STUK-B-YTO 238 / April 2005

# NUCLEAR SAFEGUARDS IN FINLAND 2004

Kauko Karila (ed.)

STUK • SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite/Address • Laippatie 4, 00880 Helsinki
Postiosoite / Postal address • PL / P.O.Box 14, FIN-00881 Helsinki, FINLAND
Puh./Tel. (09) 759 881, +358 9 759 881 • Fax (09) 759 88 500, +358 9 759 88 500 • www.stuk.fi

ISBN 951-712-974-2 (print) Dark Oy, Vantaa/Finland 2005
ISBN 951-712-975-0 (pdf)
ISSN 0781-2884

*KARILA Kauko (ed.). Nucler Safeguards in Finland 2004. STUK-B-YTO 238. Helsinki 2005.*
*26 pp. + Annexes 2 pp.*

**Keywords:** non-proliferation, nuclear materials, safeguards, illicit trafficking, nuclear smuggling, comprehensive nuclear test ban treaty (CTBT)

# Summary

This report describes safeguards implementation in Finland in 2004. 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, the implementation of the Additional Protocol and finally, the statement of the Finnish nuclear safeguards during the year 2004.

# 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 Euratom safeguards system and with the IAEA.

The Finnish safeguards system comprises the authorities and licence holders. Functioning of the national system is subject to international control. 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. By virtue of the Act STUK issues detailed regulations (YVL Guides) that apply to the safe use of nuclear energy. 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)
- 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, the European Atomic Energy Community (Euratom) and the IAEA (INFCIRC/193) entered into force in Finland on October 1, 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. The Finnish facilities and STUK have been preparing the implementation of the New Commission Regulation (No 302/2005) which came into force in the first half of 2005.

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 30, 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 national safeguards 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 materials 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 the consultation of Commission 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 STUK can not approve an inspector, it 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, preventing of 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 an important role taking care of the prevention of illicit trafficking of nuclear materials. STUK cooperates 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 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.

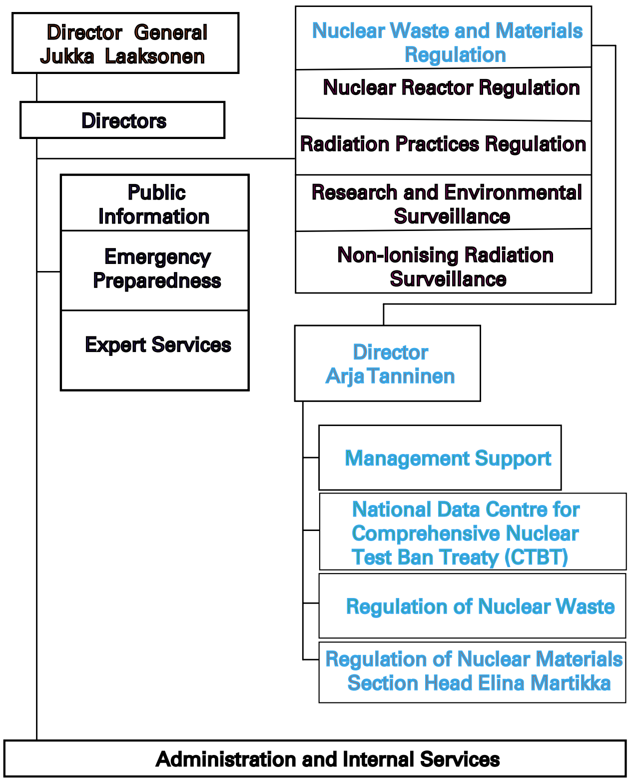


**Figure 1.** The organization of STUK.

**Figure 2.** Staff of Nuclear Materials Section 2004.

Six experts (one of them part-time) 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).

### 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 out. The Handbook, which is also the part of the quality system, is approved by STUK.

# 3 Themes of the year

It seems that the Additional Protocol and the Safeguards for Final Disposal have been the major challenges during the year 2004, that the themes of the year 2004 are the same than during the year 2003. But very many steps have been taken during the year 2004.

## 3.1 The Additional Protocol (AP)

The AP entered into force on 30 April, 2004. The extended work of updating the Commission 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. STUK has actively taken part to the experts meeting dealing with the AP – the AQG, the IAEA technical meetings and the Commission (DG TREN – Directorates H and I) meetings organised for the Member States.

In March STUK negotiated with the IAEA about the practical implementation of the AP. In April STUK visited in Luxembourg to discuss with the Commission about the implementation practises. The amendments for the Finnish Nuclear Energy legislation entered into force on May, 2004. Finland provided the declarations to the IAEA on July 8, 2004. The first complementary access was carried out in Helsinki University, Radiochemical Laboratory on December 21, 2004.

## 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 to be the location for final geological repository of spent nuclear fuel. The implementing nuclear waste company, Posiva Oy, will perform all necessary tasks and activities to ensure the safe construction of the repository at this location in Olkiluoto. It is very important to determine the requirements of the safeguards in time – including also the international (IAEA and EU) requirements. In summer 2004, the first concrete step in the Finnish final repository was taken as the excavation of the research and development tunnel, ONKALO begun. The ONKALO most probably will be a part of the final repository in the future. In order to facilitate the IAEA's State level analysis about the absence of undeclared nuclear activities, the implementing company was obligated to produce timely safeguards-relevant documents covering the whole lifetime of the repository.

