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Directorate H – Nuclear Energy
Radiation protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

ESTONIAN NATIONAL MONITORING NETWORK FOR ENVIRONMENTAL RADIOACTIVITY

REPUBLIC OF ESTONIA

19 to 23 September 2005

Reference: EE-05/04

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

FACILITIES	Monitoring network for environmental radioactivity in Estonia
SITES	Tallinn, Harku, Paldiski, Sillamäe, Kunda
DATE	19 to 23 September 2005
REFERENCE	EE-05/04
INSPECTORS	V. Tanner (team leader)
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DATE OF REPORT	10.3.2006

SIGNATURES

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TECHNICAL REPORT

ABBREVIATIONS

BSS	Basic Safety Standards
DG TREN	Directorate General for Energy and Transport
EC	European Commission
EIA	Environmental Impact Assessment
ERPC	Estonian Radiation Protection Centre
EURDEP	European Radiological Data Exchange Platform
FWHM	Full Width at Half Maximum
GM	Geiger-Müller
HELCOM	Helsinki Commission
HPGe	High Purity Germanium
IAEA	International Atomic Energy Agency
IRMM	Institute for Reference Materials and Measurements
ISO	International Standardization Organization
MCA	Multichannel Analyser
NPP	Nuclear Power Plant
QA	Quality Assurance
STUK	Finnish Centre for Nuclear and Radiation Safety
TLD	Thermoluminescence Dosimetry
UPS	Uninterruptible Power Supply

1. INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards (BSS)[1].

Article 35 also gives the European Commission (EC) the right of access to such facilities in order that it may verify their operation and efficiency.

For the EC, the Directorate-General for Energy and Transport (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) is responsible for undertaking these verifications.

For the purpose of such a review, a verification team from DG TREN visited sites located in Estonia, which are part of the national monitoring system for environmental radioactivity. The visit included meetings with representatives of the Estonian Radiation Protection Centre, The Estonian Meteorological and Hydrological Institute, the State Veterinary and Food Board, the Ökosil Company and the Alara Company.

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance in Estonia. The purpose of the review was to provide independent verification of the adequacy of monitoring facilities for air, soil, water and foodstuffs.

With due consideration to the scope of the verification mission and taking into account the relatively short time available for the execution of the programme, it was agreed that emphasis would be put on:

- Structure of the national environmental monitoring and sampling programme,
- ERPC analytical laboratory,
- On-line automatic monitoring systems,
- Environmental monitoring programme at the Paldiski site and
- Environmental monitoring programme at the Sillamäe site.

The present report is also based on information collected from documents referred to in Appendix 1 and from discussions with various persons met during the visit, listed in section 2 below.

1 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation.

2. PREPARATION AND CONDUCT OF THE VERIFICATION

2.1. Preamble

The Commission's decision to request the conduct of an Article 35 verification was notified to the Estonian Government on 2 August 2005 (letter referenced TREN.H4/CG/le D(2005) 103297, addressed to the Permanent Representation of Estonia to the European Union). The Estonian Government subsequently designated the Estonian Radiation Protection Centre (ERPC) to lead the technical preparations for this visit.

2.2. Preparatory documents

In order to facilitate the work of the verification team, some information was supplied in advance by the ERPC. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 1. The information thus provided has been extensively used for drawing up the descriptive sections of this report.

2.3. Programme of the visit

EC and ERPC discussed and agreed upon a programme of verification activities, based on a draft Communication by the EC, setting out the framework and modalities within which Article 35 verifications may be conducted.

A summary overview of the programme of verification activities is provided in Appendix 2. The verifications were carried out in accordance with the programme. The EC team was divided into two teams; one team carried out the verification of the foodstuffs monitoring programme and the Paldiski site and the other team was responsible for verification of the automatic monitoring systems and the Sillamäe site. Both teams participated in the verification of the ERPC laboratory.

2.4. Representatives of the Estonian competent authorities and the associated laboratories

During the visit the following representatives of the national authorities and other parties involved were met:

Estonian Radiation Protection Centre, Tallinn, representing the Ministry of the Environment

Ms. Merle Lust	director
Ms. Eia Jakobson	head of analytical laboratory
Ms. Evelyn Pesur	specialist, environmental monitoring
Ms. Monika Lepasson	specialist, environmental monitoring
Ms. Karin Muru	specialist, licensing of radiation practices
Mr. Toomas Kööp	adviser
Mr. Aldo Tera	specialist, early warning systems

Mr. Raivo Rajamäe	head of radiation monitoring department

Veterinary and Food Board, Tallinn

Ms. Inge Mängel	chief specialist, office for food of animal origin

Alara company, Paldiski

Mr. Joel Valge	head
Mr. Mart Varvas	technical adviser

Ökosil company, Sillamäe

Mr. Antti Siinmaa	project manager
Ms. Dina Shestakova	head of laboratory
Mr. Vladimir Nosov	technical manager
Ms. Ekaterina Shumilina	laboratory specialist
Ms. Nadezda Mironova	laboratory specialist

Estonian Meteorological and Hydrological Institute

Mr. Mati Leipalu	head of the meteorological station at Harku
Mr. Toomas Pruul	head of hydro-meteorological station at Narva-Jõesuu
Ms. Svetlana Werle	observer of the meteorological station at Kunda

The verification team acknowledges the co-operation it received from all individuals mentioned.

