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NUCLEAR ENERGY AGENCY
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

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REGULATORY INSPECTION ACTIVITIES RELATED TO RADIATION PROTECTION, LONG SHUTDOWNS AND SUBSEQUENT RESTARTS, AND THE USE OF OBJECTIVE INDICATORS IN EVALUATING THE PERFORMANCE OF PLANTS

Hosted by United States Nuclear Regulatory Commission
Sponsored by Committee on Nuclear Regulatory Activities (CNRA) and the Working Group on Inspection Practices (WGIP)

APPENDIX TO THE WORKSHOP PROCEEDINGS,
Baltimore, MD, United States
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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), Korea (12th December 1996) and the Slovak Republic (14th December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full Member. NEA membership today consists of 27 OECD Member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its Member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

The Committee on Nuclear Regulatory Activities (CNRA) of the OECD Nuclear Energy Agency (NEA) is an international committee made up primarily of senior nuclear regulators. It was set up in 1989 as a forum for the exchange of information and experience among regulatory organisations and for the review of developments which could affect regulatory requirements.

The Committee is responsible for the programme of the NEA, concerning the regulation, licensing and inspection of nuclear installations. The Committee reviews developments which could affect regulatory requirements with the objective of providing members with an understanding of the motivation for new regulatory requirements under consideration and an opportunity to offer suggestions that might improve them or avoid disparities among Member Countries. In particular, the Committee reviews current practices and operating experience.

The Committee focuses primarily on power reactors and other nuclear installations currently being built and operated. It also may consider the regulatory implications of new designs of power reactors and other types of nuclear installations.

In implementing its programme, CNRA establishes co-operative mechanisms with NEA's Committee on the Safety of Nuclear Installations (CSNI), responsible for co-ordinating the activities of the Agency concerning the technical aspects of design, construction and operation of nuclear installations insofar as they affect the safety of such installations. It also co-operates with NEA's Committee on Radiation Protection and Public Health (CRPPH) and NEA's Radioactive Waste Management Committee (RWMC) on matters of common interest.

ABSTRACT

The NEA Committee on Nuclear Regulatory Activities (CNRA) believes that an essential factor in ensuring the safety of nuclear installations is the continuing exchange and analysis of technical information and data. To facilitate this exchange the Committee has established Working Groups and Groups of Experts in specialised topics. The Working Group on Inspection Practices (WGIP) was formed in 1990 with the mandate "... to concentrate on the conduct of inspections and how the effectiveness of inspections could be evaluated...".

This appendix to the workshop proceedings contains a compilation of the responses to the survey issued to all participants.

These proceedings cover the 5TH International Workshop held by WGIP on regulatory inspection activities. The focus of this workshop was regulatory inspection activities in 3 main areas: activities related to radiation protection inspections, regulatory inspections required for long shutdowns and subsequent restarts, and the use of objective indicators by the regulatory authority in evaluating the performance of plants.

The workshop was hosted by the United States, Nuclear Regulatory Commission (US NRC) Office of Nuclear Reactor Regulation (NRR) and took place in Baltimore, Maryland from the 15th through the 17th of May 2000. This document presents the proceedings from the workshop, including: workshop programme, results and conclusions, papers and presentations and the list of participants.

Questionnaire - Part A

Radiation Protection Inspections

NOTES

- Only one response per country is required. If more than one person from your country is participating, please co-ordinate the responses accordingly.
- Please provide responses on separate sheet and clearly identify the questionnaire part and topic.
- Please provide Submittal prior to 31 March 2000. Submittals should be sent by email to: barry.kaufer@oecd.org

For preparation of the workshop, participants are invited to supply their national inspection approaches used in Radiation Protection Inspections according to the following questionnaire:

1. LEGAL MATTERS

Structure of Legislation and legal requirements, role of different national authorities involved in radiation protection

2. ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

- *Organisation of inspections (i.e. inspection planning, realisation of inspections and enforcement, joint or dedicated inspections, internal guidelines etc.)*
- *Qualification and Training of Inspectors*
- *Work load: Number of Licensees inspected per inspector*

3. INSPECTION TOPICS AT THE NUCLEAR POWER PLANT

The following list of inspection topics serves as a guide. Please describe to each topic the inspection programme (type of inspection, objectives of inspections, frequencies).

(a) Organisation of the licensee's radiation protection personnel, responsibilities, qualification

(b) ALARA management, for example:

- *Policies and requirements*
- *Work planning*
- *Use of cost-benefit-analysis as a possible tool in decision-making.*

(c) Operational radiation protection measures applied for example to:

- *access control*
- *fuel exchange*
- *maintenance and repair works*
- *outage planning*
- *regular surveys of surface and airborne contamination and dose rates in accessible areas.*
- *protection measures (protective clothing, temporary shielding etc.)*

(d) Radiation protection instrumentation and sampling, for example applied to:

- *process instrumentation*
- *stationary equipment for room dose rate survey*
- *portable instrumentation (doserate, surface- and airborne contamination)*
- *personnel contamination and incorporation control*
- *calibration and testing of instrumentation*
- *control of gaseous and liquid radioactive effluents*
- *environmental monitoring*

(e) Dosimetry, for example applied to:

- *individual and collective doses (plant personnel, contractors personnel)*
- *job doses*
- *partial body dosimetry*
- *reporting requirements.*

(f) Measures applied or planned to cope with situations after incidents, for example:

- *access restrictions*
- *clean-up of contaminated areas.*
- *support of fire fighting*

(g) Training in radiation protection, for example:

- *training of plant personnel and subcontractors personnel*
- *training of technicians and responsible persons in radiation protection*

(h) Other topics of interest to be discussed at the workshop

Responses to Questionnaire - Part A

ARGENTINA

1. Legal Framework

The radiological protection criteria applied in Argentina establish that practices using ionising radiation shall be justified, radiological protection shall be optimised, limits and established dose restrictions shall not be exceeded, and accidents shall be properly prevented. These criteria have been applied in our country for more than two decades. The justification criterion sets that any practice that implies, or could imply, personnel exposure to ionising radiation, will only be justified if it originates a net positive benefit to the society. In the case of installations involved in this report it is not considered necessary to give more details for its justification. Concerning the optimising of radiological protection systems, the ARN requires that personnel exposure due to a justified practice be kept as low as reasonably possible, taking into account social and economical factors (ALARA). In order to achieve optimisation, ARN requires that the technically available options and the collective dose reduction be detailed as well as the cost associated to each option.

Several radiation protection standards have been developed to regulate the radiation protection practices. Considering the dose contribution received by the critical group due to practices carried out at regional and global levels, and future practices, ARN has established dose restrictions (dose constraints), not only on the effective dose but also on the collective effective dose. ARN established dose limits for occupational exposure: the effective dose limit is 20 mSv per year. This value shall be considered as the average in 5 consecutive years (100 mSv in 5 years), but 50 mSv shall not be exceeded in a single year; and, the equivalent dose limit is 150 mSv in a year for the crystalline, and 500 mSv in a year for skin. These limit values have come in force in January 1995 and since then, the value of the effective dose integrated over five years is also accounted for.

3. Inspection Topics

The control and surveillance of the contents of standards and other regulatory documents, is completed with an inspection program to determine the fulfilment of the operation license and every other mandatory documentation contents. This control is carried out by ARN by means of resident inspectors and working groups who perform inspections, analyses and evaluations related to different topics on Radiation Protection area. These working teams have their own laboratories so that they are able to perform all kinds of measurements and experiments required for such purpose.

Traditional inspection methods are also used within radiation protection inspections such as monitoring and direct observations, operator’s interviews, procedures review etc.

Routine Inspections: inspection made daily by resident inspectors based on the operating licence, standards, Resident Inspector Manual and plant information. These inspections include the radiation protection areas as a routine basis like access control, maintenance activities and regular surveys. Additional routine inspections are carried out like effluents control and environment monitoring. The ARN measurement plan during a year operation consists in the measurement of the released activity in those places where effluents are emitted. This plan includes a measuring timetable routine and it is complemented with random controls

Special inspections: especially carried out when it is necessary to reinforce the inspection tasks, like outages and radiation protection events. They are carried out by ARN radiation protection support group and special reporting characteristics are specified.

Inspections during plants outages: working teams composed by resident inspectors and other ARN technical supporting staff to perform inspections before and during the outage. Special procedures are used in accordance with the safety significance of the planned works and surveillance. The team covers all relevant areas 24 hours a day even during weekends, if necessary.

Audits: Audits are performed in different radiation protection areas: instrumentation, calibration, personal dosimetry system, intercomparison exercises.

Inspection of ALARA programs: ARN standards to set the goals of dose optimisation. To validate the ALARA programs it is necessary to identify some aspects such as:

- Organisation and management: policies of radiation protection practices, selection and training of personnel, setting of goals, performance monitoring, etc.
- Personnel training: documented qualification of personnel, scope of the training.
- Dose limitation for workers: control of personnel exposure, source control, - protection barriers / equipment and administrative controls.
- Public dose control.

Operational radiation protection monitoring: example of some ARN activities considered on the radiation protection inspection plan (during routine and outages inspections)

- Daily control of “plant dose goals ”: In the case that these goals can’t be met, find out the cause and evaluate if the increases are justified.
- Equipment evaluation, shields and other protection items (e.g. clothing), are adequate in every subtask.
- Follow up of radiological events and evaluation of corrective actions.
- Control of management of radioactive wastes.
- Control of plant daily reports to detect possible omissions.
- Verify the use of criteria of individual dose limits for every job and for every day. Check up the use of ALARA criteria.
- Evaluate the operators and contractors training received by groups of maintenance.
- Control the mapping of exposure rate before the beginning of tasks and when it is required for teams work or when abnormal doses are detected.
- Make independent mapping in order to compare these measures with those made by the plant, if necessary.
- Verify that shields are calculated and built according to the optimisation of doses criteria set by the plant.
- Verify that controlled areas are prepared according to the optimisation of doses criteria and that adequate procedures are used. Control detectors and ventilation systems are used.
- Control the discharge of gaseous and liquid effluents. Verify the calibration of the detection equipment.
- Verify that a daily control of individual doses is done considering the team work and the responsibility of each worker.
- Evaluate supervision efficiency.
- Verify housekeeping.
- Inspection reports.

BELGIUM

1. Legal matters.

1) The Belgian Legislation concerning radiation protection is included in a Royal Decree of February 1963. Concepts such as maximum dose for workers and public, the as low as reasonably possible principle, the definition and protection measures for area's with different radiological hazard, annual level of intake limits, etc. are all detailed in this legislation.

2) The same Royal Decree describes the control and inspection measures concerning radiation protection. The Utility itself has to organise a Health Physics Department that controls whether all legal requirements concerning radiation protection are met. According to the same legislation an authorised inspection agency has to perform independent inspections to verify whether legislation is respected and the Physical Protection Service performs adequate control. AVN is authorised by the Belgian responsible Ministry as the RB to perform these inspections.

3) The license of a nuclear power plant refers to the FSAR as the design bases of the NPP. The design bases with respect to radiation protection of workers and with respect to gaseous and liquid radioactive releases are detailed in chapters 11 en 12 of the FSAR, according to the USNRC standard format and are, apart for the requirements of the Royal Decree mentioned above, mainly based on the American Regulation.

4) Together the Royal Decree of '68 (and later addenda) and the FSAR and American rules and guidelines referenced in the FSAR provide the legal rules and guidelines for radiation protection. They form a quite elaborate and complete set of rules on which radiation protection is based.

5) All inspections related to radiation protection in Belgian nuclear power plants are carried out by AVN only.

The ministry of labour collects date related to the workers doses (verification of annual limits of workers) and establishes reporting requirements on radiological incidents.

Another authorised agency is involved with respect to the qualification of legal dosimeters and other radiation monitors.

Administrative aspects.

To fully understand the way in which inspections related to radiation protection are organised in Belgium, it is important to know that almost all inspections related to one unit are performed by the Resident Inspector of that unit. This practise is changing. In the future it is planned to perform inspections in the field of radiation instrumentation in all units by a dedicated expert.

Radiation protection (RP) aspect is a continuous point of attention for the resident inspector during all his visits to the installation.

All RP-incidents are spontaneously communicated to AVN on a weekly bases (even those not submitted to reporting requirements).

During regular visits to the head of the Health Physics Department the Resident Inspector is informed on all planned changes in the organisation. Unplanned changes are reported as soon as possible.

Quarterly the head of the RP service is interviewed on all aspects related to radiation protection: radiation measurements, dosimetry, modifications (organisation and technical), periodic testing, working procedures, condition of the installations, organisation and surveillance of work in the controlled area, ...

In the case of an important radiation incident a reactive inspection may be performed by the resident inspector.

Resident inspectors have to be licensed by the ministry of labour. The qualification requirements for this license include a university degree in engineering or equivalent and an extensive experience and/or education in radiation physics and radiation protection.

Inspection topics at the NPP.

Formal requirements only exist for the qualification and the organisation at the management level.
The responsibilities with respect to radiation protection are described in detail in the SAR, the regulations referenced in this document and in the Belgian legislation. It is verified that these tasks and responsibilities are addressed in the working procedures and properly executed.

The ALARA principle is explicitly stated in the Belgian legislation. There is no dose/cost level used to determine whether enough effort is put into dose reduction. For all work with a total dose of more then 0.5 man-mSv a dose optimisation is made. For more then 5 man-mSv a more detailed optimisation is performed. Only work with high dose cost are discussed in some detail with the RB.

During the quarterly interviews of the head of the RP-service some of these topics are discussed. [This is certainly subject to changes in the near future.] Each topic should be covered with a yearly periodicity.

As the resident inspector himself performs the RP-inspections, all the RP matters are a continuous point of attention during all his inspections and plant walk downs.

All incidents related to any of these topics are reported to the resident inspector.

