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NUCLEAR SAFEGUARDS IN FINLAND 2005

Marko Hämäläinen (ed.)

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Summary

This report describes safeguards implementation in Finland in 2005. 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, the safeguards for final disposal and finally, the statement of the Finnish nuclear safeguards during the year 2005.

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
- R&D activities related to the nuclear fuel cycle
- the manufacturing and the export control of the dual use equipments, and
- the safeguards for the final disposal.

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. 302/2005, which came into force in 20 March 2005. Reporting format of the Commission Regulation No. 3227/76 is still used by Finnish operators.

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, safeguards duties belong to the Nuclear Waste and Materials Regulation Department (see organization chart, Figure 1). The department has 23 staff members and the following duties: 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 Mr Tero Varjoranta. In addition to the Nuclear Materials Section, two key staff members deal with safeguards: Ms Arja Tanninen, deputy director, is responsible for licensing issues related to nuclear materials; Mr Juha Rautjärvi coordinates the nuclear safeguards co-operation programme with the Russian Federation, and contributes to the non-proliferation issues.

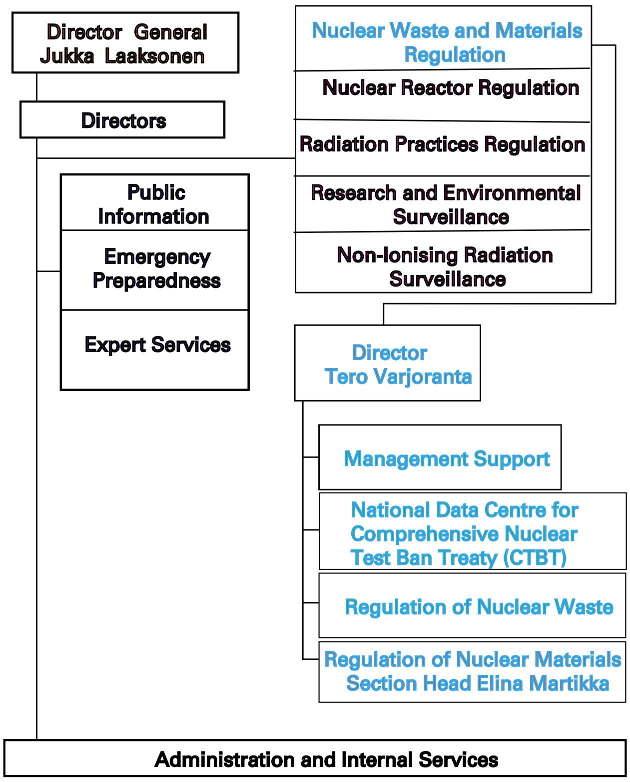

Figure 1. Nuclear Materials Section in the organisation of STUK.

Figure 2. Staff of Nuclear Materials Section.

Seven experts (one of them part-time) were working in the Nuclear Materials Section in 2005:

- Ms Elina Martikka, Section Head (national system, Additional Protocol [AP] implementation); back middle
- Mr Tapani Honkamaa, Senior Inspector (Non-Destructive Analysis (NDA), coordinator of FIN SP to IAEA safeguards)
- Mr Marko Hämäläinen, Inspector (inspections, AP implementation); front left
- Mr Kauko Karila, Inspector (reporting, documentation)
- Mr Olli Okko, Senior Inspector (research and development [R&D], final disposal); front right
- Mr Jaakko Tikkinen, Senior Inspector (transportation, illicit trafficking); front middle
- Ms Anna Lahkola, Inspector (reporting, transportation); joined in December 2005; back right.

Ms Paula Karhu, Inspector (new verification methods); back right of the picture; started in the Nuclear Materials Section on 2.1.2006.

3 Themes of the year

Implementation of the Additional Protocol and the Safeguards for Final Disposal have been the major challenges during the year 2005, as well as the construction of the new nuclear power plant OL3 in Olkiluoto.

3.1 Additional Protocol (AP)

Additional Protocol came into force in the European Union on 30 April 2004. The objective of the AP is to assure the IAEA of the absence of undeclared nuclear material and activities. The main part of this work are the declarations concerning activities carried out in the state.

There are three different sets of declarations concerning Finland, depending on who is responsible for preparing and submitting a declaration: state, (European) Commission or both.

In Finland, the state has delegated its responsibility for the declarations to STUK. STUK collects, inspects, reviews and then submits the information of those matters for which the state is wholly or partly responsible. In other words, STUK prepares and submits the declarations under articles 2a(i), 2a(iv), 2a(viii), 2a(ix), 2a(x), 2b(i) to the IAEA. As a “site representative” STUK prepares the site declarations under article 2a(iii) to be submitted to the Commission, which forwards them to the IAEA. The Commission prepares and submits the declarations under articles 2a(v)–2a(vii) to the IAEA. Depending on the aforementioned responsibilities, STUK and Commission prepare answers to any IAEA questions. STUK participates also to all IAEA safeguards activities in Finland. The Additional Protocol activities so far were:

2004

- Initial declarations
  - STUK submitted the initial declarations to IAEA and Commission 8 July 2004
  - Commission submitted initial declarations to IAEA 22 September 2004
- Complementary Access at HYRL site (University of Helsinki, Radiochemistry Laboratory), 24 h notice, 21 December 2004.