3. BACKGROUND INFORMATION

3.1. General

Estonia has no nuclear programme, but the legacy of the Soviet Union has left it with several radioactivity-related environmental issues, most important being the former naval nuclear training centre site at Paldiski and the Sillamäe uranium mining tailings pond, in addition to the general contamination of the environment by the Chernobyl accident. There are several operational nuclear reactors close to Estonia (Loviisa (Finland), Sosnovy-Bor (Russia) and Ignalina (Lithuania)), so monitoring of radioactivity in the environment is well justified.

Monitoring of radioactivity in environment and foodstuffs includes surveillance of artificial radiation and artificial radionuclides. Natural radiation and natural radionuclides are not included in the monitoring programme. Exposure to natural radiation is controlled by research activities if there is reason to suspect that natural radionuclides may cause unusually high exposure to the public (e.g. indoor radon and natural radionuclides in drinking water).

Due to the small area of the country and the fact that contamination of the Estonian natural environment may occur as result of a large scale radiological or nuclear accident in a neighbouring country, the whole territory is dealt with as one representative geographical region. In defining monitoring networks the principle of "sparse monitoring network"[2] has been followed. This is justified because of the smallness of the country and of the financial limitations

3.2. Responsible organisations

The Estonian Radiation Protection Centre (ERPC) is the competent authority towards the implementation of the Euratom Treaty radiation protection requirements in Estonia. It is the main responsible organization for the monitoring programme of radioactivity in environment and foodstuffs in Estonia. The responsibility of the overall monitoring is under the Ministry of the Environment. ERPC is in charge of the radiological monitoring under an annual contract and it receives an annual budget for this purpose.

Each year the content of the monitoring programme is agreed between the ERPC and the Ministry for Environment. A technical agreement is signed with the Estonian Meteorological and Hydrological Institute for providing maintenance of the automatic measurement stations and for performing sampling of airborne particles and radioiodine.

For the surveillance of Paldiski and Sillamäe sites there are separate monitoring contracts with specialised companies under ERPC supervision.

For monitoring of foodstuffs the overall responsibility lies with the Ministry of Agriculture, which has delegated the work to the Veterinary and Food Board. ERPC is responsible for radiological laboratory measurements.

2 According to Commission recommendation 2000/473/EURATOM of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole.

3.3. Paldiski site

Paldiski is a former Soviet Union naval base and training centre for nuclear submarines, which housed two pressurised water reactors for military training purposes. Operation of the reactors produced large quantities of radioactive waste, which was stored on site. The first nuclear reactor was started in April 1968 and shut down in January 1989. The second operated from February 1983 to December 1989.

Control of the site was handed to Estonia in 1995; the decommissioning started in 1997. Thereafter the site has been subject to a clean-up and monitoring programme.

3.4. Sillamäe site

Sillamäe is a former Soviet Union uranium mining and milling facility. There is also a plant for rare and rare-earth metals production. Uranium operations have been stopped, but production of metals continues.

Radioactive tailings from uranium production were stored in a large tailings pond next to the facility very close to the Baltic Sea. The pond is currently subject to a large scale remediation project in order to contain the radioactive material and protect the environment, especially the Baltic Sea. During the verification the remediation project was already in its final stages. The project is expected to be finished in 2007.

4. LEGAL PROVISIONS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING IN ESTONIA

Legislative acts regulating environmental monitoring issues

- Environmental Monitoring Act (RT I[3] 1999, 10, 154);
- Radiation Act (RT I 2004, 26, 173);
- Integrated pollution prevention and control act (RT I 2001, 85,512; RT I 2002, 61, 375; RT I 2003, 73, 486);
- Surveillance and assessment of the effective dose of radiation workers and members of public, dose coefficients of doses from intake and radiation and tissue weighting factors (RT L 2005,65,934);
- Statutes of the Estonian Radiation Protection Centre (RTL 2004, 97, 1528);

Guidance documents

- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole;
- HELCOM Recommendation 19/3 Manual for the Marine Monitoring in the COMBINE program of HELCOM;

3 RT = Riigi Teataja = State Gazette

Legislative acts regulating foodstuff monitoring issues

- Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC, (OJ L 125, 23.05.1996);

- Rules of Procedure for the Regulation of Monitoring of Contaminants in Foodstuffs of Animal Origin and Methods for Taking of Control Samples and Analyzing of thereof, (RTL 2003, 11 123).

