REGULATORY CONTROL OF NUCLEAR SAFETY IN FINLAND
Annual report 2003
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Abstract

This report covers regulatory control of nuclear safety in 2003. Its submission to the Ministry of Trade and Industry by the Radiation and Nuclear Safety Authority (STUK) is stipulated in section 121 of the Nuclear Energy Decree. Nuclear safety regulation focused on the design and operation of Finnish nuclear facilities as well as on nuclear waste management and nuclear materials.

No events occurred at the nuclear power plants that would have endangered the safe use of nuclear energy. At the Olkiluoto nuclear power plant, the number of plant conditions in non-compliance with the Technical Specifications was higher than usual. These had noteworthy common features, such as shortcomings in adherence to regulations, administration of periodic inspections, monitoring of plant states and identification of the requirements of the Technical Specifications. The licensee has launched the necessary development measures.

The doses of all nuclear power plant workers were below the individual dose limit. The collective occupational dose was low internationally. Radioactive releases were low and the dose calculated on their basis for the most exposed individual in the vicinity of Loviisa and Olkiluoto nuclear power plant was well below the limit established by Government Resolution.

The nuclear safety indicators describing the effectiveness of STUK’s activities did not indicate changes that would have warranted STUK’s immediate reaction, with the exception of the above indicators pertaining to anomalies at Olkiluoto plant.

No events endangering safety occurred at the FiR 1 research reactor either. In addition, the radiation doses of those working at the research reactor and radioactive releases into the environment were clearly below set limits.

The regulation of nuclear waste management focused on spent fuel storage and preparation of final disposal as well as the treatment, storage and final disposal of reactor waste. No events occurred in nuclear waste management that would have endangered safety. In the field of nuclear material safeguards, the use of nuclear materials in accordance with current regulations and the completeness and correctness of nuclear material accounting were verified.

STUK verified that nuclear liability in the event of nuclear damage has been taken care of according to legislation.

The total costs of nuclear safety regulation in 2003 were 8.7 M€. The total costs of operations subject to a charge were 7.2 M€, the full amount of which was charged to the licensees and licence-applicants.
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1 Preface

The Radiation and Nuclear Safety Authority (STUK) regulates the use of nuclear energy in Finland, as prescribed in the Nuclear Energy Act (990/1987). STUK’s responsibilities also include control of physical protection, and emergency planning as well as control of the use of nuclear energy necessary to prevent nuclear proliferation. This is a report on regulatory control in the field of nuclear energy submitted by STUK to the Ministry of Trade and Industry once a year, as stipulated in section 121 of the Nuclear Energy Decree.

It covers the regulatory control of nuclear facilities, nuclear waste management and nuclear materials, which is the task of two STUK departments: Nuclear Reactor Regulation and Nuclear Waste and Materials Regulation.

Nuclear safety regulation mostly focused on the Loviisa 1 and 2 nuclear power plant units owned by Fortum Power and Heat Oy and the Olkiluoto 1 ja 2 units owned by Teollisuuden Voima Oy as well as their nuclear waste management and nuclear materials. Fortum Power and Heat Oy and Teollisuuden Voima Oy are later in the text also referred to as licensee or utility. The planning and later implementation of the final disposal of nuclear fuel, which is part of nuclear waste management, is taken care of by Posiva Oy. Subject to regulatory control were also the research reactor operated by the VTT Technical Research Centre of Finland, small-scale users of nuclear materials as well as the transport of radioactive materials. In addition, matters relating to the new reactor in planning were dealt with.

Loviisa 1 began generating electricity to the national grid in 1977 and Loviisa 2 in 1981. Their operating permits were renewed in 1998 and will expire at the end of 2007. The highest allowable reactor nominal thermal power for each unit, according to a permit granted by the Government, is 1500 MW. The permits cover also facilities for waste management. The nominal values for electrical power 510 MW (gross) and 488 MW (net) correspond to this reactor power.

Olkiluoto 1 began generating electricity to the national grid in 1979 and Olkiluoto 2 in 1982. The operating permits of the Olkiluoto plant units were renewed in 1998. They will expire at the end of 2018 and cover also spent fuel intermediate storage as well as low and intermediate level reactor waste storage. According to the permits, the highest allowable reactor nominal thermal power for each Olkiluoto plant unit is 2500 MW. A corresponding nominal gross electrical power is 870 MW and net electrical power 840 MW. The permit conditions require that the licensee makes, by the end of 2008, an extensive intermediate safety assessment for the Olkiluoto nuclear power plant. Requirements for the contents of the assessment are set by STUK.

This report’s section on nuclear reactor regulation describes assessment of Loviisa and Olkiluoto’s safety as well as plant modifications control and of operation of licensee organisations. The efficiency and effectiveness of nuclear safety regulation is analysed using STUK’s Safety Performance Indicator System. This report contains a description of the operation of Finnish nuclear power plants, the most important operational events and safety improvements at the plants. Radiation safety at the plants is analysed by looking at occupational and collective doses at the facilities as well as at the outcome of monitoring for radiation in releases and the environment.
The chapter on nuclear waste management deals with nuclear fuel intermediate storage and preparation for final disposal as well as treatment of reactor waste.

The chapter on regulatory control of nuclear materials describes nuclear material control at the Finnish nuclear facilities and plans for the safeguarding of final disposal of spent fuel as well as regulation of radioactive materials transport. Strengthening of nuclear material safeguards and implementation of the CTBT are included as well. In addition, the report discusses the development of regulatory guides and nuclear safety regulation as well as functions in support of nuclear safety regulation, such as safety research, emergency response, communications, and development projects. Participation in international cooperation in the field of nuclear safety is described as well.
Revision and updating of YVL guides continued. The guides are detailed safety regulations for nuclear facilities, issued by STUK on the basis of the Nuclear Energy Act (990/1987) and the Government Resolution (395/1991) on the general safety regulations for nuclear power plants. The guides describe STUK’s regulatory procedures as well. STUK decides, case by case, how new guides apply to facilities already in operation. Such decisions, made in 2003, are discussed in sub-sections 3.1.1 and 3.2.1.

A total of about 45 guides were being prepared or reviewed in YVL guide working groups, with 12 guides completed by the end of the year. The number of YVL guides published in 1999–2003 is given in Fig. 1. Four guides were translated into English and two into Swedish. They were issued in print and on the Internet; the Swedish language versions were only available on the Internet, however. Principles that apply to the long-term revision of the YVL guides were incorporated in the STUK strategy and in a separate regulatory guide action plan.

The project to construct a new nuclear power plant has made it necessary to speed up the preparation of some YVL guides having a bearing on nuclear power plant design. In so far as the guides were not completed on schedule, the license applicant was regularly sent reports on their status. In addition, the license applicant was informed about any new requirements planned in the guides under revision.

During 2003, an amendment was prepared in the Nuclear Energy Act to establish a special fund arrangement for research in the field of nuclear safety. It took effect on 1 January 2004. It serves to ensure a high level in domestic research and the preservation of expertise. No amendments were prepared to the general nuclear safety regulations issued as Government Resolutions.

Nuclear safety recommendations are also given by international organisations, such as the EU, the IAEA, the OECD/NEA and various countries’ national authorities. They did not give any cause to update the Finnish nuclear legislation. STUK prepared to the IAEA statements on three draft safety guides.

The Commission of the European Communities is preparing directives on the arrangement of nuclear waste management in Member Countries and on fundamental nuclear safety requirements. STUK has followed the status of this work and assessed for its part the contents of the drafts.

Figure 1. Number of yearly published YVL guides.
3 Nuclear facilities regulation


3.1 Loviisa nuclear power plant

3.1.1 Overall safety assessment

Implementation of regulations

STUK has introduced a procedure for application of new or revised YVL guides to operating nuclear facilities. According to it, the publication of a YVL guide does not, as such, change STUK’s previous decisions. It is only after having heard those concerned that STUK will give a separate decision on the application of a new or revised YVL guide to an operating nuclear facility, or to one under construction as well as to a licensee’s operation. The guides apply as such to new nuclear power plants.

In considering the application of new safety requirements given in YVL guides to operating nuclear facilities, or those under construction, STUK takes into account a principle stipulated in section 27 of the Government Resolution (395/1991). It prescribes that, to further improve safety, measures shall be implemented justifiable considering operating experience, safety research and development of science and technology.

Decisions to implement the below YVL guides were made in accordance with the new procedure:

- Guide YVL 5.5, Instrumentation systems and components of nuclear facilities, 13 September 2002

For implementation of Guide YVL 5.5, Fortum Power and Heat Oy carried out an extensive assessment by comparing Loviisa plant’s I&C systems and administrative procedures with the requirements of the new guide. Established shortcomings and the procedures to eliminate them were presented in an action programme which was confirmed by STUK. Should any differences be observed in the systems’ implementation, most of them will be fixed in connection with the I&C system upgrading of the Loviisa plant in the near future.

STUK noted in its decision to implement Guide YVL 6.7 that the nuclear fuel quality management and assurance procedures used by Loviisa plant cover well the requirements of the revised guide. In so far as they remain unfulfilled, Fortum Power and Heat Oy presented an action plan with schedules, which STUK confirmed.

Annual safety assessment

The annual safety assessment for Loviisa nuclear power plant looks at observations made in regulatory work pertaining to plant modifications, availability and organisational operation. The various areas contained in the assessment are discussed in more detail in this report’s chapters dealing with nuclear regulation and in its appendices.

Two significant plant improvements were completed at both Loviisa nuclear power plant units in 2003: upgrading of the severe accident management system and the plant’s radiation measurement system. The utility made an important decision pertaining to management of the plant’s ageing, ie to entirely upgrade the plant’s I&C systems in 2006–2014. Conceptual design planning for the upgrading was launched by the utility in 2000.

STUK detected no significant safety-related shortcomings in 2003 during its work to ascertain the availability of Loviisa nuclear power plant. The number of plant conditions in non-compliance with the Technical Specifications was low and only one operational event required a special report. The annual maintenance outages of Loviisa nuclear power plant were refuelling outages and no significant safety-related observations were made during them. Of inspections conducted during the outage, worth mentioning are: an inspection of
the area containing the temperature sensors of the protection pipes of control rod drives and also replacement of some shroud tubes due to cracking.

No individual occupational dose at the plant exceeded the individual dose limit. The collective occupational radiation dose was low internationally. Radioactive releases were low, too, and the radiation dose calculated on their basis for the most exposed individual in the vicinity of Loviisa nuclear power plant was clearly below the limit given in a Government Resolution.

The Loviisa nuclear power plant strategy defines 50 years as the plant’s service life. In connection with the renewal of the plant’s organisation, ageing management is considered the organisation’s essential working process, which is described in procedures completed in 2003. No significant safety defects surfaced in inspections pertaining to the ageing of mechanical components, electrical and I&C systems and structures. The safety indicators for Loviisa plant’s maintenance showed a deteriorating trend in 2003.

The qualification of methods for the periodic inspection of the most important mechanical components by non-destructive testing is important in assuring the reliability of data on ageing management. The qualification of ultrasonic and eddy current testing has not been developed as quickly as STUK required, based on European recommendations. To repair the situation, new domestic arrangements have been agreed upon with both utilities for the carrying out of the qualification processes.

The renewal of Loviisa power plant’s organisation plus the associated renewal of the plant’s quality management system emphasise safety and the management of plant service life to assure plant safety and reliability. Assurance of personnel competence in connection with change of generation is related to this matter. Loviisa power plant has drawn up a plan to assure preservation of knowledge concerning the plant and its safety with the operating organisation.

The periodic inspection programme of the Loviisa power plant, implemented by STUK, revealed no significant safety defects.

STUK did not start any new investigation into the plant’s operation in 2003.

**Annual assessment of deterministic safety analyses**

The licensees update the nuclear power plants’ deterministic safety analyses in connection with the renewal of operating permits. The analyses are updated also in connection with plant modifications, or whenever operational events warrant it. STUK reviews the licensee’s analyses and conducts, or commissions the conducting, where necessary, of its own reference analyses. In 2003, no deterministic safety analyses on the Loviisa plant were submitted to STUK for review.

**Annual assessment of probabilistic safety analyses**

STUK reviewed Loviisa plant’s updated annual maintenance outage risk analysis. It contains analyses of onsite initiating events, heavy lifts and flooding during outages. As measures reducing risks during outages, modifications decided upon for other reasons, e.g. the construction of a primary circuit shutdown cooling system, procedural modifications as well as changes in inspections and testing had been identified.

The risk of cold shutdowns, \(6.5 \cdot 10^{-5}/\text{year}\), constitutes over 90% of the risk estimated so far for brief annual maintenances, or those of normal duration. Total outage risk, hot shutdowns included, is \(7.1 \cdot 10^{-5}/\text{year}\). The risk assessed for cold shutdowns mainly divides between the four initiating event groups below:

- Drops of heavy load lifts in the reactor hall (21%)
- Dilution of primary coolant boron concentration (19%)
- Flooding (19%)
- Loss of service water system (18%)

Modifications were implemented at the Loviisa plant in 2003 to reduce risk during outages. A temporary dam is always constructed on the sea water outlet channel during outages, which prevents flooding in the lower compartments of the building during their inspection. An inspection was added to the work permit routines during outages to assure a sufficiently high dam. The new inspection procedure was first used in the 2003 annual maintenance.

A sampling system piping modification was
made at both plant units to facilitate continuous primary circuit water sample analysis even during cold shutdowns and refuelling outages. The modification improves control of situations involving unplanned dilution of the primary coolant boron concentration and thus reduces the risk from this.

To further decrease risk during outages, emergency bonnets were made for the valves of the recirculation lines of the emergency core cooling system and they are to be kept easily available. The bonnets are installed without delay on the flange of a valve opened for maintenance if maintenance work is interrupted or a water or steam leak occurs through it. The modification reduces the risk of a leak through the valve during maintenance.

In addition to the modifications implemented, an analysis of the remaining service life of the reactor hall crane is under way. The objective is to reduce the risk from heavy lifts, which accounts for about 21% of outage risk.

**Safety performance indicators**

The requirements set for the safety performance indicators for nuclear power plants were fulfilled at Loviisa power plant as regards occupational doses, radioactive releases and population exposure. Releases into the sea were reduced to the current level in 1992 when caesium separation equipment were commissioned at the plant.