2005

- Annual updates
  - STUK provided the updated site declarations to Commission 31 March 2005
  - STUK submitted updated declarations to IAEA 4 May 2005
  - Commission submitted updated declarations to IAEA 13 May 2005.
- 2c questions
  - IAEA submitted three sets of questions to STUK and Commission (one for state, one for Commission anf one for both) 15 July 2005
  - STUK answered to IAEA questions 8 September 2005
  - Commission answered to IAEA questions 13 December 2005 and 24 January 2006
- Complementary Access at Olkiluoto site, 2 h notice, 13 September 2005.
- Complementary Access at STUK site, 24 h notice, 7 December 2005.
- STUK has submitted 2a.(ix)(a) declarations to IAEA and Commission on a quarterly basis: reported exports have concerned autoclaves exported to the Russian Federation by Fortum Nuclear Services.

In 2005 STUK and the Commission submitted to the IAEA 22 declarations concerning Finland. All together, 36 declarations have been submitted to the IAEA to date. STUK has provided all the information that the IAEA has requested in the given submission times.

STUK has actively taken part to the experts meetings on the topic of AP - the Atomic Questions Group meetings, IAEA technical meetings and the Commission meetings organised for member states as well as ESARDA meetings. An example is the Technical Meeting to the Transition to Integrated Safeguards for the member states, 12-15 September 2005, which IAEA organised in Bad Tatzmannsdorf in Austria. The main topic there were safeguards approaches concerning integrated safeguards. In 2005, STUK also organised, within the Finnish Support Programme for the IAEA Safeguards, two Complementary Access training courses in Finland for the IAEA safeguards inspectors. The related on-site training exercises were organised at Loviisa, VTT and STUK sites.

3.2 Safeguards for final disposal

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 re-verifiable using the traditional safeguards technologies. 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. The implementation was commenced with the underground excavation, before of the traditional time lines for conventional nuclear facilities. The first interim report was delivered to the IAEA on 8.7.2005. Moreover, the performance of the national system was demonstrated to the IAEA on 16.9.2005.

3.3 Olkiluoto 3

The Finnish Government granted the licence for constructing a new nuclear power plant, Olkiluoto 3, on 17.2.2005. In this connection, the constructor's plan for arranging the necessary measures for preventing the proliferation of nuclear weapons was approved by STUK. Construction of the reactor vessel and related internal parts of the reactor continued in Japan. The Ministry for Foreign Affairs of Finland gave to the Embassy of Japan the NSG assurances on the fuel channels to be shipped to Finland by December 31, 2010.

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 2005 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.

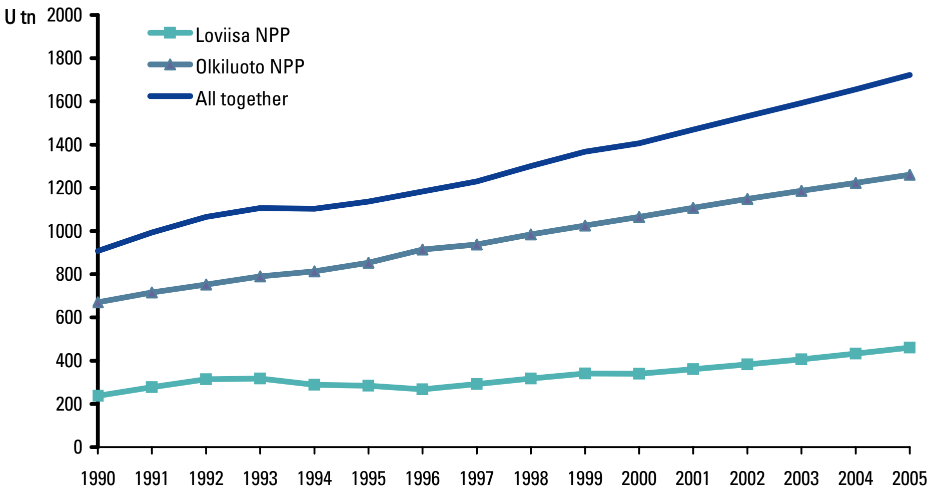

Figure 3. Uranium amount in Finnish nuclear power plants in 1990–2005.