# 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 2004 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.

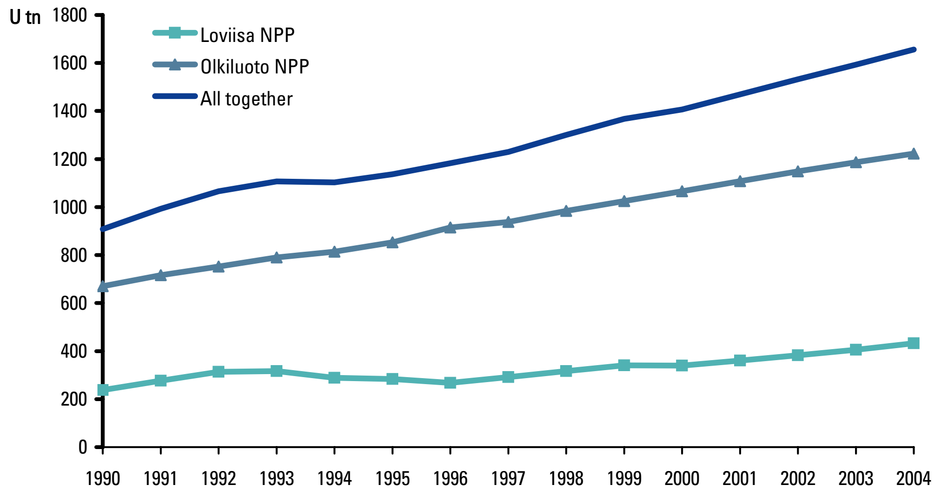


**Figure 3.** Uranium amount in Finnish nuclear power plants in 1990–2004.

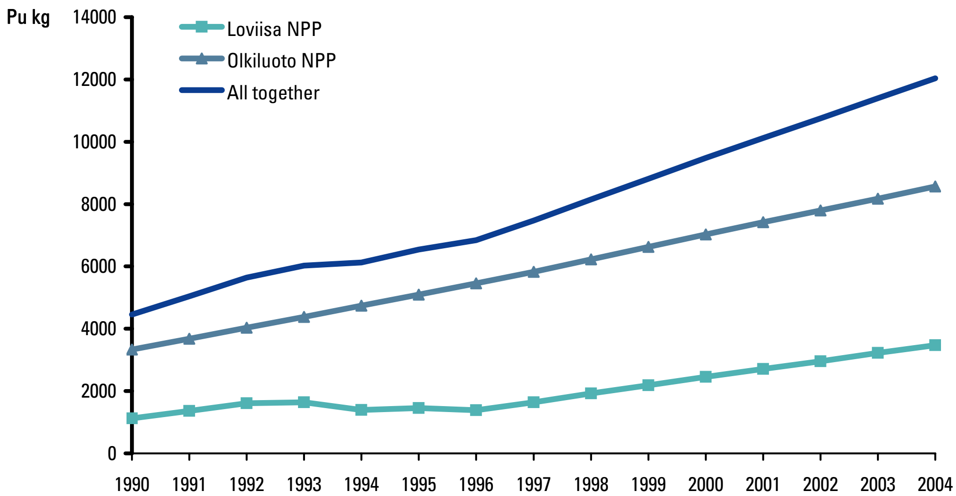


**Figure 4.** Plutonium amount in Finnish nuclear power plants in 1990–2004.

**Table I.** Summary of nuclear materials receipts and shipments in 2004.

| To | From | FA | LEU (kg) | Pu (kg) |
|---|---|---|---|---|
| **W0L1** | Germany | 114 | 19 763 | – |
| **W0L1** | Spain | 8 | 1 415 | – |
| **W0L2** | Sweden | 100 | 16 916 | – |
| **W0LS** | W0L1 | 164 | 27 121 | 241 |
| **W0LS** | W0L2 | 246 | 41 895 | 380 |
| **WL0V** | Russia | 126 | 15 120 | – |
| | Spain | 108 | 13 561 | – |

W0L1, W0L2 & W0LS = Olkiluoto NPP, WL0V = Loviisa NPP, FA = fuel assembly; LEU = Low-enriched uranium

## 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 Imatran Voima and Neste. Fortum has electric power 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 WL0V). 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 2004, STUK granted Fortum two import licences concerning the fresh fuel from Spain. Based on granted licences totally 234 fuel assemblies containing 28.7 tons of uranium was imported to Loviisa NPP: 126 fuel assemblies (average uranium enrichment 4%) from the Russian Federation and 108 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 July 24 – September 9, 2004 and for Loviisa 2 in September 4–26, 2004. In Loviisa 1 refuelling, 102 fresh fuel assemblies were loaded into the core, whereas in Loviisa 2 refuelling, 96 fresh fuel assemblies and 6 earlier discharged spent fuel assemblies were loaded into the core. Before closing of each of the reactors STUK, the IAEA and the Commission identified the fuel assemblies in the reactor cores and verified the fuel assemblies in loading ponds. Loviisa 1 was inspected on August 25–26, 2004 and Loviisa 2 on September 11, 2004. Four routine inspections were performed together with the IAEA and the Commission in March, June, September and December. In addition, during the inspection in September 2004, the IAEA and the Commission also measured fuel elements in Loviisa reactor 1 hall. STUK's measurements in Loviisa are reported in Chapter 4.8.