No events occurred at the Loviisa plant units that would have endangered plant safety. The objective set for the risk-importance of the inoperability of components with a bearing on accident risk, max 5%, was exceeded at both Loviisa nuclear power plant units. This was due to back-up diesel generator latent defects and auxiliary feed water system maintenance work. No special action by STUK was required.

The number of events reported in accordance with Guide YVL 1.5 was decreasing compared with the previous year. The indicators showed a deteriorating trend for maintenance at the Loviisa power plant in 2003. The failures of components subject to the Technical Specifications were apparent in multiple technical fields and no special problem area could be pointed out. It will be apparent in the future, whether an actual change has taken place in the previously decreasing trend.

The structural integrity of multiple barriers containing radioactive releases is good. There have been no fuel leaks at the Loviisa plant units for years now. The combined leakage rate of containment penetrations and airlocks increased but the limit was not exceeded. The leaktightness of the rubber bellows of the penetrations had been problematic and the Loviisa power plant had proposed their conversion to metal structures.

The effectiveness of STUK’s operations is evaluated by means of indicators describing plant safety. The outcome for 2003 is given in Appendix 1. It also gives some background for the indicators and the procedures for acquiring them.

**3.1.2 Oversight of plant modifications**

Oversight of plant modifications consisted of the definition of regulatory scope, the handling of documents pertaining to the modifications as well as the supervision of their implementation and commissioning. Modifications to improve the safety of the plant units are described in Appendix 2. During the 2003 annual maintenance outage, system modifications were completed at the plant that were part of a project in provision against severe accidents. A project to replace radiation measurements was also completed. STUK supervised the carrying out of component and structural modifications by inspections at the plant sites and the manufacturers’ premises as well as by reviewing documents submitted by the licensees.

Modifications oversight included STUK/licensee meetings in which the licensees’ representatives accounted for modifications planned, those due for implementation in the next annual maintenance, or later, and also the status of ongoing modifications. In many of these meetings, the planned I&C systems upgrading was discussed. Modifications were also regularly dealt with at STUK internal oversight meetings and topical meetings.

In consequence of modifications already implemented at the plant, several documents changed that describe the plants’ operation and structure - such as the Technical Specifications, the Final Safety Analysis Report and the operating and
maintenance instructions. STUK supervised the document revisions and generally followed the updating of plant documentation after the modifications. A computer-based plant modifications register was used to follow the status of safety-significant modifications. In 2003, seven new modifications at the Loviisa plant unit were entered into the register. On the register, several uncompleted modifications, registered previously, were also followed. In addition, the register was utilised in monitoring the implementation of document revisions pertaining to modifications. This resulted in the observation that document revisions relating to modifications made in 2002, which were followed on the register, were completed at the Loviisa plant in 96% by the annual maintenance of 2003 (Appendix 1, indicator A.I.6).

3.1.3 Oversight of plant operability

Compliance with the Technical Specifications

Compliance with the Technical Specifications at the Loviisa power plant was controlled by witnessing operations onsite. Subject to oversight were in particular the testing and repair of components subject to the Technical Specifications. After completion of the annual maintenance outages, the plant unit’s compliance with the Technical Specifications was established before startup. The licensee is obliged to immediately report to STUK all plant situations that are in non-compliance with the Technical Specifications.

One situation occurred at the Loviisa plant units during which a plant unit did not comply with the Technical Specifications (Appendix 1, indicator A.I.2). This was in connection with the renewal of radiation measurements. The event is looked into in more detail in Appendix 3. The licensee has planned actions to prevent recurrence.

The Technical Specifications were also deviated from by applying in advance for STUK’s approval of non-compliances. In 2003, the licensee applied for approval of 21 deviations from the Technical Specifications. (Appendix 1, indicator A.I.2). After having analysed the deviations’ safety significance, STUK approved all the applications.

Ten exemptions pertained to deviations from the Technical Specifications caused by plant modifications. Two approvals were granted for a deviation pertaining to a specific testing or fault detection. The other six related to non-compliances during repairs and maintenance.

Operational events

The Loviisa plant units operated reliably in 2003. The load factor of Loviisa 1 was 92.4% and that of Loviisa 2 was 87.9%. Fig. 2 gives the plant units’ load factors for 1994–2003. The duration of the annual maintenance outage at Loviisa 1 was 23.5 days and 16.5 days at Loviisa 2. There were no other production breaks at the plant units. In May Loviisa 2 operated for about 20 days at about 50% power to repair a leak in the hydrogen cooling system of the plant unit’s other generator and to find out the cause of an elevated turbine supporting bearing temperature. Loviisa 2 operated at about 50% even after the annual maintenance outage for replacement of the generator stator of the plant unit’s other generator. The power reduction lasted for about 41 days. In July–August power at both plant units had to be reduced due to exceptionally high sea water temperature.

Figure 3 gives the daily average gross powers of the plant units in 2003. Production losses in nominal output caused by component failures were 0.1% at Loviisa 1 and 2.6% at Loviisa 2. Production losses from component failures in a longer time period are depicted by indicators in Appendix 1 (indicator A.I.1g).

At the Loviisa plant units, one event warranted a special report and five operational transients...
were reported to STUK. No reactor scrams occurred at the plant units (Appendix 1, indicator A.II.1). In addition to event reports, the Loviisa power plant submitted to STUK daily reports, quarterly reports, annual reports, outage reports, annual environmental safety reports, monthly individual dose reports, annual operational feedback reports and nuclear safeguards reports.

The special report submitted by the Loviisa plant concerned an event during which three ventilation stack monitors were simultaneously inoperative for about 20 hours during the renewal of radiation measurements at Loviisa 2. The event was classified INES Level 0. The event is explained in more detail in Appendix 3. Figure 4 gives the number of INES Level 1 events in 1994–2003. During this time period, no events exceeding INES Level 1 occurred at the Loviisa plant.

**Annual maintenance outages**
The annual maintenance outages of the Loviisa plant units were refuelling outages, which means that, in addition to refuelling, only necessary maintenance, repairs, testing and minor modifications were carried out. The Loviisa 1 annual maintenance outage was on 2 to 25 August, 2003. It lasted 23.5 days, whereas its planned duration was 16.5 days. The extension was due, among others, to the commissioning of new reactor pit washing equipment and the repair of a regulator valve in the primary coolant pump sealing water system during startup. The Loviisa 2 annual maintenance outage was on 23 August to 9 September 2003. It lasted 16.5 days. During it a replacement of the stator of the other generator was started, which was continued after the annual maintenance.

The licensee inspected areas of the control rod drive mechanism protection pipes around their temperature measurement devices, since cracking had been detected in the protection pipes previously (Annual Report 2002, STUK-B-YTO 224). At Loviisa 1, defects in three protection pipes were found and the pipes were replaced. Seven defective protection pipes were found at Loviisa 2. The temperature measurement device insulation shield boxes, which gather humidity thus causing stress corrosion, have now been removed from about half of all the protection pipes. The rest of the shield boxes are due for removal and the protection pipes are due for inspection in the 2004
outages. Removal of insulation lowers the measured temperature value by a few degrees, which will be taken into account in assessment of the measurement results. The protection pipes are visually inspected every two weeks during operation. Even very small leaks are detectable by the boric acid crystallised on the pipe surfaces. Potential minor leaks would not endanger plant safety but it would have to be placed into cold shutdown for repairs.

Safety improvements made during the annual maintenance outage are described in Appendix 2.

The collective radiation dose incurred in outage work was 0.56 manSv at Loviisa 1 and 0.29 manSv at Loviisa 2. The highest individual dose during Loviisa 1 annual maintenance was 7.7 mSv and that for Loviisa 2 was 4.4 mSv. Figure 5 presents the collective radiation dose incurred in annual maintenance outage work in 1999–2003. Radiation safety at the Loviisa plant units as a whole is described separately in this chapter.

Regulatory oversight by STUK focused, among others, on the administrative arrangements of outage work, the activities of the operating and maintenance personnel, refuelling as well as inspections and tests by the licensee and subcontractors. Attention was also paid to the implementation of radiation protection, control room operations and housekeeping. Prior to the start of a new fuel cycle, safety analyses made for each plant unit were reviewed. In addition, it was inspected that the fuel assemblies were loaded into the reactor according to plan. The nuclear material inventory was inspected prior to the closing of the reactor pressure vessel head.

During the annual maintenance outages, STUK carried out inspections required in the Pressure Equipment Act. In addition, the periodic inspections of pressure vessels and other pressure-bearing components were controlled by re-viewing programmes pertaining to them and witnessing inspections onsite.

STUK controlled also the bringing of the plant units into a shutdown state and their subsequent startup. STUK approved on 25 July 2003 the starting of a Loviisa 1 refuelling outage and on 22 August 2003 the starting of a Loviisa 2 outage. The permission to start up Loviisa 1 was granted on 18 August 2003. STUK’s inspectors ascertained the plant unit’s start-up readiness onsite on 24 August 2003. Loviisa 1 was connected to the national grid on 25 August 2003. The permission for Loviisa 2’s start-up was given by STUK on 7 September 2003 and the plant unit’s start-up readiness was established onsite on 8 September 2003. Loviisa 2 was connected to the national grid on 9 September 2003.

The regulatory oversight of Loviisa facility’s annual maintenance outages onsite took 128 working days. One resident inspector was regularly working on the site as well.

Ageing
The strategic objective for Loviisa power plant’s service life management currently is 50 years’ operating life. Service life management is one of the main tasks of the power plant engineering divi-

![Figure 4](image1.png)  ![Figure 5](image2.png)

Figure 4. Loviisa plant’s INES classified events (INES Level > 0).

Figure 5. Collective occupational doses incurred in annual maintenance outage work at the Loviisa plant units.
sion set up at the Loviisa plant in the utility reorganisation of 2002. The procedure for service life management was revised in early 2003. It divides the plant’s systems, components and structures into four classes, based on their service life management. Those in the highest class are decisive for plant service life. In connection with the upgrading of the plant’s information management systems, the service life management information system to be upgraded has been defined, which is due for commissioning during 2004.

Significant measures in 2003 affecting the service life of the Loviisa plant were the signing of conceptual design agreements on the upgrading of the plant’s I&C systems. They are due for upgrading in 2006–2014.

STUK’s oversight of plant service life management comprised the following actions: review of follow-up reports on the ageing of mechanical components and electrical and I&C systems; and of the procedures for service life management; plus the making of periodic inspections of mechanical components, electrical and I&C systems and structures.

Inspection methods are to be qualified to improve the reliability of the in-service inspection of the most important mechanical components by non-destructive methods. Qualification according to the national model applied so far has proved inefficient and time-consuming. In 2003, based on STUK’s requests, a review of qualification procedures was started and also discussion about a possible renewal of the qualification organisation.

Radiation safety

Occupational radiation exposure

The radiation doses of all those who worked at Loviisa nuclear power plant in 2003 were below the 50 mSv annual limit. The distribution of individual doses in 2003 is given in Table I. The highest individual dose at Loviisa nuclear power plant was 12.7 mSv. It accumulated during work at Loviisa and Olkiluoto nuclear power plants. The highest individual dose incurred at Loviisa nuclear power plant alone was 11.6 mSv. Individual radiation doses did not exceed the dose limit of 100 mSv defined for any period of five years. The highest individual dose to a Finnish nuclear power plant worker in the 5-year period 1999–2003, 71.6 mSv, was received at Loviisa nuclear power plant.

The collective occupational radiation dose at both Loviisa plant units in 2003 was 0.94 manSv. The collective occupational dose was 0.61 manSv.

<table>
<thead>
<tr>
<th>Dose range (mSv)</th>
<th>Loviisa</th>
<th>Olkiluoto</th>
<th>total*</th>
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<tr>
<td>&lt; 0.5</td>
<td>220</td>
<td>450</td>
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* The data in these columns also include Finnish workers who have received doses at Swedish nuclear power plants. The same person may have worked at both Finnish nuclear power plants and in Sweden.

Source: STUK’s dose register
at Loviisa 1 and 0.33 manSv at Loviisa 2. STUK guidelines state that the threshold for one plant unit’s collective dose averaged over two successive years is 2.5 manSv per one gigawatt of net electrical power. This means a radiation dose of 1.22 manSv per one Loviisa plant unit. The value was not exceeded at either plant unit. The collective occupational radiation doses over the past years are given in Appendix 1 (indicator A.I.4).

**Radioactive releases**

Radioactive releases from Loviisa nuclear power plant were well below authorised limits in 2003. Releases of radioactive noble gases were ca 7 TBq, ie about 0.03% of authorised limit. The releases of radioactive noble gases were dominated by argon-41, ie the activation product of argon-40, originating in the air space between the reactor pressure vessel and the biological shield. The releases of radioactive iodine isotopes were about 4 MBq, ie approx 0.002% of authorised limit. Aerosol releases were approx 80 MBq, tritium releases approx 0.2 TBq and carbon-14 releases approx 0.3 TBq.

The tritium content of liquid effluents, 15 TBq, is about 10% of the release limit. The total activity of other nuclides released into the sea was about 0.3 GBq, ie about 0.03 % of the release limit.

The release limits are to maintain individual annual radiation exposure in the surrounding population of plants clearly below the threshold value (100 microSv) determined by the Government Resolution (395/1991). The calculated radiation dose of the most exposed individual in the vicinity of the plant was about 0.05 microSv, ie less than 0.1% of the set limit. Appendix 1 (indicator A.I.5) gives radioactive releases and calculated radiation doses to the most exposed individual in the plant vicinity over the past years.

**Environmental radiation monitoring**

Environmental radiation monitoring around a nuclear power plant comprises on- and off-site radiation measurements as well as determination of radioactive substances to establish public exposure and radioactive substances in the environment.

In the environment of Loviisa nuclear power plant, 293 samples were analysed in accordance with a monitoring programme. Radioactive substances originating in Loviisa nuclear power plant were measured in two samples of deposition, one sample of bottom fauna, nine samples of aquatic plants, seven samples of sinking matter and seven samples of sea water.