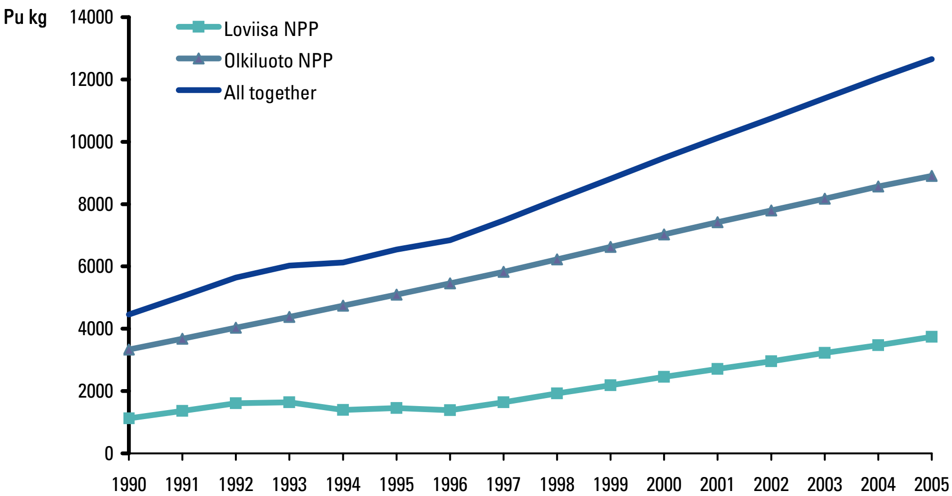

Figure 4. Plutonium amount in Finnish nuclear power plants in 1990–2005.

Table I. Summary of nuclear materials receipts and shipments in 2005.

To	From	FA	LEU (kg)	Pu (kg)
WOL1	Spain	110	19 475	–
WOL2 (1/2)	Sweden	72	12 194	–
WOL2 (2/2)	Sweden	48	8 130	–
WOLS	WOL1	287	47 497	422
WOLS	WOL2	41	6 988	48
WLOV	Russia	132	15 823	–
WLOV	Spain	108	13 544	–
Russia	WLOV	1	120	–

WOL1, WOL2 & WOLS = Olkiluoto NPP, WLOV = 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 2005, the Ministry of Trade and Industry granted an export license for returning one fresh fuel assembly to the Russian Federation. Based on previously granted import licences, in total 240 fuel assemblies containing 29.4 tons of uranium were imported to the Loviisa NPP: 132 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, and total amounts of nuclear materials are presented in Tables II and III.

The refuelling and maintenance outage of Loviisa 1 was performed during 30.7. – 16.8.2005,

Table II. Fuel assemblies in nuclear power plants on December 31, 2005.

MBA	FA/SFA *)	LEU (kg)	Pu (kg)
WLOV	3 981/3 176	460 990	3 744
WOL1	1 111/535	188 799	775
WOL2	1 139/581	193 224	877
WOLS	5 166/5 166	878 827	7 256

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)

and that of Loviisa 2 during 20.8.–5.9.2005. In both Loviisa 1 refuelling and Loviisa 2 refuelling, 108 fresh fuel assemblies were loaded into the cores. Before closing of each reactor, STUK, the IAEA and the Commission identified the fuel assemblies in the reactor cores and verified the fuel assemblies in the loading ponds. Loviisa 1 was inspected on August 7, 2005 and Loviisa 2 on August 27, 2005. Four routine inspections were performed together with the IAEA and the Commission in March, June, September and December. In addition, during the inspection in August 7, the IAEA also measured 9 fuel elements in Loviisa reactor 1 hall. STUK's measurements in Loviisa are reported in Chapter 4.9.

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

Table III. Nuclear material amounts in Finland on December 31, 2005.

MBA	U-Natural (kg)	U-Enriched (kg)	U-Depleted (kg)	Plutonium (kg)	Thorium (kg)
WL0V	–	460 990	–	3 744	–
W0L1	–	188 799	– [a)]	775	–
W0L2	–	193 224	–	877	–
W0LS	–	878 827	–	7 256	–
WRRF	1 511	60.1	0.002	–	–
WFRS	44.7	1.4	592.4	0.003	2.5
WKK0	2 419	–	–	–	–
WHEL	40.4	0.3	20	0.003	2.5
Others[b)]	< 0.1	–	817	< 0.01	–

WRRF = VTT FiR-1/VTT Processes; WFRS = STUK; WKK0 = 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

owns and operates two nuclear power plant units and an 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 2005, STUK granted three import licences for nuclear fuel to TVO. In total, 230 fuel assemblies containing 39.8 tons of uranium (3.5%) was imported to the Olkiluoto NPP, 110 from Spain and 120 from Sweden. The receipts and shipments of fuel assemblies are stated in Table I, and the total amounts of nuclear materials are presented in Tables II and III. TVO appointed three persons to be responsible for nuclear material control at the TVO NPP. After examination STUK approved them all.

