Radiation and Nuclear
Safety Authority (STUK)

April 2002

Answers to the written questions on the second Finnish National Report on Nuclear Safety Convention

The Finnish report on nuclear safety - Finnish 2nd national report as referred to in article 5 of the convention on nuclear safety

has been published as report STUK-B-YTO 210, October 2001. The report is available from STUK and also at the STUK's Internet site http://www.stuk.fi/ .

The markings used in the report are the following:

Art. is the article number of the Convention referred to

Ref. page is the number of page of the original report referred to

Question/comment is the the question or comment presented to the report.

Finland has received questions and comments from the following countries: Argentina, Austria, Belgium, Croatia, Czech Republic, Germany, Japan, Korea, Romania, Russia, Slovakia, Slovenia, Sweden, USA

The order of presentation follows the order of the articles of the Convention referred to in the questions and the Finnish report.

Art: Gen.
Ref. page: -
Question/comment: The report describes clearly the measures adopted for the safe operation of nuclear installations. Detailed information regarding development of the safety of Loviisa and Olkiluoto nuclear installations is emphasised.

This comment does not include any question. Annexes II and III (Development of the safety of the Loviisa and Olkiluoto NPPs), independently prepared by Finnish licensees, give a very informative and thorough description of the results of the recent years' safety work. The safety review reports by STUK are included in the first national report.

Art: Gen ?
Ref. page -
Question/comment: What is the current status of the approval process for NPP Unit 5 in Finland?

The Government has made the decision on building the new unit on 17.1.2002. According to the Finnish nuclear energy act this decision in principle has to be dealt with the Parliament. The Parliament may reverse the decision in principle as such or may decide that it remains in force as such. It is foreseen, that the Parliament will vote on the decision in late May 2002.

Art: Gen.
(An II)
Ref. page: 38
Question/comment: According to the report, there is information exchange system between similar plants to implement OEFB system.
1) What is the procedure to feedback the operating experience of other NPPs' to yours?
2) Do you have a legal basis to enforce the licensee to feedback items that need considerable time and expenditure?

TVO´s operating experience system is part of the Nordic System for Evaluation and Information on Operating Experience in Nuclear Power Plants ("Nordic OE system") that serves all eleven Nordic BWR's designed and delivered by Westinghouse Atom. The "Nordic OE system" is the combination of the ERFATOM process and the local "in-house" processes at the utilities. The nuclear power plants participating in the system are today Barsebäck 2, Forsmark 1, 2 and 3, Oskarshamn 1, 2 and 3, and Ringhals 1 (three of Ringhals four reactors are Westinghouse PWR) from Sweden and Olkiluoto 1 and 2 from Finland.

The main sources of operating experience information are ERFATOM, KSU, WANO and Forsmark. These sources are explained in more detail below. Information is also gained directly from several other sources (IAEA and OECD/NEA (IRS), Loviisa NPP (e.g. operating experience meetings and reports), vendors (Westinghouse Atom, Alstom Power Sweden AB), component manufacturers, WANO Network, BWROG (BWR Owners Group)).

ERFATOM activities were started on January 1st, 1994 in the premises of Westinghouse Atom (former ABB Atom) in Västerås (Sweden). Nowadays ERFATOM that is part of the NOG (Nordic Owners Group) co-operation issues reports every two weeks and topical reports when needed. ERFATOM gives recommendations. ERFATOM co-operates very closely with KSU (Swedish nuclear training and safety center). KSU concentrates on operational safety issues and has the responsibility to screen out external (international) operating events. ERFATOM screens out internal events from Swedish nuclear power plants and Olkiluoto units.

TVO is a utility member of WANO-PC (World Association of Nuclear Operators, Paris Centre). Although KSU screens out important events reported through WANO Network, TVO reviews independently all the SOERs (Significant Operating Experience Reports) and SERs (Significant Event Reports) reported by WANO.

Forsmark 1 and 2 in Sweden can be called as ”sister units” of Olkiluoto 1 and 2. Reports from Forsmark 1 and 2 (e.g. licensee event reports) and minutes of the meetings of the local safety committee are reviewed regularly in TVO.

As described in the country report a dedicated operating experience feedback group at the Loviisa plant studies operating experience of other NPPs and gives recommendations to the plant. These recommendations are then handled by the plant’s QAS meeting and their implementation is supervised as part of the normal follow-up system. Loviisa Power Plant is a member of WANO-MC and operating experience information from WANO network and IRS are readily available.

According to the Government decision 395/1991, concerning nuclear safety, operational experience from nuclear power plants as well as the results of safety research shall be systematically followed and assessed. Those actions shall be implemented which can be regarded as justified on considering operational experience and the results of safety research as well as the advancement of science and technology.

Art: Gen. (An IV)
Ref. page: 49-52
Question/comment: How is monitored and assessed the level of the plant safety culture? Could you give practical examples?

The most important activity aimed to the assessment of the safety culture at nuclear power plant is the inspection of safety management, carried out every second year at each plant. The inspection is the one most general inspection of the periodic inspection programme, and the discoveries from all other inspections are analysed on the basis of this inspection, as well as all perceptions related to the management, culture and procedures of the plant and collected from processing of plant documents. On the basis of these data the inspectors formulate the issues and concerns, which are discussed trough with the plant managers during the safety management inspection. Thus, the aim of the inspection is not solely to assess the level of the plant safety culture, but also to identify the issues and questions, which must be solved and which help to strengthen the safety culture.

Art: intro
Ref. page: 5
Question/comment: Which are the main safety aspects to consider during the Licensing process of the fifth reactor unit?

The main safety requirements are stipulated by the Nuclear Energy Act and Decree. The Act requires (Section 6), that "the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property." Further (Section 8), it is required that "Sufficient physical protection and emergency planning as well as other arrangements for limiting nuclear damage and for protecting nuclear energy against illegal activities shall be a prerequisite for the use of nuclear energy." The fundamental technical safety requirements are presented in General Regulations issued by the Government and detailed safety requirements in the Regulatory Guides issued by the Regulatory Body (STUK).

As specific safety issues recognized and discussed have been considered the following ones:

- expected lifetime of the plant reaching 60 years
- passive safety features versus active systems
- severe accident strategies
- use of digital technology in safety systems
- competence of the applicant and coming operator
- use of industrial standard mechanical components in safety relevant systems
- external hazards like air plane crashes, gas clouds, fires etc.

Art: intro
Ref. page: 5
Question/comment: Which are the major considerations taken into account in the Decision in Principle?

The Nuclear Energy Act (Section 14) stipulates, that the Decision in Principle can only be made if the Government

- has ascertained that the municipality where the nuclear facility is planned to be located is in favour of the facility, and
- no factors indicating a lack of sufficient prerequisites for constructing a nuclear facility to be safe have arisen.

Furthermore, the Government shall, in reaching its decision in principle, consider the issue from the perspective of the overall good of society, and shall take into account the benefits and drawbacks arising from the nuclear facility, paying particular attention to

- the need for the nuclear facility project with respect to the country's energy supply
- the suitability of the intended site of the nuclear facility and its effects on the environment
- arrangement for the nuclear fuel and waste management.

In the justifications of the Decision it is further mentioned, i.a., that the new plant would be beneficial to meeting the internationally agreed requirements for cutting down the emissions of greenhouse gases, and it should do this in a way economical to Finland.

Art: intro
Ref. page: 5
Question/comment: It is reported that Teollisuuden Voima Oy applied at the end of 2000 for a Decision in Principle for a fifth reactor unit in Finland and the licensing process is going on.
1) What is the long-term plan for nuclear power plants in Finland?
2) Do you have any further plan to promote construction of nuclear power stations in the future if necessary?

Finland does not have a specific nuclear programme and is not promoting the use of nuclear energy as such. Nuclear energy is considered as one option among the others to produce electricity. The operating licenses of existing units were renewed in 1998 and are valid till 2008 (Loviisa units 1 and 2) and 2018 (Olkiluoto units 1 and 2). There is no legal obstacle to extend the licences even beyond these dates. If a new plant would be build, its design lifetime would probably be 60 years.

The Government's report on energy policy was approved by Parliament in autumn 1997. The report specifies Finland's energy strategy (available in English), which contains the energy scenarios that were drawn up by the Ministry of Trade and Industry's Energy Department. See also the ministerial website at http://www.vn.fi/ktm/eng/ .

Art: 6
Ref. page: -
Question/comment: The existing reactors in Loviisa NPP are VVER type (USSR-Russian design). The Report does not make the extent of using the initial design information.

- Could you indicate where Finnish practices are applied and, in particular, highlight how they are different from Russian/USSR practices they replace?
- Who provide the safety analysis support services? These institutions have access to Russian developed engineering and analysis tools or they developed their owns?
- What procedures they use to validate, verify and endorse the code, data and computations?
- How do results compare with Russian studies?

When existing VVER-440 reactors in Loviisa were ordered, it was decided that safety standards shall meet western requirements applied in Finland, largely based on American safety requirements at that time. The following major adaptations were incorporated in the existing VVER-440 model 230 design:

- Emergency core cooling system including accumulators and both high and low pressure injection systems to cope with a guillotine break in the largest primary pipe.
- Containment capable of coping with the design basis accident pipe brake.
- Instrumentation and control systems with the exception of the reactor protection system were redesigned. These systems were supplied by Siemens.

The Loviisa NPP was originally licensed using Soviet safety analyses and comparison analyses were carried out in Finland using RELAP4 code. In years 1987-88 all the safety analyses were recalculated using RELAP5MOD3, Finnish reactor dynamics code HEXTRAN and German ATHLET code for LOCAs. Ten years later, in connection with the power upgrading and operating license renewal all the safety analyses were again recalculated using this time APROS code and HEXTRAN code in Finland. APROS code has been developed in cooperation of Fortum and VTT in Finland.

The international status of validation of the Soviet codes DYNAMIKA and TETCH was not very wide but they were believed to bring in conservative results. At that time RELAP4 and later RELAP5 were internationally widely validated codes. APROS code has been validated extensively (more than 70 cases) by modeling different test facilities and comparing calculations to a large set of selected transients. The thermal hydraulic models have been validated against a set of the separate effect tests and integral test facility transients. The thermal hydraulic and reactor models together with the automation system have been thoroughly tested by comparing calculation results with the real plant data.

The original Soviet safety analyses have proved to be conservative. For example the calculated maximum cladding temperature during reflood phase of the LBLOCA was in Soviet analyses about 1130 °C, in ATHLET analysis about 920 °C and in latest APROS analysis about 700 °C. Of course, the codes have developed, models are much more detailed, system improvements have been implemented at Loviisa NPP since startup and there is less conservatism in the assumptions made in the analyses.

Only one major incorrectness in the original Soviet design information has been discovered. It is the embrittlement rate of the pressure vessel, which was underestimated in the initial design information. Also the loads on pressure vessel wall, the possible pressurized thermal shocks (PTS), were underestimated. When the situation was discovered in 1979, several measures were taken to reduce the embrittlement rate, to soften the potential PTS-transients and to decrease the frequency of the potential PTS-transients. This resulted in modifications in plant systems in 1980s and finally in the annealing of the pressure vessel core region weld in 1996, at Loviisa unit 1.

Art: 6 ?
Ref. page: 7
Question/comment: Concerning the approach of continuous improvement of safety, the report refers to annex II and III where examples are given. Could Finland precise the concrete and practical initiatives and actions that are taken by STUK itself?

The licensee is responsible for the safety, not the regulator. Therefore, the principle of continuous improvement of safety, as stipulated by the Governmental Decision 395/1991, concerns especially the licensees. Given an atmosphere of well developed safety culture the role of the regulator in the safety work should be more a role of a catalyzer than activator. "Hall of fame" does not belong to the Finnish safety approach.

STUK supports the principle of continuous improvement by 1) financing and coordinating national safety research, 2) participating in international safety research activities, 3) following national and international operating experience, 3) contributing in international co-operation projects and rulemaking activities. The new information gained is then taken into account when systematically revising the national safety regulations.

As practical examples of major areas, where STUK has had a very active role in 1990', two items could be mentioned. They are 1) developing PSA models and analyses and, 2) elaborating severe accident policies.

Art: 6 ?
Ref. page: 43
Question/comment: Annex III, item 2, section "Implementation" states that the capacity factors of "Olkiluoto" NPP units have been satisfactory (well above 90%). According to IAEA data, capacity factor of these units in 2000 was 95%. In view of relatively short time available for maintenance work, please advise us what major principles of performing maintenance work on NPP equipment are applied in Finland?

<u>Olkiluoto plant:</u>

The Olkiluoto BWR units are equipped with fourfold safety systems. Some preventive maintenance in safety systems can be done during operation. However, most of the maintenance is done during annual outages.

An objective is to avoid unexpected repairs with a proper spare parts policy and detailed risk studies. All critical items to be inspected are analysed in advance, to determine acceptable defect levels and to plan provisional repair methods for continued operation.

There is a number of complete component replacement units, such as generator rotors, control rod drives, turbine blades, servomotors, various pumps and valves, emergency diesel engine etc.. During the outage, components are replaced and they are serviced after the outage in workshop conditions.

Planning of outages is done on three levels at the same time: long-term planning (about ten years), mid-term planning (three years) and detailed planning of the next outage, where special emphasis is put on the careful study of the critical path activities. Planning is assisted by a modern computer-based system.

To optimise outage costs and production losses, outages are divided into two types: refuelling and service. These follow each other in sequence. The typical lengths of refuelling outages and service outages are from eight to ten days and from two to three weeks, respectively.

There are dedicated Technical Specifications for outage period. Outage PSAs (Probabilistic Safety Analyses) are made to analyse critical works during outages. Outage plans and all safety-related outage activities must be approved by STUK. During outages up to 10 inspectors are working at the plant, and they are available 24 hours per day if necessary.

The availability of the professional staff is assured by long-term agreements with plant vendors and other affiliated companies. About 1000 outside workers from about 100 different companies participate in annual outages. Over 70 percent of the personnel have experience of previous outages.

Special attention is paid on the feedback got out from outages. Human errors are followed and analysed carefully.

Some main keys to short outages at the Olkiluoto plant can be summarized as follows: an advanced BWR plant design, an investment policy to keep the plant technically in modern condition and a continuous improvement management policy, motivated and experienced personnel, low radiation levels and good cooperation and "partnership relations" with plant vendors and other affiliated companies.

Loviisa plant:

Scheduled maintenance and inservice inspections and tests are made during annual refuelling and maintenance outages in intervals of 1, 2, 4, and 8 years depending on the requirements given in the Technical Specifications, pressure vessel codes and predictive maintenance programmes. The basic principle in Loviisa Power Plant is that every second year only those periodical and time consuming works are performed, which shall be made every year. This means that every second year the annual outage can be shorter, as also modifications are mainly scheduled to major annual outages.

Art: 7
Ref. page: 9
Question/comment: How the new law provide the citizens with a better access to regulatory documents in the preparation phase? And how they are informed about matters under preparation?

The leading principle of the Finnish Publicity Act (revised late 1999) is that the official documents prepared by or sent to the authorities are public, if not otherwise stipulated by law. Other changes are i.a. 1) the publicity of documents prepared during the decision making (or e.g. rulemaking) process is wider than earlier, 2) the authority has to make available to the citizens information on the matters (e.g. regulations, laws) being prepared, 3) the authorities have to actively provide information to the citizens and also assist them to find the information they are demanding. The new Act is available in English translation at the Internet site http://www.om.fi/1184.htm.