Fortum reported to STUK about its international uranium transfers. 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 2004, STUK granted to TVO two import

**Table II.** Fuel assemblies in nuclear power plants on December 31, 2004.

| MBA | FA/SFA *) | LEU (kg) | Pu (kg) |
|---|---|---|---|
| WLOV | 3 742/2 965 | 433 058 | 3 474 |
| WOL1 | 1 288/716 | 217 723 | 1 042 |
| WOL2 | 1 060/494 | 180 974 | 750 |
| WOLS | 4 838/4 838 | 824 342 | 6 771 |

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)

licences for nuclear fuel. Totally 222 fuel assemblies containing 38.1 tons of uranium (3.5%) was imported to Olkiluoto NPP, 114 fuel assemblies from Germany, 8 from Spain and 100 from Sweden. The receipts and shipments of fuel assemblies are stated in Table II. STUK also granted to TVO one import license for control rods and one import license for two steam driers.

Olkiluoto 1 refuelling and maintaining outage was performed in May 9 – May 25, 2004 and Olkiluoto 2 in May 25 – June 3, 2004. In Olkiluoto 1 refuelling, 134 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 Commission identified the fuel assemblies in the reactor cores and verified the fuel assemblies in loading ponds. Olkiluoto 1 was inspected on May 20–21, 2004 and Olkiluoto 2 on May 31 – June 1, 2004. STUK, the IAEA and the Commission verified the inventory in Olkiluoto Spent Fuel Storage on September 9, 2004. Four routine inspections were performed by STUK, the IAEA and the Commission (for each MBAs) in Olkiluoto: in March, June, September and November 2004. STUK's measurements in Olkiluoto NPP 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 Commission safeguards inspectors verified the nuclear material inventory of VTT on 23 August, 2004. The nuclear material inventory was found to be correct. The nuclear material accountancy and control were acceptably performed by VTT. The inventory of nuclear materials in the end of 2004 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 storage at STUK.

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 only activity of OMG Kokkola Chemicals concerning nuclear materials is storing process by-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.

In the end of 2004, there were ten other nuclear material holders, mostly having some minor amounts of nuclear materials, mostly exempted materials. Almost all of them have nuclear materials in the form of depleted uranium shieldings. Only three holders, Geological Survey of Finland (GTK), Metorex International and University of Jyväskylä (Department of Physics) have some other nuclear materials. GTK has ca. 1.17 g of HEU to be used as a spike material in geological studies and for mass spectrometry calibrations. Metorex has ca. 10 g of natural uranium that they use as calibration material for radiation monitoring gates. University of Jyväskylä (Department of Physics) uses small amounts of NM as a material for manufacturing targets or sources or directly to be used as a targets irradiated with accelerator ion beams or as radiation sources in calibration of radiation

**Table III.** Nuclear material amounts in Finland on December 31, 2004.

| MBA | U-Natural (kg) | U-Enriched (kg) | U-Depleted (kg) | Plutonium (kg) | Thorium (kg) |
|---|---|---|---|---|---|
| WLOV | – | 433 058 | – | 3 474 | – |
| WOL1 | – | 217 723 | – [a] | 1 042 | – |
| WOL2 | – | 180 974 | – | 750 | – |
| WOLS | – | 824 342 | – | 6 771 | – |
| WRRF | 1 510 | 60.1 | 0.002 | – | – |
| WFRS | 44.7 | 1.4 | 592.5 | 0.003 | 2.5 |
| WKKO | 1 687.2 | – | – | – | – |
| WHEL | 39 | 0.3 | 20 | 0.003 | 1.9 |
| Others[b] | < 0.1 | – | 918 | < 0.01 | – |

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

[a] TVO has ca. 10.3 kg DU samples for training and exhibition purposes in Olkiluoto.
[b] 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 | |
| Geological Survey of Finland (GTK) | – | – | – | 0.00174 | – | – | SF 0293 CA, Minor NM activities |
| Finnair Engineering | 15.5 | – | – | – | – | – | SF 0302 CA, DU radiation shielding |
| Rautaruukki, Raahe Works | 264 | – | – | – | – | – | SF 0303 CA, DU radiation shielding |
| Inspecta | 304 | – | – | – | – | – | SF 0304 CA, DU radiation shielding |
| Outokumpu Stainless | 100.98 | – | – | – | – | – | WOKU, DU radiation shielding |
| Centre for Technical Training, Metal and Machinery | 15 | – | – | – | – | – | DU radiation shielding |
| Polartest | 163.2 | – | – | – | – | – | DU radiation shielding |
| MAP Medical Technologies | 55 | – | – | – | – | – | DU radiation shielding |
| Metorex International | – | 0.0105 | – | – | – | – | U-nat standards |

detectors for basic research of nuclear structure.