Cobalt-60, the dominating radioactive substance originating in power plants, was measured in all of the aforementioned kinds of sample. The total number of observations was 19. The next most dominant were the radioactive isotope of silver (silver-110m, 7 observations) and tritium (7 observations). Also cobalt-58, the activation product of nickel (2 observations), was detected in some samples as well as manganese-54, originating in iron, (2 observations) and antimonium (Sb-124, 1 observation).

All the detected concentrations were low and had no bearing on radiation exposure.

Radioactive strontium and caesium isotopes (strontium-90, caesium-134 ja -137, plutonium 238, 239 and 240) originating from the Chernobyl accident and the fallout from nuclear weapons tests are still measurable in environmental samples. Natural radioactive substances (ia beryllium 7, potassium-40 as well as uranium and thorium with their decay products) are also detected. Their concentrations usually exceed those of nuclides originating from the power plant or fallout.

Dosimeters for external radiation measurement have been placed in about ten locations and 15 continuous-operation radiation dose rate measuring stations at a distance of two and five kilometres from the plants. The measurement data from these stations are transferred to the power plants’ control rooms and to the national radiation-monitoring network.

3.1.4 **Oversight of organisational operation**

**Safety management**

A periodic inspection pertaining to safety management was conducted at the Loviisa plant in 2003. It yielded positive results as regards organisational development, quality management, development of personnel and self-assessment. Explicit goals had been set up in all these fields at the
plant; development needs had been identified and are being acted upon. The plant’s management follows the status of the activities.

Information accumulated during document review and other inspection activity at the Loviisa plant was examined in 2003 with a view to the management of plant safety. No significant problems were observed in plant safety management.

Quality management system
Loviisa nuclear power plant has systematically maintained and developed its quality management system according to own plans. In 2002 and 2003, the system was updated to correspond to the organisational and procedural changes implemented at the plant. In addition, Fortum Power and Heat Oy has updated the guidelines describing the quality management system for the nuclear energy section of the Fortum Group.

The licensee has compared the quality management system of the Loviisa plant with, among others, the ISO Standard and the safety requirements and guidelines of the IAEA over the past three years. Based on this, the system has been further developed by, among others, management reviews and self-assessment.

The Loviisa plant regularly evaluates the functionality of its quality management system by means of an internal audit programme and a separate, independent inspection procedure.

STUK oversaw quality management by document reviews and periodic inspection. The quality management system of the licensee and Loviisa power plant was found acceptable. The procedures in use at the Loviisa plant were also found to be in compliance with the plant’s own quality management system. Remarks were given during the inspections, mostly on further development of the system and definition of detail.

Personnel qualifications and training
An organisational rearrangement took place at the Loviisa plant in 2002. It was in preparation of, among others, change of generation, and done by offering a chance to knowledge transfer from senior to junior personnel in expert tasks and by assigning junior personnel to line organisation management tasks. Several persons, who had worked for a relatively short time for the Loviisa plant, participated in Finland in a 6-week basic professional training course on nuclear safety.

Within the framework of the periodic inspection programme, STUK oversaw the appropriateness and adequacy of Loviisa nuclear power plant’s organisation and its personnel training. In a separate inspection on training, the plant procedures to assure personnel competence were reviewed and their sufficiency identified. This was in preparation of a discussion on human resources development in connection with safety management inspection.

Upon application by Fortum Power and Heat Oy, STUK authorised two persons to function as deputies to the responsible manager at Loviisa nuclear power plant, as referred to in section 79 of the Nuclear Energy Act (990/87) and sections 122–127 of the Nuclear Energy Decree (161/88).

In addition, upon application by the licensee, STUK authorised persons in the licensee’s employ to work as shift managers or operators at the power plant. Twelve persons employed at the Loviisa plant were authorised. Both authorisations and reauthorisations took place.

Operational experience feedback
Licensee operational experience feedback consisted of the handling of events at own and other plants. Even events at plants abroad were dealt with in special operational feedback working groups. The objective of operational experience feedback is to prevent recurrence of events that endanger plant safety.

STUK’s oversight of operational feedback activities was by periodic inspection and review of operational reports and the annual operational feedback report submitted by the licensee. The Loviisa plant has systematic and regulated procedures for event investigation, assessment and implementing of corrective action. In a periodic inspection, requirements were put forth for the further development of operations.

Furthermore, STUK evaluated the appropriateness of experiences learned from events abroad for consideration at Finnish plants. Event information was obtained through the Incident Reporting System (IRS) of the IAEA and the OECD. In 2003 twenty event reports were reviewed, eight of which lead to detailed inspection after preliminary
assessment. No event in 2003 warranted immediate action from the licensees. At the Loviisa plant, two events led to consideration of lessons learnt in the course of normal STUK inspection activity.

**Periodic inspection programme**
In 2003 STUK carried out 21 periodic inspections at the Loviisa plant. Safety management, the main processes of operation and also procedures as well as the technical acceptability of systems were looked into. Compliance of safety assessment, operation, maintenance and protection activities (ia radiation protection, fire protection and physical protection) with the requirements of nuclear safety regulations was verified by the inspections. The annual inspection programme was brought to the attention of the licensee at the beginning of 2003 and inspection dates were agreed upon with licensee representatives. Inspections contained in the periodic inspection programme are listed in Appendix 4.

Information was acquired through oral reports requested from representatives of the power plants, personnel interviews, document reviews, walk rounds, observing of working as well as various measurements, ia to establish accuracy of measuring equipment. None of the observations made had an immediate bearing on the safety of the plant units. Actions were initiated onsite to repair the defects observed.

**Authorisation of pressure equipment manufacturers as well as inspection and testing organisations**
Upon application by Fortum Power and Heat Oy, and in accordance with the Nuclear Energy Act, STUK authorised three manufacturers of nuclear pressure equipment.

In addition, upon application by Fortum Power and Heat Oy, testers employed by four separate testing organisations were authorised to carry out in-service inspection of mechanical components and structures at the Loviisa plant units. Previous decisions pertaining to manufacturers and testing organisations are valid, as mentioned in the decisions.

Inspection Organisation Loviisa YVL, authorised in 2002, continued in operation.

The manufacturers as well as testing and inspection organisations authorised by STUK were subject to oversight by STUK.

**Nuclear liability**
The users of nuclear energy must have acquired liability as stipulated in the Nuclear Liability Act (484/1972), or other financial guarantee, for a possible accident at a nuclear facility that would harm the environment, population and property. Fortum Power and Heat Oy has prepared for damage from a nuclear accident as prescribed by law by taking out an insurance policy for this purpose mainly in the Finnish Nuclear Insurance Pool.

In case of an accident, the funds available for compensation come from three sources: the licensee, the country of location of the facility and the international liability community. In 2003, a total of about 425 000 000 € was available for compensation from all these sources.

The ascertaining of the contents and conditions of a licensee’s insurance arrangements in Finland belongs to the Insurance Supervisory Authority. It has approved Fortum Power and Heat Oy’s liability insurance and STUK has verified its existence in accordance with section 55 of The Nuclear Energy Act (990/1987).

The Nuclear Liability Act covers also the transport of nuclear materials. STUK has ascertained that all nuclear material transport has liability insurance approved by the Insurance Supervisory Authority.

3.2 Olkiluoto nuclear power plant

3.2.1 Overall safety assessment

**Implementation of regulations**
STUK has introduced a procedure to apply new or revised YVL guides to operating nuclear facilities. A new YVL guide does not, as such, change STUK’s decisions made before its publication. Only after STUK has heard those concerned, it decides how a new or revised YVL guide applies to operating nuclear facilities, or those under construction and to licensee operations. New guides apply as such to new nuclear facilities.

When STUK decides how new safety requirements in YVL guides apply to operating nuclear
facilities, or those under construction, it takes into account a principle stated in section 27 of the Government Resolution (395/1991); namely, that to further improve safety, measures are to be implemented that are justifiable considering operational experience, safety research and the development of science and technology.

Implementation decisions in accordance with the new procedure were made on the below guides

- Guide YVL 5.5, Instrumentation systems and components of nuclear facilities, 13 September 2002

Teollisuuden Voima Oy gave its assessment of how the requirements of the new Guide YVL 5.5 have been implemented at Olkiluoto plant. STUK considered the assessment insufficient and requested a more detailed assessment of the fulfilment of the new requirements. Consideration of the requirements of the new guide were required particularly as regards the planned control room renewal of the Olkiluoto units. Assessment pertaining to implementation continued towards the end of 2003, based on a report submitted by Teollisuuden Voima Oy.

It was established that the requirements of the revised Guide YVL 6.7 were fulfilled, except for the licensee's required auditing of the fuel manufacturer. STUK did not approve of the compensatory procedure presented by Teollisuuden Voima Oy but in its decision requested adherence to the procedure given in the revised guide.

**Annual safety assessment**

The annual safety assessment for Olkiluoto nuclear power plant looks at observations made during the regulation of plant modifications, plant operability and organisational operation in 2003. The areas of assessment are dealt with in more detail in this report's chapters dealing with nuclear regulation, and in its appendices.

Minor modifications were made at Olkiluoto power plant in 2003 to improve, among others, the user interface of the plant’s process computer in the control room.

The number of plant situations in non-compliance with the Technical Specifications at Olkiluoto nuclear power plant was higher than usual. There were significant common factors underlining them, ie shortcomings in adherence to instructions, in management of periodic inspections, in monitoring of plant state and in identification of the requirements of the Technical Specifications. The licensee has undertaken the necessary development measures.

The annual maintenance outages of Olkiluoto power plant were refuelling outages by nature and no significant safety-related observations were made during them. Inspections conducted by the licensee during the annual maintenance of Olkiluoto 2 revealed fault indications in one of four feed water assemblies. This lead to additional inspections of feed water assemblies in the 2003 annual maintenance outage of Olkiluoto 1. Two fuel assemblies were removed in the Olkiluoto 1 annual maintenance outage: one was leaking and on the other corrosion products had accumulated.

No individual occupational radiation dose exceeded the limit set for nuclear power plant workers. The collective occupational radiation dose was low by international comparison. Radioactive releases were low, too, and the radiation dose calculated on their basis to the most exposed individual in the vicinity of Olkiluoto nuclear power plant was clearly below a limit set by Government Resolution.

At Olkiluoto nuclear power plant, long-term follow-up on the plant’s ageing has been reorganised during 2003. Reporting on the maintenance function has been developed so as to enhance the options for ageing follow-up. In 2003, a turbine plant upgrading project was started that is considered important for the service life management of the Olkiluoto facility. Significant safety defects have been detected in inspections relating to the ageing management of mechanical components and of electrical and I&C systems and structures. Maintenance indicators for the Olkiluoto plant showed an improved maintenance function that was indicated ia by shorter failure repair times. No common cause failures occurred that would have prevented the plant’s operation.

Qualification of the periodic inspections of the most important mechanical components by non-
destructive methods is important in ascertaining the reliability of data on ageing management. Qualification of ultrasonic and eddy current inspections has not been developed as promptly as required by STUK, based on European recommendations. To repair the situation, new national arrangements for enforcement of qualification have been agreed upon with both utilities.

At Olkiluoto power plant, the number of operational events and events warranting a special report has increased from the year 2000, and has remained high. The high number of events indicates a weakened safety and quality culture in plant operation. The high number of events could also arise from the fact that safety culture was highlighted onsite in 2003. Some of the events relate to the observation of previous errors. In a STUK periodic inspection pertaining to plant operation, development needs were observed relating to improvement of the effectiveness of operational feedback activities and to allocation of sufficient resources for the tasks in question. The licensee has taken the necessary immediate corrective action and started the necessary improvements.

In 2003, new personnel were recruited to Olkiluoto nuclear power plant who will contribute to both the design, construction and commissioning of the new plant unit and the planning of modifications to operating power plants. This assures the effective transfer of knowhow acquired in the course of the planning of the new plant unit to the modernisation projects of operating plant units, provided that sufficient resources are reserved for both tasks.

No new investigations into plant operation were started by STUK in 2003.

**Annual assessment of probabilistic safety analyses**

A review of Level 2 Probabilistic Safety Analysis (PSA) for the Olkiluoto plant was completed. Level 2 analysis assesses the amounts of radioactive substances released into the environment in the early phases of a severe accident and also the probabilities of the releases. From the viewpoint of results interpretation, the most important observation made during the review was that Teollisuuden Voima Oy has defined as caesium-137 equivalents the radioactive release resulting from a severe accident, whereas the Government Resolution (395/1991) on the general requirements for nuclear power plant safety define the release threshold only as an inventory of the caesium-137. The calculation method used by Teollisuuden Voima Oy is stricter than that defined in the Government Resolution. Therefore, the frequency \(6.4 \times 10^{-6} / \text{year}\) of a major release (100 TBq) in the early phase of an accident, as calculated by Teollisuuden Voima Oy, is somewhat higher than that \(4 \times 10^{-6} / \text{year}\) calculated in accordance with the definition contained in the Government Resolution.

**Safety performance indicators**

The requirements set for the safety performance indicators for nuclear power plants were fulfilled at Olkiluoto power plant as regards occupational radiation doses, radioactive releases and population exposure. Releases into the sea reduced to the present level in 1998 when new equipment for process water purification and treatment were introduced.

No events occurred at the Olkiluoto plant units that would have endangered safety. One reactor scram occurred at Olkiluoto 1 that was classified an initiating event. All safety systems functioned according to design during it. The objective, max 5%, set for the risk -importance of the inoperability of components affecting accident risk was exceeded at Olkiluoto 2. This was due to the repair of ceilings of the pump sumps of the shutdown reactor service water systems at both plant units under an exemption granted by STUK. In addition, one stand-up diesel generator latent defect occurred Olkiluoto 2, which was somewhat
risk-significant. It did not require any specific measures from STUK. At the same time, indicators on the quality of maintenance showed higher efficiency and better quality.

The increasing trend at Olkiluoto power plant in the number of operational events and events warranting a special report, plant conditions in non-compliance with the Technical Specifications included, for three years in succession indicates a weakened safety and quality culture in plant operation. This was also evident from the four INES Level 1 events that occurred at the plant within a short period of time towards the end of 2003. The effectiveness of STUK’s regulatory activities is also assessed by adherence to the Technical Specifications. Based on the events, STUK has started discussions with the management of Teollisuuden Voima Oy, underlining the need for a common effort in the overall development of safety culture in nuclear power plant operation.