The refuelling and maintenance outage of Olkiluoto 1 was performed during 5.–12.6.2005 and that of Olkiluoto 2 during 8.–30.5.2005. In Olkiluoto 1 refuelling, 106 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 June 10, 2005 and Olkiluoto 2 on May 22–24, 2005. STUK, the IAEA and the Commission verified the inventory in Olkiluoto Spent Fuel Storage on November 28, 2005. Four routine inspections were performed by STUK, the IAEA and the Commission (for each MBAs) in Olkiluoto: in February-March, June, September and November 2005. STUK's measurements in Olkiluoto NPP are reported in Chapter 4.9.

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.

IAEA conducted Complementary Access at TVO site in connection with the routine inspection in September. Complementary Access was directed mainly to site's waste handling capabilities.

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 20 June, 2005. 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 2005 is presented in Table III.

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)	–	–	–	0.001174	–	–	SF 0293 CA, Minor NM activities
Finnair Engineering	15.5	–	–	–	–	–	SF 0302 CA, DU radiation shielding
Rautaruukki, Raahe Works	163	–	–	–	–	–	SF 0303 CA, DU radiation shielding
Inspecta	304	–	–	–	–	–	SF 0304 CA, DU radiation shielding
Outokumpu Stainless	100.98	–	–	–	–	–	W0KU, DU radiation shielding
Centre for Technical Training, Metal and Machinery	15	–	–	–	–	–	DU radiation shielding
Polartest	163.2	–	–	–	–	–	WF1P. DU radiation shielding
MAP Medical Technologies	55	–	–	–	–	–	SF 0325 CA, DU radiation shielding
Metorex International	–	0.0105	–	–	–	–	U-nat standards
University of Jyväskylä, Dept. of Physics	–	0.003	–	0.000001	0.01	0.1	WDPJ, Basic research

4.4 Minor nuclear material holders

The locations 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. In 2005 there were no shipments. OMG Kokkola Chemicals has an operation license to store max 20 000 kg of uranium in this solution.

In the end of 2005, 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 targets irradiated with accelerator ion beams or as radiation sources in calibration of radiation detectors for basic research of nuclear structure. A list of minor nuclear material holders including close down locations is presented in Table IV.

On 7 December 2005 IAEA conducted complementary access (CA) according to AP in STUK site. CA was made according to 24 h notice.

4.5 Other nuclear items

The Finnish Nuclear Energy legislation regulates also other nuclear items than nuclear material. Possession, transfer, imports and exports of those items requires a licence or at least a notification to STUK. STUK granted Fortum Power and Heat Oy a licence to export nuclear information to Germany, and TVO a license to import two zirconium tubes from Sweden. The Ministry of Trade and Industry granted Fortum Nuclear Services a license to export APROS software to China. It also granted STUK two licenses to export the same software to the Russian Federation and Ukraine.

4.6 Geological repository

In summer 2004, the first concrete step in the Finnish final repository was taken as the excavation of the geological site characterisation tunnel, ONKALO begun. The ONKALO most probably will be a part of the final repository in the future as one of the access tunnels. 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. In connection with this, POSIVA appointed a person responsible for nuclear non-proliferation control of the ONKALO and prepared a safeguards manual to be applied in the similar manner as the Nuclear Material Handbook of a licensed material holder already in the pre-nuclear phase of the repository. After examination, STUK approved both in summer 2005.

During the fist year of underground excavations STUK carried out 14 inspection activities to ensure the sustainability of the long-term safety analysis of the planned repository. The safeguards-relevant findings of these inspections were reported to the IAEA in July 2005. In detail, STUK carried out 3 safeguards inspections to verify the as-built design information describing the excavated rock volumes. The IAEA participated in one of these inspections as an observer.

Figure 5. IAEA (Doug Dell, right) visiting at the opening of Onkalo ventilation shaft.

4.7 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 2005 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 2005 in Finland. This situation is not appreciated but it has not negatively influenced the implementation. Moreover, drafting of "Safeguards Agreement for the Finnish geological repository" was initiated with the IAEA in 2004. Consequently, a meeting between the IAEA, Posiva and STUK was organised at the Agency in September 2005 to establish formal safeguards between the State and the Agency already in the pre-nuclear phase of the repository. Sweden has a similar disposal concept to be implemented. Thus, Swedish organisations SKI and SKB, responsible for disposal of the Swedish spent nuclear fuel, participated in that meeting as observers.

STUK is responsible for the approval of the IAEA inspectors for Finland. After receiving the information about the new inspector candidates, STUK sends the requests for comments to those nuclear material holders who hold construction and operating licenses for nuclear facilities. In 2005, remarks were made on one inspector candidate by one of the nuclear material holders. STUK assigned the matter to the Ministry of Trade and Industry who did not approve the candidate. In 2005, altogether 18 new IAEA inspectors were approved to inspect Finnish nuclear installations.

