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Regulatory control of nuclear safety in Finland

Annual report 2006

Erja Kainulainen (ed.)

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Abstract

This report covers regulatory control of nuclear safety in 2006, including the design, construction and operation of nuclear facilities as well as nuclear waste management and nuclear materials.

No events compromising the safety of the use of nuclear energy occurred at the Olkiluoto and Loviisa nuclear power plants. The doses of all nuclear power plant workers were below the individual dose limit. The collective occupational dose at the Olkiluoto plant was higher than previously due to the modernisation of the Olkiluoto 1 turbine plant and exceeded the average dose measured at corresponding BWRs. The collective occupational dose at the Loviisa plant was a PWR average occupational dose. 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 plants was well below the limit established by Government Decision.

STUK's safety performance indicators for nuclear power plants, which describe the effectiveness of STUK's activities, did not indicate changes requiring STUK's immediate reaction.

The focus of the Olkiluoto 3 oversight was on reviewing detailed design documents and witnessing manufacturing of the main components. The share of onsite activities oversight was less than planned because construction work proceeded slower than originally planned. The prerequisites for organisations' operation were followed by inspection and audits. In addition, STUK made an investigation into the project's safety requirements management, which was based on deficiencies in organisations' operation that surfaced during the concreting of the base slab. Incorporated in the investigation were deficiencies that surfaced during the manufacturing of the containment steel liner and during the design of the polar crane of the reactor building.

No events compromising safety occurred at the FiR 1 research reactor. The radiation doses of those working at the reactor and radioactive releases into the environment were clearly below set limits.

No events endangering safety occurred in nuclear waste management. In 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 as required by legislation.

The total costs of nuclear safety regulation were € 11.1 million. The total costs of operations subject to a charge were € 10.1 million, the full amount of which was charged to the licensees and licence-applicants.

Sisällysluettelo

Foreword

Jukka Laaksonen

Work in the field of nuclear safety regulation increased and became more diverse when the construction of the fifth reactor proceeded and the final disposal of spent nuclear fuel neared implementation. In consequence of these Finnish projects, leaders in their field internationally, a high demand arose for STUK's experience and know-how, and their sharing within the international community.

The operating nuclear power plants are almost 30 years old. The plant units have operated reliably and, in over ten years, no disturbances significantly affecting power generation, or any other problems, have occurred. This excellent outcome may entail a risk, however: motivation for disciplined and professionally skilled plant operation and risk-informed regulation could gradually slacken. Both the licensees and STUK are aware of the need to ward off complacency and have actively sought means to underline the challenging nature of their work. The licensees have developed new methods to determine the condition of components and have replaced old components before their ageing becomes a threat to safety or the reliability of power generation. Organisational leadership and ways of action as well as personnel training and plant procedures have been improved based on own experiences and those of colleagues abroad. The plants have been modernised to enhance safety margins and to reduce susceptibility to disturbances. Examples of what has been done at each plant in 2006 are given in respective chapters. As a result of determined work on enhancements, the safety of the plants has, as assessed by STUK, continuously improved over their operating life. STUK, for its part, has striven to continuously bring new independent perspectives to its regulatory oversight effort to maintain the operating organisations' vigilance in recognising even weak signals of danger. In 2006 this principle was realised in particular by the renewal of periodic inspection programmes and by underlining the intensified utilisation of international experiences in Finland.

Radioactive waste generated by nuclear power plant processes is treated in a controlled way and the accumulation of waste to be taken to the final disposal facility is as anticipated. Posiva Oy's projects to develop final disposal have reached the technical design, construction and procedure qualification test phase, and results have been achieved quickly. A description can be found in the chapter on nuclear waste management. The excavation of the underground research facility of the final repository, which will take several years, in practice equals to the construction of the final repository proper, provided that the project progresses as designed. STUK's oversight of the work has therefore been like that of the construction of a nuclear facility.

The construction of the Olkiluoto 3 plant unit has proved more demanding than expected. Delays in the design of the first facility of this type have slowed down the project and documents have not been submitted to STUK for review according to the anticipated schedule. Problems have occurred in construction management and in the manufacturing of components to quality requirements; the resolving of these problems has required good co-operation between the parties to the project. Significant improvements were achieved in 2006, however. The problems and STUK's actions thereupon are described in the chapter on the Olkiluoto 3 project. According to STUK's assessment, the problems do not adversely affect the safety of the facility under construction or the final quality of components and structures.

Due to the increased activity, STUK has recruited more personnel to carry out the oversight of nuclear power plants and nuclear waste management. More will be recruited in 2007. Without more personnel, it will not be possible to oversee the construction of the new reactor and maintain today's accuracy of oversight, ensuring at the same time that the project schedule is not delayed without technical grounds by STUK. Experience so far has shown that accuracy of oversight and timely requirements for corrective action are required for the best possible outcome. Oversight having a sufficient scope is desirable from the viewpoint of the licensee, too. Posiva's operations in the field of nuclear waste management have become more extensive and require an increase in the equivalent STUK resources to maintain credibility of the oversight effort. The current invoicing usage facilitates easy optimisation of oversight resources according to need.

STUK's international contacts increased considerably in 2006. STUK was in high demand for visits and the active contribution of STUK's personnel was required in important international projects to harmonise safety requirements or regulatory procedures. Close contacts with all leading nuclear energy countries promote the development of Finnish safety requirements and regulatory practice but at the same time place a high burden on STUK's key personnel.

STUK's operational strategy for the 5-year period from 2007 to 2011 was renewed as well as the operational programmes of all fields of activities. In the early stages of the renewal, the entire personnel's views on the changes in the operating environment that had taken place, and those that could be anticipated to take place, were gathered. In the strategy, emphasis is placed not only on the regulatory effort proper but also on STUK's responsibility to develop domestic know-how and to openly communicate nuclear safety matters. The plans drawn up provide a good basis for regulatory oversight that supports the maintenance of nuclear safety.

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 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 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 focused on the Loviisa 1 and 2 nuclear power plant units owned by Fortum Power and Heat Oy and the Olkiluoto 1 and 2 units owned by Teollisuuden Voima Oy as well as their nuclear waste management and nuclear materials. The Olkiluoto 3 plant unit of Teollisuuden Voima Oy, which is under construction, was also subject to regulation. Fortum Power and Heat Oy and Teollisuuden Voima Oy are later in the text also referred to as licensee, licence applicant or utility. The planning and later implementation of the final disposal of nuclear fuel 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.

Loviisa 1 began generating electricity to the national grid in 1977 and Loviisa 2 in 1981. Their operating licences were renewed in 1998 and will expire at the end of 2007. The Loviisa plant units are light-water PWRs. The highest allowable reactor nominal thermal power for each unit, according to the licence granted by the Government, is 1500 MW. 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. Olkiluoto 1 and 2 are light-water BWRs. The operating licences of the Olkiluoto 1 and 2 plant units were renewed in 1998. They 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 licences, the highest allowable reactor nominal thermal power for each Olkiluoto plant unit is 2500 MW. A corresponding nominal gross electrical power is 890 MW and net electrical power 860 MW. The licence 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.

Upon application by Teollisuuden Voima Oy, the Government on 17 February 2005 granted a construction licence for Olkiluoto 3 in accordance with the Nuclear Energy Act. The new plant unit is a light-water PWR with a reactor thermal power of 4300 MW and a net electrical power of approx. 1600 MW.

This report's section on nuclear reactor regulation describes the evaluation of safety analyses for the Loviisa plant units and the Olkiluoto plant units in operation; the control of plant modifications, the availability of plant units and the operation of organisations. The efficiency and effectiveness of nuclear safety regulation is analysed using STUK's Safety Performance Indicator System. The report's appendices contain detailed information and conclusions on Safety Performance Indicators (Appendix 1), completed safety enhancements (Appendix 2) and significant operational events (Appendix 3). Radiation safety at the plants is analysed by looking at occupational and collective doses at the facilities as well as the outcome of monitoring for radiation in releases and the environment.

The report discusses the evaluation of safety analyses for Olkiluoto 3, which is under construction, plant project oversight and oversight of the operation of organisations participating in the construction project.

Plant-specific summaries are given of how new or revised YVL guides apply to operating nuclear power plant units and those under construction.

The chapter on nuclear waste management deals with spent nuclear fuel intermediate storage, preparation for final disposal, and treatment of low and intermediate level waste. The volumes of nuclear fuel as well as low and intermediate level waste stored onsite at the end of the year are given.

The chapter on nuclear non-proliferation describes nuclear material control at the Finnish nuclear facilities and plans for the safeguarding of the final disposal of spent fuel as well as activities in accordance with the IAEA's Additional Protocol. Regulation of radioactive materials transport and implementation of the Comprehensive Test Ban Treaty (CTBT) are included.

In addition to the safety regulation proper, the report discusses development of regulatory guides and nuclear safety regulation as well as safety research, emergency response, communications and participation in international co-operation in the field of nuclear safety.

2 Legislation and regulations

Vesa Ruuska, Pekka Salminen

STUK contributed to the preparation of the Ministry of Trade and Industry's legislative project to amend the Nuclear Energy Act (990/1987), the Government Decisions (395/1991, 396/1991, 397/1991, 398/1991, 478/1999) issued by virtue of it and the Nuclear Energy Decree. The project brings up-to-date regulations most of which are 15 years old. Some requirements are amended to correspond to the new constitution that took effect in 2000. Preparation has proceeded according to schedule and in co-operation with the Ministry of Trade and Industry such that key interest groups submitted their statements on the matter and their comments on the suggested law amendments.

The revision and updating of YVL guides continued. They are detailed safety regulations for nuclear facilities issued by STUK on the basis of the Nuclear Energy Act (990/1987) and the Government Decision (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. The decisions made are discussed in subsections 3.1.2, 3.2.1 and 3.3.1.

A total of about 20 guides were prepared or reviewed in YVL guide working groups, with eight guides completed by the end of the year. The number of Finnish language YVL guides published in 2001–2006 is given in Fig. 1. Seven guides were published in English and three in Swedish. The guides were available in print and on STUK's web site (*www.stuk.fi/julkaisut_maaraykset/viranomaisohjeet/en_GB/yvl/*) and on the Finlex portal (*www.finlex.fi*). Swedish language translations were available on the STUK web site only.

Revision of the structure of YVL guides was started based on a project plan. The views of an expert group, summoned in 2005 and comprised of representatives from STUK and the Finnish nuclear utilities, were considered in the drawing up of the plan. Essential revision objectives include elimination of known overlappings and deficiencies, making the set requirement level clear by removing descriptive instructions for interpretation, and reduction of detailed requirements. A requirements management system and a reference technique utilising modern IT technology will be introduced. The number of guides will be reduced to almost half and they will be easier to maintain and use. The revision is due for completion by the end of 2011.

The preparation of five guides was started. In support of STUK's experts preparing the guides, YVL guide -specific working groups were set up having representatives from the Finnish nuclear utilities and VTT State Technical Research Centre. The working groups will discuss the contents of the guides during their preparation already, thus reducing the time spent in their preparation overall. In addition, a follow-up group on the entire project has assembled with representatives from STUK, the nuclear utilities and VTT.

In a working group of the Western European Nuclear Regulators' Association (WENRA) STUK's

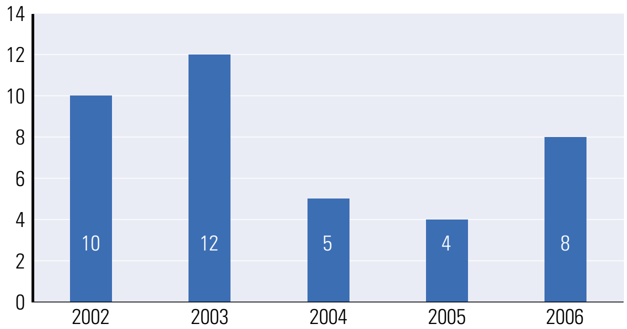

Figure 1. Number of yearly published YVL guides.

experts contributed to the drawing up of reference levels for European safety requirements. WENRA works to harmonise safety requirements in EU countries. STUK requested the Finnish licensees' opinion on the requirements and on their fulfilment at Finnish nuclear facilities. On Finland's part, certain non-conformities between the requirement level and YVL guides surfaced. However, no non-conformities in their fulfilment were detected at the nuclear facilities. Towards the end of 2006, the regulatory heads of countries contributing to the harmonisation process gave the final touches to the requirements. The experience gained in WENRA work was directly utilised in the then-ongoing work on YVL guides.

Nuclear safety recommendations are given by international organisations, such as the IAEA and the OECD/NEA. On various forums of co-operation STUK follows the work of other countries' national authorities in the field of rule-making. This did not result in any need to update the Finnish nuclear legislation. STUK prepared and delivered to the IAEA national statements on draft safety guides.

3 Nuclear facilities regulation

Kirsi Alm-Lytz, Tapani Eurasto, Timo Eurasto, Juhani Hinttala, Juhani Hyvärinen, Marja-Leena Järvinen, Rauli Keskinen, Samuel Koivula, Tapani Koljander, Jukka Kupila, Janne Liuko, Vesa Ruuska, Risto Sairanen, Pekka Salminen, Seija Suksi, Heimo Takala, Petteri Tiippana, Keijo Valtonen, Olli Vilkamo, Reino Virolainen

3.1 Loviisa 1 and 2

3.1.1 Operating licence

The current operating licence of Loviisa power plant expires on 31 December 2007. Fortum Power and Heat Oy on 1 November 2006 submitted to the Ministry of Trade and Industry an application for its extension by 20 years for Loviisa 1 and by 23 years for Loviisa 2. The utility's KLUPA project prepared the application. In addition to the licence extension, the project's aim is to deepen expertise and strategic partnership between Loviisa power plant and the Fortum Nuclear Service as well as to pass on plant related information and skills from old to new generation. Essential project sectors are lifetime management, plant safety, deterministic and probabilistic safety analyses, plant operation as well as matters relating to the environment, nuclear waste and nuclear fuel. As part of a subproject relating to plant operation, descriptions of the plant's operating organisation and safety culture will be drawn up.

STUK made more specific the follow-up plan on the Loviisa 1 and 2 operating licence renewal. It prepared for the assessment of the operating licence application, actively held meetings with the licensee and commented on draft documents to be submitted to STUK in conjunction with the licence application. The utility provided STUK with documents in accordance with section 36 of the Nuclear Energy Decree and a periodical safety assessment in accordance with Guide YVL 1.1. STUK began document review and the making of the safety analysis report according to schedule.

3.1.2 Implementation of regulations

STUK has in use a procedure for the 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 the principle stipulated in section 27 of the Government Decision (395/1991). It prescribes that, to further improve safety, measures shall be implemented that are justifiable considering operating experience, safety research and the development of science and technology.

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

- YVL 1.3, Mechanical components and structures of nuclear facilities. Approval of testing and inspection organisations, 3 February 2006
- YVL 2.4, Primary and secondary circuit pressure control at a nuclear power plant, 24 November 2006
- YVL 3.1, Nuclear facility pressure vessels, 31 January 2006
- YVL 3.4, Approval of the manufacturer of nuclear pressure equipment, 31 January 2006
- YVL 3.5, Ensuring the strength of a nuclear power plant's pressure equipment, 3 October 2006

- YVL 3.8, Nuclear power plant pressure equipment. In-service inspection with non-destructive testing methods, 10 February 2006
- YVL 3.9, Nuclear power plant pressure equipment. Construction and welding filler materials, 17 February 2006
- YVL 8.1, Disposal of low and intermediate level waste from the operation of nuclear power plants, 10 September 2003.
- YVL 8.3, Treatment and storage of low and intermediate level waste at a nuclear power plant, 29 June 2005.

Prior to the implementation of Guide YVL 1.3, Fortum Power and Heat Oy submitted to STUK an assessment of the fulfilment of the guide's requirements, presenting interpretations of the application of some of the guide's requirements at Loviisa power plant. STUK considered the interpretations mainly correct but required that the utility submits every year a description of the operation of testing organisations whose accreditation has been replaced by an assessment conducted by a third party.

Before the decision to implement Guide YVL 2.4 was made, Fortum Power and Heat Oy gave their assessment of the fulfilment of the guide's requirements. STUK approved it including a remark that required the utility to analyse the reliable operation of pressure reduction valves relating to severe accidents as regards their staying open. The assessment is to be submitted to STUK by the end of 2007.

As regards Guides YVL 3.1, YVL 3.4, YVL 3.5, YVL 3.9, YVL 8.1 and YVL 8.3, STUK made no remarks on the licensee's assessment on the fulfilment of the guides' requirements at their nuclear facility and in their operation.

As regards Guide YVL 3.8, STUK made more specific the YVL guide issued on 22 September 2003 by further specifying i.a. qualification initial data, instructions and control as well as the time of submittal to STUK of the in-service inspection summary programme. The licensee was required to submit to STUK its assessment of the fulfilment of these more specific requirements and to propose any actions it considers necessary.

3.1.3 Assessment of safety analyses

Deterministic safety analyses

The licensees update the nuclear power plants' deterministic safety analyses in connection with the renewal of operating licences. 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 contracts out where necessary, its own reference analyses.

STUK approved the introduction of the revised emergency operating procedures (HOKE) in early 2006 and they were taken into use at the plant units on 1 March 2006. Their taking into use has been controlled as part of inspections during plant operation and inspections in general.

At the end of the year, Fortum Power and Heat Oy submitted transient and accident analyses pertaining to the operating licence renewal of the Loviisa plant in 2007. Their review was begun and will continue in early 2007. No other deterministic safety analyses for the Loviisa plant were submitted to STUK for review.

Probabilistic safety analyses

Fortum Power and Heat Oy extensively updated the probabilistic safety analysis (PSA) of Loviisa power plant and submitted it to STUK for the operating licence application review. The analysis contains a Level 1 PSA on core damage frequency and a Level 2 PSA on large radioactive release frequency. The PSA covers risks arising from various initiating events (internal failures and errors, fires, internal flooding, weather phenomena and other external events as well as seismic events). The analysis covers power operation and shutdown states.

According to the updated PSA, the core damage frequency for Loviisa nuclear power plant is 8.2·10-5/year. It distributes almost equally between power operation and shutdown states. The 2005 core damage frequency estimate was 1.08·10-4/year. Plant enhancements and the use of more accurate analyses have reduced the estimate.

The update included i.a. the renewal of an oil risk analysis evaluating the risk to the power plant caused by oil spills from tanker accidents clogging sea water systems. A preliminary estimate from 2003 states that oil spills account for a significant part of the plant unit's total core damage frequency. The risk arising from oil spills during power operation was analysed as relatively low because the plant has systems, independent from sea water cooling, for decay heat removal via the secondary circuit. During an annual maintenance outage, when the primary circuit is open, the risk was assessed as high because systems independent from sea water cooling are not available then. In order to reduce the risk from oil and chemicals spills, the utility will implement plant modifications making it possible to take the sea water required by safety systems even from the sea water discharge channel if spills threaten the water intake. The modifications in question have mostly been implemented and will be taken into service in 2007.

According to the updated oil risk analysis, the risk caused by oil during power operation is extremely low (less than 0.03% of total risk) but significant during shutdown states, i.e. approx. 6% of total risk considering all operational states and all classes of initiating event. The assessment includes the plant modifications under way.

Utility guidelines aim to prevent oil getting to the sea water intake channel i.a. by oil booms. In case of the threat of oil damage, electricity generation can be discontinued and the main service water pumps stopped, in which case reduced flow decreases the risk of oil getting into the sea water channel. The utility looks for options to intensify oil destruction operations and to remove decay heat by temporary arrangements during shutdown states.

In order to reduce the risk of sea water flooding, Loviisa power plant made more specific the emergency operating procedures to be followed with exceptionally high sea water levels. The procedures were revised because sea water level reached a record high in January 2005.

In the updating of the Level 2 PSA, the remarks on methods made by STUK during earlier inspections were considered. The analysis attributes 70% of the large release frequency to shutdown states. During a shutdown, the most significant initiating events leading to a large release are heavy lifts (30%), an excessive reduction in the reactor coolant boron concentration (16%) and an oil spill ending up in a cooling water tunnel (13%). During power operation, the most significant causes of a large release are a failure external to the containment in a pipeline connected to the primary coolant circuit and failure to isolate the damage point with stop valves (25%), loss of cooling in the instrumentation area (16%) and a very strong wind (>45 m/s), which exceeds the design bases of non-loadbearing structures (15%). The Level 2 PSA will be reviewed in detail during the review of the operating licence application in 2007.

3.1.4 Oversight of plant modifications

The most significant safety improvement under way at the Loviisa plant is the upgrading of the I&C systems of the plant units. The project started with the construction of a new I&C building and is due for completion in 2014. The upgrading takes place phase by phase such that upgraded system sections are available for commissioning during annual maintenances. Modifications accommodating for a large screen display in the control room were started in the annual maintenances. STUK reviewed the plans for operational modifications due for implementation during the I&C upgrading and also system plans relating to the first phase I&C upgrading due for implementation at Loviisa 1 in 2007. These concern the reactor power limitation system and control rod control. STUK reviewed the detailed plans for the buildings to be constructed for the new I&C systems particularly for Loviisa 2 and oversaw the progress of construction work. The construction work on Loviisa 1 was almost completed and that on the Loviisa 2 buildings made significant progress.

A solidification facility for liquid radioactive waste is under construction and the final repository for low and intermediate level waste is undergoing extension work at the Loviisa plant site. The construction of the solidification facility began in 2004. System and facility level pre-operational testing was started with non-radioactive substances. Pre-operational testing will continue with radioactive substances in 2007, whereafter the facility is due for taking into service. STUK reviewed among others pre-inspection documents of facility systems, systems pre-operational testing programmes and documents pertaining to the construction of a concrete vault for the final disposal of solidified waste as well as oversaw the progress of construction and installation. On the site STUK witnessed facility pre-operational testing with non-active substances.

Fortum Power and Heat Oy will replace two pumps of the high pressure emergency cooling system with new types of pump at both Loviisa power plant units. Pump type was changed because of the problematic availability of replacement parts and to enhance system reliability. STUK in 2004 approved the utility's conceptual design plan and schedule for the replacement. During the Loviisa 2 annual maintenance, two pumps were replaced in accordance with the approved schedule, one in each redundant system part, and the relevant piping modifications were made. Corresponding work at Loviisa 1 will be carried out in the 2008 annual maintenance outage.

