratom) No 302/2005.

99.8% of all nuclear materials in Finland reside at the nuclear power plants (NPP). The nuclear material (uranium, plutonium) amounts in Finland in 1993–2011 are presented in Figures 2 and 3.

Fortum (MBA WL0V)

Fortum is a partly state-owned energy company, one of the largest in the Nordic countries. Fortum operates power plants of several types, nuclear among others.

The nuclear power plant of Fortum Power and Heat is located on the Hästholmen Island in Loviisa on the south-east coast of Finland. This first NPP to have been built in Finland hosts two power reactor units: Loviisa 1 and Loviisa 2. Loviisa 1 started its electricity production in 1977 and Loviisa 2 in 1980. These two units share common fresh and spent fuel storages and for nuclear safeguards accountancy purposes the whole NPP is counted as one material balance area (MBA code WL0V). The electricity generated by the Loviisa NPP constitutes circa 10% of the whole electricity production in Finland.

Most of the fuel for the Loviisa NPP has been 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 the spent fuel has been stored in the interim storage due to a change in the Finnish nuclear legislation, which today forbids, in general, import and export of nuclear waste including spent fuel.

The Loviisa NPP site (SSFLOV1), as per the requirements of the Additional Protocol, comprises the entire Hästholmen Island and extends to the

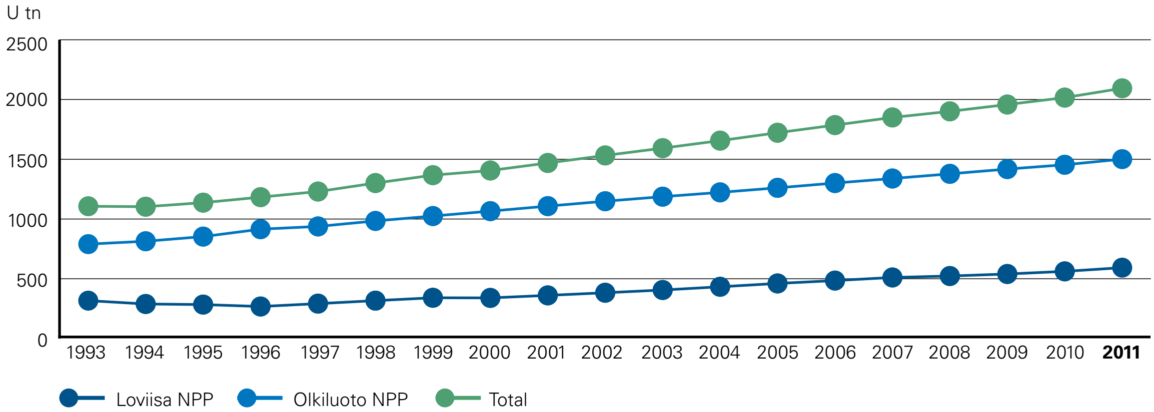

Figure 2. Uranium amount in Finland in 1993–2011.

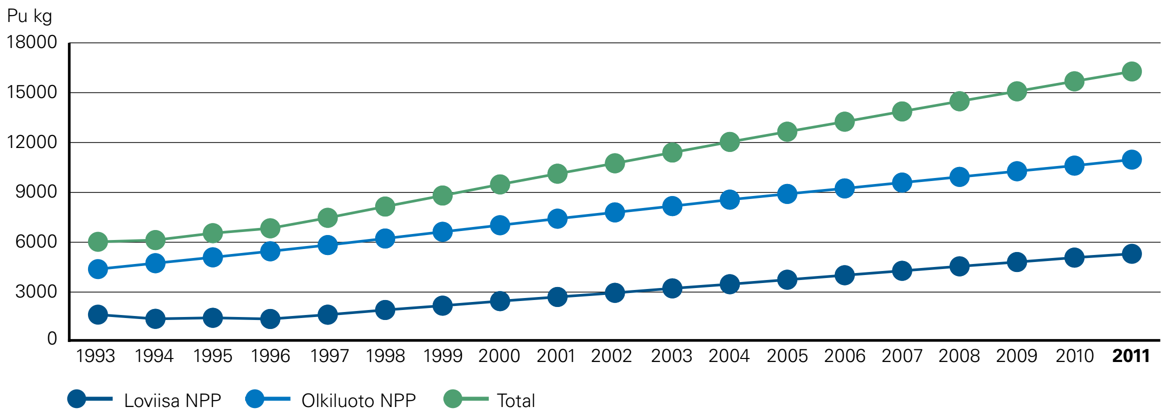

Figure 3. Plutonium amount in Finland in 1993–2011.

main gate on the continent. 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 for the Loviisa NPP.

Teollisuuden Voima (MBAs W0L1, W0L2, W0LS and W0L3)

Teollisuuden Voima Oyj (TVO) owns and operates a nuclear power plant on the Olkiluoto Island in Eurajoki on the west coast of Finland. The Olkiluoto NPP consists of two nuclear power reactor units, Olkiluoto 1 and Olkiluoto 2, and an interim spent fuel storage. Olkiluoto 1 was connected to the electricity grid in 1978 and Olkiluoto 2 in 1980. The Olkiluoto NPP contributes circa 17% of the whole electricity production in Finland. At the Olkiluoto NPP there are three active material balance areas (MBA codes W0L1, W0L2, W0LS).

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 Spain and Sweden.

The Finnish Government granted a licence for constructing a new nuclear reactor, Olkiluoto 3, on 17 February 2005. As a part of the licensing process, TVO's plan for arranging the necessary measures for preventing proliferation of nuclear weapons was approved by STUK. The construction and assembly work of the reactor unit is under way. The European Commission has assigned the MBA code W0L3 for Olkiluoto 3. The initial criticality of the reactor is scheduled for 2014.

New nuclear facilities were granted by the Government on 6 May 2010. One of these was the Olkiluoto 4 reactor. The geotechnical site characterisation works at the Olkiluoto 4 site began immediately in 2010. The selection of the vendor and the supply organisation will take place in the near future.

TVO owns most of the area of the Olkiluoto Island, but the NPP site (SSFOLK1), as per the requirements of the Additional Protocol, comprises currently the fenced areas around the reactor units, the spent fuel storage and the storage for low and intermediate level waste as well as 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 for the Olkiluoto NPP.

VTT FiR1 research reactor (MBA WRRF)

Small amounts of nuclear materials are located at facilities other than nuclear power plants. The most significant of those facilities is the VTT research reactor FiR1 (MBA code WRRF) in Otaniemi, Espoo. The research reactor was the first nuclear reactor built in Finland. It reached criticality on 27 March 1962.

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

The VTT FiR1 site (SSFVTT1), as per the requirements of the Additional Protocol, 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)

Small quantities of nuclear materials are stored by the Finnish Radiation and Nuclear Safety Authority (STUK), mainly material 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 whole building where STUK's headquarters are located in Helsinki, but non-STUK premises in the building are excluded. The storage at Olkiluoto is included in the NPP's site declaration.

The University of Helsinki, Laboratory of Radiochemistry (MBA WHEL)

The Laboratory of Radiochemistry at the University of Helsinki (HYRL) uses small amounts of nuclear materials. HYRL is located at the Kumpula university campus in Helsinki.

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

OMG Kokkola Chemicals (MBA WKK0)

The OMG Kokkola Chemicals facility does not use nuclear materials as such. However, the by-products of their cobalt purification process contain uranium, which qualifies these by-products as nuclear material. OMG Kokkola Chemicals has an operation license for production, storing and handling nuclear material. OMG Kokkola Chemicals is located on the west coast of Finland.

Norilsk Nickel Harjavalta (MBA WNNH)

Norilsk Nickel operates the nickel refining plant at Harjavalta in western Finland. The plant was commissioned in 1959, expanded in 1995 and again in 2002. Norilsk Nickel Finland became part of the Russian-based Norilsk Nickel as a result of the OM Group's nickel business acquisition in 2007. Norilsk Nickel Harjavalta refinery employs a technique of sulphuric acid leaching of nickel products. The uranium residuals will be extracted from the nickel products originating from the Talvivaara mine. In March 2010 STUK granted a license to extract less than 10 tons of uranium per year. The Norilsk Nickel company submitted the basic technical characteristics (BTC) to the European Commission in December 2010.

Other nuclear material holders

There are about 10 minor nuclear material holders in Finland. One of them is an actual material balance area: University of Jyväskylä, Department of Physics (JYFL, MBA code WDPJ), but in fact the nuclear material in 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 purposes of international nuclear safeguards. Most of these use depleted uranium as radiation shielding material.

New operators

The Talvivaara Sotkamo Ltd. mining company announced on 9 February 2010 its interest in investigating the recovery of uranium as a separate product from its sulphide ore body. The Talvivaara deposits in eastern Finland comprise one of the largest known sulphide nickel resources in Europe. The bioheapleaching technique developed for the deposits makes the extraction of metals from low grade ore economically viable. Therefore, in addition to nickel, zinc, copper and cobalt, also uranium may be economically extracted and processed at the site. The company has submitted license applications according to the mining and nuclear energy legislation in order to recover uranium. The basic technical characteristics (BTC) were submitted to the European Commission in 2010, and the MBA code WTAL has been assigned for the future uranium extraction plant. The environmental impact assessment was carried out in 2010; and the production of uranium products is expected to start during 2012 if all the relevant licence applications are granted.

Fennovoima announced on 5 October 2011 its decision to locate the new nuclear power plant on the Hanhikivi peninsula at Pyhäjoki, on the sea coast of the Bay of Bothnia. This was a recent major milestone in Finnish nuclear history. The Fennovoima company is making preparations with vendor candidates. The construction license is expected to be submitted in five years. The Hanhikivi site will be declared as the construction proceeds from a virgin green site to the nuclear power plant.

Posiva (MBA W0LF)

Posiva Oy is the company responsible for the final disposal of spent nuclear fuel in Finland. It is owned by TVO and Fortum. Posiva has been excavating an underground rock characterisation facility called "Onkalo" in Eurajoki since 2004, and thus preparing for the construction of the final disposal facility. While neither a nuclear license holder nor a nuclear material holder yet, Posiva and its activities are highly relevant to the national safeguards system because Posiva is foreseen to develop a new type of facility, the geological repository, where the nuclear material cannot be re-verified once it has been encapsulated and emplaced.