In 2005 STUK has received 20 statements by the IAEA concerning the inspections it has carried out in Finland. The only remarks in these statements concerned internal cask transfers between KMPs at the Loviisa NPP. Due to one such unverified transfer, seen through surveillance system, IAEA performed spent fuel measurements for nine fuel assemblies in connection with the Loviisa 1

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.

core verification. To avoid aforementioned anomalies in the future, direct electronic reporting system for advance notifications was established between the Loviisa NPP and the IAEA HQ.

4.8 Euratom safeguards

The Treaty of the European Atomic Energy Community (Euratom Treaty) and the EU Safeguards 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 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 is responsible of the consulting (Euratom Treaty, article 81) of the Commission's inspectors for Finland. STUK has sent the requests of the Commission safeguards inspectors for comments to the nuclear material holders. In 2005, altogether 19 new Commission safeguards inspectors were appointed to inspect Finnish nuclear installations. 173 Commission inspectors had the inspection rights in Finland on January 1, 2006.

Table VI. Spent fuel measurements in Finland in 2005.

Location	Date	Measured assemblies	Method
Olkiluoto KPA	21.–22.6.	13	GBUV
Loviisa 1 reactor hall	7.8.	9	FORK (IAEA's device)
Loviisa KPA new storage	22.–23.11.	394	SFAT

In January 2005 Finland and the Commission had the bilateral safeguards meeting in Helsinki. The main topic in the agenda was to discuss about the New Euratom Safeguards Approches. It was also discussed about the field trial to be carried out in Finland to test the Commission's new approaches in practice. Also the Nuclear Material Handbook, the quality manual for how the operator implements safeguards in the facility, and which is approved by STUK, was presented to the Commission. It was stated that the Handbook will be the main tool when the Commission starts to implement the new approaches, especially when auditing of the operator's system.

The IAEA statements were 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 2005.

4.9 STUK's spent fuel verifications

The measuring systems are the same than in year 2004. 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*, available on CD, ISBN 92-894-5654-X).

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 two measuring campaigns of spent nuclear fuel in 2005. In June 13 spent fuel assemblies were measured with GBUV method at Olkiluoto KPA spent fuel store (W0LS) and November 394 items were verified with SFAT at Loviisa spent fuel storage (WL0V). The data acquired was consistent with operator declaration.

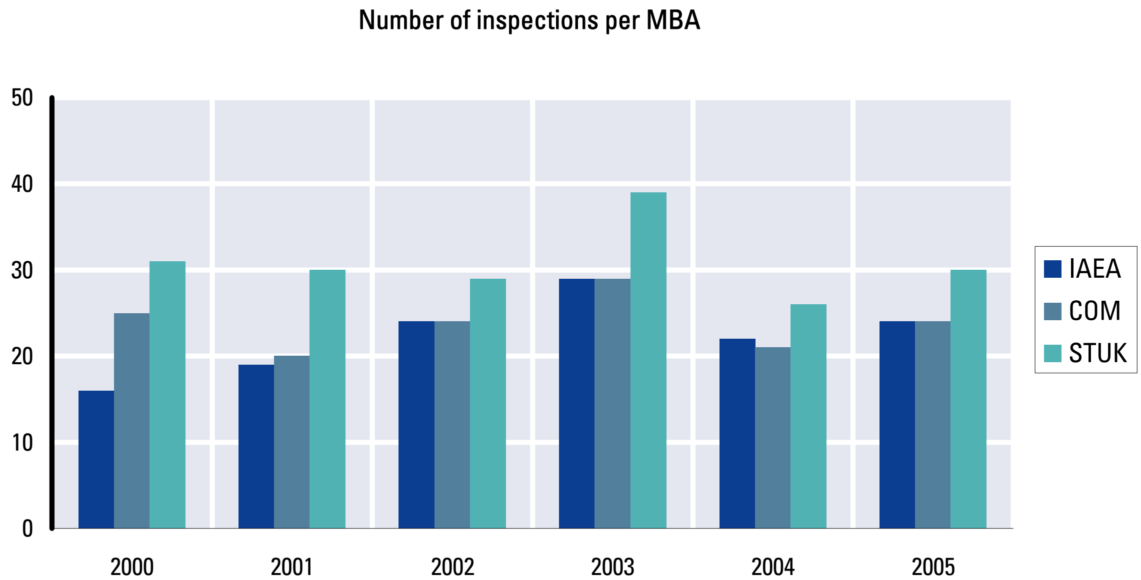

Figure 6. Number of inspections (incl. CA) carried out by the Commission, IAEA and STUK at Finnish facilities 2000–2005.