In 2004, all these small nuclear material holders have re-requested exemption (derogation in sense of EU safeguards regulation) from safeguards for these materials. 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. Possession, transfer, import and export of those item requires a licence or at least a notification to STUK. In 2004, STUK gave a statement to the Ministry of Trade and Industry on the license application of Sigma Aldrich/YA Kemia to export deuterium compounds to Estonia and the Ministry granted the license.

## 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 and the IAEA. The IAEA and Euratom safeguards have agreed on co-operation (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 Commission and IAEA activities. In 2004 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 2004 in Finland. This situation is not appreciated but it has not negatively influenced the implementation.

STUK takes care of the approval of the IAEA inspectors for Finland. When received the information about the new inspector candidates STUK has sent the requests for comments to the largest nuclear material holders. Remarks were made on two inspector candidates by the two largest nuclear material holders. STUK endorsed a document to the Ministry of Trade and Industry, that did not accept the two candidates. In 2004, altogether 40 new IAEA inspectors were accepted by STUK to inspect Finnish nuclear installations. After the entry into force of the Additional Protocol 186 inspectors from the list of 188 proposed ones were accepted to Finland.

STUK has received 21 statements by IAEA concerning the inspections during the year 2004. Eight statements of the inspections carried out during the year 2004 were not yet received in March 2005. There were no remarks about the outstanding questions in the statements.

## 4.7 Euratom safeguards

The Treaty of the European Atomic Energy Community (Euratom Treaty) and the EU Safeguards Regulation (3227/76) (amended by Regulation No 302/2005) 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