In consequence of the modifications, several documents describing plant operation and layout were revised, such as the Technical Specifications, the Final Safety Analysis Report and the operating and maintenance procedures. STUK followed these revisions and the updating of plant documentation after modifications in general. The results are given in Appendix 1 (indicator A.I.6).

3.1.5 Oversight of plant operability

Compliance with the Technical Specifications

STUK controlled compliance with the Technical Specifications of the Loviisa power plant by reviewing regular and topical reports on plant operation and 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 in non-compliance with the Technical Specifications.

Two events occurred due to which the plant units were in non-conformity with the Technical Specifications (Appendix 1, indicator A.I.2). The events are described in "Operation and operational events".

The Technical Specifications were deviated from in a planned way as well by applying in advance for STUK's approval of each non-compliance. The licensee applied for approval of four deviations from the Technical Specifications. (Appendix 1, indicator A.I.2). After an analysis of the deviations' safety significance, STUK approved the applications.

Operation and operational events

The Loviisa plant units operated reliably. The load factor of Loviisa 1 was 93.3% and that of Loviisa 2 was 88.6%. Fig. 2 gives the plant units' load factors for 1997–2006. The duration of the annual maintenance outage was 26 days at Loviisa 1 and 36 days at Loviisa 2. In addition, brief reductions in output capacity occurred at both plant units due to technical failures. The most significant of these were the replacement of the penetrations of one Loviisa 1 main transformer and the repair twice of a check valve in the main feed water line of Loviisa 2.

Production losses in nominal output caused by component malfunctions were 0.17% at Loviisa 1 and 0.51% at Loviisa 2. Production losses from component malfunctions in a longer time period are depicted by the indicators in Appendix 1 (indicator A.I.1g). Figure 3 gives the daily average gross powers of the plant units.

Five events at the Loviisa plant units warranted a special report. All the reported events are discussed in Appendix 1 (indicator A.II.1).

A special report was written on the below events

- calibration of the exhaust gas activity measurement systems of Loviisa 2 steam generators (INES Level 0)
- 6 kV switchgear buses sustained damage at Loviisa 2 (INES Level 0)
- spreading of contamination at Loviisa 2 (INES Level 1)
- emergency accumulator discharge test was not done at Loviisa 2:lla (INES Level 0)
- pressuriser discharge valves were not tested at the plant units (INES Level 0).

The events are explained in more detail in Appendix 3. Figure 4 gives the number of INES Level 1 events in 1997–2006. No events exceeding INES Level 1 occurred at the Loviisa plant during this time period.

A small primary circuit leak was detected in the steam generator of Loviisa 2 in the autumn of 2004. Leak location was performed in the 2005 annual maintenance outage and was continued in the 2006 annual maintenance. The leak could not

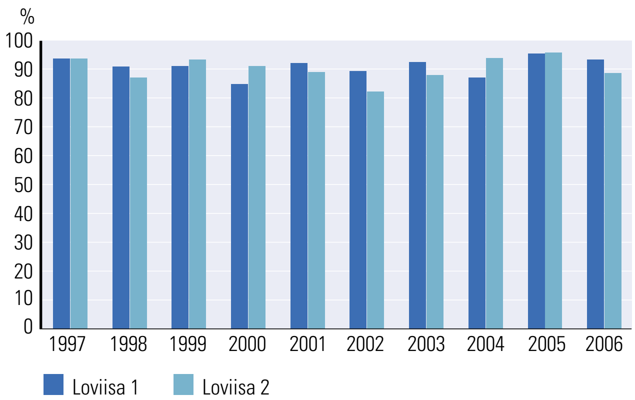

Figure 2. Load factors of the Loviisa plant units.

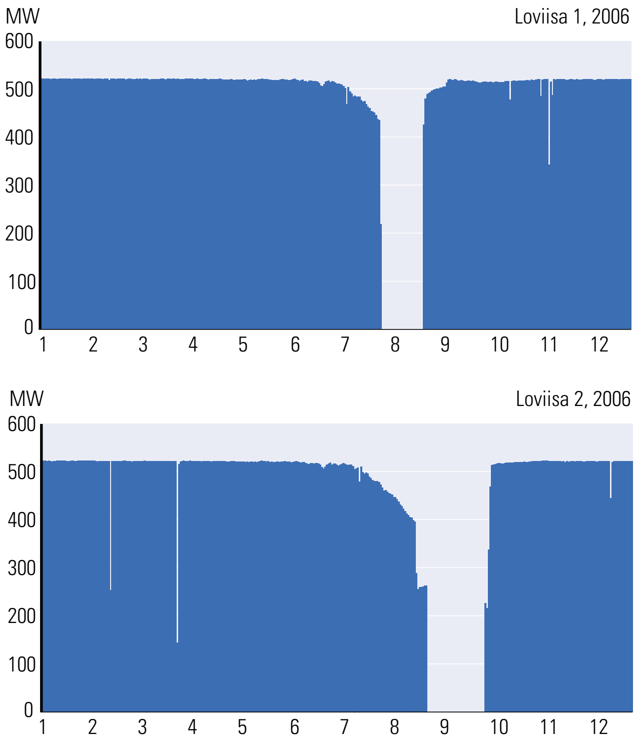

Figure 3. Daily average gross power of the Loviisa plant units in 2006.

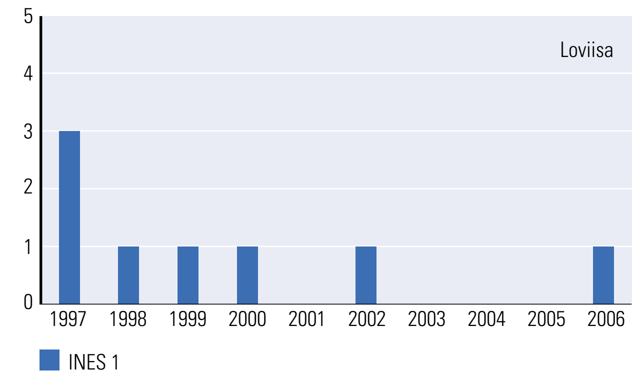

Figure 4. Loviisa plant's INES classified events (INES Level 1 and higher).

be located. It was very small and had no bearing on plant operation.

In addition to event reports, the Loviisa power plant submitted to STUK daily reports, monthly reports, annual reports, outage reports, annual environmental safety reports, monthly individual dose reports, annual operational feedback reports and nuclear safeguards reports.

Annual maintenance outages

The Loviisa 1 annual maintenance was a brief refueling outage. The plant was shut down for annual maintenance on 29 July 2006. The annual maintenance took 26 days and ended on 24 August 2006, about five days later than planned. Outage extension was mainly due to the repairing of cracks detected in the inner sealing groove of the flange of the reactor pressure vessel upper edge, primary circuit bleeding problems during start-up and the repairing of defects in two valves – first in a pressuriser spray line valve and then in a steam line isolation valve (Rockwell). The plant unit had to be brought from hot shutdown state back to cold shutdown for both repairs.

Loviisa 2 underwent a 4-yearly long annual maintenance. On 26 August the plant was shut down for an annual maintenance that ended on 1 October about three days later than planned. The outage extension was mainly due to the repairing of a crack in the inner sealing groove of the flange of the reactor pressure vessel upper edge and the repairing of the damaged voltage transformers of one of two main transformers whose repairing changed, among other things, the order in which turbines are taken into service.

The location of a very small leak in a steam generator pipe, detected in 2004, was attempted but, due to the leak's small size, this failed. The utility has continued follow-up of the leak during the new operating cycle. It has no bearing on the radiation safety of the plant and the environment.

The collective radiation dose incurred in outage work was 0.65 manSv at Loviisa 1 and 0.94 manSv at Loviisa 2. Occupational radiation doses are examined in more detail under "Radiation Safety" and in Appendix 1 (indicator A.I.4).

STUK's oversight activities focused, among others, on the administrative arrangements of outage work, the work of the operating and maintenance personnel, refueling as well as inspections and tests by the licensee and contractors. Attention was paid to the implementation of radiation protection, control room operations and housekeeping. Prior to the start of the new fuel cycle, the safety analyses for the new fuel charge were reviewed. The loading of the fuel assemblies into the reactor according to plan was ascertained. The nuclear material inventory was verified prior to the closing of the reactor pressure vessel.

STUK paid attention to housekeeping and control room operations during outages. The execution of work and housekeeping were better taken care of than during corresponding outages over the past years. However, the upkeep of housekeeping standards still needs to be enhanced.

The actions to make working in the plant's main control room hassle-free went ahead reasonably well. As in previous years, the handling of work orders had been moved mostly to a room beside the main control room. STUK regularly observed working in the control room during plant rounds and found it to be matter-of-fact and undisturbed. The new work management system caused unanticipated changes in the roles of control room operators. The utility will improve the system based on the experiences gained.

The regulatory oversight of the Loviisa plant's annual maintenance outages took 211 person days. A resident inspector worked regularly at the site. A total of 114 person days outside normal working hours was spent in inspection work to oversee annual maintenances.

Plant maintenance and ageing management

STUK preliminarily assessed the ageing management documents prepared for the operating licence application of the Loviisa plant in which the utility presents the principles and implementation of lifetime management as well as the condition and lifetime extension bases of components, structures and systems. STUK assessed the plant's ageing management process and verified the information contained in the documents in annual periodic inspections onsite.

Based on assessments and inspections, STUK required Fortum Power and Heat Oy in their choice of components to pay more attention to safety as well as to the technological ageing of electrical and I&C components. STUK required further clarifications on the instructions for the follow-up of reactor pressure vessel radiation embrittlement, long-term trends in systems exposed to erosion corrosion, oscillations in the main circulation piping and the main steam tubes inside the steam generator room, thermal fatigue of the steam generator blow-down system and the springs to prevent floating of the reactor pressure vessel internals, among others.

Preventive maintenance of components of minor importance has been removed from the maintenance programmes of Loviisa power plant. STUK considers it important that, in this connection, the need to increase resources available for the preventive maintenance of components important to safety is considered. The regular review of maintenance programmes updates, which is required in the YVL guides, has not been done at Loviisa power plant over the past years. STUK required that the utility resumes regular programme evaluation.

In a chemistry inspection, the utilisation of data on secondary circuit water chemistry in the follow-up of component ageing was evaluated. The inspection focused, among others, on chemistry related instructions, procedures for the follow-up of component ageing at the chemistry laboratory and liaison between the chemistry laboratory and units responsible for ageing management. The indications in the heat transfer tubes of one Loviisa 1 steam generator, detected in 2006, were also dealt with in the inspection. They occurred in spots having solid matter accumulations, which may have increased corrosion. The plant introduced new guidelines for secondary circuit water chemistry: procedures in accordance with them increase the options for the ageing management of secondary circuit components.

In a structural inspection contained in the periodic inspection programme, Loviisa power plant's inspection programmes for concrete structures and the steel containment as well as the condition assessment of the plant's structures in 2005 were evaluated. The utility in 2006 improved the corrosion protection of steels and steel structures in the concrete structures of sea water tunnels and inspected cooling water intake tunnels excavated in rock. Based on the inspections, STUK estimated that the structures of Loviisa power plant are in good condition.

No significant observations relating to ageing management were made during the annual maintenance outages of the Loviisa plant units. In-service inspection in accordance with Guide YVL 3.8 of the reactor pressure vessel and piping, which is the duty of the licensee, was carried out at both plant units. STUK approved the inspection programmes prior to the start of inspection, supervised the inspection and reviewed their results onsite. The final result reports will be submitted to STUK for approval after the annual maintenance. STUK reviewed onsite the results of the condition monitoring inspection of secondary circuit piping made by the licensee.

The fastening bolts of the lining of the reactor support cage at the sites of replaced fuel elements and control rods were inspected at Loviisa 1. Two penetration assemblies for control rod drive mechanisms in the reactor pressure vessel head were inspected by ultrasound because water was detected in their protection sleeves in the 2004 outage. The amount of water had remained unchanged and no bulging of the sleeves was observed. They will be replaced in an extended 2008 annual maintenance. Sealing surface cracks detected at reactor pressure vessel flange level were repaired by welding, and sealing surfaces and grooves were machined to original dimensions. A total of 24 heat transfer tubes from three steam generators were plugged, one of which could only be plugged from one end. In addition, during the annual maintenance outage, pressuriser main safety valves and their pilot valves were serviced and inspected, steam generator safety valves underwent annual testing, two primary coolant pumps were serviced and inspected and control rod drive unit mechanisms were serviced.

All fastening bolts (312 pcs) of the lining of the reactor support cage were inspected, and four were replaced. The detached bolts will be separately investigated to determine the nature of the cracks. At Loviisa 2, two protection sleeves of the penetration assemblies for control rod drive mechanisms in the reactor pressure vessel head were replaced because water had been detected in them. The replacement went in accordance with a plan previously approved by STUK. The work was more difficult than expected but was done according to plan. About 20 crack indications were detected on the flange level sealing surface of the Loviisa 2 reactor pressure vessel. They were repaired using the same technique as at Loviisa 1. In addition, a dent was repaired which occurred in 1988 when the sealing got partially caught in between a neck formed by two sealing grooves and the pressure vessel head. Two pumps of the reactor high pressure emergency cooling system were replaced and the necessary piping modifications were made. The heat transfer tubes of four steam generators were inspected and eight were plugged. In addition, the same servicing and inspection as in Loviisa 1 of primary valves, primary coolant pumps and control rod drive mechanisms were conducted.

There were no periodic inspections of pressure equipment in STUK's inspection area at Loviisa 1. The number of inspections at Loviisa 2 was 22. STUK supervised at both plant units inspections of Safety Class 3 and 4 as well as Class EYT (non-nuclear) pressure equipment made by inspection organisations.

STUK made 247 construction inspections, inspections of onsite repairs and modifications as well as three commissioning inspections.

The repair and maintenance of electrical power systems and components at Loviisa 2 included diesel generator replacements, replacements of the rectifiers of the release magnets of primary coolant pump motors and the replacement of one primary coolant pump. The repairs of I&C systems at both plant units included a modification of the automated starting sequence of back-up pumps in the service water circuit to provide for undervoltage situations and the replacement and repair of failed relays in the reactor protection system.

The electrical and I&C technology section of the inspection organisation of the Loviisa power plant made 45 commissioning inspections. STUK reviewed the modification plans and supervised some of the commissioning inspections. During annual maintenances STUK witnessed the periodic inspections and testing of electrical and I&C systems and components.

Radiation safety

Occupational radiation doses

The ALARA action programme to reduce occupational radiation dose was updated at the Loviisa plant. STUK required the Loviisa plant to first evaluate what technical measures affect radiation levels at the plant units. Additional radiation shields were used at Loviisa 2 in demanding reactor head and support cage maintenance, among others.

STUK has required that, at the Loviisa plant, the control and supervision of maintenance work in the close proximity of the reactor primary circuit should be further intensified and an assessment made of whether the order of the units' annual maintenances could be changed. Joint radiation protection training of contractors and acquisition of information on practices at reference plants abroad are to be continued in co-operation with the authorities and other parties.

The collective occupational annual dose for the Loviisa plant was a PWR average. In an OECD/NEA comparison, the collective doses for the Loviisa plant are higher than those for corresponding Central European VVER reactors. This is mostly due to the location of the primary coolant circuit, unlike in other VVER plants, inside the containment building, which leaves little room for maintenance operations.

The individual dose distribution of workers is given in Table 1. The highest individual dose to a Finnish nuclear power plant worker was 18.4 mSv, i.e. individual radiation doses did not exceed the 50 mSv annual dose limit. This dose accumulated at Loviisa and Olkiluoto nuclear power plants. 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 2002–2006 was 70.4 mSv. It was received at Loviisa, Olkiluoto and Swedish nuclear power plants.

The highest individual dose at Loviisa nuclear power plant was 13.63 mSv. The collective occupational radiation dose at Loviisa 1 was 0.68 manSv and at Loviisa 2 0.98 manSv, totalling 1.66 manSv. According to STUK guidelines, 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. With the radiation doses incurred in 2005–2006, the threshold was not exceeded at either plant unit. Collective occupational radiation doses over the past years are given in Appendix 1 (indicator A.I.4).

Table 1. Occupational radiation dose distribution at Loviisa and Olkiluoto plant units in 2006.

Dose range (mSv)	Number of persons by doses		
	Loviisa	Olkiluoto	total*
< 0.1	642	1166	1725
0.1 – 0.49	208	528	701
0.5 – 0.99	106	281	372
1.00 – 1.99	135	297	388
2.00 – 2.99	55	184	236
3.00 – 3.99	41	93	138
4.00 – 4.99	37	46	79
5.00 – 5.99	34	27	62
6.00 – 6.99	20	13	41
7.00 – 7.99	15	13	37
8.00 – 8.99	13	8	22
9.00 – 9.99	8	3	13
10.00 – 10.99	7	3	18
11.00 – 11.99	6	2	7
12.00 – 12.99	6	1	11
13.00 – 13.99	5	—	8
14.00 – 14.99	—	—	—
15.00 – 15.99	—	—	—
16.00 – 16.99	—	—	—
17.00 – 17.99	—	—	—
18.00 – 18.99	—	—	1
19.00 – 19.99	—	—	—
20.00 – 20.99	—	—	—
21.00 – 24.99	—	—	—
> 25.00	—	—	—

* The data in this column include Finnish workers who have received doses also 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

Radioactive releases

The plant's Technical Specifications determine annual limits for radioactive releases into the environment from nuclear power plants. Radioactive releases from Loviisa nuclear power plant were well below authorised limits. Releases of radioactive noble gases were approx. 5.8 TBq, i.e. approx. 0.03 % of authorised limit. They were dominated by argon-41, i.e. the activation product of argon-40, originating in the air space between the reactor pressure vessel and the main concrete shield. The releases of radioactive iodine isotopes were about 0.3MBq, which is approx. 0.0001% of authorised limit. Aerosol releases were approx. 0.1 GBq, tritium releases approx. 0.2 TBq and carbon-14 releases approx. 0.1 TBq.

The tritium content of liquid effluents was approx. 17 TBq, i.e. approx. 11% of the release limit. The total activity of other nuclides released into the sea was approx. 0.6 GBq, i.e. about 0.06 % of the release limit.

The release limits are intended to maintain the annual individual radiation exposure of the population surrounding the plants clearly below the threshold value (100 microSv) determined by the Government Decision (395/1991). The calculated radiation dose of the most exposed individual in the vicinity of the plant was approx. 0.06 microSv, i.e. 0.1% of the set limit. Appendix 1 (indicator A.I.5) presents radioactive releases and calculated radiation doses to the most exposed individual in the plant's 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, 324 samples were collected. Radioactive substances originating in the plant were measured in six samples of sinking matter, nine samples of aquatic plants, two samples of deposition, two samples of sea water, one sample of air and one sample of bottom fauna.

Cobalt-60, the dominating radioactive substance originating in power plants, was measured in 16 samples. Silver-110m (10 observations), cobalt-58 (8 observations), antimonium-124 (6 observations), tritium (2 observations), manganese-54 (5 observations), niobium-95 (2 observations), zirconium-95 (2 observations), tellurium-123m (2 observations), chromium-51 (1 observation) and iron-59 (1 observation) were measured as well.

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

Radioactive strontium, caesium and plutonium isotopes originating from the Chernobyl accident and the fallout from nuclear weapons tests are still measurable in environmental samples. Natural radioactive substances (i.a. 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.

The external radiation dose rate is continuously monitored by 15 automatic stations at the distance of two and five kilometres from the plants. The measurement data are transferred to the power plants and to the national radiation-monitoring system. In addition, there are ten passive dosimeters around the nuclear power plants. In external radiation, no changes occurred exceeding normal fluctuations in natural background radiation. The external radiation dose rate is continuously monitored by 15 automatic stations at the distance of two and five kilometres from the plants. The measurement data are transferred to the power plants and to the national radiation-monitoring system. In addition, there are ten passive dosimeters around the nuclear power plants. In external radiation, no changes occurred exceeding normal fluctuations in natural background radiation.

3.1.6 Oversight of organisational operation

Safety management

During document reviews and other inspection activity, and based on information submitted by the Loviisa plant, STUK evaluates how the utility attends to plant safety.

Within the framework of the periodic inspection programme, STUK inspected the I&C systems upgrading project at Loviisa. The inspection dealt with project management; co-operation within the network comprised of Loviisa power plant – FNS – component supplier – sub-contractors; user training; and the entire organisation's preparedness for the introduction of the new I&C system. The project management procedures were found functional and have been further developed on the basis of experiences from previous projects at the Loviisa plant.

Deficient personnel resources in some areas of activity important to safety were identified as the most important development need in safety management at the Loviisa plant during 2005 already. This was due to retirement, change of duties within plant or utility, or resignation from the utility's employ. STUK's oversight included discussions with the plant's responsible manager and the conducting of an inspection on personnel management as part of the periodic inspection programme. Information on the plant's human resources planning, recruitment procedures and sufficiency of human resources was gathered by interviews with personnel from the power plant engineering and safety units, and by reading related documents. STUK has required an action plan on the fixing of the human resources deficiency established in the inspection. The Loviisa plant has begun substitutive recruitment. The inspection results will be utilised in a safety assessment pertaining to the operating licence renewal.

Quality management

Loviisa nuclear power plant has systematically maintained and developed its quality management system according to own plans. Guidelines have been routinely updated in accordance with agreed practices. Fortum Power and Heat Oy, the licensee, updated five chapters in the quality manual.

The licensee has earlier compared the quality management system of the Loviisa plant with, among others, the standard ISO 9001 and the safety requirements and guidelines of the IAEA. Based on this, the system has been further developed by, among others, management reviews and self-assessment to improve the management system and the organisation's operation. The Loviisa plant regularly evaluates the functionality of its quality management system by an internal audit programme and a separate, independent inspection procedure.

Personnel qualifications and training

STUK supervised personnel training at the Loviisa plant by inspections of the periodic inspection programme. The most significant challenges in the enhancement of know-how at the plant in 2006 were preparing for the I&C upgrade, validation pertaining to new emergency operating procedures and training given in the use of these procedures. Other important training tasks included operator training and follow-up of the implementation of familiarisation plans aimed at new personnel. Eight people from the Loviisa plant participated in a 5-week basic professional training course on nuclear safety arranged in co-operation between STUK, the utilities, VTT and universities. For several reasons, the turnover of personnel at the Loviisa plant has been greater than over the past years, making it necessary to pay more attention than before to the orientation of those having new or changed tasks.

Upon application by the licensee, STUK authorised persons in the licensee's employ to work as shift managers, operators or operator trainees at the power plant. Authorisations were granted to 21 persons employed by the Loviisa plant, three of which are new shift managers and six are operator trainees. Other authorisations were periodic renewals of old decisions.