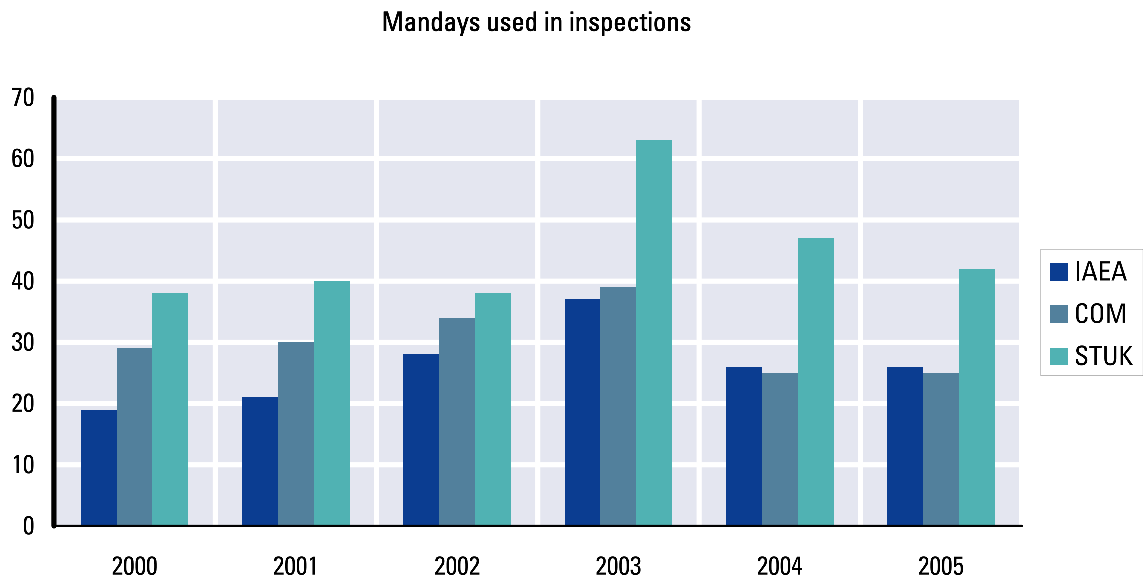

Figure 7. Number of inspection mandays during inspections (incl. CA) carried out by the Commission, IAEA and STUK at Finnish facilities 2000–2005.

4.10 New verification methods

4.10.1 Satellite imagery

The site declarations are to be verified by the authorities. Although, STUK has access to the Finnish nuclear facilities, the declarations generated by the operators need to be verified for their completeness and correctness. In order to confirm the comprehensiveness of the site maps they are compared with optical satellite imagery. Satellite imagery provides also a tool to monitor activities at the ground level remotely. STUK has participated in national research project to evaluate the applicability of commercial satellite radar and optical imagery in safeguards purposes.

4.10.2 Geophysical techniques

Geophysical sounding and monitoring methods may provide indirect indications of natural or man-made subsurface structures or activities in the subsurface underground depending on the local site specific soil and rock properties (Okko 2005). The applicability of the ground penetrating radar was analysed for its performance in safeguards applications (Saksa et. al 2005). Although geophysical methods can be considered as inconclusive in the classical safeguards, the remote passive seismic method is applied continuously at the repository site of Olkiluoto to confirm the absence of undeclared activities. The sounding methods need to be performed at the site.

4.10.3 Environmental sampling

Initial plans were laid out for a programme of swipe samples and analyses in support of strengthened national safeguards. The programme aims to enhance the system of nuclear materials inspections and to ascertain the consistency of declarations made to date.

5 Transport of radioactive and nuclear materials

In addition to the regulations concerning transport of dangerous goods, transport of nuclear material is subject to licence as stipulated in the Nuclear Energy Act. These licences are usually granted for a longer period and no new transport licences were granted in 2005. 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 2005, fresh nuclear fuel was transported into Finland from Spain, 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 2005 STUK approved six package designs by validation of a foreign certificate. Three transport plans for import of nuclear fuel were approved.

6 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 1990's there were several shipments for which the entry into Finland was denied because undeclared radioactivity in the cargo. The radioactivity was usually caused by contaminated material or by a sealed source among recycling metal. The maximum number of denials was in 1997 when 23 shipments were returned. Since 2001 the number of denials has been nil. The co-operation is also extended to border officers of neighbouring countries.

STUK will continue to participate in the international work in preventing nuclear terrorism and illicit trafficking of radioactive and nuclear material. In 2005 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.

Figure 8. Automatic radiation portal monitor at Raja-Jooseppi border station.

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 2005 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 2005 no anomalies were observed among the monitoring results.