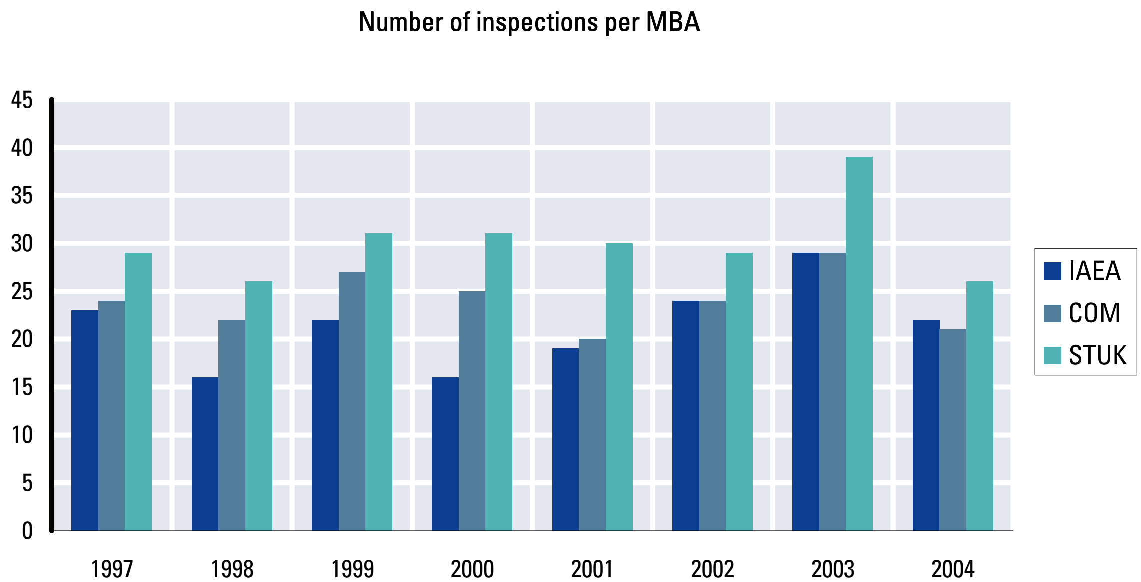


**Figure 5.** Number of inspections carried out by the Commission, IAEA and STUK at Finnish Facilities 1997–2004.

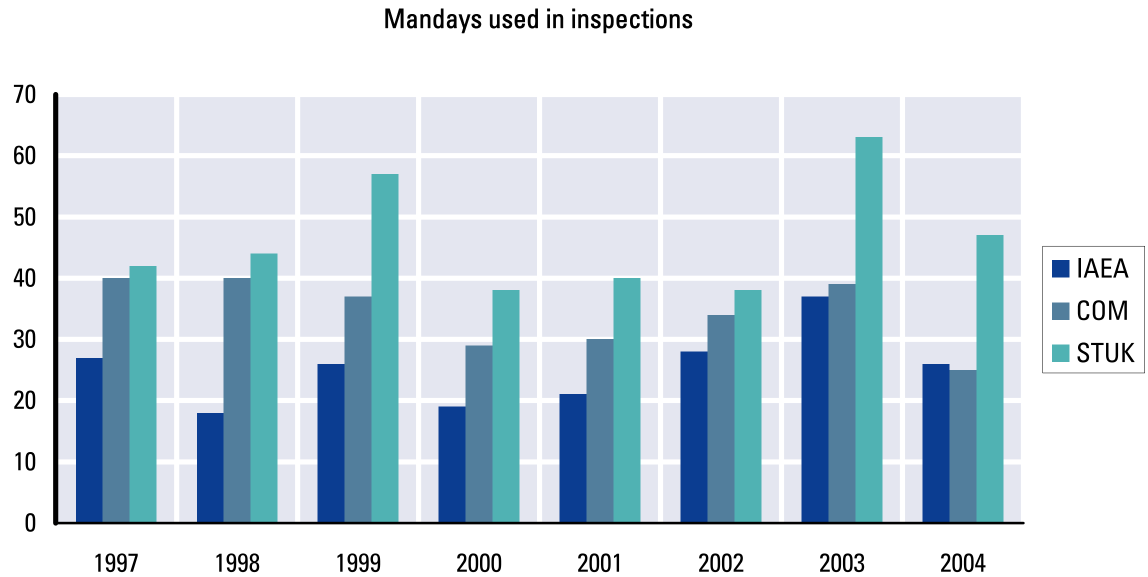


**Figure 6.** Number of inspection mandays during inspections carried out by the Commission, IAEA and STUK at Finnish Facilities 1997–2004.

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

| | Method | Characteristics | 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 (Neutron/Gamma Ray Verification) equipped with 20 mm3 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 (detector 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 separate detector above water level. HPGe or NaI detectors have been used. |

submit reports and other data to the Commission 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 Commission 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 Commission 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 takes care of the consulting (Euratom Treaty, article 81) of the Commission inspectors for Finland. STUK has sent the requests of the new Commission safeguards proposed inspector candidates for comments to the largest nuclear material holders. No remarks were made. In 2004, altogether 5 new Commission safeguards inspectors were consulted to inspect Finnish nuclear installations. There were a total of 190 Commission inspectors that had the right of inspection in Finland on December 31, 2004.

The IAEA statements was sent to the Commission, and the Commission amended its own conclusions to the statements before providing them to the State. The conclusions by the Commission were in line with the IAEA remarks – there were no outstanding questions at the end of 2004.

## 4.8 STUK´s spent fuel verifications

The measuring systems are the same than in year 2003. 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, 25$^{th}$ Annual Meeting, Stockholm, May 2003*, available on CD, ISBN 92-894-5654-X).

**Table VI.** Spent fuel measurements in Finland in 2004.

| Location | Date | Measured assemblies | Method |
|---|---|---|---|
| Olkiluoto KPA | 29.6.–1.7. | 23 | GBUV |
| VTT with PIV | 23.8. | 4 | IAEA instrument |
| Olkiluoto KPA | 7.–8.9. | 125 | SFAT |
| Loviisa 1 reactor hall | 7.10. | 13 | FORK (IAEA device) |
| Loviisa KPA old storage | 14.–16.12. | 129 | SFAT |

The system itself is adequate to run the regular measuring programme consisting typically two inspections per nuclear power plant per year and all types of fuel.

In December 2004 STUK received new gamma spectrometric software "Unisampo", which runs in Linux operating system, which was used in Loviisa SFAT campaign. The experience was very good, because the system was very reliable and stable. Also the new software is simpler to operate than the previous version. However, some essential functions should be added to the software before it fully satisfies STUK's needs.

STUK made three measuring campaigns of spent nuclear fuel in 2004. The campaigns are listed in Table VI. The table includes also Fork-measurements made in Loviisa 09/2004, which STUK also participated and independently analysed the results. No anomalies were observed.

# 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 proceeded to the underground phase in 2004 when the excavation of the tunnel system for bedrock characterisation at repository site begun. The final disposal facility will consist of the surface installations including the encapsulation plant and the underground galleries. In general, the siting 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 is not subject either to the Finnish Nuclear Energy Act or to the Commission Safeguards Regulation COM 302/2005 until it is evident and it has been accepted that spent fuel will be moved through these tunnels to final disposal. 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, the safeguards approach in the pre-operational phase at Olkiluoto site is requested. 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. Although the underground rock characterisation facility is declared as the States general nuclear fuel cycle related plan under the Additional Protocol, STUK has made a proposal towards the IAEA to share knowledge about the progress at the repository site in order to enable the IAEA to fulfil its obligations.

**Figure 7.** The implementing company Posiva is presenting its activities at the ONKALO to the IAEA delegation.

**Figure 8.** Underground excavation of the research galleries for final disposal of spent nuclear fuel begun in 2004.

## 5.2 National system for final disposal

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 repository area, needed 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. In addition, the group collected baseline data for safeguards purposes using geophysical, i.e. passive seismic techniques and satellite imagery during 2003.This work continued in 2004 to evaluate the methods for their relevance concerning the safeguards. During the construction of the underground galleries, the responsibility to generate the safeguards relevant data is at the implementing company.