Operational experience feedback

In its operational experience feedback work the licensee reviewed events at own and other plants. Events at plants abroad were dealt with in a special operational feedback group. Operational experience feedback aims to develop and improve operations and prevent recurrence of events compromising plant safety. Operational experience feedback information was passed on to the personnel in the form of reports and training.

STUK's oversight of operational feedback was by review of event reports and the annual operational feedback report submitted by the licensee. The Loviisa plant has systematic guidelines for event investigation, assessment and corrective action. In 2005, deficient human resources were the most significant problem in operational feedback assessment at the plant, which was corrected in 2006. The delay in reporting, detected in 2005, remains, however. In addition, the reports have not been fully up to the required quality level.

An IRS team operating in STUK monitors operating experience feedback from nuclear power plants abroad. Event information was received through the IAEA/OECD Incident Reporting System (IRS). The feasibility of the experiences gained from the events is evaluated from the viewpoint of Finnish plants.

Due to the electrical power systems failure at Forsmark nuclear power plant in Sweden, the potential for a corresponding event at the Loviisa plant was evaluated. The event at Forsmark is described in Appendix 4.

Event investigation
No event investigations pertaining to the Loviisa plant were started by STUK. An event investigation team is appointed when the licensee's own organisation has not operated as planned during an event or when an event is estimated to lead to significant modifications in the plant technical layout or procedures. A STUK investigation team is set up also if the licensee has not adequately clarified the root causes of an event.

Pressure equipment manufacturers as well as inspection and testing organisations
Upon application by Fortum Power and Heat Oy's Loviisa power plant, and in accordance with the Nuclear Energy Act, STUK authorised four manufacturers of nuclear pressure equipment.

Upon application by Fortum Power and Heat Oy, and in accordance with the Nuclear Energy Act, STUK authorised testing personnel from 12 different testing organisations to carry out manufacturing-related testing and periodic testing of mechanical components and structures at the Loviisa plant units. Previous decisions on manufacturers and testing organisations are valid as stated in the decisions. Loviisa power plant's inspection unit "Inspection Organisation Loviisa YVL", authorised in 2002, continued in operation.

STUK oversaw at both plant units inspection of Safety Class 3 and 4 as well as Class EYT (non-nuclear) pressure equipment by inspection organisations. STUK oversaw the inspection of Safety Class 3 and 4 as well as Class EYT mechanical components by the utility's own inspection organisation. Safety Classification is based on STUK's Guide YVL 2.1 according to which components are divided into the Safety Classes 1, 2, 3 and 4 as well Class EYT (non-nuclear). Components of the highest safety importance belong to Safety Class 1.

STUK oversaw the operation of manufacturers as well as the testing and inspection organisations it had approved by inspections as well as document review and follow-up visits. Their operation was established as being in accordance with the requirements of Guides YVL 3.4 and YVL 1.3.

STUK oversaw the operation of the "Inspection Organisation Loviisa YVL, Electrical Engineering and I&C Technology" it has approved as well as the electrotechnical and I&C systems related commissioning inspections made by its inspectors. Its operation was established as being in accordance with Guide YVL 5.2.

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 provided 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 accident, funds for compensation are available through three sources: the licensee, the facility's country of location and the international liability community. About €425 million was available for compensation from all these sources. In the coming years, an increase in the sum is expected as international negotiations about the revision of the "Paris/Brussels nuclear liability agreements" were completed in 2004. The funds available for compensation will more than triple in the near future compared with the current situation. Finland has decided to enact unlimited licensee liability by law. The law amendment has not taken effect as yet but is pending the entry into force of the aforementioned international agreements.

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

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

3.1.7 Safety performance indicators

The requirements set for the safety indicators of the effectiveness of STUK's operations were fulfilled at Loviisa power plant in all the areas where they had been established: occupational radiation doses, radioactive releases from nuclear facilities and the population exposure arising from them, safety-compromising events at nuclear facilities and the condition of components contributing to accident risk at nuclear facilities.

The individual and collective doses of nuclear power plant workers were below set limits. Radioactive aerosol and liquid releases as well as the radiation exposure caused by them to the surrounding population remained small and below set limits.

Judged by the safety indicators, no significant safety-related shortcomings were detected in the operation of Loviisa power plant. The plant units were mostly operated in compliance with the Technical Specifications, with the exception of two deviations. The first one was due to the calibration of the steam generator exhaust gas activity measurement system when the condenser activity measurement system, which substitutes it, was inoperable. The second occurred because the changed testing interval of the high capacity pressuriser discharge lines had not been entered in the Technical Specifications.

No safety-compromising events occurred at the Loviisa plant units. Five events at the Loviisa 2 plant unit warranted a special report. Compared with previous years, the number of events requiring a special report is on the increase at the Loviisa plant. In addition to the above deviations from the Technical Specifications, three other events warranting a special report occurred. They pertained to damage in switchgear buses detected during periodic testing, the spreading of contamination from insufficiently decontaminated equipment used in the cleaning of the reactor pool during an annual maintenance outage and an emergency accumulator discharge test not having been done after servicing. The doubling of the number of operational transient reports, as compared with 2005, is due to changed reporting procedures, which makes the figure not proportional to the figures of previous years. The immediate causes of the events have emphasis on errors made in own operation, whereas previously it was mainly on technical malfunctions. One event classified as an actual fire occurred at Loviisa power plant: the explosion of a voltage transformer, followed by a fire at Loviisa 2.

The safety performance indicator system looks also at the risk-importance of operational events. Events are divided into three categories according to their risk-importance, the indicator in each category being the number of events. The number of risk-significant events at Loviisa slightly increased compared to 2005. The difference in their number is considered normal statistical fluctuation. The most significant events pertained to cooling system malfunctions in the instrumentation rooms of air conditioning systems and control rooms as well as to safety system malfunctions. Preventive maintenance of auxiliary feed water systems during annual maintenance was included in risk-significant events. The number of other risk-significant events was about the same as in 2005 and the unavailabilities at the plant were mainly due to component malfunctions. The events analysed for 2006 are considered part of normal operation and called for no additional actions by STUK.

STUK's safety performance indicators include among others the following objective from the viewpoint of the condition of components contributing to accident risk at nuclear power plants: accident risk at nuclear facilities is reduced or remains unchanged. Risk is assessed by probabilistic risk analysis whose code contains regularly updated component reliability data, among others. Due to certain plant modifications and more detailed analyses, accident risk for the Loviisa plant has somewhat reduced from 2005 on.

The trend for maintenance at the plant was difficult to assess. The number of annual maintenance tasks on components subject to the Technical Specifications was not directly comparable to that from 2005 because the recording procedures on which the indicator is based have changed. In spite of the changes, the preventive maintenance/fault repair ratio remained at the level of previous years' average. The maintenance function has thus been estimated to be in balance and implemented as before. The volume of the plant's preventive maintenance work is affected by preventive maintenance work dictated by the length of annual maintenance outages. In the future, the indicators should reflect the changed order of annual maintenances, which would indicate a functioning maintenance strategy.

The slight increase in the total number of repairs of components subject to the Technical

Specifications during power operation discontinued. In plant maintenance, fault detection and anticipation have been continuously improved. Components have been replaced based on an increase in anticipated failure risk. Due to these actions, a possible negative effect pertaining to the plant's ageing is not apparent in the indicator or the related failure data, which indicates functioning component lifetime management and successful component maintenance.

The average repair times of failures causing unavailability of components subject to the Technical Specifications have remained reasonably stable at the Loviisa plant units for years. Average repair times decreased at Loviisa 1 but increased at Loviisa 2 where the repair time annual trend has been unstable. Average repair time at Loviisa 2 seems to be on the increase due to repairs for which the Technical Specifications allow a long repair time. With the adequacy of the maintenance resources of the Loviisa plant and its efficiency of operation in mind, actions should be taken to shorten the repair times of even such components. Production losses due to component failures in all systems remained small, which is indicated by the high load factors of the plant units.

According to international indexes measuring the unavailability of safety systems, the inoperabilities of followed systems are still at a normal low level. The unavailability of emergency diesel generators and the emergency feed water system were on a slight increase at the Loviisa plant units. The diesel generator malfunctions were caused by regular component ageing phenomena and the unavailability of the emergency feed water system was due to servicing during annual maintenances.

The indicator for investments on plant maintenance and modifications showed that investments at the Loviisa plant have remained at a level above the average. Provision for severe accidents and a turbine modernisation were the major investments made at the Loviisa plant over the past years. The most significant ongoing plant modification is the upgrading of the plant units' I&C system with costs resulting from the construction of new buildings and simulator development. After the plant modifications made during the Loviisa 2 annual maintenance outage, plant documents to be updated by start-up had been updated sufficiently well.

The structural integrity of multiple barriers containing radioactive releases has been mostly good. No fuel leaks have occurred at the Loviisa plant units after 1999.

The results of STUK safety performance indicators depicting plant safety are given in Appendix 1.

3.1.8 Overall safety assessment

No disturbances occurred in the operation of Loviisa nuclear power plant, with the exception of some anomalies. No significant nuclear safety related shortcomings surfaced during STUK's oversight activities. The radiation safety objectives set for the individual radiation doses of the plant's workers, the collective occupational dose and the dose to the most exposed individual in the environment of the plant determined by calculation were well achieved. However, as regards radiation protection, Loviisa power plant needs to further enhance the handling of contaminated components and the reduction of collective occupational dose.

Action taken at the plant to prevent initiating events has worked well. The effects of ageing, among others, are not apparent in maintenance related safety indicators. At Loviisa 2, two high pressure emergency cooling pumps of the reactor have been replaced and operational preconditions in the event of an accident have been improved by new emergency operating procedures. The structural integrity of barriers containing radioactive releases has remained good.

Loviisa power plant has the procedures and personnel to safely operate the plant. The ageing management process has been well integrated in long-term planning at the plant. The process still needs to be improved in the following respects, however. When optimising the plant maintenance programme, special attention is to be paid to the allocation of resources to items important to safety. The ever extensive introduction of programmable technology at the plant increases the significance of technological ageing in ageing management.

Personnel carrying out tasks important to safety have changed to a significant extent. This has lead to certain problems in human resources. The plant's human resources planning and recruitment procedures as well as operational experience feedback are to be further improved.

3.2 Olkiluoto 1 and 2

3.2.1 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 an 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 Decision (395/1991). It prescribes that, to further improve safety, measures shall be implemented that are justifiable considering operating experience, safety research and the development of science and technology.

The decisions to implement the below YVL guides were made in accordance with the new procedure

- YVL 1.3, Mechanical components and structures of nuclear facilities. Approval of testing and inspection, 3 February 2006
- YVL 2.4, Primary and secondary circuit pressure control at a nuclear power, 24 November 2006
- YVL 3.1, Nuclear facility pressure vessels, 31 January 2006
- YVL 3.4, Approval of the manufacturer of nuclear pressure equipment, 31 January 2006
- YVL 3.5, Ensuring the strength of pressure equipment at nuclear power plants, 3 October 2006
- YVL 3.8, Nuclear power plant pressure equipment. In-service inspection with non-destructive testing methods, 10 February 2006
- YVL 3.9, Nuclear power plant pressure equipment. Construction and welding filler materials, 17 February 2006
- YVL 5.5, Instrumentation systems and components at nuclear facilities, 22 September 2006.
- YVL 8.1, Disposal of low and intermediate level waste from the operation of nuclear power plants, 10 September 2003.
- YVL 8.3, Treatment and storage of low and intermediate level waste at a nuclear power plant, 29 July 2005.

STUK had no remarks to make on the utility's description of the fulfilment of the requirements of Guides YVL 1.3, YVL 2.4, YVL 3.4, YVL 3.5, YVL 3.9, YVL 8.1 and YVL 8.3 at its nuclear facility and in its operation.

Two non-conformances were identified as regards Guide YVL 3.1. The guide requires classification of heat exchangers in their entirety to a higher safety class. The classification in use at the Olkiluoto plant is based on systems separation: the primary and secondary sides of heat exchangers could thus belong to different safety classes. The second non-conformance relates to a requirement according to which the guide is to be applied to steam turbine condensers as well. At the Olkiluoto plant, a condenser is a steel structure by definition and the requirements for steel structures have been applied in its construction. STUK considered both non-conformances acceptable.

As regards Guide YVL 3.8, STUK made more specific the YVL guide issued on 22 September 2003 by further specifying i.a. qualification initial data, instructions and control as well as the time of submittal to STUK of the in-service inspection summary programme. The licensee was required to submit to STUK its assessment of the fulfilment of these more specific requirements and to propose any actions it considers necessary.

In the decision implementing Guide YVL 5.5 STUK presented for Olkiluoto 1 and 2 the requirements for the implementation a modern emergency control room, diversification of protective trips triggered by reactor water level and more consistent plant design documentation.

3.2.2 Assessment of safety analyses

Deterministic safety analyses

The licensees update the nuclear power plants' deterministic safety analyses in connection with the renewal of operating licences. The analyses are updated in connection with plant modifications as well, or whenever operational events warrant it. STUK reviews the licensee's analyses and conducts, or contracts out where necessary, its own reference analyses.

A feasibility study of the SVEA-96 Optima 2 fuel was reviewed. Based on it, STUK approved the taking into use of this fuel type at Olkiluoto nuclear power plant up to an average assembly burn-up of 45 MWd/kgU. It will be introduced into use in a 2007 refueling outage.

The SVEA-96 Optima 2 fuel assembly is based on the earlier SVEA-96 Optima concept of which the Olkiluoto plant has operating experience since 2000. These two assemblies are dissimilar as regards the number and length of part length fuel rods. Materials and most components are similar. Before this, the Optima 2 fuel type has been taken into use in several countries and used in reactors having conditions similar to those at Olkiluoto 1 and 2 – the last reactors supplied with the SVEA-96 Optima fuel assemblies.

The Optima 2 fuel assembly was established to fulfil criticality safety requirements in all fuel storage racks of the Olkiluoto plant, but the margin for fuel design changes is small. STUK required that the criticality safety of the fuel racks be separately inspected in case refueling -specific changes are made to parameters affecting the criticality safety of the Optima 2 fuel assembly.

No other deterministic safety analyses on the Olkiluoto plant were submitted to STUK for review.

Probabilistic safety analyses

In co-operation with the Swedish BWR plants, Teollisuuden Voima Oy in 2005 analysed how the loss of reactor building heating during a heavy cold affects i.a. the impulse lines of the instrumentation area. In Sweden it has been assessed that the freezing of impulse lines at certain BWRs is possible if the reactor building heating is lost at about – 20°C and, at the same time, the air conditioning remains in operation. The loss of reactor level measurement caused by frozen impulse lines could seriously compromise reactor control. STUK required Teollisuuden Voima Oy to submit a plan for action to reliably prevent the freezing of impulse lines in such a situation.

The utility commissioned a plant-specific analysis of the freezing of instrumentation rooms containing impulse lines. According to a Westinghouse analysis, reduction of temperature to 0oC in the instrumentation room takes several hours at the Olkiluoto plant units when open-air temperature is –35°C. The freezing of impulse lines at the Olkiluoto plant units is thus considerably less likely than initially assessed, and, based on plant-specific analyses, the loss of reactor building heating does not present a significant risk. An alarm signal to the control room on low instrumentation room temperature has been added at the plant and the situation has been addressed during simulator training to operators.

3.2.3 Oversight of plant modifications

The Olkiluoto plant is undergoing turbine plant upgrading, which includes replacement of steam dryers in the reactor pressure vessel. These modifications were implemented at Olkiluoto 1. The safety improvements completed at the plant units are described in Appendix 2.

Plant modifications oversight included definition of regulatory scope, handling of documents pertaining to the modifications as well as supervision of their implementation and commissioning. STUK supervised component and structural modifications by inspections onsite and the manufacturers' premises as well as by reviewing documents submitted by the licensees. Modifications oversight included STUK/licensee meetings and STUK internal meetings.

In consequence of the modifications implemented at the plant, several documents describing plant operation and structure changed, like the Technical Specifications, the Final Safety Analysis Report and the operating and maintenance procedures. STUK reviewed the document revisions and generally followed the updating of plant documentation after the modifications. The results of the follow-up are given in Appendix 1 (indicator A.I.6).

3.2.4 Oversight of plant operability

Compliance with the Technical Specifications

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

Four events occurred at the Olkiluoto plant during which the plant unit was in non-compliance with the Technical Specifications (Appendix 1, indicator A.I.2). They were as follows

- Operator maximum working hours were exceeded
- Periodic inspection of batteries at the spent fuel storage was not made
- The 2-yearly testing of the radiation dose rate monitor of the off-gas stack of Olkiluoto 1 was not done in 2004 and 2006
- Dryout margin went below its smallest allowable value during power reduction at Olkiluoto 1.

The events are described in more detail in Appendix 3, which also explains the actions planned and carried out by the licensee to prevent recurrence.

The Technical Specifications were deviated from in a controlled manner as well, in which case STUK's approval of the non-conformities was applied for in advance. The licensee applied for the approval of four situations in non-compliance with the Technical Specifications. (Appendix 1, indicator A.I.2). STUK approved the applications after an analysis of the safety significance of the events. Two exemptions pertained to deviations made from the Technical Specifications due to plant modifications or modernisation and two to fuel and control rod transfers during annual maintenance.

Operation and operational events

Both Olkiluoto plant units operated reliably. The load factor of Olkiluoto 1 was 93.8% and that of Olkiluoto 2 was 96.9%. Figure 5 gives the load factors of the plant units in 1997–2006. The annual maintenance outage of Olkiluoto 1 took 21 days and that of Olkiluoto 2 took 8 days. Outage progress and the measures carried out are separately described in this chapter.

No breaks in power generation or significant power losses due to component failures occurred at Olkiluoto 1 and 2. The most significant transients were due to the shutting down twice of the primary coolant pumps at Olkiluoto 1 and a turbine trip at Olkiluoto 2 due to the failure of an electronics card in the turbine measuring system.

Losses in nominal output from component malfunctions were 0.33% and 0.21% at Olkiluoto 1 and 2 respectively. Appendix 1 looks at production losses from component malfunctions for a longer period (indicator A.1.1.g). Figure 6 gives the daily average gross powers of the plant units.

Four events warranting a special report occurred at the Olkiluoto plant units. All events subject to a report are addressed in Appendix 1 (indicator A.II.1).

A special report was written on the below events at the Olkiluoto plant

- Operator maximum working hours were exceeded (INES Level 0)
- The time limit for the periodic inspection of batteries at the spent fuel storage was exceeded (INES Level 0)
- The 2-yearly testing of the radiation dose rate monitor of the off-gas stack of Olkiluoto 1 was not done in 2004 and 2006 (INES Level 0)
- Dryout margin went below its smallest allowable value during power reduction at Olkiluoto 1 (INES Level 0).

The events are described in Appendix 3.

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.

Figure 7 gives the number of INES Level 1 events in 1997–2006. No events exceeding INES Level 1 occurred during that time.

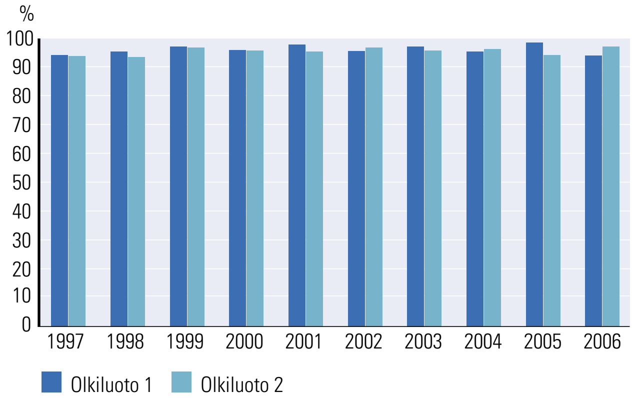

Figure 5. Load factors of the Olkiluoto plant units.

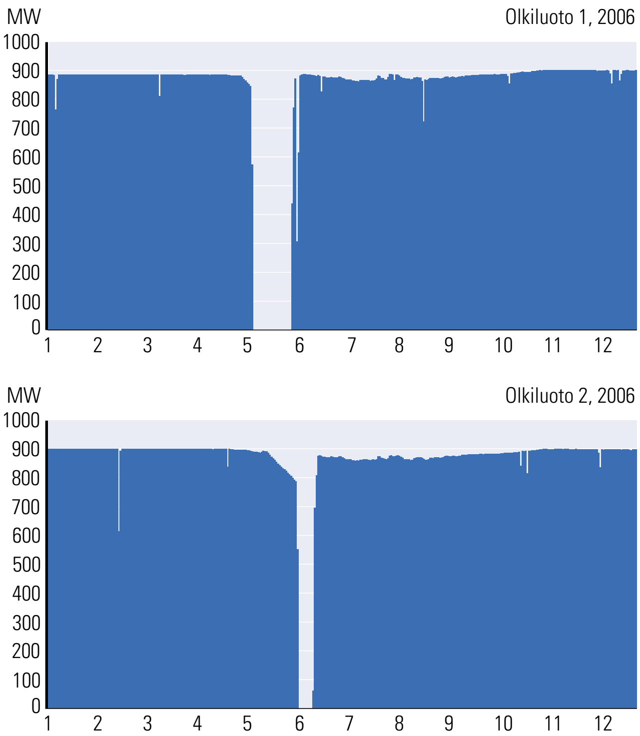

Figure 6. Daily average gross power of the Olkiluoto plant units in 2006.

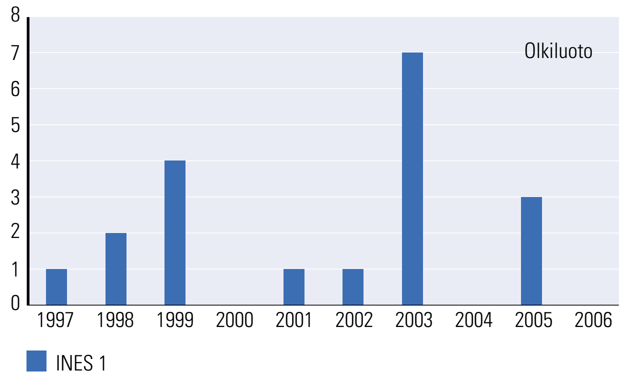

Figure 7. INES classified events at Olkiluoto plant (INES Level 1 and higher).

