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NUCLEAR SAFEGUARDS IN FINLAND 2003

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Summary

This report describes safeguards implementation in Finland in 2003. The report covers the legal basis for safeguards, activities of license holders, the inventories of the nuclear materials, the inspections performed by STUK, the International Atomic Energy Agency, IAEA, and the European Union and finally, the statement of the Finnish nuclear safeguards during the year 2003.

Contents

1 Introduction

The peaceful use of nuclear materials has to be guaranteed by the most credible way. The national nuclear safeguards system has been established for this purpose: to ensure that the nuclear materials, equipment and technology are used only for the declared, peaceful purposes. The national safeguards system cooperates with the EU regional safeguards system (DG TREN – Safeguards and Non-Proliferation) and with the IAEA.

The Finnish safeguards system comprises the authorities and licence-holders. Functioning of the national system is subject to international controls. Undistributed responsibility on safety, security and safeguarding of its nuclear materials is on the licence holder. It is the responsibility of the competent state authority to ensure that the licence-holders comply with the requirements of the safeguards agreement.

Nuclear materials safeguards apply to:

- nuclear materials (special fissionable material and source material)
- other nuclear items (components, equipment, materials suitable for producing nuclear energy or for nuclear weapons, agreements and technology)
- licence-holders' activities, expertise, preparedness and competence.

2 Finnish national safeguards system

2.1 Legal basis

The basis of the national safeguards is comprised of the Finnish Nuclear Energy Act and Decree (http://www.stuk.fi/english/regulations/). By virtue of the Act STUK issues detailed regulations (YVL Guides) that apply to the safe use of nuclear energy. (http://www.stuk.fi/english/publications/yvl-guides.html). The main guides related to 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) and
- Reports to be submitted on nuclear materials (Guide YVL 6.10).

Finland was the first state where the INFCIRC/153-type safeguards agreement with the IAEA entered into force (INFCIRC/155, February 9, 1972). This agreement was suspended after Finland joined to the European Union and the agreement between the non-nuclear weapon States of the EU, Euratom and the IAEA (INFCIRC/193) entered into force in Finland on October 4, 1995.

The national safeguards system was maintained after Finland joined the EU and to the Euratom safeguards system on January 1, 1995. The basic motivation for maintaining the national system has to do with the responsibilities assumed by the state following the NPT. The Euratom safeguards is based on the Euratom Treaty and the Commission Regulation No. 3227/76, as amended.

Finland signed the Additional Protocol in Vienna, 22 September 1998, with the other EU member states and ratified it in August 2000. The AP entered into force in April 2004 after all the EU countries ratified it.

Finland has several bilateral agreements in the area of peaceful use of nuclear energy. Upon joining to the EU, the agreements with Australia, Canada and the USA were partly substituted by the Euratom agreements with these states. Also the agreements with Sweden and the UK have partly been expired. The old agreement made with the Soviet Union was continued for five years in 1999 and the negotiations with the Russian Federation about new agreement are now underway.

2.2 Parties of the Finnish safeguards system

2.2.1 Ministries

The Ministry for Foreign Affairs is responsible for non-proliferation policy and the international agreements. The Ministry of Trade and Industry is responsible for highest management and control of nuclear energy in Finland. It is responsible for legislation related to nuclear energy and it is also the competent safeguards authority mentioned in the Euratom Treaty. Also other ministries, such as the Ministry of the Interior and the Ministry of Defence are contributing to the efficient function of the system.

2.2.2 STUK

According to the Finnish nuclear legislation, STUK is responsible to maintain the national safeguards system in order to prevent the proliferation of nuclear weapons. It regulates the license-holders' activities and ensures that the obligations of international agreements concerning peaceful use of nuclear material are met. Regulatory control of STUK is directed at the possession, manufacture, production, transfer, handling, use, storage, transport, export and import of nuclear material and other nuclear items.

STUK takes care of the approval of the IAEA and Euratom inspectors for Finland. STUK shall approve an inspector if his activities are not considered to endanger the safe use of nuclear energy or the prevention of the proliferation of nuclear weapons. If it can not approve an inspector, STUK shall assign the approval to the Ministry of Trade and Industry.

The safeguards implementation by STUK covers all the typical measures of the State System of Accounting for and Control of Nuclear Materials (SSAC). In addition, STUK has its own independent audit and verification programme particularly for the spent nuclear fuel to ensure the completeness and correctness of the operator data. The safeguards implementation in national level is closely linked with other functions like export/import control, customs and border control, transport safety, illicit trafficking, physical protection and certain measures of the Comprehensive Nuclear Test Ban Treaty (CTBT).

The transportation of nuclear and other radioactive materials are very closely linked to the safeguards objectives. In Finland, STUK's safeguards section is responsible to regulate the radioactive material transportations and acceptance of the transport packages. Finland, being the eastern border of the EU, has a very important role taking care of the prevention of illicit trafficking of nuclear materials. STUK cooperates very closely with the Finnish Customs and offers its expertise to develop the monitoring of radioactive materials on the borders, and also to train the Custom officers.

At STUK, the safeguards section is a part of the Nuclear Waste and Materials Regulation Department, with 21 staff members. See organization chart, Fig. 1. The duties of the department are in the following: nuclear waste management, national data centre for the CTBT (Comprehensive Nuclear-Test-Ban Treaty) and nuclear materials regulation including transportation of radioactive materials. The director of the department is Mrs Arja Tanninen. She has an administrative staff dealing with safeguards. Mr Juha Rautjärvi is a coordinator of the co-operation programme for the Russian Federation. He is also contributing to the non-proliferation issues. Mrs Erja Kainulainen is the coordinator of the Finnish Support Programme to the IAEA safeguards and is responsible for licensing of nuclear materials and other nuclear goods.

Six full time experts are working in the nuclear materials section:

- Mrs Elina Martikka, Section Head (national system, Additional Protocol (AP) implementation)
- Mr Tapani Honkamaa, Senior Inspector (Non-Destructive Analysis (NDA), final disposal)
- Mr Marko Hämäläinen, Inspector (inspections, AP implementation)
- Mr Kauko Karila, Inspector (reporting, documentation)
- Mr Olli Okko, Senior Inspector (research and development (R&D), final disposal)
- Mr Jaakko Tikkinen, Senior Inspector (transportation, illicit trafficking).