The structural integrity of multiple barriers to contain radioactive releases has been good. The number of fuel leaks at Olkiluoto plant has been small. In the operating cycle 2002–2003, unidentified leaks from the primary circuit increased, being at Olkiluoto 2 as much as 9.4% from the limit of the Technical Specifications, compared with the previous operating cycle. This was attributed to leaking check valves in the relief system of the main steam system during the entire operating cycle. The licensee is devising a new sealing solution for the valves.

The outcome of the indicators on plant safety, used in assessment of the effectiveness of STUK’s operations, in 2003 are given in Appendix 1. In addition, some background is given to the indicators and the procedures used in their acquisition.

3.2.2 Oversight of plant modifications
Oversight of modifications made at the Olkiluoto plant comprised definition of their regulatory scope, handling of documents pertaining to them and control of their implementation and commissioning. Safety modifications are described in Appendix 2. STUK oversaw the implementation of component and structural modifications by inspections onsite and at the component manufacturers’ premises as well as by licensee documents. Pertainning to the modifications oversight were meetings between STUK and the licensee as well as meetings internal to STUK, as described in subsection 3.1.2.

The status of safety-significant modifications was followed on a computer-based plant modifications register held at STUK. In 2003 the number of new modifications at the Olkiluoto plant units, entered in the register, was nine. Several unfinished modifications, registered earlier, were monitored on the register as well. It was also utilised specifically in monitoring the implementation of modifications-related document revisions. As a result of the follow-up, it was noticed that 86% of the document revisions made after plant modifications at the Olkiluoto plant in 2002 had been completed by the next annual maintenance.

3.2.3 Oversight of plant operability
Compliance with the Technical Specifications
Adherence to the Technical Specifications at Olkiluoto power plant was controlled by witnessing operations onsite. Specific areas of control included the testing and repair of components subject to the Technical Specifications. When the annual maintenance outages had ended, the plant unit’s state in compliance with the Technical Specifications was ascertained prior to start-up. The licensee is responsible for reporting to STUK without delay all situations deviating from the requirements of the Technical Specifications.

At the Olkiluoto plant units, eight situations occurred, mentioned in the “Operational events”, during which the plant unit was in non-compliance with the Technical Specifications. Two deviations were detected in the course of STUK’s regulatory inspections.

The number of plant conditions in non-compliance with the Technical Specifications at the Olkiluoto plant has increased (Appendix 1, indicator A.I.2). “Operational events” presents their causes and “Safety management” in subsection 3.2.4 looks into them from the viewpoint of organisational operation.
The Technical Specifications were deviated from also by applying in advance for STUK’s approval of a deviation. In 2003 the licensee applied for approval of seven situations in non-compliance with the Technical Specifications (Appendix 1, indicator A.I.2). After an analysis of their safety significance, STUK approved them all. Four of the exemptions were deviations from the Technical Specifications due to modifications, repairs or maintenance. One exemption was granted for a deviation due to a specific test.

Operational events
Both Olkiluoto plant units operated reliably. The load factor of Olkiluoto 1 was 97.0% and that of Olkiluoto 2 was 95.5%. Figure 6 gives the load factors of the plant units in 1994–2003. The annual maintenance outage of Olkiluoto 1 was nine days and that of Olkiluoto 2 was 14 days. The progress of the outages and the measures taken during them are described later in this chapter.

A reactor scram occurred at Olkiluoto 1 from low reactor water level during post-outage start-up. Since the reactor control rods were inside the reactor at the time, no actual scram occurred but only scram-related safety systems actuated. The event is explained in more detail in Appendix 3. In addition to the annual maintenance outage, a brief break in production occurred at Olkiluoto 1 to repair a leaking sealing in the inspection opening of a moisture separator and at Olkiluoto 2 to balance the turbine and to repair a leaking valve in the feed water system. In July–August, power of both plant units had to be reduced due to exceptionally high sea water temperatures.

Figure 7 gives the daily average gross powers of the plant units in 2003. Production losses from component failures were 0.2% at Olkiluoto 1 and 0.4% at Olkiluoto 2. The indicators given in Appendix 1 look at production losses from component failures for a longer period (indicator A.1.1.g).

Eight events warranting a special report, one reactor scram and eight operational transients reported to STUK occurred at the Olkiluoto plant units (Appendix 1, indicator A.II.1). In addition to event reports, Olkiluoto plant submitted to STUK daily reports, quarterly reports, annual reports, outage reports, annual environmental safety reports, monthly individual radiation dose reports, annual operational feedback reports and safeguards reports.

Events at the Olkiluoto plant, on which a special report was drawn up, and their INES classification, are as follows:

• Deterioration of the containment isolation function due to the failure to operate of a steam line isolation valve at Olkiluoto 1. INES Level 1.
• Inoperability of emergency coolant pumps at Olkiluoto 2 during annual maintenance. INES Level 1.
• A strainer clogged up at Olkiluoto 1 during annual maintenance. INES Level 0.
• The rate-of-change limit for reactor water temperature given in the Technical Specifications was exceeded at Olkiluoto 1. INES Level 1.
• Inoperability of a fire damper in the staircase of the Olkiluoto 2 reactor building. INES Level 1.
• Inoperability of a fire pump at Olkiluoto nuclear power plant. INES Level 1.
• The floor drainage level measurement function at the Olkiluoto spent fuel storage was not inspected. INES Level 1.
• High vibration levels on emergency coolant pumps at Olkiluoto 1. INES Level 1.

Event descriptions can be found in Appendix 3.

None of the events endangered plant safety. However, common factors underlying them, i.e. shortcomings in adherence to instructions, in administration of periodic inspections, monitoring of
plant states and identification of the requirements of the Technical Specifications. Event initiation has also been affected by the insufficiency in operational feedback activities to identify event causes and thus prevent recurrence. Underlying causes include also factors relating to safety culture and procedures. The licensee set up a working group to look into the development measures necessary because of the events. Several of them have already been implemented to prevent recurrence.

Figure 8 gives the number of INES Level 1 events in 1994–2003. No events above that occurred.

**Annual maintenance outages**

The refuelling and maintenance outage of Olkiluoto 2 was on 11 to 26 May, 2003 and that of Olkiluoto 1 on 27 May to 6 July, 2003. Olkiluoto 1 discontinued electricity generation for about nine days and Olkiluoto 2 for about 14 days.

At Olkiluoto 1, a fuel leak detected on 27 February 2003 was localised during the annual maintenance outage to one leaking fuel bundle. In addition, one fuel bundle with an exceptional amount of corrosion products was detected. The bundles were removed from the reactor. Fuel cladding integrity over the past years is examined in Appendix 1 (indicator A.III.1).

In a periodic inspection during annual maintenance, an indication along the pipe centre line was detected at Olkiluoto 2 in one of four reactor pressure vessel feedwater assemblies. This is explained in more detail in Appendix 3. An internal inspection of feedwater assemblies was conducted at Olkiluoto 1, too, because of the event, even if it was not due according to the 2003 inspection programme. No reportable indications were detected at Olkiluoto 1, however.

Safety improvements made in the annual maintenance outage are explained in Appendix 2.

The collective occupational dose during the outage was 0.20 mSv at Olkiluoto 1 and 0.71 mSv at Olkiluoto 2. The highest individual radiation dose at Olkiluoto 1 during the outage was 2.5 mSv and 7.9 mSv at Olkiluoto 2. Figure 9 presents the collective radiation doses incurred in annual maintenance in 1999–2003. Radiation safety at the Olkiluoto plant overall is separately described in this chapter.

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**Figure 7.** Daily average gross power of the Olkiluoto plant units.
Regulatory oversight by STUK focused on the administrative arrangements of outage work, the activities of the operating and maintenance personnel, refuelling as well as inspections and tests by the licensee and sub-contractors. Attention was also paid to the implementation of radiation protection, control room operations and housekeeping. Prior to the start of a new fuel cycle, safety analyses made for both plant units were checked. In addition, it was checked that the fuel assemblies were loaded into the reactor according to plan. The nuclear material inventory was inspected prior to the closing of the reactor pressure vessel head.

During the annual maintenance outages, STUK carried out inspections required in the Pressure Equipment Act. In addition, periodic inspections of pressure vessels and other pressure-bearing components were controlled by reviewing programmes pertaining to it and witnessing inspections onsite.

In addition, STUK controlled the plant unit’s placement in a shutdown state and its subsequent startup. On 8 August 2003 STUK approved the starting of refuelling-related measures. A corresponding approval was granted to Olkiluoto 1 on 22 May 2003. The permission to start up Olkiluoto 2 was granted on 23 May 2003. STUK’s inspectors ascertained the plant unit’s start-up readiness onsite on 25 May 2003. Olkiluoto 2 was connected to the national grid on 26 May 2003. The permission to start up Olkiluoto 1 was given on 3 June 2003 and the plant unit’s start-up readiness was ascertained onsite on 3–4 June 2003 by STUK’s inspectors. A minor water leak from the cable penetrations of a primary circulation pump was detected in start-up inspections and the plant unit was brought back to cold shutdown for repairs. During the plant’s cooling down a reactor scram occurred from erroneous operational action (see Appendix 3 for a separate description). The leaking penetrations were fixed after which start-up continued. Olkiluoto 1 was connected to the national grid on 6 June 2003.

One hundred and thirteen working days were spent onsite on the regulatory oversight of the annual maintenance outages of the Olkiluoto plant units. In addition, two resident inspectors were working on the plant site.

Ageing
In the organisation of Olkiluoto power plant, responsibility for the long-term monitoring of components, structural and systems ageing in the 2003 organisation has been with the technical department. The maintenance unit of the department of operation monitors and reports ageing phenomena observed during maintenance activities. Reporting on maintenance activities and the related database were reorganised at Olkiluoto in 2003 to facilitate monitoring of component ageing.

A project significant for the service life of the Olkiluoto plant units was started in 2003, namely turbine plant upgrading, which includes replacement of the steam driers inside the reactor pressure vessel.

STUK has reviewed follow-up reports on the ageing of mechanical components as well as of electrical and I&C systems and carried out periodic inspections pertaining to the monitoring of ageing in which also the monitoring of structural ageing was assessed.
Inspection methods are to be qualified to improve the reliability of the in-service inspection of the most important mechanical components by non-destructive methods. Qualification according to the national model applied so far has proved inefficient and time-consuming. In 2003, based on STUK’s requests, a review of qualification procedures was started and also discussion about a possible renewal of the qualification organisation.

**Radiation safety**

*Occupational radiation doses*
The radiation doses of those who worked at Olkiluoto nuclear power plant in 2003 were below the 50 mSv annual limit. The distribution of individual doses in 2003 is given in Table I. The highest individual dose at Olkiluoto nuclear power plant was 7.9 mSv. Individual radiation doses in 1999–2003 were below the 100 mSv dose limit determined for any period of five years.

In 2003 the collective occupational dose was 0.27 manSv at Olkiluoto 1 and 0.76 manSv at Olkiluoto 2; the total for both plant units being 1.03 manSv. STUK guidelines state that the threshold for one plant unit’s collective dose averaged over two successive years is 2.10 manSv. This value was not exceeded in either plant unit. The collective occupational radiation doses incurred over the past years are given in Appendix 1 (indicator A.I.4).

*Radioactive releases*
Radioactive releases into the environment from Olkiluoto nuclear power plant were well below authorised limits in 2003. The releases of noble gases into the atmosphere were about 0.1 TBq, ie approx 0.0008% of authorised limit. Iodine releases into the atmosphere were approx 0.02% of authorised limit. Aerosol releases into the atmosphere were approx 33 MBq, tritium releases into the atmosphere approx 0.3 TBq and carbon-14 releases into the atmosphere approx 0.7 TBq.

The tritium content of liquid effluents released into the sea, ie 1 TBq, is approx 6% of the annual release limit. The total activity of other nuclides released into the sea was 0.6 GBq, ie approx 0.2% of the plant-site specific release limit.

The calculated radiation doses of the most exposed individual in the environment of the Olkiluoto plant was approx 0.04 mikroSv, ie less than 0.1 % of the limit prescribed by a Government Resolution (100 mikroSv). Appendix 1 (indicator A.I.5) presents radioactive releases and the radiation doses calculated for the most exposed individual in the plant’s environment over the past years.

*Environmental radiation monitoring*
Radiation monitoring in the environment of a nuclear power plant encompasses those on- and off-site radiation measurements and determination of radioactive substances that are carried out to establish population radiation exposure and radioactive substances in the environment.

In the environment of Olkiluoto nuclear power plant, 288 samples were analysed. Radioactive substances originating in Olkiluoto nuclear power plant were measured in one sample of lichen, two samples of fish, two samples of bottom fauna, in 17 samples of aquatic plants and in 15 samples of sinking matter. The dominating power plant-based radioactive substance, cobalt-60, was measured in all of the aforementioned samples. The total number of observations was 37. Apart from cobalt, silver-110m was measured in one sample of sinking matter and manganese-54 and antimony-124 in one sample of aquatic plants each. In addition to cobalt-60, one sample of aquatic plants contained also cobalt-58, the activation product of nickel, and manganese-54, the activation product of iron.

All the detected concentrations were low and had no bearing on radiation exposure.

Dosimeters for external radiation measurement have been placed in about 11 locations and 10 continuous-operation radiation dose rate measuring stations at a distance of about five kilometres from the plants. The measurement data from these stations are transferred to the power plants’ control rooms and to the national radiation-monitoring network. The monitoring of external radiation is complemented by dose rate and spectro-
metric measurements. Two spectrometric measurements were made in the environment of the Olkiluoto plant.

3.2.4 Oversight of organisational operation

Safety management
Information on Olkiluoto nuclear power plant, which had accumulated in the course of document reviews and other inspection activity, was looked at during 2003 with a view to plant safety management.

A relatively large number of deviations from the procedures were observed during the annual maintenance outage, which were due to either human error or organisational factors, or due to which trouble shooting and repairs were problematic. The number of operational events was higher than usual also after annual maintenance. A meeting was therefore arranged on 25 September 2003 in which the licensee presented their own view on the event causes and the necessary measures. STUK did not consider the licensee’s explanation sufficient and the matter will be dealt with again in 2004.