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. Therefore, Posiva has been required to develop a non-proliferation handbook, such as a nuclear materials handbook, to describe Posiva's safeguards procedures and reporting system already before becoming a nuclear material holder. The preliminary basic technical characteristics (BTC) have been provided and the European

Commission has already assigned the MBA code W0LF for Onkalo. The facility without nuclear materials but having the BTC constitutes a site according to the Additional Protocol. The Posiva site (SSFPOS1) covers the fenced area around the support buildings for the repository construction.

Other stakeholders

Non-nuclear technology holders and suppliers serving nuclear and other industry are obliged to take care that non-proliferation sensitive technology does not get into the hands of unauthorized non-state actors and thereby contribute to the proliferation of mass destruction means. The introduction of the Additional Protocol (1996) extended the scope of safeguards to the non-proliferation control of nuclear programmes and fuel cycle related activities in Member States around the world. Additionally, the United Nations Security Council Resolution 1540 (April 2004) requires every State to ensure that export controls, border controls, material accountancy and physical protection are efficiently taken care of and calls all States to develop appropriate ways to work with and inform industry and the public regarding their obligations. The control of non-nuclear technology holders and suppliers 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. According to the enlarged non-proliferation regime and the amendments to the Finnish legislation, the companies that have activities defined in the Additional Protocol or have customers for dual-use equipment abroad are under strengthened reporting requirements and export control.

1.3 IAEA and Euratom safeguards in Finland

The IAEA and the European Commission nuclear safeguards both have their separate mandates to operate in Finland. These two international inspectorates have agreed on cooperation, which aims to reduce undue duplication of effort. The year 2009 introduced a significant change from the traditional safeguards procedures in Finland as the implementation of integrated safeguards began on 15 October 2008.

IAEA regular inspections:

Facilities at nuclear power plants (NPP):
- *Physical Inventory Verification (PIV) / Design Information Verification (DIV) 1/year*
- *Random Interim Inspection (RII) at 24 h notification (at least 1/year)*

Spent fuel storages at NPPs
- *PIV/DIV 1/year*
- *RII at 2h i.e. Unannounced Inspection (UI)/24 h notification (at least 1/year)*

Research reactor and locations outside facilities (LOF)
- *PIV/DIV 1/4–6 years*

New reactor (OL3), under construction
- *DIV and PIV later like at the NPPs*

Repository (Onkalo), under construction
- *PIV/DIV most likely as at spent fuel storages*

Complementary accesses at 2/24 h notification to verify declared activities or to detect undeclared activities.

Integrated safeguards include traditional nuclear safeguards as per INFCIRC/193, and safeguards activities in accordance with the Additional Protocol, fitted 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 decreases. In contrast to this, the IAEA will additionally perform 1–3 unannounced or short notice inspections per year in a state that has a number and type of nuclear installations that resembles the situation in Finland.

The operators report to the European Commission as required per Commission Safeguards regulation No 302/2005. It is the Commission's task to audit the license holders' accounting and reporting systems. Both the Commission and STUK have increased preparedness for short notice and unannounced inspections and complementary access (abbreviated SNUICA). Every weekday, one of STUK's inspectors is prepared to attend a possible IAEA inspection.

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. The time difference between the unannounced inspections at the two spent fuel storages (i.e. 2 hours for Loviisa and 48 hours for Olkiluoto) was due to the difference in the surveillance at the storages and in the reasonable access time for a STUK inspector. The current notification time (see infobox) was reduced to 24 hours for Olkiluoto - the same as is applied by the IAEA in all EU member States; whereas, after the installation of new surveillance equipment at Loviisa, that notification time was kept at 2 hours. STUK continues with annual routines with approximately 40 inspections, which enables the reduction in the effort of the international inspectorates.

1.4 Verified declarations for state evaluations

A state's declarations on its nuclear materials and activities are the basis for the 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 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 timely to the Commission and to the IAEA.

In Finland, there are currently six sites in the sense of the Additional Protocol: the two nuclear power plant (NPP) sites in Loviisa and Olkiluoto respectively, the geological repository site in Olkiluoto, and three minor sites: the Technical Research Centre of Finland (VTT), the Radiation and Nuclear Safety Authority (STUK) and the Laboratory of Radiochemistry at the University of Helsinki (HYRL). STUK reviews and verifies the correctness and completeness of the information about the sites provided by the stakeholders.

STUK reviews annually the information about research and development activities that might be eligible for declaration, as well as activities specified in Annex I of the Additional Protocol. STUK maintains the information on general plans related to the nuclear fuel cycle for the next 10 years and keeps account of the exports of specified equipment and non-nuclear materials, as listed in Annex II of the Additional Protocol.

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 e.g. the enrichment of uranium, the burnup, and the cooling time of nuclear fuel. The technical analysis methods in use are non-destructive assay (NDA), environmental sampling and satellite imagery.

STUK employs three NDA methods for verifying spent nuclear fuel. One method lends itself for rapid scanning, as the detector is mounted on the fuel transfer machine and the fuel elements can be measured from above the fuel pond without moving the elements. The other two methods, on the other hand, allow confirming with greater confidence the correctness of the declared burnup and the cooling time. With the most precise method, the absence of a fuel pin or pins from a fuel element can be discovered. STUK reports to the Commission and the IAEA about the NDA measurement campaigns.

All nuclear materials leave traces of their identity, source of origin and treatment. Safeguards environmental samples (ES) are used to investigate these traces, which provide further clarity in establishing whether the nuclear activities are in accordance with the declarations. In the Finnish nuclear safeguards system environmental samples are collected as surface swipes. The IAEA may collect independent environmental samples during its complementary access type of inspections.

Satellite imagery is applied to verify the site declaration pursuant to the Additional Protocol. Timely imagery is used to monitor different kinds of activities at the sites or elsewhere in Finland. STUK contributes to the work of the satellite image analysts of the IAEA and the Commission.

1.5 Export/import control and licensing as elements of nuclear non-proliferation

According to the Finnish Nuclear Energy Act, in addition to nuclear materials also other nuclear fuel cycle related activities are under regulatory control. A license is required for possession, transfer and import of components, equipment, materials and technology suitable for producing nuclear energy (nuclear dual-use items).

The list of these other items is based on Nuclear Suppliers' Group (NSG) Guidelines (INFCIRC/254 Part 1). The license holder is required to provide STUK annually with a list of the above mentioned items. Moreover, the export, import, and transfer of such items shall be reported to STUK.

Mining and mineral processing operations that aim to produce uranium or thorium are also under nuclear safeguards and regulatory nuclear safety control. In order to carry out these activities a national license and an accounting system to keep track of the amounts of uranium and thorium are required. A national license is also required to export and import uranium or thorium ore, and these activities must be authorised by the Euratom Supply Agency and the European Commission. These mining and milling activities and production shall be reported to STUK, to the Commission and to the IAEA.

Finland's export control system is based on the EU Council Regulation (EC) No 428/2009 of 5 May 2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items. 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. The licensing authority is the Ministry for Foreign Affairs. An authorisation is required to export nuclear items outside the European Union. A license is also required for EU internal transfers of NSG Part 1 items, excluding non-sensitive nuclear materials.

1.6 The regulatory control of transport covers nuclear materials

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, TS-R-1, and their purpose is to protect people, property and the environment from the harmful effects of radiation during transports of radioactive material. Based on these regulations, STUK is the competent national authority for the regulatory control regarding 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 for a few years. A transport plan and a transport security plan approved by STUK are mandatory for each transport of nuclear material or nuclear waste. A certificate of nuclear liability insurance shall also be delivered to STUK before the transport. Furthermore, a package may be used for the transport of fissile nuclear material only after the package design has been approved by STUK.

1.7 STUK's contribution to international safeguards development

Nuclear non-proliferation is, by its nature, an international domain. STUK therefore actively participates in international nuclear safeguards related cooperation and development efforts.

STUK is a member of the European Safeguards Research and Development Association (ESARDA), and has nominated Finnish experts to its committees and most of its working groups. STUK participates in the ESARDA Executive Board meetings and in several working groups.

Upon request by the IAEA, STUK's experts have contributed to the IAEA's international evaluation missions, such as the International SSAC Advisory Service (ISSAS). The ISSAS mission reviews State Systems of Accounting for and Control of Nuclear Materials (SSAC) and provides suggestions for improving them.

STUK's Expert Services and Nuclear Materials Section promote safeguards implementation and good practices worldwide. These sections plan and arrange training and education on request.

STUK keeps close contacts with the respective Nordic authority organisations. The development of geological repositories for the disposal of spent nuclear fuel deepens the cooperation between Finland and Sweden.

1.8 The Comprehensive Nuclear-Test-Ban Treaty

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an important part of the international regime for the non-proliferation of nuclear weapons. The CTBT bans any nuclear weapon test explosions in any environment. This ban is aimed at constraining the development and qualitative improvement of nuclear weapons, including also 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. The CTBT 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. On December 6, 2011 the Indonesian parliament approved ratification of the CTBT, bringing the treaty one important step closer to entry into force.

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.

Finland signed the CTBT on its day of opening in 1996 and ratified it less than three years later. In addition to complying with the basic requirement of the CTBT of not to carry 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: STUK operates the Finnish National Data Centre (FiNDC) and one of the sixteen radionuclide laboratories in the IMS (RL07). The most important task of the FiNDC is to inspect data received from the IMS and inform the national authority about any indications of a nuclear weapons test. The radionuclide laboratory contributes to the IMS by providing support in the radionuclide analyses and in the quality control of the radionuclide station network. The third major national collaborator is the Institute of Seismology at the University of Helsinki, which runs an IMS seismology station (PS17 in Lahti), and provides analysis of waveform IMS data (Figure 4).