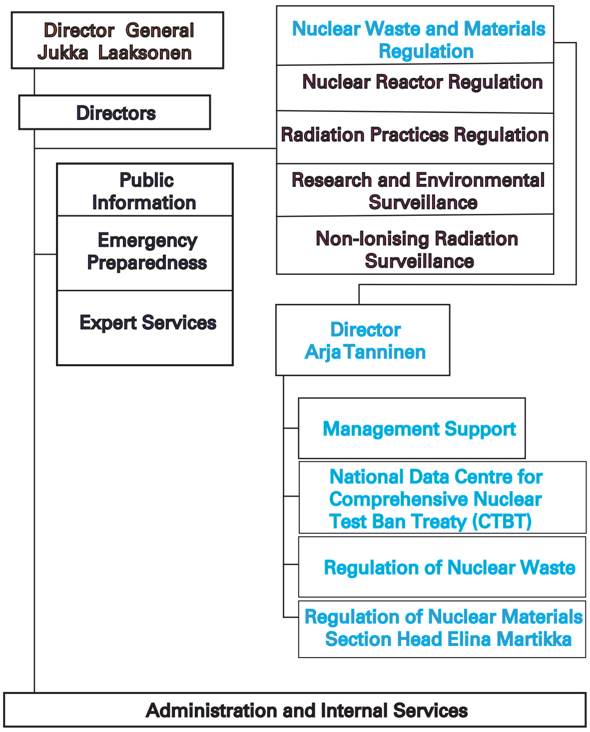

Fig. 1. The organization of STUK.

Fig. 2. Staff of Nuclear Materials Regulation 2003.

2.2.3 Operators

The last but not the least parties in the safeguards system are the operators. The operators have the core of the State's safeguards system concerning the facility level nuclear material accountancy and control with the authentic source data of the nuclear materials. The operators have to prepare the Nuclear Material Handbooks covering all the information how the safeguards in that individual facility is carried. The Handbook, which is also the part of the quality system, is accepted by STUK.

3 Themes of the year

3.1 The Additional Protocol (AP)

Finland signed the Additional Protocol in Vienna, 22 September 1998, with the other EU countries and ratified it in August 2000.The AP will enter into force after all the EU countries have ratified it. Italy and Ireland ratified the AP in the end of the year 2003. The extended work of updating the Euratom Safeguards Regulation, which gives the legal basis for the Commission to carry out its responsibilities defined in the AP, has been finished in the Atomic Questions Group (AQG) in March, 2004. The AP came into force on 30 April 2004. STUK has actively taken part to the experts meeting dealing with the AP - the AQG, the IAEA technical meetings and the ES meetings organised for the Member States. Also a field trial with the IAEA, the Euratom Safeguards (ES), the Technical Research Centre of Finland (VTT) and STUK was performed during 2000–2003 in order to test the AP implementation procedure in practise. The final report of the field trial was concluded in September 2003.

3.2 Safeguards for final disposal

Finland has decided that all spent nuclear fuel produced in Finnish power plants will be disposed in the Finnish bedrock. After careful studies, Olkiluoto in the Eurajoki municipality was chosen as a possible site for final geological repository of spent nuclear fuel. The nuclear waste company, Posiva, will perform all necessary tasks and activities to ensure the safe construction of the repository. It is very important to determine the requirements of the safeguards in time – including also the international (IAEA and EU) requirements. In July 2004, the first concrete step in the Finnish final repository will be taken. The excavation of the research and development tunnel, ONKALO, will start. The ONKALO most probably will be a part of the final repository in the future. STUK has organised and participated actively the technical meetings with the IAEA, the EU and other states interested in the final disposal. STUK sent a letter to the Director General of the IAEA late in 2003, providing at this early state information about the project and inviting the IAEA to establish an initial knowledge base and start its implementation and R&D activity as considered necessary.

4 Safeguards implementation

Most of the nuclear material in Finland (see Fig. 3 and 4) is used as a fuel for the Finnish nuclear power plants (NPPs). The main areas relevant to the nuclear materials safeguards during 2003 were the supply of the nuclear fuel, import, transportation, storing, handling and use of it. The decision to build the fifth Finnish power reactor in the Olkiluoto NPP area, beginning in 2005, has also been taken into account in the plans of the next year's safeguards activities.

4.1 The Loviisa NPP

Fortum is one of the biggest energy companies in Scandinavia. In the past, Fortum was a state-owned company formed from comprised of Imatran Voima and Neste. Fortum has electric power

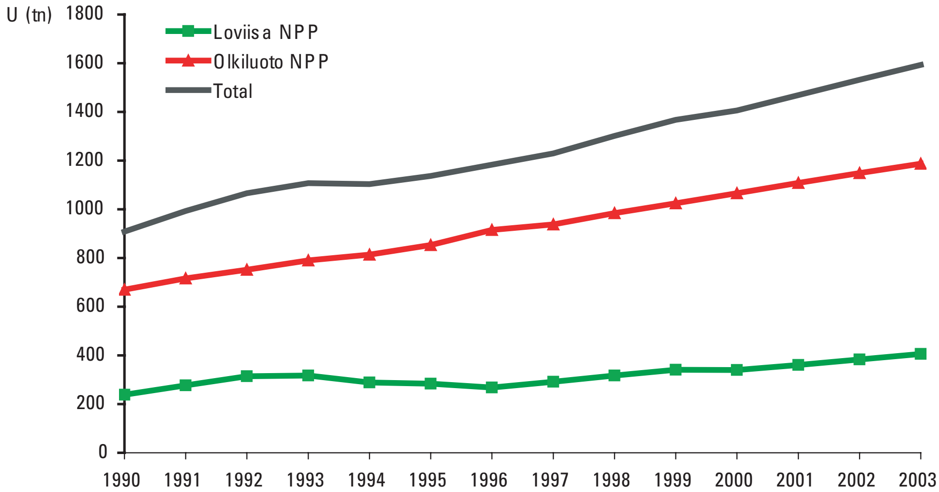

Fig. 3. Uranium amount in Finnish nuclear power plants in 1990–2003.