The part of the RP-instrumentation submitted to Tech Spec requirements such as effluents monitoring instrumentation, post accident monitoring instrumentation, process instrumentation with automatic actions to mitigate accident consequences, are closely followed by the RB. Any unavailability of such instrumentation is reported to the resident inspector and its performance is discussed during the quarterly visits. All modifications to this instrumentation have to be reported to and approved by the RB.

The performance of the instrumentation for the radiation monitoring of the workers is discussed during the quarterly visits. Modifications are reported to the resident inspector and can be subject to approval by the RB.

Every month a report on the environmental monitoring is sent to the RB.

The histogram of individual doses and the collective doses of different work activities during and after each outage.

All incidents that involve important external or internal contamination (of people subjected for any reason to a whole body count) are reported to the resident inspector who may decide on further inquiries.

Formal reporting requirements are listed in the Tech Spec and correspond to severe irradiations, contaminations or incidental radioactive discharges.

This topic is only discussed on an ad hoc basis, when such problems occur. Incidents can be subject to specific inspections by the resident inspector.

On the other hand, the radiation protection to be implemented after a major accident, is routinely discussed.

The training program of the plant personal in general, RP-personnel and subcontractors are discussed on an ad hoc basis, in particular when they are related to the root cause of an incident.

Only the head of the RP-service is subjected to a legal qualification and training program.

CANADA

LEGAL MATTERS

- Regulatory body presently Atomic Energy Control Board changing to Canadian Nuclear Safety Commission.
- Established by Federal Law.
- Law allows the regulator to produce regulations
- Law allows the regulator to use licences to regulate all aspects of nuclear power including construction, operation and decommissioning
- Regulator may impose any license condition it deems necessary for safety and protection of the environment, however licensee has a right to appeal license conditions to the Commission.
- Radiation Protection Regulations include dose limits for the public and Nuclear Energy Workers. Regulations also require licensees to establish a radiation protection program.

ADMINISTRATIVE MATTERS

Routine Radiation Protection Inspections

- carried out by regulatory staff stationed at Nuclear Power Plant
- combined with other inspection activities carried out at plant
- inspector reviews performance of workers, dose records internal event reports to verify compliance of the licensee staff
- inspectors are normally experienced personnel hired from nuclear industry
- training in Radiation Protection is normally the same as that received by Utility staff
- usually approximately 4 inspectors per 4 Unit Station
- noncompliances brought to attention of licensee with remedial action either requested or ordered.

Non-Routine Radiation Protection Evaluations

- carried out by RP specialists from Headquarters in conjunction with site inspectors
- usually 4 team members per evaluation 3 HQ, 1 site
- usually 1 week duration consisting of observations, interviews and document review
- evaluation findings include strengths and weaknesses
- evaluation findings may lead to remedial actions ranging from Recommendations based on good industry practices to Directives associated with noncompliances or safety problems

- evaluations use performance objectives and criteria based on INPO Objectives/Criteria and IAEA OSART Guidelines and Regulator experience
- usually 1 to 2 evaluations per plant per year

- training and qualifications for evaluators consist of
  a) on-the-job training
  b) specialised courses in Radiation protection, Auditing, Investigations
  c) experience in Nuclear Plant

INSPECTION TOPICS AT THE NUCLEAR POWER PLANT :

Non-Routine Inspections (RP Evaluations) cover the following areas of RP at CANADIAN CANDU nuclear power plants. The specific areas covered during a particular evaluation are determined based on the following; licensee performance history including significant events, regulatory campaigns (plant comparisons) length of time since last evaluated etc.

Organisation and Administration of Radiation Protection

The organisation and administration of radiation protection (RP) programs provides effective implementation and control of radiation protection activities. The roles, responsibilities and qualification requirements of all persons involved in the RP program are clearly defined. All levels of management and workers are committed to RP requirements and practices within their level of responsibility. A performance review process is established to evaluate the effectiveness of the RP program.

General Employee Qualification and Performance in Radiation Protection

Workers, supervisors, contractors, and visitors have the qualifications (knowledge, skills, experience) needed to effectively perform radiation protection practices associated with their work. A requalification program is implemented to maintain this qualification.

Radiation Protection Personnel Qualification and Performance

Radiation protection personnel and radiation protection supervisors have the qualifications (knowledge, skills, experience) needed to effectively implement and conduct the radiation protection program.

Radiation Exposure and Dose Control

Radiological conditions are monitored and sources of external and internal radiation exposures are controlled. Access and work in radiological areas are controlled so that collective and individual radiation exposures are kept ALARA.

Radiation Protection Instrumentation and Equipment

Radiation protection instrumentation and equipment is calibrated, maintained and used so that radiation levels are accurately determined.

Solid Radioactive Waste and Transportation of Radioactive Packages

A radioactive waste management program is implemented to control and minimise the volume of radioactive waste. All radioactive material is transported in accordance with applicable procedures and regulations.

Personnel Dosimetry

The personnel dosimetry program ensures that external and internal radiation doses to individuals are accurately determined and recorded.

Radioactive Contamination Control

Appropriate contamination control measures are implemented to control and minimise the contamination of areas, equipment and personnel.

Emissions Monitoring

Radioactive effluent releases are controlled, documented and comply with regulatory requirements. The emission monitoring program adequately assesses the emissions resulting from the licensed activity.

CZECH REPUBLIC

Legal Matters

Legislation is based on the **Atomic Act** (Act of Peaceful Utilisation of Nuclear Energy and Ionising Radiation, 18/1997Coll) and Regulation No 184/1997Coll of the State Office for Nuclear Safety on Radiation Protection Requirements.

The main role given by the Law has the **State Office for Nuclear Safety** (SONS), which a.o. executes the state supervision over nuclear safety, nuclear items, physical protection, radiation protection and emergency preparedness in premises of nuclear installation or ionising radiation source workplaces and inspects adherence to a fulfilment of obligations given by the Law. The **Czech Metrology Institute** according to the Law on metrology No 505/1990 Coll is concerned in metrology of selected instruments. In the event that a licence to discharge substance into the environment is issued by a ministry or other administrative body under specific regulations (“the **Water Act**” No 138/1973Coll, “the **Air Act**” No 309/1990Coll) and the content of radionuclides is one of the aspects under consideration for issue of the licence, approval by the Office is an obligatory basis for issue of the licence.

Administrative aspects of the regulatory bodies inspections on radiation protection.

Organisation of inspections.

Under Act No 18/1997 Coll. and related regulations, the supervisory activities can be divided into reviewing/assessment activities and inspection activities. The latter can be divided as routine inspections visits and special visits. Reviewing and assessment include operator performance assessment by modified SALP system (Systematic Assessment of Licensee Performance, applied by US regulatory body), assessment of the safety indicators and review of documentation. Information extracted from periodical (daily, weekly and monthly) operating reports is also exploited within the supervisory activity.

Findings and conclusions of inspections at nuclear facility are rated as 1 to 3, grade 1 being the most favourable rating, grade 3 needs remedial provisions implemented by facility. In the year 1999, there were altogether 17 inspections at NPP´s; 14 inspections were rated as grade 1, 3 inspections as grade 2.

When check of measurements of licensee have to be performed, the National Radiation Protection Institute of which State Office of Nuclear Safety is a managing authority, has the qualified staff for such measurements and interpretation of it.

Qualification and Training of Inspectors.

Inspector must be a university graduate in a relevant field and must have three years of professional experience. Inspector must meet requirements verified by a method established in a specific Act (Act of the Czech National Council, No 552/1991 Coll., on State Inspection and Monitoring, in the wording of Act No 166/1993 Coll)

Work load: *Number of licensees inspected per inspector*

There are altogether 51 inspectors in radiation protection. Based on Act 18/1997, ionising radiation sources are divided into 5 classes with respect to the increasing extent of possible endangerment of human health and the environment: insignificant sources, minor sources, simple sources, significant sources, and very significant sources. Inspections for the potentially most hazardous sources are more frequent, extensive and detailed. Among workplaces with very significant sources are nuclear power plants and other nuclear facilities. There are altogether 371 significant sources; sources classified by lower grades are few thousands.

Six inspectors are members of specialised group which in 1999 performed 17 inspections (16 NPP Dukovany, 1 in the NPP Temelín)

Inspection topics at the nuclear power plant

(b) ALARA management

Policies and requirements.

Use of ALARA principle is given by the Atomic Act formulated explicitly that anybody, who utilises nuclear energy or provides practices leading to exposure or provides interventions to reduce exposure from natural sources or exposure resulting from radiation incident, shall maintain such level of nuclear safety, radiation protection, physical protection or emergency preparedness, that risks to life and health of people and to the environment are as low as reasonably achievable, taking into account social and economical factors. It is further specified in the regulation No 184/1997 Coll on Radiation Protection Requirements: The reasonable achievable level of radiation protection is possible to prove by the procedure during which there are compared the costs for the alternative measures for the upgrade of radiation protection (e.g. by the construction of additional barriers) with the financial assessment of expected reduction of exposure. The reasonably achievable level of radiation protection is considered as proved and the measures shall not be carried on, as far as costs would be higher than the contribution of measure. The contributions of measure is numerically expressed at this procedure so, that the reduction of collective effective dose in the case of exposed collective of workers with sources or in the case of population is multiplied by the coefficient. Financial equivalents are given numerically in the regulation. In work planning and decision making, cost – benefit -analysis is used routinely (esp. during non- routine maintenance and repair operations)

(d) *Radiation protection instrumentation and sampling*

According to Atomic Act, licensee is obliged to monitor, measure, evaluate, verify and record values, parameters and facts with an impact on nuclear safety, radiation protection, physical protection and emergency preparedness. There are annexes to the Atomic Law describing necessary documentation which has to be approved from the national authorities. The monitoring programme shall include for both the normal operation and also for the foreseen deviations from the normal operation, including the radiation accidents and if need also the radiation emergencies:

- the definition of quantities that will be monitored, the way, the scope and the frequency of measurements,
- the instructions for the evaluation of results of measurements,
- the values of reference levels and the overview of relevant measures in the case of their exceed,
- the specification of methods of measurements,
- the specification of parameters of used types of measuring instruments and aids.

The instruments which measure quantities which are subject of limitation (given in the document Limits and Conditions) have to be meteorologically checked in preselected intervals.

Incorporation control is performed by whole body counting, thyroid counting and counting of urine samples for tritium in monthly intervals.

Control of gaseous and liquid radioactive effluents is performed continuously and principally in two ways: to enable to signalise exceeding of any preselected level and to enable balancing of the annual release of all radionuclides, that relevantly contribute to the exposure of population. (Regulation 184/1997 Coll.). For balancing monitoring, semiconductor gamma spectrometry is employed both for aerosol monitoring and for monitoring of radioactive noble gases.

Environmental monitoring is aimed mostly for the emergency preparedness. It serves also for the evidence that the impact of releases is below given limits (in practice during normal operation it is negligible; apart of tritium in surface waters and ^{137}Cs and ^{90} Sr from Chernobyl accident and nuclear weapons tests, there are no artificial radionuclides measurable in the environment of NPP)

(e) Personal dosimetry

In the NPP Dukovany, which is the only one in the operation in the Czech Republic, no personal effective dose exceeded limits for personnel in 1999. Altogether 2261 workers were followed (from this number, 881 employees of the NPP). Annual collective dose was 1,39 Sv, annual average effective dose was 0,61mSv. The highest effective dose in one month was 12,4mSv (employee of a contractor). The highest effective dose from internal exposure was 0,24mSv (employee of a contractor).

Other topics of interest to be discussed at the workshop

Derivation of investigation levels for measurement of effluents.
Models used for the estimation of committed effective dose from internal contamination
Procedures for the rapid estimation of internal contamination

FINLAND

LEGAL MATTERS

According to the Nuclear Energy Act the Ministry of Trade and Industry is responsible for the highest management and supervision of nuclear energy matters. It is also stated that the Radiation and Nuclear Safety Authority (STUK) is responsible for the supervision of the safe use of nuclear power (including radiation protection). In addition STUK shall be responsible for attending to the supervision of physical protection and emergency planning, and for necessary control of the use of nuclear energy to prevent the proliferation of nuclear weapons.

The Radiation Act and Decree were revised in 1991, taking into account the recommendations in ICRP Publication 60. The principles of this Act are applied to the use of nuclear energy. Latest amendments were made to the Act in the end of 1998 to meet the requirements in EU-directives.

In the Radiation Act it is stated that the Ministry of Social Affairs and Health is the supreme authority on supervision of compliance with this Act in matters that concern:

general evaluation of the health hazards caused by radiation,
evaluation of the need for measures to limit exposure to radiation, and laying down the requirements concerning such measures, or
requirements that concern monitoring of the radiation exposure of workers and other persons exposed to radiation.

The supreme authority on the supervision of practices involving exposure to radiation is the Ministry of Social Affairs and Health, except in the following branches, where the supreme authority is the Ministry of Trade and Industry:

- use of nuclear energy as referred to in the Nuclear Energy Act,
- work in mines as referred to in the Mining Act,
- commercial manufacture of and trade in radiation sources, and imports and exports of the same.

Based on the Nuclear Energy Act, the Council of State have also issued general decisions. Detailed safety requirements (also in radiation protection) are provided in YVL Guides. The YVL Guides also provide administrative procedures for regulation of the use of nuclear energy. These Guides are issued by STUK, as stipulated in the Nuclear Energy Act. The YVL Guides are rules an individual licensee or any other organisation concerned shall comply with, unless some other acceptable procedure or solution has been presented to STUK by which the safety level laid down in an YVL Guide is achieved.

ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

The inspection activities can be divided into inspections described in the YVL Guides, topical inspections and inspections of the Periodic Inspection Programme (PI-programme).

A separate guide lays down the structure of the Periodic Inspection Programme concerning the regulatory control of safety at an operating NPP (there are 4 NPP units in Finland) as well as the procedures for inspection planning, performing, documenting and result reviewing. The periodic inspection program is divided into three different levels:

- Assessment of the level and development of management’s activities in the safety point of view (level A)
- Propriety of the safety functions in the main working processes (level B)
- Propriety of the different organisational units and technical areas (level C).