Comprehensive Nuclear-Test-Ban Treaty (CTBT) Status (31.12.2011)

- *CTBT Member States* 182
- *Total Ratifications* 155*
- *Annex 2 Ratifications* 35*

** The Indonesian parliament approved ratification on 6 Dec 2011.*

1.9 Nuclear safeguards and nuclear security

STUK is the national authority for the regulatory control of nuclear and radiological safety, security and safeguards. All these three regimes are means to a common end: protection of people, society, environment and future generations from the harmful effects of ionising radiation. From the definition of nuclear security, it is clear that the majority of the activities that aim at non-proliferation of nuclear weapons, nuclear materials and sensitive nuclear technology contribute to nuclear security. Moreover, such classical elements of security as physical protection of nuclear materials and facilities contribute to non-proliferation. Within STUK's organisation, some of its nuclear security related

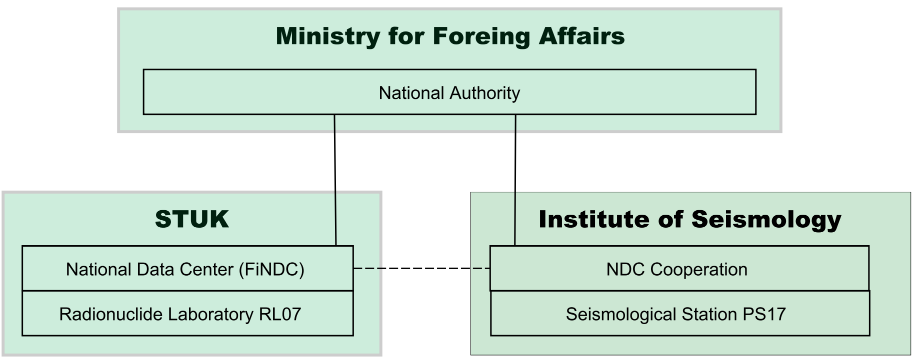

Figure 4. The Finnish CTBT organisation.

tasks fall – solely or partly – under the duties of the nuclear non-proliferation process and the Nuclear Materials Section:

- the national system for the control of nuclear materials and nuclear dual-use items, which facilitates international nuclear safeguards activities in Finland
- the regulatory control of the transport of nuclear materials and nuclear waste
- import and export control
- advising the Finnish Customs on radiation monitoring and interpretation of radiation detections at the borders, concept development and technical specifications; providing more sophisticated on-site measurements and analyses in response to border monitoring alarms and training Customs officers
- participation in the work of the international nuclear safeguards and nuclear security communities and working groups (IAEA, ESARDA, AQG, ITWG…), and
- participation in STUK's response in cases of radiological or nuclear incidents.

The Finnish regulatory system for nuclear security was audited by an IPPAS mission in 2009. One of the recommendations arising from the audit, namely the need for more detailed security requirements for minor holders of nuclear materials, was in the Nuclear Materials Section's area of responsibility. As a result, the new regulation on safety and security, i.e. the YVL Guide for nuclear materials control, under review since 2010 and expected to come into force in 2012, will contain more detailed security requirements for these minor holders.

2 Themes of the year 2011

2.1 Safeguards for new facilities

The Government approved three Decisions-in-Principle in 2010: for TVO's Olkiluoto 4 unit, for Posiva's spent fuel management project related to Olkiluoto 4, as well as for Fennovoima's new nuclear power plant. The applicants for new nuclear power plants are required to submit their nuclear construction license applications within five years. The facility construction may start after the license is granted. Owing to the authorisation of these three new nuclear facilities, STUK initiated negotiations with the operators and the European Commission and the IAEA to prepare for the implementation of safeguards timely and in coordination with facility development. The first 3-day course on the implementation of safeguards by design was arranged at Sannäs Manor 15-17 June 2011 in close cooperation with STUK, the Commission and the IAEA, under the IAEA Safeguards-by-Design initiative. As a follow-up action, separate one-day meetings were held with the new facility managers and developers in September and October to facilitate early interaction between facility designers and the safeguards authorities. Finally, on 5 October 2011 Fennovoima announced its decision to build the new nuclear power plant on the Hanhikivi peninsula in Pyhäjoki.

The topics discussed with new and also operating facilities were the needs to facilitate nuclear material verification, remote monitoring and data transmission. In order to initiate remote data transmissions from the containment and surveillance equipment operating at the Finnish facilities, STUK arranged a first meeting on 24 May 2011 between the Finnish operators and the authorities. In connection to the routine inspections in October, safeguards inspectors and technician of the IAEA and the Commission visited the Loviisa nuclear power plant and the Olkiluoto construction sites and familiarised themselves with the current practises and possibilities to find technical solutions to begin with remote data transmission. This new automated method is expected to reduce the number of international inspection days in Finland in the near future. The major advantage is improved data transfer security compared with the current practices, i.e. an inspector personally carrying the confidential data.

One major obstacle in applying safeguards to new facilities has been the lack of clear regulations for safeguards measures and implementation. The planning and implementation of safeguards measures for a new facility begins, in the traditional approach to safeguards, after the design and construction phase, when the formal Design Information is available to the IAEA. However, the experiences obtained from current construction projects clearly show the need to bring in the safeguards requirements at an early stage of facility design, much before the complete formal Design Information is available. Thus an early interaction between the stakeholders in nuclear non-proliferation and security issues should be initiated in a similar manner as in the nuclear safety assessment. The 2011 revision of the IAEA Safety Standards Series NS-R-1 "Safety of Nuclear Power Plants: Design" (GOV/2011/43, 10 August 2011) includes also provision for safeguards and security to be applied in an early phase of facility design. The revised standard facilitates the early planning of safeguards instrumentation for containment and surveillance, non-destructive assay, remote data transmission etc. needed for the implementation of cost-efficient, information-driven IAEA safeguards at new facilities.

The first STUK and Commission inspections of the uranium production at the Harjavalta nickel refinery and at the Talvivaara mine took place in 2011. These companies are studying methods to extract uranium from their nickel production processes. Industrial scale mineral processing may start in 2012 after commercial agreements and nuclear licensing. The first inspections to these new stakeholders are described in detail in the implementation section 3.1.8 of this report.

2.2 The Fukushima event – the international concern of 2011

The Tohoku pacific earthquake of magnitude 9.0, followed by a tsunami and the consequent nuclear accident at the Fukushima Dai-ichi nuclear power plant in Japan on 11 March 2011 shocked the nuclear community worldwide. The tsunami generated by the massive earthquake seriously damaged the site. The loss of electricity, i.e. both on-site and off-site power and back-up generators, and later also battery back-ups, resulted in the loss of the reactors' cooling systems and further in a nuclear disaster that was followed by the media as online as possible.

At STUK, emergency preparedness actions took place 24 hours a day for two weeks in order to analyse the situation in Japan and to serve the Finnish citizens, public and media promptly. During the first days of the incident media was present at STUK premises following the analysis and near time prognosis for expected and reported radioactive releases due to the accident. STUK issued daily and later weekly media releases. The accident at the Fukushima nuclear power plant highlighted the need for effective communication of information about emergency incidents to states and relevant organisations (e.g. the IAEA).

In principle, a natural disaster that takes place on the other side of the globe should not affect the daily work of a safeguards inspector much. However, several of STUK staff members are assigned also to the Emergency Preparedness and the Public Communications of STUK. Therefore, the event had a major effect to STUK human resources, including the safeguards staff and the analysis system for the Comprehensive Nuclear-Test-Ban Treaty (CTBT). In particular, the process to simultaneously renew all the new STUK regulations, the YVL Guides, is delayed since tens of staff members of the nuclear reactor safety regulation department have been involved in the analysis of the Fukushima event. The Finnish authorities and nuclear facilities have carried out the stress test required by the Ministry of Employment and the Economy and the European Commission. As requested, on 30 December 2011 STUK sent a national final report on nuclear power plant stress tests to the Commission. According to the report, a tsunami similar to the one that hit Fukushima is not possible in Finland, but nevertheless the Finnish nuclear power plants are investigating the need to improve provisions for extreme natural phenomena and for the simultaneous loss of the operational capacity of several safety systems. The national reports will be reviewed in 2012.

The international monitoring system of the CTBT organisation includes global networks of seismic and radionuclide measuring stations. The seismic network provides real-time data to tsunami warning systems, and was able to assist in warning the Japanese public of the tsunami. The radionuclide network provided reliable measurement data of the dispersion of radionuclides throughout the northern hemisphere. The Finnish national data centre for the CTBT (FiNDC) analysed the International Monitoring System data as it arrived, and provided the STUK Emergency Preparedness with information, which was unique in its reliability and global coverage. FiNDC also initiated an informal international cooperation between NDCs and affiliated organisations and distributed analyses results to several countries, for some weeks after the accident, while getting valuable information in return.

2.3 Competences at the operators are under control

Essential parts of the national nuclear safeguards system are competent stakeholders. Each license holder has to operate its safeguards system according to its own nuclear materials handbook. The handbook is a part of the facility's quality system and is reviewed and approved by STUK. According to the Nuclear Energy Act as amended in 2008, the management system of a nuclear facility shall pay particular attention to the impact of safety related opinions and the attitudes of the management and personnel towards the maintenance and development of safety. The licensee shall appoint persons responsible for ensuring emergency response arrangements, security and the control of nuclear materials. The new STUK requirement, i.e. the YVL Guide under preparation for nuclear material accountancy and control, will require the licensee to nominate a deputy for the person responsible for the control of nuclear materials.

Moreover, the licensee has to appoint a responsible manager and his or her deputy for the construction or operation of a nuclear facility; for mining and milling operations aimed at producing uranium or thorium; and for the possession, manufacture, production, handling, use, storage and transport of nuclear materials and nuclear waste. It is the responsible manager's task to ensure that the provisions, licence conditions and regulations issued by STUK, concerning the safe use of nuclear energy, the arrangements for security and emergencies, and the control of nuclear materials, are complied with. The licensee shall ensure that the responsible manager occupies the position required by the task and possesses adequate authority and the actual prerequisites required for bearing the responsibility vested in him or her. Only persons approved by STUK specifically for each position can be appointed.

In order to control that the safeguards procedures are taken care of by the management system of each of the licensees, STUK examines, through interviews, that the responsible managers and persons responsible for safeguards arrangements, including nuclear material accountancy and control, have an adequate position in their organisations and that they are aware of their tasks so they can fulfil the requirements set by the legislation. In 2011, STUK interviewed and approved nine persons to be appointed for these positions, which is the highest number of approvals per year thus far. In addition, STUK examined the updates of two nuclear materials handbooks. The first educational course for Finnish operators, mainly for nuclear power plant staff, was arranged in June 2011 at Sannäs Manor, as mentioned above. After the entry into force of the new STUK requirement to nominate deputy persons for safeguards control and for also every minor nuclear material holder to have a nuclear materials handbook, the number of interviews and approvals will grow in the future.