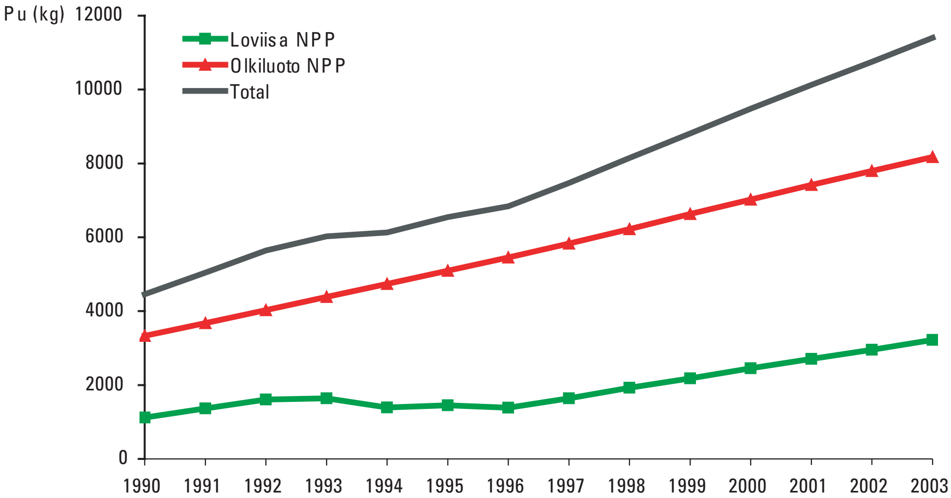

Fig. 4. Plutonium amount in Finnish nuclear power plants in 1990–2003.

plants of many types: nuclear, gas, coal, oil, among others. The nuclear power plant of Fortum Power and Heat is located in Loviisa in eastern Finland, where there are two nuclear power reactor units with common spent fuel storages (material balance area WLOV). The electricity generated in Loviisa NPP – ca. 10% of the whole electricity production in Finland – is used as a primal supply source in Finnish electrical network.

Fortum has earlier purchased the fuel for reactor units Loviisa 1 and 2 mainly from the Russian Federation as complete assemblies. Nowadays about half of the fuel assemblies are imported from the Russian Federation and the remaining half from Spain. The most of uranium is of Russian origin. Until 1996 the spent fuel was returned back to the Russian Federation. Due to the change in the Finnish nuclear legislation the spent fuel has been stored in the interim storage since 1996.

In 2003, STUK granted Fortum a licence concerning the export of three spent fuel rods for inspection and research to Studsvik, Sweden. Based on earlier granted licence totally 192 fuel assemblies containing 23.6 tons of uranium were imported to Loviisa NPP: 90 fuel assemblies (average uranium enrichment 4%) from the Russian Federation and 102 fuel assemblies (3.7%) from Spain. The receipts of fuel assemblies are stated in Table I.

Loviisa 1 refuelling and maintaining outage was performed in August 2–25, 2003 and for Loviisa 2 in August 23 – September 9, 2003. In Loviisa 1 refuelling, 108 fresh fuel assemblies were loaded into the core, whereas in Loviisa 2 refuelling, 102 fresh fuel assemblies and 12 spent fuel assemblies were loaded into the core. Before closing of each of the reactors STUK, the IAEA and the ES identified the fuel assemblies in the reactor cores and verified the fuel assemblies in loading ponds. Loviisa 1 was inspected on August 10, 2003 and Loviisa 2 on August 30, 2003. Five routine inspections were performed together with the IAEA and the ES in January, April, July, September and December. In addition, STUK made one inspection concerning nuclear equipment and other items and three inspections concerning fuel assemblies which were opened for operation research purposes. During the routine inspection in September 2003, the IAEA and the ES also measured dummy elements in Loviisa spent fuel storages. STUK's measurements in Loviisa are reported in Chapter 4.8.

Table I. Summary of nuclear materials receipts and shipments in 2003.

To	From	FA	LEU (kg)	Pu (kg)
W0L1	Germany	118	20 467	—
W0L2	Spain	118	19 964	—
W0LS	W0L2	164	27 842	247
WLOV	Russia	90	10 791	—
	Spain	102	12 781	—

W0L1, W0L2 & W0LS = Olkiluoto NPP
WLOV = Loviisa NPP
FA = fuel assembly; LEU = Low-enriched uranium

Fortum reported to STUK about its international fuel contracts, fuel transfers and shipments. On the basis of its verification and assessment, STUK has concluded that Fortum has complied with its safeguards obligations.

4.2 The Olkiluoto NPP

Teollisuuden Voima (TVO) is a private company owned by Finnish industrial and power companies to whom it provides electricity at cost price. TVO owns and operates two nuclear power plant units and a interim spent fuel storage in Olkiluoto, in the municipality of Eurajoki on the west coast of Finland. Olkiluoto NPP produces ca. 16% of whole electricity production in Finland. In Olkiluoto there are three material balance areas (W0L1, W0L2 and W0LS).

TVO uses uranium of Australian, Canadian, Russian and Chinese origin. Uranium is enriched in the Russian Federation or in the EU. The fuel assemblies are manufactured in Germany, Spain and Sweden.

In 2003, STUK granted to TVO four licences for importing nuclear fuel. Totally 236 fuel assemblies containing 40.4 tons of uranium (3.2%) were imported to Olkiluoto NPP, 114 fuel assemblies from Germany and 118 from Spain. The receipts and shipments of fuel assemblies are stated in Table I. STUK also granted TVO one license to export samples of spent fuel to Sweden, two import licenses for control rods, one import license for core loading software and one possession/operation license for depleted uranium samples.

Table II. Fuel assemblies in nuclear power plants on December 31, 2003.

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
WL0V	3515/2774	405 597	3224
W0L1	1330/746	224 771	1089
W0L2	1206/612	207 057	936
W0LS	4428/4428	755 326	6150

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

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

Olkiluoto 1 refuelling and maintaining outage was performed in May 27 – June 6, 2003 and Olkiluoto 2 in May 11–26, 2003. In Olkiluoto 1 refuelling, 130 fresh fuel assemblies and in Olkiluoto 2 refuelling, 128 fresh fuel assemblies were loaded into the core. Before each of the reactors was closed STUK, the IAEA and the ES identified the fuel assemblies in the reactor cores and verified the fuel assemblies in loading ponds. Olkiluoto 1 was inspected on June 3, 2003 and Olkiluoto 2 on May 23, 2003. STUK, the IAEA and the ES verified the inventory in Olkiluoto Spent Fuel Storage on September 10, 2003. Five routine inspections were performed by STUK, the IAEA and the ES (for each MBAs) in Olkiluoto: in January, April, July, September and December 2003. In addition, STUK made one inspection concerning nuclear equipment and other nuclear items. STUK's measurements in Olkiluoto are reported in Chapter 4.8.

TVO reported to STUK about its international fuel contracts, fuel transfers and shipments. On the basis of its verification and assessment, STUK has concluded that TVO has complied with its safeguards obligations..

4.3 VTT FiR 1 -research reactor

Small amounts of nuclear materials are located on other facilities than nuclear power plants. The most significant of those is VTT research reactor (MBA WRRF) in Otaniemi, Espoo. STUK, IAEA and ES verified the nuclear material inventory of VTT on 5 June, 2003. The nuclear material inventory was found to be correct and the nuclear material accountancy and control functions acceptably performed by VTT. The inventory of nuclear materials in the end of 2003 is presented in Table III.

4.4 Minor nuclear material holders

The location outside facilities are STUK (WFRS), the Laboratory of Radiochemistry at Helsinki University (WHEL) and OMG Kokkola Chemicals (WKK0).