Annual maintenance outages

The Olkiluoto 1 refueling outage was on 7 to 30 May and the Olkiluoto 2 maintenance outage on 4 to 12 June. Olkiluoto 1 discontinued electricity generation for about 23 and Olkiluoto 2 for about 8 days. The Olkiluoto 1 outage took about a day longer than planned, that of Olkiluoto 2 went almost according to plan.

The Olkiluoto 1 annual maintenance outage was an extended maintenance outage during which, in addition to the refueling outage programme, extensive maintenance work, modifications and modernisation were carried out. The most significant modifications were turbine plant upgrading, 6.6 kV switchgear replacements, reactor steam dryer replacement, containment intermediate level sealing renovation and replacement of the supports of main steam pipes. Similar modifications were implemented at Olkiluoto 2 in 2005.

After the synchronisation of Olkiluoto 1, test runs following the turbine plant upgrading started, including system and plant specific testing. Where nuclear safety is concerned, the most significant test was the scram test completing the test runs. After the tests, a long term test was started to ascertain the plant unit's operation after the modifications.

According to preliminary measurements, the net electrical power of Olkiluoto 1 increased by approx. 18 MW in consequence of the turbine plant upgrading.

In plant unit testing, during post-shutdown start-up, problems were detected in the movement of some control rods. The rods in question were submitted to several tests and inspections but the final cause of the problem was not found. STUK required the testing of all control rods after the completion of the annual maintenance (by a scram test for example) and that the utility takes action to ensure the movement of the rods during operation and that potential failure mechanisms are analysed during the fuel cycle. No problems have occurred during operation.

In inspections at Olkiluoto 2, cracks were detected in a steam dryer that has been in operation for a year. It was replaced with an old steam dryer. The dryer has a weaker performance in steam separation, causing a higher steam moisture content and elevated radiation levels at the turbine plant.

In addition to refueling, the utility carried out maintenance and inspections of components, structures and systems during the annual maintenances, which are described in more detail later in the report under “Plant maintenance and ageing”. The safety improvements made at the plant during annual maintenance are described in Appendix 2.

Teollisuuden Voima Oy submitted to STUK applications for two exemptions from the requirements of the Technical Specifications for fuel and control rod transfers. During the transfers, the dose rate threshold of the radiation monitors of the refueling machine was exceeded and the work could not be continued. The effect on radiation safety of the changing of the threshold value was evaluated and, based on this, the value was reset to facilitate safe working.

Regulatory oversight of the annual maintenance outages of Olkiluoto nuclear power plant focused, among others, on the administrative arrangements of outage work, the activities of the operating and maintenance personnel, refueling as well as inspections and tests by the licensee and sub-contractors. Of specific interest were the trial runs of the Olkiluoto 2 turbine plant and switchgear after their modernisation, the most important of the trial runs being the scram test. It was performed in accordance with a STUK-approved test programme. The plant operated according to design. Based on the approved results of the tests, STUK gave Teollisuuden Voima Oy permission to start long-term testing.

Attention was paid to the implementation of radiation protection, control room operations and housekeeping. In the annual maintenances the utility promoted a theme under the heading A Clean Process to pay attention to cleanliness and protection of processes from loose parts. Prior to the start of the new fuel cycle, safety analyses for the new fuel charge were reviewed. In addition, the loading of fuel assemblies into the reactor according to plan was ascertained. The nuclear material inventory was verified prior to the closing of the reactor pressure vessel head. STUK controlled the placement of the plant units into shutdown state and their post-outage start-up.

The collective radiation dose incurred in outage work was 1.77 manSv and 0.25 manSv at Olkiluoto 1 and 2 respectively. Occupational radiation doses are discussed in more detail later in the report under “Radiation safety” and in Appendix 1 (indicator A.I.4).

The regulatory oversight of Olkiluoto facility’s annual maintenance outages onsite took 133 working days. Two resident inspectors were regularly working at the site. In addition, a total of 126 inspection days outside normal working hours were spent in outage oversight.

Plant maintenance and ageing

STUK assesses the lifetime management programme of the Olkiluoto plants by technical field specific inspections of the operational inspection programme and during annual maintenance oversight.

In an inspection of the maintenance of mechanical components STUK evaluated the monitoring and inspection of fatigue and erosion corrosion caused by pressure and temperature transients as well as inspection results over the past years, and also operating experiences from the auxiliary feed water system. STUK required that the utility investigates in a pilot project during a periodic safety assessment how the corrosiveness of an operating environment potentially speeds up the fatigue phenomenon. In the inspection, several items surfaced where, by change of methods, stress to structures important to safety can be avoided.

In an inspection of the maintenance of mechanical components, STUK evaluated the power plant’s maintenance instructions, particularly their suitability for use by personnel externally contracted for annual maintenances and user training. STUK also required that the utility complements its instructions on Safety Class 2 pumps.

Every year the utility reports on the ageing of electrical and I&C components. The most significant ageing phenomena, observations about ageing and actions necessary for lifetime extension are described. The observations mostly relate to the ageing of the structural parts of components. Other previously detected ageing phenomena under monitoring are whisker growth on zinc coated surfaces and wear of the sliding surfaces of position indicators, among others. As a result of an inspection of electrical and I&C components included in the periodic inspection programme, STUK required that the utility develops maintenance programmes for medium and low voltage switchgear and the condition monitoring of containment cabling and also investigates the design bases and qualification procedures of accident resistant cables inside the containment and their performance in case of need.

Condition monitoring programmes are in place for monitoring the condition of the buildings of Olkiluoto power plant. The following were measured, among others: containment strain, deformation of the expansion joint between the containment building and the reactor building and of the containment building intermediate level, temperature and moisture of containment building concrete structures; visual inspections of containment internal concrete structures and coatings were made and cracks in concrete structures were monitored. Based on the inspections and investigations, STUK assessed the condition of the structures of Olkiluoto power plant as good.

No significant ageing management related observations were made in the annual maintenances of the Olkiluoto plant units. In-service inspection of the reactor pressure vessel and piping, which is the duty of the licensee, was carried out at both plant units in accordance with Guide YVL 3.8. STUK approved the inspection programmes prior to the start of inspection and oversaw the inspections and their results onsite. The observations made during inspection included, among others, indications found in the welded seams between the assemblies of the reactor spray system and their safe-ends. VTT Technical Research Centre of Finland analysed the indications and STUK approved that they are monitored, not repaired. The final result reports of inspections in accordance with Guide YVL 3.8 will be submitted to STUK for approval after the annual maintenance. The results of the condition monitoring inspections of secondary piping made by the licensee were reviewed by STUK onsite.

Olkiluoto 1 underwent an extended outage during which steam reheaters and a high pressure turbine as well as the steam dryer inside the reactor pressure vessel were replaced. Similar work was done at Olkiluoto 2 in 2005. Cracks in the lugs of feedwater distributors were repaired during the annual maintenance based on experiences gained in the 2005 outage. STUK expects the utility to monitor the condition of the distributors in forthcoming outages. Other work included, among others, the replacement of an inner isolation valve of the shutdown reactor coolant system.

A steam dryer installed in 2005 was inspected in a brief Olkiluoto 2 annual outage. Cracks were detected in the welds of the flat bar irons of its outermost array of sheets. The dryer was removed from the reactor and replaced by an old dryer. The new dryer is intended to be repaired during the operating cycle and reinstalled into the reactor in the 2007 outage.

During the annual maintenance outage, repairs and improvements pertaining to ageing management were carried out at the Olkiluoto plants. A minor leak of the steel lining of the condensation pool, which has taken place at Olkiluoto 1 for several years, was located and repaired. The joint between the containment building intermediate level and the cylinder wall was reinforced to withstand severe accident conditions. In addition, The sealing of the expansion joint of the transportation shaft was replaced. The utility improved the corrosion protection of steels in the concrete structures of sea water tunnels.

The repairs and maintenance of electrical and I&C systems and components included, among others, replacement of the rotor and exciter of the Olkiluoto 1 main generator and upgrading of the 6.6 kV medium voltage switchgear. One safety-classified battery and five valve actuators were replaced at Olkiluoto 1. At Olkiluoto 2, one original starting transformer and one safety classified battery were replaced. At both plant units, relays subject to heaviest loading and important to operability were replaced due to the ageing of their comb material. A rectifier replacement project began at Olkiluoto 2 in the autumn of 2006.

STUK made seven periodic inspections of Safety Class 1 and 2 items of pressure equipment and 12 commissioning inspections of a new item of pressure equipment at Olkiluoto 1. Six commissioning inspections were made at Olkiluoto 2.

STUK made 209 construction inspections and inspections of repairs and modifications. Most of them were made during outages.

The Teollisuuden Voima Oy inspection organisation made 43 commissioning inspections of safety classified items in electrical and I&C systems.

STUK reviewed their pre-inspection documents and witnessed some of the commissioning inspections. During the annual maintenances, STUK oversaw the periodic inspections and testing of electrical and I&C systems.

Radiation safety

Occupational radiation safety

The ALARA action programme to reduce occupational radiation dose was updated at the Olkiluoto plant. The high moisture content of turbine steam has affected radiation protection. A major decision to reduce the steam moisture content was made at Olkiluoto in 2005 and 2006. Old steam dryer was reinstalled at Olkiluoto 2 so that the defects detected in the new dryer, which had been in operation for a year, can be repaired.

An essential part of the collective occupational dose incurred at nuclear power plants accumulates during annual maintenances, in which case practical work is, to a substantial degree, done by contractors external to the plant. Doses have been reduced by developing work procedures and work order. In order to limit radiation levels at the plants, components have been replaced with components having cobalt-free coatings.

The results of radiation protection at the plants in 2005 and 2006 were good considering the exacting nature of the work done; work requiring special attention was implemented according to plans. In a comparison carried out by the OECD/NEA, the collective occupational dose at the Olkiluoto plants was among the best for BWRs, with the exception of the last two years during which a very extensive turbine modification was carried out at the plant units.

A summary of occupational radiation exposure at the Finnish nuclear power plants is given in the section about the Loviisa plant.

The highest individual occupational dose at Olkiluoto nuclear power plant was 12.2 mSv. The collective occupational dose was 1.88 manSv at Olkiluoto 1 and 0.33 manSv at Olkiluoto 2, totalling 2.20 manSv. Olkiluoto 1 underwent an exceptionally extensive annual maintenance outage as regards the amount of work done. With the present plant unit output (860 MW), the threshold, in accordance with STUK guidelines, for one Olkiluoto plant unit's collective dose averaged over two successive years is 2.15 manSv for Olkiluoto 1 and 2. With the radiation doses incurred in 2005-2006 this 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

Annual thresholds for radioactive releases to the environment are determined in a plant's Technical Specifications. Radioactive releases to the environment from Olkiluoto nuclear power plant were well below authorised limits. The releases of noble gases to the atmosphere were approx. 0.6 TBq, i.e. approx. 0.004% of the set limit. Iodine releases were approx. 0.2 GBq, i.e. approx. 0.1% of the set limit. Aerosol releases were approx. 31 MBq, tritium releases approx. 0.3 TBq and carbon-14 releases approx. 0.8 TBq.

The tritium content of liquid effluents released into the sea, 2.5 TBq, is approx. 14% of the annual release limit. The total activity of nuclides released into the sea was 0.7 GBq, i.e. approx. 0.2% of the plant-site specific release limit.

The release limits are intended to maintain the annual individual radiation exposure of the population surrounding the plants clearly below the threshold value (100 microSv) determined by the Government Decision (395/1991). The calculated radiation dose of the most exposed individual in the environment of the Olkiluoto plant was approx 0.06 microSv, i.e. less than 0.1% of the limit prescribed by Government Decision (100 microSv). 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

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 Olkiluoto nuclear power plant, 301 samples were analysed. Radioactive substances originating in the plant were measured in nine samples of aquatic plants, 11 samples of sinking matter, three samples of air, one sample of bottom fauna and one sample of sea water.

Cobalt-60, the dominating radioactive substance originating in power plants, was measured in 23 samples. Manganese-54 (5 observations), tritium (1 observation), cobalt-58 (1 observation) and strontium-89 (1 observation) were measured as well.

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

The external radiation dose rate is continuously monitored by 10 automatic stations at the distance of five kilometres from the plants and by four corresponding measuring stations at about a kilometre from the plants. The measurement data are transferred to the power plant and the national radiation-monitoring system. In addition, there are 11 passive dosimeters around the plant, which are separately read. No changes occurred in external radiation that would have exceeded fluctuations in natural background radiation.

3.2.5 Oversight of organisational operation

Safety management

Based on information accumulated during document review and other inspection activity at the Olkiluoto plant, STUK assesses how the utility attends to plant safety.

The construction of the new plant unit requires a considerable amount of work and learning of new skills of the technical experts of operating plants. In an inspection of the periodic inspection programme made by STUK, development needs surfaced in the plant's human resources planning and recruitment practices. STUK will follow the development of these practices in 2007.

Quality management system

Teollisuuden Voima Oy has systematically maintained and developed its quality management system according to own plans. The licensee has regularly evaluated the functionality of its quality management system by an internal follow-up programme. An assessment of the utility's activities during annual maintenance and operation by The World Association of Nuclear Operators (WANO) looked at the quality management system as well. Development needs have surfaced and improvements will be implemented over the next years. The report proper is due for completion in 2007.

STUK oversaw quality management and its functionality by document reviews and inspections of its periodic inspection programme. The quality management system of the licensee was found acceptable. The operation of Teollisuuden Voima Oy was found to be in compliance with the plant's own quality management system. The remarks made during the inspections were mostly about further development of the system and definition of detail. In the quality assurance inspection, a remark was made on the evaluation of the functionality and scope of quality assurance. Evaluation is to be developed such that, in the evaluation reports, not only recommendations are given but also an assessment, in accordance with Guide YVL 1.9, of the condition of the quality management system.

Personnel qualifications and training

STUK oversaw personnel training at Olkiluoto power plant within the framework of the periodic inspection programme. A challenge in the enhancing of expertise at the Olkiluoto plant was preparing for the operation of Olkiluoto 3. The training of new operators was important as well. Training procedures and their functionality need to be further developed to ensure operator competence. A 5-week basic professional training course on nuclear safety in Finland was attended by 17 persons from the Olkiluoto plant.

Upon licensee application, STUK authorised its employees to act as shift managers or operators at the nuclear power plant. A total of 32 Olkiluoto personnel were authorised, of which two are new shift managers, seven are new operators and nine operator trainees. The other decisions of approval were periodic revisions of old decisions.

Operational experience feedback

STUK oversaw operational feedback activities by reviewing event reports and the annual operational experience feedback report submitted by the licensee. The Olkiluoto plant has systematic procedures for event investigation, assessment and corrective action.

The licensee's operational experience feedback consisted of the review of events at own and other plants. Events at plants abroad were discussed in a special operational feedback working group with the aim of developing and improving operations and preventing recurrence of events compromising plant safety. Operational experience feedback information was disseminated to the personnel in the form of reports and training.

STUK met with Teollisuuden Voima Oy in January to discuss recurring events recorded in operational experience feedback. Plant conditions in non-compliance with the Technical Specifications still occurred at the Olkiluoto plant. Underlying the events are recurring deficiencies in the administration of periodic testing and the identification of the requirements of the Technical Specifications. Corrective action to remedy the situation has been insufficient so far.

An IRS team that follows operational experience feedback at foreign nuclear power plants operates at STUK. Event data was obtained through the IAEA and the OECD's Incident Reporting System (IRS). STUK evaluates the applicability of the lessons learned thereof at Finnish plants.

Due to a disturbance in the electrical power systems at Forsmark nuclear power plant in Sweden, the probability of a similar event at the Olkiluoto plant was assessed. The Forsmark event is described in Appendix 4.

Event investigation

STUK started no event investigations on Olkiluoto 1 or 2. An event investigation team is set up whenever the licensee's organisation has not functioned as planned in connection with an event or when an event is assessed to lead to significant modifications in the plant technical layout or procedures. A STUK investigation team is set up also in case the licensee has not sufficiently analysed the root causes of an event.

Pressure equipment manufacturers, and inspection and testing organisations

Upon application by Teollisuuden Voima Oy, and in accordance with the Nuclear Energy Act, STUK authorised 25 manufacturers of nuclear pressure equipment.

In accordance with the Nuclear Energy Act, STUK authorised 26 testing organisations to conduct nondestructive testing relating to the manufacturing of mechanical components and structures for the Olkiluoto plant units. Testers employed by four separate testing organisations were authorised to carry out the in-service inspection of mechanical components and structures of the Olkiluoto plant units. Previous decisions pertaining to manufacturers and testing organisations are valid as mentioned in the decisions.

The inspection unit of the Olkiluoto plant, "Teollisuuden Voima Oy inspection organisation", authorised in 2002, continued in operation as well as two other inspection organisations approved in 2005.

STUK oversaw at both plant units the inspections of Safety Class 3 and 4 as well as Class EYT (non-nuclear) pressure equipment carried out by the inspection organisations. STUK controlled also the inspection of mechanical components in Safety Classes 3 and 4 and Class EYT (non-nuclear) by the utility's own inspection unit. Safety Classification is based on STUK's Guide YVL 2.1, according to which components are assigned to the Safety Classes 1, 2, 3 and 4 as well as Class EYT (non-nuclear). Items with the highest safety significance belong to Safety Class 1.

The manufacturers as well as testing and inspection organisations authorised by STUK were subject to regulatory oversight by inspections, review of documents and audits. Their operation was established to comply with the requirements of Guides YVL 3.4 and YVL 1.3

STUK oversaw the operation of Teollisuuden Voima Oy's inspection unit "Teollisuuden Voima Oy, Inspection, electrical and I&C inspection", authorised by STUK, and the electrotechnical and I&C commissioning inspections made by its inspectors. These were found to be in compliance with Guide YVL 5.2.

Nuclear liability

The users of nuclear energy must have acquired liability, or other financial guarantee, as stipulated in the Nuclear Liability Act (484/1972) 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 the 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. About €425 million was available for compensation from all these sources. An increase in the sum is expected in the near future since international negotiations about the revision of the Paris/Brussels agreements on nuclear liability were completed in 2004. The funds available for compensation will more than triple in the coming years compared with the current situation. In addition, Finland has decided to enact unlimited licensee liability by law. The amendment has not taken effect yet but is pending the coming into force of the aforementioned agreements.

The revision of the contents and conditions of a licensee's insurance policy in Finland belongs to the Insurance Supervisory Authority. It has approved Teollisuuden Voima Oy's liability insurance and STUK has verified the existence of the policy in accordance with section 55 of the Nuclear Energy Act (990/1987).

The transport of nuclear materials is subject to the Nuclear Liability Act. STUK has seen to it that all nuclear material transport has had liability insurance in accordance with the Paris Convention and approved by the Insurance Supervisory Authority or the authorities of the sending country

3.2.6 Safety performance indicators

The requirements set for the safety indicators of the effectiveness of STUK's operations were fulfilled at Olkiluoto power plant in all the areas where they had been established: occupational radiation doses, radioactive releases from nuclear facilities and the population exposure arising from them, safety-compromising events at nuclear facilities and the condition of components contributing to accident risk at nuclear facilities.

Individual and collective occupational doses at the nuclear power plant were below set limits. The collective occupational radiation dose for Olkiluoto power plant in 2005-2006 was higher than in the preceding years. This was due to the annual maintenance outages that were of exceptional scope as regards human resources and work load. Radioactive aerosol and liquid releases as well as the radiation exposure caused by them to the surrounding population remained small and below set limits. Iodine and aerosol releases from the Olkiluoto plant grew slightly owing to fuel leaks at both units.

The safety performance indicators showed no significant deficiencies in the plant's operation. The plant units were mostly operated in accordance with the Technical Specifications, with the exception of four deviations: operator maximum working hours were exceeded, the time limit for the periodic inspection of batteries at the spent fuel storage was exceeded, the 2-yearly testing of the radiation dose rate monitor of the off-gas stack of Olkiluoto 1 was not done in 2004 and 2006 and the dryout margin went below its smallest allowable value during a power reduction at Olkiluoto 1. These non-conformities were the only events warranting a special report. The number of events at the Olkiluoto plant of which a special report is written has not changed compared with the previous years. Four operational events occurred whose direct cause in most cases was a technical failure, not human error. A wastepaper basket caught fire during the Olkiluoto 1 annual maintenance, and this was classified as an actual fire event.

The safety performance indicator system for nuclear power plants looks also at the risk-importance of operational events. Based on their risk-importance, events are divided into three categories, the indicator being the number of events in each category. The number of risk-significant events at Olkiluoto, in comparison to 2005, was unchanged. The most significant events were due to diesel generator preventive maintenance packages and latent failures in the auxiliary feedwater systems. The number of other risk-significant events at Olkiluoto was approximately the same as in 2005. Unavailabilities at the plant were caused, as before, by planned component unavailabilities. The events were quite evenly distributed between the plant units. The events analysed are part of a nuclear power plant's normal operation and required no further action by STUK.

The safety indicators of the effectiveness of STUK's operations include, among others, the following objective important for the condition of components significant to accident risk: accident risk at nuclear power plants is reduced or remains unchanged. Risk is assessed by Probabilistic Safety Analysis in which the model includes i.a. regularly updated component reliability data. Accident risk at the Olkiluoto plant was reduced to some extent from 2005 due to certain plant modifications and more detailed analyses.

The trend in the maintenance function at the Olkiluoto plant was difficult to assess. The volume of maintenance annually done on components subject to the Technical Specifications was not directly comparable to that of previous years since the recording procedures on which the indicator is based have changed. Despite the changes, the preventive maintenance/fault repair ratio remained at the average level of previous years. Based on this, the maintenance function is assessed to be in balance and implemented on the same bases as before. Preventive maintenance work, dictated by the length of annual maintenance outages, affects the volume of preventive maintenance done at the plants. Changes in the indicators should in future mainly reflect the changing order of annual maintenances, which could be considered an indication of a functioning maintenance strategy.

The mild upward trend in the total for fault repairs of components subject to the Technical Specifications during power operation stopped. Fault detection and anticipation have been continuously improved and components replaced in the plants' maintenance function. Owing to this, the possible negative effect of ageing on the plants is not visible in the indicator or the fault data on which it is based. This indicates functioning component lifetime management and successful component maintenance.

The average repair times of failures causing unavailability of components subject to the Technical Specifications have remained moderately stable at the Olkiluoto plant units for years. They became shorter at both plant units. Production losses due to malfunctions in all systems were small, which is also indicated by the plants' high load factors.