5. ENVIRONMENTAL RADIOACTIVITY MONITORING IN ESTONIA

5.1. External ambient gamma dose rate

Gamma dose rate is measured continuously by an automatic network consisting of two independent sub-networks. The locations of both types of measurement stations and exact coordinates are presented in Appendix 3.

The older sub-network is “the area radiation monitoring system” AAM-95 which includes three automatic stations. The stations of this system are able to measure the total ambient gamma dose rate and are connected to the server situated in the ERPC. After detecting a value above the pre-set alarm level (300 nSv/h in all stations), stations send an alarm message to the central server.

The new part of the countrywide network consists of seven “PMS” stations. These are fully automatic stations of a new generation, which measure the total gamma dose rate and NaI gamma spectra. The latter feature makes it possible to discriminate between increases in the dose rate caused by natural activity and by contamination by artificial radionuclides. The stations analyse the dose rates from five different components of the total gamma spectrum for which independent alarm levels are preset, providing early warning even in the case of very low levels of atmospheric contamination. The alarm trigger values are as follows:

- Total gamma dose rate 200 nSv/h
- Dose rate from radon (equilibrium) 200 nSv/h
- Dose rate from radon (disequilibrium) 200 nSv/h
- Dose rate from normal background 200 nSv/h
- Dose rate from artificial sources 95 nSv/h

Radiological data are transferred through public telephone networks in normal situation once per day to the servers in the ERPC. Information from all stations is processed by central software in the main information server. All radiological information is stored in a common database.

Alarm messages are stored on the main server and distributed through an Internet service to GSM phones and local area computer networks to call for duty specialists on 24h

basis. Measurement integration time and interval lengths for data sampling are separately adjustable for each station. The radiological data measured in the environment is used for modelling of dispersion of the radioactivity using the ARGOS software[4].

5.2. Airborne particulates

Airborne radioactivity is monitored in major Estonian towns to provide information for decision-makers about the concentration of radioactive gases and particles in the atmosphere.

In Estonia three air filtering stations have been installed (Appendix 3) in meteorological stations in the vicinity of the larger cities. The oldest filter station located near Tallinn at the Harku site was designed and constructed in 1994. Its design is very simple; it does not have a gauge for permanently measuring the air flow and calculating the filtered air volume. The filtering capability was determined once during the initial installation and then after technical repairs. The air flow rate was estimated at about 2600 m^3/h in September 2005. The device was designed to sample only particles using the Petryanoff type filter material which has insufficient adsorption ability for aerosols. Because of this disadvantage the isotope data measured on filters from this site should be used with caution.

In late 1996 a modern air filter station *Snow White JL-900* (Senya Ltd., Finland) was installed at Narva-Jõesuu for detecting, as early as possible, air contamination in the event of a nuclear accident at the Leningrad Nuclear Power Plant at Sosnovy Bor, some 60 km from the Estonian border. Gamma spectra of glass fiber and activated charcoal filters from this station are analyzed by a large volume HPGe detector. In 1997 a smaller air filter station *Hunter JL-150* (Senya Ltd., Finland) was installed in Tõravere, in the south-eastern part of Estonia.

In all filter stations the filters for air particles are exposed for one week and impregnated charcoal filters (sampling organic iodides) for one month. Filters are sent by post to the ERPC laboratory in Tallinn, which performs the radiation measurements by a gamma-spectrometer. Routinely Cs-137 and natural Be-7 are detected in the samples.

In the event of a radiological threat, indicated by a concentration of artificial isotopes above 10 $\mu Bq/m^3$ in the air, the filter change frequency will be increased depending on the situation.

The use of charcoal filters was temporarily suspended in 2003 due to problems in obtaining activated charcoal.

5.3. Surface water

Radioactivity of surface water is monitored both in inland water and in seawater. For the first media two sampling stations were defined at the two largest rivers of the country: rivers Narva and Pärnu (Appendix 3). The radioactivity of water in river Narva is affected by radioactive contaminants of Chernobyl origin deposited on the large catchment area in eastern Estonia covering Lake Peipus and the draining areas of tributary rivers to the lake, both on Estonian as well as on Russian territory. The

4 Prolog Development Center A/S, Denmark

catchment area of river Pärnu is in southern Estonia; the radioactivity of river water reflects mainly the global contamination.

Radioactivity in the marine environment is monitored in the area of the Gulf of Finland by taking samples in the locations defined by the HELCOM Recommendation 19/3[5]. Sample types and radioisotopes measured correspond to this guidance as well (Appendix 3).

5.4. Drinking water

For drinking water monitoring there are two sampling stations: one with raw water taken from a surface water reservoir (lake) and another with groundwater from a deep underground aquifer. The water from the surface water site is analysed for artificial radionuclides and the water from the ground water site for natural radionuclides. A description of the sampling sites is given in Appendix 3.

5.5. Milk produced in Estonia

Milk is sampled at the biggest milk dairies in Harjumaa, Järvamaa and Ida-Virumaa counties. Monthly samples collected by the Veterinary and Food Board are combined to form quarterly samples for analysis of artificial radionuclides and K-40. Data on sampling sites is presented in Appendix 3.