The radiation protection (RP) inspection is annually in level C, but RP aspects are naturally inspected also in levels B and C. A responsible inspector, a person nominated for each inspection separately, is in charge of implementing the inspection according to a internal guide and an annual periodic inspection plan. For RP inspection there is one responsible inspector. At his disposal there are many experts as well from own RP Office as from other offices.

In addition to the PI programme there are several separate inspections especially during outages. Also new RP monitors, major changes in the controlled area etc. are normally inspected at the site. Also meetings are arranged concerning current topics.

Planning of a periodic inspection (PI)

The planning of a PI shall be started in good time before the inspection. The responsible inspector is in charge of planning the inspection with the help of the working group. The planning of the inspection consists of the following phases:

- Collecting information
- Planning
- Nominating the inspection group (An inspection group is nominated according to the chosen areas and objects of inspection).
- Preparing the inspection announcement
- (The inspection procedures and the inspection date shall be discussed and agreed with the licensee in good time before the inspection.)
- Preparing an inspection plan
- Handling and distribution of the inspection plan

Documenting and reporting the PI

A protocol of the inspection is compiled in duplicate. The deviations from the set requirements are presented in an appendix of the protocol.

After the inspection, the inspection group prepares an inspection report where STUK's assessment of the status of the inspection area in question is presented. The inspection summary consists of the following chapters:

- Deficiencies and deviations that presuppose repair or improvement
- Potential objects of improvement
- Development taken place after the previous inspection
- Remarks concerning regulations and the control of nuclear safety

STUK's decision on the inspection report:

A decision of STUK is prepared after a PI. The decision includes STUK's requirements based on the observations presented in the inspection report (and the inspection protocol).

Annual report

The PI co-ordinator collects and compiles a summary of the execution of the PI-programme and the results of all inspections into an annual report. In that report PR-inspection is also represented.

WORK LOAD IN STUK

About 70 professionals are working in the field of nuclear energy. The expertise of STUK covers all the essential areas needed in the safety control of the use of nuclear energy. In the Radiation Protection Office there are 5 experts.

Almost all of the professional staff of STUK conducting safety assessments and inspections have a degree of university level. A training programme has been established for the staff of STUK. The training in the branch of inspection can be described to be a continuos process.

STUK also has close connections with foreign regulatory bodies for exchanging information on important safety issues. The average experience of the staff is about 14 years in the nuclear field.

INSPECTION TOPICS AT THE NUCLEAR POWER PLANT

A PI is focused on the appropriateness of radiation protection methods and procedures. The radiation protection function covers the radiation safety of NPP personnel (own and contractors) and of the surrounding population. It encompasses technical and administrative radiation protection, occupational dosimetry, radioactive releases and monitoring of discharges and radiation level measurements on-site and in the plant's vicinity. Organisation of radiation protection as well as training and instructions are assessed in this inspection. The fulfilment of QA requirements related to this area is reviewed. The Main inspection criteria used are:

- Requirements in the Radiation Act
- Requirements in YVL Guides
- Licensee's own instructions

In a periodic RP inspection organisation *of the licensee's radiation protection personnel, responsibilities, qualification are annually taken into consideration. Today there is a tendency that experts are more and more out-sourced. It is considered essential that there are enough resources at the NPP.*

ALARA management and work planning are inspected annually. These topics are discussed also on the basis of outage planning reports which NPPs are obliged to send to STUK before outages. Up-to-date ALARA programs shall be written and also sent to STUK for information.

Cost-benefit-analysis as a tool in decision-making is not widely in use. It is seen unacceptable that extra doses are permitted on the basis of cost-analysis.

Measures in RP applied for access control, protection measures, maintenance and repair works, measurements, etc. are inspected routinely during outages. Outage planning is normally inspected separately in the periodic inspection before an outage.

RP instrumentation and calibration and testing are normally inspected once in two years. Modifications or new RP equipment at the plant are inspected separately. Also if there are some longer periods in which monitors are out of function, separate inspections are usually performed.

The control of gaseous and liquid radioactive effluents is inspected annually. Personnel contamination and incorporation control are normally inspected during outages.

Environmental monitoring is normally inspected in detail once in three years. The research department in STUK has an own service for environmental analysis.

Dosimetry is inspected annually. The inspection is a part of the annual periodic inspection in RP. Normally blind-tests are made for the TL-dosimeters used. In outages dosimetry (use of official TL-dosimetry as well as electronic dosimetry) will be always inspected at the plant. The National Dose Registry is held by STUK. The inspectors in RP are allowed to read the information in the Registry making it possible to inspect reporting. Reporting requirements are stated in separate regulatory guide. In reports individual and collective doses (plant personnel, contractors' personnel, job doses) are included. This gives good bases for inspection work.

For incident-reporting there is a specific regulatory guide. But in many cases STUK will establish an incident investigation group, in which inspectors from different areas (for example human factors) are involved.

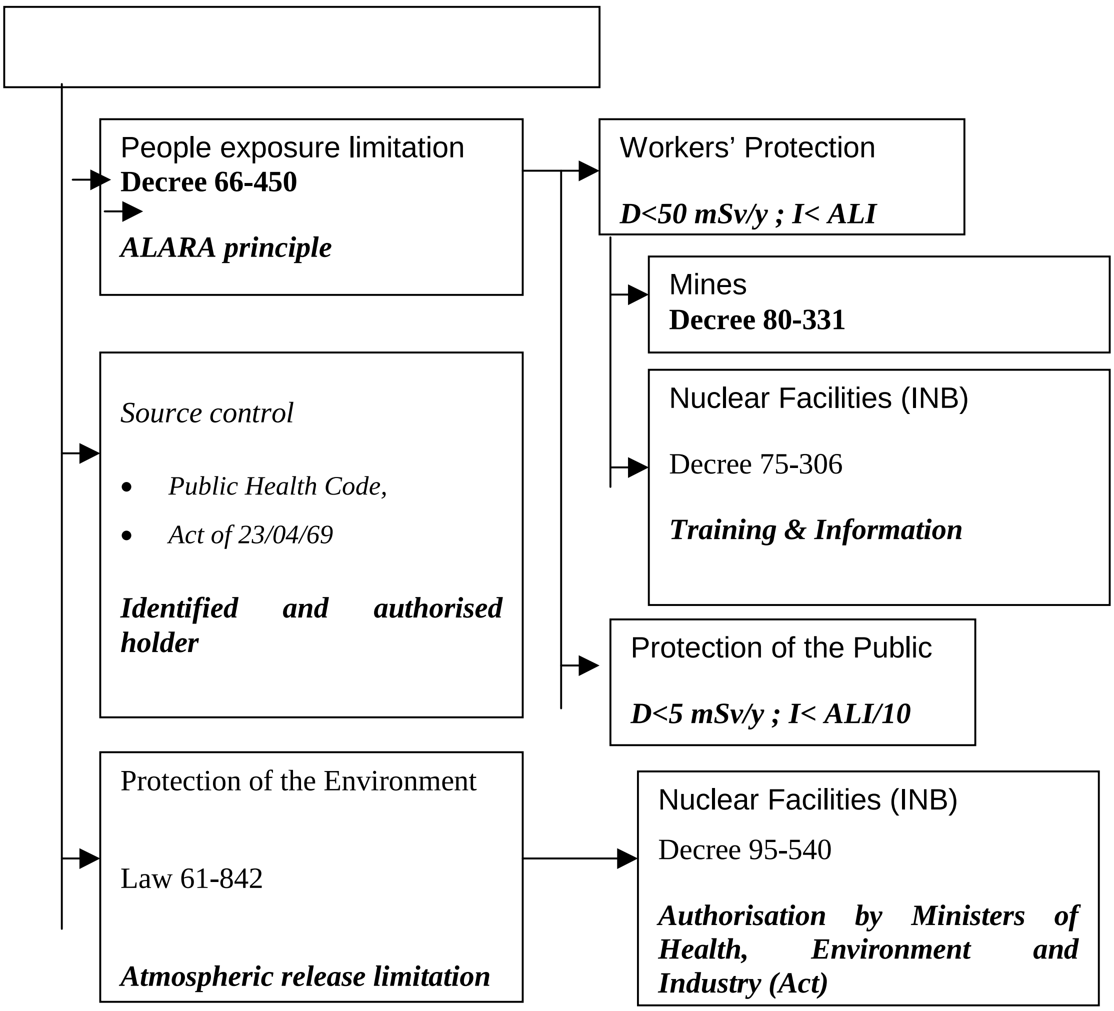
The area of *RP training* is inspected routinely. STUK has an own annual periodic inspection concentrating on the training of NPP personnel. In this inspection aspects concerning RP are usually included.

FRANCE

LEGAL MATTERS

1.1 Structure of Legislation

The present national legislation can be described by the following pattern.



[*] OPRI : Office de Protection contre les Rayonnements Ionisants (see below)

1.2 Legal Requirement

1.2.1 Workers exposure limits

Workers are classified in 2 categories according to their possible annual exposure : Category A for those who are likely to be exposed to more than 3/10 of the legal limits, under normal work conditions, Category B for the others.

Legal limits are derived from ICRP recommendation n°26, through European Directives n°80/836 and 84/467.

New (lower) legal limits resulting from ICRP recommendation n°60, through European Directive n°96/29, will be enforced in 05/2000.

1.2.2 Plant zoning

Basically, 2 types of zones must be defined by the licensees :

Supervised zones, where exposure under normal work conditions may be higher than 1/10 of annual legal limits, but lower than 3/10 of these limits. They only have to be signposted.
Controlled zones, where exposure under normal work conditions may be higher than 3/10 of annual legal limits. They have to be signposted and delimited.

Inside each controlled zone, *specially ruled* or *forbidden zones* must be defined by the plant manager, as exposure is likely to exceed specified thresholds. Conventionally, they are pointed out with colours (yellow, orange, red) with respect to the following table.

	Irradiation limits	Contamination limits
Yellow zone	2 µSv/h to 2 mSv/h	1 to 80 DAC
Orange zone	2 mSv/h to 100 mSv/h	80 to 4000 DAC
Red zone	> 100 mSv/h	> 4000 DAC

They must be clearly indicated. Access to orange and red zones has to be strictly limited to namely authorised people.

1.2.3 Medical measures

Medical fitness has to be established for any worker destined for working under ionising radiation exposure. This fitness has to be confirmed every 6 months for workers in category A.

For each worker in category A, a specific medical file, related to his possible exposure, is kept by the plant doctor.

1.2.4 Miscellaneous

A radiation protection « competent person », or a competent department according to the size of the facility, certificated by the Health Ministry, must be appointed by the plant manager to control the implementation of appropriate protective dispositions.

A specific training of exposed workers on radiation protection is required before doing their job. This training has to be periodically renewed. The licensee also has to provide them an information note on ionising radiation hazards.

Permanent monitoring of radiation level in the plant must be achieved and the equipment dedicated to this must be regularly controlled.

1.3 National Authorities Involved in Radiation Protection

The General Directorate for Health (DGS) of the Health Ministry, through its Radioprotection Bureau (BRP), is in charge of defining the general policy relating to the prevention and mitigation of health hazards resulting from exposure to ionising radiation. It elaborates the legislation and implements control means to enforce this policy.

The Office for Protection against Ionising Radiation (OPRI), under the custody of both Health and Labour Ministries, is in charge of verifying the correct application of legal requirement as regards radiation protection. It collects, processes and records legal data on doses to the workers. It permanently supervises the level of radiation all over the national territory and performs measurements, analyses or dosages in the environment when necessary. It also watches over the protection techniques. Finally, in case of nuclear accident, it advises the Administration on Public Health provisions to take.

The Interministerial Commission for Artificial Radionuclides (CIREA) is in charge of monitoring the use of artificial radionuclides in both industrial and medical applications. It also formulates proposals to improve the regulation of radioactive sources.

The Nuclear Installation Safety Directorate (DSIN) of the Environment and Industry Ministries, is in charge of the supervision of large nuclear facilities, mainly on the viewpoint of operation safety and nuclear material transportation. It elaborates the related legislation and defines the specific technical prescriptions for each facility in terms of operating rules, releases in the environment, dismantling.

The Directorate for Labour Relationships (DRT) of the Labour Ministry is in charge of the monitoring of workers' protection through the plant inspection services. It also elaborates the legislation in this respect.

The Regional Directorates for Industry, Research and Environment (DRIRE) are local authorities in charge of the supervision of facilities on the nuclear safety and environment aspects. In addition, they carry out inspection on labour regulation in the NPPs.

Finally, in case of crisis, operational rescue means would be provided by the Directorate for Defence and Civil Security (DDSC) of the Home Ministry.

In some specific aspects, other bodies may also be involved.

ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

As written in 1/, 3 bodies are involved in inspection on radiation protection :

- the OPRI, which interventions in nuclear power plants are linked with incidental or accidental cases,
- the Labour inspection departments : 3 to 5 inspections per reactor yearly focused on the requirements detailed at § 1.2.

- the safety authority (DSIN + DRIRE) : In practice, fields of safety and radiation protection widely overlap, whether we consider nuclear power plant operation, nuclear material transportation, radioactive waste management, gaseous and liquid radioactive effluents,…. Consequently, it is important for nuclear safety and radiation protection authorities to co-ordinate their actions and share their experience. As a result, inspectors of the French safety authority are extending the scope of their actions to cover the item of radiation protection. So, a part of the inspection program of the French safety authority deals with radiation protection on nuclear power plants.

2.1 Organisation of inspections

The French safety authority is planning the inspections program of the nuclear power plants yearly. This program gives the items on which the plant will be inspected without scheduling them. It gives also the name of the people who will attend the inspections, and especially its leader. Usually, an inspection is carried out by two inspectors with the help of an expert of the inspected field. Obviously, this program may be adapted according to the events that happen during the year.