In practice, the most used way of disseminating information to the citizens today is the Internet. STUK provides information about its doings (annual plans, reports, rule making, all regulations, event specific information etc.) at its own Internet site http://www.stuk.fi/english/. Also many other governmental servers are doing the same. Written documents can be requested from all authorities and usually they are also available in public libraries.

Art: 7
Ref. page: 9
Question/comment: How is the process of re-evaluation and updating of the regulatory guides?. Which are the major changes about safety produced during last years? Could you please, give some examples?

The major changes in the Finnish nuclear legislation were made in late 1980's, when the Nuclear Energy Act (1987) and Decree (1988) were totally revised. The General Regulations on the safety, emergency preparedness, physical protection and reactor waste disposal were issued in 1991 by the Government. The latest general regulation on final disposal of spent fuel was issued in 1999. After exceeding the age of 10 years all the general regulations issued in 1991 were reviewed in 2001 for need of revising them. The review indicated that there is no hurry for starting the revisions but, however, the experts recognized some need for uppdating and refining these documents. The schedule of the work for revising them has not been made up yet.
The regulatory guides are being re-evaluated first time after 5 years from the original issuance and after that every 2 years. At the age of 10 years the revision is started automatically. This means that there are always some tens of guides being revised in order to reflect the latest knowledge on the subject.

As examples of some new or revised guides in the regulatory guide system during the last years could be mentioned:
- YVL 1.10, Requirements for siting a NPP (2000, new guide)
- YVL 1.12, INES-classification of events at nuclear facilities (2002, new guide)
- YVL 1.14, Mechanical equipment and structures of nuclear facilities. Control of manufacturing (rev. 1999)
- YVL 1.16, Control of nuclear liability insurance policies (2000, new guide)
- YVL 2.1, NPP systems, structures and components and their safety classification (rev. 2001)
- YVL 2.6, Provision against earthquakes affecting nuclear facilities (rev. 2001)
- YVL 3.5, Ensuring the strength of pressure equipment (2002, new guide)
- YVL 4.2, Steel structures for nuclear facilities (rev. 2001)
- YVL 4.3, Fire protection at nuclear facilities (rev. 1999)
- YVL 6.2, Design bases and general design criteria for nuclear fuel (rev. 1999)
- YVL 6.9, The national system of accounting for and control of nuclear material (rev. 1999)

- YVL 6.10, Reports to be submitted on nuclear materials (rev. 1999)
- YVL 7.4, Nuclear power plant emergency preparedness (rev. 2002)
- YVL 7.9, Radiation protection of NPP workers (rev. 2002)
- YVL 7.10, Monitoring of occupational exposure at NPPs (rev. 2002)
- YVL 8.2, Exemption from regulatory control of nuclear waste (rev. 2002)
- YVL 8.4, Long term safety of disposal of spent nuclear fuel (2002, new guide).

The regulatory guides (most of them also in English) are available at STUK's Internet site at www.stuk.fi.

Art: 7
Ref. page: 9
Question/comment: To what extent was developed the limited self-assessment carried out to evaluate the consistency of requirements that apply to the submitting of document to STUK?

The regulatory guides (at the moment approx. 70 guides) identify the documents (applications, reports etc.) which have to be submitted to STUK in the context of operating and maintaining a NPP. There are two basic ways to submit the documents to the authority: for approval or for information. The self-assessment of these requirements was carried out to review the submittance of operational documents to STUK. After hearing all the experts involved finally no major changes were considered necessary. The results of the assessment will be taken into account when revising next time the regulatory guides in question.

As a target for development to take advantage of the modern information technology, discussions between the regulator and licensees are going on about introducing Extranet applications, which could reduce the need for submitting large written documents (like FSAR) to the regulator.

Art: 7
Ref. page: 9-10
Question/comment: Which are the characteristics and criteria of the Risk Informed Regulation practices under development? How you are planning to implement such approach and training the inspectors in this area?

The guidelines for performing and applying PSA are set forth in the Regulatory Guide YVL 2.8 issued by STUK in 1987 and renewed in 1996 and under renewal in 2002. Living PSA is formally integrated in the regulatory process of NPPs in the early design phase and it is to run through the construction and operation phases. The life cycle model of PSA forms the concept of risk informed regulation and risk informed safety management. In the life cycle model the risk informed regulatory activities and safety management activities are tightly connected. It is essential that the plant staff performs PSA as far as possible in-house in order to become well prepared for using the PSA for decision making purposes.

The essence of the risk informed regulation and safety management in Finland is that the Living PSA works as an interactive communication platform between the licensee and STUK. Accordingly, STUK and the licensees made a special agreement to support this central idea. The agreement states that an identical, reviewed PSA model is used for resolution of safety issues both by the licensees and STUK. For this purpose the licensees are committed to provide STUK with a PSA model in electronic form and to regularly maintain and update it. STUK is committed to make its SPSA code available for the licensees free of charge and to maintain and update it.

It is required in the licensing process of a new NPP unit that the licensee provides STUK with a preliminary plant specific level 2 PSA as a part of application for the construction permit and a complete level 2 PSA as a part of application for the operating license. The prime purpose of a preliminary plant specific level 2 PSA of the design phase is to confirm that the plant´s safety is in compliance with the numerical design objectives set forth in the Regulatory Guide YVL 2.8. In case the design objectives are not met the safety of the plant has to be improved. The following design objectives are set forth in the Regulatory Guide:

- The mean value of the core damage frequency is less than 1E-5/a.
- The mean value of the frequency of a release exceeding the target value defined in section 12 of the Government decision (359/1991) must be smaller than 5E-7/a (this can be interpreted as a large early release frequency).

In addition the licensee has to indicate by means of the design phase PSA that the foundation of the plant design is fit and the used norms are adequate. The aim is also to identify the interconnections and interactions between the safety and support systems as well as common cause failures and potential weak points in the plant design.

Many specific applications of the PSA have already been introduced for operating plant units such:

- Identification of main risk contributors
- Identification of Needs for Plant Changes and Backfitting
- Working up of Personnel Training Program
- Uppgrading of Emergency Operating Procedures
- Analysis of adequacy of present Technical Specifications
- Maintenance Planning
- Exemption from Technical Specifications
- PSA Based Event Analysis (incl. risk follow-up of licensee events and precursor studies)

Development of some important applications is still in progress concerning Risk Informed ISI (pilot complete) and Graded QA (pilot in progress). Further application in progress is development of Risk Informed Technical Specifications.

The risk informed activities have been introduced step by step since the beginning of 1990´s. STUK has been advocating the risk informed approaches developing PSA computer code SPSA, conducting risk informed pilot applications, financing related research and developing respective regulatory guides. STUK is in progress of training more inspectors to understand and use the PSA insights, while planning the inspection programs and conducting regulatory inspections at site. A special PSA Info system is in progress in order to use the insights of PSA for training the inspectors, to upgrade their risk perception and to demonstrate the importance of most significant accident sequences

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Art: 7
Ref. page: 9
Question/comment: It is reported that the new law “Publicity Act” issued in 1999, provides the citizens with a better access to regulatory documents in the preparation phase, and also requires, that the authorities actively inform the citizens on matters under preparation.
1) What kinds of measures are taken to provide the citizens with a better access and information in preparation phase?

2) How do you evaluate the opinions of citizens and how do you make them reflected in regulations?

As regards the first question, please, look at the earlier response to the question about public access to regulatory documents.

All feedback coming directly from the citizens through STUK's Internet site or by other routes is forwarded to the Quality Manager of STUK and to the employee, to whom it concerns. The feedback is also collected to a specific Feedback Register maintained in STUK's internal Intranet -system, which is accessible to all employees. All the written questions of citizens are answered.

What concerns feedback from citizens on rule making, it has been very limited during the recent years. If received, it has been forwarded to the working group of experts being responsible for developing the new guide or other regulatory document. It shall be pointed out, that the rulemaking process as such always includes giving opportunity for presenting opinions on the draft regulations to all those counterparts (e.g. licensees, TSOs, manufacturers) who are affected by the new rule.

Art: 7
Ref. page: -
Question/comment: It is mentioned that since 1999 the procedures of applying new guides to existing nuclear facilities have been focused. Please explain.

According to the application rule, the publication of an YVL guide 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 and to licencees' operational activities. The guides apply as such to new nuclear facilities.

When considering, how new safety requirements presented in YVL guides apply to operating nuclear power plants 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.*

If deviations are made from the requirements of the YVL guides, STUK shall be provided with some other acceptable procedure or solution, by which the safety level set forth in the YVL guides is achieved.

Art: 7
Ref. page: -
Question/comment: What practical conclusions have been drawn by STUK from the reported VTT study of the regulatory guides? What is the most important argument for keeping the comprehensive YVL-guides, taking into consideration the competence of the Finnish licensees and the existence of the IAEA Safety Standards?

The objective of the study was to survey the opinions of the licensee employees, whether or not the Finnish regulatory guide system is considered too detailed and prescriptive and therefore, could have a negative impact on the safety culture and the own initiativeness of the licensees. The main conclusion of the study was, that this is not the case. The Finnish regulatory guide system was considered to give an overall structure to the safety work and all the interviewed persons had a positive view of the guide system. Based on this result, no major changes are necessary in the Finnish rulemaking approach in the near future.

Some critical comments were also presented during the interviews. The practical conclusions on them are: 1) internal training on new or revised guides is necessary to ensure a unified interpretation of the regulatory requirements, 2) the contents of Impact Analysis (document prepared during the rulemaking process) will be developed to include clearer analysis for application of changed requirements, 3) the maintaining of internal consistency between all the 70 guides needs even more attention by the responsible coordinator for rulemaking; a set of definitions and glossary will be developed to ensure a consistent use of terms in all guides, 4) the European harmonisation of others' requirements with the Finnish ones is supported; STUK is taking part in the WENRA activity to develop European reference safety requirements.

Some guides (5 out of 70) were especially mentioned in the interviews being "problematic". They were YVL 1.0, YVL 2.1, YVL 2.2, YVL 6.2, YVL 5.5. All these guides are being revised in near future and the comments presented will be separately assessed during the revision work.

The recent years' very strong development of IAEA safety standards has been noticed also in Finland. We welcome this international effort and are convinced that these safety standards will be of use also in Finland. Already today a basic requirement of STUK quality system to YVL Guide Working Groups is to take into account the relevant Agency safety standards as part of the Working Plan. It is also a practise today, that the IAEA safety standards are often given as references in the Finnish YVL guides, if the reader would be interested in more detailed information. The use of IAEA guides by endorsing them totally or partially is principally also possible.

The wider use of IAEA guides e.g. by replacing national regulations totally with them, is out of the question. There are several reasons for that, 1) the minimum safety level of requirements is not acceptable to us, 2) the IAEA guides are usually too detailed and presciptive, 3) the updating process is out of the hands of one member state, 4) they dont include descriptions of regulatory activities providing transparency. In fact, a major part of the YVL guides provides information on regulatory procedures.

STUK honors the competency of Finnish licensees, but does not consider it to be reason to neglect national rulemaking on safety matters. Furthermore, the YVL guides do not only give design requirements for systems, components and structures but also provide guidance on how to deal with authorities and descriptions, what is expected from the utilities in various circumstances. In addition, the YVL guides also make the Finnish safety requirements and regulatory policies known to the layman as well to the neighbouring countries.

Art: 7, 8
Ref. page: -
Question/comment: It is mentioned in the VTT study of the regulatory guides that STUK has had an outspoken policy to move away from technical details to inspect and review work processes by the licensees. The interviews made in the study seem to indicate an opposite trend. What is the driving force in this development?

The STUK policy is to move away from inspecting technical details to review quality systems, e.g. working processes. The driving force to this development trend is obvious: acknowledging the competence of the licensees, their good safety records, and - limited regulatory resources.

The statement made in the study (Chapter 6.5, Challenges for the future) that "…STUK's regulatory oversight had been moving further into details" is based on some interviewed individuals' comments and does not reflect in any way the main results of the study. It is presumable, that the comment has been made on the (practical) inspection activities of STUK, and does not relate to the actual topic of the study.

Please, look also at the response to the next question.

Art: 7 ?
Ref. page: -
Question/comment: What are the practical provisions for insurance of your nuclear power plants?
Finland is a Contracting Party in Paris and Brussels Nuclear Liability Conventions. The national provisions are manifested in Nuclear Liability Act. At the moment the liability amount of the operator is limited to 175 million SDR (Special Drawing Rights). Based on the conventions given above the total amount of compensation available to the victims of a nuclear accident would be 300 million SDR. Finland has supported the international efforts to further increase the liability amounts of Paris and Brussels Conventions. The governmental decision made earlier this year to build a new nuclear power plant includes a principal statement, that the nuclear liability amount has to be increased. As a result of the favorable negotiations to revise the liability conventions it is foreseen that in near future the total liability amount will be increased.

Art: 7
Ref. page: 9
Question/comment: The report addresses that periodic inspection program for nuclear power plants was renewed during 1998 and inspections in 1999 were conducted according to the new program consisting of 30 inspections altogether.
What kind of regulatory inspections are performed and what are the main issues obtained from the 1999 regulatory inspections?

Regulatory control of NPP operations contains three main areas as follows:

1. Control of operation
2. Topical inspections: state of vital components, plant modification, fuel reloads, control room operators, etc. Topical inspections are done at request by the licensee, as required in YVL guides.
3. Review and assessment of applications, plans, analysis, etc.

The control of operation contains:

- Periodic inspections as specified by STUK in plant specific programmes
- Reactive actions; event specific inspections / investigations
- Safety review and assessment: reassessment of the plants' safety cases. Consideration of operating experience/safety research/development of science and technology. These are included in the annual plans of the STUK
- Resident inspectors day to day work at the site
- Periodic Safety Review, which is made every ten years.

The inspections of the periodic inspection programme are focused on the licensee's activities, which are most important to safety. The goal of the inspection program is to

- verify that the plant is operated and maintained according to regulatory rules, design basis, quality manual and procedures of the licensee
- produce an assessment of the status of the licensee activities to maintain and develop the safety of the plant and also to assess the safety policy of the management and operating experience feedback process.

In general, the goal is to assess the functioning of the licensee quality system. The program also produces information for the development of the regulatory control.

An internal quality guide has been prepared to help and guide the inspectors work. The programme, planning process, conducting of inspection, reporting, and individual inspections are described in that guide. The periodic inspection programme accounts for about 5-6 man-years (10%) of the work load of the Nuclear Safety Regulation department.

The inspection programme contains 15-20 inspections at one site depending on the annual plan. Inspections are divided into three levels as follows:

<u>A Safety management:</u>
Level and development of the management's activities from the safety point of view.
Attention is paid on the following areas of management activities: Quality management (mission, values, vision, short and long time planning processes, commitment of the organization to goals and plans, follow-up of performance and results), Fulfillment of safety regulations, Co-operation with regulatory body, Safety culture issues.

This inspection is performed once in two years.

<u>B Main processes:</u>
Propriety of the safety functions in the main working processes. Special attention is paid on: the methods and procedures used in the main working processes, the interface between different working phases and on the feedback included into the main working processes.

- B1 safety assessment and enhancement
- B2 operations
- B3 maintenance

These inspections are performed annually.