STUK's nuclear activities are mainly storing of nuclear materials. STUK has the Central Interim Storage for Small-User Radioactive Waste ("Small-Waste Storage") located in the NPP waste cave in Olkiluoto and the small radionuclide

Table III. Nuclear material amounts in Finland on December 31, 2003.

MBA	U-Natural (kg)	U-Enriched (kg)	U-Depleted (kg)	Plutonium (kg)	Thorium (kg)
WL0V	—	405 597	—	3 224	—
W0L1	—	224 771	—	1 089	—
W0L2	—	207 057	—	936	—
W0LS	—	755 326	—	6 150	—
WRRF	1 511	60.1	2	—	—
WFRS	45	1.4	347	0.003	2.5
WKK0	712.6	—	—	—	—
WHEL	39	2	20	0.003	1.9
Others*	< 1 kg	—	540	< 1 kg	—

WRRF = VTT FiR-1/VTT Processes; WFRS = STUK; WKK0 = OMG Kokkola Chemicals; WHEL = Helsinki University's laboratory of radiochemistry.

* Others means the small laboratories and minor NM holders listed in Table IV

Table IV. Amounts of nuclear material at minor nuclear material holders.

Company	Nuclear material (kg)						MBA + use of NM
	U-dep	U-nat	U-Leu	U-Heu	Pu	Th	
University of Helsinki/ Dept. of Physics							SF 0291 CA, NM activities finished
VTT Industrial Systems							SF 0292 CA, NM activities finished
Geological Survey of Finland (GTK)				0.00174			SF 0293 CA, Minor NM activities
Finnair Engineering	15.5						SF 0302 CA, U-dep radiation shielding
Rautaruukki, Raahe Works	264						SF 0303 CA, U-dep radiation shielding
Inspecta	304						SF 0304 CA, U-dep radiation shielding
Outokumpu Stainless	100.98						U-dep radiation shielding
Centre for Technical Training, Metal and machinery	15						U-dep radiation shielding
Polartest	163.2						U-dep radiation shielding
MAP Medical Technologies	55						U-dep radiation shielding
Metorex International		0.0105					U-nat standards
Defence forces					0.00015		Pu used in gas detectors

storage at STUK. The inventory was verified by the IAEA and the ES on September 3, 2003.

At moment the Laboratory of Radiochemistry of Helsinki University has no nuclear activities excluding store of minor amount of nuclear material. Anyhow it is possible that they will continue the research work with nuclear materials in the future. The inventory of Laboratory was verified by STUK, the IAEA and the ES on September 3, 2003.

The only activity of OMG Kokkola Chemicals concerning nuclear materials is to process side products. While obtaining clean cobalt, they are getting sodium uranate solution among other substances. This sodium uranate solution has been timely shipped to Comurhex in France. OMG Kokkola Chemicals has an operation license to store max 20 000 kg of uranium in this solution. STUK made the inspection on MBA WKK0 on July 15, 2003 and the inventory was verified by STUK, the IAEA and the ES on September 4, 2003.

In 2003, STUK sent a specific inquiry of nuclear material and its use to 17 potential small nuclear material holders: 10 of these had some, mostly exempted nuclear material. Almost all of them have nuclear materials in the form of depleted uranium shielding. Only two holders, Geological Survey of Finland (GTK) and Metorex International have some other nuclear materials. GTK has ca. 1.17 g of HEU to use as a spike material in geological studies and for mass spectrometry calibrations. The operation license concerning the use of high enriched uranium, the maximum amount being 1.5 g (0.8 g of U-235), were granted to GTK for the next 10 years. Metorex has ca. 10 g of natural uranium that they use as calibration material for radiation monitoring gates. A list of minor nuclear material holders including close down locations is presented in Table IV.

4.5 Other nuclear items

The Finnish Nuclear Energy legislation regulates also other nuclear items than nuclear material. Import and export of heavy water requires a licence or at least a notification to STUK. In 2003, STUK gave a statement to the Ministry of Trade and Industry about the license application of Sigma Aldrich/YA Kemia to export deuterium compounds to Estonia and the Ministry granted the license. STUK also received one notice from YA Kemia concerning transfer of deuterium solution inside Finland.

4.6 IAEA safeguards

The IAEA safeguards in Finland is based on the Safeguards Agreement (INFCIRC/193) between the non-nuclear weapon states of the EU, the European Atomic Energy Community (Euratom) and the IAEA. The IAEA and Euratom Safeguards (ES) have agreed on cooperation (New Partnership Approach, NPA) with the aim of reducing the undue duplication of effort. In Finland this has not decreased the number of inspection days. There is still overlap with the ES and IAEA activities. In 2003 the IAEA safeguards activities were carried out without significant changes compared with the previous year.

The facility attachments (FA) according to the Safeguards Agreement (INFCIRC/193) were not in force in 2003 in Finland. This situation is not appreciated but it has not negatively influenced the implementation.

STUK has sent the requests of the new IAEA inspector candidates for comments to the largest nuclear material holders. No remarks were made and STUK accepted all the proposed inspector candidates. In 2003, altogether 23 new IAEA inspectors were accepted to inspect Finnish nuclear installations. There were a total of 139 IAEA inspectors that had the right of inspection in Finland on December 31, 2003.

STUK has received 24 statements by IAEA concerning the inspections during the year 2003. One statement of the inspection carried out during the year 2003 is not yet received when writing this (June 2004). There were no remarks about the outstanding questions in the statements.

4.7 Euratom Safeguards (ES)

The Treaty of the European Atomic Energy Community (Euratom Treaty) and the EU Safeguards Regulation (3227/76) based on the Treaty form the foundation for the Euratom safeguards. Nuclear material holders and producers of ores that contain uranium or thorium have the responsibility to maintain the nuclear material accountancy system and submit reports and other data to the ES in Luxembourg. The copies of the reports and other data have to be sent to STUK.

Based on Basic Technical Characteristics provided by the operators the ES prepares particular safeguards provisions (PSPs) for each material balance area. For the Loviisa NPP and the VTT Research reactor (FiR 1 -reactor) the PSPs came into force in 1998. The ES has asked for and got the comments on the PSPs from STUK and TVO in 2001, but the PSPs concerning the Olkiluoto NPP are still under preparation.

STUK has sent the requests of the new ES proposed inspector candidates for comments to the largest nuclear material holders. No remarks were made. In 2003, altogether 9 new ES inspectors were declared to inspect Finnish nuclear installations. There were a total of 211 ES inspectors that had the right of inspection in Finland on December 31, 2003.