Then, the leader of the inspection schedules the date of the inspection and its preparation. The preparation consists in defining the specific points that have to be verified, in accordance with the item of the inspection. The choice of these points is made upon:

- the specific knowledge of the inspectors,
- the licensees' weaknesses (known by previous inspections, incidents,…)
- the internal inspection guideline dealing with the item (the Safety authority is writing inspection guidelines for the major part of the inspection items).

The inspection items are numerous; some are dedicated to radiation protection, and many are closed-connected (see 3/).

2.2 Qualification and training of inspectors

Inspectors are usually engineers. A formalised technical training scheme has been set up to manage the inspectors qualification level. This training scheme comprises the following categories of training courses, depending on the functions of each applicant within the safety authority :

- inspector training,
- senior inspector training,
- specific technical training

In a few words, an inspector of the French safety authority has followed a training period -usually one year- (inspector training) in order to get sufficient theoretical and practical knowledge to lead an inspection. Then, this qualification is enforced (senior inspector training) and / or specialised (specific technical training) in the context of specific activities. For instance, inspectors who will deal with radiation protection attend specific courses, in addition to the general training scheme.

2.3 Work load

Inspection is not the exclusive work for members of the French safety authority ; they also have others activities (monitoring of power reactor outage, processing of incidents and events, regulation). As a result, it is difficult to consider the work load of an inspector towards licensees. Despite, we can consider the time devoted to radiation protection inspections. Approximately, per year, 27 inspections are devoted to radiation protection and 170 inspections are close-connected (about 20% time of each is devoted to radiation protection). For each inspection, about:

- one day for preparation,
- one day on site,
- two days for the follow-up of the inspection : questions addressed to the licensee and review of the answers.

Nearly, in one year, 240 days are devoted to radiation inspection, face to 20 nuclear power plants (corresponding to 60 reactors)

INSPECTION TOPICS FOR THE NUCLEAR POWER PLANTS

The following items are periodically inspected :

- radiation protection management,
- radiation protection management during shutdowns,
- gaseous and liquid radioactive effluents management,
- radioactive waste management,
- nuclear material transportation,

1/ radiation protection management,

Frequency : 1 inspection each 3-years at least for a plant, so 7 inspections per year for the 20 French nuclear power plants. The objective of these inspections is to have a general overview of the licensees' radiation protection management. They deal with :

- organisation of the licensee's radiation-protection personnel, responsibilities, qualification (are the licensee's means devoted to radiation protection sufficient ?)
- ALARA management (how does the licensee apply this legal requirement ?)
- operational radiation protection measures (does the licensee take enough measures on this topic for its normal operation and maintenance activities, for its own personnel and subcontractors personnel ?)
- radiation protection instrumentation and sampling (is this instrumentation efficient, guaranteed, controlled ; does this instrumentation allow a good survey and knowledge of the radiation level and effects ?)
- dosimetry (are the personnel doses in accordance with legal requirement ?)
- emergency measures planned to cope with incidents (are these measures defined, are they achievable ?)
- training in radiation protection (does the training program for the personnel respect the legal requirement ?)

2/ radiation protection management during shutdowns,

Shutdowns are scheduled for fuel exchange, maintenance or repair works. These activities are sensitive for safety and radiation exposure. As a result, about a quarter of an inspection carried out during a shutdown is devoted to radiation protection.

Frequency : about 3 inspections per each reactor shutdown, so 150 inspections per year for the 20 French nuclear power plants (approximately, a plant is composed for half of two reactors and for half of four reactors ; each reactor shuts down every 12 to 16 months)

These inspections are dealing with the following items, as listed in 1/ :

- in particular protective clothing, ways of access, survey, protection measures and containment for areas where contamination or radiation exposure are rising a significant level,
- in particular for the survey of the radiation exposure level and the survey of contamination level on the tools, materials and personnel,
- in particular the comparison of the achieved doses compare to the doses evaluated with the ALARA approach,
- in particular for the subcontractors personnel.

3/ gaseous and liquid radioactive effluents management,

4/ radioactive waste management,

5/ nuclear material transportation,

All are normal activities that a licensee has to deal with, and these activities are the source of radiation exposure.

Frequency : about 7 inspections each year for each of these 3 topics, in order to inspect all the 20 French nuclear power plants in three years on these topics.

The objective is to verify that licensees, for these activities, take a good care, first of the safety requirements, but also of the radiation protection requirements which are corresponding to b/, d/, e/, f/ and g/ topics.

In addition, depending on the weaknesses of the licensee, the regular inspection program can be reinforced on specific items. These items are defined as a ‘priority’, and an inspection is performed on each plant in the year.

Frequency : during the concerned year, 1 inspection on each nuclear power plant, so 20 inspections. The objective is to obtain from the licensee an improved performance on the chosen topic.

The topics which were chosen these last years are :

- containment of radioactive liquids and gases,
- control of the contamination outside the installations,
- control of the contamination inside the installations.

GERMANY

1. LEGAL MATTERS

Licensing of construction, operation, modification and decommissioning of nuclear power plants is performed under the Atomic Energy Act, which refers to the Radiation Protection Ordinance concerning all radiation protection matters. All details on radiation protection are regulated in this ordinance which will be amended soon according to the European Basic Safety Standards (directive 96/29/EURATOM).

Licensing and inspection authorities are departments of the competent federal *Länder* ministries. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supervises the

Länder regarding expediency and legality. The Radiation Protection Commission serves as an expert advisory body to the BMU in all matters of radiation protection. Regulations and guidelines implementing the legal requirements on radiation protection are issued by the BMU after discussion and in consensus with the *Länder* authorities.

Inspection on radiation protection often is delegated to a subordinate agency of the respective *Land*. In addition, the authority is supported by independent expert organisations (e.g., TÜV).

2. ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

The radiation protection inspection authority is in charge of inspecting all RP measures at the NPP. In most cases, expert organisations (e.g., TÜV) are contracted for inspecting individual measures, results of dosimetry, adequacy of measuring equipment and their functional tests and calibrations. Main inspection tasks belong to outage planning and plant walk-downs. The TÜV has internal guidelines for such plant walk-downs covering the entire RP policy, procedures and measures taken by the operator.

The inspectors are qualified as to their professional education in the corresponding area, additional training courses and regular exchange of practical experience supplement their qualification.

3. INSPECTION TOPICS AT THE NUCLEAR POWER PLANT

a) Organisation of the licensee's radiation protection personnel, responsibilities, qualification

Responsible for all radiation protection matters is the licensee. In person, this is a member of board (responsible person for RP) who in most cases delegates the practical work of this task to the plant manager within the NPP organisation. He and the radiation protection commissioner, a function required by the radiation protection ordinance, jointly carry the responsibilities for all legal RP requirements. The radiation protection commissioner is to be nominated separately and has a strong position within the NPP organisation with defined competencies and reporting directly to the responsible person for RP. In most cases the RP commissioner is head of the NPPs radiation protection department. Within the NPPs organisational structure, this department normally is independent from the plant operation and other technical departments.

Detailed qualification, training and retraining requirements exist for the RP commissioner and for all personnel according to their duties and responsibilities. The organisational structure and qualifications are described in the plants operation manual and are subject to regulatory approval and inspection.

b) ALARA management

Restricting all occupational doses to the necessary doses as low as practical and possible and minimising all doses even below the prescribed limits is common policy and also required by the radiation protection ordinance. In order to apply this principle in practice, all work to be performed in the controlled zone is to be judged and approved by the radiation protection commissioner or his deputy. A corresponding work order procedure is laid down in the operation manual and is subject to regulatory approval and inspection. Work plans involving collective job doses exceeding 50 man-mSv or individual doses of >10 mSv have to be worked out in detail and submitted to the inspection authority for regulatory review and approval.
Other radiation protection procedures and instructions are inspected as well.

c) Operational radiation protection measures

Access control and regular radiation protection surveys are described in the operation manual and corresponding instructions and procedures. The necessary radiation protection measures during fuel exchange, plant outage and maintenance and repair works are taken by the radiation protection personnel according to the work order procedure which is part of the operation manual. In most cases, all individual maintenance work done by any craftsmen in the controlled zone in accompanied by RP personnel, which gives instructions, support and advice. The adequacy of these measures and their results are reviewed regularly by the inspection authority.

d) Radiation protection instrumentation and sampling

All radiation protection instrumentation and sampling equipment is to be checked regularly by functional tests and calibrations. These checks are part of the plants recurrent testing plan. The test results are to be documented and are reviewed by the inspection authority. Also, the adequacy of the instrumentation and sampling equipment as well as the resulting measurements are reviewed by the inspection authority or their experts. In addition to the plants own instrumentation for control of gaseous and liquid effluents the inspection authority operates an independent remote monitoring system transmitting emission, immission and some operational data to the authority's office. For the environmental monitoring the plant operator and the inspection authority are involved running both a separate programme which are complementary to each other.

e) Dosimetry

Individual and collective doses both of the plant and contractors personnel are documented according to the radiation protection ordinance. Partial body dosimetry is conducted as required by the respective job. All dose results and job doses are to be reported regularly to the authority. In particular, events with doses or contamination exceeding the prescribed limits are to be reported immediately according to the reporting regulations.

f) Measures applied or planned to cope with situations after incidents

All measures to be taken at an accident are described in the operation manual. The radiation protection commissioner participates in defining the actions to be taken. In case of a fire in the controlled zone, the plants own fire brigade is trained in radiation protection measures. The external fire brigade is supported by the plants radiation protection personnel which gives advice and directions for access and fire fighting strategy in order to minimise doses and radioactive releases or contamination.

g) Training in radiation protection

For the plants radiation protection commissioner and his deputy detailed qualification and training requirements exist. Radiation protection specialists and technicians have a respective professional educational degree and additional qualification by special training courses. All other plant personnel as well as contractors personnel is to be instructed and trained in safety and radiation protection measures and ALARA principles on a regular basis. The training programme is subject to approval by the regulatory inspection authority, which also reviews the conduct of these training measures.

h) Other topics of interest to be discussed at the workshop

Evaluation of radiation protection related incidents and events regarding human factor influence role of inspection authority for feed-back of experience to improve RP results in the light of the ALARA principle.

HUNGARY

LEGAL MATTERS

Structure of Legislation and legal requirements, role of different authorities involved in radiation protection

The *Act on Atomic Energy* (Act No. CXVI of 1996) allocates regulatory, official and professional administrative tasks to several ministries.

The regulation of radiation protection (RP directly affecting humans) belongs to the *Ministry of Health*, the technical side of RP is the task of the *Hungarian Atomic Energy Authority (HAEA)*, the issue of releases and thus protection of the environment belong to the *Ministry for Environmental Protection*, the tasks related to the radioactivity of the soil and the vegetation belong to the scope of the *Ministry of Agriculture and Regional Development*.

While these responses were being produced, a temporary regulatory situation was in evolution: the *Act on Atomic Energy* has been in force since 01 Jul 1997, but some of the decrees concerning its implementation have yet to be prepared. In these situations the former regulation is used. The present system of RP is based on ICRP 26, a new regulatory framework is under consideration, however, which will be based on ICRP 60 instead.

The *Decree No. 7/1988 SZEM* of the *Minister of Public Health* (currently: Minister of Health) lays down the RP requirements that should be applied to all activities where nuclear energy and ionising radiation are used.

It stipulates that a RP service should be set up in all installations using nuclear energy. All users are obliged to prepare an internal RP standard, which should be approved by the competent authority (the *State Public Health and Medical Officer's Service* in this case). The annexes of this decree deal with the limits of the doses of workers and members of the public; the radiation safety principles of workplaces, RP training; dosimetric control; the treatment of those suffering from a radiation injury; the tasks of the radiation protection service, the handling of accidents, the special RP requirements for nuclear power plants and the disposal of radioactive waste. Annex 10 deals with special issues of the nuclear power plant, such as the division into controlled and free zones, the measurement of the radiation parameters of certain areas and the main radiation protection criteria.

The *Govt. Decree No. 108/1997* put the technical issues of RP related to nuclear installations and their systems and equipment into the *HAEA*'s scope of competence. These issues are addressed in the *Nuclear Safety Standards* which are schedules of the Decree.

Volume 1 defines the contents of the RP related sections of the Preliminary Safety Analysis Report necessary for the request of the installation and Operating Licences and that of the same section of the Final Safety Analysis Report. The same volume prescribes the regular analysis of the RP indicators of the operation and the utilisation of the experience within the framework of the periodic safety review.

Volume 3 sets out the main RP principles related to the design of nuclear power plants, the stipulations concerning the handling of fresh and irradiated fuel and radioactive waste, and the requirements toward dosimetric control systems, shielding and systems influencing radioactive emission.

Volume 4 summarises the requirements concerning the execution and documentation of RP activities. The same volume deals with the requirements related to the handling of nuclear fuel and radioactive wastes.

The *Decree No. 1/1980 OKTH* of the *National Commission on Environmental Protection* (currently: Ministry for Environmental Protection) regulates the atmospheric emission of the nuclear power plant, while the limits and other conditions of liquid discharges were defined in the water use licence for the Paks NPP by the *regionally competent environmental and water affairs administration* during the licensing procedure of the NPP.

The official annual limit of additional radiation dose caused by any releases is 250 µSv/GW_e in respect to the critical group of the public. This exposure limit consists of two parts: the dose caused by atmospheric emission can equate to 2/3 of the total dose, while the dose coming from liquid discharges may reach 1/3 of the value. The activity limits of atmospheric emission are as follows:

Table 1. Atmospheric radioactive emission limits for power plants of 1000 MW_e performance

Radioactive substance	**Emission limit [Bq/day]** (1)
Sr-89 and Sr-90	$5.6x10^4$
Radioiodine isotopes, in I-131 equivalent	$1.1x10^9$
Total radioactive aerosols (with a half-life over 24 hours)	$1.1x10^9$
Radioactive noble gases (2)	$1.9x10^{13}$

Remarks:

(1) values are for the average of emission over a 30-day period

(2) at the simultaneous shutdown of two reactors using boric acid, this value may achieve a maximum of $6.5x10^{13}$ Bq/day once a week.