5.6. Foodstuffs - mixed diet

Monitoring of radioactivity in mixed diet is carried out in one location and dealt with as an additional indicator of public dose. The sampling site (hospital) is chosen to represent large population groups and the average daily food for adult persons. Samples including beverages are taken twice a year and analysed for Cs-137 and Sr-90.

5.7. Products from natural ecosystems

Since areas in north Estonia were contaminated by Chernobyl fallout there is a monitoring programme for radioactivity in such natural products which can be consumed by a large number of people (wild berries, game and mushrooms). Sampling is carried out at the central market of Tallinn by the ERPC. Additional samples are collected directly in areas of highest contamination. Samples are analysed for Cs-137 only.

5.8. Residues monitoring programme of food of animal origin

Monitoring of safety of foodstuffs of animal origin is performed by the Veterinary and Food Board according to the programme which is harmonised with the Directive 96/23/EC. The presence of contaminants in foodstuffs of animal origin is established in compliance with an annual control programme; in addition random samples are collected and analysed.

5 HELCOM Recommendation 19/3 concerning the Manual for the Marine Monitoring in the COMBINE Programme of HELCOM

6. VERIFICATION ACTIVITIES

6.1. National monitoring programme

The Estonian national programme covers a large variety of samples (air, water, milk and food as described in Tables 1 to 5 in Appendix 3). The samples are taken by different organisations in different locations covering the country (Figure 1 in Appendix 3). All the measurements are performed in the laboratory of the ERPC in Tallinn.

As regards the structure of the programme, the verification team made the following observations:

- The frequency of mixed-diet samples at the hospital is low and the general representativeness of this sampling may not be optimal.
- The periodicity of sampling of food and natural products is not very well defined.
- There is no sampling of rain water and grass.
- Duly formalised sampling procedures are needed for all outsourced activities (sampling of sediments, fish and marine biota).

The verification team suggests comparing the Estonian national monitoring programme with other Member States, looking essentially at the nature and frequency of sampling. The verification team recommends a revision of the programme in order to correct the deficiencies identified above and to bring the programme in line with good practises adopted in other Member States.

6.2. ERPC laboratory

General

The laboratory has a Quality Management system and an ISO 17025:2000 accreditation[6] by the Estonian Accreditation Centre (Eesti Akrediteerimiskeskus) for gamma-spectrometry (not for all geometries), for measurement of some radionuclides and for personnel dosimetry. The ERPC plans to achieve accreditation also for other methods used in the laboratory. The laboratory has participated in several intercomparison exercises (IAEA, STUK, IRMM, EC, HELCOM); the aim is to participate in as many intercomparisons as possible.

The verification team supports the on-going work towards accreditation of other laboratory analysis methods and acknowledges the extent of the intercomparison exercise activity.

Sample receipt and pre-treatment

Incoming samples are received in a sample pre-treatment room, which houses a sample storage cabinet, a refrigerator and a hydraulic sample press. Filter samples from Harku, Tõravere and Narva-Jõesuu arrive by mail along with their relevant collection

6 Issued 29.04.2005, valid until 28.04.2010.

information sheet. A contamination check is performed on each sample. Incoming samples are registered in a paper log; there is no electronic sample database in the laboratory. There are no numbers on incoming filter samples; a number is allocated after pressing. There is usually only one sample received at a time, so there should be no risk of confusing samples. A similar receipt procedure is in place for incoming water samples (50/30 litres). Water samples are evaporated according to the laboratory Quality Manual, which refers to HELCOM guidelines.

During the verification the sample press was lacking oil and therefore the target pressure of 5 bar could not be reached. It appeared that there may be a possibility of unnecessary deviations in the sample geometry due to non-stable pressure.

All samples are kept for three months, which is the limit defined in the laboratory Quality Manual. Thereafter the filter samples are sent to the University of Tartu for research purposes. All documents and manuals are stored in the analysis office; all lab personnel know where the manuals are.

The verification team suggests making sure the filter sample geometry is maintained as constant as possible by measuring the sample height after pressing. Additionally the verification team suggests that a central database be created for the laboratory in order to further improve sample and data management routines.

Ashing and drying

There are three furnaces for ashing the samples (450ºC maximum) and two drying ovens. One furnace is reserved for potentially contaminated material.

Verification does not give rise to particular remarks.

Results archive

Laboratory analysis results are archived for 3 years on paper and on computer; monitoring results are kept for 5 years. There is no central database; the files are kept on the laboratory PC and on a central server. The results are not signed by staff, but the analyst is identified in the files.

Verification does not give rise to particular remarks.

Scales

The laboratory uses electrical scales, which are annually calibrated by an external calibration service. Calibration files and monthly control files are available for each scale.

Verification does not give rise to particular remarks.