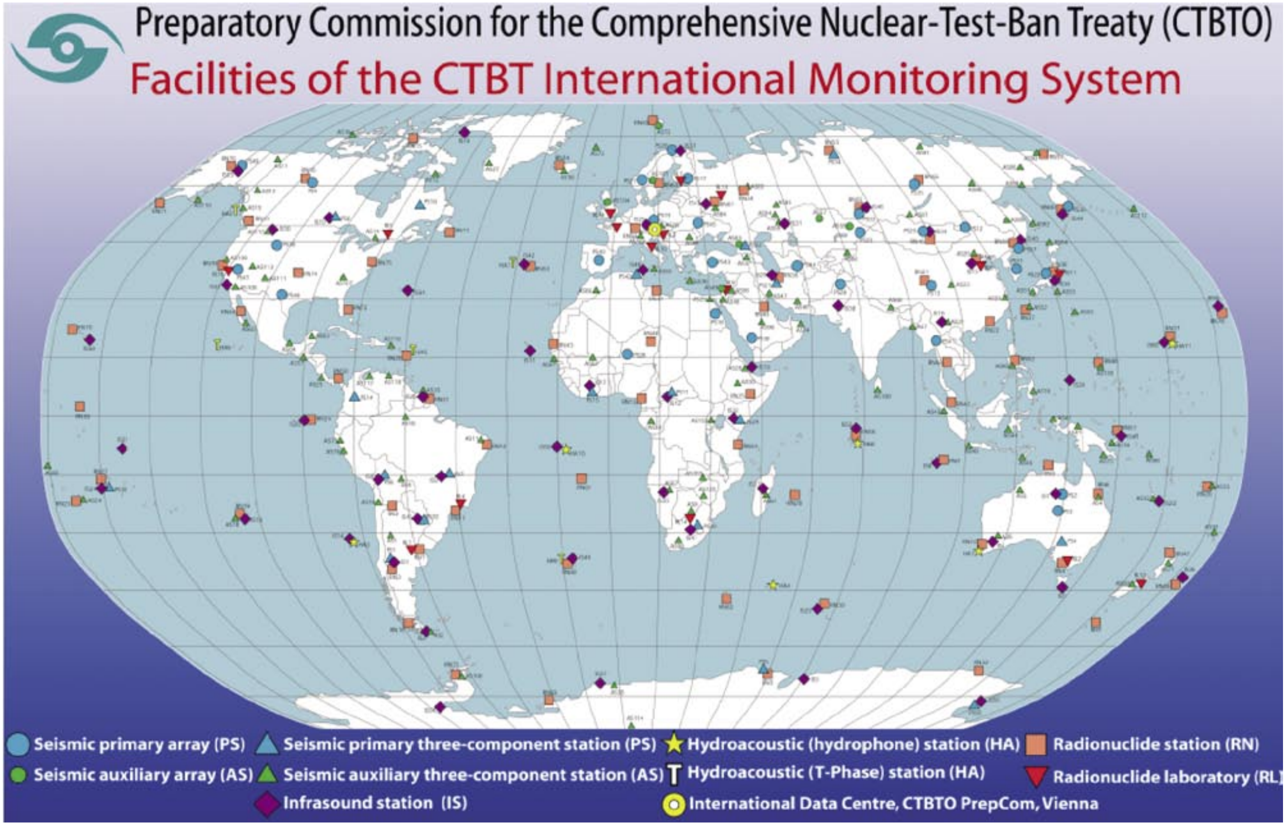

Figure 9. The network of 321 monitoring stations supported by 16 radionuclide laboratories, will be capable of detecting shock waves from a nuclear explosion underground, in the seas and in the air, as well as radioactive particles and noble gases released into the atmosphere.

8 International safeguards cooperation

8.1 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. The focus during this year has been on the cooperation with the Russian authorities.

The resources of about 150 000 Euros made available by the Foreign Ministry were, during the year 2005, used within the Co-operation programme with Russian Federation. The projects covered review of four regulations, two dealing with physical protection requirements for facilities and transportation. One was regulating targeted inspections and one established requirements for accountancy and control of radioactive substances and sources.

Co-operation was extended in 2004 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. During 2005 Rostechnadzor inspectors were present in the safeguards inspection at Loviisa NPP. The experiences were assessed and results proved to be very interesting for both parties.

The construction in Finland of a spent fuel measurement device (SFAT) for the demonstration purposes at Kola NPP is progressing. All required components have arrived and construction started. The Russian delegation participating in the annual review meeting visited the workshop and received technical brief from STUK on the task status. Administrative responsibilities were clarified to ensure timely completion of the project during 2006.

The scope of the programme was extended by organizing a seminar in the area of transportation of dangerous goods. Particular focus was on the practices, procedures and qualifications required in implementing the safety advisor function. The seminar was conducted in coordination with the Ministry of Transport and Communications, including the Finnish Vehicle Administration (AKE). This was done as a response to the expressed desire by the Russian Authority. Also one workshop and seminar was conducted in the area of regulating the MOX fabrication in Russia. These new tasks due to their importance and priority were undertaken during 2005 despite risking thereby stretching the limits of the given budget.