Table 2. Liquid discharges limits for the 4 units

Radioactive component	**Activity limit [GBq/year]**
Total beta	14.8
Sr-90 from the total beta	0.148
H-3	$30x10^3$
Total alpha	Around background (at detection threshold)

The limits of atmospheric and liquid releases are basically identical to the design values featured in the technical designs of the nuclear power plant.

ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

Organisation of inspections (i.e. inspection planning, realisation of inspections and enforcement, joint or dedicated inspections, internal guidelines etc.)

The scopes of competence are shared by different authorities.

The *Tolna County Institute of the State Public Health and Medical Officer's Service* regularly inspects the radiation protection conditions of the work areas of the NPP. Practically weekly joint inspections are performed by one or two permanent inspectors of the regional institute. For special cases (e.g. assessment of occupational exposure due to intakes of radionuclides) experts of *National Research Institute for Radiobiology and Radiation Hygiene* (Budapest) are also involved.

Unfortunately there are no internal guidelines concerning the inspection activities of the radiohygiene authority.

Inspections of the *HAEA* include the analysis of documentation on the matter and the performance of on the spot inspections in the following fields: source evaluation, operation of systems providing radiation safety, RP during maintenance, preparation of unit outages, spent fuel and waste management, evaluation of off-normal situations. Practically two inspectors of the authority deal with the RP issues of NPP.

Guidelines concerning nuclear and radiation safety are issued by the DG of HAEA. Currently the first RP guidelines are under finalising.

The *Lower Danube Valley Environmental Inspectorate* enforces the fulfilment of requirements related to discharge limits and other environmental stipulations contained in resolutions and applicable to the NPP. This inspectorate is an environmental protection licensing authority in the first instance but it also participates in different licensing procedures as a specialised authority. Practically only one inspector deals with these RP issues. There are no internal guidelines concerning the inspection activities of the environmental authority.

Qualification and Training of Inspectors

The above mentioned decree (of the Minister of Health) lays down the qualification and training requirements that should be applied to all activities where nuclear energy and ionising radiation are used. A refreshing training course with exam is obligatory in every 5 year.

Work load: Number of Licensees inspected per inspector

See above at 'Organisation of inspections'

INSPECTION TOPICS AT THE NUCLEAR POWER PLANT

The following list of inspection topics serves as a guide. Please describe to each topic the inspection programme (type of inspection, objectives of inspections, frequencies).

The following section describes the health physics activities of the NPP which are the topics of our inspections.

The executive orders specifying the details of the RP activities have not been issued in full entirety yet. After issue of the these orders the RP regulation of the Paks NPP has also to be fit into this new legal background. This is unlikely to cause any problem since, from more considerations such as dose boundary limits, the internal regulations of the power plant conform to the recommendations of the ICRP 60.

The internal RP regulations of the NPP are essentially incorporated in the *Plant Radiation Protection Code* that includes the organisational, technical and hygienic measures and the implementation procedures required ensuring the radiation safety of the operation. This *Code* is approved by the *State Public Health and Medical Officer's Service.*

The *Nuclear Safety Standards* also summarise the requirements concerning the execution and documentation of RP activities.

Organisation of the licensee's radiation protection personnel, responsibilities, qualification

The *Plant Radiation Protection Code* includes the organisational chart and responsibilities of the RP personnel.

The *Radiation Protection Department* is independent from the operation and maintenance and has about 60 employees. The continuous RP survey is performed by the shift operational staff (5 workers in day shift, 4 workers in the afternoon and night shifts) of the department, while personal dosimetry control, the release and environmental monitoring activities are performed by the engineers and technicians.

Besides the staff directly reporting to the head of the *Radiation Protection Department* they have members of staff of other departments with distinguished RP responsibility. The *Radiation Protection Service* is made up of such nominated workers of the operational and maintenance organisations responsible for the works performed in Radiation Controlled Area who, in addition to their technical knowledge within the field concerned, are well trained also from RP point of view. These nominated workers (71 persons including 11 persons from contractors at the moment), with the support of the *Radiation Protection Department*, are involved in the continuous improvement of the operational and maintenance procedures of the respective organisation of the plant from RP point of view. The department consider them as primary contact persons of the line organisations for RP issues.

ALARA management:

The regulations, rules, organisational and technical measures specified by the *Plant Radiation Protection Code* are adopted in the form of procedures. Among the procedures used for optimisation of the RP, the dose planning of works, the preparation of the works involving presumably higher exposure and the evaluation of experiences require special emphasis, due to the role played in the optimisation of the collective and personal doses.

Operational radiation protection measures applied for example to:

- *access control*
- *fuel exchange*
- *work planning*
- *maintenance and repair works*
- *outage planning*
- *regular surveys of surface and airborne contamination and dose rates in accessible areas*
- *protection measures (protective clothing, temporary shielding, etc.)*

The outages have decisive effect on the collective and personal exposures, at Paks more than 90 % of collective dose is related to these activities. Therefore, the dose planning for outage can be one of the most important means for optimising the exposures. The *Radiation Protection Department* participates in work of the *Outage Preparation Team* and during the work planning identifies the activities that have to be followed with special attention by RP point of view. Normally this team completing the main structure of the outage plans till the end of October and finalises the detailed outage plan 6 weeks before the outage. Based on this detailed plan, the *Radiation Protection Department* jointly with the operation and maintenance organisations (in the practice together with the RP nominated workers) provides forecast for the collective doses expected during the work to be performed during the outages. The data relating to place of works, phases of works, planned man-hours, predicted dose rates of work places and collective doses of the previously performed works are used in the dose planning procedure.

The data on the radiation conditions within the NPP are provided by the help of a comprehensive monitoring programme carried out by the *Radiation Protection Department* during each outage. The gamma dose rates are measured within the rooms of the Unit stopped for maintenance and in the environment of the major equipment of the primary circuit in the frame of this monitoring programme.

The *Plant Radiation Protection Code* also includes the way of approving the works exposed to radiation hazards. Any activity presumably involving a radiation exposure in excess of the personal control level for a day (0.2 mSv) is subject to approval using *Dosimetry Work Permit.* The purpose of this is to declare the necessity of the work and to provide control and limitation for the personal dose. The necessity of the work has to be certified on the *Dosimetry Work Permit* by the manager of the operational or maintenance organisation in the function of the anticipated radiation exposure. Similarly, the work instruction has to be approved on the *Dosimetry Work Permit* by the operative manager of the radiation protection area, the manager of the *Radiation Protection Department*, or, on emergency, by the General Manager of the NPP in the function of the anticipated radiation exposure.

Radiation protection instrumentation and sampling, for example applied to:

- *process instrumentation*
- *stationary equipment for room dose rate survey*
- *portable instrumentation (dose rate, surface- and airborne contamination)*
- *personnel contamination and incorporation control*
- *calibration and testing of instrumentation*
- *control of gaseous and liquid radioactive effluents*
- *environmental monitoring*

The site of the plant is divided into free access and controlled zones. Radiation levels in the free access zone may not exceed 1 μSv/h. Within the controlled zone, rooms are classified into 3 categories according to permitted radiation levels and surface contamination. These are the manageable, restricted manageable and not manageable rooms. Data are continuously controlled by an installed RP system with cca. 500 measurement channels per twin-unit. The control includes the gauging of dose rates and air-activity concentrations in the rooms, and the measurement of the activity of different technological substances.

Signals from the detectors are transmitted to the *Dosimetry Control Room*, where they are visually displayed with audio warning (alarm and emergency levels). The computerised display and archiving of measurement results also takes place in this control room. In addition to the installed system, local measurements and laboratory tests of samples are performed as well.

In order to ensure the accuracy and uniformity of measurements of legal consequences, NPP established a secondary standard laboratory, approved by the *National Office of Measures* (Budapest).

Release and environment monitoring is carried out in two fundamental ways:

- The *on-line* system has an installed telemetric system, the units of which are situated
- at the stacks (iodine and noble gas activity, aerosol and airflow measurement),
- the water sampling stations (total gamma activity, temperature, water flow measurement),
- the meteorological tower (measurement of wind direction, wind speed, temperature and wind fluctuations at different altitudes),
- and at the environmental monitoring stations set up within 1.5 km surrounding of the power plant (air iodine activity, dose rate).

Data are transmitted to the *Dosimetry Control Room*.

The off-line laboratory measurements serve to compare the sampling and release data. The stations perform off-line measurements related to fall-out, dry-out, grass, soil, aerosol, ^{14}C, atmospheric tritium activities and doses.

Dosimetry, for example applied to:

- *individual and collective doses (plant personnel, contractors personnel)*
- *job doses*
- *partial body dosimetry*
- *reporting requirements*

A unified central film-dosimetric service (operated by the *National Research Institute for Radiobiology and Radiationhygiene*) is operating in Hungary for the tracing of external radiation exposure of workers. Currently the recording level is 0.1 mSv/exposure (1 month or 2 months). The monitoring of exposure of NPP personnel includes all workers working in controlled zones and thus monitoring is manifold as it includes the wearing of an official film dosimeter badge, the TLD system (with a neutron track detector) and EPDs. For particular activities a special TL dosimeter is used to trace partial body exposures.

In the case of those activities which can only be executed by holding a dosimetric permit, an operative dosimetric control performed by ALNOR electronic dosimeters. The recording level is 0.001 mSv/exposure (daily activity).

The plant regularly controls the internal exposures by thyroid and tritium excretion measurements and by whole body measurements. Internal exposure generally has a very low contribution to the annual exposure of workers.

After finishing the outage, the *Radiation Protection Department* draws up a detailed report which assesses the collective and individual doses, the radiation and contamination conditions, the planned and actual collective doses, emissions during outage, feedback experiences, etc. According to requirements of the *Nuclear Safety Standards*, this report has to be sent to the HAEA. The *Annual Report* shall be submitted to the same authority until 31st March of the year after the subject year.

Training in radiation protection, for example:

- *training of plant personnel and subcontractors personnel*
- *training of technicians and responsible persons in radiation protection.*

The basic training, the follow-up and additional RP training and the subsequent regular tests incorporates to transfer and testing the knowledge used in the optimisation of the RP activities.

In addition to the theoretical and experimental training, a practical training takes part too. In these practical trainings typically participate the mechanical maintenance staff and contractor employees working in maintenance areas. The *Maintenance Training Centre*, which is on the site of the power plant, plays an important role this practical training. In the *Maintenance Training Centre* with the aid of installed original components, identical to those operating in the plant, the maintenance workers are able to practice the safe and error-free job performance taking into account RP requirements.

Trainings of the technicians and other responsible persons on RP are organised by the *Training Centre* of the NPP. Topics of the training courses are approved by the *State Public Health and Medical Officer's Service.*

Other topics of interest to be discussed at the workshop

Monetary value

Although the ALARA principle is applied qualitatively in Hungary, the monetary value has not yet been defined, the NPP has introduced an *alpha value* (cca. 100 USD/man mSv, in 1999), corrected yearly. The plant has determined the method of cost-benefit analyses as the quantitative technique of the optimisation, too.

Occupational Exposures in Paks NPP

Fig.1. Maximum annual individual doses according to official film-dosimeter readings

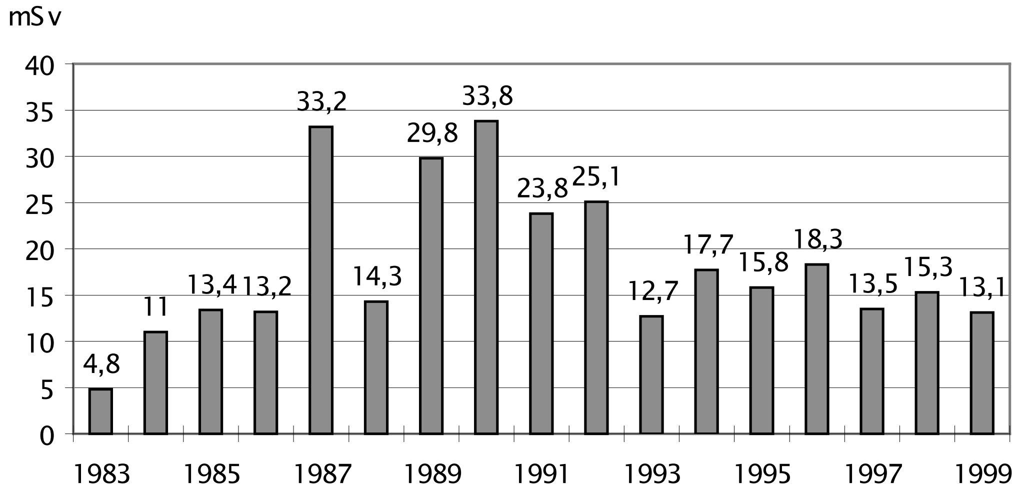


Fig. 2. Annual collective doses according to official film dosimeter readings in Paks NPP