Gamma spectrometry

The laboratory operates three gamma-spectrometry systems; one analogue Oxford, one digital Canberra (low energy system with carbon composite window) and one analogue BSI (Baltic Scientific Instruments) system. Only the Oxford system has accreditation according to the quality system. A UPS system is available, but there is no long-term

electrical back-up. Records for liquid nitrogen supply and instrument control (Energy and peak width (FWHM) for Co-60 and Cs-137) are available. The calibration procedure includes self-attenuation and summing corrections.

The gamma spectroscopy room has air conditioning. Temperature and humidity are continuously monitored. The room is fairly small, leaving little space for new equipment.

All three gamma-spectroscopy systems in the ERPC use different electronics and software. This is a problem, since staff has to learn to use each system and having different systems increases the probability of error and limits measurement flexibility. In principle the BSI system could take over measurements now performed with the accredited Oxford system, but there may be practical problems associated with the change.

Samples are measured for a maximum of 24 hours. Long measurement times limit the system throughput, so in the event of an emergency the laboratory becomes quickly overloaded.

> *In order to improve measurement service reliability and reduce complexity the verification team recommends that the gamma-spectroscopy hardware and software in the ERPC analysis laboratory be developed towards a more harmonised system, which would allow for greater flexibility in the measurement operations and have sufficient measurement capacity also for emergency situations. This would also improve comparability of results and make training and maintenance easier.*

Liquid scintillation counting

The ERPC laboratory has a Wallac 1415 liquid scintillation counter, which is over 10 years old but still fully functional. There is an on-going co-operation project with the IAEA in order to purchase a new counter.

> *Verification does not give rise to particular remarks.*

Alpha spectroscopy

The laboratory has four Tennelec 256 Alpha Spectrometers, but during the verification these were out of order, i.e. the laboratory had no Plutonium measurement capability (not needed in routine work).

> *Verification does not give rise to particular remarks.*

Standards

Gamma ray emitting standards are kept in a locked and alarmed standards storage room in a sufficient distance from the HPGe-detectors. Czech Republic origin multinuclide standards are used for gamma spectroscopy system calibration. Standard activity certificates issued by the Mendelejev Institute in Russia and the Czech Metrological Institute were available. The laboratory QA manual describes also the instrument control programme.

> *Verification does not give rise to particular remarks.*

6.3. Automatic measurement network

The ERPC hosts the data collection centre of the Estonian automatic radiation measurement network, which currently consists of 7 PMS stations and 3 older AAM-95 stations. The central server polls the data via ISDN lines on 10 minute intervals for the station in Tallinn and one day intervals for the others. The alert threshold is set at 300 nSv/h, the normal background level being below 100 nSv/h. Alerts are forwarded to the ERPC duty officer's mobile phone.

Data from the automatic network is published on-line immediately; in addition there is a restricted website with ARGOS-simulations for use by authorities. The data is also provided on 10 minute intervals to the EURDEP system data centre in Ispra, Italy, where it is available to authorities and the general public throughout Europe.

The ERPC maintains the data collection centre of the network with very small staff; in practise there is only one expert in charge of the data collection and retransmission operations.

All network measurement stations except the Tallinn station are located on the premises of meteorological stations, which allows the Estonian meteorological office to take care of their maintenance. PMS stations have 72 hour electrical back-up; the older stations do not have any electrical back-up.

> *The verification team recommends the ERPC to ensure permanent availability of competence in the handling and maintenance of the on-line monitoring system central database.*

6.4. Mobile measurement vehicle

The ERPC operates an independent 4x4 mobile radiation survey vehicle, which is equipped with a 4-litre Exploranium NaI detector and a measurement unit Envispec GR-320, coupled with a GPS positioning system. The system includes built-in Cs-137 control sources to control system stability. The system is able to produce a radiation map of the surveyed area.

The vehicle is on permanent stand-by for emergency situations, but apparently ERPC staff limitations would restrict its full-time use during an emergency situation.

> *The verification team suggests making sure there is enough trained staff to operate the vehicle on a continuous basis during emergency situations.*

6.5. PMS system in Tallinn

The PMS system located in the ERPC premises is the only PMS station not maintained by the Estonian meteorological service. As all PMS stations, it comprises a NaI detector, GM-tube, rain detector (not heated), temperature sensor and a humidity sensor. The equipment is located in a locked cabinet on the roof of the ERPC entrance building. This station is polled by the system server on 10 minute intervals. It has a battery back-up.

> *Verification does not give rise to particular remarks.*

6.6. Harku meteorological station

The Harku meteorological station operates a high-volume air sampler constructed in 1994 in a local small technological bureau. A new pump motor was recently installed. In order to save electricity the sampler is operated in six hour cycles. Filter material is Russian "Petryanoff" large filter cloth, which collects particulate material only. The filter is changed weekly. Flow calibration had been performed recently (5 September 2005). The flow rate was found to be about 2600 m^3/h.

The Harku meteorological station is manned on a 24h basis. There is no electrical back-up for the equipment.

Verification does not give rise to particular remarks.