In the autumn of 2003, several measures to improve organisational operation were started at the Olkiluoto plant. The licensee set up a separate working group to develop its operations, employed more personnel for operational feedback tasks and commissioned analyses and training to external consultants. In addition, the licensee will carry out a safety culture self-assessment based on IAEA guidelines.

Quality management system
The licensee has systematically maintained and developed the quality management system of the Olkiluoto plant in accordance with their own plans. A new quality management system, based on the ISO-9001 Standard, was commissioned in 2001.

The licensee regularly assessed the functionality of their quality management system by means of an internal audit programme and a separate individual inspection procedure.

STUK oversaw quality management by document reviews and periodic inspection. In the inspections it was established that the licensee’s quality management programme is acceptable. STUK has established that the operation of Teollisuuden Voima Oy complies with the plant’s own quality management system. Remarks were given during the inspections, mostly on further development of the system and definition of detail.

Personnel qualifications and training
Within the framework of the periodic inspection programme, in two periodic inspections, STUK oversaw the appropriateness and adequacy of Olkiluoto power plant’s organisation and its personnel training. Both inspections focused on the plant’s operating unit. The objective is to ascertain, by regular inspection, that sufficient personnel is kept at the operating Olkiluoto plant units in both direct operations and their support operations during the design, construction and commissioning of the new nuclear power plant unit.

Personnel recruitment by Teollisuuden Voima Oy has continued, mostly for the purpose of the new nuclear power plant. Experienced operating personnel from the operating plant units have moved to tasks pertaining to the new plant unit and new employees have been recruited in their place. Several persons recently employed by Teollisuuden Voima Oy participated in a 6-week basic professional training course on nuclear safety organised in Finland.

Upon licensee application, several of their employees were authorised to act as shift managers or operators at the nuclear power plant. A total of 28 authorisations were granted for the Olkiluoto plant, which mostly pertained to a new 3-year period.

Operational experience feedback
Licensee operational experience feedback consisted of the handling of events at own and other plants. Even events at plants abroad were discussed in a special operational feedback working group. The objective of operational experience feedback is to prevent recurrence of events that endanger plant safety.

The Olkiluoto plant units reported 16 operational events to STUK in 2003. Several internal reports on minor anomalies or operational events were drawn up at the plant as well.
STUK’s oversight of operational feedback activities was by periodic inspection and review of operational reports and the annual operational feedback report submitted by the licensee. The Olkiluoto plant has systematic and regulated procedures for event investigation, assessment and conducting of corrective action. In a periodic inspection, requirements were put forth for the further development of operations.

Furthermore, STUK evaluated the appropriateness of experiences learned from events abroad for consideration at Finnish plants. Event information was obtained through the Incident Reporting System (IRS) of the IAEA and the OECD. In 2003 twenty event reports were reviewed, eight of which lead to detailed inspection after preliminary assessment. No event in 2003 warranted immediate action from the licensee. At the Olkiluoto plant, three events lead to consideration of lessons learnt in the course of normal STUK inspection activity.

**Periodic inspection programme**

In 2003 STUK carried out 17 periodic inspections at Olkiluoto plant. Inspections contained in the periodic inspection programme are listed in Appendix 4. Safety management, the main processes of operation and also procedures as well as the technical acceptability of systems were looked into. Compliance of safety assessment, operation, maintenance and protection activities (in radiation protection, fire protection and physical protection) with the requirements of nuclear safety regulations was verified by the inspections. The annual inspection programme was brought to the attention of the licensee at the beginning of 2003 and inspection dates were agreed upon with licensee representatives.

Information was acquired through oral reports requested from representatives of the power plants, personnel interviews, document reviews, walk rounds, witnessing of working as well as various measurements, in to establish accuracy of measuring equipment. None of the observations made had an immediate bearing on the safety of the plant units. Actions were initiated onsite to repair the defects observed.

**Authorisation of pressure equipment manufacturers as well as inspection and testing organisations**

Upon application by Teollisuuden Voima Oy, and in accordance with the Nuclear Energy Act, STUK authorised three manufacturers of nuclear pressure equipment. In accordance with the Act, STUK also authorised one testing organisation to carry out non-destructive testing of mechanical components and structures at the Olkiluoto plant units. Testers employed by six different testing organisations were authorised to carry out in-service inspection of mechanical components and structures at the Olkiluoto plant units. Previous decisions pertaining to manufacturers and testing organisations are valid, as mentioned in the decisions.

The inspection organisation of Teollisuuden Voima Oy, authorised in 2002, continued in operation. By a decision made upon application by Teollisuuden Voima Oy, the scope of activities of the inspection organisation was extended to cover periodic inspection and tests that are part of preventive maintenance.

The manufacturers as well as testing and inspection organisations authorised by STUK were subject to oversight by the Authority.

**Nuclear liability**

The users of nuclear energy must have acquired liability as stipulated in the Nuclear Liability Act (484/1972), or other financial guarantee, for a possible accident at a nuclear facility that would harm the environment, population and property. Teollisuuden Voima Oy has prepared for damage from a nuclear accident as prescribed by law by taking out an insurance policy for this purpose mainly in the Finnish Nuclear Insurance Pool.

In case of an accident, the funds available for compensation come from three sources: the licensee, the country of location of the facility and the international liability community. In 2003, a total of about 425 M€ was available for compensation from all these sources.

The ascertaining of the contents and conditions of a licensee’s insurance arrangements in Finland belongs to the Insurance Supervisory Au-
authority. It has approved Teollisuuden Voima Oy’s liability insurance and STUK has verified its existence in accordance with section 55 of The Nuclear Energy Act (990/1987).

The Nuclear Liability Act covers also the transport of nuclear materials. STUK has ascertained that all nuclear material transport has had liability insurance approved by the Insurance Supervisory Authority or in accordance with the Paris Convention and approved by the authorities of the sending state.

3.3 New nuclear power plant project

Oversight planning
Preparation for the oversight activities of the new nuclear power plant continued. Parliament had in 2002 left in force the Decision-in-principle on the construction of a new nuclear power plant as proposed by the Government. Teollisuuden Voima Oy thereafter launched a bidding competition for the construction of the new plant. In December 2003 Teollisuuden Voima Oy announced that the winning bid came from Framatome ANP who offered a 1600 MWe pressurised water reactor (EPR).

Because of the extent of the execution of regulatory oversight pertaining to the new plant, an oversight project comprising 11 sub-projects had been set up in STUK in 2002. Project and sub-project managers were designated and the project group line-up was established in the spring of 2003.

The project plan, which describes responsibilities and procedures as well as essential tasks for implementation of regulatory oversight, was drawn up. In addition, a process description of the licensing process was made. The most essential tasks in preparing for oversight were the establishment of project and sub-project specific oversight plans and discussions with the licensee to facilitate a smooth licensing process. Revision of YVL guides was of essential importance as well. YVL guides revision is dealt with in Chapter 2. In the plans for sub-projects, specifically tasks most important in the handling of the construction permit application have been identified and prioritised and also resources required for the review and oversight have been identified. The plans address identification of sub-project interfaces to ascertain the full scope of oversight. In addition, sub-projects mapped what external support was needed.

In addition to oversight plans, plans were drawn up to monitor the licence applicant’s quality management during the project and principles were set up for an inspection programme during the plant’s construction and its implementation. An important task for the project group was to develop requirements management for the systematic control of safety requirements for the entire project. In addition to the development work, the task contained the incorporation into the requirements management system of YVL guides having the most bearing on the plant’s safety design,. The system is for monitoring of the fulfilment of requirements during the plant’s design, construction and commissioning. Commercial tools for requirements management were assessed and an own application was developed.

Co-operation with domestic and foreign liaison groups
There was co-operation with domestic liaison groups within the framework of the oversight project. Licensing-related discussions were had with the Ministry of Trade and Industry. STUK informed the Ministry on the status and results of work being done in preparation for the oversight work. A plan to develop analysis capabilities were drawn up and executed together with VTT State Technical Research Centre of Finland. The objective was to gain readiness to analyse, during the review of the construction permit application, the different plant alternatives brought forth during the bidding competition. Potential research needs and expert opinions in other fields of technology to support STUK’s regulatory work were also discussed. STUK presented YVL guides and their requirements to sub-contractors potentially participating in the project. There were over 200 participants in two training events.

Experiences were exchanged with the authorities of different countries (in the USA, the Czech Republic, France, Belgium) on the licensing of
nuclear power plants and its possible outcome, requirements pertaining to the various plant alternatives and plant construction experiences. In addition, options for future co-operation were mapped. Apart from regulatory co-operation, potential foreign consultants for areas in which there is no domestic expertise, or where a potential external third party is required, were charted. STUK underwent preliminary discussions with US, German, French and British consultants and technical support organisations. Topics included automation, accident analysis and the control room.

**Liaison with the license applicant**
The detailed contents requirements of the licence documents and their supply schedules as well as the time STUK needs to review them were discussed with the license applicant. STUK and the license applicant arranged a quality seminar in which the license applicant presented the principles applied to quality management and STUK those applied to regulatory oversight.

Essential topics of discussion were the interpretation of safety requirements for the plant alternatives. STUK met vendors upon the license applicant’s request. In the meetings the vendors introduced plant designs and the modifications made to meet Finnish safety requirements. STUK gave its opinion of designs unacceptable from the Finnish safety requirements point of view.

Upon the license applicant’s request STUK participated also in the handling of reactor pressure vessel material manufacturing. STUK gave the license applicant a statement on the starting of the material’s manufacturing and took part in the assessment of the manufacturers’ quality management systems. In addition, external statements were requested on the quality management systems.

### 3.4 FiR 1 research reactor
STUK regulates electricity-generating nuclear power plants as well as the FiR 1 research reactor operated by the VTT Technical Research Centre of Finland. The reactor is located in Espoo, and its maximum thermal power is 250 kW. The reactor is used for fabrication of radioactive tracers, activation analysis, student training and Boron Neutron Capture Therapy (BNCT) as well as the development of BNCT.

STUK’s periodic inspection in 2003 focused on the reactor’s quality management, operation, radiation protection, radioactive releases and safeguards. On the proposal of the VTT Processes, four reactor foremen and one operator were authorised. No significant problems were observed in the reactor’s operation in 2003. Occupational radiation doses and radioactive releases into the environment in 2003 were clearly below set limits.

### 3.5 Other nuclear facilities
The regulatory control of nuclear facilities relating to nuclear waste management, such as storage space, is dealt with in Chapter 4.
4 Nuclear waste management regulation

Esko Ruokola

4.1 Spent nuclear fuel

4.1.1 Interim storage

STUK’s regulatory control of spent nuclear fuel storage included regular inspections and review of plans and other documents. No safety-endangering events occurred in the operation of the storage facilities. The volume of spent nuclear fuel onsite the Olkiluoto plant in the end of 2003 was 5786 assemblies (1019 tU, tonnes of original uranium) with an increase of 256 assemblies (45 tU) in 2003. Corresponding accumulation in the Loviisa plant was 2755 assemblies (330 tU) including 210 assemblies (25 tU) placed in storage in 2003.

STUK made an assessment of the condition of spent nuclear fuel assemblies during storage as well as of the appropriateness of the condition of fuel intermediate storage. The conclusion was that the integrity of spent nuclear fuel bundles is not expected to be essentially compromised during the planned approx. 40 years of interim storage. Some fuel assemblies with a fuel channel have become somewhat bent or warped, which makes their manoeuvring in the storage positions less easy. The monitoring programmes are mostly appropriate and only minor adjustments in them are required.

4.1.2 Preparation for final disposal

Posiva Oy, a company owned by Teollisuuden Voima Oy and Fortum Power and Heat Oy, carries out R&D and technical design aiming at implementation of spent fuel disposal at a later date. Upon the company’s application, the Government made a Decision-in-principle on the construction of a final disposal facility in Olkiluoto. The goal of the R&D and design programme is to ascertain the suitability of the repository site, to design the necessary facilities and to acquire the research data necessary for assuring the safety of final disposal.

Teollisuuden Voima Oy and Fortum Power and Heat Oy applied for an amendment in the Ministry of Trade and Industry’s policy decision on the schedule of activities leading to the disposal of spent fuel in so far as it applies to the presentation of construction permit-related reports and plans to the regulatory authority. STUK in its statement was in favour of postponing the planned target date from 2010 to 2012, which was also set as the new objective in the Ministry’s decision of 23 October 2003.

Repository site investigations and underground research facilities

Posiva Oy continued to carry out geological research programmes in Olkiluoto. The aim was to complement the baseline data of the site and, specifically, to investigate in detail the area of the underground research facility to be constructed on the site. Facility construction is due to start in mid-2004. It may later become part of the repository proper, which has to be considered in the application of regulatory oversight on its implementation. STUK gave Posiva and the Ministry of Trade and Industry its assessment of Posiva’s report on the facility’s location and its access route designs and gave to the Eurajoki board of construction a statement on Posiva’s application for a municipal construction permit for the facility.

Posiva published reports describing the baseline of conditions on the site of the research facility, the plan for its technical implementation and the related research and monitoring programmes as well as the disturbances in the bedrock caused by the construction project. STUK reviewed the reports, supported by external teams of experts on bedrock structures, geohydrology, geochemistry and rock movements. The review was given to Posiva and the Ministry of Trade and Industry in February 2004.

Posiva commissioned a microseismic measur-
ing station on the island of Olkiluoto to observe tectonic earthquakes within approx. one square kilometre and, in the future, even seismicity arising from the excavation of the underground research facility. The measurement data yields additional information on bedrock structure and stability.

**Encapsulation and disposal technology**

Posiva continued technical R&D on spent fuel encapsulation and disposal. Two siting options for the encapsulation facility exist: either the repository site or in connection with the Olkiluoto interim storage for spent fuel. STUK gave Posiva and the Ministry of Trade and Industry its assessment of the two alternative disposal facilities. Posiva completed an Olkiluoto-specific encapsulation and final disposal facility plan that also examines facility operation and provision for accidents.