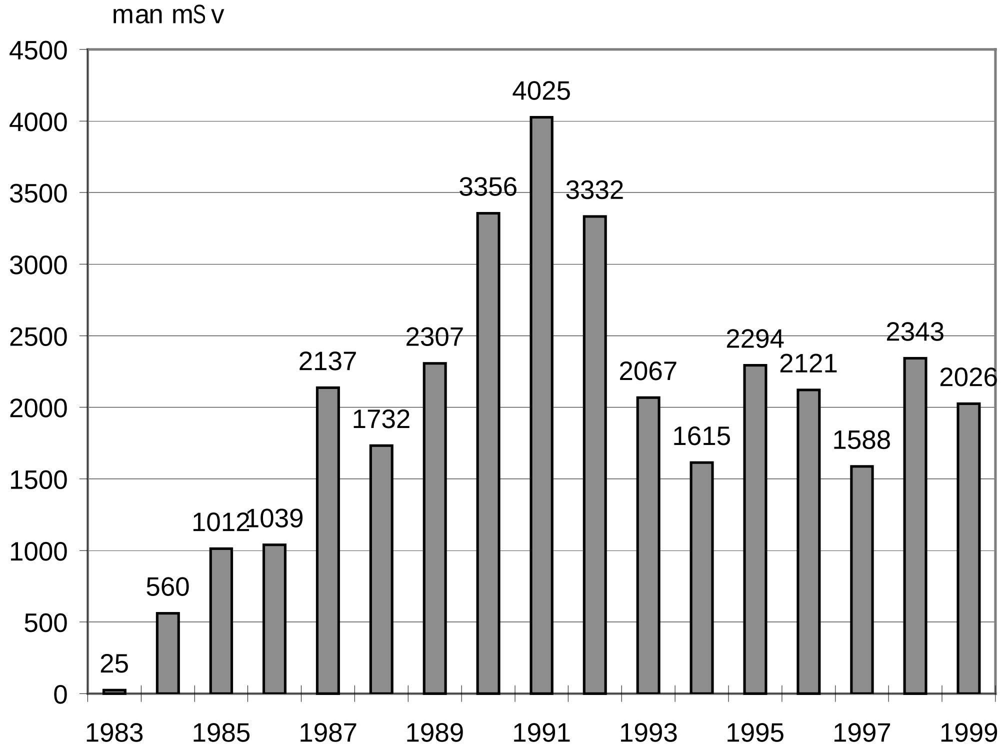
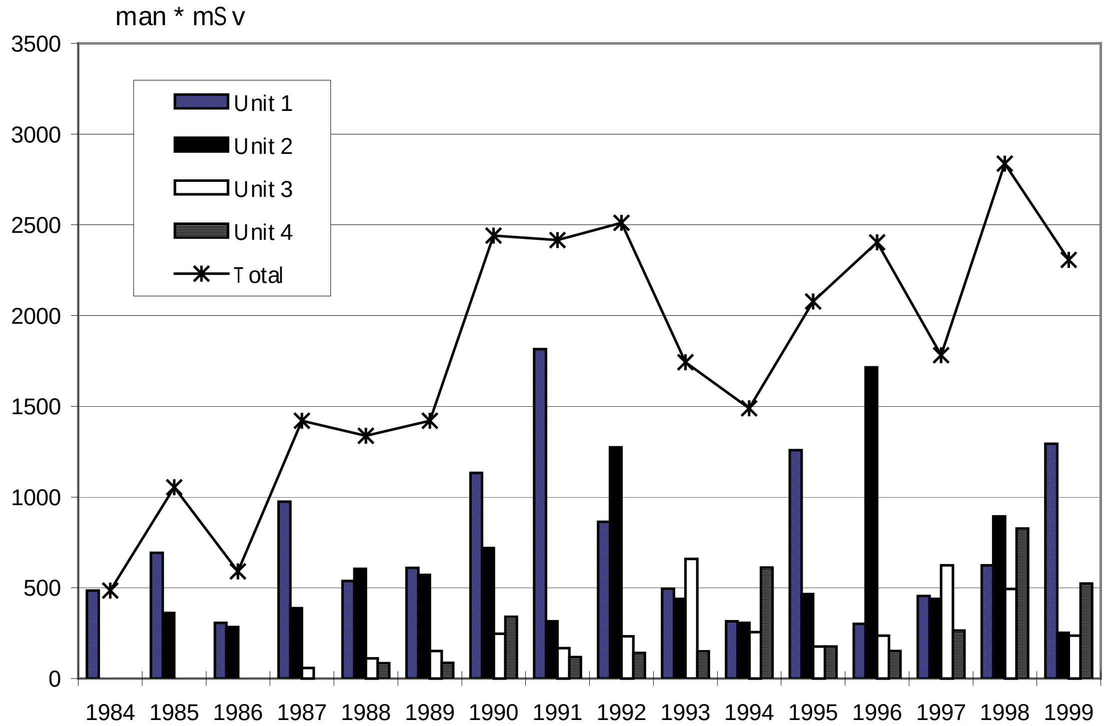


Fig. 3. Collective doses during overhauls based on operative dosimetric measurements



JAPAN

Structure of Legislation and legal requirements, role of different national authorities involved in radiation protection

(Ministry of International Trade and Industry)

The Electric Utility Industry Law (EUIL)

The purpose of this Law shall be to protect the benefits of consumers of electricity and to contrive sound development of the electric utility industry by rendering its public safety and to prevent causing public nuisance by regulating its work of installing, constructing, maintaining and operating its electrical plants and facilities.

The Law for the Regulations of Nuclear Sources Material, Nuclear Fuel Material and Reactors (RNNR)

The purpose of this Law shall be to ensure the peaceful uses of nuclear source material, nuclear fuel material and reactors and, at same time, the public safety by preventing from the accidents thereof.

(Ministry of Labour)

The Law of Safety and Health of Labour

The purpose of this Law shall be to maintain safety and health of labours at workplace, and to promote establishment of comfortable work environment.

ADMINISTRATIVE ASPECTS

Organisation of Inspection

Concerning commercial NPPs, MITI inspector witnesses the important equipment related to safety (Class A Inspection) or reviews the inspection records of which JAPEIC already witnessed in the scope of important safety related equipment other than Class A (Class B Inspection). On the other hand, MITI confirms some results of which Utility carried out self- inspection for equipment other than above(Class C,D Inspection). For the Class A or B equipment, the sound function preventing from release of radioactive material shall be confirmed. As an example of the Class C,D inspection, the function of area-process monitor, off site monitor and so on are confirmed. Both shall be inspected within 13 months after previous periodical inspection. MITI has by-law of Periodical Inspection.

In addition to Periodical Inspection, resident inspectors of safety management (Nuclear Safety Inspector) confirm the observance of self-safety regulation by Licensee through patrol, interview and so on. Permission is required for the self-safety regulation according to RNNR. The self-safety regulation manual stipulates organisation, countermeasure, radiation control, training and so on with regards to radiation protection.

Principally, duplicated regulation shall be avoided, Ministry of Labour mainly inspects for safety of labours. There is no co-operative inspection of ML and MITI.

Qualification and Training of Inspectors

Training program for inspectors contains radiological physics, however there is no specific inspector qualification for radiation protection.

Work load

About 150 Inspectors and about 80 Nuclear Safety Inspectors for 51 NPPs. (Under consideration of restructure)

THE NETHERLANDS

Administrative aspects of the regulatory bodies inspections on radiation protection

(a) Structure of legislation / role of national authorities.

The basic legislation on nuclear activities in the Netherlands is the Nuclear Energy Act. Based on this act a number of decrees are issued. The most important decrees for the safety aspects of nuclear installations and radiation protection of the workers and the public are: the Nuclear Installations, Fissionable Materials and Ores Decree (Bkse) and the Radiation Protection Decree (BsK).

The Bske deals with licensing application, responsibilities and organisational structure; the BsK deals with dose-limits (ICRP-60, 96/29/Euratom) and ALARA-principles.

Radiation protection at transport by road of Fissionable Materials, Ores and radioactive materials is regulated in Decree VLG, which is a Dutch version of the European "Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR).

The nuclear safety department KFD is the regulatory body who performs at the nuclear facilities the radiation protection inspections in relation with consequences inside the fence; the inspectorate of the Ministry of Housing, Spatial Planning and the Environment (VROM) is the regulatory body who performs those inspections in relation with consequences outside the fence. Up to now the KFD is part of the Ministry of Social Affairs and Employment (Labour inspectorate); mid 2000 the KFD (and its tasks) will be part of the Ministry of VROM.

(b) Inspections on radiation protection.

Radiation protection inspections are part of the normal inspection activities carried out by the KFD. To inspect the seven nuclear facilities (only 1 nuclear power plant) in the Netherlands 4 (field-)inspectors are available, all qualified as radiological expert level 3. A regular retraining is carried out. The (field-)inspectors can have assistance by a (desk-)inspector, qualified as radiological expert level 2 (highest level).

According to an inspection planning the normal inspection activities are carried out. For some nuclear facilities internal guidelines are available. In relation to the NPP a new internal guideline will be set up this year.

Dedicated inspections by the field- en desk-inspector are carried out prior, during and after the reactor outage period of the NPP. The anticipated collective dose estimate and the dose evaluation report of an outage period is assessed by the KFD.

Inspection topics at the NPP

(a) Legal and technical requirements, guidelines and rules.

The licence states that the NPP is subject to the (amended) IAEA Codes and Safety Guides. Safety Guide 2.2.5 (50-SG-O5 of the IAEA), dealing with radiation protection complements the requirements set by the BsK, and lays down more specific requirements on:

- the lay-out of the control zones;
- the facilities within the controlled zones;
- staff qualifications and training; and
- the radiation protection programmes.

In the license also specific requirements are mentioned in the area of radiation protection as: control of transportcontainers, an effective radioprotection programme (inclusive procedures, responsibilities and reporting system) and dosimetry of personnel.

As said in section A (b) inspections on radiation protection are part of the normal inspection activities and is looked after at each walk-down. Each year during normal operation a special inspection is carried out focusing on radiation protection. Once every 5 years the radioprotection programme is audited.

In the monthly-report the NPP gives information about acquired doses of personnel and contractors to the KFD.

(b) Organisation of the licensees radiation protection personnel.

One of the conditions of the license is that the manager responsible for radiation protection (and its replacement) shall be adequately qualified (radiological expert level 2). The person in question is also required to hold a sufficiently independent position in the organisation to allow him to advise the plant or site manager directly on all matters of radiation protection. The qualifications of the other personnel of the radiation protection department is given in the Technical Specifications and covered by the appropriate training programme.

The position and authorisation of the manager responsible for radiation protection is laid down in the Technical Specifications. At each reorganisation of the NPP it is checked that no deviations in this area will occur. The inspection/assessment of the training programme of the radioprotection department is part of the audit.

(c) Operational radiation protection measures.

Almost all of the topics, addressed in the questionnaire are inspected in the way as described under B (a). The outage planning (and the evaluation of the planning after the outage) is inspected as described under A (b).

Major maintenance work (modification of the installation) must be approved by the KFD. Where applicable an ALARA-consideration is part of the to be approved documentation. When approved the inspection of the maintenance work (including the radiation protection measurement) will be scheduled in the inspection planning.

(d) Radiation protection instrumentation and sampling.

Effluents and environmental monitoring.

In the licence it is prescribed that all discharges of radioactive effluents must be monitored, quantified and documented. The licensee must report the relevant data to the regulatory body. On behalf of the regulatory body, the National Institute for Public Health and the Environment (RIVM) regularly checks the measurements of the quantities and composition of discharges. The licensee is also required to set up and maintain an adequate off-site monitoring programme, which includes measurements of radiological exposures (with ThermoLuminescentieDosismeters, TLDs) and possible contamination of grass and milk in the vicinity of the installation. The results are reported to, and regularly checked by, the regulatory body (VROM).

Occasionally VROM witnesses the testing and checks the calibration of the (process-) instrumentation needed to control/register the effluents and environmental monitoring.

Instrumentation/equipment used for radiation protection on site.

During walk-downs and witnessing of maintenance, repair or test work the KFD regularly checks the presence and use of calibrated instrumentation and equipment. (a sticker with calibration dates is attached). At the special inspection attention is paid to the instrumentation to measure internal and external contamination of personnel. At the audit the calibration programme of the instrumentation/equipment is assessed.

(e) Dosimetry of personnel.

Each person, entering the controlled zone of the NPP wears two types of doses registration systems: one which gives a direct reading (provided and registered by the NPP) and one (a TLD-type) which has to be analysed by a certified company. The results are registered in the National Doses Registration and Information System (NDRIS). The KFD has access (read only) to this system.

Inspections on dosimetry of personnel will only take place when an abnormal situation has occurred.

As stated in B (a) the NPP gives in the monthly-report information about acquired doses of personnel and others. If an individual doses of more than 5 mSv within one month is reported, the KFD will check at a next regular inspection the WHY, ALARA, etc.

When a not-foreseen individual doses is acquired of more than 10 mSv the NPP has to inform the KFD within 30 days; when the criteria of the decree BsK are exceeded (more than 20 mSv) the KFD will be informed within 8 hours (both reporting conditions are described in the Technical specifications). A special investigation/inspection will then be held.

Each year the radioprotection department must evaluate and document the performance of the radiation protection programme. This report will be discussed with the desk- and field-inspector.

Inspections on job doses or partial body dosimetry are not performed. The planning of job doses and the evaluation afterwards is discussed during the dedicated inspections around the outage period of the NPP (see also A (b)).

(f) Measures applied or planned to cope with situations after incidents.

In chapter 4.6 of the Safety Serie 50-SG-O5 is described what kind of procedures, facilities and equipment the NPP must have to cope with emergency situations. At the special inspection and audit these points are assessed.

(g) ALARA management.

All activities of the NPP are identified in their Quality-handbook and described in a procedure-handbook. In the section of the procedure-handbook related to radiation protection the policies, requirements, procedures and documentation system are explained. At the audit these points are assessed.

In the past the NPP has set an average of 10 mSv per year as the objective for the individual effective dose limit for a radiological worker. In 1995 the NPP has set a new goal: to reduce the long-term average of each radiological worker below7 mSv per year. Work planners have an up-dated oversight of the acquired doses over the years of the employee (life-line curves) in order to reach this new goal. No direct inspection in this area are carried out; it is addressed at the audit and the evaluation of the yearly report of the radioprotection department (see also B (e)).

No official quantitative cost-dose reduction ratio has been formally established in the Netherlands. However, the regulatory body has made clear that it believes that a factor of
f. 1.000,= per man-mSv (450 euro) collective dose reduction would be a reasonable lower threshold.

(h) Training in radiation protection.

Every year all plant personnel are retrained in radiation protection. Records of these training are inspected (especially shift-personnel).