6.7. Veterinary and Food Board

The verification team visited the Estonian Veterinary and Food Board, which is responsible for sampling of foodstuffs. The programme of the sampling organised throughout the country is based on the Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products.

Milk samples are taken on a monthly basis in the locations given in Appendix 3, Table 5. Ten samples were taken in 2004. The samples are sent to the ERPC where they are measured on a quarterly basis for artificial radionuclides (Cs, Sr) according to the national programme. In addition monthly measurements are performed on request of the Veterinary and Food Board. The results of the measurements are collected, published and stored by the Veterinary and Food Board.

Up to now, meat is sampled on an annual basis. The number of meat samples is 2 for bovines, 2 for pigs and 3 for poultry. The samples are taken in a slaughterhouse. The team was informed that the meat sampling could be stopped in the future.

The verification team verified the existence of sampling procedures and related sampling forms. The organisation of sampling is done respecting the usual QA principles.

Verification does not give rise to particular remarks.

6.8. Paldiski site

The verification team visited the Paldiski site in order to verify the adequacy of the monitoring programme and its implementation. The responsible organisation for the site monitoring is the Company Alara Ltd, owned by the Estonian Government. It is responsible for:

- the administration of the Paldiski and Tammiku sites (facility for storing low- and intermediate-level waste),
- decommissioning activities on the Paldiski site,
- the operation of the interim storage facility at the Paldiski site.

The company applies the license for site radiation protection practices, radioactive waste management and storage, and takes care of the administration of the Paldiski and Tammiku sites. Regulatory discharge limits are determined in Government Regulation No. 10 of 15 February 2005. An annual report to the Ministry of the Environment and the local environmental services is produced.

The programme for environmental monitoring performed by the operator at Paldiski consists of:

- quarterly sampling of ground water from one borehole (occasionally from another borehole);
- quarterly sampling of off-site drainage water at coastal outfall;
- monthly measurement of gamma dose rate at four locations.

This site-related programme is completed on an annual basis by seawater samples taken by the Estonian Marine Institute and by marine radioecological samples (fish, algae, sediments), which are taken by a private consultant under an ERPC contract. The contract provides the localisation, the number, the nature and the weight of the different samples. The samplings follow the HELCOM rules. Results are compared with the other results reported in the HELCOM database.

All the measurements of the different samples are performed by the ERPC in its laboratory in Tallinn. Analyses of tritium and Sr-90 from ground water and drainage water samples are made by liquid scintillation counting.

Based on a recent environmental impact assessment new recommendations were worked out concerning upgrading of the Paldiski program. Based on these recommendations a new monitoring program has been developed by the operator of the site (Appendix 4). This new program will be introduced stepwise beginning from year 2006. It includes more sample types and the sampling frequencies are better defined.

The verification team endorses the new monitoring programme at Paldiski.

6.9. Meteorological station at Narva-Jõesuu

The Narva-Jõesuu meteorological station is located at the border between Russia and Estonia, some 65 km from the Russian Sosnovy-Bor nuclear power plant (RBMK type). The station has a Snow White JL-900 high-volume air sampling system installed on the building roof, which is operated in 6 hour cycles in order to save electricity. The station measures independently the filtered air volume and operation time. The system has been operational for nine years. Filter (Whatman GF/A glass fibre 46x57 cm) change is performed once a week. The use of activated charcoal filters for the collection of organic iodines was discontinued in 2003 due to problems in obtaining activated charcoal. The verification team was informed that the ERPC intends to resume these measurements once the technical and financial problems have been resolved.

There is also a standard PMS monitoring station at Narva-Jõesuu, which is identical to the system in Tallinn.

The verification team supports the efforts to resume the measurements using activated charcoal filters at all Estonian air sampling stations as soon as possible.

6.10. Narva river water sampling

Narva river water is sampled about 3 km upstream of Narva-Jõesuu. The sample volume is 30 litres. Analysis is performed in the ERPC laboratory after pH adjustment.

Verification does not give rise to particular remarks.

6.11. Meteorological station at Kunda

The Kunda meteorological station operates a standard PMS station. The station is located in a fenced-in area close to the Baltic Sea. It has electrical back-up. The station is manned during working hours (2 persons), otherwise it is guarded electronically.

Verification does not give rise to particular remarks.

6.12. Sillamäe site

General

Environmental monitoring of the Sillamäe tailings pond site is largely done by contractor companies, which must have accreditations according to Estonian standards. Major contractors involved are the Ökosil laboratory, the ERPC laboratory, the Environment Protection Centre laboratory and the Estonian Geological Survey laboratory. The verification concentrated on the company Ökosil, since it is responsible for most of the radiological measurements.

At the time of the verification the situation at the site was such that the interim cover of the tailings pond was in place and the final cover was under construction. The final cover is some 2.3 meters thick and includes 5 different layers. Restrictions on moisture content make the work process complicated and it cannot be performed during winter. It is expected that two more working seasons are needed to complete the final cover. The aim is that after the remediation project the radiation background at the site would be comparable to normal and the only remaining land use restriction would be a restriction on digging in the final cover area.