3 Safeguards activities in 2011

3.1 The regulatory control of nuclear materials

STUK continued with national safeguards measures as in the past. In 2011 the focus was on minor nuclear material holders and new stakeholders, which increased the number of STUK inspection days. Nuclear material inventories at the end of 2011 are shown in Tables 2 and 3 in Appendix 1. The development of inspections and inspection person days per Material Balance Area (MBA) is presented in Figures 5 and 6. The inspections by STUK, the IAEA and the European Commission in 2011 are presented in Appendix 2.

The application of integrated safeguards began in Finland on 15 October 2008. Thus, in the year 2009 the number of IAEA inspections was reduced from approximately 25 person days to 15. Similarly, the Commission reduced its inspection activities significantly. In 2010 the number of inspection days rose somewhat owing to the first inspections at the geological repository site, additional inspection days at the Loviisa Nuclear

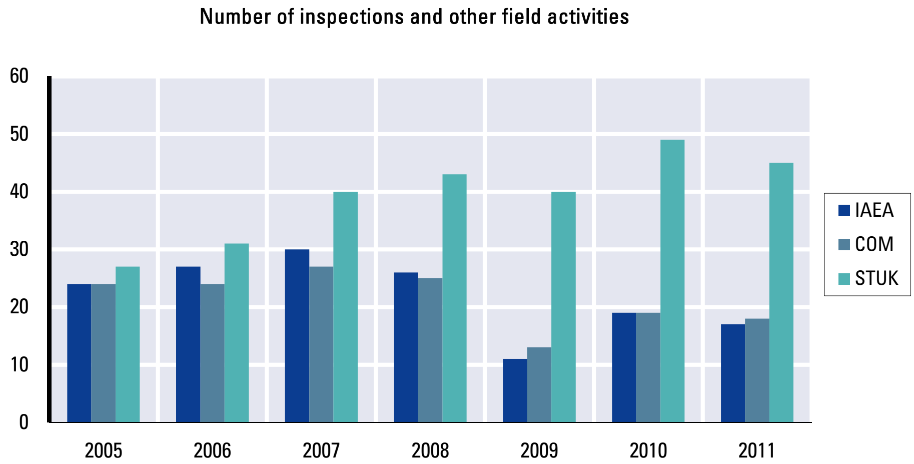

Figure 5. The number of inspections from 2005 to 2011.

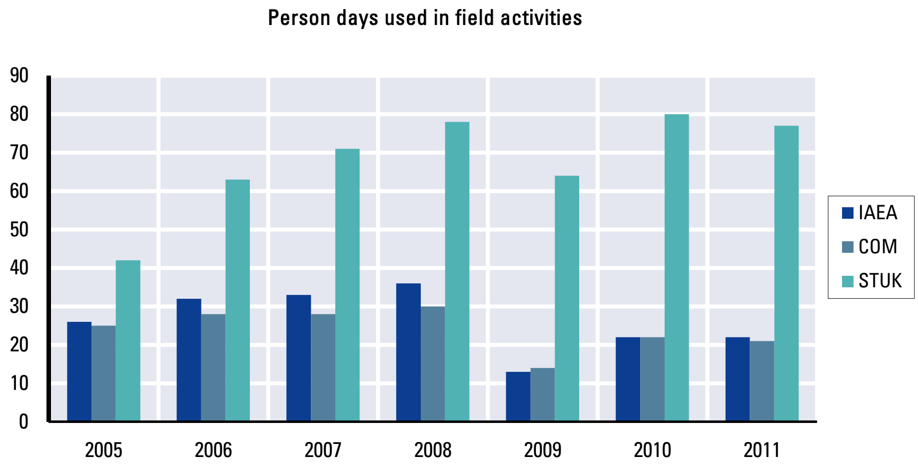

Figure 6. Inspection person days from 2005 to 2011.

Power Plant (NPP) and the increased number of random inspections in Finland. In 2011 STUK, the Commission and the IAEA had more frequent meetings that usual in order to agree on procedures for safeguards for new facilities, including the final disposal facility for spent nuclear fuel, and also for beginning with remote data transmission in Finland. The site surveys for beginning with remote data transmission were combined with the regular inspections in October. As a consequence, the number of regular inspections in 2011 remained at the same level as in 2010, i.e. the current number of the annual IAEA inspection days in Finland is around 20 person days.

3.1.1 Declarations and approvals of new international inspectors

All the relevant license holders sent their updated information for the national declaration, which is compiled by STUK, in time by 1 March 2011. STUK submitted Finland's annual declaration updates to the Commission on 28 March and to the IAEA on 13 May as required. Additionally, STUK submitted the quarterly declarations on exports in February, May, August and November.

In 2011, altogether 67 IAEA and 10 European Commission new inspectors were approved to perform inspections at nuclear facilities in Finland.

3.1.2 The Loviisa nuclear power plant site

In 2011, STUK approved one new person to be appointed deputy responsible manager and one to be deputy for the person responsible for nuclear safeguards at the Loviisa NPP. In addition, one person responsible for the nuclear safeguards of dual-use items and sensitive technology in the operator's organisation was approved. In 2011 STUK granted the operating company Fortum three import licenses for nuclear dual-use items, i.e. equipment used in nuclear reactors.

STUK inspected and verified the annual site declaration on 2 March 2011. The IAEA carried out a complementary access - with the presence of the Commission and STUK – to the site on 22 March 2011 in order to verify the absence of undeclared activities and the status of the latest, i.e., the 2010 declaration. The new solidification plant and the underground premises, which are both under construction, were the main targets of the complementary access. In addition, the IAEA carried out an unannounced inspection to the spent fuel storage on 23 November. As results, a few recommendations to improve the site declaration and the design information were suggested.

The refuelling and maintenance outage of the Loviisa 1 reactor unit took place 21 August – 7 September 2011, and that of the Loviisa 2 reactor unit 10 September – 30 September 2011. Owing to the new integrated safeguards approach for Finland, the IAEA and the Commission performed a before Physical Inventory Taking (pre-PIT) inspection with STUK before the outage, on 18–19 August 2011. Temporary surveillance cameras were installed in the reactor halls for the outage period, and removed during the Physical Inventory Verification (PIV) carried out after the outage, 3–4 October 2011. Remote Data Transmission in the future was discussed with the operator in connection to this inspection. During the outage and before the closing of each reactor, STUK identified the fuel assemblies in the reactor cores and item counted the loading ponds. The Loviisa 1 core was inspected on 29 August 2011 and the Loviisa 2 core on 19 September 2011. During the outage, the cask transfer was inspected on 30 August 2011 by the IAEA and the Commission. In addition to the PIV and the core controls, STUK carried out two routine inspections and two measurement campaigns.

At the Loviisa NPP STUK performed one non-destructive assay (NDA) verification measurement campaign on spent fuel elements in 2011. Since there was only a single campaign this year, as opposed to two in the previous years, the campaign

Figure 7. The Finnish State System of Accounting for and Control of Nuclear Materials (SSAC) staff and STUK emergency officer on duty reviewing the procedures to urgently contact the on-alert short notice and unannounced inspections and complementary access (SNUICA) inspector and the facility safeguards staff after receiving the fax indicating an unannounced inspection at Loviisa.

was extended to three days from two days in previous years. Taking into account the time that goes to setting up the measurement devices, this extension effectively doubled the measurement time of the campaign. The campaign, 31 October – 2 November, was carried out with FORK equipment (named for its physical resemblance of a fork), which delivers a gross gamma signal from an ionisation chamber and a neutron count rate from a fission chamber. STUK's FORK equipment is sometimes referred to as enhanced FORK (eFORK), because it incorporates a CdZnTe-gamma spectrometer, too. 40 assemblies were successfully verified during this campaign, compared to 21 assemblies and 2 dummies in the previous year's two-day campaign. The measurements and the environmental samples collected at the Loviisa NPP did not indicate any inconsistencies in the reporting by the operator.

Based on its own assessment as well as on IAEA and Commission inspection results, STUK concluded that Fortum's Loviisa NPP has complied with its nuclear safeguards obligations in 2011.

3.1.3 The Olkiluoto nuclear power plant site

In 2011, STUK approved one new person to be appointed deputy for the person responsible for nuclear safeguards and nuclear material accountancy for the international transfers of uranium at the operating company TVO. During 2011 STUK also granted to TVO eight import licences and three possession licenses. These covered the import of fresh nuclear fuel and nuclear dual-use items, i.e. technology and instrumentation for the operating units and equipment to the new unit under construction. The possession licenses were needed for temporary storage of components in the harbour of Olkiluoto.

During 2010 and 2011, old superheaters weighing in total about 700 tonnes were transported by M/S Sigyn to Sweden, to be treated in Studsvik. With Studsvik's treatment concept it is usually possible to free release and recycle 80–90 per cent of the metals in the end-of-life components, which reduces both storage costs and the environmental impact. Residual products from the treatment are sent back to Finland for final storage. During 2011 residual products were transported from Sweden to Finland in several shipments. Most of the material was transported back to Finland but a few shipments are scheduled to 2012.

The refuelling and maintenance outage of the Olkiluoto 1 reactor unit took place 1–11 May 2011 and that of the Olkiluoto 2 reactor unit 10 May – 8 June 2011. Similarly to the Loviisa NPP, the IAEA and the Commission performed a pre-PIT inspection with STUK 26–27 April 2011, before the outage, and the PIV after the outage, 28–29 June 2011. The outage at the Olkiluoto 2 unit was the longest maintenance break in the facility's history. It took 29 days to replace and upgrade turbines, coolant systems etc. The power output was increased with almost 20 MW similarly to Olkiluoto 1 in the previous year.

During the refuelling and maintenance outage STUK identified the fuel assemblies in the reactor cores and verified and item counted the loading ponds before the reactors were closed. The Olkiluoto 1 reactor was inspected on 6 May 2011 and the Olkiluoto 2 reactor on 3 June 2011.

IAEA's short notice random interim inspection addressed to the Olkiluoto NPP was carried out on 16 November at the reactor unit 1. STUK carried out two additional routine inspections of the Olkiluoto site and the material balance areas (MBA) at the Olkiluoto NPP.

At the Olkiluoto NPP STUK performed two non-destructive assay (NDA) verification measurement campaigns on spent fuel elements in 2011: 31 August to 2 September on Olkiluoto 1 spent fuel pool and 10 to 12 October on Olkiluoto 2 spent fuel pool. During both of the campaigns STUK performed Gamma Burnup Verification (GBUV) measurements. Altogether 69 spent fuel assemblies were verified. The results were archived in the mobile version of the NDA measurement database.