At each topic-audit the training of the relevant personnel is addressed.

The (re-)training and qualification (see section B (b)) of technicians and responsible persons in radiation protection is assessed at the audit radiation protection.

SPAIN

Legal matters

Structure of legislation and legal requirements

Laws

- Nuclear Energy Act (1964)
- Nuclear Safety Council Foundation Act (1980)
- National Electric Industry Regulation Act (1997)

Decrees & Regulations

- Nuclear Safety Council Statute (1982, amended 1996)
- Regulations for Nuclear and Radioactive Facilities (1972, amended 1999)
- Regulations on the Sanitary Protection against Ionising Radiation (1992)
- Regulations for the Operational Protection of Outside Workers (1997)

Ministerial Orders

- Basic Nuclear Emergencies Plan (1989)

Nuclear Safety Council Safety Guides

- *Role of different national authorities involved in radiation protection*

The Spanish Nuclear Safety Council (CSN) holds the exclusive authority for Nuclear Safety and Radiation Protection in Spain. It is a public entity independent of the State's Central administration, with its own legal status and assets.

The CSN is a collegiate body governed by a Plenary Board formed by a Chairman and four Members appointed by the Government for a period of six years. Functions with which the CSN is commissioned are:

- It proposes to the Government rules and regulations in nuclear safety and radiation protection
- It issues mandatory and binding reports to the Government prior to any authorisation for nuclear and radioactive facilities
- It inspects nuclear and radioactive facilities and enforces remedial actions when necessary
- It provides technical support in the event of a nuclear emergency and approves emergency plans
- It controls and supervises radiation doses which may be received both by exposed workers and the general public
- It examines and grants licenses for radiation protection officers and other qualified experts
- It advises the courts and public administration bodies on matters of nuclear safety and radiation protection
- It carries out and promotes research programs on nuclear safety and radiation protection
- It authorises Dosimeter Services and Radiation Protection Units
- It manages the National Registry of Outside Undertakings and the Radiological Passport
- It manages the National Environmental Radiological Monitoring Network

Administrative aspects of the regulatory bodies inspections on radiation protection

Legal matters

The legal framework for CSN radiation protection inspections is established in the Regulations for Nuclear and Radioactive Facilities (1972, amended 1999)

After performing and inspection CSN radiation protection inspectors are required to prepare an official inspection report. Inspection reports should be issued not later than 12 workdays after inspection completion.

In accordance with national regulations, official inspection reports are sent back to the Licensee to allow make any allegation about the contents. CSN inspectors are officially required to take (or not) into consideration the allegations. The whole set: inspection report, allegations and inspector approval (or rejections) of allegations are considered as "public documentation" and it is sent to the Local State Agency of Ministry of Industry.

Qualification and training of Inspectors

All CSN radiation protection inspectors are required to have a university degree in scientific or technological areas. Additionally, in order to belong to CSN Technical Staff, it is necessary to pass a competitive examination including topics on Nuclear Technology, Nuclear Safety, Radiation Protection and Legislation matters.

Periodical training of CSN radiation protection inspectors is performed according with a general training programme approved by the CSN Technical Management.

Organisation of Inspections

Preparation:

- Review of previous CSN Inspection & Assessment reports
- Review of licensing official documentation
- Review of monthly operation reports submitted to CSN by NPPs.

Realisation:

Topics to be covered by CSN radiation protection inspections in nuclear power plants are established in a specific technical procedure.

Workforce

The CSN Technical Staff assigned to radiation protection inspection is constituted by:

- Four experts in charge of occupational radiation protection inspections.
- Three experts in charge of environmental and radioactive effluents inspections.

These experts also carry out evaluations activities in nuclear power plants and evaluations and inspections in other fuel cycle facilities.

Two Inspectors cover each radiation protection inspection simultaneously. There are nine operating light-water reactors; additionally, one gas-cooled reactor is being dismantled.

Type of Inspections

Routine: They are carried out once per operation cycle, in the case of occupational radiation protection the inspections are performed during the refuelling outages.

Special: They are carried out for:

- Supporting the licensing process in case of design modifications involving radiation protection issues.
- Supporting assessment procedures following radiation protection incidents.

Radiation Protection Inspection topics at nuclear power plants[1]

- Organisation of the licensee's radiation protection personnel.
- Official documentation supporting the organisation.
- Fulfilment of legislation requirements.
- Functional and responsibilities charts.
- Human and technical means (owner or contracted).

Licensee's ALARA Organisation

- Fulfilment of CSN Safety Guide supporting the practical implementation of the optimisation principle during the operation of nuclear power plants.
- Verification of the licensee's commitment at different levels.
- Directive level: Review of practical strategies adopted to promote ALARA principle and the approval of ALARA Program.
- Executive level: Review of proposed ALARA Program and objectives and checking responsibilities of various departments involved.
- Technician level: Review of general work management and suggestions made.
- Verification of the endorsement of ALARA policy in Official documents.
- Review of ALARA Program in aspects such as:
- Objectives;
- Work management (planning, implementation, lessons learned);
- Source term control/reduction;
- ALARA review of design modifications;
- ALARA training;
- Audits.
- Retrieval of records supporting this Organisation and Program

Review of existing contractor's ALARA Organisation

General operational radiation measures

Access control

- Check the physical devices and administrative measures to control access of workers and public
- Verification of the requirements for exposed workers to enter radiological zones, included in the Radiological Passport, related to:
- Control of internal and external doses
- Training
- Medical surveillance

Administrative aspects

- Fulfilment of administrative or legal limits - special permits
- Review of the Work Radiation Permit (WRP) in aspects such as:
- Task description
- Radiological surveillance to prescribe protective equipment (dose rate, surface and airborne contamination)
- Dose limitations
- Dosimetry required

1. These inspections are performed during refuelling outages

Auxiliary RP personnel

- Time control
- Task responsible
- Number of persons
- Verification of dates and signatures

Review of the DLD dosimeter management in relation to entries to Controlled Zone (CZ) and tasks to be performed.

Review of the integrated management to control the links among persons/ WRP/DLD/tasks

Radiological surveillance of zones

- Check the routine monitoring program (dose rate, surface and airborne contamination) - frequency and location of surveys
- Review of criteria for special monitoring
- Review of number of contamination cases in portal monitors versus total measures

Review RP actions in case of decontamination of persons

Check fulfilment of RP rules in changing rooms and resting areas.

Review criteria applied to

- Assign of respiratory protective equipment (check maintenance, decontamination and test on these equipment)
- Reuse protective clothes
- Leaving radioactive material form CZ

Waste management

- Check in origin segregation, signals
- Review of operational RP measures in conditioning radioactive wastes activities

To verify during visit to CZ:

- Area signals according to criteria for classification of zones
- Signals in hot spots and stock zones
- General behaviour of personnel in CZ and when leaving CZ
- General impression of the plant:
- Cleanliness
- Signals
- General planning of task
- Entry/exit to contaminated zones
- Availability of protective clothes and protective equipment
- Check expiry date for filters
- Existence of controls for surface contamination
- Existence of separate buckets for used protective clothes and equipment

Training

- Verification of contents and frequency for basic training program
- Verification of contents and frequency for specific training program for contractors
- Verification of contents and frequency for specific ALARA training program

Dosimetry

- Review of statistics and tables for collective and individual doses (plant and contractors)
- Review of the distributions of doses by tasks according to ISOE classification
- Check the assignment of dosimeters
- Check actions taken in case of exceeding legal or administrative limits
- Review criteria applied to
- Assign doses in case of lost of dosimetry
- Assign doses in case of discrepancy between TLD/DLD
- Assign partial body dosimeters
- Internal dosimetry
- Check internal dosimetry frequency
- Review of cases exceeding the record or investigation level and the actions taken
- Review, if any, bioassay cases
- Review of RP requirements (surveillance, signals, access control, administrative controls, etc.) in temporary radioactive waste storage
- Source and radioactive material control - remittance and reception of radioactive material

Instrumentation

- Calibration and verification program for:
- Stationary equipment (dose rate and airborne contamination)
- Neutron equipment's
- Exit ZC portal monitors
- Portable instrumentation (dose rate, surface and airborne contamination)
- Clothes surface contamination monitor
- Electrometer
- Gaseous and liquid radioactive effluents monitors

Review of calibrations and/or verifications records for all of this type of equipment

Review of calibration and verification procedures

Review of and check alert and alarm set points

Compliance with Off site Dose Calculation Manual

- Controls
- Requirements for surveillance
- Instrumentation operability
- Limits
- Monitoring requirements

Review of outage planning in aspects such as:

Estimated doses versus actual real doses

Works in course – deviations

Previsions

Review of relevant works in terms of collective dose and selection of several to focus on. For this selected works or activities check:

ALARA organisation

- Documentation (Minutes of Committee and ALARA Groups)
- Specific procedures
- Work management (planning, implementation)
- Specific ALARA training
- Unforeseen

Specific operational radiation measures (temporary shielding, special tools or techniques, special protective equipment, etc.)

Radiological surveillance (routine or special)

Work radiation permits (WRP)

Radiological passport

Measures applied to cope with situations after incidents

Review of actions taken in compliance with existing procedures

Review of investigations about incident and root causes

Check if measures are taken according to radiological conditions

- Prior information of participant personnel about risks
- Adequate dosimeter(s) to participate personnel
- Control permanence time
- Adequate respiratory equipment
- Adequate protective clothes

Review of actions taken related to the assessment of internal and external doses

Check if persons were informed about risks prior entry

Review of dose records

Review of lessons learned and subsequent modification of procedures

SWEDEN

Regulatory Bodies for Nuclear Facilities in Sweden:

In accordance with legal authorisations and mandates defined by the Government, the Swedish Radiation protection Institute (SSI) and Swedish Nuclear Power Inspectorate (SKI) conduct regular inspections and assessments of the Swedish reactors to ascertain compliance with regulations and licence conditions.

The major inspection programmes are conducted as follows:
Essentially three types of regulatory inspections are performed:

- Regular or routine inspections,
- Topical inspections
- Special inspections or investigations trigged by events of special safety significance.

Describing SSI:s nuclear facilities inspection program separately it has the following features:

- SSI does all inspections on site with its own staff
- SSI does not use residential inspectors; the inspectors have their normal duties at the main office of SSI in Stockholm.
- SSI also has inspectors for other radiation facilities (hospitals, research institutions, veterinarians etc.). An inspection guidebook for all these areas is under development. For the separate branches there are partly separate instructions.

Regular or routine inspections are carried out by inspectors (one inspector for each nuclear reactor site) once or twice per month.
Specific forms are used for following-up and written inspection reports are required. A copy is always sent to the site in question. When there are complains or findings from the authority these are always announced in official letters to the inspected facility.
Topical inspections are used to get deeper insights in particular topical areas. Such areas include maintenance preparation from radiological point of view, emergency preparedness, ALARA-programs for short and long terms, training-education in RP, dosimetry control, waste handling and environmental control, to mention some actual areas.
Special inspections or investigations trigged by events of special safety significance are also performed by SSI inspectors. From regulations the nuclear power plant has to report all events of radiological significance to SSI. Also included near misses where an accident or incident might have happened.
Joint SSI –SKI inspections are also performed where there is an overlap of responsibilities between the two regulatory bodies. One example of this is in the area of “on site emergency preparedness”.

This is a short summary of how SSI is performing its inspection duty in the area of nuclear facilities. More detailed information will hopefully be discussed in the coming discussions in the OECD/NEA workshop.

SWITZERLAND

Legal Matters

Licenses for NPP are granted under the nuclear act (Atomgesetz, AtG). Subsequent ordinances (Atomverordnung, Bundesbeschluss zum Atomgesetz) regulate more detailed responsibility and competence of the involved regulatory bodies. The Swiss Nuclear Safety Inspectorate (HSK) is in charge for inspections on nuclear safety and radiation protection on site. Environmental measurements are carried out by HSK and other involved parties.

The Radiation Protection Act (StSG) sets up the legal framework for radiation protection; it is detailed in the Radiation Protection Ordinance (dose limits, clearance levels, basic procedures, etc.; StSV) Further technical aspects are laid out in subsequent ordinances.

A third level are the guidelines of the HSK: On one hand they lay out procedures for reporting and authorisation; on the other hand they define the current state of the art. If a licensee follows the technical guidelines, he will be granted to receive an authorisation for a practice.

Administrative Aspects of the Regulatory Bodies Inspections on Radiation Protection

Inspection plans cover one year and are based on a five year inspection plan and are updated according to the current operation experience and shutdown plans of the NPP under question.

Inspection on radiation protection issues are carried out by two sections:

- Radiological Instrumentation and Radioecology (7 persons) (MER)
- Radiological Work Protection (5 persons) (RAS)

Not all persons carry out inspections!

Qualification: The same person carries out assessments and takes over inspection duties. The education is according to the main working topics: Minimal qualification is technician. HSK will establish dedicated training for inspections; i.e. auditing and answering techniques.

The work load per inspector is as following: Four sites with a total of five units. Each inspector covers all units! (This is only valid for radiation Protection). Depending on the inspection topic there are 1 to 5 inspections per year per site! The bulk of inspections is carried out during outages of the NPP.

Inspection Topics

The following table summarises the inspection topics on radiation protection. Usually, at one inspection, one to two inspectors are present.

Inspection procedure as follows:

- Preparation of inspection, including announcement and meetings. (For inspections on operational aspects during outages, all follow up inspections are arranged on the inspection on outage planning.)
- Introductory discussion of the inspection topics (on site)

- Visit of the relevant places, study of documents,...(on site)
- Presentation of the inspection findings (on site)
- Documentation of the inspections

Joint inspections are carried out on a regular basis on waste management, transport of spent fuel. Other joint inspections are set up on demand.