The team was informed that the issue of the Sillamäe site long term surveillance programme after conclusion of the remediation work is still under discussion and there is no agreement on these responsibilities.

The verification did not give rise to particular recommendations. The verification team points out that the Sillamäe site requires long-term radiological surveillance. In order to ensure a continuous and credible monitoring programme also in the future the responsibilities need to be defined very clearly and sufficient resources need to be allocated for the monitoring programme.

Ökosil laboratory

The verification team visited the Ökosil laboratory at the Sillamäe site. The laboratory has a quality manual according to standard ISO 17025 and it has participated in intercomparison exercises with the Wismut site laboratory in Germany. The laboratory produces monthly reports on the Sillamäe monitoring programme. It was estimated that 20-25% of the laboratory working time is used for the tailings pond remediation project.

Laboratory equipment consists of dose rate monitors (several types), a total alpha counter (Eberline FHT 7705 one chamber counter), a radon monitor (Alpha Guard) and an aerosol sampler for field measurements. The laboratory has also a gamma-spectroscopy system (Canberra), but this is not used in the current monitoring programme.

The laboratory equipment was presented to the team and a demonstration was organised for radon exhalation measurements on top of the final cover.

Verification does not give rise to particular remarks.

7. CONCLUSIONS

All verification activities that had been planned were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, was useful.

The information provided and the verification findings led to the following observations:

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil with regard to the surveillance of the Estonian territory are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) However, a few recommendations are formulated, mainly in relation to general quality assurance and control. These recommendations aim at improving some aspects of the environmental surveillance. These recommendations do not detract from the general conclusion that the Estonian national monitoring system is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The recommendations are detailed in the ‘Main Findings’ document that is addressed to the Estonian competent authority through the Permanent Representative of Estonia to the European Union.

APPENDIX 1

REFERENCES AND DOCUMENTATION

1) National monitoring programme of radioactivity in environment and foodstuffs in Estonia, preparatory information for the verification provided by Mr R. Rajamäe, ERPC.

2) Questionnaire on the implementation of Art. 35 of the EURATOM Treaty in the Republic of Estonia, ERPC, 2005.

3) Environmental monitoring and control program for Sillamäe radioactive tailings pond remediation, Report no. E745, Ökosil Ltd.

4) The Sillamäe radioactive tailings pond remediation, Preparatory information for the verification provided by Mr R. Rajamäe, ERPC.

5) Environmental monitoring programs for Paldiski and Tammiku sites, presentation by Mart Varvas, ALARA AS, 2005.

6) Country Waste Profile Report for Estonia (IAEA), 2000.

7) Decommissioning of Paldiski nuclear Facilities, presentation by Mr Joel Valge, ALARA AS.

APPENDIX 2

VERIFICATION PROGRAMME

Monday 19/09

1. Opening meeting: introduction and presentations
2. Team 1 starts verification activities (ambient gamma dose-rate on-line measuring system; environmental media sampling; Tallinn and surrounding region).
3. Team 2 starts verification activities (foodstuff and feeding stuff sampling; Tallinn and surrounding region).

Tuesday 20/09

4. Team 1 continues verification activities (environmental samples measurement laboratory; data centre; Tallinn and surrounding region).
5. Team 2 continues verification activities (foodstuff and feeding stuff samples measurement laboratory; data centre; Tallinn and surrounding region).

Wednesday 21/09

6. Team 1 travels to Sillamäe; verifies monitoring facilities.
7. Team 2 travels to Paldiski; verifies monitoring facilities; return to Tallinn.

Thursday 22/09

8. Team 1 verifies monitoring facilities at Narva-Jõesuu and Kunda; return to Tallinn.
9. Team 2 verifies sample measurements for the Paldiski site and handling of site related data; continues with environmental monitoring system.

Friday 23/09

10. Closing meeting

Team 1: **V. Tanner**
E. Henrich

Team 2: **P. Vallet**
Y-B. Bouget

APPENDIX 3

Figure 1. Environmental radioactivity monitoring stations and sampling locations in Estonia

Table 1. Air monitoring stations in Estonia

No	Station	Gamma dose rate	Airborne particles (filtering)	Coordinates	
				N	E
1.	Harku		**F**	59°23’50”	24°35’58”
2.	Kunda	**A**		59°31’05”	26°32’44”
3.	Kärdla	**A**		58°59’38”	22°49’19”
4.	Mustvee	**A**		58°51’55”	26°57’09”
5.	Narva-Jõesuu	**A**	**F**	59°27’46”	28°02’45”
6.	Pärnu	**A**		58°22’53”	24°30’00”
7.	Sõrve	**A**		57°54’45”	22°03’25”
8.	Tallinn	**A**		59°26’55”	22°43’00”
9.	Tõravere		**F**	58°15’53”	26°27’42”
10.	Türi	**A**		58°48’34”	25°24’35”
11.	Valga	**A**		57°47’18”	26°02’00”
12.	Võru	**A**		57°50’43”	27°01’10”