The IAEA statements has been circulated via the Euratom safeguards, and the ES had amended their own conclusions about the inspections to the statements before providing them to the State. The conclusions by the ES were in line with the IAEA remarks – no outstanding questions.

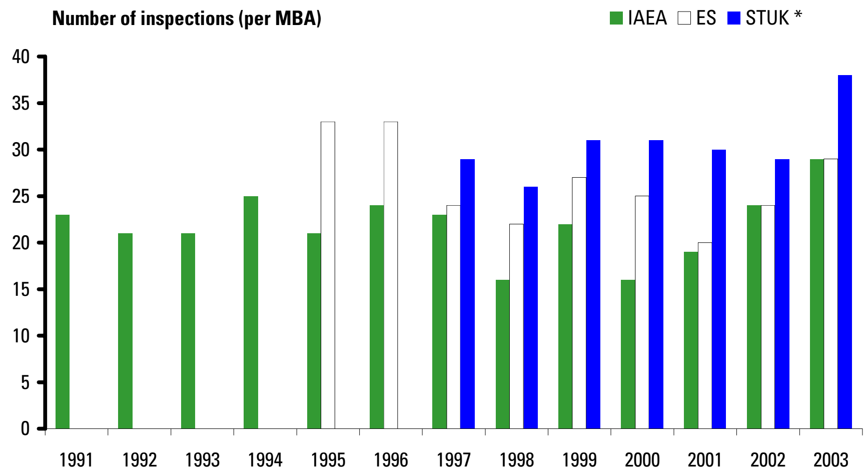

Fig. 5. Number of inspections carried out by the ES, the IAEA and STUK at Finnish Facilities 1997–2003.

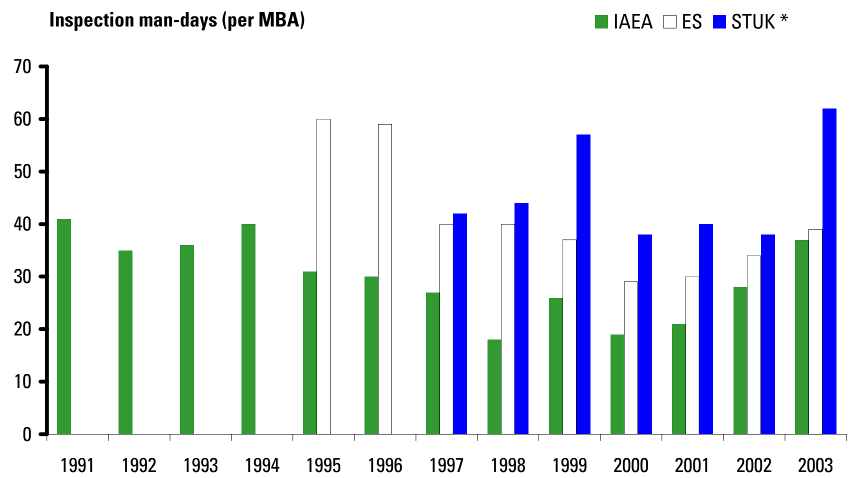

Fig. 6. Number of inspection man-days during inspections carried out by the ES, the IAEA and STUK at Finnish Facilities 1997–2003.

* The numbers of inspections and man-days have been calculated comparable with the IAEA and the ES numbers since 1997.

Table V. STUK's Non-Destructive Analysis measuring equipment of spent fuel.

	Method	Charasteristics	Note
1	GBUV (Gamma Burn-Up Verifier)	Portable, relative eff. 20%, HPGe (High Purity Germanium detector) placed behind 3 mm slit in spent fuel pool.	Only Olkiluoto has slits in the pool walls.
2	EFORK (enhanced FORK detector)	Traditional FORK (Neu-tron/Gamma Ray Verification) equipped with 20 mm^3 CdZnTe spectrometer	Transferable. Can be used in Olkiluoto and Loviisa.
3	Olkiluoto SFAT (Spent Fuel Attribute Tester)	Completely underwater (NaI detector inside watertight cover). Moving telescope.	Operation with Olkiluoto fuel transfer machine.
4	Loviisa SFAT (new storage)	Completely underwater (detec-tor inside watertight cover). No moving parts inside.	Operation with Loviisa fuel transfer machine.
5	Loviisa SFAT (old storage)	Pipe and supporting structure. The detector can be either 20% HPGe or NaI detector.	Pipe has a holder for sepa-rate detector above water level. HPGe or NaI detectors have been used.

Table VI. STUK's spent fuel measurements in 2003.

Location	Date	Measuring days	Measured assemblies	Verification method (see Table V)
Loviisa KPA	04/2003	2	329	SFAT (4)
Olkiluoto KPA	06/2003	2	14	GBUV (1)
Olkiluoto KPA	09/2003	1	62	SFAT (3)
Loviisa KPA	12/2003	2	20	EFORK (2)

4.8 STUK's spent fuel verifications

STUK has developed Non-Destructive Analysis (NDA) measurement systems for several years. At the moment it has a regular programme to measure spent nuclear fuel at both nuclear power plants. The purpose is to verify the operator's nuclear material data including burn-up calculations. Depending on local circumstances a bit different methods is used at Loviisa and TVO facilities. List of the methods is presented in Table V.

The characteristics of different measuring equipment are described in more detail in various technical reports. An overall view of STUK's measuring activities can be obtained from the reference (Honkamaa T, Hämäläinen M, How STUK verifies Spent Fuel – And WHY? Proceedings of ESARDA, 25th Annual Meeting, Stockholm, May 2003).

STUK made four measuring campaigns of spent nuclear fuel in 2003. The campaigns are listed in Table VI.

The number of measured assemblies is 425. In addition, a few dummy elements were verified. Also the IAEA made measurements with an IRAT (Irradiated Fuel Attribute Tester) device in Loviisa in September 2003, where about 30 assemblies and dummies were measured (Fig. 8). No anomalies were observed.

Fig. 7. Setting up Spent Fuel Attribute Tester measuring equipment in Loviisa nuclear power plant.

Fig. 8. The IAEA inspectors are preparing the Irradiated Fuel Attribute Tester measurements at the Loviisa KPA store.