<u>C Specific technical areas and organizational units:</u>
The goal of these inspections is to verify the fulfillment of the set requirements in specific technical areas and organization units.

- C1 safety systems and functions
- C2 electricity and I&C
- C3 mechanical components
- C4 civil engineering and structures
- C5 use of PSA
- C6 information technology
- C7 chemistry
- C8 nuclear waste management
- C9 radiation protection
- C10 fire protection
- C11 emergency preparedness and radiological safety of the environment

- C12 physical protection

These inspections are performed annually.

The annual plan has provision for unannounced inspections. The topics and time of those inspections are not announced to the licensees before the inspections. Annually one or two unannounced inspections are conducted.

Planning process

Annual plan of the periodic inspection programme is presented in form of timetable. Inspection leaders assess the need for inspection and based on that assessment they suggest which inspection should be done and what would be the best month to conduct the inspection. The information of these assessments is gathered up in one table and circulated for comments by the coordinator of the programme. Finally the inspection plan is submitted to the licensee for information.

The planning of an individual inspection is done by the inspection group. The leader of the inspection group has the overall responsibility of the planning of the inspection. The inspection group depends on the topics of the year. In most of the inspections the constant topics has been divided into several years. The annually changing topics depend on the experiences from previous inspections; possible incidents and plant modifications etc. may have effect on the inspection. The inspection group prepares a detailed inspection plan, which is submitted to the licensee for about one week before the inspection.

Conduct of inspections

An inspection starts with a kick-off meeting. In the meeting the inspection topics, timetable and inspection methods are shortly discussed.

After the start up meeting the group may split up to review their own areas. There are usually two inspectors interviewing one person. Situations where there are employee and manager interviewed at the same time, should be avoided. An independent assessment of the status of inspection area is formed based on the material and findings collected before and during the inspection. Both major deficiencies and minor deficiencies especially in a case of repetition are noticed. During the inspection the group may have meetings to discuss about findings and to build up a general view from the area. At the end the results are compared to the set criteria. Findings are written in protocol.

The inspection is finalized with an exit meeting. The findings and general assessment of the status of the inspection area are presented to the licensee and a protocol is prepared.

Documentation and reporting of the inspections

In the protocol the deficiencies and findings are presented. Requirements for corrective actions can be given in protocol if there is need for immediate actions, but normally thay are given in a STUK's decision. In this way the information is circulated more efficiently in STUK and repeating same requirements can be avoided.

Inspection report is prepared on every inspection. In the report the requirements for corrective actions and recommendations are presented with justifications. The development taken place after the previous inspection and issues according the inspection plan are also presented in the report. Also remarks considering regulatory work should be presented in the report.

An annual report is prepared of the periodic inspection activities. The execution of the programme, an assessment of the results of the inspections, the most important findings, the feedback from the licensee and next years programme are presented in the report.

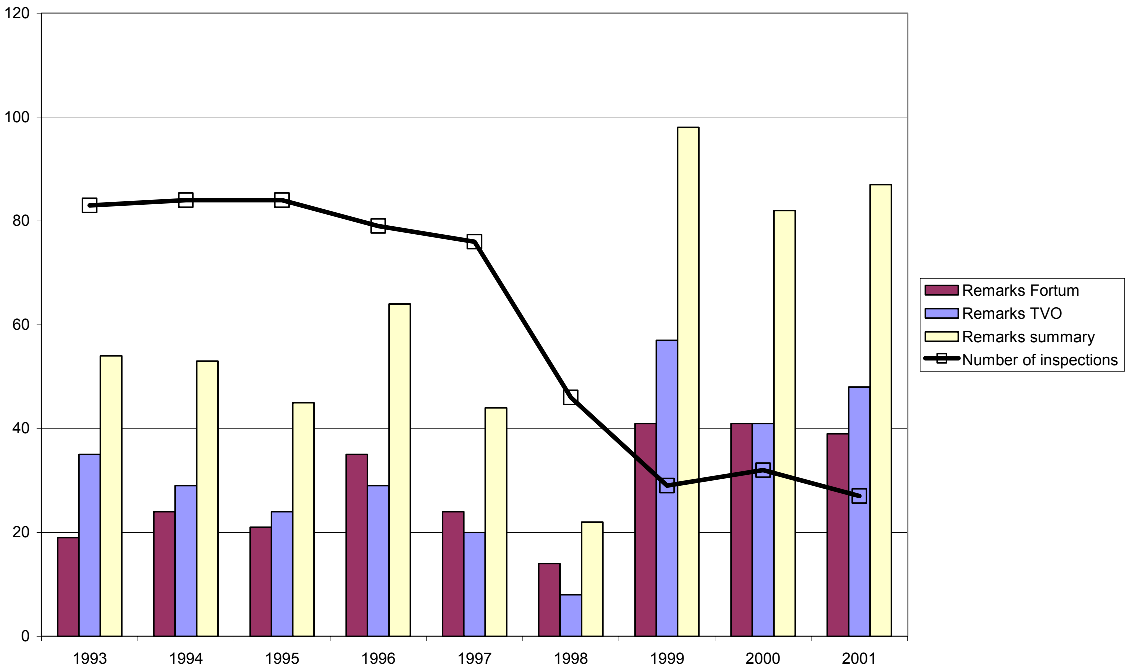
Follow up of the program

The execution and the progress of the programme are followed by the coordinator, who is reporting the department meeting regularly.

Annual seminar of the inspection activities is organized at the beginning of the year. The aim of the seminar is to give feedback to the inspectors of the implementation of the program, discuss about the results and coming year. It also serves as feedback tool from the inspectors to the department management and to the coordinator of the inspection program.

Results of the inspection programme 1999-2001

The following picture shows the total number of inspection performed by STUK and the number of given remarks in 1993-2001. The total number of the inspections was reduced almost to one third during the renewal process of the programme in 1998 by combining inspections and targeting the inspections more to the licensee main working processes. The number of remarks has risen remarkably since 1997. One reason for the rise is that there was a relicensing and power upgrading process during 1996-1998 which took considerably regulatory resources and the STUK was not able to perform all the inspections. But also a new point of view has revealed some issues connected to management and co-operation in the licensee organization, which STUK could not see with old segmented inspection programme. Also the inspectors have been well motivated to do the new inspections, which can be seen in the inspection results.



The number of inspections and given remarks in 1993-2001.

Art: 8
Ref. page: -
Question/comment: What enhancement measures have been proposed by STUK in the internal quality system of VTT to eliminate/reduce potential dependency between regulatory support projects and other utility driven projects carried out at VTT?

From the STUK point of view, the most important requirement is that the organization performing work in support of the regulatory decisions has to make sure that the experts involved have not been directly engaged in the particular utility work being reviewed in the regulatory support projects.

STUK has paid a particular attention to this principle also when performing quality audits at contractors. The results of the audits have been satisfactory, from this perspective also, and STUK will continue to keep this under surveillance. In connection with the audits, it is required that the independence issue related to the experts engaged in STUK orders be directly visible in the quality system; and if not, this has to be corrected.

The independence issue is not a simple "black-and-white" question on the organisational level, at least not in Finland, and it has to be dealt with case-by-case. As mentioned in the Finnish report, STUK considers it most important that its own competence suffices to make independent conclusions from the research results. In addition, independence of experts ("expert diversity") is required whenever this is relevant. In special cases, where the requirement on expert diversity at VTT can not be fully satisfied, alternative way to maintain independence are the use of diverse analysis methods or STUK´s dominant expert role in defining the analysis scenarios, key assumptions and main calculation parameters.

In practical cases, where STUK orders work to support a regulatory decision, it is quite easy to agree on the individual experts that will do the actual work, and also to check that they are independent of the utility generated evidence. The more important the related issue is, the stronger is the attention of STUK to independence when setting up the contract.

VTT, as the main technical support body, highlights its impartial role as part of its corporate mission and integrity. This is part of the VTT quality system, i.e., not just part of the quality system of individual VTT research units. Due to the national scales in nuclear safety related research work, it is not practical to require that in each area of expertise, there has to be two different, competent research organizations. However, if this turned out to be problematic in a specific case, and sufficient independence of experts could not be ensured, also international contacts could be taken.

In this context, it also should be mentioned that the research or review orders made by STUK vary a great deal. Quite much of the nuclear plant related research work has to do with long-term buildup of national expertise in novel areas, without a particular pressure on independence issues as such. On the other hand, if a specific project is ordered to support a regulatory decision, the independence issue is directly relevant.

In the middle of these extremes, there may be examples where new competence and new models are developed to support regulatory evaluation (such as the applicability of the experimental data to be generated for high burnup fuel); and it is required that the modelling work, also, is kept reasonably independent from the utility work. In the very long run, however, it is not possible to require that scientific information or expertise generated with regulatory funded research projects, could only be used for regulatory related work.

In areas such as the safety culture research, just as an example, expertise has been and is being built up in this way, but STUK does not want to imply constraints on applying such results and the related expertise directly on the utility side, quite on contrary. And on the other hand, even though a certain individual had been working, in the past, with utility research projects, he or she could be engaged in a regulatory contract as long as independence of the particular utility case being reviewed were preserved.

Art: 8
Ref. page: -
Question/comment: Does the new financing principle of STUK mean that any regulatory efforts done in addition to what is planned, have to be invoiced separately? If that is the case, could this in any way hamper the decision to make an ad-hoc inspection when needed?

The new financing principle does not mean that additional regulatory work would be invoiced separately. In fact, all the regulatory work in the nuclear field is monthly invoiced from the licensees based on the actual costs. If ad-hoc inspections are carried out, the costs of them are invoiced together with other costs.

Art: 8 ?
Ref. page: 49, An. IV
Question/comment: STUK's quality system aims a frank and balanced relationship with the utilities. How is this concept made practical and what is the perception of the media and the public of it?

STUK's quality system aims a frank and open dialogue between the lisensees and the regulator. This dialogue is done on a professional basis, and technical discussions take place in many organisational levels, including the level of inspectors.

There has been no indications from the media or public that this open dialogue would somehow be questioned. Publicity and openess are key issues in the governmental approach to good administration.

Art: 8
Ref page: 10-11
Question/comment: Article 8 of the report (pages 10-11) states that quality audits of work processes essential to nuclear safety and related research were performed in 2000 at the Technical Research Centre of Finland (VTT), the regulatory body's main technical support organization. In addition, follow up audits were to be conducted at VTT later in 2001. An audit was also to be performed at the Geological Survey of Finland (GTK). Please provide an update on the audit findings. In addition, if VTT or other outside organizations also perform work for the NPP operating organizations, how is a conflict of interest avoided, so that decisions made by the regulatory body based upon such outside technical support remain independent?

Please, look at the question thee ones backwards and the response to it.

Three units of VTT were audited in 2000, VTT Energy, VTT Manufacturing, and VTT Automation. The audits were focused on the Quality System and how to maintain independency in research. In 2001 two additional audits in these units (VTT Energy, VTT Automation) were performed to check the improvements made based on the earlier audits. In the beginning of

2002 the functions of VTT were totally reorganized and at the moment such units as audited do not exist any more.

The units audited were in different phases in their quality work. One had authoritatively planned Quality System in use and two other units were developing their Quality Systems. In all of them procedures in project management need to be strengthened. Internal evaluation of projects, project reviews and use of customer feedback should be motivated among researchers. Additional audits showed clear improvement in their quality work.

Additionally, the main audit findings at GTK were: the Quality Manual of GTK is not yet completed, but it has been scheduled to be complete before the end of 2003. For the research orders no established internal procedure exists. Attention has been paid in practice to the independence of different studies, however, there is no documentation to cover this issue.

Art: 8 ?
Ref. page: -
Question/comment: The report does not address what restraints or sanctions the regulatory body may place upon the operating organizations when the organizations do not implement identified fixes to address safety issues in an agreed upon time period. Please provide an explanation of the sanctions, if any, that the regulatory body may impose on the operating organizations.

The strongest enforcement tools available to the regulatory body (STUK) are given in the Finnish nuclear energy act, chapter 10:

- should a defect or fault cause immediate danger, or should there otherwise be a justified cause to suspect the operation to present an immediate danger, the Radiation and Nuclear Safety Authority (STUK) may, if possible upon consulting the licence-holder, interrupt the operation or limit it until the cause which has led to the issuing of such an order has ceased to exist.
- STUK may reinforce its orders (e.g. in case of need for plant modifications) by a conditionally imposed fine, or a threat to interrupt or limit the operation or to have the neglected obligation fulfilled at the expense of the neglecting party.

These very strong tools have so far not been needed in Finland. All the safety relevant events or possible new safety concerns raised have been analyzed by the licensees and proper decisions e.g. for shutting down a unit have been made by the licensees themselves. A professional and open communication dialog between the licensees and regulatory body together with the atmosphere of well developed safety culture is the basis for this approach.

Art: 8
Ref. page: -
Question/comment: One of the most difficult challenges in assessing the safety performance at a nuclear power plant is to recognize the early signs of declining safety performance, before conditions become so serious that regulatory sanctions must be imposed or, worse, a serious incident or accident occurs. In this connection, it is widely known that a good approach is to have senior resident inspectors who can observe the day-to-day operations of the plant.
(1) What is the role of resident inspectors in the regulatory framework?
(2) What is the size(number) of resident inspectors per reactor or site?
(3) What are the major activities of resident inspectors?
(4) What are the requirements for the qualification of resident inspectors?

The role of the resident inspector in the regulatory framework

The resident inspector

- is a contact person at the plant site in connection with disturbances and other plant events
- regularly follows the operation of the facilities, among other things, by making inspections in the control room and inspection rounds at the plant
- witnesses inservice inspections
- follows the overall outage situation, participates in meetings dealing with the outage situation and events, and communicates to STUK's various organisational units any issues that have emerged
- during outages follows STUK's regulatory activities and monitors the status of inspections
- at his discretion communicates to STUK any significant inspection findings reported to him by other units
- together with other inspectors conducts inspections ensuring plant start-up readiness on the basis of documents sent by the power company and reports from STUK's various organisational units
- writes memorandums about operational transients
- contributes to the review of special reports, scram reports and operational transient reports
- participates in the investigation of operational events
- participates in inspections of the periodic inspection programme
- contributes to examinations held for NPP operators
- follows implementation of quality assurance at the facility
- reports the results of his inspections to STUK every week
- when necessary, is a substitute for the resident inspector for Mechanical Engineering.

The number of resident inspectors

There are 2 resident inspectors per site (2 at TVO and 2 at Loviisa); one oriented in operational topics and the other in mechanical topics.

Major activities

Please look at paragraph (1) above.

Qualification of resident inspectors

All resident inspectors are experienced (more than 10 years at nuclear field). There has not been any formal qualification requirements so far. However, qualification requirements regarding whole regulatory staff are under development.

Art: 10
Ref. page: 11
Question/comment: It is reported that both utilities have independent safety committees with external expert members in addition to the safety units.
1) What type of and how many external specialists are included in the safety committee?
2) What is the responsibility of the committee? Only advice?
3) Is there any regulation to select the external specialists?

Olkiluoto plant:

In accordance with the rule of TVO's safety committee, there may be one or more external expert members in the committee. At this moment there is only one external expert member.

The external expert member, professor Rainer Salomaa, is the head of the Laboratory of Advanced Energy Systems (former Nuclear Engineering Laboratory) in the Helsinki University of Technology. His research interests are nuclear engineering, fusion and plasma physics and lasers and quantum optics.