The measurement campaigns were targeted on the reactor building spent fuel pools since the construction of the spent fuel storage enlargement severely limited measurement access to spent fuel in the storage. Therefore, there were no spent fuel transfers to the spent fuel storage at Olkiluoto in 2011. This situation is expected to continue for few more years.

The construction of the new Olkiluoto 3 reactor (OL-3) has proceeded to such a stage that nuclear dual-use items are being installed at the site. The main components are under assembly and STUK's regulatory control. TVO prepared a draft for the basic technical characteristics (BTC) of the new unit in 2008. This first BTC was reviewed by

STUK, the IAEA, and the Commission twice in 2008. Thus, the inspectorates have the possibility to plan the surveillance and containment measures in advance. During 2009, actions were waiting for the advancement of the construction of the fuel handling buildings. The IAEA and the Commission visited the OL-3 construction site on 3 March 2010 and on 27 April 2011 to adjust containment and surveillance instrumentation on site. The principal locations of cameras and control units were agreed to for the reactor building in 2010 and for the fuel handling building in 2011. The commissioning of the OL-3 unit is postponed until 2014.

The Decision-in-Principle (DiP) to construct the new Olkiluoto 4 reactor (OL-4) was made in July 2010. The geotechnical works have started at the site, but the decisions for the reactor type and the vendor organisation are still pending. The nuclear construction license application with technical details is expected to be submitted within five years after the Decision-in-Principle.

The spent fuel storage building at the Olkiluoto NPP will be enlarged to have capacity for the spent fuel of the future. New ponds will be constructed for fuel assemblies from the operating reactors and from that under construction. During the enlargement and also during future operation, the existing surveillance is expected to cover accurately the whole enlargement area of the storage. The IAEA and the Commission inspectors reviewed the plans and visited the spent fuel storage during the site survey for remote data transmission for all Olkiluoto MBAs on 6–7 October 2011. Based on its own assessment as well as on IAEA and Commission inspection results, STUK concluded that TVO's Olkiluoto NPP has complied with its nuclear safeguards obligations in 2011.

3.1.4 The VTT FiR1 research reactor site

In 2011 STUK carried out two interim inspections at the VTT research rector site. The site declaration and activities and internal control systems were reviewed on 8 March. Safeguards inspectors from STUK and the European Commission verified the nuclear material inventory of VTT on 31 August 2011. There were some inconsistencies in reporting but the nuclear material inventory was concluded to be correct during the inspection. The inventory and consequently the inspection was postponed and carried out in connection with the regular inspections scheduled in August.

VTT submitted the operating licence application to the Government on 30 November 2010. The handling of the application included a statutory hearing procedure. During the handling process there was special focus on ensuring that the continued use of the research reactor meets specific safety requirements. In its statement on 30 October 2011, STUK commented also on the need for competences for the whole licensed period. On 8 December 2011, the Government granted the operating licence for VTT research reactor FiR1, until the end of 2023. In connection to this procedure, STUK examined a person to be nominated as the deputy for the responsible manager at the research reactor. The update of VTT's nuclear materials handbook was approved in April 2011.

Based on its own assessment as well as on IAEA and Commission inspection results, STUK concluded that the VTT FiR1 operator has complied with its nuclear safeguards obligations in 2011.

3.1.5 The STUK site

Organisational questions at the STUK operator were remarked on by STUK Nuclear Materials Section. Owing to outsourcing of staff and activities at the national waste receiving station of STUK, the responsibilities and boundaries at the operator were not clearly indicated. In 2011, STUK Nuclear Materials Section approved one new person to be appointed as the responsible manager for nuclear safeguards at STUK and also a deputy for this manager. Thus, the operating unit at STUK fulfils the requirements for national safeguards arrangements.

Based on its assessment and inspection results, STUK concluded that the STUK operator has complied with its nuclear safeguards obligations in 2011.

3.1.6 The University of Helsinki site

Safeguards inspectors from STUK and the European Commission verified the nuclear material inventory of the University of Helsinki on 3 June 2010. As the Commission inspections scheduled for June 2011 at VTT, STUK and Helsinki University were not carried out as planned, the Commission inspection at STUK and University of Helsinki were postponed. STUK carried out its inspection of the University of Helsinki site on 25 March 2011.

Based on its own assessment and inspection results, STUK concluded that the University of Helsinki has complied with its nuclear safeguards obligations in 2011.

3.1.7 Minor nuclear material holders

In 2011 several STUK inspections were focused on the minor nuclear material holders in order to assure that the capabilities and procedures are adequate. The new requirement, to be issued in a YVL Guide, to require a nuclear materials handbook also of the minor holders was already addressed above. As a routine, STUK inspected the reports from the minor nuclear material holders, but the number of inspections – five in total – to these minor holders' premises was notable in 2011. During 2010 and 2011 STUK has inspected all except one minor holders. The international inspectorates did not make any types of inspections to the minor holders.

Based on its own assessment and inspection results, STUK concluded that the minor nuclear material holders have complied with their nuclear safeguards obligations in 2011.

3.1.8 New operators in the front end of the fuel cycle

STUK granted an operation license to Norilsk Nickel Harjavalta for producing, storing and handling uranium as a by-product of the nickel purification process, for an annual amount of less than 10 metric tons in 2010. In February 2011 STUK carried out the first inspection to this operator. In addition to safeguards, security and radiation protection issues were addressed during the inspection.

During early 2011 STUK evaluated the licence application of Talvivaara Sotkamo Ltd. to begin uranium production as a by-product at the Talvivaara nickel mine, and made a statement to the Ministry of Employment and the Economy about radiation and nuclear safety, security and safeguards issues. STUK and the European Commission carried out the first Design Information Verification inspection to Talvivaara on 16 November 2011. The aim was to get to know the staff at the site and to agree on reporting procedures. Talvivaara Sotkamo Ltd. got the approval from the Euratom Supply Agency to sell uranium concentrate to Cameco Corporation in November 2011. It is expected that the European Commission will authorise and the Finnish Government will grant Talvivaara Sotkamo Ltd the license for the uranium extraction plant in early 2012. Before commissioning the plant, STUK shall inspect all relevant arrangements, including the nuclear materials handbook and the responsible persons for nuclear material accountancy and control.

3.1.9 The final disposal facility site for spent nuclear fuel

During the year 2011 STUK carried out three interim inspections at the underground premises of the final disposal facility. The IAEA and the Commission joined one of these by means of Design Information Verification. The IAEA inspected the underground premises, the shaft and the ventilation technology building where there will be access routes to the underground premises. STUK Nuclear Materials Section examined one person to be appointed as the responsible manager for the construction of the underground premises, called Onkalo, and approved one person to be nominated as responsible for safeguards at the facility.

Posiva updated its non-proliferation handbook in February, June and October 2011 to clarify and update the descriptions of Posiva's safeguards practices. However, the updates did not consider the early provision of Design Information as indicated by the IAEA and the Commission. In addition, STUK remarked on a few principal descriptions in the handbook. Therefore, the updated handbooks were not accepted by STUK, and further actions were requested of Posiva.

The update in October contained a principal change in safeguards practices. Owing to experience of and difficulties in excavating the deep galleries, the possible time window for inspecting the virgin rock surfaces was reduced to a minimum before shotcrete was applied to reinforce the deep underground premises. The operator has now on-alert geologist and surveyors to map and document the rock surfaces after every blasting. No advance notifications are made before the surfaces are covered. Safeguards inspectors have to be acquainted with these changes made due to operational safety reasons.

Several meetings were arranged between STUK, the Commission and the IAEA during the year 2011 in order to clarify and facilitate safeguards measures for the final disposal of spent nuclear fuel. These meetings were focused on the verification issues prior to spent fuel encapsulation. It was commonly agreed that the spent fuel verification should take place at the encapsulation plant. This was discussed with Posiva's design managers at the Safeguards-by-Design meeting on 6 October 2011. It is expected that Posiva will submit the nuclear construction license application for the disposal facility in 2012. Therefore, it is important that designers are aware of the safeguards measures to be applied at the facility at an early stage of facility development.

3.1.10 Nuclear dual-use items, export licenses

In 2011 the Ministry for Foreign Affairs issued five licences for exporting nuclear process modelling software to Croatia, Slovakia, Sweden (two licenses) and the Czech Republic and one licence for exporting design information for a nuclear power plan to several European Union countries. In addition, the Ministry issued licences to export small amounts of nuclear material to Austria and Canada and calibration equipment to Germany.

In 2011 there were new types of applications to handle dual-use item equipment and other sensitive technology. TVO was granted licences to possess fuel handling machines and other items outside of the facility, i.e. temporarily in the Olkiluoto harbour. A Finnish engineering company was granted two licences to import, possess and transfer nuclear technology to its fifteen subcontractors. A licence to possess this information was also granted to all these subcontractors.

3.1.11 Transports of nuclear materials and nuclear waste

In 2011, fresh nuclear fuel was imported to Finland from Spain, Sweden and the Russian Federation (Table 1). In relation to these imports, three transport plans, one transport security plan and its one update as well as one package design were approved by STUK. Furthermore, STUK granted approvals for an update to a transport plan for nuclear waste, one transport with special arrangements and one report regarding transport arrangements. In addition, STUK issued a certificate for non-objection for nuclear shipping and granted extra time for submission of material regarding a package design approval. STUK inspected three transports of fresh nuclear fuel during the year. The inspections were performed in cooperation with the police. Nuclear material and nuclear waste transports as well as STUK's regulatory requirements were also discussed with the police in several meetings during 2011.

3.1.12 International transfers of nuclear material

In 2011, TVO reported to STUK about its international fuel contracts, fuel transfers and fuel shipments. STUK carried out an on-site inspection where TVO's nuclear material accountancy on the fresh fuel imported in 2011 was verified against the original shipment documents covering the international transfers. The accountancy of the natural uranium in TVO's possession but stored outside of the Olkiluoto NPP site was also inspected. Based on the findings, STUK concluded that TVO has complied with its safeguards obligations in purchasing the nuclear fuel and managing its international transfers.

3.2 The Finnish National Data Centre for the Comprehensive Nuclear-Test-Ban Treaty

3.2.1 International cooperation is the foundation of CTBT verification

During 2011 the Finnish National Data Centre (FiNDC) participated in meetings of the Working Group B (WGB) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The WGB is a policy making organ for the technical development of the verification regime. By participating in the work of the WGB and its subsidiaries (workshops and expert groups), the FiNDC can provide technical expertise to the CTBTO, while also attending to the Finnish national interests.