In co-operation with the Swedish nuclear waste company SKB, Posiva continues to develop waste canister manufacturing techniques. Posiva is responsible for the development of the pierce-and-draw method for fabricating the copper shell in which progress was made in manufacturing tests in Germany. Promising results have also been reported in manufacturing tests based on the extrusion-and-forging method that SKB is responsible for.

In addition, development and manufacturing tests of the cast-iron inner part of the waste canister continued. In a manufacturing test at Rautpohja, commissioned by Posiva, the desired metallurgical composition of the casting was not reached. SKB was more successful in its corresponding manufacturing tests.

Posiva is responsible for the development of electron beam welding of the lid of the copper canister. Welding tests in Germany failed due to problems with equipment and Posiva therefore cooperates with Patria Aviation to modernise the electron beam welding equipment in Linnavuori for future testing there.

Posiva also participates in the development of friction stir welding of copper at SKB’s Oskarshamn laboratory where full-scale equipment were installed in 2003. The Posiva–Outokumpu venture on narrow gap arc welding supported by National Technology Agency of Finland (TEKES) has been completed with the conclusion that the method cannot be applied to closing a 50 mm-thick copper canister.

### 4.2 Reactor waste

The utilities in 2003 followed earlier practices in carrying out their intermediate and low-level waste maintenance activities. A solidification facility is Loviisa power plant’s most important nuclear waste project, the Preliminary Safety Analysis Report of which STUK approved in 2001. A modification plan for the plant was submitted to STUK for approval but the facility’s construction was postponed until early 2004, in which case it could be commissioned in 2007 at the latest.

STUK inspected the handling, storage and disposal of reactor waste at both plant sites. Specific attention was paid to the storage of highly activated spent core internals on both nuclear power plant sites as well as the sufficiency and appropriateness of the handling and storage facilities for intermediate and low-level waste at Loviisa power plant.

No safety-related problems occurred in the treatment, storage and disposal of reactor waste. Currently approx. 44% of the waste from the Loviisa plant and approx. 91% of that from the Olkiluoto plant has been disposed of. The volume of reactor waste onsite the Loviisa plant at the end of 2003 was 2685 m$^3$ with an additional 183 m$^3$ in 2003. Corresponding waste accumulation at the Olkiluoto plant was 4335 m$^3$ with an added 123 m$^3$ in 2003.

### 4.3 Other regulatory activities

STUK gave the Ministry of Trade and Industry a statement, as referred to in section 78 of the Nuclear Waste Energy Decree, about the licensees’ nuclear waste management measures and plans. The statement assesses how, in preparing for nuclear waste management, the licensees have proceeded in relation to goals set out by the Government. STUK also gave statements, as referred to in section 90 of the Nuclear Energy Decree, about making financial provision for the costs of nuclear waste management, which assess the technical plans based on which the financial provision is made.
5 Regulatory control of nuclear materials

Marko Hämäläinen, Arto Isolankila, Elina Martikka, Jaakko Tikkinen

5.1 Nuclear material safeguards

5.1.1 Safeguards at Finnish nuclear facilities

International safeguards were implemented by the IAEA and the Euratom Safeguards of the EU. IAEA safeguards are based on the Non-Proliferation Treaty and the Safeguards Agreement (INFCIRC/193) signed by the non-nuclear EU member states. Euratom safeguards are based on the Euratom Treaty and Commission Regulation 3227/76 given by virtue of the Treaty. STUK’s safeguards activities aim to assure regulatory control of the use of nuclear energy necessary to prevent nuclear proliferation. In addition, STUK’s tasks include control related to international agreements in the field of nuclear energy signed by Finland.

In so far as nuclear power plants are concerned, STUK’s safeguards activities are mostly focused on fuel import, transport, storage, internal transfer and refuelling. The utilities submit to STUK activity programmes, advance notifications and reports relating to safeguards according to the requirements.

A total of 13 inspections were made at Loviisa power plant in 2003 and 20 inspections at Olkiluo- to power plant. Euratom ja the IAEA participated in 25 of them.

In addition to domestic nuclear power plants, minor amounts of nuclear materials are used at other facilities. The most significant of these is FiR 1, the research reactor operated by the VTT, where one inspection was conducted in 2003. The Laboratory of Radiochemistry of the University of Helsinki, OMG Kokkola Chemicals and STUK also have small amounts of nuclear materials in their possession. They were all inspected. STUK, the IAEA and Euratom participated in the inspections. STUK made one inspection at OMG Kokkola Chemicals without the IAEA and Euratom. The amounts of nuclear materials are given in Table II. Licences and approvals in accordance with the Nuclear Energy Act are given in Appendix 5.

Nuclear material safeguards employ several methods to verify that data on nuclear materials reported by the operator, such as burn-out and cooling time, are correct and complete. Other nuclear-safety related data, from operational safety to final disposal, can also be verified by measurements. In 2003 STUK verified by non-destructive methods 76 and 349 spent fuel assemblies at Olkiluoto and Loviisa power plant respectively. In

<table>
<thead>
<tr>
<th>Location</th>
<th>Natural uranium (kg)</th>
<th>Enriched uranium (kg)</th>
<th>Depleted uranium (kg)</th>
<th>Plutonium (kg)</th>
<th>Torium (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loviisa plant</td>
<td>–</td>
<td>405 597</td>
<td>–</td>
<td>3 224</td>
<td>–</td>
</tr>
<tr>
<td>Olkiluoto 1</td>
<td>–</td>
<td>224 771</td>
<td>–</td>
<td>1 089</td>
<td>–</td>
</tr>
<tr>
<td>Olkiluoto 2</td>
<td>–</td>
<td>207 057</td>
<td>–</td>
<td>936</td>
<td>–</td>
</tr>
<tr>
<td>Olkiluoto / Spent-fuel storage (KPA)</td>
<td>–</td>
<td>755 326</td>
<td>–</td>
<td>6 150</td>
<td>–</td>
</tr>
<tr>
<td>VTT: FiR 1 research reactor</td>
<td>1511</td>
<td>60</td>
<td>&lt;1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>OMG Kokkola Chemicals</td>
<td>712.6</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Others (non-nuclear)</td>
<td>84</td>
<td>1.7</td>
<td>471</td>
<td>0.005</td>
<td>4</td>
</tr>
</tbody>
</table>
addition, the IAEA, Euratom and STUK measured 30 dummy elements removed from the reactors of the Loviisa plant, which contained no nuclear material.

Every material balance area operated in compliance with STUK-approved manuals and in a way facilitating STUK’s fulfilling of the obligations of international agreements signed by Finland.

In 2003 STUK authorised nine Euratom and 23 IAEA inspectors to make inspections in Finland.

5.1.2 Strengthening of the IAEA safeguards

Measures to strengthen the IAEA safeguards began after the disclosure of the Iraqi nuclear weapons programme. By way of administration, safeguards strengthening is based on the Model Protocol Additional (INFCIRC/540). Finland signed the Protocol together with other EU countries in September 1998. The Protocol comes into force after all EU member states and the Commission have ratified it. Finland ratified it in the summer of 2000. In December 2003 Italy and Ireland, the last countries in the EU to ratify, announced its ratification, making possible its coming into force in 2004.

In 2003 STUK mapped the information available from Loviisa, VTT and STUK for inclusion in site declarations, as required in the Model Protocol Additional (article 2a (iii)). A declaration of the Olkiluoto site will be available in early 2004. In Olkiluoto’s case, it is to be considered how the construction of the new plant unit and the excavation of the research tunnel to be connected to the planned final disposal facility affect definition of the site. In addition, STUK charted R&D activities in the nuclear field (article 2a (i)) and also new undertakings subject to oversight after the coming into effect of the Protocol.

Together with the IAEA and Euratom, STUK arranged a meeting in which the final report of a VTT field trial was approved. A field trial of safeguards implementation in accordance with the Protocol was carried out at VTT in 2000–2002, with participation from the IAEA, Euratom, VTT and STUK. Based on the experiences gained from this, STUK has been able to essentially affect safeguards implementation in accordance with the Protocol within the entire EU.

A STUK expert participated in an IAEA meeting in London in which a revision of IAEA guidelines on the implementation of safeguards in accordance with the Protocol was prepared. STUK’s experts also took part in a Euratom Safeguards meeting in Luxembourg where the launching of safeguards in accordance with the Protocol within the EU was discussed. Notifications to the IAEA in accordance with the Protocol and a Euratom proposal for the harmonisation of the flow of information were addressed. STUK’s opinion is that the proposal would not support the implementation of effective IAEA safeguards, quite the contrary. STUK submitted its written comments on the proposal to the Commission.

The Commission provided the member states with a revised version of Euratom Regulation 3227/76 for comments in 2002. The Regulation’s revision is important now as due to safeguards in accordance with the Protocol, the EU’s enlargement and the reporting format in use today.

A working group of the Council’s Atomic Questions Group, AQG, has discussed the Regulation’s revision. It met 13 times in 2003. STUK was active in its meetings.

5.1.3 Safeguards of nuclear fuel final disposal

The final disposal of nuclear fuel in an underground repository presents new challenges to safeguards implementation since, after encapsulation, nuclear material verification will be impossible in practice. In so far as safeguards on final disposal are concerned, STUK had started work on creating national requirements for an encapsulation and final disposal facility.

Together with the IAEA and Euratom, STUK arranged an international meeting on safeguards of final disposal (SAGOR). Its objective was to chart safeguards methods for long-term final disposal and to devise procedures particularly for the Olkiluoto final disposal concept. STUK’s experts came forth with a preliminary plan for the control of final disposal by the Finnish regulatory system and for co-operation with the IAEA.

STUK sent the IAEA a letter about the start of construction of an underground research facility, because that facility is envisaged to become a part of a spent fuel repository in 2004. At the same time STUK requested a statement from the IAEA.
on the Agency’s safeguards requirements. STUK also looked into the applicability of new safeguards methods, such as satellite imagery, seismic measurement and remote sensing methods, for control applied during the construction of the final disposal facility. In early 2004, the finishing touches will be applied to a plan on safeguards control during the construction of the underground research tunnel.

5.2 Supervision and control of radioactive materials transport

About 20 000 radioactive packages are transported in Finland every year. STUK is not aware of any transport accidents involving radioactive materials, or of any other safety hazards in 2003. The transport of nuclear materials require a licence from STUK. Nuclear liability insurance and sufficient physical protection, among others, are conditions for the licence. STUK approved four transport plans, three of which for the import of fresh fuel and one for the export of irradiated fuel rods for analysis. Six types of packaging were approved for use in Finland. Three of these approvals had been applied for potential transits that did not take place, however. The most significant forms of nuclear material transport in 2003 were the import of fresh fuel to the Finnish nuclear power plants from Germany, Sweden, Spain and Russia as well as the export of three irradiated nuclear fuel rods to Sweden for analysis. Of the consignments of nuclear material transported in 2003, one batch of nuclear fuel was picked up for detailed inspection. No remarks were made in the inspection. In addition, one consignment was approved for transport subject to special arrangements.

The import of radioactive and nuclear materials is subject to a licence. No related smuggling attempts were detected at the Finnish border in 2003.

No illicit consignments containing radioactive material were turned back at the border in 2001–2003. The highest number, 23 consignments, was turned back in 1997. The reason was typically radioactivity measured in scrap metal. The decrease in number is partly due to the most significant consignors now measuring the radioactivity of their scrap metal. On the other hand, consignments of scrap metal to Finland have decreased.

Safeguards as well as supervision and control of nuclear material transport are looked into in detail in the report Nuclear Safeguards in Finland 2003 (STUK-B-YTO 231).

5.3 The Comprehensive Nuclear Test Ban Treaty (CTBT)

The Comprehensive Nuclear Test Ban Treaty (CTBT) prohibits all nuclear testing. The Treaty was opened for signing in 1996. It enters into force after ratification by 44 separately designated states. Finland ratified it in 1999. Adherence to the Treaty is monitored by means of an international observation network, which will comprise 321 monitoring stations.

The National Data Centre (NDC) in conjunction with STUK, which is based on the CTBT, contributed to the work of the preparatory commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) in establishing a cost-effective organisation functional also from the Finnish point of view. The NDC’s own automatic routine monitoring was in operation for the whole year. It is facilitated by an alarm system transmitting data on unusual observations to the NDC personnel. The NDC observed on abnormal activity in 2003.

A database was developed for data yielded by the Centre’s analysis programme.

In 2002 STUK signed an agreement with the makers of the analysis programme about its handing over to the national data centres of other countries for use in CTBT work. In 2003 the programme was forwarded to the national data centres of Estonia and Lithuania. In addition, the national data centres of Rumania, Iceland and Algeria requested for the programme.
STUK-financed safety research focuses on two areas: development of safety assessment methods and expertise as well research in direct support of regulatory decisions. The former benefits first of all from the national nuclear power plant safety and waste research programmes SAFIR and KYT. Excluded from these programmes is research commissioned by STUK pertaining to its own decisions, which must be independent of similar research by licensees or licence-applicant. In addition to these two main areas, STUK commissions independent research to develop regulatory control.

STUK’s experts controlled and monitored the SAFIR and KYT programmes and contributed to the support and managing group work of the SAFIR programme. The framework of SAFIR is based on the multiple safety challenges to nuclear power plants identified for the current decade due to the ageing of operating facilities and the new nuclear power plant.

The general research topics of the SAFIR programme, which started in 2003, were fuel and reactor core; primary circuit; containment and process safety functions; automation; control room and information technology; organisations and safety management; and risk-informed safety management. The programme was arranged into 18 research projects whose results are available at http://www.vtt.fi/pro/tutkimus/safir/, where also information about the SAFIR programme can be found. In the field of reactor safety, STUK contributed to several projects within the OECD/NEA and also worked with the US NRC. Of STUK-commissioned research projects outside the SAFIR programme, the most significant pertained to the development of analysis facilities needed in the regulatory oversight of the new nuclear power plant and the plant’s safety analyses.

The focus of the KYT programme in 2003 was similar to that of the earlier JYT2001 programme i.e. earth sciences, technical barriers, migration of radioactive substances, safety analyses and technical solutions. Information on the programme can be found at www.vtt.fi/pro/tutkimus/kyt/.