The purpose of the safety committee is to act as an organ who gives recommendations and present opinions on issues related to the nuclear safety and quality assurance in connection with the design, erection, commissioning, operation, decommission of the nuclear facility and in connection with the final disposal of nuclear waste.

The recommendations and opinions of the safety committee have status of advice but if someone wants to depart from a recommendation, the final decision in that issue will be made by the managing director of the company.

There are no regulations on selection of external specialists.

Loviisa plant:

According to the Management Rules of the Loviisa NPP one member of the safety committee is a specialist outside from Fortum concern. During the recent years he has been the nuclear engineering professor from Lappeenranta University of Technology.

The Loviisa NPP safety committee is nominated by the board of plant owner, Fortum Power and Heat Oy, to act as an advisory and supervisory body. Its duties include among other things:

- To give advices and statements to the plant manager about safety issues
- To handle significant changes in plant structures, systems and components from the point of nuclear safety and in the FSAR and Technical Specifications
- To handle the principles for emergency preparedness
- To handle the reports on special situations and other safety significant incidents and observations
- To follow the working of plant's QAS meeting
- To carry out the tasks given by the board of Fortum Power and Heat Oy.

The safety committee reports to the board of Fortum Power and Heat Oy four times per year. In addition the safety committee, on its own initiative, can give statements and make proposals to the production manager of Fortum Power and Heat Oy or to the plant manager.

There are no regulations on selection of external specialists.

Art: 10
Ref. page: 11
Question/comment: Both (NPP) utilities have organisational units for safety. Who controls these safety units? How many and of what professional profile are members of these safety units?

Olkiluoto plant:

There are two organisational units related to safety at TVO: Corporate Safety Office and Nuclear Safety Office.

The Corporate Safety Office belongs to the production department. The main activities of the Corporate Safety Office are related to the emergency preparedness, security, fire protection and information safety. The office manager reports to the director of the Production Department and in matters concerning corporate safety, also reports directly to the managing director.

The Corporate Safety Office consists of about eight members. The office manager is a PhD (physics) and the others have education on the fire protection area (fire officers and fire fighters). The security staff comes from a separate security company

The Nuclear Safety Office consists of the following units: Operational Safety, Reactor Safety, Radiation Safety and Reliability. The Nuclear Safety Office belongs to the Engineering Department. The office manager acts as secretary of the Safety Committee. He reports to the director of the Engineering Department.

The main responsibility areas of the Nuclear Safety Office are to maintain the general design basis of the nuclear power plants, analyse the plant in terms of safety and availability and maintain the safety analysis reports, classification documents, administrative rules, PSA analyses, Technical Specifications and emergency preparedness plans. Additionally, the office performs independent nuclear safety evaluation of the operation and maintenance of the plant and coordinate operating experience feedback activities in the company. The Nuclear Safety Office is also responsible for the nuclear licensing of the plants.

The Nuclear Safety Office consists of about ten people. Most of them have the degree of Master of Science in Engineering.

Loviisa plant:

The nuclear safety unit of the operating organisation consists of five professional safety engineers who normally have the decree of Master of Science in engineering. One of the safety engineers leads the group and reports to the head of the Safety Section directly under the General Manager of the Plant. In addition there is a Project Manager of the PSA studies (PhD) who reports to the General Manager of the Plant.

Safety analyses and updating of the Final Safety Analysis Report are mainly performed by Fortum Nuclear Services Ltd on contract basis. Fortum Nuclear Services has a staff of about 100 persons including about 15 professional nuclear safety engineers.

Art: 10
Ref. page: 12
Question/comment: Has any impact been observed when the deregulation of Finnish energy market was carried out? According to trends in the Figures, the Fig. 1 for Olkiluoto NPP shows decreasing investments in last 2 years, while Loviisa NPP shows increased investment in this period. Please, comment these trends.

<u>Olkiluoto plant:</u>

Olkiluoto 1 and 2 are producing electricity only for TVO's shareholding companies and at cost. The shareholding companies are paying fixed cost in the proportion they own TVO's shares and variable cost in accordance they take electricity produced by Olkiluoto 1 and 2. The variable production cost has been normally much lower than the pool price. Therefore, the units have been operated at full power with a few minor exceptions.

Olkiluoto 1 and 2 were modernized extensively in 1995-1998 so that they meet most of the modern safety requirements. Therefore, the need of safety related investments has decreased after that period. In a couple of years, investments are expected to rise to the level before the modernization.

<u>Loviisa plant:</u>

The deregulation of the energy markets has not influenced on the short term investment rate. Annual fluctuations arise because of term of payments in major modifications and upgrading projects.

In the coming years the renewal of the automation will need substantial financing.

Art: 10 ?
Ref. page: 11
Question/comment: STUK uses as indicator the rate of annual investment but on another hand declares not to take into account economical factor. How are these two statements made compatible? Which are the other factors that STUK uses in its indicator system?

Licensee's annual investments is one of the newest indicators included into the STUK indicator system. The indicator was taken along some years ago to indicate and follow the potential influences and consequences of the deregulation of electric market and the possible increase of competition.

The scope of indicator "investments" is: Utilities' maintenance investments in a contemporary value of money improved by the building cost index. The figure includes all recent acquisitions at the plants. The data has been got from the management of plants. The purpose of the indicator is to observe whether there are significant reductions in investments that would reveal a general change in the investment policy.

Use of the indicator should not be mixed with the general requirement that safety should take precedence over the production of electricity. Manifestation 'STUK does not take into account economical factor' means, that in its decision making STUK always sets the safety in the first place regardless of the costs.

The YTO Indicator System is divided in two principal groups that are the safety of a nuclear facility and the regulatory activities. 'Safety of nuclear facilities' is divided into 3 areas based on the concept of "Defence in Depth". The areas (layers) under consideration are: Safety and quality culture, Operational events and Physical barriers. 'Regulatory activities' is also divided into 3 areas: working processes, resource management and regeneration and ability of work. Indicators for describing the safety of nuclear facilities can also be utilised to assess effectiveness of STUK, from regulator's point of view "outcome " of activities. These indicators are called indirect indicators because these reflect mostly the achievements of the operating organisations, but STUK can also make some contribution on them.

The principal groups A, "Safety of nuclear facilities" and B, "Regulatory activities" of the YTO Indicator System are divided into sub-groups and further into indicator areas as follows:

A. Safety of nuclear facilities	**B. Regulatory activities**
A1 Safety and quality culture A1.1 Failures and their repairs A1.2 Number of TTKE deviations A1.3 Availability of safety systems A1.4 Radiation doses A1.5 Radioactive releases A1.6 Documentation A1.7 Investments	B1 Working processes B1.1 Fulfilment of outcome targets B1.2 Timely decision making B1.3 Maintenance of regulations B1.4 Implementation of inspection program B1.5 Steering of contracted safety research B1.6 Actions in abnormal situations
A2 Operational events A2.1 Number of events A2.2 Significance of events A2.3 Causes of events A2.4 Number of fire alarms	B2 Resource management B2.1 Resources for regulatory control of nuclear safety B2.2 Distribution of work load
A3 Structural integrity A3.1 Integrity of nuclear fuel A3.2 Integrity of primary circuit A3.3 Integrity of containment	B3 Regeneration and ability to work B3.1 Maintenance of YTV Quality Manual B3.2 Execution of development projects B3.3 Execution of training program B3.4 Work satisfaction B3.5 Compliance with values

At the moment system consists of more than 40 indicator areas in which there are about 200 separate indicators. The large number of indicators is explained by the fact that most of them are calculated separately for each plant unit. The review period of the indicators relating to the safety of nuclear facilities is calendar year but in some cases also operating cycle. The indicators relating to the regulatory operations are determined every calendar year.

Art: 10 ?
Ref. page: -
Question/comment: Could you provide some basic information on the FINNUS programme organisation, management, and funding?

The FINNUS programme is managed by the top-level steering group and by the reference groups related to the different research projects (topical areas).

Both the steering group and the reference groups involve representatives from all sides: regulatory body, utility, and research organisations. In addition, the Ministry of Trade and Industry (KTM) is represented in the steering group.

Most of the research is performed by VTT.

The FINNUS funding comes mainly from KTM, VTT and STUK. Utitilies have funded some parts mainly related to the international cooperation.

The wide participation in the steering group and the reference groups is considered beneficial, because the FINNUS programme is directed to the development of expertise and methods. Here, it should be emphasized that the FINNUS programme does not involve generation of utility evidence to be sent to the regulatory body (STUK).

The reference groups have proved to be very valuable forums for the exchange of information and viewpoints. Most importantly, the reference groups have provided important practical feedback to the researchers, improving the focusing of this publically funded research work.

The current FINNUS programme reaches its end this year. A working group has been set up, under the auspices of the FINNUS steering group, to plan the main contents of a similar national research programme, to be started in 2003.

More FINNUS information can be found through the VTT home pages
www.vtt.fi and www.vtt.fi/ene/tutkimus/finnus .

Art: 11
Ref. page: -
Question/comment: How is adequate recruitment of graduate students assured in order to cover future teaching and expert staff needs?

Olkiluoto plant:

The annual need of persons having university degree in the nuclear energy field has been relatively small. Therefore, any special efforts for the recruitment of new students into the field have not been required. This situation is changing in the future. The approaching retirement boom of the expert workforce in the nuclear energy field is seen as a major challenge of the whole field to generate ideas on the recruitment and education of new students. A good co-operation between the universities, safety authorities, utilities and research organisations is essential for the education of this new expert generation.

Loviisa plant:

The policy of the company has been to employ students from technical universities to practice during their summer holidays, to carry out their compulsory exercises and finally to make their Master's Theses. R&D projects have provided good and useful subjects for the exercises and Master's Theses. This policy is followed in cooperation with the universities. It has been very common that a student first practices during two to three summer holidays and then makes his Master's Thesis at the company and after that joins the permanent staff. This policy has worked pretty well during the last 20 years and we have recruited skilful and well trained staff.

In the national report of Finland (Article 11) there is information about the national committee set up by the Ministry of Industry and STUK to survey the situation of human resources in Finland.

Art: 11
Ref. page: -
Question/comment: It is mentioned that there are uncertainties related to the continuation of the public funding of nuclear safety research and that this could affect the attractiveness of the nuclear field to young engineers. What is the nature of the uncertainties? What practical meas-

ures are planned or discussed in order to ensure the necessary nuclear expertise in Finland for the future, especially if construction of unit 5 will not be permitted by the Parliament?
This point has been reported because it requires continuous attention and practical measures, as pointed out by the related working group in 2001 and already discussed in the Finnish report. So far the sufficiency of public research funding has been satisfactory taking into account also the added international funding, mainly from the EU. The impending decreases in research institutes' budget funding and public funding in general require active practical measures.

The national research programme on radioactive waste is being continued with a broader funding structure, and the national research programme on nuclear power plant safety (currently called FINNUS 1999-2002) is being planned for a start of a new period in 2003. As mentioned in the Finnish report, the current situation is adequate from the university training standpoint. However, the more profound familiarisation in details of nuclear engineering and ensuring the long-term attractiveness to young scientists require reasonable sufficiency of public funding at research institutes and demanding research topics. At the end of this decade the university training of new experts has to be considerably increased as well, when the present expert generation will retire.

There are always uncertainties associated with public funding of research, and if changes were to be foreseen or implemented, STUK would need to look at this from the safety perspective.

The current practical measures for ensuring nuclear expertise – research, training, recruitment – need to be continued and strengthened. The different organisations – the utilities and the regulator – need to keep track of their resources, knowhow and challenges, including the research support. It is the responsibility of STUK to continue the supervision of the measures mentioned above to ensure the maintenance of sufficient expertise in view of high safety culture aspects as well.

Significant problems are likely to become visible in practical matters related to reactor performance, design changes and modernisation efforts, concerning both plant safety and availability. Any early signs of problems need to be taken seriously.

Concerning the Parliament decision on the possible fifth unit, the above responses remain the same if the Parliament decision is negative. If the Parliament decision is positive, it is likely that the field becomes more attractive, while also the work load is increased. In this respect, the design and construction phases are most challenging, including the supplier side as well. Any problems on the expertise side are expected to surface in the licensing process too; and be accordingly handled. For the operational phase, the challenges are very much the same as with the existing units, staff retirement and recruitment.

Consequently, the Parliament decision is foreseen to play a major role for the attractiveness of the field, but not for ensuring adequate nuclear knowhow. With a negative decision, stronger recruitment actions are likely to be needed, not to mention the possibilities of international co-operation.

Art: 11
Ref. page: -
Question/comment: Has financing scheme for the radioactive waste including spent fuel disposal and the decommissioning of nuclear power plants been agreed upon and regulated?

The framework of the financing system for future nuclear waste management is defined in the Nuclear Energy Act (1987) and Decree (1988). The detailed prodedures are defined in the Decree on the State Nuclear Waste Management Fund (1988) and related Government decisions.

To ensure that the financial liability is covered, the utilities must each year present cost estimates for the future management of nuclear wastes. The cost estimates is reviewed and approved by the Ministry of Trade and Industry. The Ministry consults STUK for the review of the technical basis of the cost estimates.

The current estimates, including costs from the storage, conditioning and disposal of existing spent nuclear fuel, management of other nuclear waste and from the decommissioning of NPPs, arise to about 1200 million euros with no discounting. The utilities are obliged to set aside the required amount of money each year to the State Nuclear Waste Management Fund, which is under the auspices of the Ministry of Trade and Industry. At the end of the year 2001 the funded money covered the whole liability.

Art: 11
Ref. page: 12
Question/comment: How are the funds for financing nuclear and radiation safety research formed?

The nuclear safety research can be divided into three major areas: the industry research, the national research, and the regulatory research. The industry (power utilities TVO and Fortum, waste company Posiva) invests part of their R&D funds into safety matters, and in certain areas they also get funding from the National Technology Agency (Tekes) for this. The national research is mainly financed by the Ministry of Trade and Industry (KTM), the research organisation's own budget (VTT), and the regulatory body (STUK), with limited funds from the industry. The regulatory research programme on nuclear safety is financed by the regulator, but recovered through licensee fees. STUK carries out itself research on radiation safety.

The new national research programme on radioactive waste has been started this year. The research of the industry (Posiva) on one hand, and of the regulator (STUK) on the other hand, will continue on the basis of the decision in principle made by the Parliament in 2001.

The new national research programme on nuclear plants (FINNUS) will be started next year and a working group has been set up to plan for that. See also the Czech question nr 9 above.

Art: 12
Ref. page: 13
Question/comment: What was the subject and scope of STUK investigations/assessments regarding human factors in abnormal events and transients mentioned in the National Report in Article 12 (page 13)?

STUK has undertaken an investigation concerning all events including deviations from Technical Specifications at both nuclear power plant sites in Finland during the year 1999. In the investigation generic causes for the events were explored. The methods used by utility organisation in the examination of events were also considered. Especially, the ability of the utility organisation to identify the human and organisational factors were questioned. As result, no unambiguous generic causes were identified. The events resulted from complex processes, in which several factors were mingled. However, in all events some factors were identified, associating either with individual error or social events. The utilities usually identified factors related with knowledge and skills of the employees. However, there were factors relating with the social pressure or weariness, which usually were not noticed by the utility.

Art: 12
Ref. page: -
Question/comment: Which arrangements at the plants ensure proper and timely feedback of plant modification and operational experience into the licensing safety analysis and Probabilistic Safety Assessment? What are the related regulations for this process?