Finally, a workshop on the further development of the customs courses was organized instead of a course planned originally. The December timing of the course appeared not convenient. The IAEA, Russian Authority, Finnish Customs and STUK participated in the workshop. The new course agenda was developed, including the learning exercises in the Helsinki harbour and at the Vaalimaa boarder station. The parties were very satisfied with the outcome. The first new course will be held in Finland in February 2006.

The projects were carried out by STUK in co-operation with the Finnish nuclear facilities and experts from other organizations like the State Research Centre. The Ministry of Transport and Communications as well as the Finnish Vehicle Administration also provided important contribution thus ensuring successful results during 2005.
Attention of Finland was also directed to support Ukraine in their efforts to hold an international conference on safeguards and material security in Ukraine in January 2006. With the financial resources of this programme representative of STUK participated in the work of the coordination com-

mittee. Ukraine appears to be in need for support in implementation of the Additional Protocol obligations. This may have impact on the 2006 programme priorities.

8.2 Finnish support programme to the IAEA safeguards

For 2005 the Ministry for Foreign Affairs allocated 200 000 Euros for the Finnish Safeguards Support Programme to the IAEA (FINSP) which was implemented under the coordination of STUK. The key areas of the programme in 2005 were training of the IAEA inspectors and development of verification methods.

In 2005 FINSP organised two training courses for IAEA inspectors concerning implementation of the Additional Protocol. During the courses the trainees went through simulated Additional Protocol Complementary Access. The courses were held at STUK headquarters, VTT Research Reactor site and Loviisa NPP. The help of VTT and Loviisa NPP personnel is acknowledged.

In development of verification methods FINSP had two major tasks, which continue in 2005. Firstly, VTT developed a methodology to produce quality assurance samples for IAEA laboratories. The work included to set up apparatus to produce standardised uranium particles, which can be introduced to QA samples in known amounts. Secondly, FINSP took part in joint task of EC, Sweden and Hungary to develop new type of verification device for IAEA use. This device, known as Passive Gamma Emission Tomographic Verifier, is expected to be capable to detect single missing pin inside PWR

Figure 10. STUK's verification expert Tapani Honkamaa (left) is presenting the spent fuel measurement device (SFAT) to the Russian delegation at STUK.

assembly. The prototype is expected to be ready for testing in 2007.

8.3 Activities in ESARDA

STUK is a member of the European Safeguards Research and Development Association (ESARDA), and has nominated Finnish experts to committees and most of the working groups (see Table VII). 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 London with two presentations. STUK participated in the ESARDA Executive Board meetings where a new ESARDA Agreement was negotiated.

Table VII. Finnish representatives in ESARDA organisation.

Body of ESARDA	Member
Steering Committee	Elina Martikka
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

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 and other nuclear items at the end of 2005 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 302/2005, 8 February 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 expired on 20 February 1999.

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

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

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

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

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

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

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

ANNEX 2 IAEA, Commission and STUK safeguards inspections in 2005

General Information			Inspections			Inspection Mandays		
MBA	**Date**	**Inspection type**	**IAEA**	**COM**	**STUK**	**IAEA**	**COM**	**STUK**
ONKALO	30 Jan.				1			1
W0L1,W0L2, W0LS	28 Feb. – 1 March	Routine inspection	3	3	3	3	3	3
WLOV	3 March	Routine inspection	1	1	1	1	1	1
ONKALO	(18) – 24 May				1			1
W0L2	22 – 24 May	PIV	1	1	1	2	2	3
WLOV	7 June	Routine inspection	1	1	1	1	1	1
W0L1,W0L2, W0LS	9–10 June	Routine inspection + OL1 PIV	3	3	3	3	3	3
WRRF	20 June	PIV	1	1	1	1	1	1
W0L1 (+OL2)	21June	OL1 POST PIV (+OL2)	2	2	2	2	2	2
W0LS	21–22 June	STUK GBUV			1			5
WLOV	7 Aug.	Loviisa 1 core verification + IAEA FDET	1	1	1	1	1	1
WLOV	27 Aug.	Loviisa 2 core verification + PIV	1	1	1	1	1	1
W0L1,W0L2, W0LS	12–13 Sep.	Routine inspection	3	3	3	3	3	3
Olkiluoto site	13 Sep.	CA (2h notice)	1	1	1	1	2	1
WLOV	15 Sep.	Routine inspection	1	1	1	1	1	1
WLOV	22–23 Nov.	STUK SFAT			1			6
W0L1,W0L2, W0LS	28–29 Nov.	Routine inspection	3	3	3	3	3	4
W0L1,W0L2, W0LS	30 Nov.	System inspection			1			1
WLOV	1 Dec.	Routine inspection	1	1	1	1	1	1
STUK site	7 Dec.	CA (24h notice)	1	1	1	1	1	2
ONKALO	21 Dec.				1			1
TOTAL			**24**	**24**	**30**	**25**	**26**	**42**

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