International indexes measuring safety systems unavailability showed that the inoperabilities of monitored systems are at a low level, which is to be considered normal. There were less containment spray system and back-up diesel generator unavailabilities and the condition of diesel generators was good. The unavailability index of the auxiliary feedwater system slightly increased at Olkiluoto 1 due to the system's malfunctioning recirculation and safety valves. As corrective action, the torque values of the actuator motors of the valves in the recirculation line have been changed and the construction of a separate testing line for the safety valves has been preliminarily discussed.

The indicator for maintenance and modification investments at the plant showed that investments have remained at a level above average. Major investments at the Olkiluoto plant over the past years include a turbine plant upgrading, which includes replacement of steam dryers. In addition, the construction of a gas turbine plant, started in 2005, was continued. By plant start-up, the plant documentation had been quite well updated after the modifications made during the annual maintenances.

The structural integrity of multiple barriers containing radioactive releases has been mostly good. Fuel leaks have recently occurred every year at the Olkiluoto plant units. In 2006, the Olkiluoto 1 reactor contained leaking fuel for a short period prior to the annual maintenance outage. Olkiluoto 2 contained leaking fuel for the entire burn-up period 2005–2006 and a new leak occurred right after the annual maintenance outage. The leaks' effects are an increased iodine-131 concentration of reactor water during operation as well as increased iodine and aerosol releases.

The chemistry indexes showed a successfully maintained chemistry. The reactor water and feedwater chemistry have been in accordance with the target values set by the utility, with the exception of the sulphite concentrations of reactor water showing variability due to the runtimes of condensate clean-up filter masses, and the above-average high temperature of the condensate in the summer. The cobalt-60 concentration of reactor water has been on the increase at Olkiluoto 2. Along with replacement parts or components installed during extensive modifications in 2005, materials containing cobalt have entered the circuit. The spacer grid material of a certain fuel type has added to the increase in concentrations.

Primary circuit leaks are monitored by operating cycle. During the 2005–2006 operating cycle, the volumes of identified and unidentified leaks from the primary circuit were low at both Olkiluoto plant units. This is a third successive operating cycle with no primary leaks to the containment airspace.

The leaktightness of containment buildings has remained good. At Olkiluoto 1, the sum of the leaktightness tests of outermost isolation valves after the first leaktightness tests was small, like in the previous years. At Olkiluoto 2, the sum clearly increased as compared to 2005, exceeding the limit set in the Technical Specifications. Half of the leak came from a leaking valve in the controlled leak collection system and almost twenty percent from a leaking valve in the spray system of the reactor pressure vessel head. After the repairs, combined leak rate is clearly below the limit set in the Technical Specifications. The share of isolation valves passing the leaktightness test at first try has remained good and improvement from 2005 is apparent at the Olkiluoto plants. The combined leak rate of openings at the Olkiluoto plant has remained small.

The outcome of STUK indicators for plant safety are given in Appendix 1.

3.2.7 Overall safety assessment

The operation of Olkiluoto power plant has been free from disturbances, with the exception of a couple of deviations. STUK did not detect any significant defects affecting safety. Individual and collective occupational doses at the plant as well as the dose calculated to the most exposed individual in the environment of the plant were in accordance with set objectives. The collective occupational dose was high by international comparison due to the turbine plant upgrading at Olkiluoto 1. Occupational doses can be reduced by returning the new steam dryer back to service after repairs. In addition, the plant is to find out how to further reduce occupational doses.

Actions to prevent initiating events at Olkiluoto power plant have worked well. The effects of ageing, among others, were not visible in the safety indicators for maintenance. Upgrading of the plant's electrical and I&C systems has improved the reliability of its protective functions.

The structural integrity of multiple barriers containing radioactive releases has been good although fuel leaktightness has presented problems every year. The loose parts campaign, launched at the Olkiluoto plant in the 2006 annual maintenance outage, has not yet yielded the desired results. Plant modifications implemented in the annual maintenance outage have helped ascertain the leaktightness of the coolant circuit and the containment.

The plant's ageing management process very systematically ascertains the implementation of system and component modifications. In this process, the avoidance of component loadings is to be better considered than before. The qualification of cabling important to safety is to be verified better than before.

Olkiluoto power plant has in place the procedures and human resources to safely operate the plant. Several items in this field require further enhancement. The use of external assessment is a good practice but does not reduce the significance of, and the requirements for, self-assessment. The training of new operators is a significant challenge for the plant unit under construction and those in operation. The training procedures and their functionality need to be further developed to maintain good operator competence. Conditions in non-conformity with the Technical Specifications have still occurred at the plant. It has not been possible to sufficiently well eliminate the causes underlying them.

3.3 Olkiluoto 3

Main emphasis in the oversight of Olkiluoto 3 was in the review of detailed design documents and the manufacturing of main components. The share of onsite operations in oversight was less than planned because construction work progressed slower than planned. Prerequisites for the operation of organisations were oversawn by inspection and audits. In addition, STUK performed an investigation based on problems in organisations' operation, which surfaced during the concreting of the plant's base slab. Included in the investigation were deficiencies that surfaced during the manufacturing of the containment steel liner, the designing of the reactor building polar crane and of the material lock. The investigation and its outcome are reported in more detail in subsection 3.3.4.

3.3.1 Implementation of regulations

The presentation of new requirements in updated YVL guides does not, as such, alter any previous decisions made by STUK. After having heard those concerned, STUK makes a separate decision on how a new or revised YVL guide applies to operating nuclear power plants, or those under construction, and to licensees' operational activities. This procedure applies to Olkiluoto 3 in the enforcement of YVL guides published after 17 February 2005, i.e. the granting date of the construction licence.

When considering how new safety requirements presented in YVL guides apply to operating nuclear power plants, or to those under construction, STUK takes into account section 27 of the Government Decision (395/1991), which prescribes that for further safety enhancement, action shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology.

As regards Olkiluoto 3, which is under construction, brought into force as such were the following revised YVL guides:

- YVL 2.4, Primary and secondary circuit pressure control at a nuclear power plant, 24 November 2006
- YVL 3.1, Nuclear facility pressure vessels, 31 January 2006
- YVL 8.3, Treatment and storage of low and intermediate level waste at a nuclear power plant, 29 July 2005.
- In addition, STUK made the below additional decision pertaining to Olkiluoto 3, as regards a YVL guide issued before the granting of the construction licence:
- YVL 3.8, Nuclear power plant pressure equipment. Inservice inspection with non-destructive testing methods,10 February 2.2006

In the decision STUK requires that the utility submits the inservice inspection summary programme to STUK during construction already.

3.3.2 Assessment of safety analyses

Transient and accident analyses

Teollisuuden Voima Oy did not submit to STUK for review accident and transient analyses of the behaviour of Olkiluoto 3. Commissioned by STUK, VTT State Technical Research Centre in Finland continued to develop models for analysis of plant behaviour to correspond to plant detailed design. STUK thus prepares for the review of analyses during the operating licence phase. To assist in the review of detailed design, STUK commissioned independent assessments and analyses of hydrogen management during severe accidents and of a potential recriticality risk during a steam generator heat exchanger tube break.

Fire and flood analyses

The utility submitted to STUK for review updated fire analyses for the containment, the annulus and cable ducts as well as the turbine building plus flood analyses for the containment and the annulus, the diesel building and the auxiliary service water pump units. The review of fire and flood analyses will continue in 2007. In support of the review, STUK commissioned to VTT independent fire safety analyses of fire retardant non-corrosive cables.

Buildings analyses

STUK reviewed a non-linear 3-D model for the containment and analyses for vibrations in the containment, the fuel building and the safeguard buildings generated by aircraft impacts. STUK reviewed the design for adequate strength and stress analyses for the aircraft impact walls, etc. structures, of these buildings.

Probabilistic Safety Analysis

In 2005 STUK reviewed the Probabilistic Safety Analysis (PSA) for Olkiluoto 3. Despite its defects, STUK found the analysis and its general design bases adequate. The then detailed plant design was incomplete in many respects. STUK in 2006 assessed how the design bases had been implemented in the detailed design documents of systems and structures. The objective was to ensure adequacy of design, particularly as regards local events (e.g. fires and flooding onsite) and external events, and to identify interdependencies between systems and possible tendencies for common cause failures.

The Probabilistic Safety Analysis and its computer model were not submitted to STUK for review in 2006. An unofficial PSA model update was submitted to STUK for information in which STUK's earlier comments were taken into account in part. A project plan for the preparation and application of the analysis and its update as well as a plan for a seismic PSA were submitted to STUK for review. Of the applications of the PSA, STUK reviewed method descriptions for the choice of items in the piping periodic inspection programme and for the drawing up of Technical Specifications.

3.3.3 Oversight of plant project

Conceptual design planning

Of the conceptual design planning documents of Olkiluoto 3, the utility submitted to STUK for review the general design objectives to provide against internal and external threats, among others. The documents included separation principles for minimising the consequences of internal threats, like flooding and fire, between divisions. The review brought forth matters that the utility and the vendor are to take into account in future planning. They mostly relate to a more unambiguous documentation of the design criteria. The review of conceptual design planning will continue in 2007.

STUK continued to review the layout of the buildings, structures and components of Olkiluoto 3 using a 3D-model of the plant. Teollisuuden Voima Oy updated the model as planning progressed.

The utility submitted to STUK for review documents describing the structure of the Technical Specifications essential for the operational safety of Olkiluoto 3. The remarks made by STUK dealt with improvement of the usability and clarity of the Technical Specifications. The utility and STUK began discussions of how to ensure the safety of actions taken during the plant's annual maintenances.

Radiation safety

STUK reviewed the technical and functional requirement specifications of the radiation measurement systems of Olkiluoto 3 and their quality plans. STUK required the enhancing of the seismic endurance of certain measurement systems and the ascertaining of power supply to release sampling to ensure its availability during severe accidents and other design-basis accidents. STUK reviewed a plan to renew the radiation monitoring system in the environment of the plant site.

Commissioned by STUK, VTT Technical Research Centre in Finland, launched independent reference analyses to analyse the severe accident source term. The utility and STUK began discussions about the detailed planning of an automated data transfer system for use at Olkiluoto 3 during emergency response situations.

As part of their pre-inspection, STUK reviews systems' radiation safety requirements.

Ageing management

The basis for the ageing management of main components and other safety-significant mechanical equipment is that their materials and manufacturing techniques are to be technologically second to none in all fields. STUK paid attention to the matter during review of the structural plans of the main components and during control of manufacturing. Of specific interest was the safe-end weld between the reactor coolant lines and the reactor pressure vessel. The welding filler material and technique used are new and no operating experience exists. STUK called for a follow-up programme to monitor weld characteristics during manufacturing and plant operation.

Regular inspections of the inservice inspection programme pertaining to the commissioning of mechanical components at Olkiluoto 3 are to be made using methods qualified in accordance with Guide YVL 3.8. The vendor and Teollisuuden Voima Oy have launched qualification of the inspection methods and STUK has reviewed the first documents pertaining to qualification. STUK required from the utility an inservice inspection summary programme in accordance with Guide YVL 3.8. It will be submitted to STUK in 2007.

No significant review of documents on electrical and I&C components was begun in 2006. Ageing -related matters will be presented in component feasibility studies to be submitted to STUK. During the review of the Preliminary Safety Analysis Report STUK required that a preliminary ageing follow-up programme is to be drawn up for electrical and I&C components during the construction of the plant unit.

Systems planning

STUK continued to review the detailed plans for process systems. The approval of plans for systems most important to nuclear safety was mainly completed. The conditions of approval included detailed requirements for future planning. The review of I&C and electrical planning for process systems will continue in 2007.

STUK reviewed plans for the electrical power supply systems of the reactor plant and the turbine plant as well as for systems relating to secured electrical power supply. In addition, the following were inspected, among others: consumer lists, frequency and voltage limits to be observed in process planning, the generator and its auxiliary systems, failure analyses of programmable electrical components, and cabling isolation requirements to ensure fire safety at the plant.

The utility submitted the technical and functional requirement specifications of the main I&C systems as well as their quality plans and systems descriptions to STUK for review. STUK reviewed the design criteria for the electrical isolation of the main I&C systems, how the diversity principle has been observed in the measurement of process parameters, and evaluated software planning and the life cycle of I&C systems planning. In addition to the main I&C systems, STUK reviewed individual I&C systems, such as those of the containment condition monitoring system, the seismicity monitoring system and the fuel handling system.

STUK began review of control room and simulator documents. Control room quality plan and its design verification and validation plans were reviewed by STUK.

Component and structural design

The review of detailed component design focused on the construction and manufacturing plans of the main components (the reactor pressure vessel and steam generators with their internals, the pressuriser, the reactor coolant pumps, the reactor coolant lines and the control rod drive mechanisms. Attention was particularly focused on the safe-end weld between the reactor coolant line and the reactor pressure vessel as well as on the availability of a suitable testing method for the reactor coolant line material. STUK and the inspection organisations authorised by it continued to review the construction plans of other mechanical components. STUK reviewed plans for the refuelling machine and other fuel handling equipment, among others.

The review of electrical equipment began with the review of the construction plans of pump motors in the intermediate coolant circuit. STUK made numerous remarks on the contents of the construction plan. Due to the work arising from this, the utility postponed the submission to STUK of other construction plans. In addition, the qualification of software for a multifunctional protective relay and the project specifications of batteries, rectifiers and cabling were reviewed. STUK required an analysis of the reliability of programmable components. As a result, the utility ended up presenting various types of programmable equipment for different voltage levels.

The handling of fuel licensing documents began with a review of fuel operational and behavioural analyses, fuel fabrication quality plans and documents as well as fuel design plans. STUK required from the utility further analyses (i.a. a fuel feasibility study) to complement the fuel design and fabrication documents.

Manufacturing and construction

Regulatory oversight in component manufacturing focused on the inspection of main components. STUK's inspectors supervised by regular monthly visits the manufacturing of the reactor pressure vessel at the factory of Mitsubishi Heavy Industries in Japan and of steam generators at the factory of Chalon in France. During the visits, the manufacturing of other components, such as the pressuriser, primary coolant piping and the primary coolant pumps was supervised. At the factory of Skoda in the Czech Republic, the manufacturing of reactor pressure vessel internals was supervised and in Poland the manufacturing of the steel liner that ensures the leaktightness of the containment. STUK thus aims to ensure adequate manufacturer, vendor and utility supervision and compliance of products with the requirements.

Construction oversight focused on the manufacturing and installation of Safety Class 2 steel and concrete structures. The lowest segment of the steel liner was installed in May. Three inspections of the readiness to start Safety Class 2 concreting were performed at the site: levelling casting beneath the steel liner, ground slab inside the liner and the fastening plates of the containment pre-stressing cables. STUK inspected the elements inserted in the concrete casting i.e. steel structures, grip plates and piping as well as earthings and other protective devices on buildings.

Qualification and suitability assessment
The utility submitted to STUK for review the plans for qualification of components and structures for accident conditions. STUK made remarks on the qualification plans and the utility has to take them into account when planning and implementing qualification. The utility began qualification of electrical equipment (cabinets and batteries) against vibrations arising from seismic events and aircraft impacts. STUK witnessed testing.

Modifications and repairs

Repairs
Several items (e.g. welding and manufacturing defects) requiring repair have surfaced during the manufacturing of main components. Welds have been repaired in accordance with approved repair plans. Of highest importance were repairs of the safe-end welds between the reactor pressure vessel and the reactor coolant line as well as repairs of the castings of the pump housings of primary coolant pumps. The forgings of the primary coolant lines were rejected due to the large grain size of their material. A new batch was manufactured since the large grain size of the first batch does not allow for ultrasonic inspection. Defects were detected in the forgings of the reactor pressure vessel internals and the vendor decided to manufacture a new batch. The vendor manufactured new components to replace the pressuriser forgings rejected in 2005.

Due to the porosity of the concrete in the base slab, caused by too high a water-cement ratio, the utility decided to protect the perpendicular walls of the base slab with a coating to prevent the entry of corrosive agents, among others, into structural steels during plant operation. The application of the coating was postponed to a later date due to the incompleteness of the implementation plan. The utility had to have repairs made in the turbine building (i.a. additional expansion joints) due to design defects. The provisions of the Finnish Code of Building Regulations (RakMK) were not appropriately observed in design.

Owing to heavy winds at the construction site in the autumn, a segment of the steel liner shifted from place and suffered damage. The vendor plans to locally repair the damage instead of manufacturing a replacement segment. Repairs were postponed until 2007 due to a delay in the completion of their plans.

Significant design modifications
In order to enhance fire safety at the plant, the utility implemented modifications to original design. STUK required external feed assemblies to the safeguard and diesel buildings of the nuclear island in order to ensure the supply of fire extinguishing water during seismic events. The vendor changed the routes of electrical power cables in the safeguard buildings to improve their physical separation between safety system subsystems.

STUK and the utility have discussed other modifications whose final implementation is being planned by the vendor. They include, among others, installation of room -specific leak monitoring to rooms significant to safety, ascertaining the cooling of components and systems important to plant safety by increased diversity in heat removal and a change in the mode of primary circuit pressure reduction to prevent pressuriser heat stratification during plant shutdown.

Due to the event in Forsmark, the vendor decided to modify the design of the plant's electrical power systems. By the design modification, the availability of stand-by power supply was made independent of the operation of the UPS system. The reliability of power supply to the plant's I&C systems was enhanced due to the modification. The Forsmark event is described in Appendix 4.

3.3.4 Oversight of the operation of organisations participating in plant construction

STUK oversees the operation of organisations when overseeing the implementation of the plant project. The operation of organisations participating in the project is overseen by inspections onsite and at the manufacturers' premises. By its periodic inspection programme during construction, STUK oversees (see Safety management below) the utility's actions to ensure the project's controlled implementation. STUK made an investigation into the operation of organisations. Its basis and outcome are described in more detail at the end of this subsection.

By inspections and other supervision STUK verified the organisations' operational readiness for the project's future phases. Inspected were, among others, planning and control of installation oversight, storage procedures onsite as well as planning and control of the plant's commissioning, STUK found several development needs in the operational instructions and procedures of the utility and vendor.

STUK reviewed and supervised the training given to personnel who will work at Olkiluoto 3 and described operator licensing and related requirements to the utility. Together with the utility, STUK audited the planning of training at the vendor's premises. STUK consequently required that the utility ascertains the appropriateness of operator training material and develops actions to supervise vendor training activities. In addition, STUK called for procedures to incorporate plant design modifications into operator training.

Safety management

STUK continued inspection of Teollisuuden Voima Oy's operations in accordance with the periodic inspection programme during construction. The programme is used to inspect and evaluate the utility's operations to ensure high quality implementation of the new nuclear power plant. Every six months STUK draws up a plan for the programme's implementation. In 2006 the programme included inspection of the project's main functions, such as management, quality management, project management and safety issues. Inspection of other functions included quality assurance in various fields, training and the utilisation of PSA, the utility's inspection procedures and various technical fields (layout planning, air conditioning systems). Based on the inspections, the operation of Teollisuuden Voima Oy needs to be further improved, particularly as regards procedures pertaining to vendor supervision and review of vendor designs.

In order to evaluate the vendor's operation STUK participated in the utility's audits assessing control room design, training, construction site quality management as well as vendor quality management and procurement operations.

STUK has participated in 34 utility audits on component suppliers to ascertain their capability to take part in the plant project. Deficiencies were established in the operation of many of them; quality plans specific to Olkiluoto 3 and changes to improve the operation of organisations were required, among others.

Management and quality management system

The quality management system of Teollisuuden Voima Oy contains procedures and responsibilities for the management and implementation of the Olkiluoto 3 project. The quality management system, which is based on processes, is integrated in the operating system of the existing Olkiluoto plant units. The project's quality assurance covers the evaluation and control of the operation of the project itself and that of its subcontractors, the consortium and vendors.

Based on internal audits and the results of STUK's inspections, among others, Teollisuuden Voima Oy has maintained and improved the project's management and quality management system. The remarks in STUK's inspection results required, among others, that the utility's internal auditing is to be further developed and that any defects detected in its operation are to be corrected by a given deadline. STUK required that the utility develops the systematic analysis of audit observations such that recurring deficiencies would be identified. STUK required the utility to ascertain that the quality systems of subcontractors who manufacture components important to safety meet the quality management requirements and quidelines of the respective IAEA quality standards. During management system inspections it has been required that the utility improves i.a. the handling of safety matters and construction control procedures and initiates actions to develop the project organisation.

STUK approved changes to the project's quality management system as presented by the utility.

Human resources in the project's quality assurance unit have been increased according to plans. Teollisuuden Voima Oy recruited more quality assurance engineers to all areas of technology.

Inspection and testing organisations as well as vendors of nuclear pressure equipment

Upon application by Teollisuuden Voima Oy, and in accordance with the Nuclear Energy Act, STUK authorised 22 manufacturers of nuclear pressure equipment for Olkiluoto 3. In accordance with the Nuclear Energy Act, STUK further authorised 25 testing organisations to conduct destructive and nondestructive testing of mechanical components and structures at Olkiluoto 3.

The manufacturers as well as testing and inspection organisations authorised by STUK were subject to regulatory oversight. Their operation was established to comply with the requirements of Guides YVL 3.4 and YVL 1.3.

Event investigation

On 7 March STUK appointed an investigation team to evaluate the management of safety requirements during the construction of Olkiluoto 3. After the surfacing in February 2006 of non-conformities in the casting of the base slab of Olkiluoto 3 in the autumn of 2005, STUK considered it necessary to examine the procedures for selecting and controlling the construction site's subcontractors as well as their capability to meet requirements specific to nuclear power plant construction. The delivery of the concrete base slab, the supply chain for the containment steel liner and the early design stages of the polar crane and the material lock were looked into as examples.

According to the investigation team, the problems related to the strict overall schedule of the plant project and its framework of costs. The time and workload required by detailed planning was underestimated when the overall schedule was agreed. Most problems in component manufacturing and construction had to do with project management. This was clearly visible as regards the casting of the concrete base slab where the roles and responsibilities of various operators turned out to be ambiguous. The definition and management of the concrete delivery contract failed due to the vendor's inexperience in construction work.

The vendor's subcontractors had no earlier experience of nuclear construction work. During the bidding and contract signing phase the inexperienced subcontractors were not informed clearly enough about essential quality requirements and potential additional costs arising from them. The subcontractors' workers were given insufficient training in the code of practice in the nuclear power field and in the safety significance of their own work; control and supervision by the vendor were insufficient to ensure problem-free execution of work.