Olkiluoto plant:

Safety Analysis Report

Plant modification procedure requires to assess the possible impacts of the plant modification to the Safety Analysis Report and to the related Topical Reports. Major changes to the documents will be made and reviewed in the draft form before the implementation of the corresponding plant modification. Minor changes to the documents will be made as a campaign once a year.

Probabilistic Safety Assessment

TVO has an internal procedure that defines the updating of PSA, responsible organizations and responsible persons to deliver the information to the PSA specialists. Initiating events are checked annually from the own statistics. Operational experience from component failure data is collected in co-operation with the Swedish utilities. The data is published in T-book that has been revised three times in ten years. The PSA is used continuously, and the model is updated, if appropriate, in connection with the application. The plant modifications are checked before the installation, whether they are in the systems modeled in PSA. The list with short descriptions of plant modifications in proposal or in design phase is circulated monthly, and the requirements on PSA analyses are updated on these lists. The PSA model is kept up-to-date, but the documentation is updated every 2-4 years.

Loviisa plant:

Plant modifications

In the modification planning the design basis is first assessed. If there are deviations from the assumptions of the licensing safety analyses, a new analysis is needed, if deviations are not conservative.

Plant/system modification plans (documents) are reviewed at an early design stage for safety/risk significance. (Some modifications are initiated specifically to reduce risk.) Safety related plans are assessed by deterministic and probabilistic safety assessment (PSA) before the plans are approved. After the modification is completed, PSA models and data are updated within a few months, depending on the extent of modifications. Currently PSA –personnel have to follow up to determine if and when the modification was actually completed.

Operational experience

A computerised on-line failure and maintenance data collection system has been implemented early on as a plant-specific data base for PSA. All equipment are covered as a part of the normal work order routine, with a specialist review for safety related equipment. This raw-data does not automatically go to PSA: parameters for PSA are calculated and updated about every other year, and for individual systems when the system fault-tree model is updated or introduced. Trends in failure rates and unavailabilities are identified and current values are used in PSA.

Other operating experience like transients and errors cause reviews of the PSA data, models and assumptions. Safety related events are analysed and documented by safety engineers at the plant, and documents are circulated to PSA –personnel.

STUK:

The FSAR and PSA are so called licensing documents especially mentioned in Section 36 of the Nuclear Energy Act. These documents have to be kept updated continuosly as in detail described in regulatory guides YVL 1.1, STUK as the regulatory authority for the use of nuclear energy, and YVL 2.8, Probabilistic safety analyses (PSA), respectively.

Art: 12
Ref. page: -
Question/comment: What is the situation regarding the plant practice on reporting, evaluating and feedback of human errors and human induced incidents?

An event report to STUK shall be compiled if the requirements of guide YVL 1.5, Reporting NPP operation to STUK, are met. One Finnish utility is using a program (Event Root Cause Analysis Tool and Database), which is a tool based on the ASSET (Assessment of Safety Significant Events Team) methodology, for the evaluation and reporting of events, including human errors and human induced incidents. The other utility is using the INPO/WANO based HPES (Human Performance Enhancement System) methodology for the root cause analysis.

Art: 12
Ref. page: 13
Question/comment: What are the methods which the unit are using for the human and organizational factors assessment?
Have you use also the methods which are based on PSA in the event analysis? What are the initial experiences with the mentioned group? What are the profiles of the group members? What is the interference with the other group which are doing the event assessment and operating experience evaluation?

A systematic root cause analysis includes the review of human and organisational factors. One Finnish utility is using a program (Event Root Cause Analysis Tool and Database), which is a tool based on the ASSET methodology, for the evaluation and reporting of events, including human errors and human induced incidents. The other utility is using the INPO/WANO based HPES methodology for the root cause analysis.

PSA based event-analysis results are used as an indicator. The analyses cover exemptions from technical specifications, failures and preventive maintenance of systems covered by technical specifications and reportable events specified in regulatory guides.

The procedure developed at STUK is aimed to produce results that are accurate enough for regulatory use and to give valuable insight into the risk significance of various operational events with reasonable use of resources. The main use of the risk follow-up results is to provide guidance for the regulatory staff. According to an unofficial internal limit adopted by STUK the combined risk of the aforementioned events should not significantly exceed 5 per cent of the annual core melt probability. These "risk follow-up" results are calculated once a year.

The organizational changes at the Nuclear Reactor Regulation department have been continued since preparing the Finnish report. The experts of the Office of Human and Organisational Factors have been moved into the Office of Safety Management (PhD in Psychology, Docent; e.g. safety culture related research) and Management Support Unit (MSc in Chemistry; e.g. investigation of operational events). Other units of the department are providing their expertise to these coordinating (especially in event investigation) persons, as needed.

Art: 12
Ref. page: 13
Question/comment: The second paragraph of Article 12 describes that STUK has paid special attention to the assessment of the human and organizational factors in abnormal events, transients and working processes in the nuclear power plants. What are the major activities of regulatory body to evaluate the human and organizational factors?

The Article 12 relates the evaluation of human and organisational factors during an event investigation. However, the human and organisational factors are more regularly evaluated during periodic inspections. Different aspects of the nuclear power plant as well as the operation of the utility organisation are inspected yearly. In several inspections the safety management, operational experiences, quality management, personnel development etc. are assessed.

For the periodic inspection programme, please, look at the response to question about regulatory inspections earlier in this report.

Art: 13
Ref. page: 13,14
Question/comment: What is the period after which the licensee's QA system is reviewed by the regulatory body?

STUK has a periodic inspection programme which includes 16 separated inspections grouped in three levels. The performance of QA-topics is included within the scope of all inspections. However, the overall performance is reviewed within the top level inspection A1, “Safety Management” in every two years.

Art: 13 ?
Ref. page: -
Question/comment: Who is responsible to review the contractor’s QA, are QA programs submitted to STUK?

According to the Government decision (395/1991) advanced quality assurance programmes shall be employed in all activities which affect safety and relate to the design, construction and operation of a nuclear power plant. STUK’s guide YVL 1.4, QA of NPPs, states that a quality assurance programme shall be required from the facility's main supplier, the supplier of fuel as well as other organisations taking part in the design, manufacture, installation and commissioning of the facility, whose activities affect the safety of the nuclear power plant. The Nuclear energy act states that the manufacturers of safety classified pressure equipment must be approved by STUK. This principle is also valid for other mechanical equipment.

The main responsibility for reviewing, evaluating and approving the contractor's QA programs belongs always to the licensee.

In case of safety class 1 and 2 mechanical components the licensee has to show in the application for manufacturer approval that the manufacturer has a QA program fulfilling the requirements of Finnish regulations. In practice this normally means that the QA program is submitted also to STUK. The evaluation of this program is the basis for granting a manufacturing license for a maximum period of 5 years. This procedure is valid for domestic manufacturers. In case of foreign manufacturers the QA program is evaluated in connection with the construction plan review. In both cases manufacturing plant level inspections can be carried out if they are considered necessary by STUK . For components in safety classes 3 and 4 it is sufficient that the manufacturer's QA system is approved by a notified body of the EU.

In the case of safety class 2 electrical and I&C systems and components and in the case of safety class 3 essential accident instrumentation the QA programmes and QA plans are submitted to STUK for review as a part of the pre-inspection documentation. The manufacturing plant level inspections can be carried out if they are considered necessary by STUK.

The review and approval of QA programs of other organisations taking part in the design, manufacture, installation and commissioning of the plant is considered separately by STUK in evaluating the construction license application.

Art: 13
Ref. page: 13
Question/comment: Has the STUK organized a team or group independent of regulatory activities to perform internal audits and self-assessments? If so, how many staffs are in the independent team or group?

A group of about 20 people have been trained to perform internal audits. Additionally, when special expertise is needed, other persons are invited to participate audits as well. Thus about 30 members of personnel are participating in the audits. These persons come from different departments of STUK, from departments having regulatory activities and from other departments or units. It is taken care of when planning the audits that no one audits his or her own activities, but sometimes an expert from the same department is used. Many times it is even preferable to use as one member of the audit team an expert who is familiar with the activity in question.

Self assessments are made, as the word suggests, by the members of the departments or units by themselves. There is no special group of experts trained to perform self-assessments independently. In some cases external evaluators (outside from STUK) have been used to assess some specific activity, e.g. research activities of STUK.

Art: 14
Ref. page: 14
Question/comment: It is reported that the risk-informed regulatory scope at STUK is progressing towards Risk In-formed In-service Inspection/In-Service Testing, and Risk Informed Technical Specifications activities and a related study has recently been completed by STUK.
1) Could you please explain the main study results?
2) Did you cooperate with an overseas organization to study them?
3) How will you reflect them to the future regulations?

Pilot study on risk informed in-service inspection

The pilot applications on ISI of piping both in PWR and BWR plant units have been completed. The pilot study contains the high-pressure injection system and the emergency feed water system at a PWR and the shutdown cooling system and the service water system at a BWR plant. The Finnish licensees contributed to the pilot study by providing qualified systems information data to STUK.

STUK's risk-informed procedure combines both the plant specific PSA information and the traditional insights in support of the system specific detailed ISI program selection. At the starting point all systems important to safety are exposed to the selection procedure irrespective of the ASME class (1, 2, 3 or even non-code piping). The procedure includes several steps such as selection of systems and identification of the evaluation boundaries and functions, evaluation of the qualitative degradation mechanisms of piping, evaluation of consequences by PSA and division of the segments into different categories containing high, medium and low risk segments, respectively. Finally the expert panel combines the traditional and probabilistic information. The panel is to ensure the quality of the preliminary results and to support the decision making for the final categorization of the pipe segments.

Technical Specifications

The correctness and balance of Technical Specifications have to be assessed with the PSA as stated in the Regulatory guide YVL 2.8, Probabilistic safety analyses (PSA).

Certain inconsistency in the AOT's in comparison with the respective risk impact has been identified between various safety systems. Analysis indicated that the risk contribution of twofold subsystem failure in service water system is higher than that of fourfold subsystem failure in auxiliary feedwater system. In addition some asymmetry between various, formally similar failure combinations of subsystems has been identified as well. This implies that risk contribution of e.g. twofold failure combinations of trains A&B and A&C in the service water system are not identical. An explanation for the asymmetry is that the trains A and C are more vulnerable to common cause initiators such as fire and flooding than trains A and B due to shortages in physical separation.

Further, the insights from PSA have questioned the traditional conclusion that in all faulted states the shutdown would be the safest procedure. Accordingly the study on risk informed Tech Specs identified situations in which the plant shutdown with failed components may cause higher risk than repairing the failures in power operation. In this spirit a licensee has applied for a change in the Tech Specs for certain plant configurations (with specific safety system trains inoperable) on the basis of risk studies. In certain faulted states (i.e. a loss of equipment important for decay heat removal) it may be safer to continue power operation than to shutdown the plant immediately, if required by the Tech Specs.

Cooperation

No overseas organisations were consulted during the pilot studies.

Future regulations

The pilot study on ISI of piping produced essential experience for further RI-ISI applications. Furthermore, the study also gave guidance to further development of the method. Accordingly, it is stated in the draft Regulatory Guides YVL 2.8 and YVL 3.8 (In service inspections) under revision that the licensees can utilize the PSA insights in drawing up and development of inspection programs of pipings.

As to the In–service Testing it is stated in the draft Regulatory Guide YVL 2.8 that the licensee has to use PSA to optimize the test intervals and effect testing procedures of those systems, structures and components which contain the major risk reduction potential.

The correctness and balance of Technical Specifications have to be assessed with the PSA, as stated in the Regulatory guide YVL 2.8. The evaluation has to deal with such situations, in which components of more than one safety systems are simultaneously failed in either full power or shutdown modes. Further the PSA has to be used for identifying such situations, in which the plant shutdown with failed components may cause higher risk than repairing the failures in power operation.

Art: 14
Ref. page: 14
Question/comment: It is reported that special attention has been paid to seismic events in Finland, although Finland is not in a seismically active area.
1) Could you please explain the more detailed technical background and circumstances, which requested to pay attention to the seismic event in Finland?

For the sake of completeness the PSA program included also risk analysis of seismic events irrespective of the fact that the Finnish soil is stable as to the seismicity. The seismic risk assessment identified some problems in the plant units. The reason is that the original plant design basis did not take into account the seismic events. Hence also small seismic events can affect some electric equipments and contribute to the plant risk more than anticipated.

The remedial actions at TVO BWR plant included upgraded anchorage of battery system backing the DC systems and the cabinets of DC/AC rectifiers. The plant modifications were made step by step in 1998-2001. The seismic events have been taken into account also in the modernization project of TVO while renewing electrical systems. For example the rotary converters have been replaced with UPS systems.

The similar problems were identified also at Loviisa plant, but becauce of very small contribution to the total core damage frequency no plant changes have been yet made.

Art: 14
Ref. page: 15
Question/comment: It is reported that STUK has established an own plant modification database, including the whole operating history of the Finnish plants.
1) Could you please provide more detailed explanation for the concrete application of the database?
2) What is the feature of the own plant modification database?
3) How detailed plant modification data are included in the database?
4) Are the data of the overseas plants included in the database?

Plant modification database is a Microsoft Access based application, which user application is made trough STUK's intranet and browser program. Access is used only for administrative use, for example database supplementing.

Each plant modification has its own register record, which includes following fields: identifiers (record number, reactor unit, licensee work number or project name, head title), safety class (highest), implementation time and plant condition (power operating or shutdown), influence to the yearly core melt frequency (if possible to evaluate), general description, safety significance, STUK's observations, inspection documents and necessary plant documentation modifications (Technical Specifications, FSAR, operating instructions) and their implementation and also STUK´s reporting.

By using plant modification database is afterward possible to find out significant modifications and some details of them and also documents, where you can get more information. Some indicators, for example documentation updating time, are calculated by plant modification database. It is also useful for valuation of recurrent error in licensees' modification process. Collective follow-up of present time modifications is also possible through database.

Modification description is usually rather general, but can also include technical details for experts. Database introduces all details for STUK's point of view and emphasis.

There is no data from overseas plants. The database covers only the plant modifications of the Loviisa and Olkiluoto plants.

Art: 14
Ref. page: -
Question/comment: It is mentioned as a new requirement that all safety significant plant modifications have to be assessed by an independent part of the licensee organisation, before being submitted to STUK. What is the criterion for a safety significant modification? Does it include organisational and procedural modifications?

The question deals with the new requirements in draft YVL Guide 2.0, "Requirements for the systems of a NPP". According to this guide all documents dealing with the plans and modifications of systems in safety classes 1, 2 and 3 shall be assessed independently from the design. This requirement shall be extended to safety class 4 systems, when it is needed for assessment of the total safety of the plant. The requirement of independent assessment does at present not include changes in the organisations of the licensee. These issues will be addressed in the coming revision of another regulatory guide (YVL 1.8, Repairs, modifications and preventive maintenance at NPPs).

In draft YVL 2.0 it is also required, that when a plan has a significant effect on nuclear safety or design or planning requires special expertise, the licensee shall evaluate, whether the assessment should be made by an expert or by an organisation, which is totally independent from the licensee.

Art: 14 ?
Ref. page: 51
Question/comment: Annex IV, section "Research on safety culture in Finland" says that since 1999 VTT has been developing a methodology for assessing organizational culture in safety critical organizations including safety culture assessment.