3.2.2 The analysis pipeline is a well established daily routine

The FiNDC continued developing its own routine monitoring system for the data received from the network of the International Monitoring System (IMS). The FiNDC routinely analyses all radionuclide measurement data generated at the IMS radionuclide stations across the world. The IMS network is still developing, and the number of operational air filter stations was about 60 at the end of 2011 (at the final stage there will be 80). The operational stations generated more than 700 gamma spectra per day for the FiNDC analysis pipeline to handle. The analysis pipeline is linked to the LINSSI database and equipped with an automated alarm system, to enable efficient and fully automated screening of the data.

The number of IMS stations equipped with radioxenon measurement capabilities was about 30 at the end of 2011. Six IMS radioxenon systems where certified by the CTBTO by the end of 2011. During the year FiNDC started a joint project with Health Canada, to further develop the tools for analysing and viewing radioxenon data. Radioxenon measurements are especially important for CTBT verification, because xenon, as a noble gas, often leaks also from underground tests, which seldom release particulate matter.

3.2.3 Fukushima radionuclides in the IMS network

The IMS of the CTBTO includes global networks of seismic and radionuclide measuring stations. The seismic network provides real-time data to tsunami warning systems, and was able to assist in warning the Japanese public of the tsunami on 11 March 2001. The radionuclide network provided reliable measurement data of the dispersion of radionuclides throughout the northern hemisphere. The measurement process at air filter stations takes 72 hours, from the start of collecting the sample on an air filter to the final result, while radioxenon stations provide final data in approximately 30-48 hours, so the results are not normally available in real time. However, as experienced at one station after the accident, if radionuclide levels are high enough in the station air, the measurement system will detect these nuclides directly (in situ), and provide reliable information of which radionuclides are present, though only coarse estimates of the activity level. Detecting such a situation is extremely important, as a misinterpretation would be strongly misleading, indicating that the plume had arrived two days earlier than it did.

The Finnish national data centre for the CTBT (FiNDC) analysed the IMS data as it arrived, and provided the STUK Emergency Preparedness with nuclide specific activity concentration information, which was unique in its reliability and global coverage. Through the above mentioned in situ process FiNDC could provide the first completely reliable information on the mix of gamma active radionuclides released from Fukushima, already in the morning of 15 March. Subsequently FiNDC continued to manually analyse IMS data from up to 40 stations daily and provided highly accurate and reliable information on the dispersion of radionuclides throughout the northern hemisphere. Within two weeks the cloud was seen on all IMS radionuclide stations in the northern hemisphere, and the released activity stayed detectable for approximately three months after the accident by a large number of stations. This was due to that the IMS network is extremely sensitive: it has a typical detection limit of about 1 µBq/m^3.

FiNDC also initiated an informal international cooperation between NDCs and affiliated organisations and distributed analyses results to several countries, for some weeks after the accident, while getting valuable information in return. Especially fruitful was the cooperation with Health Canada (HC), which uses a similar LINSSI database for storing IMS analysis results. Because of this FiNDC and HC could exchange analysis results directly on a database level, which effectively lessened the need of analysis work at both institutions.

3.3 International co-operation

In the international nuclear safeguards development fora, the major topics during the year 2011 were related to the IAEA Long-Term Strategic Plan. The IAEA makes use of the full range of available information of safeguards relevance in order to build a complete picture of each state's nuclear activities and capabilities. The IAEA plans to diversify the types of information that it uses and to take account of a broader range of state-specific factors which have hitherto been underutilised. The IAEA is developing a framework that links general state-level safeguards objectives to specific safeguards activities in a state in a way that reflects the establishment of risk-based priorities. The state-specific factors can be of technical nature, such as fuel cycle considerations, the use of remote monitoring and unannounced inspections, and the performance of the State System of Accounting for and Control of Nuclear Materials (SSAC) in general, while others can be of non-technical nature, such as the history of safeguards implementation in the state, the degree of transparency with its nuclear programme and the level of cooperation between the state and the IAEA. These topics were addressed at the ESARDA symposium in Budapest and at the INMM annual meeting in Palm Desert and at the ESARDA-INMM symposium in Aix-en-Provence.

The implementation of safeguards in Finland was addressed at several meetings with the IAEA and the Commission. In addition, STUK continued its participation in the ESARDA working groups and in the steering committee meetings. STUK had a strong influence in the ESARDA Executive Board and via ESARDA also at the INMM and IAEA conferences as shown by several references in section 6.

Finland's bilateral cooperation programmes in the area of non-proliferation are directed mainly towards our neighbouring countries outside the EU and are motivated by the continued need for enhancements in the regional security environment. Accordingly, STUK continued its cooperation programme with the Russian Federation under the Ministry for Foreign Affairs' regional cooperation programme. Collaboration with Ukraine in mutually beneficial areas was re-established in 2008 and an agreement about a programme was made between the State Nuclear Regulatory Committee of Ukraine, since 2011 the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) and STUK.

In 2011 STUK contributed to the inter-institutional development cooperation programme of the Ministry for Foreign Affairs by supporting the Geological Survey of Finland in their tasks related to uranium mining and milling in Namibia and Zambia. In both states there are plans for new uranium mining, but authorities need assistance when developing mining regulations. In the non-proliferation regime the main tasks in these two states are related to the ratification and implementation of the Additional Protocol. The co-operation with Namibia is comfortable owing to the personal contacts established during the IAEA fellowship visit of Ms. Helena Itamba at STUK in 2006. Similarly, in 2011 STUK hosted two IAEA fellowship students from the Czech Republic, and as a part of the co-operation under the EU framework a group of Egyptian safeguards authorities.

3.3.1 ESARDA Working Groups at STUK

The head of STUK's Security Technology Laboratory continued his term as chairperson of the ESARDA Novel Approaches/Novel Technologies Working Group. The Meeting on Stand-off Detection Technologies was organised jointly between the Novel Approaches and Novel Technologies (NA/NT) Working Group and the ESARDA Non-destructive Analysis (NDA) Working Group. The meeting was hosted by STUK in Helsinki, Finland 28–29 September 2011.

The joint working group meeting had three overall goals: firstly, to consider scientific and technological innovations that have potential applications for meeting current and future safeguards challenges; secondly, to establish contacts between participant end-users in international verification and non-proliferation organizations and leading R&D experts in new and novel technology areas; and thirdly, to introduce to the participants the long-term research and development plan of the IAEA Department of Safeguards. Over the two days of the meeting, 17 presentations were given. Presenter abstracts and their respective PowerPoint presentations can be found at the ESARDA CIRCA website.

3.3.2 The final disposal programme at several fora

In 2011, the group of experts for Application of Safeguards to Geological Repositories (ASTOR) met at Bure in France in October. Novel technologies to be applied for safeguards purposes at this new type of facility were presented and discussed during the meeting. STUK contributed to the satellite imagery task. The final report of the sub-group was prepared for the ASTOR meeting. Seismic monitoring and experiences at the Olkiluoto repository were discussed both at the ASTOR group and several ESARDA working groups during 2011. In addition to the repository safeguards, verification of spent nuclear fuel prior to disposal was addressed at the ASTOR meeting.

The six-party group (the IAEA, the Commission, and Finnish and Swedish authorities and operators) founded in 2010 to develop safeguards measures for the final disposal processes in Finland and Sweden did not meet during 2011. However, the Finnish and Swedish authorities had a premeeting in November 2011 to define common tasks and needs. In particular, the technical needs for the verification of spent fuel to be disposed of were addressed. It is realised that the programmes in Sweden and in Finland are reaching the licensing phase, and the safeguards measures are to be those agreed upon by all parties, facility designers, operators and the inspectorates.

3.3.3 Cooperation with the Rostechnadzor, Russia

Cooperation between Finnish and Russian authorities, technical support organisations and industrial partners included seminars. A seminar was held on the rules for physical protection in transportation of radioactive sources and radioactive materials that are now in force in Russia. Also Rosenergoatom instructions on the “Implementation of confirming measurements of inventories and inventory changes in the system of the account and control of radioactive substances and waste” were reviewed. Another joint seminar was held in November to exchange information and experiences on the accounting for and physical protection of radioactive waste and disposal of low, intermediate and high-level radioactive waste from nuclear facilities, particularly NPPs. A technical visit was conducted to Olkiluoto NPP and to the disposal facility of low and intermediate level radioactive waste.

The demonstration of the spent fuel attribute tester (SFAT) measurement device for the Rostechnadzor was successfully carried out in 2008 at the Kola nuclear power plant. Since that a new computer was obtained for the system and software was installed accordingly, and steps were taken to organize the shipment to the Ozersk Office of the Rostechnadzor in 2011. This bilateral work complements the work done within the EU-financed TACIS project aiming at improving the control of the handling of nuclear material at the Mayak reprocessing plant. The first part of this project was completed in 2010; the second part was completed in November 2011. In addition, a new pilot project was implemented to prove the security of confidential data and information communicated electronically within the inspection regime of the Rostechnadzor.

The Finnish and Russian Customs Authorities decided to continue with the joint custom officers training activities. The two week joint training course and associated exercises were conducted in May 2011. The programme was focused more on practical work than during the first bilateral courses in 2007 and 2008. The Customs Authorities and STUK met in December 2011 to review the progress and experiences and to plan for the future activities. Among the specific issues are metal scrap contaminated with radioactivity, and the new project on CBRN protection of the fast train connection between St. Petersburg and Helsinki.

3.3.4 The programme with Ukraine: capacity building extends to new areas

Since 2009 the focus of the programme with Ukraine was on manufacturing and delivering a mobile laboratory vehicle for the use of the State Nuclear Regulatory Committee of Ukraine (SNRCU). The mobile measuring laboratory, called Sophisticated ON-site Nuclide Identification (SONNI) enables identifying and analysing radioactive sources and nuclear materials in the environment, at industrial facilities and in cases of threatening situations. The laboratory includes measuring, sampling, positioning and communication systems. Data can be transmitted in real time to the control centre, where the data may be entered into a map system, thus providing real-time information for the management of the operations. At locations where the vehicle cannot have access, a portable application with the same functionality can be used.