Appendix 6 lists STUK-financed safety research completed in 2003. It was commissioned to external organisations, which too, are listed in this Appendix. The cost of nuclear safety research in 1999–2003 is given in Fig 10. Growth is due to research project orders pertaining to the new nuclear power plant.
Figure 10. The cost of nuclear safety research.
7 Nuclear facilities regulation and its development

Kaisa Koskinen, Pekka Salminen, Arja Tänninen, Reino Virolainen, Kaisa Åstrand

7.1 Processes and structures

Document handling

A total of 1520 documents were submitted to STUK for review in 2003. The number of documents submitted in 2003 and earlier, whose review was completed in 2003, was 1619. The figure includes licences granted by STUK in accordance with the Nuclear Energy Act, which are listed in Appendix 5. Average document review time was 51 days. The number of documents and their average review times in 1999–2003 are given in Fig 11. Figs 12 and 13 give the distribution of the review times of documents on the Loviisa and Olkiluoto plant units.

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**Figure 11.** Number of documents received and reviewed as well as average document review time.

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**Figure 12.** Distribution of time spent on preparing decisions about the Loviisa plant units.

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**Figure 13.** Distribution of time spent on preparing decisions about the Olkiluoto plant units.
STUK's own operation
The renewal of STUK's strategy was completed. The new strategy for 2003–2006 considers the following factors in the field of nuclear safety regulation as affecting its regulatory control: ageing of operating nuclear power plants, construction of the new nuclear power plant and de-regulation of the electricity market as well as spent fuel final disposal and the coming into force of the IAEA Additional Protocol. An important task in 2003 was the development of working processes and competence. Processes essential for nuclear safety regulation were determined: overall safety assessment, plant projects and modifications control, plant operability control and organisational operation control. They divided into 7–9 sub-processes. The non-proliferation process includes safeguards, control of radioactive materials transport and control based on the CTBT. The nuclear waste process includes control of nuclear waste management operations as well as of R&D and planning activities in the area of nuclear waste management. Process and sub-process owners were designated and the drawing up of process descriptions were started. Sub-sections 3.1 and 3.2 of this report are structured along these processes.

An IRRT (International Regulatory Review Team) of the IAEA visited STUK from 31 August to 9 September 2003. Comprised of six experts, its task was to find out if STUK's operations have been improved in accordance with recommendations given in an assessment of its regulatory operations in 2000. The Review Team established that the majority of recommendations it had given in 2000 had lead to improved operations. The Team gave STUK two more recommendations and 18 proposals to consider whether certain matters could be taken care of better, using the alternative method proposed. The recommendations given dealt with the strengthening of the legal basis for the regulation of spent fuel final disposal planning and research as well as of radioactive materials transport.

The Team identified 14 procedures worth pointing out to other authorities. These pertained to the planning of own operations and the development of nuclear power plant and nuclear waste regulation. Based on the recommendations and proposals, STUK assessed the necessary further actions.

Ideas for development of own operations were obtained also from international operational experiences. An extensive fuel failure during maintenance operations at Paks nuclear power plant, Hungary, showed that requirements for the licen- see's indivisible responsibility for safety and their ability to supervise their sub-contractors is to be emphasised in regulations. The licensees in Finland have been outsourcing their operations while their own operations have focused on key know-how. Supervision of sub-contractors by the licensees has become topical in Finnish safety regulation.

Document management
A STUK long-term document management project moved to the realisation phase. In 2003, several types of document management software offered by various suppliers were compared and visits made to suppliers and also to companies where such software had been commissioned. Choice was made after a call for bids and a detailed comparison of products with the help of a consultant. The software main components included a portal, a document management application, a team work application and an archiving application.

In 2003, identification and assessment of all STUK departmental processes and the associated flow of documents, presupposed by the new software, were also launched. It was specifically identified what types of document pertain to each work process, the meta data presupposed by them as well as the information resources to be transferred to the new system. Definition of the portal's functionality and content has also been started. The new system is due for commissioning in 2004.

Safety culture
STUK has target-orientedly aimed at strengthening Finnish safety culture in the whole of the nuclear field. In support of this, co-operation in related questions has been organised between Finnish safety authorities.

A seminar was held at STUK in June dealing with the bases for and procedures of the regulatory oversight of safety management and culture. The participants, of which there were 50, were from STUK, the Safety Technology Authority (TUKES), the Finnish Rail Administration, the
Finnish Maritime Administration and the occupational safety unit of the Ministry for Social Affairs and Health. The starting point for the seminar was awareness of the fact that there are latent risk factors in technical systems, in the operation and management of the objects of regulation, legislation, regulatory activities and the global economy, which contribute to, and when worst comes to worst, lead to accidents. A well operating and managed organisation with a strong safety culture is capable of identifying risks and operating safely. The role and tasks of authorities in safety regulation are undergoing change and it looks necessary to focus oversight specifically to assuring organisational operating capability.

The common challenge Finnish safety authorities are now facing is how to evolve from technical inspectors to overseers and promoters of the safety operations of organisations. The seminar dealt with abstract and practical questions pertaining to safety management and safety culture. Presentations and general discussion looked for a common opinion on how insufficient safety in technology and human activity come about and how they can be prevented by safety management. The seminar was a good means of sharing knowledge and experiences on the regulatory procedures used in the oversight of technical systems and organisational procedures.

STUK’s representatives have contributed to international opinion exchange on safety culture in the nuclear field. The role of authorities in particular in the strengthening of safety culture was discussed at an IAEA meeting in September. An authority is to foster positive development in the safety culture of other organisations by setting a good example in its own field and being consistent in regulatory work.

STUK has aimed to add transparency and practicality to the concept of safety culture and the associated concept of safety management. Safety management and, more widely, management research has served as a source of concrete information as to what affects safety behaviour and organisations’ safety results and what management teams in safety critical fields are to consider. A master’s thesis on this topic is under way at STUK. The data thus obtained has been utilised in the revision of YVL guides as well.

Risk-informed regulatory control

Risk-informed quality management

A piece of research was completed in 2003 in how to use risk analysis to support the establishment of a quality management system and classification (Graded QA). Both utilities participated by submitting the material on what was chosen as an example and the VTT State Technical Research Centre of Finland conducted the related research. Both utilities have already classified certain organisational functions such that eg a function’s safety significance and related operational experiences and requirements for operability have been considered in defining a task's requirement level. However, classification has been case by case and probabilistic safety analysis has not been utilised in the assessment of a task's safety significance. The research done showed that the utilisation of risk analysis in the classification of organisational functions makes possible the focusing of a utility’s resources to where the risk from the plant’s operation can be most effectively reduced.

Risk-informed development of the Technical Specifications

In 2003, a Technical Specifications development project was completed. It yielded a calculation method for identifying transients during which a change in the plant operating state may entail a bigger risk than component repair during power operation. However, prior to its commissioning, reliable reference analyses are yet to be conducted requiring a major contribution from experts in the field.

Development of the FinPSA computer program

The risk assessment program FinPSA proceeded to its test operation phase. Almost all features pertaining to management of the Level 1 PSA model have been completed. The most important numerical calculation routines (minimal cuts, their importance measures and those of basic events) have been established. The Olkiluoto plant’s risk model was transferred to an entirely new program.

PSA information system

STUK has developed a Probabilistic Safety Analysis Information System (PSAIS) as a tool for risk-
informed regulatory control of nuclear safety. The system provides detailed data on the results of risk analyses, methods, conclusions made, their application and utilisation in nuclear safety regulation. PSAIS is an information system from whose hypertext environment the information needed can be extracted in several ways. The system will be made available in STUK’s intranet.

The first phase of PSAIS was completed in 2003 and it contains the below thematic entities on Olkiluoto nuclear power plant:

- PSA level 1 main results
- Systems analyses
- Accident progress and plant response
- General (initiating events, success criteria in various initiating events, etc)

A plan was devised for transferring this information to STUK’s intranet. System programming and preparation of its intranet pages is under way.

7.2 **Renewal and working ability**

A competence analysis, which was started in 2002, was completed and, on the basis of its results, competence development programmes were drawn up. The survey gathered information on competence relating to special skills and to general working skills; it defined the target situation and the current state of affairs; and their most essential gaps. On the basis of the results, training and development programmes to enhance know-how will commence.

Facilities and competence relating specifically to the new nuclear power plant in planning were developed. With this in mind STUK participated in the preparation and execution of a basic professional training course on nuclear safety with other organisations in the field. The 6-week course commenced in September 2003 and continued in 2004. Over 50 junior experts in the nuclear field from various organisations participated, eleven of which were from STUK.

A survey on well-being at the workplace was carried out at STUK. Actions to enhance it were agreed upon based on the results of the survey. Some actions could be realised right away and the implementation of some will continue in 2004.

7.3 **Finances and resources**

The duty area of nuclear safety regulation included basic operations subject and not subject to a charge. Basic operations subject to a charge mostly comprised of the regulatory control of nuclear facilities, with their costs charged to those subject to control. Those basic operations not subject to a charge included international and domestic co-operation as well as emergency response and communications. Basic operations not subject to a charge are publicly funded. Overheads from rule-making and support functions (administration, development projects in support of regulatory activities, training, maintenance and development of expertise, reporting as well as participation in nuclear safety research) were carried forward into the costs of both types of basic operation and of contracted services in relation to the number of working hours spent on each function.

In 2003, the costs of the regulatory control of nuclear safety subject to a charge were 7.2 M€. The total costs of nuclear safety regulation were 8.7 M€. Thus the share of activities subject to a charge was 83%.

The 2003 income from nuclear safety regulation was 7.2 M€. Of this, 2.3 M€ and 3.9 M€ came from the inspection and review of Loviisa and Olkiluoto nuclear power plants, respectively. In addition to the operating plant units, the income for Olkiluoto’s part includes regulatory control of the new reactor in planning. The regulation of Posiva Oy’s operations yielded 1.0 M€. The income from other objects of regulation (ia regulation of the FInR 1 research reactor, regulation of small-scale users of nuclear materials) was 0.01 M€. Figure 14 gives the annual income and costs of nuclear safety regulation in 1999–2003.

The time spent on the inspection and review of Loviisa nuclear power plant was 10.3 man-years, ie 12.2% of the total working time of the regulatory personnel. For Olkiluoto nuclear power plant it was 10.0 man-years, which accounts for 11.8% of total working time. In addition to the oversight of the operation of domestic nuclear power plants, the figure includes nuclear material control. The time spent on nuclear waste management inspection and review was 2.5 man-years. Preparation of the regulatory oversight of the new nuclear power
The number of inspection days onsite and at the component manufacturers’ premises totalled 1321. Not only inspections pertaining to the safety of nuclear power plants but also nuclear waste management and safeguards inspections are included. In addition, two resident inspectors worked at Olkiluoto nuclear power plant and one at the Loviisa plant. The number of inspection days in 1999–2003 is given in Figure 16.

Table III. Distribution of working hours (man-years) of the regulatory personnel in each duty area.

<table>
<thead>
<tr>
<th>Duty area</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic operations subject to a charge</td>
<td>25.3</td>
<td>26.4</td>
<td>26.3</td>
<td>27.6</td>
<td>29.2</td>
</tr>
<tr>
<td>Basic operations not subject to a charge</td>
<td>5.5</td>
<td>7.5</td>
<td>7.4</td>
<td>6.9</td>
<td>6.4</td>
</tr>
<tr>
<td>Contracted services</td>
<td>7.0</td>
<td>5.4</td>
<td>4.4</td>
<td>3.8</td>
<td>4.9</td>
</tr>
<tr>
<td>Rule-making and support functions</td>
<td>24.6</td>
<td>25.5</td>
<td>28.5</td>
<td>27.1</td>
<td>28.2</td>
</tr>
<tr>
<td>Holidays and absences</td>
<td>14.8</td>
<td>15.0</td>
<td>16</td>
<td>16.2</td>
<td>15.9</td>
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<tr>
<td>Total</td>
<td>77.2</td>
<td>79.8</td>
<td>82.6</td>
<td>81.6</td>
<td>84.6</td>
</tr>
</tbody>
</table>
Figure 15. Working time spent on main functions.

Figure 16. Number of inspection days onsite and at component manufacturers premises.
8 Emergency preparedness

Tuulikki Sillanpää

STUK arranged several training events and exercises to test and develop its own emergency response. In addition, STUK controls preparedness of the operating organisations of nuclear power plants to act in unusual situations. No such situations occurred in 2003.

Emergency response at nuclear power plants is under continuous development during plant operation and regularly tested in emergency exercises as part of emergency preparedness training. STUK has approved the emergency plans of Loviisa and Olkiluoto plants and yearly reviews the implementation of the emergency preparedness regime, including training and emergency exercises.

Two domestic emergency exercises were arranged in 2003 which STUK participated in. On 25 November 2003, over 30 domestic authorities and co-operators, media and Nordic nuclear and radiation safety authorities participated in an extensive emergency exercise of Loviisa nuclear power plant. STUK went in full-scale, with approx. 120 participants. The exercise tested inter-authority co-operation, the forming of an overall picture of the accident situation and the dissemination of information for the public and media. Tested were also the emergency plan, operation and management of the Rescue Region of Itä-Uusimaa to be established. Nordic radiation and nuclear safety authorities assessed the need for mild protective measures in the Nordic countries in the emergency event in question, based on the overall picture of the accident situation communicated by STUK. Protective measures could include interaction restrictions to Finland, measures imposed on trade and transportation as well as communicating information to visitors from own country to Finland.

The Olkiluoto annual emergency exercise was carried out on 19 November 2003 as a classroom exercise, with all parties taking part. The preceding training session went through the changes in operation brought about by the new emergency response centre system and the rescue region.

Fire drills were organised at Loviisa nuclear power plant on 21 May 2003 and 12 November 2003. A fire drill was organised at the Olkiluoto plant on 10 November 2003.