Please advise us on the basic principles of safety culture assessment foreseen by this methodology.

VTT has developed a methodology including document analysis, interviews, survey and team work, aimed to reveal the features of the organisation culture as well as the demands for the job undertaken in an organisation. The methodology is heavily based on researcher effort and requires confiding relations between the members of the organisation and the researchers. The strength of this methodology is, that the organisation culture is not seen in vacuum, but in real context of the goals and the demands of the task.

Art: 14 ?
Ref. page: -
Question/comment: What is the scope and types of documents related to safety significant plant modification, which are submitted to the Finnish regulatory authority (STUK) for review, evaluation and assessment? Which of these documents are to be approved by the regulator? Does the safety important modification (e. g. New computer-based Reactor Protection System), requires the same licensing procedure as for new nuclear facilities (Decision on Principle, Construction License and Operating License) or an individual permit, is granted stage by stage based on the successful implementation of previous work?

The scope and content of documents to be submitted to STUK depends on the safety class of the system to be modified. In safety classes 1, 2 and 3 a principal design plan has to be submitted for STUK`s approval. In the principal design plan the overall principles of technical solution of the modification are presented. The detailed technical solutions on system level are presented in the preinspection document of the system, which shall be submitted for STUK's approval after STUK has made a decision on the principle design plan. The preinspection documents of components shall also be submitted for approval, depending however on the safety class of the component.

Generally the licensing of a modification requires approval of the above-mentioned documents and in addition to that acceptance of installation and commission inspections at the site. In connection of larger system modifications a commissioning programme is carried out. The commissioning programme and its results shall be submitted for STUK's approval.

STUK has the authority to accept also major modifications within the license conditions. However, e.g. the increase of reactor power would require a new operating license.

Art: 14
Ref. page: 14
Question/comment: Article 14 (page 14) states that the utilities use the information from living probabilistic safety assessments (PSAs) in decisions related to safety management. Please provide further details on how this PSA information factors into utility decisions.

<u>Olkiluoto plant:</u>

TVO has an internal procedure that defines the use of PSA. The use in connection with plant modifications is similar to US NRC Reg. Guide 1.174, but the limits are one order of magnitude lower. This is based on the Guide YVL 2.8, in which it is required that CDF < 1E-5 and LERF < 5E-7 per reactor year.

The safety related modifications are checked with the living PSA model in advance or during the design phase. Also, the exemptions from the Technical Specifications are evaluated with the living PSA model.

Loviisa plant:

PSA information factors into utility decisions in several ways

When a new chapter of PSA is completed (e.g. flood, fire, severe weather, refuelling, boron dilution, etc.): if it is concluded that risk reduction should be implemented to satisfy an internal/unofficial goal, dominating accident sequences are used in brainstorming sessions and in preliminary design of plant improvements. Tens of plant modifications have been implemented at the Loviisa plant on this basis.

PSA is used also during detailed design and implementation to verify that new risks are not created, when eliminating others by modifications.

Sometimes there are several options for plant betterment. Then the costs and risk impacts of many combinations may be assessed to support final decision making.

When a system modification is suggested for other reasons, the risk-impact is assessed before final approval of the modification.

Suggested temporary system configurations (typically created by some unusual failure combinations) are assessed by PSA to determine, whether they are acceptable, or whether repairs can be postponed to a scheduled outage.

Some test/inspection intervals have been extended based on acceptable impact on PSA results.

Operational events/transients are analysed afterwards by PSA to determine safety significance and to identify "lessons learned" to avoid similar events (errors or failures) in the future.

A computerised failure and maintenance data collection system that serves PSA allows identification of ageing trends in failure rates.

Other applications (e.g. Risk-informed in-service inspection and Graded QA) are in planning stage or under consideration in a pilot study.

A few details may be found in an article in *Nuclear Engineering and Design* 185(1998) 335-345.

Art: 14 ?
Ref. page: -
Question/comment: Is the probability and acceptability of a particular scenario used as prerequisite to determine the design basis accident? If so, what probabilities are considered.

In Finnish regulations the incidents and postulated accidents have divided into three categories; anticipated transients, minor accidents and major accidents. Each category has the acceptance criteria of their own. The probability of anticipated transients is more than 10^{-2}/reactor year, minor accidents from 10^{-2}/reactor year to 10^{-3}/reactor year and major accidents less than 10^{-3}/reactor year. In addition, there is a category of severe accidents.

Art: 14
Ref. page: 14
Question/comment: The report addresses that "the new requirements mean in practice that all safety significant plant modifications have to be assessed by a unit which is independent of the design and implementation of the modification."
Does the 'independent unit' refer to independent organization or independent department within the same organization of the design modification organization?

Please, look at the question about criterion for a safety significant modification earlier in this reportand the response to it.

Art: 14
Ref. page: 14
Question/comment: It is described that comprehensive and systematic safety assessment is an essential part of licensing renewal for every 10 years. What were the major corrective actions required from the result of the safety assessment?

Safety enhancement of the nuclear power plants is a continuous process in Finland. Every 10th year comprehensive and systematic safety assessment related to licensing renewal is carried out. Corrective actions depend on the case. Last time, few years ago when licensing renewals were carried out for both nuclear power plants in Finland, licensing renewals included also power upratings of the plants, which required new safety analysis and number of modification at the plants. It was more or less like licensing of the new plant. In normal case there are less modifications, covering e.g. some aging related inspections and modifications, if needed due to new safety requirements.

Art: 14
Ref. page: 14
Question/comment: It is describe that related study to risk-informed regulatory scope has recently been completed by STUK. Regarding this:

1. What kind of study has been completed in association with risk-informed regulatory scope in STUK? (Development of guides, methodology, etc.)
2. What is actual status with regard to risk-informed change in regulatory requirement? Is there any proposal from licensee?
3. Do you allow risk (CDF) increase in your risk-informed approach? If so, it would be appreciated if you provide quantitative criteria.

Please, look at the response to the question about audits and self-assessments earlier in this report.

Insights from PSA are used e.g. to give arguments for exemption from Tech Specs. Once a licensee applies for a temporary exemption from Tech Specs, it has to assess the safety significance of the respective exemption with PSA. However, the granting of exemption from Tech Specs provides that the short exceeding of the allowed outage time contributes only a tiny increment to the core damage probability compared with normal operation. The procedure for exemption from Tech Specs includes the use of deterministic and probabilistic reviews as complementary methods to each other.

Art: 15
Ref. page: 16
Question/comment: What is the reason for great reduction of population dose in the environment of the Finnish NPP in the last decade?
Is this due to significant decrease of discharge activities or due to different method or models for dose assessment?

Olkiluoto plant:

Doses from airborne releases from Olkiluoto plant are caused mainly by C-14, the contributions of other nuclides are negligible. C-14 releases are proportional to the produced energy and have slightly increased during the last decade.

Activity releases to the sea have decreased significantly. In 1996-1997 TVO installed centrifuge equipment in order to improve purification of water to be released. In 1997-1998 TVO built large water storage tanks, which enable reactor pool water recycling during refuelling, instead of the release to the sea.

Loviisa plant:

The great reduction of the doses in the environment of the Loviisa NPP has been caused by the significant decrease of radioactive nuclides into the sea. This is mainly due to the high efficiency removal of cesium in the liquid waste treatment. In 1990, the radioactive release into the sea was 2 % of the authorised limit, but later the releases have been 0.01 - 0.1% of the limit. Although the modelled transfer factor of nuclides (except for cobalt) from sea water to the coast has been reduced, this has had only insignificant effect on the reduction of the estimated total doses.

Since the year 2000 the dose model has been changed to take into account the location of the local farm and the portion of the local carbon and hydrogen in a more realistic way. This reduces the estimated doses even if the releases were kept constant. The reduction of the dose caused by the changes in the dose calculation model is 70 %. The first year the changed model was used was 2000.

Art: 15 ?
Ref. page: -
Question/comment: While deciding the siting and/or construction of nuclear facilities, are the acceptance criteria for exposure to members of the critical group of population at emergencies (up to design basis accident) identical to dose limits for members of the public at normal operation? If different, provide specification.

In Finland the following dose limitations apply to the operation and design of nuclear power plants (*Government decision 395/1991 "General Regulations for the Safety of Nuclear Power Plants"*):

Section 9, limit for normal operation
The limit for the dose commitment of the individual of the population, arising from normal operation of a nuclear power plant in any period of one year, is 0.1 mSv. Based on this limit, release limits for radioactive materials during the normal operation of a nuclear power plant are to be defined.

Section 10, limit for an anticipated operational transient
The limit for the dose of the individual of the population, arising, as the result of an anticipated operational transient, from external radiation in the period of one year and the simultaneous radioactive materials intake, is 0.1 mSv.

Section 11, limit for a postulated accident
The limit for the dose of the individual of the population, arising, as the result of a postulated accident, from external radiation in the period of one year and the simultaneous radioactive materials intake, is 5 mSv.

Section 12, limit for a severe accident
The limit for the release of radioactive materials arising from a severe accident is a release which causes neither acute harmful health effects to the population in the vicinity of the nuclear power plant nor any long-term restrictions on the use of extensive areas of land and water. For satisfying the requirement applied to long-term effects, the limit for an atmospheric release of cesium-137 is 100 TBq. The combined fall-out consisting of nuclides other than caesium-isotopes shall not cause, in the long term, starting three months from the accident, a hazard greater than would arise from a caesium release corresponding to the above-mentioned limit.

The possibility that, as the result of a severe accident, the above mentioned requirement is not met, shall be extremely small.

The requirements and the sections which concern entirely design are the two last ones (section 11 & section 12). The term of "individual of the population" has been defined in the regulatory guide YVL 7.2. This definition is in line with the generally known "member of the critical group".

In the annexes 5 and 6 (STUK-B-YTO 179 and STUK-B-YTO 180) of the first national report of Finland a thorough description of the dose limitation system and its implementation was given.

Art: 15 ?
Ref. page: -
Question/comment: Is the effect of releases from nuclear facilities under normal operation evaluated as regard the exposure to critical groups of population in their vicinity? If so, specify the models used and how they reflect changes of the actual weather situation throughout the year.

Yes, the effect of releases from Finnish nuclear facilities under normal operation is evaluated as regard the radiation exposure to a critical group of population in their vicinity. The corresponding requirements for the nuclear power plants are given in Sections 9 and 26 of *the Decision of the Government (395/1991) "General Regulations for the Safety of Nuclear Power Plants"* and in STUK's *Guides YVL 7.1* (Sections 2.1.1 and 2.2.1), *YVL 7.2* (Section 2.2), *YVL 7.7* and *YVL 7.8* (Section 4). These requirements are also applied to the final repositories of low and intermediate level operating waste that are situated at the nuclear power plant sites (*Government Decision 398/1991) on "General Regulations for the Safety of a Disposal Facility for Reactor Waste"* and *Guide YVL 8.1 "Disposal of reactor waste"*).

The licensees use their own methods for assessing doses to a member of a critical group. The assessments and assessment methods are subject to the approval by STUK. The requirements are given in STUK's *Guides YVL 7.2 "Evaluation of population doses in the environment of* *nuclear power plants"* and *YVL 7.3 "Evaluating the dispersion of radioactive releases from nuclear power plants under operating and in accident conditions"*. STUK also has its own means for assessing the corresponding doses (documented only in Finnish).

Actual atmospheric dispersion conditions are measured at the power plant sites by instruments mounted on a meteorological tower in accordance with STUK's *Guide YVL 7.5 "Meteorological measurements of nuclear power plants"*. Based on these measurements, annual average dilution factors are calculated for different sectors and distances. Grazing season is taken into account so that, for example, deposition on vegetables is possible only during a certain period. Separate dilution factors for grazing season may also be used. The effect of rain on deposition of radio-nuclides is based on a conservative annual rain estimate. Releases, too, are averaged over the calendar year. The aforementioned averaging has been used because of small releases and because the release rate of the ^{14}C, at present the most significant radionuclide in atmospheric releases from Finnish nuclear power plants, is rather constant. Activity limits for annual atmospheric releases have also been calculated using constant release rates for noble gas and iodine radioisotopes.

Art: 15 ?
Ref. page: -
Question/comment: Could you explain the principles used for collective dose limit of 2,5 man-Sv/GWe for NPP personnel as stated in Guide YVL 7.9.?

Previously there was a common Nordic recommendation on the radiation protection (‘flag book’) where 2 manSv/GW-year was suggested as a basic criteria. It was consequently decided that a similar indicative requirement for the operational radiation protection of nuclear power plants should be given in the STUK *Guide YVL 7.9 "Radiation protection of nuclear power plant workers"*. A recurrent evaluation of the cumulated operating experiences of Finnish NPPs have later shown that this requirement of 2,5 manSv/GW-year triggers action most often (say once in three years) at one of the Loviisa reactor units. Normally this is the case when there is extraordinary annual maintenance work to be done in the close vicinity of the primary circuit and in the room of the steam generators of the plant. Generally the occupational collective doses of the Finnish NPPs, especially at Olkiluoto BWR plant, have been reasonably small, compared to the reference values from other countries.

Art: 15
Ref. page: 16
Question/comment: The report states that radioactive release into the environment of the Finnish NPPs has been well below authorized limits.

1) Are the authorized limits specified for each nuclide? What are the specified values of authorized limits for each nuclide?
2) What are the actual releases of radioactive effluents for each NPPs?

Release limits are specified for nuclide groups:

- Gaseous effluents: noble gases and iodines
- Liquid effluents: Tritium and other nuclides (gamma-activity).

Requirements pertinent to the limitation of radioactive releases are set forth in *Guide YVL 7.1 "Limitation of public exposure in the environment and limitation of radioactive releases from nuclear power plants"*.

Release limits are to be derived on the basis of the provisions of *the Government Decision 395/1991 "General Regulations for the Safety of Nuclear Power Plants"*. In the Government Decision 395/1991 it is enacted:

- The limit for the dose commitment of an individual of the population, arising from normal operation of a nuclear power plant in any period of one year, is 0,1 mSv.
- The limit for the dose of an individual of the population, arising, as the result of an anticipated operational transient, from external radiation in any period of one year and the simultaneous radioactive materials intake, is 0,1 mSv.

Facility-specific release limits are subject to the approval by STUK. Release limits are given in the *Technical Specifications of a nuclear power plant*.