The safeguards meetings between Posiva and STUK have been organised regularly. The main target was to find the most concrete solution for the national safeguards measures in case of an unusual “facility”. By the end of 2004 STUK defined the requirements of how to implement the safeguards in ONKALO, and Posiva provided the first safeguards reports to STUK.

Also a meeting between IAEA, Posiva and STUK was organised. The aim of the national requirements, concerning presently ONKALO and later the repository, is to meet and cover all the international needs. The drafting of “Safeguards Agreement for ONKALO” has been initiated with the IAEA.

## 5.3 International model

Underground facilities for final disposal of spent create a new challenge to the safeguards society. The main concern is that after safe disposal in the subsurface, there is still a need to have a credible assurance about the absence of safeguards-relevant activities, although the nuclear materials are not accessible or reverifiable using the traditional safeguards technologies. Therefore, new geophysical methods are supposed to play a remarkable role in safeguarding repositories. STUK has evaluated these methods site-specifically for Olkiluoto in co-operation with the expert’s group supporting the IAEA.

# 6 Transport of radioactive and nuclear materials

Transport of nuclear material is subject to transport licence as stipulated in the Nuclear Energy Act. These licencens are usually granted for a longer period and no new transport licences were granted in 2004. For each transport, there must be a transport plan approved by STUK. Also a physical protection plan and a certificate of nuclear liability insurance is 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 2004, 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, where it was loaded onto trucks and driven to Loviisa power plant. In 2004 STUK approved six package designs by validation of a foreign certificate. Three transport plans for import or export of nuclear fuel were approved. In addition, three package designs were validated for transit shipments.

# 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 2004 there was no such case (Table VII). The co-operation 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.

**Figure 9.** Automatic portal radiation monitor controlling cargo traffic at the Port of Helsinki.

**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 |
| 2004 | 0 |

STUK will continue to participate in the international work in preventing nuclear terrorism and illicit trafficking of radioactive and nuclear material. In 2004 STUK participated in a meeting arranged by the 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.

# 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 2004 the National Data Centre participated in the meetings of the working 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. The National Data Centre provided a training course for NDC managers from developing countries. The course was funded by the Ministry for Foreign Affairs. The National Data Centre continued developing its own routine monitoring system for the data received from the international verification regime. During 2004 no anomalies were observed among the monitoring results.