STUK also participated in nuclear power plant emergency exercises of international scale, which in 2003 contained no actual analysis of plant situations. A series of four EU-funded emergency exercises, held on 27 May 2003, tested the support systems to decision-making that are employed during a nuclear power plant accident to assess an accident’s harmful effects in the plant’s environment and the benefits of protective measures.
9 Communications

Risto Isaksson

In 2003 STUK issued 14 press releases on nuclear safety regulation. The press release of 26th November on the unusually high number of INES Level 1 events at Olkiluoto nuclear power plant got the most attention. Another press release reporting events at domestic plants was about a leak in the hydrogen system of a Loviisa 2 generator; the plant unit’s other turbine was stopped to repair the leak. Two press releases routinely reported the plants’ annual maintenance outages.

STUK’s international co-operation and events abroad were reported in the form of press releases. Topics included eg CTBT and assessment of nuclear waste programmes internationally. The fuel failure at Paks nuclear power plant, Hungary, was dealt with in one bulletin and in a complementing memorandum at STUK’s web site. Information about the opening for public access of the Nuclear Events Web-based System (NEWS) was disseminated as well.

Together with its partners in co-operation, STUK in September started a basic professional training course on nuclear safety. The need for this arises from not only change of generation in the field but also from the challenges set by the new nuclear power plant. This was reported in a press release and in the STUK magazine Alara. The composition of the new Advisory Committee on Nuclear Safety was the topic on one September press release.

All the bulletins on STUK’s safety regulatory effort in 2003 exceeded the news threshold but caused no big headlines. The power plants disseminated information about their annual maintenance at the same time, so it cannot be said that STUK made them headlines.

In addition to press releases, the operation of and events at the domestic nuclear power plants were dealt with in quarterly reports on nuclear safety, which were sent to the media and interest groups. The reports were also available at STUK’s web site.


In early 2003, a popular review of nuclear power plant safety was published.
10 International co-operation
Ilari Aro, Juhani Hyvärinen, Elina Martikka, Matti Ojanen, Hannu Ollikkala, Esko Ruokola, Pekka Salminen, Kirsti Tossavainen, Olli Vilkamo

Co-operation with the IAEA
The IAEA continued revision of its nuclear safety guidelines (formerly Nuclear Safety Series NUSS). The revision is almost done and is expected to be completed in the coming years. STUK prepared for the IAEA several statements on draft guidelines requested from Finland. It also contributed to the work of teams preparing the draft guidelines. A representative of STUK continued as chairman of the NUSSC (nuclear safety) committee. In addition, STUK-representatives were active in the WASSC (waste safety) and RASSC (radiation safety) committees.

The first review meeting on the Joint Convention on the safety of spent nuclear fuel management and on the safety of radioactive waste management was held in Vienna in November 2003. The Convention requires the submission, every three years, of a report on how its obligations have been met. STUK was responsible for the drawing up of Finland's country report and a delegation headed by STUK participated in the review meeting into which 33 countries participated. Finland's written and oral reports were received rather favourably: several good practices were referred to and the recommended safety improvements were the ones already mentioned in the country report.

STUK was Finland’s liaison organisation for the below information exchange systems for nuclear facilities maintained by the IAEA:
- Incident Reporting System (IRS)
- Incident Reporting System for Research Reactors (IRSRR)
- International Nuclear Event Scale (INES)
- Power Reactor Information System (PRIS)
- Nuclear Fuel Cycle Information System (NFCIS)
- Net enabled Waste Management Database (NEWMDB)
- Directory for Radioactively Contaminated Sites (DRCS)
- Illicit Trafficking Database (ITDB)
- Events that have arisen during the Transport of Radioactive Material (EVTRAM).

A report was forwarded to the IRS system about cracking in the shroud tubes of control rod drives connecting to the Loviisa 2 primary circuit, detected towards the end of 2001 and in 2002. No events reportable to the INES and IRSRR systems occurred. Yearly information on the operation of the Finnish nuclear power plants was forwarded to the PRIS system.

The Director General of STUK was invited as Vice Chairman of the International Nuclear Safety Advisory Group INSAG for the next four year period. The Group provides information and advice to the Director General of the IAEA in nuclear safety issues and gives recommendations for safety improvements in the IAEA member countries.

Funded from the IAEA’s safeguards support programme, a STUK-representative worked as a co-ordinator to East and Middle European assistance programmes. The programme is financed by the Ministry for Foreign Affairs and executed by STUK. Its objectives include development of the IAEA's safeguards procedures, training of inspectors and provision of expert assistance. Expert assistance will not continue in this form in 2004.

In IAEA expert capacity, a STUK representative participated in the IRRT assessment of the Bulgarian and Slovakian nuclear and safety authorities as well as the investigation of the extensive fuel failure at Paks nuclear power plant in Hungary.
Co-operation with the OECD/NEA

International co-operation in nuclear safety research was mostly channelled through the OECD/NEA. The organisation also facilitated an exchange of opinions about current nuclear safety questions. STUK was represented in all of the organisation’s main committees dealing with radiation and nuclear safety. The main committees are as follows:

- Committee on the Safety of Nuclear Installations (CSNI)
- Committee on Nuclear Regulatory Activities (CNRA)
- Committee on Radiation Protection and Public Health (CRPPH), and
- Radioactive Waste Management Committee (RWMC).

STUK's Director General acted as chairman of the CNRA.

STUK took part also in the work of the below CNRA and CSNI Working Groups:

- Working Group on Inspection Practices (WGIP)
- Task Group on Regulatory Effectiveness Indicators (CNRA/TGRE) and Task Group on Safety Performance Indicators (Joint CNRA/CNSI/TG-SPI)
- Working Group on Public Communication of Nuclear Regulatory Organisations (WGPC)

The CSNI Working Groups’ fields of activity were as follows:

- Working Group on Operating Experience (WGOE)
- Working Group on Integrity of Components and Structures (IAGE)
- Working Group on Accident and Analysis (GAMA)
- Working Group on Risk Assessment (WGRISK)
- Special Expert Group on Human and Organisational Factors (SEGHOF)
- Special Expert Group on Fuel Safety Margins (SEGFSM).

A STUK-representative was chairman of the CRPPH Expert Group on Effluent Release Options (EGRO). The final report on this work was published in 2003.

Co-operation with the EU

The Atomic Questions Group (AQG) of the Council of the European Union in the autumn of 2003 sent out an expert group to Bulgaria to gain insight into safety improvements made at Kozloduy nuclear power plant and the reorganisation of the country’s nuclear sector in accordance with the requirements of EU membership. A STUK representative contributed to the preparation, execution and results assessment of this mission. The Group’s final report will be completed in the spring of 2004.

STUK participated in the work of three working groups of the NRWG. One of the groups looked into the suitability of Risk Informed In-Service Inspection (RI-ISI) for the drawing up of a piping inspection programme for nuclear power plants. Represented in the working group are also authorities from France, Spain, Belgium, Sweden, Germany, England and Switzerland. The working group has been in close contact with the utilities’ ENIQ working group, corresponding working groups of the OECD and the IAEA as well as the organisations that developed the methods (Westing house and EPRI) and utilities. It has drawn up a draft report describing the contents of various RI-ISI methods, European and American applications, differences/similarities between traditional methods and RI-ISI methods. In addition, the report assesses the pros and cons of the RI-ISI procedures from a regulatory point of view.

Another NRWG working group, to whose work STUK participated, dealt with the qualification of non-destructive examination. The group's task was to exchange experiences in the implementation and development of qualification in European countries and to follow and assess inspection qualification with an eye to regulatory work. Based on a survey it conducted, the working group prepared a report describing the status of qualification in nuclear EU countries and applicant countries.

STUK took part in the operation of an NRWG working group on safety-critical software. The group’s task is to gather common position of EU authorities on requirements of safety-critical software.

STUK contributed to the work of the advisory Expert Group A31 of the Commission of the Euro-
pean Union. It’s main tasks pertain to radiation protection.

In the field of nuclear material safeguards, STUK participated in the operation of the European Safeguards R&D Association (ESARDA). ESARDA’s task is to promote and harmonise European R&D in nuclear material control. ESARDA offers a forum for information and ideas exchange to authorities, researchers and nuclear power plant operators.

Via the activities of the Regulatory Assistance Management Group (RAMG) of the EU, STUK participated in Phare and Tacis co-operation in support of East European regulatory organisations and their support organisation. There were two meetings of the group in 2003. It assessed the appropriateness of projects prepared by the EU to support regulatory work. STUK contributed to the then-ongoing Phare and Tacis projects. STUK participated in the work of the CONCERT working group consisting of the heads of nuclear safety authorities of the EU member states and applicant countries. The group assembled twice to discuss EU-related questions touching on regulatory work.

NKS co-operation

The new research programme of NKS, Nordic co-operation in nuclear safety, commenced in 2002. It is headed by two responsible programme managers. For the first part of 2003, STUK’s representative was responsible for the programme’s sub-area of reactor safety, after which responsibility was handed over to a representative of Fortum Nuclear Services Oy. STUK participated in the work of the sub-area of emergency preparedness and environmental safety. In addition, STUK has a representative in the NKS management team.

Projects on reactor safety relate well to Finland’s national research programme and needs. Several experts from STUK work with the emergency preparedness and environmental safety programme that includes focus areas important to Finland.

The new programme’s content in its entirety serves well co-operation between the Nordic authorities, which is a permanent objective of NKS co-operation.

Bilateral co-operation

A representative from STUK was a permanent member of the Reactor Safety Committee assisting the Swedish Nuclear Power Inspectorate (SKI). A representative of SKI was an invited expert in the Advisory Committee on Nuclear Safety that functions in conjunction with STUK. Co-operation with SKI continued, with regular meetings during which current questions of nuclear safety regulation were discussed. Information exchange with the Swedish Radiation Safety Authority (SSI) continued as regards doses to Finns who had worked at nuclear power plants in Sweden and to Swedes who had worked at Finnish plants.

A representative of STUK was chairman of a nuclear safety committee that supports the Belgian nuclear safety authority and participated as a permanent member in the work of a corresponding Lithuanian advisory committee.

STUK’s co-operation with the USNRC focused on information exchange in nuclear safety matters of interest to both parties. A STUK representative worked at the USNRC as a visiting expert for one year. STUK continued, in co-operation with USNRC and VTT, development of the FRAPTRAN/GENFLO code for fuel transients. Additionally, and in co-operation with Fortum Service, Argonne National Laboratory (ANL) was provided with Zr1%Nb cladding material for the USNRC’s LOCA tests. Discussions on the licensing of new nuclear power plants and experiences in their construction were had with US authorities.

Discussions were had with the French authority (DGSNR) and the Czech Republic’s authority (SUJB) on the licensing of new nuclear power plants and experiences on their construction.

An expert on I&C technology from the Swiss authority (HSK) worked at STUK for six weeks. The visit’s topic was regulatory control and supervision of extensive I&C modifications at nuclear power plants, in which the Swiss have gained experience in the past few years.

Co-operation between STUK and the Russian nuclear safety authority Gosatomnadior (GAN) in nuclear material and waste control continued, based on a co-operation arrangement signed in 1998. For the part of nuclear waste, the develop-
ment of regulatory guidelines was of particular interest.

Safeguards co-operation between STUK and the Australian Safeguards and Non-proliferation Office (ASNO) continued. STUK provided ASNO with information about nuclear materials imported to and kept in Finland as agreed.

Other forms of co-operation
STUK participated in the work of the Western European Nuclear Regulators' Association (WENRA). In 2000, a working group on harmonisation had been set up to develop a method for drawing up uniform nuclear safety requirements. In accordance with the recommendations of the working group's final report, an extensive nuclear safety requirements development project was commenced in early 2003. It serves to establish nuclear safety requirements for 19 safety issues plus their status in the 17 participating countries. STUK in 2003 actively contributed to the project by drawing up draft requirements for licensee training and qualifications approval as well as probabilistic safety analysis related areas.

The VVER Regulators Forum in 2002 set up a working group of authorities to compare the risk analyses (PSA) conducted for VVER facilities and to analyse their causes. The working group met twice in 2003; one of the meetings was held in STUK. The working group consists of national nuclear safety authorities from Armenia, Bulgaria, Ukraine, Russia, Slovakia, the Czech Republic, Hungary and Finland. In 2003 each participating country drew up a summary report of the PSA for their own country’s VVER plants and, based on their PSA, analysed in more detail one initiating event leading to an accident plus a subsequent accident chain.

STUK participated in the work of the Network of Regulators of Small Nuclear Programs (NERS). NERS met once in 2003.
The Advisory Committee on Nuclear Safety

Pekka Salminen

In accordance with section 56 of the Nuclear Energy Act (990/1987), the preliminary preparation of matters relating to the safe use of nuclear energy is vested with the Advisory Committee on Nuclear Safety. It is appointed by the Government and functions in conjunction with STUK. Its term of office is three years. The Committee was appointed on 16 August 2000 and its term of office ended on 15 August 2003. A new Committee was appointed on 10 September 2003.

In early 2003 the Committee's Chairman was Professor Pentti Lautala (Tampere University of Technology) and its Vice-Chairman was Head of Research Rauno Rintamaa (VTT Technical Research Centre of Finland). In 2003 the members were Senior Researcher Riitta Kyrki-Rajamäki (VTT), Director Ulla Koivusaari (Pirkanmaa Regional Environment Centre), Director Olli Pahkala (Ministry of the Environment), Professor Rainer Salomaa (Helsinki University of Technology), Branch Manager Paavo Vuorela (the Geological Survey of Finland). Professor Jukka Laaksonen, Director General of STUK, was a permanent expert to the Committee. Invited experts were Doctor of Technology Antti Vuorinen and Director Christer Viktorsson (the Swedish Nuclear Power Inspectorate).

Mr Olli Pahkala and Mr Rainer Salomaa left the Committee during the year. In their place, the Government assigned Director Timo Okkonen (TUKES) and Senior Researcher Ilona Lindholm (VTT). Mr Pentti Lautala continues as Chairman and Mr Rauno Rintamaa as Vice-Chairman. Mr Antti Vuorinen and Mr Christer Viktorsson continue as invited experts.

The Committee convened eight times in 2003.

The Committee has three divisions for preparatory work: a Reactor Safety Division, a Nuclear Waste Division as well as an Emergency Preparedness and Nuclear Material Division. In addition to the Committee members proper, distinguished experts from various fields have been invited to the Divisions. A total of twelve Division meetings were held in 2003.