A Gamma dose rate measurement on-line
F Sampling of airborne particles and aerosols by filtering

Table 2. Sampling stations for surface water (rivers)

River, catchment area (km^2)	Description, coordinates		No of samples per year	Remarks
River Pärnu, 6900	Bridge Sindi		4	Surface water, sample size 30 l
	58°25’02”	24°40’16”		
River Narva, 56200	Small resort place		4	Surface water, sample size 30 l
	59°25’50”	28°07’41”		

Table 3. Sampling stations for sea water and other marine samples

Media	Station name	Coordinates		Remarks
		N	E	
Sea water	N5	59°28’30”	28°00‘30”	Surface water
	EE17	59°43‘00”	25°01‘00”	"
	PE	59°22‘48”	24°09‘18”	"
	PW	59°20‘30”	24°02‘00”	"
	EE22	59°26‘00”	23°09‘00”	"
Bottom sediments	EE17	59°43‘00”	25°01‘00”	Differentiated by 2 cm interval, depth 20 cm
Fish	Sillamäe	59°28’00”	27°45’00”	Baltic herring and sprat
	Paldiski	59°22’00”	24°10’00”	"
Marine biota	Sillamäe	59°28’00”	27°45’00”	Aquatic plants, algae
	Paldiski	59°22’00”	24°10’00”	"

Table 4. Sampling stations for drinking water

Water supliers	Sampling time	No of samples	Remarks
Tallinn, Tallinna Vesi Ltd., Row water from Lake Ülemiste	April, October	2	Sampled in the Food Depot of Regional Hospital of North-Estonia, at Sütiste tee 19, Tallinn; Analyzed for H-3, Cs-137, Sr-90
Town Maardu, Maardu Vesi Ltd., raw water from an underground well No 379	April, October	2	Sampled at the Hospital of Maardu, Maardu, Ringi tn. 13a; Analysed for Ra-226, Ra-228

Table 5. Sampling sites for milk

County	Sampling site	No of samples per yr	Remarks
Ida-Virumaa	Hea Meier Ltd., Jõhvi	4	Monthly samples taken by Veterinary and Food Board are combined to quarterly ones
Harjumaa	Tallinna Piimatööstuse Ltd., Tallinn	4	“
Järvamaa	E-Piim Ltd., Paide	4	“

APPENDIX 4

NEW PALDISKI MONITORING PROGRAMME

1. From January 1, 2006.

Sample type	Location	Frequency	Analytical programme
Borehole (upper groundwater aquifer	PA1and PA6	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90
TLD-s	3 locations on site perimeter	Quarterly	Gamma dose (over natural background)
	3 locations on Main Building	Monthly	Gamma dose (over natural background)
Off-site sewage water	Coastal outfall	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90, suspended matter, BHT-7, total-N, total-P
Seaweed*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Fish*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Tap water	Drinking water at the Site	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137), Sr-90

2. From January 1, 2007.

Sample type	Location	Frequency	Analytical programme
Borehole (upper groundwater aquifer	PA1and PA6	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90
TLD-s	3 locations on site perimeter	Quarterly	Gamma dose (over natural background)
	3 locations on Main Building	Monthly	Gamma dose (over natural background)
Off-site sewage water	Coastal outfall	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90, suspended matter, BHT-7, total-N, total-P
Seaweed*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Fish*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Tap water	Drinking water at th Site	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137), Sr-90
Grass	3 locations near the Main Building	Twice a year	Gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90
Soil	0-5 cm, 3 locations near the Main Building	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137), Sr-90
Air	Reactor sarcophagi nr 1 and 2, interim storage	Permanently	Aerosols gamma dose, H_2, CO_2,

* The monitoring will be conducted under the HELCOM programme.

3. From January 1, 2008.

Sample type	Location	Frequency	Analytical programme
Borehole (upper groundwater aquifer	PA1, PA6 and PA9	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90
TLD-s	3 locations on site perimeter	Quarterly	Gamma dose (over natural background)
	3 locations on Main Building	Monthly	Gamma dose (over natural background)
Off-site sewage water	Coastal outfall	Quarterly	Tritium, gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90, suspended matter, BHT-7, total-N, total-P
Seaweed*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Fish*	Coast	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137)
Tap water	Drinking water at the Site	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137), Sr-90
Grass	3 locations near the Main Building	Twice a year	Gamma scan (with specific reporting of Co-60 and Cs-137), annual bulk for Sr-90
Soil	0-5 cm, 3 locations near the Main Building	Annually	Gamma scan (with specific reporting of Co-60 and Cs-137), Sr-90
Air	Reactor sarcophagi nr 1 and 2, interim storage	Permanently	Aerosols gamma dose, H_2, CO_2,

* The monitoring will be conducted under the HELCOM programme.