Control of construction and component manufacturing was mainly implemented as planned and carried out by competent individuals in the utility and vendor organisations. Non-conformities were documented by those responsible for quality control and their repair was monitored. The project's quality organisation had insufficient authority, power of execution and courage to intervene without delay in the non-conformities and require their correction.

The investigation team emphasised a code of practice in accordance with a good safety culture. Of importance is the attitude to safety and how it shows in everyday work. The aim is that work is planned, carried out and documented as well as possible; an indifferent attitude to problems or quality must not be accepted.

The team gave the plant vendor and orderer several recommendations for the quality of plans, the presentation of quality assurance requirements, the choice, supervision and training of subcontractors as well as how to deal with non-conformities. Teollisuuden Voima Oy was given recommendations on the management of the Olkiluoto 3 project and on the promotion of safety culture at the construction site. All organisations contributing to the project were given a recommendation pertaining to the quality systems and safety culture requirements presented in the IAEA's safety standards; the vendor, Teollisuuden Voima Oy and STUK shall clarify to their personnel the essential requirements of the mentioned safety standards, which are to be observed in the operation of organisations contributing to construction and component manufacture. Any deviations from the requirements detected during inspection and audits as well as corrective action are to be presented in as concrete and unambiguous a manner as possible.

Due to the recommendations, Teollisuuden Voima Oy and the vendor drew up a detailed action plan for use by utility and vendor to standardise and develop non-conformity reporting and analysis. The aim is to clarify work-related responsibilities, increase supervision and develop instructions, among others.

STUK underlined the importance of expertise in construction project management and the fact that project management and the construction site must have sufficient construction expertise. The vendor replaced site manager in early November and Olkiluoto 3 project leader in early December. Job descriptions at the site have been made more specific.

3.3.5 Overall safety assessment

In the overall safety assessment of the new plant project, observations are examined that were made based on information and experience gained from the review of detailed plans, manufacturing and construction oversight, the outcome of the periodic inspection programme during construction, oversight of the vendor and their subcontractors as well as dealings between STUK, Teollisuuden Voima Oy and the vendor.

Based on the review of detailed plans, STUK is able to establish that the plant design has continuously become more detailed but that the vendor and the utility still need to improve the drawing up of detailed design documents. Attention was paid to this, among others, in the investigation's recommendations. STUK required that the deficiencies found in the design documents are to be corrected, which in practice delays design. Their correction is necessary, however, for STUK to review and approve the detailed design.

Based on the oversight of manufacturing and construction STUK established deficiencies in the operation of both vendor and utility. They were dealt with in the investigation results; utility and vendor have presented actions by which operation can be assumed to improve. Organisations participating in the manufacturing of the main components as well as vendor and utility have operated appropriately but observations indicate a need for extensive manufacturing oversight.

Manufacturer and supplier audits showed that many operators have not in their work observed the quality requirements of the nuclear field. Attention was paid to this and STUK required that Teollisuuden Voima Oy, in co-operation with the vendor, draws up unambiguous documents to ensure the timely transfer to subcontractors of special requirements for quality management and assurance.

As a result of the periodic inspection programme during construction, STUK was able to form an opinion of Teollisuuden Voima Oy's project management, resources, handling of safety matters, quality management and functions supporting these main functions. The outcome of the inspection programme showed that the utility's operation is adequate as regards management as well as construction planning and control. As regards the development needs identified in operation, Teollisuuden Voima Oy has presented plans of action whose implementation is followed by STUK during the project.

Assessment of vendor operation is based on dealings with them at meetings, review of documents drawn up by them, review of their quality management system and quality management plans, review of project manuals, and audits and investigation of their operation.

Based on the dealings with the vendor, STUK has established that they have sufficient expertise to complete the plant's design. STUK expects the management of subcontractors and of the entire construction project to improve as a result of actions taken on account of the investigation, among others. The vendor has strengthened the quality management and control procedures and resources at the site and added new project expertise resources to those available for use by the project leadership.

3.4 FiR 1 research reactor

In addition to nuclear power plants, STUK regulates the FiR 1 research reactor operated by the VTT Technical Research Centre of Finland. The reactor is located in Otaniemi, Espoo, and its maximum thermal power is 250 kW. It began operation in March 1962 and its current operating licence will expire at the end of 2011. It is used for production of radioactive tracers and for activation analysis, student training and BNTC (Boron Neutron Capture Therapy) treatment of tumors as well as development of treatment methods.

The reactor continued to operate as in previous years. No exceptional events affecting safety occurred. Occupational radiation doses and radioactive releases into the environment were clearly below set limits.

VTT Technical Research Centre of Finland submitted to STUK information on an organisational change in the reactor's operation. STUK reviews regularly reactor documents referred to in the Nuclear Energy Act. Reactor rules and regulations were submitted to STUK for approval. STUK made regular operational safety inspections according to an annual plan. Four reactor foremen and one operator were authorised by STUK.

The most concrete technical maintenance measures at the research reactor in the future will focus on nuclear fuel as well as the control and monitoring system. A human resources and training plan has been drawn up on the handling of important safety tasks by the FiR 1 operating staff. The reactor's responsible manager may continue until the end of the operating licence period. The next regular renewal of operator authorisations in 2007 and 2008 will apply to several reactor operators.

According to the nuclear waste management plan for the FiR 1 reactor, approved by the Ministry of Trade and Industry, the spent nuclear fuel may returned to its country of origin (the United States) after the expiration of the present operating licence.

The operational safety of the FiR 1 reactor, the availability of its structures, systems and components as well as its human resources and the related plans are adequate for the present operating licence period.

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 Nuclear waste management programmes

In accordance with the policy outlined in the Ministry of Trade and Industry letter of 3 November 2002, Posiva Oy, Teollisuuden Voima Oy and Fortum Power and Heat Oy published the report TKS-2006, Nuclear waste management of the Olkiluoto and Loviisa power plants, Programme for research, development and technical design for 2007–2009. It is an overview of the R&D and technical design in the field of nuclear waste management by Posiva and its owners in the recent years and also a plan for future activities. It is focused on the years 2007–2009.

The report on nuclear waste management, put out by the utilities in 2006, was largely based on the above TKS-2006 report. STUK reviewed the utilities' nuclear waste management related documents and drew up a statement on them in accordance with section 78 of the Nuclear Energy Decree.

STUK reviewed also updated documents on the financial provision made for the costs of nuclear waste management referred to in section 90 of the Nuclear Energy Decree and gave statements on them to the Ministry of Trade and Industry. In its statements STUK assessed the technical plans and cost estimates on which financial provision is based.

4.2 Spent nuclear fuel

4.2.1 Intermediate storage

STUK oversaw spent nuclear fuel storage by regular inspections and review of the plans for and work on storage systems. No safety-endangering events occurred in the operation of the storage facilities. The volume of spent fuel onsite the Olkiluoto plant at the end of 2006 was 6510 assemblies (1147 tU, tonnes of original uranium), with an increase of 226 assemblies (41 tU) in 2006. Corresponding accumulation at the Loviisa plant was 3361 assemblies (403 tU) with an increase of 204 assemblies (25 tU). A decision has been made to increase the storage capacity of the Loviisa plant by the introduction of fuel racks that can take more fuel assemblies. STUK in 2006 approved the pre-inspection documentation for the fuel racks.

4.2.2 Preparation for final disposal

Posiva Oy's operations most important from the nuclear safety regulatory point of view are as follows:

Encapsulation and final disposal

The design of Posiva's encapsulation and final disposal facilities has progressed based on long-term planning and preliminary design stage plans were completed towards the end of 2006. The development of waste canister manufacturing techniques continued in co-operation with the Swedish nuclear waste company SKB. Using the pierce and draw method, which is Posiva's responsibility, the first copper canister with an integrated bottom that meets the given specifications was manufactured in Germany in 2006. The canister's iron insert casting tests at the Rautpohja foundry, Jyväskylä, produced a canister that meets both geometric requirements and those set for the casting material.

In co-operation with Patria, Posiva has continued copper canister lid electron beam welding tests at Linnavuori factory in Nokia. Posiva has made distinct progress in welding technology development. Development of canister inspection techniques has become more well-defined and Posiva has started planning of the inspection qualification procedure.

STUK made a review of the waste canister design report published in 2005; the outcome of the review was submitted to Posiva and the Ministry of Trade and Industry for information. A database on open issues relating to the development of engineered barriers was set up and updated by both STUK and Posiva.

In 2006 Posiva launched its own bentonite buffer project, the BENTO-project, to reply questions relating to the performance of bentonite and to develop manufacturing and installation technologies as well as domestic expertise in the field. R&D in tunnel backfilling techniques will be implemented in co-operation with SKB within the framework of the Baclo project whose second phase is nearing completion.

The most significant design and development projects in final disposal relate to the horizontal disposal of waste canisters (the so called KBS-3H concept). Posiva has a development programme on this concept with SKB, extending to 2007. Preparatory work for full-scale demonstration tests has begun at the Äspö hard rock laboratory in Sweden.

Site investigations

Posiva Oy continued confirming repository site investigations and construction of the underground research facility ONKALO. Following a change in the mode of operation made in 2006 Posiva now acts as construction developer and oversees construction work and its quality. The project schedule and cost estimate were revised following the change. ONKALO's construction proceeded according to the revised schedule: by the end of the year, excavation depth was approx. 160 metres.

In 2006 STUK intensified oversight of ONKALO's construction. The number of inspections made at the construction site was 26. In addition, an ONKALO construction inspection programme was launched within the framework of which four inspections were made. Follow-up meetings and semiannual meetings to comprehensively review issues with Posiva continued according to previous usage. A list of open issues pertaining to Olkiluoto's confirming site investigations was updated twice with the assistance of an international team of experts. Assisted by the same team, STUK is currently assessing the quality guides for safety critical functions pertaining to ONKALO's construction.

Posiva's newest update on the ONKALO region's rock model is expected to be completed in early 2007. An analysis of disturbances arising from ONKALO's construction was updated and, based on it, recommendations for sealing strategies and methods will be reviewed. Research on excavation damage zones in ONKALO was begun. The first niche for the purpose of geological investigations in ONKALO was completed towards the end of 2006.

Posiva drilled four new deep holes in the investigation area and conducted established geophysical and hydrological investigations there. One research excavation was mapped for rock fissuring, rock type distribution and degree of alteration. The first summary reports on the monitoring programme in the ONKALO area were completed. An extensive description of the bedrock research methods used by Posiva in investigations made from surface and in research done in ONKALO was completed. In addition, numerous other interpretations of investigations made in Olkiluoto and also geological background analyses were published in the Posiva report series.

Safety research

Posiva's safety research is mostly based on long-term bi- or multilateral collaboration projects. Most bilateral research projects are contained in the Posiva/SKB (Sweden) collaboration, which was renewed in 2006. The most significant multilateral projects are the integrated projects NF-PRO, FUNMIG, PAMINA and THERESA within the EU's sixth framework programme in which Posiva and Finnish research institutes participate.

Posiva organised the compilation of the safety case via the SAFCA project set up in 2005. The project objective is to attend to the development of the necessary expertise as well. Posiva's safety case strategy is contained in the report 'Plan for Safety Case'. The future safety case will be published as a Safety Case Portfolio, which will consist of ten main reports to be updated every few years. In 2006 Posiva published the first version of a Portfolio report that includes a description of the evolution of the site and the repository.

In 2005–2006 Posiva completed an extensive set of reports on the Olkiluoto biosphere. One of the objectives of these safety cases is to provide information for the baseline of the disposal site: the second update to the report in question (Olkiluoto Site Description 2006) comes out in early 2007. A second main objective is to produce initial data and modelling tools for a biosphere analysis contained in the Safety Case Portfolio. A summary report of the analysis was published in 2006.

Posiva's other safety research focused on the studies and modelling of the performance of engineered barriers (uranium matrix, waste canister, bentonite buffer, backfilling materials) of the disposal system. The objects of research specifically included mutual interactions between barriers as well as those between them and substances in ground water.

4.3 Low and intermediate level waste

The utilities followed earlier practices in their low and intermediate level waste maintenance. No safety-related problems occurred in the treatment, storage and final disposal of waste.

The volume of low and intermediate level waste onsite the Loviisa plant at the end of the year was 2990 m^3. Volume increase from 2005 is 150 m^3. Corresponding waste accumulation at the Olkiluoto plant was 6011 m^3 and the increase was 586 m^3. Approx. 47% of the waste from the Loviisa plant and approx. 76% of that at the Olkiluoto plant has been disposed of. At the Loviisa plant, maintenance waste taken to the Kymenlaakson Jäte Oy landfill and recyclable scrap metal were cleared from control. At the Olkiluoto plant, maintenance waste taken for burial at the local landfill, waste oil taken to Ekokem Oy, recyclable scrap metal and some reusable components were cleared from control.

The most important low and intermediate level waste projects at the Loviisa plant are the commissioning of a solidification facility and of an extension to the disposal facility, due in early 2007 according to current plans. At first, only evaporation residues will be solidified and disposed of; treatment of ion exchange resins will only be started when experience has been gained of the operation of the solidification facility. STUK has approved, with certain additional requirements, an update to the safety case pertaining to the extension of the Loviisa final disposal facility.

The Loviisa plant plans to develop low and intermediate level waste management by taking into use facilities for the centralised treatment, activity measurement and temporary storage of waste. A relevant plan has been completed and project realisation is due in 2006–2009.

The planning of Olkiluoto-3 radioactive waste treatment systems reached detailed planning phase and STUK reviewed the relevant systems descriptions.

In accordance with the operating licence conditions, the safety case for the Olkiluoto final facility for low and intermediate level waste (VLJ repository) was updated towards the end of 2006, considering the experiences gained and the research completed over the repository's operating lifetime so far. The updated safety case includes the disposal of waste from Olkiluoto 3 in the VLJ repository. STUK will review the safety case update and submit a statement about it to the Ministry of Trade and Industry in 2007.

5 Nuclear non-proliferation

Marko Hämäläinen, Arto Isolankila, Elina Martikka, Olli Okko, Anna Lahkola

5.1 Safeguards of nuclear materials

5.1.1 Safeguards at Finnish nuclear facilities

The objective of STUK's safeguards activities is to take care of the control necessary to prevent the proliferation of nuclear weapons. In addition, STUK's task is to attend to the control pertaining to international agreements in the field of nuclear energy signed by Finland. International safeguards are implemented by the IAEA and EU safeguards by the European Commission's Directorate-General for Transport and Energy, Directorates H and I. IAEA safeguards are based on the Nuclear Non-Proliferation Treaty and the Safeguards Agreement (INFCIRC/193) signed by the non-nuclear EU member states, the European Atomic Energy Agency and the IAEA. EU safeguards are based on the Euratom Treaty and Commission Regulation EURATOM 302/2005.

Insofar as nuclear power plants are concerned, STUK's safeguards activities are mostly focused on fuel import, transport, storage, internal transfers and refuelling. The utilities submit to STUK activity programmes, advance notifications and reports relevant to their nuclear material management.

Ten inspections were carried out at Loviisa power plant and 16 inspections at Olkiluoto plant, totalling in 26 inspections at the Finnish plants. Euratom participated in 21 and the IAEA in 24 of them. STUK made six safeguards related inspections at the construction site of the Olkiluoto final repository.

In addition to 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 VTT, where one inspection was made. It was carried out by STUK, the IAEA and Euratom. In addition to VTT's FiR 1 research reactor, STUK, the Laboratory of Radiochemistry at the University of Helsinki, OMG Kokkola Chemicals, the University of Jyväskylä, the Geological Survey of Finland and some other small nuclear materials holders have small amounts of nuclear materials in their possession. The amounts of nuclear materials at Finnish facilities are given in Table 2 and licences and approvals in accordance with the Nuclear Energy Act in Appendix 4.

An important objective of nuclear material safeguards is to verify that the data on nuclear materials reported by the operators, such as burn-up and cooling time, are correct and complete. STUK verified by non-destructive methods 24 and 58 spent fuel assemblies at Olkiluoto and Loviisa power plants respectively. For the Olkiluoto measurements, the gamma burn up verification (GBUV) method was used, which reveals i.a. a missing rod. The use of GBUV requires fuel transfers, which limits the number of assemblies that can be measured. For the Loviisa measurements, a spent fuel attribute tester (SFAT) attached to the fuel transfer machine was used, which facilitates measurements without fuel assembly transfers. SFAT measurements facilitate verification of operator-given data. In Loviisa, an EFORK measuring device was used to measure three spent fuel assemblies and 19 dummy elements. EFORK requires fuel transfer and is thus slower than SFAT.

Seven Euratom and 28 IAEA inspectors were approved to carry out inspections in Finland.

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

Table 2. Amounts of nuclear material in Finland 31 December 2006.

Location	Natural uranium (kg)	Enriched uranium (kg)	Depleted uranium (kg)	Plutonium (kg)	Thorium (kg)
Loviisa plant	–	485 407	–	4 015	–
Olkiluoto 1	–	188 156	–	756	–
Olkiluoto 2	–	192 881	–	862	–
Olkiluoto / Spent fuel storage (KPA)	–	911 744	–	7 621	–
VTT/FiR 1 research reactor	1 511	60	0.002	–	–
OMG Kokkola Chemicals	2 613	–	–	–	–
STUK	44.7	1.4	823	0.003	2.5
University of Helsinki, laboratory of radiochemistry	40.4	0.3	20	0.003	2.5
Other facilities	~0	~0	~817	~0	–

5.1.2 Activities in accordance with the Additional Protocol (INFCIRC/540)

To facilitate the IAEA's discovery of secret nuclear programmes, an Additional Protocol to the Nuclear Materials Safeguards Agreement has been drawn up to intensify the IAEA safeguards and extend their scope. By virtue of the Protocol, the IAEA is entitled to receive from states data more extensive than previously on the nuclear fuel cycle, R&D projects included. In addition, the IAEA is entitled to gather data on open sources, to operate satellites and to collect environmental samples. For assurance of state given data, the IAEA has a more-extensive-than-before right of access enabling verification of reported functions. The IAEA is also entitled to make complementary access visits at very brief notice. The Additional Protocol came into force within the EU on 30 April 2004.

STUK prepared declarations required in the Protocol, the most important of which were descriptions of plant sites and of R&D pertaining to the nuclear fuel cycle. STUK delivered within the given time limits direct to the IAEA, and for information to the Commission in May, declarations that were Finland's responsibility, and those under the joint responsibility of the Commission and Finland to the Commission and for information to the IAEA in March. The Commission further delivered the updates of declarations under its own responsibility and of those it was jointly responsible for with Finland to the IAEA and for information to STUK in May. In addition, Finland delivered quarterly information about exportations in accordance with the Protocol. STUK delivered to the IAEA and the Commission a total of 14 declarations and the Commission to the IAEA four declarations pertaining to Finland. On 17 November the IAEA conducted at the Loviisa plant site a complementary audit in accordance with the Protocol at two hours' notice. The Commission participated in the audit.

5.1.3 Safeguards for final disposal

The final disposal of nuclear fuel in an underground repository presents new challenges to safeguards implementation since, after encapsulation, direct verification of nuclear material will be impossible. By virtue of the Nuclear Non-Proliferation Treaty, the government is under obligation to facilitate effective IAEA safeguards in Finland. STUK has considered it appropriate to oblige Posiva Oy, who are looking into final disposal and its implementation, to take care, in the manner of a nuclear facility, of the implementation of nuclear safeguards during the construction of the underground research facility (ONKALO) of the final repository. This decision aims to assure the IAEA of Finland's capability to implement sufficient safeguards and to plan national control and inspection procedures. In accordance with Commission Regulation (EURATOM) 302/2005, licensees are obliged to submit technical basic data on new facilities not later than 200 days prior to the estimated receipt of the first batch of nuclear materials. On 11 May STUK forwarded to the IAEA a summary of the inspections made during the first year of ONKALO's construction and reported the project as part of regulatory oversight in accordance with the Additional Protocol.

As regards the final disposal facility, STUK approved an update to the Code of conduct for nuclear non-proliferation in ONKALO, prepared by Posiva, which is equivalent to a nuclear material accounting and control manual. It focuses on the verification of construction documents and environmental monitoring prior to the handling and transfer of nuclear materials to the underground facilities. STUK approved and introduced into use an YTV quality manual on nuclear non-proliferation during the construction of the final repository.

During 2006, inspections of the underground research facility (ONKALO) of the final repository were mostly implemented simultaneously with oversight usages relating to the construction of ONKALO. As regards nuclear non-proliferation, before the covering of rock surfaces, it was verified by six systematic inspections that the excavated premises were equivalent to the as-built documentation. A meeting of a group of consultants discussing the long-term safety of nuclear waste management for final disposal and the related visit to the underground premises under construction were attended on 31 May 2006 by two IAEA inspectors as observers during STUK's inspection of the premises. Towards the end of 2006, STUK inspected Posiva's nuclear material safeguards system and verified the excavated premises.

5.2 Control of radioactive materials transport

About 20 000 radioactive packages are transported in Finland every year. No accidents or safety hazards involving the transport of radioactive materials occurred in 2006. The transport of nuclear materials requires a licence from STUK. The conditions for the licence include nuclear liability insurance and sufficient physical protection. STUK approved three transport plans for the import of fresh fuel. The most significant cases of nuclear material transport were the imports of fresh nuclear fuel to the Finnish nuclear power plants from Sweden, Spain and Russia.

The import of radioactive and nuclear materials is subject to a licence. No attempts on illicit import were detected at the Finnish border.

No illicit trafficking of radioactive materials was detected at the border in 2001–2005. 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, also the number of consignments of scrap metal to Finland has decreased.

Safeguards as well as the supervision and control of nuclear material transport are described in more detail in the report *Nuclear Safeguards in Finland 2006* (STUK-B 74).

5.3 The Comprehensive Nuclear Test Ban Treaty

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. Compliance with the Treaty is monitored by an international observation network, which, when complete, will comprise 321 monitoring stations. Of the stations, 80 measure radioactive particles in the atmosphere. The results are available for use by all member states.

A special Preparatory Commission, which assembles in Vienna, is preparing for the Treaty's coming into force. All States Signatories are represented in it. The Provisional Technical Secretariat that works i.a. on the establishment of an international observation network operates in Vienna as well

The National Data Centre (NDC), which is based on the CTBT and operates in conjunction with STUK, contributed to the work of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) in establishing a cost-effective organisation that is functional from the Finnish point of view. The NDC's own automatic routine monitoring was in operation for the whole year, analysing results yielded by stations detecting radioactive particles in the atmosphere. Routine monitoring is facilitated by an alarm system transmitting data on unusual observations to the NDC personnel. No abnormal activity levels were observed by the NDC.