5 Safeguards for final disposal in geological repository

5.1 Safeguards requirements

The final disposal of spent nuclear fuel in the geological repository at Olkiluoto was accepted by the local municipality and the state authorities, and was finally endorsed by the Parliament of Finland in 2001. The geological site investigations will proceed to the underground phase in 2004 when the excavation of the tunnel system for bedrock characterisation at repository site begins. The final disposal facility will consist of the surface installations including the encapsulation plant and the underground galleries. In general, the sitting of these facilities at the territory of Olkiluoto is not yet designed. Moreover, the plan to construct an underground rock characterisation facility that includes a ramp, a tunnel and a shaft (Fig. 9) is not subject to the Finnish Nuclear Energy Act until it is evident and it has been accepted that spent fuel will be moved into these tunnels. Nevertheless, the possibility to have this underground space as a licensed part of the nuclear repository shall be considered already during the construction phase. Referring to the recommendations generated in the IAEA´s Programme for Development of Safeguards for Final Disposal of Spent Fuel in Geological Repositories (SAGOR), the safeguards approach in the pre-operational phase at Olkiluoto site is suggested. At this pre-operational phase the main obligation is the verification of the excavated rock space and its geometrical volume. In addition, the international community must be ensured about the absence of undeclared nuclear or other safeguards-relevant activities at or near the repository already during the excavation of the investigatory galleries.

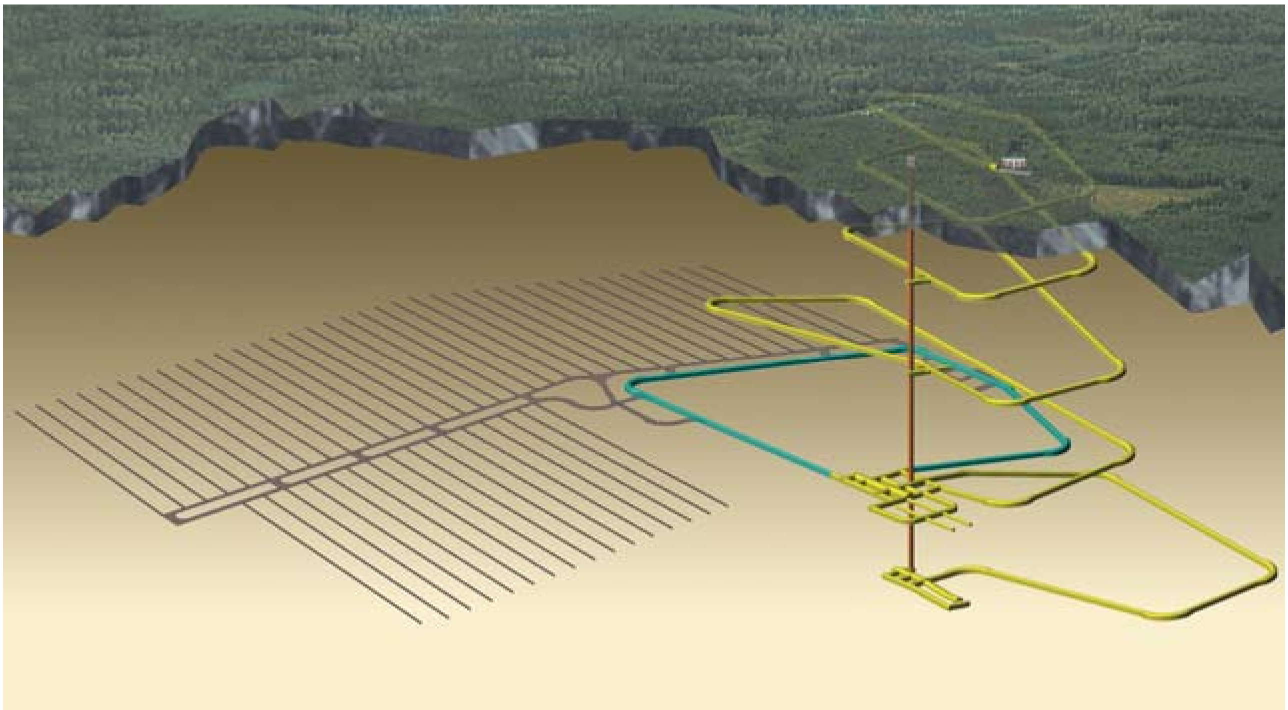

Fig. 9. Generic plan for the underground disposal facilities. The rock characterisation phase is shown as tunnels in yellow and blue.

5.2 National system

The plans to construct the underground facility for the final disposal of spent nuclear fuel signify that the first safeguards measures, e.g. baseline mapping of the site area, needs to be taken prior to the excavation phase. In order to support the development and implementation of the regulatory control of the final disposal programme, STUK established an independent national expert group, LOSKA, in April 2002. The group supports STUK in the development of the technical safeguards requirements, in the implementation of the safeguards and in the evaluation of the facility operator plans. The group reviewed the IAEA recommendations for safeguarding a geological repository with the focus on the conditions at Olkiluoto, located in a crystalline Precambrian bedrock at the Latitude North of 61°15´ (Okko O (ed.), 2003, Safeguards for final disposal of spent nuclear fuel. Methods and technologies for the Olkiluoto site, STUK-YTO-TR 199). In addition, the group collected baseline data for safeguards purposes using geophysical, i.e. passive seismic techniques and satellite imagery during 2003. This work is scheduled to continue in 2004 to evaluate the methods for their relevance concerning the safeguards.

Fig. 10. National expert group LOSKA is ensuring feedback from relevant parties at the Rauma Symposium in autumn 2003.

5.3 International co-operation

Owing to the present conditions and development with the Olkiluoto repository, STUK invited the IAEA and its Expert Group on Geological Repositories to visit the Olkiluoto geographical site and provided an opportunity to get acquainted with site specific information during the one-week symposium held at Rauma on Sept 29 – Oct 4, 2003. During the symposium, baseline material collected by the national LOSKA Group and other institutions involved in the environmental monitoring at Olkiluoto was discussed (Fig. 10). Later, on November 18, Jukka Laaksonen, Director General of STUK, invited officially the IAEA, with a copy to the Euratom, to start negotiations concerning the implementation of safeguards measures during the pre-operational phase of the final repository. Attached to this official letter, an initial set of pertinent information was provided to the IAEA. This initiative is expected to result in a cooperation through which efficient safeguards can be ensured during the construction and operation of the repository.

6 Transport of radioactive and nuclear materials

Transport of nuclear material is subject to transport licence as stipulated in the Nuclear Energy Act. This licence for nuclear facilities is usually granted for a longer period and that is why no new transport licences were granted in 2003. For each transport, there must be a transport plan approved by STUK. Also a physical protection plan and a certificate of nuclear liability insurance are required either separately or in connection with the transport plan. Before a package can be used for fissile material transport, the package design must be approved by STUK.

In 2003, fresh nuclear fuel was transported into Finland from Spain, Germany, Sweden and Russia. The western fuel was transported on trucks or trailers which are shipped by sea to a Finnish harbour and driven by road to the power plant. The Russian fuel was transported by rail over the border to Vainikkala station, where it was loaded onto trucks and driven to Loviisa power plant (Fig. 11). In addition one irradiated fuel rod was transported to Sweden by road for inspection.