Annual release limits

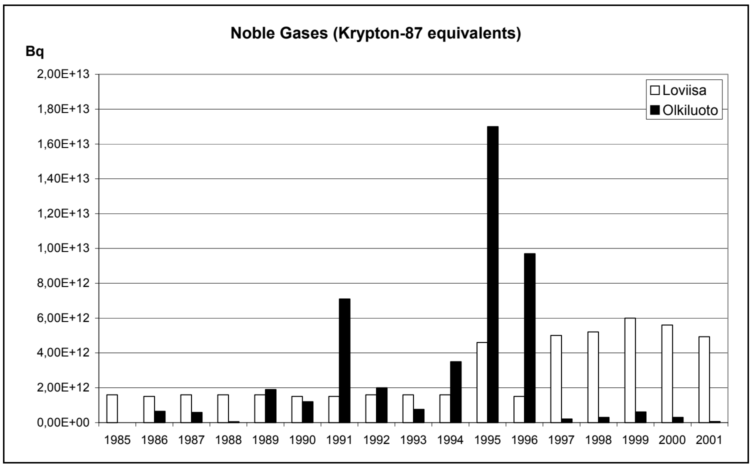
	Loviisa NPP	Olkiluoto NPP
Noble gases [Bq]	2,2E+16	1,77E+16
Iodines [Bq]	2,2E+11	1,14E+11
Tritium (liquid effluents) [Bq]	1,5E+14	1,83E+13
Other nuclides (liquid effluents) [Bq]	8,9E+11	2,96E+11

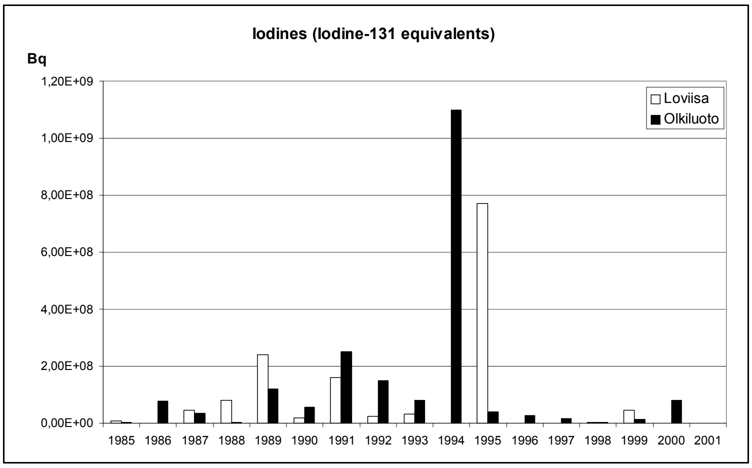
2) Measured radioactive releases from Loviisa and Olkiluoto plants in 2001 are given in the following table.

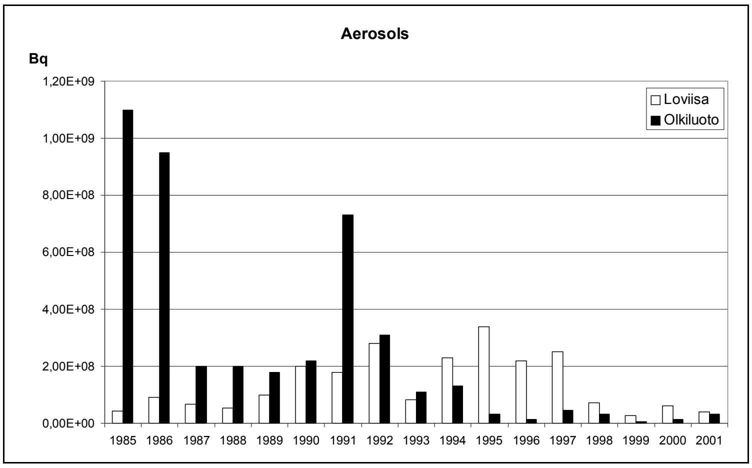
	Loviisa NPP	Percent of the release limit	Olkiluoto NPP	Percent of the release limit
Gaseous effluens by nuclide group				
Noble gases (Krypton-87 equivalents) [Bq]	5,0E+12	0,03 %	5,7E+10	0,0004 %
Iodines (Iodine-131 equivalents) [Bq]	under detection limit		under detection limit	
Aerosols [Bq]	4,1E+07		3,3E+07	
Tritium [Bq]	1,9E+11		3,9E+11	
Carbon-14 [Bq]	3,1E+11		8,7E+11	
Liquid effluents by nuclide group				
Tritium [Bq]	1,4E+13	10 %	9,0E+11	5 %
Other nuclides (beta- and gamma-active nuclides dominating (Co-60, the most significant)) [Bq]	1,3E+09	0,2 %	8,7E+08	0,3 %

Measured radioactive releases from Loviisa and Olkiluoto plants in 1985–2001 are presented in the following figures.

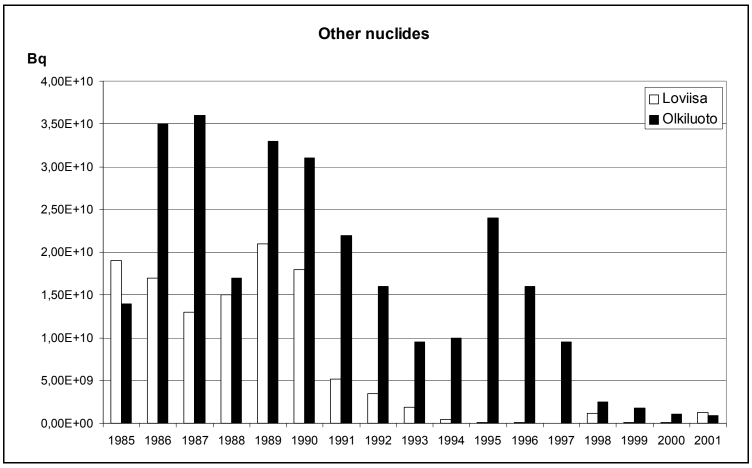
Gaseous effluents







Liquid effluents



Art: 15
Ref. page: 15-17
Question/comment: As was referred in the first paragraph, the ALARA principle is a part of the Radiation Act, and the licensees of Finnish NPPs have agreed on the implementation of plant-specific ALARA programs as was mentioned in page 17.

1) What are the main contents of the plant-specific ALARA programs?
2) What are the measures and tools that the regulatory body adopts to confirm whether the licensee meet the requirements of ALARA principle or not?

3) Is the concept of dose constraint a part of the regulatory requirement? If yes, what is the example of dose constraint values that are currently applicable?

A content of a plant specific ALARA plan:

- Organisational structures (ALARA committee, ALARA working groups)
- ALARA goal (collective dose/year)
- Radiation protection training
- Water chemistry requirements
- Material requirements
- Prevention of contamination
- Decontamination
- Radiation work planning and management
- Special duties of radiation protection group

These are the key items, additional instructions (e.g. on work permits and real-time worker dosimetry) may be given as a part of the ALARA plan or in the other radiation protection instructions of the plant.

Regular review of the implementation of the radiation protection procedures including the ALARA plan is done by STUK in connection with the annual inspections on-site, when STUK expert team makes their pre-planned audits. Additional assessment of the situation at certain intervals includes also comparison with the relevant international experiences.

A new dose constraint was given in the recently revised Guide YVL 7.9 "Radiation protection of nuclear power plant workers" where a maximum of 20 mSv/year as a design goal for the nuclear power plant worker dose. The legal requirement is 100 mSv/ five years or 50 mSv/one single year, given in the Radiation legislation.

Art: 16
Ref. page: -
Question/comment: What is the status of decision-support systems? Are up-to-date computerized decision-support systems being used?

The computerised decision support systems that are currently being used by STUK include the following:

Systems and tools for dispersion estimates, dose calculations and countermeasures

- AINO is a microcomputer program for fast prediction of nuclide concentrations and radiation levels (dose rates and doses) resulting from atmospheric releases of noble gases and iodine.
- Finnish Meteorological Institute and VTT has developed SILAM model, which is a particle model for dispersion and dose calculations. VALMA is the dose calculation part of SILAM for long-term consequences and countermeasures.
- RODOS (= Real-time On-line Decision Support) is used at STUK for real-time estimations such as dispersion, radioactive doses, health effects and economical consequences, for collecting measurements data and for decision support.

Meteorological workstation

The meteorological workstation displays meteorological information in real time from the system of the Meteorological Institute. Particle trajectories and weather data are available through the workstations.

USVA radiation monitoring information system.

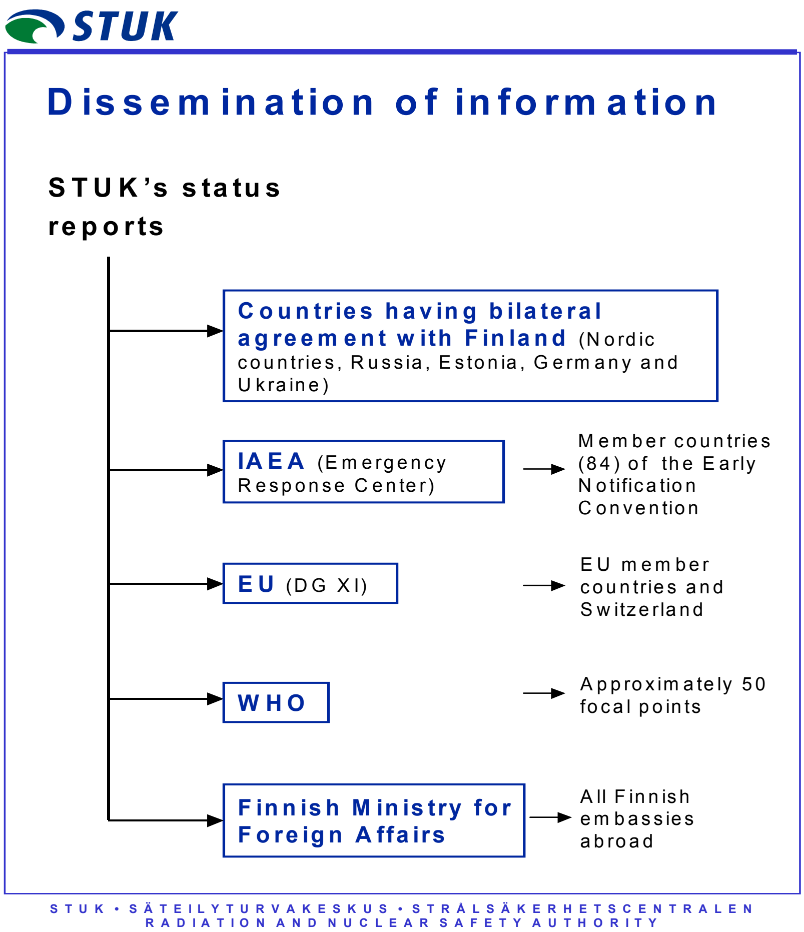
The dose rate of external radiation is measured by a monitoring network maintained by STUK and local rescue services. The network comprises about 300 stations. Measurement data is stored in the national data system.

Automatic data transfer

Nuclear power plant process computers are connected to STUK's emergency centre via data link. STUK's emergency centre receives data from 200 - 500 on-site measurements in 2 - 5 minute intervals. This data can be used to analyse the plant past and current status. Computerised analysis tools that could be used to plant status prognosis are under development.

Art: 16
Ref. page: -
Question/comment: What are the implemented technical means and organizational structure that ensure that neighboring countries receive early information on emergency situations?

Finland has ratified the international conventions regarding early notification and assistance and has implemented guidelines presented in ENATOM (Emergency Notification and Assistance, Technical Operations Manual) in national arrangements. Radiation and Nuclear Safety Authority, STUK, is in Finland the national competent authority for domestic accidents and for accidents abroad. Thus STUK is the body sending information of nuclear or radiological hazards to neighboring countries and to the relevant international organisations. STUK is the national warning point, too, having the responsibility to be immediately available on 24-hour basis.
STUK also has a duty to fulfil requirements regarding emergency arrangements within the European Union and requirements presented in bilateral agreements with neighboring countries (see the figure).



Threshold for initial notification is low: in practise all foreign counterparts are promptly informed about all events in Finland which are considered to be of acute interest to the others.

Early (initial) notification is always sent by fax. Alarm fax numbers of national warning points of relevant foreign bodies are used. Additional information may be sent by electronic mail, too, allowing transmission of graphics, meteorological data, maps etc. Information is also available on Internet.

The Baltic Sea countries have an agreement regarding exchange of monitoring data. All counterparts have access to each other's database of environmental monitoring results. STUK also supplies monitoring data to EURDEP database at Ispra.

Art: 16
Ref. page: -
Question/comment: What is the level of Finnish participation in Swedish exercises (is there a common analysis/evaluation of exercise)? Is the scenario for the exercise jointly prepared?

Nordic countries (Finland, Sweden, Norway, Denmark and Iceland) have a close cooperation regarding emergency exercises. In 1993, first two joint Nordic exercises were arranged. The exercises were performed simultaneously with identical objectives in all countries. Scenarios for those exercises were prepared in a Nordic work group and evaluation results were published in a joint report. The next full-scale exercise with joint Nordic objectives was INEX-2-FIN in 1997. A Nordic evaluation report was published.

Nowadays, Nordic countries actively invite each other to take part in national exercises. The main joint objective is to test communication and harmonisation of decision making. In addition, countries may send their own experts to emergency response centres in other countries to observe action of various response teams. Evaluation results are issued separately but results are discussed in the Nordic work group of emergency preparedness issues. Exercise scenarios are primarily planned and prepared by the accident host country.

Radiation and Nuclear Safety Authority, STUK, participates in practise annually in nuclear / radiological emergency exercises arranged by Sweden. Depending on the scenario, other relevant Finnish bodies are invited, too. Correspondingly, Sweden is invited to take part in Finnish national exercises.

Art: 16 ?
Ref. page: -
Question/comment: Is the emergency planning zone in the vicinity of nuclear power plants specified as a special area with predefined actions for a severe (beyond design basis) accident? If so, what criteria are used to define this emergency planning zone?.

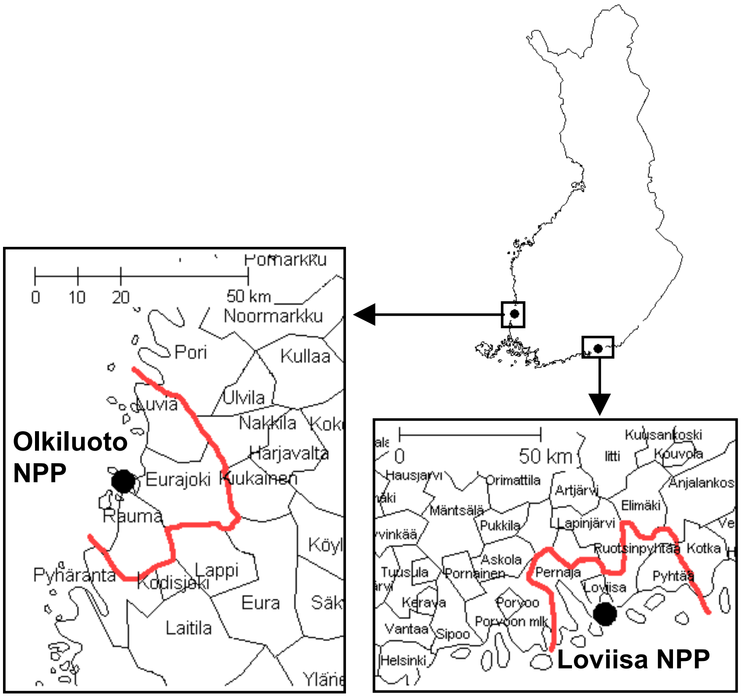
The emergency planning zone is a specified area in the vicinity of the Finnish nuclear power plans. The legislation and regulations concerning that area are:

- *Act on Rescue Services (561/1999) section 9, second paragraph:* the basic requirement for local authorities to prepare off-site emergency plan
- *Decree of the Ministry of the Interior (774/2001) section 3:* the demand for the content of the plan
- *STUK's guide VAL 1.1 "Operational Intervention Levels in Finland" (15.6.2001):* the definition of the emergency planning area with the lists of communities
- *STUK's guide YVL 1.10 "Safety Criteria for Siting a Nuclear Power Plant" (1.1.2001):* land use restrictions in protective zone (0 - 5 km)

The emergency planning zone extends about 20 km distance from the facility and it follows the borders of the communities (See next Figure). The main criteria to define the area is the need for immediate protective measures in the early face of the severe accident. The decisions are based on plant conditions.