The North Korean underground nuclear test on 9 October 2006 was detected by seismic observation stations whose operation is based on the Treaty. No radioactive particles possibly leaked to the atmosphere from the test were detected by the observation stations due to the incompleteness of the observation network in the Far East and the unfavourable winds prevalent in the area of operating observation stations.

Under the auspices of the Ministry for Foreign Affairs, The NDC arranged in November a 3-day course on the operation of the NDC, directed in particular to the data centres of developing countries. Participants from the data centres of the Philippines, Kenya, Malaysia, Peru and Uganda attended.

The functioning and reliability of the NDC's data processing system was improved by the purchase of a backup disc drive for data storage and by the decentralisation of functions to various servers with automated status monitoring. In addition, analyses activities were developed.

In 2002 STUK signed an agreement with the developers of the analysis programme used by the NDC about its handing over to the national data centres of other countries for use in CTBT work. In 2006 the programme was delivered to the national data centres of Malaysia and the Philippines.

6 Safety research

Marja-Leena Järvinen, Arja Tanninen

STUK gave a statement on the publicly-funded SAFIR research programme for 2006 in January and on the KYT2010 programme in February. The purpose of the programmes is to ascertain the maintenance and development of Finnish expertise in nuclear safety and nuclear waste management. STUK controls this research by contributing to the work of the programmes' steering and reference groups.

The programme of the last year in the SAFIR 2003–2006 research programme was essentially equivalent to those of the previous years. The project entity comprised 22 research projects with a total volume of €5 million. It focused on fuel and the reactor core, the reactor coolant circuit and its mechanical components, the containment and process safety. Research included control rooms, programmable I&C, safety culture, and management of risk-informed safety. The research projects contain theoretical and empirical research important for the assurance and development of expertise. The research projects include projects to develop technical expertise and those relating to the operation of organisations. They include a training angle. The final seminar of the SAFIR 2003–2006 research programme took place in January 2007.

During the first half of 2006, a proposal for a new framework plan for a publicly-funded nuclear safety research programme for 2007–2010 was prepared as well as a proposal for how to organise it. STUK headed the planning and contributed actively to the preparation of the proposal. The work was implemented as a strategy process spanning the whole spring, with 90 experts in the field contributing during the various phases of the process. The general plan for the SAFIR2010 research programme, proposed by the work group, was published in conjunction with the research programme's call for projects in September. The new programme's steering and reference groups began work right after the call for projects had expired. At the end of the year they prepared a proposal for the project entity to be funded in 2007. Information about the SAFIR programme can be found at *http://virtual.vtt.fi/safir/*.

In early 2006 a new 5-year research programme, the KYT2010, was launched and, like the previous KYT programme, it focuses on strategic analyses of nuclear waste management. New topics include nuclear non-proliferation and sociological research. In March 2006, a final seminar was held where the results of research in 2002–2005 and the KYT2010 programme were presented. The KYT programme for 2006 comprised 19 research projects with a total volume of €1.2 million. Information about the KYT programme can be found at *http:/www. ydinjatetutkimus.fi*.

7 Nuclear facilities regulation and development of regulation

Marja-Leena Järvinen, Erja Kainulainen, Kaisa Koskinen, Pekka Salminen, Arja Tanninen

7.1 Processes and structures

STUK ascertains by inspection and other oversight that the prerequisites for operation, and the operation, of the licensee and their subcontractors as well as the systems, structures and components of nuclear facilities meet set safety requirements. STUK's oversight is composed of document reviews and various types of inspections onsite or at the suppliers' premises. The YVL guides presuppose document review as well as inspections onsite or at the suppliers' premises. In addition, STUK carries out its own inspection programmes during construction and operation, and resident inspectors work at the plant site. The inspection procedures are described in the quality manual for nuclear safety regulation. Document review, the various types of inspection and the related indicators are described in more detail below. The results of the review and inspections are dealt with in Chapters 3–5 of this report.

Document review

A total of 3148 documents were submitted to STUK for review, 1395 of which concerned the plant under construction. The number of completed document reviews was 2677, including documents submitted in 2006, those submitted earlier and licences granted by STUK in accordance with the Nuclear Energy Act, which are listed in Appendix 5. Average document review time was 53 days. The number of documents and their average review times in 2002–2006 are given in Fig 8. Figs 9, 10 and 11 give the distribution of document review times at each plant unit.

Inspections onsite and at suppliers' premises

Safety management, the main processes and procedures of operation as well as the technical acceptability of systems were looked into in inspections of the periodic inspection programme. The compliance of plant safety assessment, operation, maintenance and protection activities with the requirements of nuclear safety regulations was verified by the inspections. The annual inspection programme was brought to the attention of the licensee early in the year and the inspection dates were agreed upon with the licensee's representatives. The inspections contained in the periodic inspection programme are given in Appendix 6.

The construction inspection programme of Olkiluoto 3 aims to verify that the functions required by the construction of the plant ensure high quality implementation in accordance with approved plans in compliance with regulations and without endangering the plants already operating

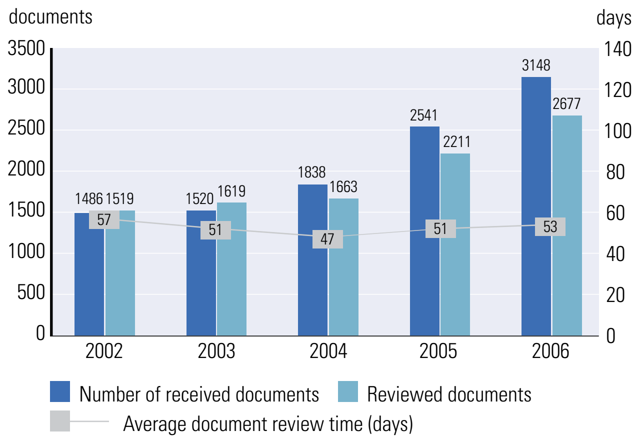

Figure 8. Number of documents received and reviewed as well as average document review time.

on the site. The inspection programme assesses and supervises the licensee's activities to implement the plant project, the procedures pertaining to the plant's construction in the various technical fields involved, licensee expertise and their use of it, handling of safety matters, and quality management and control. STUK draws up a bi-annual plan for the Olkiluoto 3 inspections. Inspections of the periodic inspection programme during construction are given in Appendix 7.

The data acquisition methods used in the inspections were reports requested from utility representatives, personnel interviews, document reviews, walk rounds and observation of working practices. None of the observations thus made had significant bearing on the safety of the plant units.

Thirty inspections of the periodic inspection programme were conducted, 15 at each plant. One of the inspections planned for the Loviisa plant was postponed to 2007.

STUK conducted 12 inspections in accordance with the periodic inspection programme implemented during the construction of Olkiluoto 3.

A total of 840 inspections (other than inspections of the periodic or construction inspection programmes, of the safeguards of nuclear materials and of the construction inspection programme of the Olkiluoto underground research facility, which are looked into later in this document) onsite or at the suppliers' premises were made. An inspection comprises one or several partial inspections such as a review of results documentation, an inspection of a component or structure, a pressure or leakage test, a functional test or a commissioning inspection. Of the inspections, 220 pertained to oversight of the plant under construction and 620 to that of the operating plants. Relevant documents are reviewed prior to onsite inspection.

The total number of inspection days onsite and at the component manufacturers' premises during office hours was 2024. Not only inspections pertaining to the safety of nuclear power plants but also nuclear waste management and safeguards inspections are included as well as audits and inspection of the Olkiluoto underground research facility. In addition, 239 inspection days outside the office hours were spent at the operating nuclear power plants, mostly during annual maintenance outages as well as 35 inspection days at the plant under construction. The number of days spent on inspection has increased due to inspections relating to the construction of the new nuclear power plant. Two resident inspectors worked at Olkiluoto nuclear power plant. Two new resident inspectors were recruited one of which began work in Olkiluoto in early September. The Loviisa plant has one resident inspector. The number of inspection days onsite in 2002–2006 is given in Fig. 12.

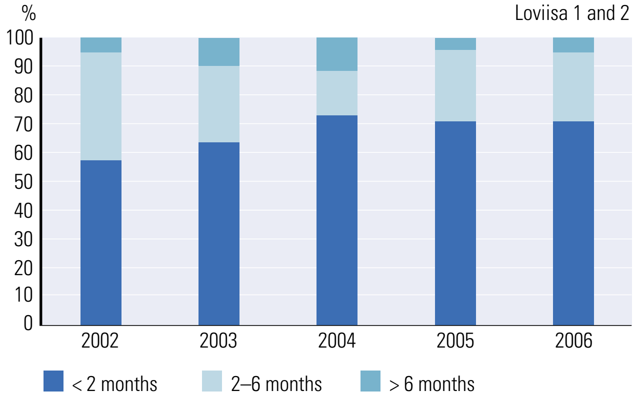

Figure 9. Distribution of time spent on preparing decisions on the Loviisa plant units.

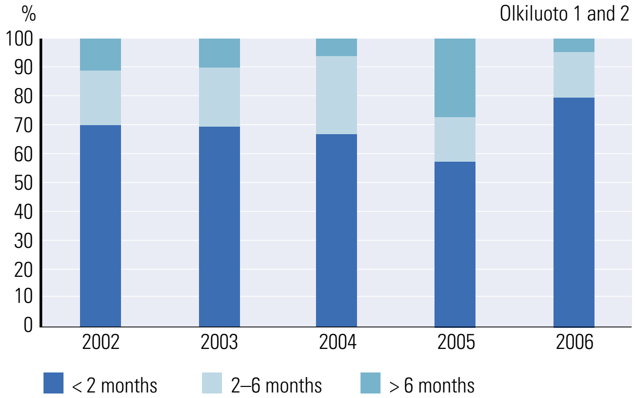

Figure 10. Distribution of time spent on preparing decisions on the Olkiluoto plant units 1 and 2.

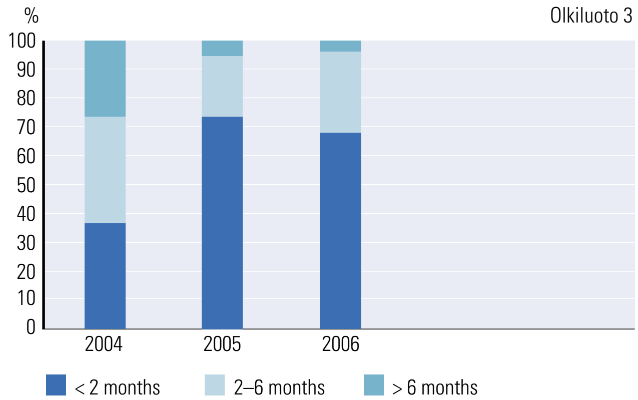

Figure 11. Distribution of time spent on preparing decisions on the Olkiluoto plant unit 3.

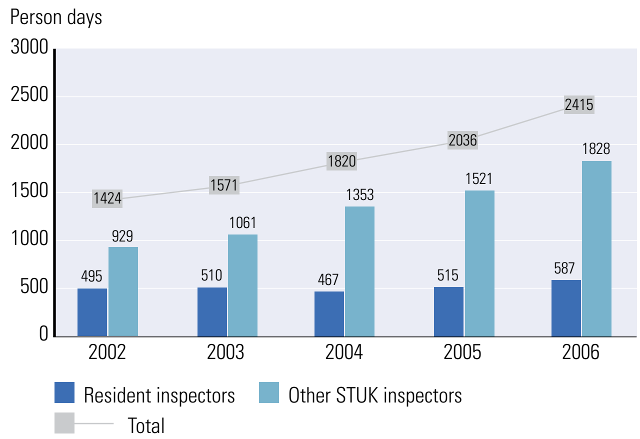

Figure 12. Number of inspection days onsite and at component manufacturers' premises.

STUK's own development projects

The development of own operation focused on processes, development of data systems that support operation as well as development of interaction between regulatory authorities and those subject to regulation. Process-related work consisted of the updating of the contents of the guidelines in the quality manual on nuclear power plant regulation and of the changing of the division of the guides to make them correspond to today's processes. Recommendations given during an investigation relating to the construction of Olkiluoto 3 were taken into consideration in the updating of the quality manual.

The periodic inspection programme (KTO) was evaluated in the spring of 2006. As the evaluation objective, development of own operation had been set such that objectives set for the KTO would be fulfilled better and more effectively than before. All persons in charge of inspections participated in the evaluation. Development actions were decided based on the outcome of the evaluation: underlining of the role of the KTO, more distinct focusing of inspections according to safety functions, digitalisation of inspection documents, enhancement of annual planning and training relating to the KTO programme.

The relationship between the regulatory authority and the licensees was studied by interviewing 28 persons from the operating power plants and the unit under construction. The objective was to find out the functionality of the procedures in use at the department of nuclear reactor regulation and also utility attitudes towards the department's operation at present. By the interviews also matters relating to interaction and co-operation as experienced by representatives of the utilities were mapped. Another objective was to evaluate the fulfilment in regulatory work of the principles presented in the quality manual for nuclear safety regulation and to compare the results to those of earlier surveys.

The results show the licensees are mostly satisfied with STUK's operation. Regulatory principles and values are well realised, openness and interactivity have increased. The licensees appreciate the authority's expertise and the well-functioning co-operation between themselves and the authority. They also valued STUK's service attitude and efficient decision-making when in a hurry. However, they would like to see STUK operate more consistently and present a more uniform requirement level. In addition, the suggestion was made that any forthcoming changes in the regulatory practice should be more actively announced in the future.

A separate project (the Onkalo monitoring project, ONP) was set up directly under the management team of the Department of Nuclear Waste and Material Regulation to enhance the oversight of the construction of Posiva Oy's underground research facility at Olkiluoto. The project was set up to ensure that the design and construction of the research facility proceeds without compromising the long-term safety of final disposal and in accordance with regulations. The objective is that the research facility is constructed such that it can be later approved as part of the final disposal facility to be constructed at Olkiluoto. Assisting in the oversight of the underground research facility is a team consisting of external experts, which looks into special issues addressed to it and evaluates Posiva's reports and matters relating to the construction of Onkalo.

The renewal of STUK's entire strategy was launched and, related to that, the compilation of plans of action pertaining to nuclear power plants, nuclear waste management and nuclear non-proliferation was begun.

In their development seminars the divisions of Nuclear Reactor Regulation and Nuclear Waste and Material Regulation discussed the roles and responsibilities of director, manager, and expert in a regulatory organisation.

Development of document management

The long-term project to develop a records management solution for STUK continued.

The RM (Records Management) system supplied by Affecto-Genimap Oy will in the near future replace STUK's existing separate records systems and registers. The new system makes possible internal digital records management (workflow) at STUK. The system preliminarily provides for electronic services to external clients. A complete review and updating of STUK's registry establishment plan (AMS) has been launched as well.

7.2 Renewal and human resources

Development of competence continued based on earlier plans. Own training focused on increasing knowledge of the features of facility design of the new plant. Newly recruited personnel were given basic professional training in nuclear safety in Finland arranged for the fourth time by STUK in the autumn in co-operation with other parties active in the nuclear field. In addition, two nuclear materials inspectors participated in the course "Nuclear Safeguards and Non-proliferation", arranged by European Safeguards Research and Development Association (ESARDA).

Recruitments continued to ensure adequate know-how and personnel resources. Four new experts were recruited for the Department of Nuclear Reactor Regulation and the recruitment of two more was begun. Those newly recruited became resident inspectors for the new plant in Olkiluoto and inspectors in the field of mechanical equipment as well as in their manufacturing and inspection techniques. The resident inspectors underwent an approx. 6-month orientation period at STUK's premises in Helsinki. One began work in Olkiluoto in the autumn 2006 and the other in early 2007. The resident inspectors specifically follow and evaluate the operation of organisations onsite. With the development of Posiva Oy's operations, additional resources are needed also in the oversight of nuclear waste management. Towards the end of the year, the recruitment of five new personnel for oversight of the repository project and of low and intermediate level waste was begun.

As part of the launching of work on STUK's strategy, the work atmosphere in the Department of Nuclear Waste and Material Regulation was mapped and, based on the results, a development project was begun in co-operation with an external consultant. Nuclear waste regulation was consequently reorganised in early 2007.

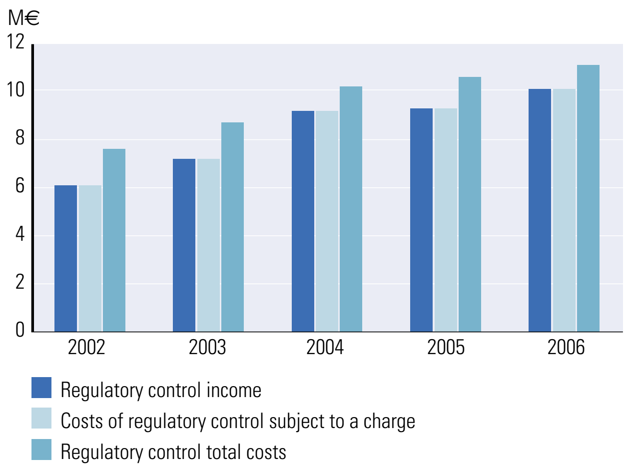

Figure 13. Income and costs of nuclear safety regulation.

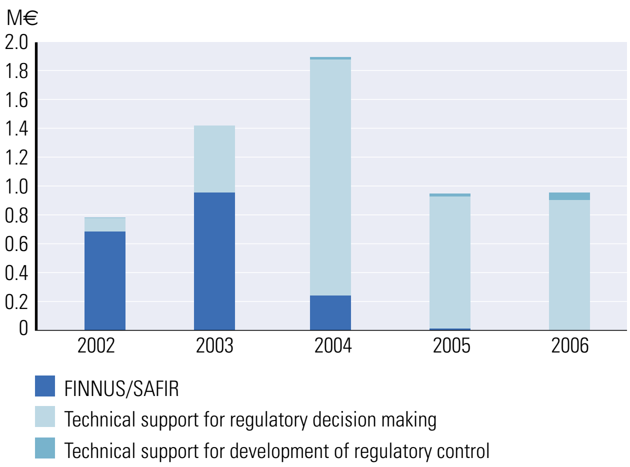

Figure 14. The cost of research and commissioned work pertaining to the safety of nuclear power plants.

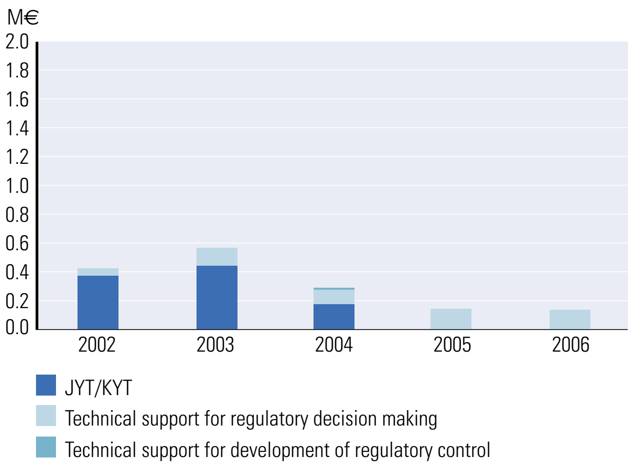

Figure 15. The cost of research and commissioned work pertaining to nuclear waste management and nuclear non-proliferation.

Table 3. Distribution of working hours (person-years) of the regulatory personnel in each duty area.

Duty area	2002	2003	2004	2005	2006
Basic operations subject to a charge	27.6	29.2	44.7	47.1	53.6
Basic operations not subject to a charge	6.9	6.4	5.1	7.2	5.7
Contracted services	3.8	4.9	5.1	3.3	3.0
Rule-making and support functions	27.1	28.2	22.7	27.5	28.8
Holidays and absences	16.2	15.9	16.9	16.9	20.0
Total	81.6	84.6	94.5	101.9	111.0

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 nuclear safety regulation, training, maintenance and development of expertise, reporting and 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.

The costs of the regulatory control of nuclear safety subject to a charge were €10.1 million. The total costs of nuclear safety regulation were €11.1 million Thus the share of activities subject to a charge was 90.8%.

The income from nuclear safety regulation was €10.1million. Of this, €2.0 million and €7.2 million came from the inspection and review of Loviisa and Olkiluoto nuclear power plants, respectively. In addition to the operating plant units, the income from the Olkiluoto plant includes regulatory control of the new plant unit. The regulation of Posiva Oy's operations yielded €0.8 million. Figure 13 gives the annual income and costs of nuclear safety regulation in 2002–2006.

The time spent on the inspection and review of Loviisa nuclear power plant was 11.3 person-years, i.e. 10.3% of the total working time of the nuclear regulatory personnel. For Olkiluoto nuclear power plant's operating units it was 9.8 person-years, which accounts for 8.8% of total working time. In addition to the oversight of the operation of nuclear power plants, the figure includes nuclear material control. The time spent on the inspection and review of Olkiluoto 3 was 27.6 person-years, i.e. 24.9% of total working time. The time spent on nuclear waste management inspection and review was 4.9 person-years and that spent on the FiR 1 research reactor 0.08 person-years. The working time spent on small-scale users of nuclear material was 0.02 person-years.

Where necessary, STUK commissions independent safety analyses and research in support of regulatory decision-making. Figures 14 and 15 give the costs of nuclear safety research in 2002–2006. In addition to technical support projects, the pre-2005 figures show the costs of national nuclear safety research. The costs for 2006 mostly relate to reference analyses and independent assessments made for the plant unit under construction. Appendix 8 lists completed STUK-financed technical support projects.

The distribution of the yearly working time of the nuclear regulatory personnel according to duty areas is given in Table 3. Figure 16 presents the distribution of working time spent on main functions in 2002–2006.

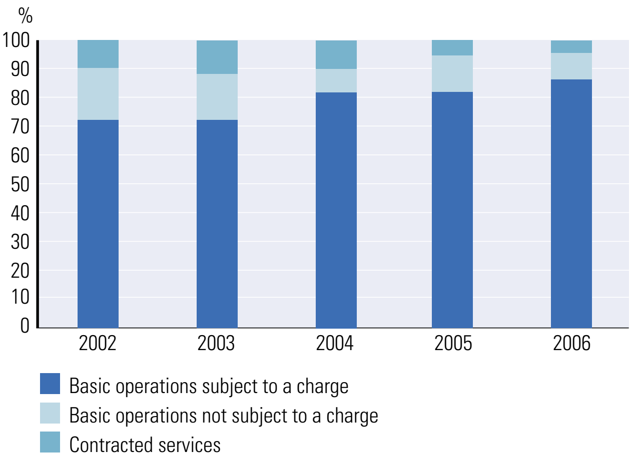

Figure 16. Working time spent on main functions.