In 2003 STUK approved three package designs by validation of a foreign certificate. Four transport plans for import or export of nuclear fuel were approved. In addition, three package designs were validated for transit shipments.

Fig. 11. Loading of fresh fuel packages from train onto a truck for transport to power plant.

7 Preventing illicit trafficking

Import and export of radioactive and nuclear material is subject to licence. STUK works in close cooperation with the Finnish Customs in order to prevent illegal import of radioactive and nuclear material into Finland. In 2003 there was no such case (Table VII). The cooperation is also extended to border officers of neighbouring countries and STUK organised two training courses for Baltic border officers in border control of radioactive materials.

STUK will continue to participate in the international work in preventing nuclear terrorism and illicit trafficking of radioactive and nuclear material. In 2003 STUK participated in meetings arranged by the IAEA, EU or ITWG (International Technical Working Group of Nuclear Smuggling) dealing with technical means to detect illicit trafficking, organisational preparedness for operations in real case, exchange of information, etc.

Table VII. Number of shipments for which entry into Finland was denied due to undeclared radioactivity.

Year	Number of denied shipments
1996	18
1997	23
1998	9
1999	7
2000	2
2001	0
2002	0
2003	0

8 The Comprehensive Nuclear-Test-Ban Treaty (CTBT)

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an important part of the international regime on the non-proliferation of nuclear weapons. It bans totally 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 September 24, 1996. The Treaty will enter into force after it has been ratified by the 44 states listed in its Annex 2. These 44 states participated in the 1996 session of the Conference on Disarmament, and possess nuclear power or research reactors.

A global verification regime is being established in order to monitor compliance with the CTBT. The verification regime consists of the following elements: International Monitoring System (IMS), consultation and clarification process, On-Site inspections (OSI) and confidence-building measures.

Finland has signed and ratified the CTBT. In addition to complying with the basic requirement of the Treaty not to carry out any nuclear weapon tests, Finland takes part in the international monitoring network aimed at verifying more global compliance with the obligations of the Treaty.

In the CTBT framework, the National Authority is the Ministry for Foreign Affairs. STUK has two roles: STUK operates both the National Data Centre and the radionuclide laboratory. The main tasks of the National Data Centre are to monitor data received from the international monitoring system and to inform the National Authority about its monitoring results. The radionuclide laboratory serves the International Monitoring System by providing support in the radionuclide analyses and in the quality control of functions. Other national collaborators are the Institute of Seismology and the Ministry of Defence.

During 2003 the National Data Centre participated in the meetings of the work group of the Preparatory Commission for the CTBT Organization. The task of the working group is to deal with the examination and development of the verification issues. In the framework of the bilateral support for the Baltic States, the National Data Centre provided training and technical support for the establishment of a functional National Data Centres of Estonia and Lithuania.

The National Data Centre continued developing its own routine monitoring system for the data received from the international verification regime. To improve the usability of the monitoring results, a database was developed and taken into everyday operation. During 2003 no anomalies were observed among the monitoring results.

9 International safeguards cooperation

Finland is committed in the non-proliferation of nuclear materials and supports actively strengthening and developing of the international safeguards related to the Non-proliferation Treaty (NPT).

9.1 The IAEA Fellowship visitor

The IAEA fellowship visitor, Mr Zulkefle Hussin, was working six weeks at STUK's Nuclear Materials Regulation section. For the meantime Mr Hussin is working in a Nuclear Installation Division of AELB in Malaysia. The aim of the fellowship visit was to study and familiarize the regulations, safety standards and procedures which have been implemented on radiation and nuclear activities in Finland.

9.2 Safeguards cooperation in the neighbour areas

The primary objective is to enhance security in Finland's neighbouring areas. Accordingly Finland has established a bilateral safeguards support programme for the Baltic States and a cooperation programme with the Russian Federation. The aim of the support and cooperation is to assist these countries in establishing, enhancing and maintaining a national system of nuclear material control covering also physical protection, export/import and border control issues. These programmes are funded by the Ministry for Foreign Affairs of Finland. In 2003 the total funds allocated for these programmes were 200 000 Euros. Implementation of the support projects is carried out by STUK in co-operation with the Finnish nuclear facilities and other expert organisations. All the projects are implemented on a bilateral basis between respective authorities and experts from the participating countries and Finland taking into account international coordination and co-operation with other countries involved, the European Commission and the IAEA. See also the report Finnish Support Programme for Nuclear Safety, Progress Report Annual Summary 2003.

Fig. 12. During October 6 – November 14, 2003 Zulkefle Hussin (second from the right) was working as an IAEA fellowship visitor in the Nuclear Materials Regulation at STUK.

9.3 Finnish support programme to the IAEA safeguards

Finnish Safeguards Support Programme to the IAEA was started in 1988. Since the beginning, the programme has been implemented under the coordination of STUK in close cooperation with the Finnish nuclear facilities and other expert organisations in Finland. It has also taken into account the other IAEA Member States' support programmes. In 2003 the Ministry of Foreign Affairs allocated 300 000 Euros for the programme. The main areas of support in 2003 consisted of the development and testing of instruments and methods related to nuclear material verification, initiation of the development of a new IAEA training course concerning implementation of the Additional Protocol, training of the IAEA inspectors in using verification instruments, cost-free expert support and a project related to the final disposal of spent fuel.

Table VIII. Finnish representatives in ESARDA organs.

Body of ESARDA	Member
Steering Committee	Arja Tanninen
Executive Board	Elina Martikka
Scientific Committee and Co-ordination Board	Tapani Honkamaa
Non-Destructive Assay Working Group	Marko Hämäläinen
Containment and Surveillance Working Group	Tapani Honkamaa
Integrated Safeguards Working Group	Olli Okko and Elina Martikka
Verification Technologies Working Group	Juha Rautjärvi
Back end of Fuel Cycle	Käthe Sarparanta, TVO

9.3 Activities in ESARDA

STUK is a member of the European Safeguards Research and Development Association (ESARDA), and has nominated Finnish experts to all committees and most of the working groups (see Table VIII). In addition, STUK took actively part in the Stockholm symposium in May 2003. STUK chaired two sessions and had three presentations.

10 Historical survey on Finnish nuclear non-proliferation policy during the Cold War

Mr Arno Ahosniemi from University Helsinki, Department of Social Science History, Political History unit made a survey on Finnish non-proliferation policy during the Cold War. He tried to find out what did the Finns know about nuclear weapons and how the Finnish Non-Proliferation Policy during the Cold War was linked to broader context of the Finnish foreign and security policy. The survey has been published only in Finnish (Ahosniemi Arno, 2004, Jotta Suomessa voitaisiin huoletta kulkea, Ydinaseiden ja ydinpolttoainekysymysten seuranta Suomessa kylmän sodan aikana, STUK-YTO-TR 201). The résumé of the survey describes the situation as follows:

It is clear that nuclear bombs dropped by the United States on Hiroshima and Nagasaki in summer 1945 revolutionised international security. The nuclear arms race started and the nuclear weapons became the symbol of the whole Cold War era and the horror picture of the total destruction.