The top-modern radiation measuring vehicle with the portable application unit was donated to the IAEA and further to the SNRCU in Kiev in December 2010. Two one-week long educational sessions were organised in the autumn to train the new crews, and a field exercise was conducted in December 2011. The capacity building in this area is financed by the Ministry for Foreign Affairs at it will continue also during 2012.

In addition, a new EU project was approved by the European Commission to enhance the border control functions by provision of new technical means for CBRN protection of selected border stations or other nodal points. The Terms of Reference document has been discussed and STUK was identified by the European Commission as the implementing organisation. The project will be implemented in 2012.

STUK continued its participation in the tasks of the cooperation programme between the Swedish Radiation Safety Authority (SSM) and the Ukraine authorities including the renamed SNRIU. Experts from STUK participated in the review and development of the national system of nuclear material accountancy and control and in the non-proliferation regime including the nuclear fuel cycle related activities in Ukraine. The 2011 joint meeting was arranged by SSM in Stockholm in November 2011.

3.3.5 Regulations for uranium mining and milling in southern Africa

STUK and the Geological Survey of Finland are cooperating under the financing instrument inter-institutional development and cooperation, which was launched in 2008 by the Finnish Ministry for Foreign Affairs (MFA), to promote small-scale projects between government authorities and agencies. The Finnish public sector participates in development cooperation by cooperating with the partner countries' public sector. The objective of the projects is to support capacity-building in the partner agencies.

The Namupol project (Support for Drafting of Uranium Mining and Milling Policy, Legislation and Regulations and Development of Minerals Database) has its origins in a visit to Namibia by the Finnish Minister for Foreign Trade and Development in October 2008. In consultations with the minerals sector, half a dozen topics were identified and the need for a uranium production policy was considered to be the most pressing issue. Due to the rapid upsurge in exploration for uranium in Namibia, the government had been forced to impose a moratorium on the issuance of new licenses. The Ministry of Mines and Energy of Namibia and the Geological Survey of Finland submitted a project proposal to the MFA in April 2009. This was revised in 2009 and radiation protection issues and nuclear regulations were incorporated in the proposal. An assignment was received from the MFA in September 2010 and the first policy workshop was held in Namibia in November 2010 with participants from the Namibian stakeholders and Finnish partners, Geological Survey, STUK, and the MFA. At this workshop, it was announced that Namibia needs to have regulation, not only for uranium mining and milling, but also for the whole nuclear fuel cycle. This raised the importance of non-proliferation regulations since uranium production does not implicitly require safeguards measures like fuel cycle facilities and related technology do. The draft nuclear fuel cycle policy was written in 2011, and two stakeholder workshops were held in September and in December 2011.

In Zambia, there are no current industrial uranium mining activities, though uranium has been mined in the past. Currently uranium is stockpiled and overseen at one of the Zambian copper mines as by-product, and in addition one mining license application for uranium mining in sandstone has been submitted to the local authorities. The national legislation has recently been updated for the mining of uranium. However, the MFA identified the need to improve legislation and financed the Geological Survey of Finland and STUK to carry out a mission to Zambia in 2011 to assess the mining, environmental and radiation protection legislation and relevant competences at the responsible authorities, i.e. the Zambian Ministry of Mines and Minerals Development, Environmental Management Agency and Radiation Protection Authority. In addition, the preparedness to implement the Additional Protocol and integrated safeguards was addressed.

3.3.6 International capacity building at STUK

In spring 2011 two IAEA fellowship visitors from the Czech State Office for Nuclear Safety (SUJB) spent a two-month training period at STUK Nuclear Materials office. The training period was an advanced and specialised course aiming for profound knowledge of and experience on the Finnish safeguards field. Most of the training consisted of lectures and discussions given by the STUK experts. The number of sessions and different topics was around forty. The fellows participated actively in the daily safeguards work, attending regular meetings at STUK and inspections at facilities. In that way the fellows familiarised themselves with many aspects of the Finnish safeguards system. The interaction was fruitful and valuable for the Finish safeguards staff as well. As a part of the training the fellows gave lectures about the safeguards practices in their country. Particular attention was paid to uranium mining and existing remote data transfer from the nuclear power plants (Figures 8 and 9).

A group consisting of staff members from the National Centre for Nuclear Safety and Radiation

Figure 8. Czech fellowship visitor Adam Pavlik exchanges experiences in safeguards implementation.

Figure 9. Ondrej Stastny gives lectures and exchanges experiences in safeguards implementation.

Control (NCNSRC) of the Egyptian Atomic Energy Authority (EAEA) visited STUK for one week's training under the provision of the EU's Instrument for Nuclear Safety Cooperation (INSC) project, with the aim of strengthening and enhancing EAEA's capability in Nuclear Safeguards (Figure 10). During the week basic knowledge about the Finnish national safeguards system and its functions was presented. Within the INSC project the group subsequently participated in further complementary training and workshops at the French Institute for Radiological Protection and Nuclear Safety (IRSN) and at the Hungarian Atomic Energy Authority (HAEA) in September 2011. The same basic information as shared with the Czech fellows in two months was given during one week of intensive lecture sessions. The training material produced for this training at STUK can serve also in the future, when introducing new safeguards inspectors worldwide.

Figure 10. Egyptian visitors at STUK. Among STUK's staff, STUK summer trainee Suvi Lehtinen (first on the left) and French student Aurelien Lepetitdidier (5th in the back row from the left) joined the training.

4 Human resources development

Nuclear safeguards by the Nuclear Materials Section of STUK cover all typical measures of a State System of Accounting for and Control of Nuclear Materials (SSAC), and many other activities besides. The nuclear fuel cycle related activities, e.g. research and development activities not involving nuclear material and manufacture of certain equipment as defined it the Additional Protocol, have enlarged the scope of traditional safeguards. Nuclear safeguards on the national level are closely linked with 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). Continuous analysis of the developments in the involved fields of both technology and politics is a daily, multidisciplinary task at the STUK Nuclear Materials Section.

The personnel's competence is systematically developed taking into account the needs of the organisation and the wishes of the individuals (see Figure 11). Those aiming at an expert's career are valued as highly as those interested in managerial duties. At the Nuclear Materials Section during 2011, the management participated in the general course for managers at government organisations provided by the Finnish Institute of Public Management. The internal training programme of the section continued, and our experts also participated in a few international courses. There was one seminar lecture arranged at STUK: it concerned STUK's regulatory requirements for Talvivaara mine. The Nuclear Materials Section hosted two IAEA fellowship students from the Czech Republic in the spring of 2011, and as a benefit of this scholarship visit, two STUK inspectors participated in the training course tailored for IAEA safeguards inspectors in June 2011 at the Dolni Rozinka mine, the only operating uranium mine in Europe, which is located in the Czech Republic. STUK also arranged a visit to uranium production facilities in Canada and to Health Canada for staff at MEE and STUK, including the STUK Nuclear Materials Section Deputy Director, who is responsible for the licensing of the Talvivaara mine. Two of the Nuclear Materials Section staff members participated in a 5-week national course for nuclear safety and one staff member took part in a course regarding marine transports.

The RADAR project, which aims to upgrade the radiation monitoring systems at the Finnish border crossing stations, is running from 2009 to 2014. The main goals of the project are to modernise radiation monitoring equipment at the Finnish border crossing stations and to educate the personnel of the stations. The project is done in cooperation with the Finnish Customs, who are the end users of the equipment. Suvi Lehtinen was employed at STUK as a trainee during the summer to assist the instrumentation at the border control stations. The main outcome of 2011 was the procurement of the Helsinki-Vantaa airport system. An airport is a challenging monitoring environment, since all traffic is typically very hectic. The new radiation monitoring system utilizes novel system architecture, which facilitates quick response in case of an alarm. It will be taken into operational use during the first half of 2012.

In addition to being the responsible section for the above cases, the personnel of the Nuclear Materials Section assist other sections in response to any incidents that may include nuclear materials or require their expertise for some other reason. Some of the Nuclear Materials Section staff are also part of the pool of Experts-on-Duty, who receive the notifications for incidents and are responsible for initiating STUK's response. In 2011, a few staff members of the Nuclear Materials Section took part in the bi-annual emergency exercise at the Olkiluoto nuclear power plant. The Fukushima accident caused intensive work in March and April, and additional tasks during the rest of the year, too.

The staff of STUK Nuclear Materials Section in the same order as in the photo, from left to right. All section staff participate in the core safeguards tasks. Additionally, each person has some special areas of expertise to focus on.

Ms. Ritva Kylmälä	Assistant	
Ms. Anna Lahkola	Senior Inspector	Transport of nuclear materials, central accountancy
Mr. Tapani Honkamaa	Senior Inspector	Non-destructive assay, FINSP to the IAEA safeguards
Ms. Elina Martikka	Section Head	Management
Mr. Timo Ansaranta	Inspector	Control of competence at facilities and at small holders
Mr. Olli Okko	Senior Inspector	Safeguards of research and development, final disposal
Mr. Antero Kuusi	Inspector	Databases, non-destructive assay
Mr. Marko Hämäläinen	Senior Inspector	Inspection coordination, handbooks, Additional Protocol implementation
Mr. Mikael Moring	Senior Inspector	Finnish National Data Centre for the CTBT, non-destructive assay, environmental sampling
Mr. Risto Paltemaa	Director	Resourcing, Management
Ms. Arja Tanninen	Deputy Director	Licensing, permits

Figure 11. The staff of Nuclear Materials Section.

5 Conclusions

STUK continued with national safeguards measures and field activities with 77 inspection days and 45 inspections. The implementation of the IAEA integrated safeguards began in Finland on 15 October 2008. Thus, the year 2009 was the first whole year with the new approach. The number of the International Atomic Energy Agency (IAEA) inspection days was reduced from the approximately 25 person days per year of the past to 13. Similarly, the European Commission reduced its inspection activities to 14 person days. In 2010 and 2011 the number of the inspection days of these international organisations was somewhat higher than in 2009, because of the raised number on random interim inspections, partly due to new stakeholders to be inspected. In 2010 and 2011 the number of inspection days has been close to 20 per year. The implementation of the IAEA integrated safeguards reduces the total number of annual routine inspections days of the international inspectorates, but it includes short notice random inspections. In order to be present at all of the short notice IAEA inspections STUK has preparedness to have a daily on-the-alert inspector.