8 Emergency preparedness

Tuulikki Sillanpää

STUK organised several training events and exercises to test and develop its own emergency response. In addition, STUK supervises the emergency preparedness of the operating organisations of nuclear power plants to act in abnormal situations. No situations occurred that would have endangered the safety of the population or the environment and would have required protective action.

The emergency response systems of nuclear power plants have been under continuous development during plant operation and regularly tested in emergency exercises as part of emergency preparedness training. Other related training by the licensees encompasses practical exercises for radiation measurement teams, sampling during accidents and measurement of samples, assessment of accident situations and review and development of emergency guidelines in seminars. STUK has approved the emergency contingency plans of the Loviisa and Olkiluoto plants and yearly reviews the implementation of emergency preparedness, including training and emergency exercises.

Two domestic emergency exercises involving nuclear power plants were organised. The participants to a Loviisa nuclear power plant rescue operations exercise, “LOVIISA 06”, on 23 November, were some 50 domestic authorities or partners in co-operation, the media and nuclear and radiation safety authorities from Russia, Sweden and Hungary. Initiation of activities, inter-authority co-operation, assessment of accident situation and dissemination of information to the public and the media were tested as well as the emergency plans, operation and management arrangements of the Itä-Uusimaa rescue services area. STUK’s emergency operations were fully activated in the exercise. Over 70 persons from STUK participated.

The annual Olkiluoto power plant emergency exercise was on 18 December. It was a tabletop exercise with the participating organisations working at the same premises. Thus they had the opportunity to follow the activities of others when the exercise progressed. The participants were the emergency response organisation of the power plant and, in part, those of STUK and the rescue services. Tested in the exercise were the assessment and maintenance of an accident situation as well as co-operation between participating organisations, among others. At the same time, the participants gained a general view of the tasks and responsibilities of other emergency response organisations during an emergency response situation.

Fire drills are arranged annually at both power plants with fire brigades from the plants and the rescue services of the surrounding municipalities participating. Loviisa power plant’s fire drill was on 17 May and that of Olkiluoto power plant on 13 November.

STUK participated in international nuclear power plant emergency exercises during the year. Sweden arranged on 4 October 2006 the Falken exercise that was also a RESPEC exercise between the European Commission and STUK. STUK received messages during the exercise, followed the accident status and actively relayed information to the European Commission about the accident’s progress and the migration of radioactive substances, in accordance with the Commission’s RESPEC agreement on emergency preparedness activities.

9 Communication

Risto Isaksson

STUK issued five press releases on nuclear safety regulation in Finland. Two press releases on events at Swedish nuclear power plants were issued as well.

The press releases were sent to the media and partners in co-operation and were made available to read at STUK's web page. The news section of the STUK web pages told about the annual maintenances of Olkiluoto and Loviisa nuclear power plants.

Problems and delays in construction work at the construction site of the nuclear power plant in Olkiluoto made big headlines in the domestic media the whole year. In three press releases STUK reported its own actions i.e. the setting up of an investigation team and the report given by the team. STUK's experts were interviewed about the construction site on an almost weekly basis.

Finnish and some foreign media made several interviews with STUK's experts about problems detected at Swedish nuclear power plants. Forsmark nuclear power plant was stopped in late summer due to malfunctions. The exceptional INES Level 2 event raised much interest also in Finland. It is described in Appendix 4.

In the spring STUK held journalists a third course on the fundamentals of radiation and nuclear safety. The participants visited nuclear power plants in Loviisa and Kola, Russia. Eighteen journalists participated in the course.

10 International co-operation

Timo Eurasto, Juhani Hyvärinen, Marja-Leena Järvinen, Kaisa Koskinen, Pentti Koutaniemi, Elina Martikka, Ronnie Olander, Lasse Reiman, Heikki Reponen, Esko Ruokola, Pauli Suvanto, Petteri Tiippana, Jaakko Tikkinen, Kirsti Tossavainen, Keijo Valtonen, Olli Vilkamo, Reino Virolainen

10.1 International conventions

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

A review meeting in accordance with The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was held in Vienna on 15 to 24 May 2006. At the meeting, 40 countries and the Commission of the European Union reported their nuclear waste management arrangements. The participants assessed one another as regards the fulfilment of the Convention's obligations and the improvements made since the 2003 meeting.

STUK sent five participants, one of which acted as chairman to an assessment team. The nuclear waste management arrangements in Finland were considered good. The spent nuclear fuel repository project in particular was considered successful. The project is exemplary by way of its unambiguous regulations, wide acceptance locally and politically as well as its financing arrangements.

The need for certain improvements relating to the maintenance of radioactive waste originating mostly from sources other than nuclear power plants was brought forth in the assessment pertaining to Finland. It was also considered important that Finland pays attention to the maintenance and development of know-how in the long term.

In consequence of the recommendations STUK set up an internal work group to specify STUK's duties and internal job sharing in matters relating to radioactive waste and to make plans for the collection, intermediate storage and disposal of radioactive small-scale waste in Finland in the long run. Know-how is developed by recruiting new experts and intensifying training and co-operation.

10.2 Co-operation in international organisations and bilateral co-operation

Co-operation with the IAEA

The IAEA continued revision of its nuclear safety guidelines (formerly Nuclear Safety Series NUSS). STUK prepared for the IAEA statements on draft guidelines requested from Finland. Representatives of STUK contributed to the preparation of the draft guidelines in working groups. A representative of STUK continued as chairman of the NUSSC (nuclear safety) committee. In addition, STUK's representatives were active in the WASSC (waste safety), TRANSSC (transport safety) and RASSC (radiation safety) committees.

As a result of the work of the committees, the IAEA published in November a new safety standard, Fundamental Safety Principles, which combines the previously separate Safety Fundamentals publications on the safety of nuclear facilities and of radioactive waste handling, as well as on radiation protection and radiation sources. The ten nuclear and radiation safety basic principles listed in the new standard have a safety philosophy common to all IAEA safety standards.

STUK was Finland's liaison organisation for the below information exchange systems that are 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)
- Discharges of Radionuclides to the Atmospheric and Aquatic Environment (DIRATA).

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

STUK co-ordinates and implements the Finnish Support Programme to IAEA Safeguards (FINSP) financed by the Ministry for Foreign Affairs. The programme's main objectives are to develop verification methods and to train IAEA inspectors. FINSP continued co-operation in an international project to develop for the IAEA a new type of fuel measurement device. The IAEA's safeguards inspectors were given a course on complementary access visits in accordance with the Additional Protocol in Finland. Based on an order from FINSP, VTT Technical Research Centre of Finland has been developing for the IAEA a method for producing quality control materials for environmental sampling. FINSP has also supported development of the IAEA's nuclear material safeguards for repository sites. The programme's implementation was followed in meetings of the national steering group and in joint meetings of FINSP and the IAEA's representatives.

International nuclear materials safeguards for repositories are being developed by ASTOR (Application of Safeguards to Repositories), which operates within the framework of the IAEA's support programmes and reports to SAGSI, which assists IAEA's management. STUK has taken an active part in the operation of ASTOR which establishes the framework for future safeguards measures. The founding meeting of ASTOR was in Vienna in April and the first technical meeting in October.

Co-operation with the OECD/NEA

STUK was represented in all of the OECD'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 in the work of the below CNRA Working Groups

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

CNRA's TGRE assembled in Washington in March. It is not a working group proper anymore but has assembled regularly to discuss the use of safety indicators in the evaluation of regulatory effectiveness in the various member states. Agreed upon were the evaluation of direct indicators and collection of data on their use on the CNRA server.

STUK took part in the work of CSNI and its working groups.

The fields of activity of the working groups were as follows

- 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).

Each working group holds at least one general meeting annually as well as the necessary topical meetings in which STUK's representatives participated during 2006.

STUK contributed to the work of the Information System on Occupational Exposure (ISOE) of the CRPPH and of the Integration Group for the Safety Case (IGSC) of RWMC.

Co-operation with the EU

Upon the request of the Ministry of Trade and Industry, STUK participated in the work of the Working Party on Nuclear Safety (WPNS). Its task is to formulate a comment to the Working Party on Atomic Questions and, further, to the Council of the European Union. This was a follow-up task called for by the Council when it aborted the handling of the nuclear safety package proposed by the European Commission. STUK participated in the work of two of the three WPNS subgroups (Subgroup 1 "Safety of Nuclear Installations" and Subgroup 2 "Safety of the Management of Spent Fuel and Radioactive Waste"). The WPNS' work was accomplished. The chairman of the third subgroup (Subgroup 3 "Financing of the decommissioning and dismantling of nuclear installations and financing the spent fuel and radioactive waste") was from the Ministry of Trade and Industry. Reports were completed in December according to schedule.

Despite the Commission's initiative, no new working groups were set up in place of the Nuclear Regulators Working Group (NRWG) and the Concertation on European Regulatory Tasks (CONCERT), which were dismantled in 2005. Regulatory working groups based on the work done within the WPNS will probably be set up in 2007 under the Council of the European Union.

STUK contributed to the work of the advisory Expert Group A31 of the European Commission. It's main tasks pertain to radiation protection regulations.

An expert from STUK participated in the work of the Commission's permanent working group on the transport on radioactive materials.

The renewal of Euratom Safeguards began six years ago with the objective of renewing the Commission's safeguards measures such that the effects on the Euratom safeguards of the EU's enlargement and of developments that have taken place in the nuclear field, technological developments considered, are taken into account. A secondary objective was to adjust the Commission's nuclear material safeguards such as to make them better serve the IAEA's strengthened safeguards. In 2005 the Commission presented the Member States with new safeguards models. During Finland's EU chairmanship, in conjunction with the Atomic Questions Group (AQG) of the Council of the European Union, a meeting of safeguards experts was arranged in STUK on 15 October. At the meeting, the Commission presented the document "Implementing Euratom Treaty Safeguards", which was given the finishing touches at a meeting in Luxembourg on 28 November. The document describing the Commission's reorganised nuclear material safeguards is very important not only for the Member States but also for the IAEA safeguards. In the same connection the IAEA and the Commission began discussions on the restarting of High Level Liaison Committee (HLLC) meetings after a 5-year break. In addition to the Commission and the IAEA, Member States would be participating in the HLLC.

STUK participated in the EU-financed Phare and Tacis co-operation in support of East European regulatory organisations and their support organisations. The co-operation covered participation in the activities of the Regulatory Assistance Management Group (RAMG) and in several individual projects the beneficiaries of which were Armenia, Bulgaria, Kazakhstan, Lithuania, Ukraine, Belarus and Russia. The European Commission was the beneficiary in a couple of projects.

The year 2006 is the last TACIS programme year but the projects in the programme will be implemented according to plan, i.e. the last projects will be implemented as late as in 2010. After the TACIS programme, in 2000–2013, nuclear financing will be distributed using a new instrument (Instrument of Nuclear Safety Co-operation (INSC) based on the Euratom Treaty.

NKS co-operation

The 4-year research programme of NKS, Nordic co-operation in nuclear safety, commenced in 2002. The programme comprises two project entities: reactor safety research as well as emergency preparedness and environmental safety research. The projects are headed by programme managers. STUK's experts participated in projects of the emergency preparedness and environmental safety research programme. STUK played an active role in the work of the NKS steering committee.

The project entity on reactor safety contains projects relating to Finland's publicly financed SAFIR research programme. The emergency preparedness and environmental safety programme includes focus areas important to Finland such as development of information management and communication during emergencies. The programme was evaluated and a seminar was held encompassing the 2002–2005 programme period. The steering committee started a renewal of the framework programme.

The programme's content serves well co-operation between the Nordic authorities, which is a permanent objective of NKS co-operation.

Bilateral co-operation

STUK's representative was a member of the Reactor Safety Committee that assists the Swedish Nuclear Power Inspectorate (SKI). Co-operation with SKI continued with regular meetings during which current questions of nuclear safety regulation, emergency preparedness, waste management and nuclear material safeguards were discussed.

Two experts from the Hungarian Atomic Energy Authority (HAEA) worked for two months at STUK through the IAEA's Fellowship Visitor programme. They evaluated the regulations and ways of action in use at STUK and HAEA as regards operation, quality management, operational experience feedback and training in particular.

STUK's Director General was chairman of a nuclear safety committee that supports the organisation conducting regulatory activities in Belgium and participated as a permanent member in the work of a corresponding advisory committee supporting the Lithuanian nuclear regulatory authority.

An agreement with The United States Nuclear Regulatory Commission (USNRC) about the exchange of technical information and co-operation was renewed in September. It is for five years at a time and is about the exchange of information on matters pertaining to regulation of, and requirements for, nuclear facilities.

A mutual agreement on information exchange and co-operation as regards the safety of nuclear facilities and the final disposal of radioactive waste was signed with the Korean Institute of Nuclear Safety of the Republic of Korea (KINS) in September.

STUK's representative was a member in the French Groupe permanent d'experts charge Réacteurs (GPR) and participated in meetings dealing with the EPR plant that is due for construction in Flamanville. He also participated in the joint meeting of the advisory committees on nuclear safety of major nuclear power states in Washington. The joint meeting was attended by France's GPR, Germany's RSK, the US's ACRS and Japan's NSC as well as the separately invited Sweden, Switzerland and Finland.

STUK collaborated with the French authority as regards regulatory control of the design, manufacturing and construction of the new plant project. At meetings, information was exchanged about design solutions, construction status, construction oversight, experiences gained on the manufacturing of main components, accident analyses and aircraft impact analyses.

Safeguards co-operation between STUK and the Australian Safeguards and Non-proliferation Office (ASNO) continued. In accordance with the agreed practice, STUK provided ASNO with information on nuclear materials of Australian origin imported to Finland.

Under financing from the Ministry of Foreign Affairs, STUK is engaged in bilateral co-operation with nuclear power plants in Russia's neighbouring areas and with the Russian regulatory safety authority. The prevention of nuclear accidents is enhanced by expert services and component deliveries. Mitigation of local environmental risks and terror threats encompass the support given to nuclear waste management projects and projects to prevent illicit shipments of radioactive substances.

The support given to the development of radiation monitoring systems in the vicinity of nuclear power plants and to the development of accident response readiness ensures reliable information on potential disturbances or accidents. STUK co-ordinates the co-operation, carries out some of the expert work itself and commissions the rest to operators in the field.

The co-operation themes in 2006 were training of the power plant's operating and maintenance personnel, component acquisitions to ascertain the integrity of pressure-bearing components plus user training, corrosion protection projects, fire safety improvements and training, access control systems renewals and co-operation in safety analysis. In addition, STUK compiled a progress report on safety developments at, and the present condition of, the two oldest units of Leningrad power plant for publication as one entity.

When collaborating with other authorities, STUK regularly read semi-annual reports from the resident inspectors of Rostechnadzor at the Kola and Leningrad nuclear power plants. They contain descriptions of safety significant events and safety improvement projects at the plants. A seminar on the experiences gained from the PSA analyses of VVER reactors was held at STUK.

The data transmission and direct alarm connections of external radiation monitoring networks in the environment of Leningrad and Kola nuclear power plants were maintained through co-operation in the fields of accident preparedness and radiation safety. STUK's representatives attended the commissioning of the new premises of a local emergency preparedness centre in St Petersburg. STUK's representative was an observer at the Russian annual national emergency exercise at Novovoronesh nuclear power plant.

In the field of co-operation in nuclear waste management, safety assessment of the commissioning of nuclear facilities and the cementation of liquid wastes was addressed at a joint seminar between STUK and the Russian nuclear safety authority. STUK contributes actively to the work of the Contact Expert Group for international radioactive waste projects in Russia (CEG). CEG coordinates assistance in nuclear waste matters from the West to Russia. A CEG seminar on radioactive waste disposal was held in Olkiluoto in June and STUK contributed to the arrangements.

Regulations were further developed within the framework of the bilateral nuclear non-proliferation support programme between Finland and Russia. The manufacturing of a spent fuel attribute tester (SFAT) for use by Kola nuclear power plant was completed at STUK and its functioning was tested at Loviisa power plant. Based on the teachings of the St Petersburg Customs Academy, a renewed course on customs matters was arranged in February. STUK participated in international co-operation meetings to ascertain awareness of the "Illicit-Trafficking" situation.

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 was set up to develop a method of drawing up uniform nuclear safety requirements. In accordance with the recommendations of the working group's final report, an extensive nuclear safety requirements and nuclear waste management development project was commenced in early 2003.

Nuclear safety requirements for 17 safety areas were formulated in the project. The status of requirements in the 18 participating countries was analysed. The results were introduced to the representatives of industry, utilities and other interested organisations in a seminar in Brussels early in the year. After the seminar, comments on the reference requirements were requested from European and national organisations. STUK requested the licensees' opinions on the requirements and also their assessments of their fulfilment at the Finnish nuclear facilities. The WENRA working group continued work on the development of the requirements during the second half of the year. Towards the end of the year the requirements were being given the finishing touches by the regulatory heads of the WENRA countries.

STUK was active in WENRA's decommissioning and nuclear waste working group, which put out draft reference requirements for the decommissioning of nuclear facilities and the storage of nuclear waste. The implementation status of the requirements will be evaluated in 2007.

The working group on safety-critical software that operated under the NRWG, which was abolished by the Commission of the European Union, continued its work at WENRA's request and put the finishing touches to the document "Licensing of safety critical software for nuclear reactors. Common position of European nuclear regulators and safety authorities". The document was completed in early 2007. The working group comprises representatives from Belgium, Spain, France, Sweden, Germany, Finland and the United Kingdom.

STUK participated in the Multinational Design Evaluation Programme (MDEP), an international project to develop a model for the multinational safety assessment of new nuclear power plants. The US nuclear safety authority, the NRC, started the project that encompasses two simultaneous phases. Phase 1 concerns the safety assessment of EPR type nuclear power plants, the participants being France, Finland and the USA. In practice Phase 1 is continuation to bilateral co-operation between France and Finland's nuclear safety authorities, now joined by the USA. Ten countries contribute to Phase 2. In addition to those mentioned above: Canada, China, Japan, Korea, Russia, South Africa and Great Britain. The secretariat of Phase 2 is the OECD's NEA, the IAEA participating as well. Regulatory practices and requirements relating to the approval of nuclear power plants are due for assessment during Phase 2: safety objectives, grounds for approval and inspection routines will be first on the list. Severe accidents, requirements for emergency cooling systems design, programmable automation and mechanical components were chosen as the areas to be focused on first. The target in the fourth area is to define objectives by which authorities in different countries can co-operate in assessing the manufacturing of new components.

The working group on risk analysis set up by the VVER Regulators Forum in Finland in 2005 is a continuation of the working group on risk that was set up in 2002 and completed its work in 2005. The Forum gave the new working group the task to continue comparison calculations for new accident initiating events and to identify the causes of differences in risk analyses. The new project spans three years. The group held its first meeting in Finland in 2006 and decided to compare initiating events used in the Probabilistic Safety Analysis (PSA) of VVER plants, specifically: loss of the service water system, loss of the feed water system, breaking of steam generator tubing as well as risk analysis methods for fires and low power levels. A decision was made to compare different countries' risk assessment requirements as well as legislation and regulations. A decision was also made to compare the member countries' PSA applications as well as the ability and availability of support organisations operating in the member countries to draw up a PSA and its applications. At a meeting in Vienna in December, risk analyses for the loss of sea water systems at VVER plants were reviewed and further analyses to be made in 2007 were decided upon. STUK hosted a summer meeting of the I&C working group of the VVER Forum in Helsinki, taking an active role in the preparation of the group's report. The work is anticipated to continue for some more years. The report deals with the member countries' experiences in the licensing of digital I&C. The section of the report, which was assigned to STUK, is almost completed.

STUK participated in the work of the Network of Regulators of Small Nuclear Programs (NERS). It is a channel via which information about the ways of action and experiences of colleagues working on similar-sized nuclear energy programmes can be exchanged. Nuclear safety authorities from countries outside Europe, Argentina, South Africa and Pakistan participate in the co-operation. Four topics were discussed during the year, namely ageing management at nuclear power plants, plant life management as well as oversight of radioactive sources, wastes and radioactive materials transport. The Pakistani authority maintains a site (www.ners.info) containing information about nuclear power plant safety in the countries participating in the co-operation.

As regards physical protection in the nuclear field, STUK has participated in the work of the European Nuclear Security Regulators Association (ENSRA) and in that of the Fysiskt skydd i Nordisk kärnteknisk verksamhet (NORDFYS).

STUK is a member of the Nordic working group on transport (NORTRAM), which did not meet this year.

11 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. The Committee is appointed by the Government and it functions in conjunction with STUK. Its term of office is three years. The Committee was appointed on 10 September 2003 and its term of office ended on 9 September 2006. A new Committee was appointed on 1 October 2006 for the next 3-year period.

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). The members were Professor Riitta Kyrki-Rajamäki (Lappeenranta Technical University), Director Ulla Koivusaari (Pirkanmaa Regional Environment Centre), Development Director Timo Okkonen (INSPECTA OY), Senior Researcher Ilona Lindholm (VTT) and Branch Manager Runar Blomqvist (the Geological Survey of Finland). Professor Jukka Laaksonen, the Director General of STUK, was a permanent expert to the Committee. An invited expert was Dr. Sc. (Tech.) Antti Vuorinen. In the autumn Professor Lautala left the Committee and the Government appointed Riitta Kyrki-Rajamäki as the new Chairman. Antti Vuorinen was appointed full member of the new Committee.

The Committee convened six times. It prepared statements to STUK on seven YVL guides under revision. The preparation of a statement on one more draft guide was started. The Committee heard a STUK representative about the plans for a new SAFIR research programme, followed regularly the progress of the construction of the Olkiluoto 3 plant unit and operating events at the operating nuclear facilities, and participated, together with the Advisory Committee on Nuclear Energy, in the organising of an annual nuclear energy seminar. It convened once at the Olkiluoto nuclear power plant, specifically acquainting itself with the Olkiluoto 3 plant unit under construction and hearing the management of Teollisuuden Voima Oy about problems detected during construction (concreting problems).

The Committee took a step forward in international co-operation: its representatives met with members of the French National Public Debate Commission (CNDP) during the year and were invited to participate in the meeting in the USA of a body of co-operation established by the major nuclear power states (the USA, France, Germany, Japan).