The immediate evacuation is executed in protective zone (0-5 km) after the declaration of 'general emergency' in plant, because the hazard of a radioactive materials leak exists. At the same time sheltering indoors, iodine prophylaxis and evacuation are to be considered for the emergency planning zone (5-20 km). All options are considered simultaneously, and the choice of the countermeasure depends on e.g. weather conditions, too.

Fig. The emergency planning zones in the vicinities of the Finnish NNPs.



Art: 16 ?
Ref. page: -
Question/comment: What guidelines were used to prepare the EIA study for NPP Unit 5 and how did you address the issues of „zero alternative“ or „severe accidents“?

<u>Olkiluoto plant:</u>

The contents and procedures of the EIA are defined in Finnish legislation. In the EIA report current status of the Olkiluoto plant and its environment were described. For the zero alternative it was assumed that the impacts on the environment remain at the current level until decommissioning of the existing plant units.

Decision 395/1991 of the Government on the general regulations for the safety of nuclear power plants gives a limit for the release of radioactive materials arising from a severe accident. Additionally, the decision requires that "The possibility that, as the result of a severe accident, the above mentioned requirement is not met, shall be extremely small". Therefore, a release corresponding to this limit was defined, and the consequences of such release were described in the EIA report.

<u>Loviisa plant:</u>

The EIA study followed the Finnish requirements.

The zero alternative was "not to construct a new NPP and to construct/purchase the same amount of electricity", and the impact of the zero alternative was described. The discharges of the zero alternative to the atmosphere were estimated on the basis of modern new fossil fuel (gas or coal) power plants and average present emissions of the imported electricity from neighbouring counties. The economical and social impact to local people was described, too.

The severe accident was selected according to the Finnish requirements (release limit of severe accident). This limit states that the atmospheric release should not cause acute health effects, and the release of Cs-137 has to be smaller than 100 TBq. This release requirement was compared with the IAEA INES classification of accidents. The selected accident was identified to belong to the severity class of 6. The effect of the selected release was described by graphs and explanations. The maximum distance, where the potential evacuation, sheltering and management of contaminated milk would be needed, were pointed out.

Art: 16
Ref. page: 18
Question/comment: In relation to the automatic radiation monitoring network, which is referred in the last paragraph for the Article 16 in page 18, is there any tool for the regulatory body to monitor the plant safety conditions independently in case of emergency? If yes, it would be appreciated if some description on it is provided. If not, how the regulatory body can verify the decision of the licensee on the plant safety conditions in emergency situations.

STUK has a data transfer line from both nuclear power plants to STUK's emergency center, in which we can display safety significant information on screen and follow accident development independently on line. Based on that information STUK can verify the decisions of the licensee.

Art: 17
Ref. page: 18
Question/comment: The last paragraph states that each site is very remote to population and there are no large industrial facilities or transport routes near the sites. Are the changes in these factors re-evaluated during plant operation?

These factors are re-evaluated during power plant operation, especially in connection with renewing the operating licenses of the plants. The latest renewal of the operating licenses took place in 1998. For the protection zone, which extends to about 5 km's distance from the plants, there are land use restrictions pertaining to population and facilities. Safety criteria for siting a nuclear power plant are given in STUK's *Guide YVL 1.10*.

Art: 18
Ref. page: -
Question/comment: What plant systems relevant to safety have been upgraded based on digital technology? When accepting these changes, which requirements have been imposed by the regulator?

Most important I&C systems (such as RPS) at the Finnish nuclear power plants are today based on analogue technology. However, during the modernization project at the Olkiluoto NPP at he end on 1990s' some systems have been replaced by digital systems. At Loviisa NPP the modernization of the whole I&C at both of the units will be made during next 10 -12 years.

As an example of modernized systems and their safety classification can be mentioned neutron flux monitoring systems and main circulation pump drive systems in safety class 2 at Olkiluoto NPP. In safety class 3, there have been turbine control and protection system, refueling machine at Olkiluoto NPP and there is ongoing the modernization of radiation monitoring systems at the Loviisa NPP. Also at the Olkiluoto NPP there is ongoing licensing of various components for electrical and I&C systems.

There are several YVL Guides, which deal with I&C systems in respect of the design and operation of the nuclear power plants. Guide YVL 1.0, Safety Criteria for Design of Nuclear Power plants, provide the general safety design principles, including the I&C systems. The requirements for the design of safety systems are presented in a new Guide YVL 2.0, Design criteria for the safety systems. The requirements for safety classification are presented in the Guide YVL 2.1, Nuclear power plant systems, structures and components and their safety classification.

Detailed requirements concerning the transient and accident analyses are presented in Guide YVL 2.2, Transient and Accident Analyses for Justification of Technical Solutions at the Nuclear Power Plants, detailed requirements for failure analysis are given in Guide YVL 2.7, Ensuring a Nuclear Power Plant's Safety Functions in Provision for Failures and the requirements concerning the reliability and risk analyses in Guide YVL 2.8, Probabilistic Safety Analyses (PSA).

Requirements for the commissioning testing and testing at the site are presented in the Guide YVL 2.5, Pre-operational and start-up testing of nuclear power plants.

The Guide YVL 5.5, Supervision of electrical and instrumentation systems and components at nuclear facilities, gives the requirements specific to I&C systems. This guide is being updated and modernized. The issuance process of this new guide is underway. In principle there is no limitations of using the existing YVL Guide 5.5 to digital I&C systems. In the national hierarchy of the requirements below the YVL guides are applicable standards. The choice and compliance with the standards has to be justified in the licensing application of systems important to safety. In the draft Guide YVL 5.5 for equipment belonging to safety class 2 and safety class 3 essential accident instrumentation a type approval or independent assessment based on nuclear standards made by competent body is required.

The neutron flux monitoring systems generates trip signals for the reactor protection system. The design of this system is from the beginning of 1990s'. The system is composed of the digital part and the most important safety functions have diverse analogue hardwired backup. Due to the problems in the safety demonstration of the digital systems, the safety functions with analogous hardwire backup are credited in the safety assessment.

Art: 18
Ref. page: 19
Question/comment: Digital I&C is already used or will be implemented in Olkiluoto and Loviisa NPPs. Which requirements and procedures are used for licensing digital I&C? Is digital I&C used for safety functions (e.g. RPS) and if yes, how was it certified?

Please, look at the previous question and the response to it.

Art: 18
Ref. page: 19
Question/comment: 'Digital instrumentation and control technology has already been implemented in some modernized systems.' Could you please provide a few examples were these digital technology is used?
Could you shortly explain how licensing has been performed?

Please, look at the previous question.

Art: 19
Ref. page: -
Question/comment: What is the coverage of symptom based Emergency Operating Procedures that are reported to be under development? Are they limited to design basis accident or extended to severe accidents (accident management)?

According to the regulations in Finland, severe accidents are design bases accidents, which means that new symptom based Emergency Operating Procedures will cover also severe accidents.

Art: 19
Ref. page: 20
Question/comment: It is reported that Loviisa nuclear power plant is developing new symptom based emergency operating procedures as part of its severe accident management project, and the new procedures will be taken into operation in 2005.

1) Could you please provide more detailed explanation for the new symptom based emergency operating procedures?

The question is about combined symptom and event based procedures. The objective is to develop a set of emergency and disturbance procedures with background and training material, covering the important internal initiating events according to PSA-results. Severe accident procedures will remain at the present level, but will be coupled with new procedures. The project will apply French approach to the procedures and consultants from a consortium of EdF and Framatome participate in the work. The project group of Fortum consists personnel both from the Loviisa plant and from Fortum Nuclear Services Ltd. A full scope simulator is used during the process and finally to validate and train new procedures. The contract with the vendors has an option to continue the project with emergency procedures for shut-down states.

Art: 19
Ref. page: -
Question/comment: How is ensured the adequacy of engineering and technical support available in Teollisuuden Voima Oy for the 5th reactor in Finland ?

TVO’s need of engineering and technical support is depending substantially on the project implementation model. A turnkey delivery (excluding civil works) is a main option. According to a preliminary plan, TVO’s project organisation could consist of about 60 persons. Many of them have been involved in the Olkiluoto 1 and 2 construction projects. In addition, outside consultancy will be relied on. TVO is already now utilising some international consulting companies.

Art: 19
Ref. page: -
Question/comment: How will be sustained the expertise of nuclear safety personnel in the Finnish deregulated environment ?

<u>Olkiluoto plant:</u>

In a short term, the effects of the deregulated environment are small. In a long term, the maintaining the competence can be a challenge.

Projects offering technical challenges to the staff will be pursued. Participation in the research and development work related to new reactor types is useful and attractive for young people. A new nuclear power plant project in Finland would be of great importance in this respect.

Development of efficient methods to transfer tacit knowledge from the old generation (being involved in construction and licensing of current plants) to the young generation is under consideration.

Loviisa plant:

At the Loviisa plant mostly graduated students have recruited from the engineering physics department of the Helsinki University of Technology and from the nuclear engineering department of the Lappeenranta University of Technology, following the policy described above (please look at the response to the question of Croatia on the article 11). It is believed that in cooperation with these Universities the utilities will have sufficiently skilled experts also in future.

Art: 19?
Ref. page: -
Question/comment: What actions and programmes are implemented by the operator to extend the planned lifetime, and how are those programs discussed with the regulatory body?

Olkiluoto plant:

Olkiluoto I and 2 were modernised in 1995-1998. The main technical goals of the extensive modernization program were: safety enhancement, power uprating and life extension. The modernised units fulfil most of the advanced safety requirements in Finland. The net output of each unit was increased from 710 MW to 840 MW (18.3 %) by uprating the thermal power and by increasing thermal efficiency.

The licensing steps of the modernization were as follows:

- Uprating Safety Analyses Report (like PSAR) and Uprating Probabilistic Safety Assessment (level 1 PSA) were reviewed by STUK.
- Design modifications and test runs were accepted by the STUK before implementations.
- Final Safety Analyses Report (FSAR) and related Topical Reports were rewritten. Almost all transient and accident analyses, as well as component stress calculations, were redone taking into account the uprated power level and modified plant design. The FSAR and Topical Reports were reviewed by STUK in the connection with the operation license renewal.
- Operation license renewal application, covering design modifications and power uprating, was reviewed by various organizations in accordance with the nuclear legislation.
- The Government granted a new operation license for Olkiluoto 1 and 2 in 1998. The licence is valid until 2018.
- Power uprating was reviewed also according to the Environmental Impact Assessment (EIA) legislation.

Loviisa plant:

Current planned lifetime of the Loviisa plant is about 50 years. New lifetime predictions for main components are based on the analyzed operating experience and more accurate calculations. The plant management emphasizes the importance of gentle treatment of all equipment during normal operating states and tests, i.e. limiting, as far as possible, the number and magnitude of thermal and hydraulic transient loads and maintaining the water chemistry parameters in all cooling systems within their specified limits.

The ageing management of the Loviisa plant is based on the predicted lifetimes of the critical main components, e.g. reactor pressure vessel. However, the annealing of the reactor pressure vessel of Loviisa 1 in 1996 gave the possibility to change the ageing management strategy. When planned lifetime of the plant is fixed, the components with faster ageing rates should be listed and their replacing schedule should be fixed in time. The systematic process for selecting, analyzing and collecting data of the critical components was established in 1998.

In Finland the operation licence can be renewed only after a thorough safety review. The current 10-year operating license of both Loviisa units will expire at the end of 2007 and the periodic safety review at 2005-2006 will include also comprehensive assessment of ageing. Therefore, the plant has recently established a life management programme (LMP), which should improve and unify the present programmes and projects.

At the Loviisa plant the modernisation of automation is the most important plant life management issue at the moment. The existing automation and instrumentation will be replaced within the next ten years by new type of automation. The work for preliminary scheduling and scoping of the modernisation of automation is going on.

All programmes are presented and discussed with STUK. STUK does not officially approve this kind of strategies or programmes, but modification plans and component renewals are subject to the approval by STUK.

Art: 19 ?
Ref. page: -
Question/comment: The report does not discuss the use of performance indicators. Are performance indicators used by the regulatory body or the operating companies? If so, what are those indicators, and how are they used?

<u>Olkiluoto plant:</u>

TVO uses WANO indicators. The trend of all WANO indicators is investigated and published quarterly. A graphic presentation of the actual situation regarding WANO indicators is included in TVO's intranet. Own results are compared annually with a reference group of NPP units. If any indicator shows that TVO is worse than the median of the reference group, investigations are performed.

<u>Loviisa plant:</u>

Fortum uses and reports WANO Performance Indicators which are: Unit Capability Factor, Unplanned Capability Loss Factor, Unplanned Automatic Scrams per 7000 Hours Critical, Safety System Performance (High Pressure Safety Injection System and Auxiliary Feedwater System), Fuel Reliability, Chemistry Performance, Collective Radiation Exposure, and Industrial Safety Accident Rate. Trends are followed and discussed at the plant and some indicators have target values in the annual plan (Unit Capability Factor and Industrial Safety Accident Rate).

STUK:

Please, look at the question about the factors that STUK uses in its indicator system earlier in this report and the response to it.

Art: Plan Act.
Ref. page: 23
Question/comment: Which type of ageing considerations has been included into the National Finish research program on nuclear power plant safety?

The Finnish National Research Program (FINNUS) has been launched by the Ministry of Trade and Industry for the period 1999-2002. STUK has had a dominant role in planning and guiding the program. The research objectives of the program are classified under three themes, ageing, accidents and risks. The ageing field covers material sciences of the metallic structures in nuclear power plants, structural integrity studies and in-service inspection and monitoring methods.

Identification of critical components, ageing mechanisms and changes in in-service properties is crucial in order to develop preventive actions as well as remedial measures and to evaluate the remaining component lifetimes. The program develops and applies methods for determining in-service properties of aged materials and components. The aim is to model the effects of water environment and irradiation exposure on the ageing phenomena and particularly, the effects of re-irradiation after annealing of the Loviisa pressure vessel.

The objectives of the work on structural integrity are creation of verified experimental and computational methods and also verification of the existing methods for assessing the remaining lifetime of components and their ability to withstand possible accidents.

The reliability of in-service inspections is improved by applying advanced inspection techniques and new analysis methods. The qualification of inspection systems is seen as one area of major importance. On-line monitoring techniques are considered for acquisition of structural integrity data during plant operation.

As can be understood from the general description of ageing theme of FINNUS the program is mainly concentrated on understanding ageing mechanisms of materials used in the main components of Finnish NPPs , on developing methods and techniques for assessing their effects and on improving the reliability of in-service inspections. The evaluation of ageing of special components is not the objective of this program but the purpose is to give tools for the licensees to carry out the Plant Life Management activities in an optimised manner and for the authority to assess these activities. The work with the effects of re-irradiation on the annealed Loviisa reactor pressure is an exception to this principle.

There is also a small project on the ageing phenomena and failure mechanism related to the new digital electronics.

Art: Plan. Act.
Ref. page: 23
Question/comment: Article 3 describes that the issue of aging has also been included into the national Finnish research program on nuclear power plant safety.
On which components are the aging research program performed in the aging research program?

Please, look at the previous question and the response to it.