In 2011 STUK performed 29 safeguards inspections at the Finnish nuclear power plants (NPP), nine at the Loviisa NPP and 17 at the Olkiluoto NPP. The Commission and the IAEA took part in 19 of these inspections. STUK performed three non-destructive assay measurement campaigns, two at the Loviisa NPP and two at the Olkiluoto NPP. In 2011 STUK carried out five inspections of the minor holders of nuclear materials. At other facilities, the Commission took part in the physical inventory verification at the VTT research reactor and in the verification of the basic technical characteristics at the Talvivaara Sotkamo mine, and together with the IAEA in the design information verification of the geological repository at the final disposal site at Olkiluoto. The IAEA sent its safeguards statements to the Commission, which amended them with its own conclusions and forwarded them to STUK. The conclusions by the Commission were in line with IAEA's remarks as well as STUK's findings; there were no outstanding questions by the IAEA or the Commission at the end of 2011.

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 licence holders' declarations. One stakeholder's organisational safeguards procedures were remarked at during the year. Neither the IAEA nor the Commission made any remarks nor did they present any required actions based on their inspections. By their nuclear materials accountancy and control systems, all license holders enabled STUK to fulfil its own obligations under the international agreements relevant to nuclear safeguards and non-proliferation.

The purpose of the Finnish chemical, biological, radiological, and nuclear (CBRN) Task Force, of which STUK is a member, is to advance measures to deter, prevent, detect and respond to illicit CBRN activities, and to enhance coordination and cooperation between national authorities involved in the counter-CBRN effort. In 2011 STUK's Nuclear Materials Section cooperated closely with the Finnish Customs to offer expert advice in the development of radiation monitoring at borders, including training for Customs officers.

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 have to be taken in the political arena, and an important prerequisite for positive political action is that the verification system of the CTBTO is functioning and able to provide assurance to all parties that it is impossible to make a clandestine nuclear test without getting detected. 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. The radionuclide network provided reliable measurement data of the dispersion of radionuclides from the Fukushima accident throughout the northern hemisphere. The FiNDC analysed the data from the International Monitoring System, as it arrived, and provided information to the STUK Emergency Preparedness during the evaluation and assessment of the consequences of the accident.

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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)

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

HAEA
Hungarian Atomic Energy Authority

HC
Health Canada

HEU
High-enriched uranium

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, eg. INFCIRC/193, Safeguards Agreement, or INFCIRC/140, the Non-Proliferation Treaty)

IPPAS
International Physical Protection Advisory Service

IRSN
Institut de Radioprotection et de Sûreté Nucléaire (French Institute for Radiological Protection and Nuclear Safety)

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

LINSSI
an SQL database for gamma-ray spectrometry

MBA
Material Balance Area

MEE
Ministry of Employment and the Economy

MFA
Ministry for Foreign Affairs

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

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

PIT
Physical Inventory Taking

PIV
Physical Inventory Verification

PSP
Particular Safeguards Provisions

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

Pu
Plutonium

RL07
Radionuclide Laboratory to the CTBT hosted by STUK (FIL07)

SA
Subsidiary Arrangements

SAGSI
Standing Advisory Group on Safeguards Implementation

SFAT
Spent Fuel Attribute Tester

SNRCU
State Nuclear Regulatory Commission of Ukraine

SNRI
Short Notice Random Inspection

SNRIU
State Nuclear Regulatory Inspectorate of Ukraine (prev. SNRCU)

SNUICA
Short notice, unannounced inspection, complementary access, on-alert inspector

SSAC
State System of Accounting for and Control of Nuclear Materials

SSM
Swedish Radiation Safety Authority

SUJB
Czech State Office for Nuclear Safety

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)

APPENDIX 1 Nuclear materials in Finland in 2011

Table 1. Summary of nuclear material receipts and shipments at NPPs in 2011.

To	From	FA	LEU (kg)	Pu (kg)
WOL1	Spain	116	20 509	–
WOL2 (1/3)	Sweden	60	10 387	–
WOL2 (2/3)	Sweden	46	7 961	–
WOL2 (3/3)	Spain	4	721	-
WLOV (1/2)	Russian Federation	128	15 997	–
WLOV (2/2)	Russian Federation	130	16 288	–

WOL1, WOL2 = Olkiluoto NPP, WLOV = Loviisa NPP, FA = fuel assembly; LEU = low-enriched uranium, Pu = plutonium.

Table 2. Fuel assemblies at 31 December 2011.

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
WOL1	1 022/444	175 556	676
WOL2	1 005/433	167 702	625
WOLS	6 556/6 556	1 110 318	9 306
WLOV	4 851/4 171	561 874	5 075

MBA = material balance area, FA = fuel assembly, SFA = spent fuel assembly

*) FAs in core are accounted as fresh fuel assemblies
(Loviisa NPP 313 FAs and Olkiluoto NPP 500 FAs per reactor)

Table 3. Total amounts of nuclear material at 31 December 2011.

MBA	Natural U (kg)	Enriched U* (kg)	Depleted U (kg)	Plutonium (kg)	Thorium (kg)
WOL1	–	195 086	–	876	–
WOL2	–	167 742	-	626	–
WOLS	–	1 110 318	–	9 306	–
WLOV	–	593 001	–	5 304	–
WRRF	1 511	60.098	0.002	< 0.001	0.063
WFRS	0.170	0.537	99.952	~ 0	0.083
WKKO	2 599.7	–	–	–	–
WHEL	49.717	0.293	20.010	0.003	2.992
Minor holders	0.216	0.00115	1233.1	~ 0	0.163

MBA = material balance area, WRRF = VTT FiR-1/VTT Processes, WFRS = STUK, WKKO = OMG Kokkola Chemicals, WHEL = Laboratory of Radiochemistry at the University of Helsinki, U = uranium. *) Less than 150 g of high-enriched uranium, mainly used in detectors.

APPENDIX 2 Safeguards field activities in 2011

General information			Inspections			Inspection person days		
MBA	**Date**	**Inspection type**	**IAEA**	**COM**	**STUK**	**IAEA**	**COM**	**STUK**
WNNH/Norilsk Nickel Harjavalta	3 February	Initial inspection	0	0	1	0	0	2
WLOV	2 March	Interim inspection + site check	0	0	2	0	0	2
WRRF	8 March	Activities and site	0	0	1	0	0	1
WOL1, WOL2, WOLS	22–23 March	Interim Inspection	0	0	3	0	0	3
WOLF	22 March	As built DIV	0	0	1	0	0	2
WLOV	22 March	Complementary Access	1	1	1	2	1	1
SSFHYRL (WHEL)	25 March	Site check	0	0	1	0	0	1
SSFSTUK(WFRS)	25 March	Site check	0	0	1	0	0	1
WOL1, WOL2	26 April	Pre-PIT	2	2	2	2	2	2
WOL3	27 April	DIV	1	1	1	1	1	1
WOL1	6 May	OL1 core verification	0	0	1	0	0	1
WOL2	3 June	OL2 core verification	0	0	1	0	0	1
WOLS, WOL1, WOL2	28–29 June	Interim inspection PIV	3	3	3	3	3	3
WOLF	30 June	As built DIV	1	1	1	1	1	1
WLOV	6 July	Interim Inspection	0	0	1	0	0	1
WOLS	16 August	PIV	1	1	1	1	1	1
WLOV	18–19 August	Pre-PIT	1	1	1	1	1	1
WLOV	29 August	LO1 core verification	0	0	1	0	0	1
WLOV	30 August	Transfer cask verification	1	1	1	1	1	1
WRRF	31 August	PIV	0	1	1	0	1	1
WLOV	17 September	LO2 core verification	0	0	1	0	0	1
TVO, Helsinki Headquarter	23 September	International uranium transfer bookkeeping	0	0	1	0	0	1
WLOV	3–4 October	PIV	1	1	1	4	2	2
WOL1, WOL2, WOLS	6–7 October	Site survey for Remote Data Transmission	3	3	3	3	3	3
WOLF	7 October	As built DIV	0	0	1	0	0	2
SF0304CA/ Inspecta Oy	19 October	PIV + System inspection	0	0	1	0	0	2
SF0336CA/AEL Oy	20 October	PIV + System inspection	0	0	1	0	0	2
WDPJ	3 November	PIV + System inspection	0	0	1	0	0	2
SF0325CA/MAP Medical Technologies Oy	4 November	PIV + System inspection	0	0	1	0	0	2
WTAL	16 November	BTC verification	0	1	1	0	2	2
WOL1	16 November	SNRI	1	1	1	1	1	1
WLOV	23 November	UI	1	0	1	1	0	1
WOL2, WOLS	8 December	Interim inspection	0	0	2	0	0	2
SF0303CA/ Rautaruukki Oyj	13 December	PIV + System inspection	0	0	1	0	0	1
NDA MEASUREMENTS								
WOLS	31 August – 2 September	GBUV	0	0	1	0	0	9
WOL2	10–12 October	GBUV	0	0	1	0	0	9
WLOV (KPA-varasto)	31 October – 2 November	eFORK	0	0	1	0	0	6
TOTAL			**17**	**18**	**45**	**22**	**21**	**77**

Note: At the Olkiluoto NPP, inspections are counted per MBA. MBA = material balance area, PIV = Physical Inventory Verification, CA = Complementary Access, ES = Environmental Sampling, NM = nuclear material, SFAT/eFORK/GBUV = methods of non-destructive assay.

APPENDIX 3 International agreements and national legislation relevant to nuclear safeguards in Finland

Valid legislation, treaties and agreements concerning safeguards of nuclear materials and other nuclear items at the end of 2010 in Finland (Finnish Treaty Series, FTS):

1. The Nuclear Energy Act, 11 December, 1987/990 as amended.

2. The Nuclear Energy Decree, 12 February, 1988/161 as amended.

3. The Treaty on the Non-proliferation of Nuclear Weapons INFCIRC/140 (FTS 11/70).

4. The Agreement with the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, 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 1997. Valid for Finland from 1 October 1995.

5. 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, 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.

6. 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.

7. Commission Regulation (Euratom) No 302/2005, 8 February 2005

8. Council Regulation (EC) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering, and transit of dual use items.

9. 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.

10. 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.

11. 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.

12. The Agreement between Sweden and Finland concerning guidelines on export of nuclear materials, technology and equipment (FTS 20/83).

13. 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.

14. 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).

15. 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 concerning transfer of nuclear material from Australia to the European Atomic Energy Community.

16. 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.

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