Nuclear disarmament was put on the agenda of the established United Nations and the UN Atomic Energy Commission. It soon became clear that the goal of the UNAEC was unattainable. The Soviet Union, in 1949, and United Kingdom, in 1952, were able to achieve the status of the nuclear weapon state on their own. Also Sweden was engaged in activites aimed at nuclear weapon capability. In general, the beginning of 1950s´ was very problematic concerning nuclear non-proliferation. In the end of 1953, the U.S. decided to use co-operation as a nuclear non-proliferation tool. The “Atoms for Peace” initiative of President Eisenhower offered assistance to countries willing to accept international control of their nuclear activities for peaceful use of nuclear energy. But the question was not that simple. Many countries, including Finland, did not want to place the development of their atomic energy and military research into the hands of foreign states.

However, one consequence of the Atoms for Peace initiative was the establishment of the IAEA in 1957. The aim of the IAEA was to control the proliferation of nuclear weapons, components of nuclear devices and other nuclear material. Despite the “The First Détente” – era in the superpower relations after the death of Soviet leader Josef Stalin in 1953 – the negotiations and discussions regarding nuclear disarmament and arms control continued to be unsuccessful in the 1950s. This decade is particularly interesting from the point of view of our research about the Finnish Nuclear Non-Proliferation policy. The shaping of the Finnish domestic and foreign policy was still going on after the difficult years after the Second World War. At this point most of the foreign countries were not very determined about the side of the iron curtain that Finland stood on. When the status of Finland in the world politics was not very clear, the Finnish political leadership had to be very cautious about developments in the superpower relations. They had to be extremely sensitive to what was going on in the Soviet Union. The memories of the war and the so-called years of danger (1945-1948) were still very vivid. The research and development, during these early decades, were guided by consideration that had to take into account the following basic conditions: The 1947 Paris Peace Treaty stipulated that Finland shall not possess nuclear weapons. There was a real concern about the safety of the people in case of detonation of nuclear weapons in Finland, were it caused by accidental or intended action. Finland did not want to see a condition developing that the Soviet Union refers to the pact about cooperation and mutual assistance and offers its assistance to Finland in the area of the use of nuclear energy for peaceful or military purposes. Finland was also interested to play an active role in the nuclear disarmament process. In short, Finland aquired level knowledge about nuclear weapons that was considered necessary for security and was understood to support also the Finnish role in the disarmament discussion.

11 Conclusions

All the actions including nuclear materials and other nuclear items were carried out according to the Finnish nuclear legislation and regulations. Also the requirements of the international agreements have been fulfilled. Based on results of STUK's regulation it is possible to conclude that the nuclear materials and other nuclear items were used for intended, peaceful, use.

ANNEX 1

International agreements

A list of valid legislation, treaties and agreements concerning safeguards of nuclear materials at the end of 2003 in Finland (reference to Finnish Treaty Series, FTS)

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

2. 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 4 October 1995.

5. 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 con-centrations of ores, 2 February 1960.

6. Commission Regulation (Euratom) No 3227/76, 19 October 1976 and Amendments:
   - Commission Regulation (Euratom) No 220/90, 26 January 1990 (a new inventory change code, MP)
   - Commission Regulation (Euratom) No 2130/93, 27 July 27 1993 (basic technical characteristics for new facilities and reporting from Euratom to IAEA).

7. Council Regulation (EC) No 1334/2000 setting up a Community regime for the control of Exports of dual-use items and technology as amended.

8. 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).

9. 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).

10. 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).

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

12. 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.

13. 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).

14. The Agreement between the Government of Republic of Finland and the Government of Australia concerning the transfer of nuclear material between Finland and Australia (FTS 2/80). 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.

15. 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.

ANNEX 2 IAEA, ES and STUK inspections in 2003

General information			Inspections			Inspection man-days		
MBA	Date	Inspection type	IAEA	ES	STUK	IAEA	ES	STUK
WOL1, WOL2, WOLS	14–15 Jan.	Routine inspection	3	3	3	3	6	3
WLOV	14 Jan.	FA inspection			1			1
WLOV	16 Jan.	Routine inspection	1	1	1	1	2	1
WLOV	21 Jan.	FA inspection			1			1
WLOV	27 Feb.	Other nuclear items			1			2
WLOV	6 March	FA inspection			1			1
WOL1, WOL2, WOLS	1–2 April	Routine inspection	3	3	3	3	6	3
WLOV	3 April	Routine inspection	1	1	1	1	2	1
WLOV	15–16 April	STUK SFAT			1			4
WOL2	23–24 May	PIV	1	1	1	2	2	2
WOL1	2–3 June	PIV	1	1	1	2	2	4
WLOV	2 June	Spent fuel rods (to be exported to Sweden)			1			1
WRRF	5 June	PIV	1	1	1	1	1	2
WOLS	23–25 June	STUK GBUV			1			6
WLOV	8 July	Routine inspection	1	1	1	1	1	1
WOL1, WOL2, WOLS	10–11 July	Routine inspection	3	3	3	3	3	3
WKKO	15 July	STUK system inspection			1			1
WLOV	10 Aug.	Loviisa 1 core verification	1	1	1	1	1	1
WLOV	30 Aug.	Loviisa 2 core verification + PIV	1	1	1	1	1	1
WFRS	3 Sep.	PIV	1	1	1	1	1	1
WHEL	3 Sep.	PIV	1	1	1	1	1	1
WKKO	4 Sep.	PIV	1	1	1	1	1	1
WOLS	8–10 Sep.	STUK SFAT + PIV	1	1	2	1	1	6
WOL1, WOL2, WOLS	22–23 Sep.	Routine inspection	3	3	3	3	3	3
WLOV	25 Sep.	Routine inspection (+ IAEA/ES IRAT)	1	1	1	3	1	2
WLOV	3–5 Dec.	STUK FORK			1			6
WOL1, WOL2, WOLS	9–10 Dec.	Routine inspection	3	3	3	6	3	3
WLOV	12 Dec.	Routine inspection	1	1	1	2	1	1
TOTAL			**29**	**29**	**39**	**37**	**39**	**63**

Note: In Olkiluoto, inspections are counted per MBA. FA = Fuel Assembly, PIV = Physical Inventory Verification