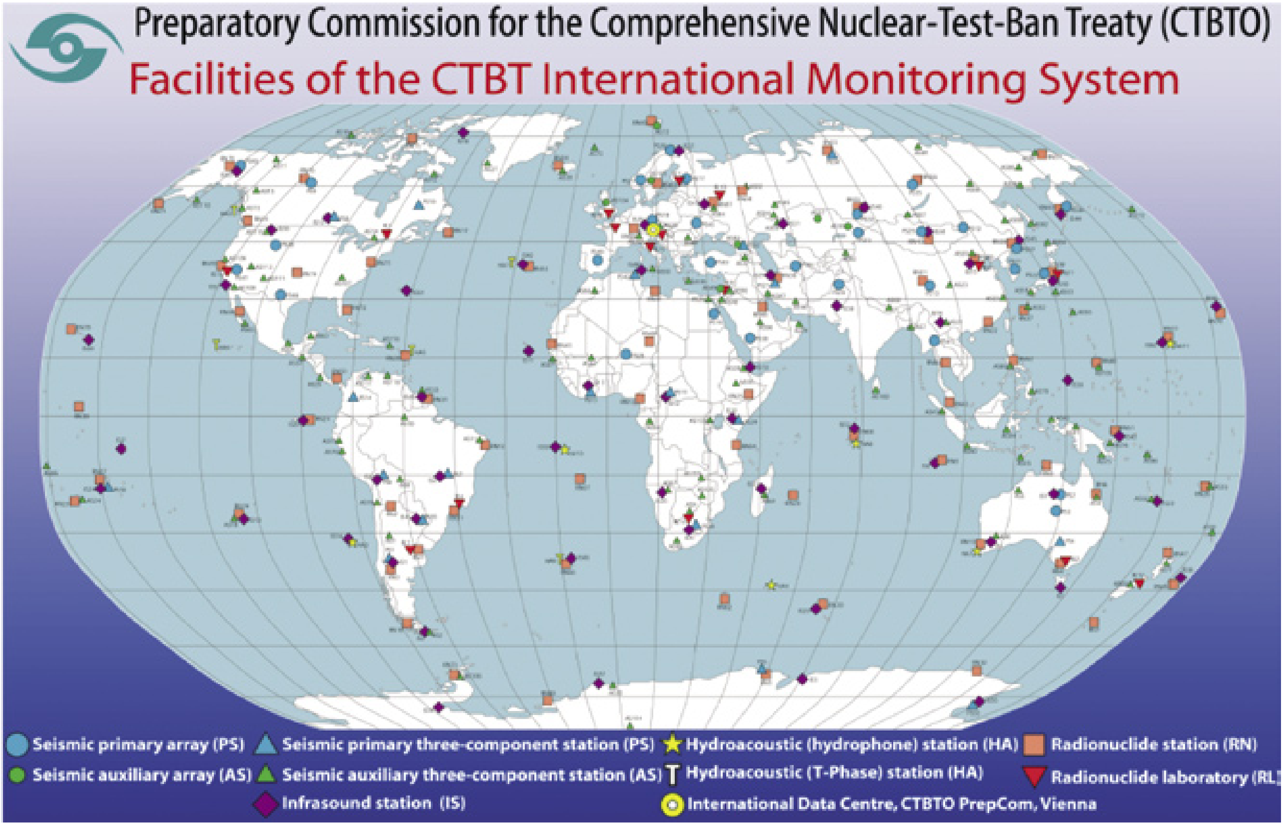


**Figure 10.** The network of 321 monitoring stations supported by 16 radionuclide laboratories, will be capable of detecting shock waves from a nuclear explosion underground, in the seas and in the air, as well as radioactive particles and noble gases released into the atmosphere.

# 9 International safeguards cooperation

## 9.1 Hungary safeguards fit for the EU

The PHARE project of the European Commission on safeguards was carried out between Hungary, Finland and Sweden. The major objective was to provide expert support and advice for the Hungarian Atomic Energy Authority (HAEA) who operates the Hungarian State System of Accounting and Control (SSAC) in the development of the country's strategy for the accession. The project was successfully completed by the end of November 2004.

STUK acted as the lead organisation for the project implementation. Experts of SKI contributed effectively to the project. The HAEA was offered an opportunity hereby to appreciate a diverse set of information and experiences for its planning and decision making while preparing for the accession. All relevant areas of interest were addressed and questions relating to the legal system, operational experiences and practices as well as those relating to the R&D in the area of safeguards were responded to.

The project progressed in good atmosphere in accordance with the plan. The engagement of the Task Leaders and the efficient work of the Beneficiary were ensuring success. In addition to the normal progress review meetings, a meeting in Luxembourg with the officers of the Commission were held on 16.–17.9.2004. The aim was to ensure the visibility and understanding of the project and its outcomes as well as to reflect on issues of co-operation in the implementation.

**Figure 11.** Mr. A. Peto (HAEA) highlighting the major achievements to the Project Manager Mr. E. Deksnis from the Commission, in Budapest on 4.11.2004.

The final meeting of the project was conducted in Budapest in the premises of the HAEA on 4.–5.11.2004. The Project Manager Mr. Eduard Deksnis from the European Commission's Enlargement Directorate-General was present and informed about the findings and final results of the project. His experience, comments and guidance contributed to the quality of the Final Report.

As a result of this project and changes in the area of international safeguards the question about the sustainability of the work done appeared as an important one. It was understood that further work will be required in the area of infrastructure, organization, resources and implementation processes. In order to precede the following ideas discussed briefly and are hereby reproduced for information:

- HAEA and the Operators will, on the basis of the results and recommendations, make further efforts to enhance the infrastructure, net work of competences and functions of the national system, so as to be in a position to continue supporting the further strengthening of the security relevance of safeguards.
- This project brought together competencies in the Commission, Hungary, Sweden and Finland and developed the process that could be useful, as one of the resources, for the Commission in its efforts to ensure the adequacy of the safeguards in other EU member states.

- Further to the above, this experience and the resources could be seen as an asset in the context of EU programs aimed at improving security of nuclear and other radioactive materials in Russia, Ukraine and Bulgaria, for example.
- The Hungarian safeguards R&D programme, infrastructure and competences should be integrated into the European research area.

## 9.2 Safeguards co-operation in the neighbour areas

The safeguards co-operation with the neighbouring areas is motivated by the need for continuing enhancement of the regional security environment. Accordingly Finland had a safeguards support programme for Estonia, Latvia and Lithuania as well as continue its co-operation with Russian Federation in this area.

Because the Baltic States joined the European Union in 2004 the support programme that was funded by the Foreign Ministry was finished and collaboration continued within the framework of the Union programmes and institutions. In addition, STUK continue to maintain contact, as need arises, with the regulatory authorities of these States. The issues of interest cover such areas as maintenance and development of the national systems, including that responding to the Comprehensive Nuclear Test Ban Treaty (CTBT), nuclear material accountancy, physical protection and export/import control issues.

The resources of about 150 000 Euros made available by the Foreign Ministry were, during the year 2004, used within the Co-operation programme with Russian Federation. The projects covered development of regulations and exchange of experiences in regulating and controlling the nuclear materials and other radioactive substances. Co-operation was extended to cover also a case where an inspector from STUK was present in person during an inspection of nuclear material carried by the Russian Authority. The aim of this exercise is enable the parties to improve their practices in implementation of the respective powers. The experiences of this exercise will be assessed in STUK during the current programme. Further to this the construction in Finland of a spent fuel measurement device (SFAT) for the demonstration purposes at Kola NPP was initiated. The purpose is to provide an in situ opportunity for the Russian operators and Authority to get acquainted with the project, technology and its application. Finally, a course was organized for the officers of the Russian and Finnish customs. This was planned to be the first one in the series of courses (about 8) extending over years with the aim over covering the border of the Russian Federation. Implementation of the projects is carried out by STUK in co-operation with the Finnish nuclear facilities and experts from other organizations like the State Research Centre.

## 9.3 Finnish support programme to the IAEA safeguards

In 2004 the Ministry for Foreign Affairs allocated 200 000 Euros for the Finnish Safeguards Support Programme to the IAEA which was implemented under the coordination of STUK. Active participation of the Finnish nuclear facilities and other expert organisations in Finland is essential for the realization of the programme tasks. Major tasks require also cooperative efforts with the other IAEA Member States' support programmes. The most remarkable support task in 2004 was the development of a new IAEA training course concerning implementation of the Additional Protocol. Other support consisted of training of the IAEA inspectors in using verification instruments, development of safeguards measurement and analysis methods and support tasks related to the final disposal of spent fuel.

**Figure 12.** First Complementary Access Course in Finland in October 2004.

## 9.4 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 participated in ESARDA's working groups, especially the Integrated Safeguards working group (IS WG). STUK contributed to the ESARDA's symposium in Luxembourg with two presentations. STUK participated in the ESARDA Executive Committee meetings where a new ESARDA Agreement was negotiated.

## 9.5 Nordic Society

The Nordic Society, Seminar on Non-Proliferation Issues, was organised by STUK on October 5–6, 2004 in Helsinki. The seminar covered most of the topical issues regarding non-proliferation of today. Director General of STUK, Professor Jukka Laaksonen opened the seminar. It was followed by a topical presentation by the IAEA and the Commission. Implementation and the first steps towards to implementation of the Additional Protocol in Norway, Sweden, Finland and Estonia as well as the further implementation work in Hungary and Lithuania were on the agenda. Political perspective for non-proliferation was presented by the Ministry for Foreign Affairs of Finland. Other interesting topics were the co-operation with Russian Federation, physical protection and border control. The last but certainly not the least topic was the safeguards for final disposal.

**Table VIII.** Finnish representatives in ESARDA organisation.

| 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 Working Group | Käthe Sarparanta, TVO |

**Figure 13.** Käthe Sarparanta (TVO), Veli-Matti Ämmälä (Posiva) and Anna-Maija Kosonen (TVO) concentrating on the messages of the Nordic Seminar.

# 10 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. The implementation of the Additional Protocol was started rapidly. 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 2004 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 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 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 newfacilities and reporting from Euratom to IAEA).
   - Commission Regulation (Euratom) No 302/2005, 28 February 2005 (New Safeguards Regulation; came into force on March 2005).

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

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 have 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). Validity of the Agreement has been extended in 1999 and 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).

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.

# ANNEX 2 IAEA, Commission and STUK safeguards inspections in 2004

| General Information | | | Inspections | | | Inspection Mandays | | |
|---|---|---|---|---|---|---|---|---|
| **MBA** | **Date** | **Inspection type** | **IAEA** | **COM** | **STUK** | **IAEA** | **COM** | **STUK** |
| WLOV | 8 Jan. | Suplementary inspection | 1 | | 1 | 1 | | 1 |
| WLOV | 26 Jan. | FA inspection | | | 1 | | | 1 |
| WOLS | 9–10 March | Routine inspection | 3 | 3 | 3 | 3 | 3 | 6 |
| WLOV | 12 March | Routine inspection | 1 | 1 | 1 | 1 | 1 | 1 |
| WOL1 | 20–21 May | PIV | 1 | 1 | 1 | 2 | 2 | 2 |
| WOL2 | 31 May – 1 June | PIV | 1 | 1 | 1 | 2 | 2 | 2 |
| WOL1,WOL2, WOLS | 8–9 June | Routine inspection | 3 | 3 | 3 | 3 | 3 | 3 |
| WLOV | 10 June | Routine inspection | 1 | 1 | 1 | 1 | 1 | 1 |
| WOLS | 29 June – 1 July | STUK GBUV | | | 1 | | | 6 |
| WRRF | 23 Aug. | PIV | 1 | 1 | 1 | 1 | 1 | 1 |
| WLOV | 25–26 Aug. | Loviisa 1 core verification | 1 | 1 | 1 | 2 | 2 | 2 |
| WOL1,WOL2, WOLS | 7–10 Sep. | STUK SFAT + WOLS PIV + routine inspection | 3 | 3 | 4 | 3 | 3 | 10 |
| WLOV | 11 Sep. | Loviisa 2 core verification + PIV | 1 | 1 | 1 | 1 | 1 | 1 |
| WLOV | 7 Oct. | POST PIV | 1 | 1 | 1 | 1 | 1 | 1 |
| WOL1,WOL2, WOLS | 29–30 Nov. | Routine inspection | 3 | 3 | 3 | 3 | 3 | 3 |
| WLOV | 2–3 Dec. | Routine inspection | 1 | 1 | 1 | 2 | 2 | 2 |
| WLOV | 14–16 Dec. | STUK SFAT | | | 1 | | | 4 |
| **TOTAL** | | | **22** | **21** | **26** | **26** | **25** | **47** |

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