Frequencies: Y = yearly; P = periodically; D = on demand; O = mainly during outages; L = during normal operations. SUN : Organisation unit of the inspectorate in charge with overall emergency preparedness

Topic	**Who / frequencies**	**Remarks**
Organisation of radiation protection personal	RAS / P	
Work planning and ALARA management Outage planning Work planning & optimisation of exposure	RAS / P, D RAS / Y, D RAS / Y before outage, D	Written procedures and effective results Overall aspects: Jobs and doses, other issues... Jobdose > 0.05 man-Sv, according Art. 6 StSV
Operational radiation protections aspects: Protection measures (clothing, temporary shielding, contamination zones...) Regular radiological surveys Development of jobdoses Waste treatment and storage	RAS RAS / O, P, D RAS / O, Y RAS / O, Y TEN – RAS / Y, L	 According guideline HSK R07 Compliance with installations written procedures / Results Comparison with planned doses Joint inspection
Radioprotection Instrumentation, including emergency instrumentation: Radiological process instrumentation Radiological room instrumentation Gaseous and liquid discharge: instrumentation and sampling Portable instrumentation (doserate and contamination) Person contamination and incorporation monitors Calibration and testing of instrumentation	 MER / D MER / D, P; RAS: D MER / Y, L; MER / Y; RAS / Y, O, L, MER / P; RAS / Y, O MER / Y	 Compliance with technical specifications MER: technical aspects; RAS: operational aspects, joint inspections Compliances with technical specifications; results MER: technical aspects; RAS: sporadic checking of instrumentations in use MER: technical aspects; RAS: Operational aspects, results Assessment of instrumentation through external experts Compliance with guideline HSK R-47
Aspects of exposure: Job-, collective and individual doses Technical aspects of the dosimetry systems External and internal contamination of personnel Reporting	 RAS / Y, O, L MER / P MER / P; RAS / Y, O RAS / Y	 Follow up of jobdosimetry during outages. Ringversuch, follow up inspections, third party assessment of instrumentation Technical aspects, analysis of reported data
Emergency preparedness Operational aspects during intervention Estimation of offsite consequences	 RAS / D MER / D; SUN / D	Joint inspections with SUN / MOS and others, usually in emergency exercises
Training in radiation protection: Plant staff (specially HP-staff) Basic radiation protection training	 RAS / P RAS / P, O	 HP: HSK–representative is member of examination board As required by legislation
Clearance of materials and controlled areas Unconditional release of bulk materials Clearance of controlled areas	 MER / P, D MER / P, D	 Own measurements of authority Own measurements of authority

UNITED KINGDOM

1) Legal Matters

Structure of legislation and legal requirements, role of different national authorities involved in radiation protection.

Under UK law the licensee of a nuclear power plant is responsible for safety. UK licensees are regulated in relation to safety by the Nuclear Installations Inspectorate (NII) as part of the Health and Safety Executive (HSE). HSE grants nuclear site licences which are subject to licence conditions to suitable corporate bodies who wish to build, operate, decommission or demolish nuclear power plants in the UK. None of these activities can take place without a valid nuclear site licence. One of the attached licence conditions, LC 18, deals specifically with radiological protection, although a number of others have indirect links by the requirement to have adequate arrangements for licensable activities. A secondary form of legislation is the Ionising Radiations Regulations 1999 (IRRs). These set out in a more detailed way requirements for those involved in working with ionising regulations and have a wider sphere of influence beyond nuclear licensed sites. They are supported by an Approved Code of Practice which is 'evidential' in UK law.

Apart from NII, the Environment Agency (EA) and the National Radiological Protection Board (NRPB) should be mentioned. EA are responsible for protection of the environment and regulate by means of the Radioactive Substances Act 1997. NRPB provide advice on radiological protection to UK Government.

NII is the enforcing authority for nuclear and radiation protection legislation at nuclear sites whereas EA is the enforcing authority for environmental matters. Transport safety is regulated mainly by the Department of Transport, the Environment and the Regions (DETR). There is clear liaison between NII, EA and DETR.

2) Administrative Aspects of the Regulatory Bodies Inspections on Radiation Protection

Organisation of inspections (i.e. inspection planning, realisation of inspections and enforcement, joint or dedicated inspections, internal guidelines etc.)
Qualification and Training of Inspectors
Work Load: Number of Licensees inspected per inspector

Inspections are organised as part of an inspection plan that each inspector creates annually. This includes planned inspection against licence conditions and the IRRs. The planned inspection is flexible and allows for reactive inspection against events and incidents which may precipitate enforcement action. Joint inspections are undertaken with EA inspectors and Department of Transport inspectors as well as dedicated inspections on specific topics with NII/HSE specialists, which include radiological protection specialists.

All Nuclear Inspectors are highly qualified with upper class university degrees in an appropriate subject, postgraduate qualifications/corporate membership of a Society, e.g. Society of Radiological Protection (SRP). They usually have previous experience in the nuclear industry and receive extensive training on joining NII and throughout their career.

Normally, one inspector will be responsible for regulating one large nuclear licensed site. However, it is not unusual for an inspector to have responsibility for a number of smaller licensed sites.

3) Inspection Topics at the Nuclear Power Plant

Description of each topic below in relation to the inspection programme (type of inspection, objectives of inspections, frequencies)

a) Organisation of the licensee's radiation protection personnel, responsibilities qualification

Topics are checked as part of the rolling planned inspection programme against licence conditions so that judgements can be made as to whether licensee's arrangements are adequate. Licensing requires that sufficient resource and expertise is demonstrated (including radiological protection) before a licence is granted and a new licence condition gives NII powers to prevent changes in the licensee's organisation that could be deleterious to safety. NII inspections frequently interface with the licensee's radiation protection department allowing judgements to be made of organisational adequacy and expertise. Managers of RP Departments will normally be accredited Health Physicists which requires them to hold SRP membership and often includes a Certificate of Competence in Applied Radiological Protection. More senior members of the Department will, in addition, have passed a Course run by NRPB in Advanced Radiological Protection. Health Physics Monitors usually hold City & Guilds qualifications or equivalent in applied radiation protection.

b) ALARA management e.g. Policies and requirements; Work planning; Use of cost-benefit analysis as a possible tool in decision-making

When carrying out inspections NII expects to see ALARP budgets in place for higher dose rate tasks. Such work would be assessed in advance by examination of safety cases/method statements to check that suitable and sufficient measures were being taken to ensure ALARP. NII can place 'hold points' by means of legal instruments that require the licensee to satisfy NII that the proposed work has been properly planned, categorised, adequately conceived and suitable safety precautions are in place before work can proceed. Cost benefit analyses usually form part of the licensees safety arguments in the safety case and would be scrutinised by NII specialist assessors. Site inspectors routinely check Permits-for-Work, Health Physics Documentation, logs, surveys, dose records and witness selected tasks to check that ALARP dose controls are adequate.

c) Operational radiation protection measures applied for example to access control, fuel exchange, maintenance and repair works, outage planning, regular surveys of surface and airborne contamination and dose rates in accessible areas. Protection measures (protective clothing, temporary shielding etc.)

All the above examples would be the topics of inspection under the licence conditions and IRRs. Much of the NII site inspector's work will be carried out by 'sampling' i.e. examining tasks, records, documentation, "interviewing" and discussing with individuals to satisfy the inspector that there is competent, awareness of the risks/hazards and that all that is reasonably practicable is being done to ensure safety. If it is found that short-cuts, improper protection, inadequate or inappropriate measures are being taken in radiological matters, then "deeper slice" sampling of the work/documentation will be taken to determine the extent of non-compliance. NII radiological specialists can be called in to provide more detailed assessment and advice on matters that have been raised or detected. Intervention, including enforcement would be actioned if inspection reveals deterioration in standards.

d) Radiation protection instrumentation and sampling, for example to: process instrumentation, stationary equipment for room dose rate survey, portable instrumentation (doserate, surface and airborne contamination), personal contamination and incorporation control, calibration and testing of instrumentation, control of gaseous and liquid effluents and environmental monitoring

Much of the equipment described is seen to be very important by inspectors and would be routinely inspected in the course of plant walk-rounds (which may be targeting other aspects of compliance). Indicators of a slipping culture can be, for example, expired calibration tags/certificates or unavailability of personnel monitors. There are licence conditions that require that operational limits are set for some instrumentation and for the use of safety mechanisms, such as gamma alarms. It would be expected that trigger levels would be set for instruments so that personnel can take action prior to dose rate/airborne levels reaching a hazardous level. Although NII is responsible for regulating gamma radiation at the site boundary and radioactive wastes within the licensed site, regulation of gaseous and liquid effluents together with environmental monitoring is the remit of the Environmental Agency.

e) Dosimetry, for example applied to: individual and collective doses (plant personnel, contractors personnel), job doses, partial body dosimetry and reporting requirements

Inspectors would regularly review doses and request the licensee to provide information in an appropriate form i.e. by dose cohorts related to groups or tasks. Licensees have an absolute liability for contractors who work on the site. Both licensees and contractors must comply with the IRRs which include a requirement for radiation passbooks for contractors. Checks would be carried out to ensure correct dosimetry is used for the task in hand, e.g. wearing of extremity thermoluminescent dosimeters or passive air samplers. Reporting requirements for events/incidents are specified in legislation and licence conditions (e.g. LC 7).

f) Measures applied or planned to cope with situations after incidents, for example: access restrictions, clean-up of contaminated areas, support of fire fighting

Inspections would periodically target aspects where contingency arrangements have to be available, e.g. lead pots and tongs for radiographic work, availability of chelating agents and decontamination solutions. Emergency preparedness (LC11) is an important licence condition which not only expects adequate arrangements but requires an adequate demonstration of emergency capability to be observed annually by NII.

g) Training in radiation protection, e.g.: training of plant personnel and subcontractors personnel, training of technicians and responsible persons in radiation protection

The requirements for training are specified in a specific licence condition (LC10) as well as in the IRRs, particularly in respect of Radiation Protection Advisers and Supervisors. Training arrangements and practices are inspected as part of the site inspection programme. Induction training for personnel new to the site, including contractors, is usually attended by inspectors periodically to assess its suitability.

h) Other topics of interest to be discussed at the Workshop

To be raised at the Workshop itself.

UNITED STATES

LEGAL MATTERS

Structure of Legislation and legal requirements, role of different national authorities involved in radiation protection

The Nuclear Regulatory Commission (NRC) was established by the Energy Reorganisation Act, enacted by the US Congress, in 1974. This Act abolished the Atomic Energy Commission and transferred all licensing and related regulatory functions assigned to the Atomic Energy Commission by the Atomic Energy Act of 1954. The Nuclear Regulatory Commission is composed of five members, one of which is designated by the President of the United States as Chairman. The Commission is responsible for licensing and regulating nuclear facilities and materials and for conducting research to support these activities. The Executive Director for Operations (EDO) supervises and coordinates policy development and operational activities of the NRC staff. The EDO reports for all matters to the Chairman. The three major program offices, the Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Materials Safety and Safeguards (NMSS), and the Office of Research; several support offices (including the Office of Enforcement); and the four Regional Offices report to the EDO. The inspection program is developed and maintained by NRR and NMSS for their respective areas. However, the inspection program is generally implemented (inspection planning, inspector supervision, etc.) by the Regional Offices for the licensees in their respective regions.

The NRC has the authority to establish regulations to provide for the public health and safety in all matters associated with the production and use of licensed material within the licensed facility. Non-radiological occupational safety hazards within the facility are under the authority of the Occupational Health and Safety Administration. The environmental impact of facility operations, and the off-site portions of the emergency preparedness and response, are under the jurisdictions of the Environmental Protection Agency and Federal Emergency Management Agency, respectively, and in some cases under individual State authority.

The basic NRC requirements for radiation protection are found in Title 10 to the Code of Federal Regulations, Part 20, "Standards For Protection Against Radiation" (10 CFR 20)

ADMINISTRATIVE ASPECTS OF THE REGULATORY BODIES INSPECTIONS ON RADIATION PROTECTION

Organisation of inspections (i.e., inspection planning, realisation of inspections and enforcement, joint or dedicated inspections, internal guidelines, etc.)
Qualification and Training of Inspectors
Work load: Number of Licensees inspected per inspector

The program for inspecting the safety of nuclear power plants, including the radiation protection aspects of plant operations, is developed and maintained at NRC Headquarters by NRR. This includes the writing of inspection procedures, directing the emphases of the inspection program, and setting the level of effort expected in implementing each program element.

New regional inspectors are required to complete an extensive training and qualification program before they can conduct independent inspections. This program which requires about a year to complete includes NRC offered training courses in BWR and PWR reactor system design, and rad-waste processing. Unqualified inspectors are required to conduct several inspections accompanied by a qualified inspector.

As part of the qualification program inspectors must complete a required reading list (that includes NRC regulations, regulatory guidance documents, position or policy papers, and pertinent industry and international standards.) and pass an examination on their comprehension of the material.

Region based inspectors typically devote about thirty percent (30%) of their work time to direct inspection effort. Although some pre-inspection preparation time is counted, direct inspection effort is the time an inspector is on the licensed facility conducting inspections. The exact work load on the inspectors varies slightly from region to region.

INSPECTION TOPICS

The following list of inspection topics serves as a guide. Please describe to each topic the inspection programme (type of inspection, objectives of inspections, frequencies).

In addition to the radiation dose limits, 10 CFR 20 contains specific requirements on radiation surveys and monitoring, access control to radiologically significant areas of the facility, respiratory protection practices, and the storage and control of radioactive materials. In addition, 10 CFR 20 requires each licensee to implement a radiation protection program commensurate with the extent of licensed activities. For nuclear power plants, scope of the program is defined in a license condition that requires the licensee to develop and implement procedures in a wide range of radiation protection areas, including contamination control, use of protective clothing, and job controls. Implicit in this regulatory structure is that these procedures are effective at achieving their stated goal (i.e., the radiation detection instrumentation calibration procedures do assure operable equipment with acceptable accuracy and precession). The effectiveness of the licensee's program and procedures is the primary focus of the radiation protection inspection programs.

LICENSEE'S ORGANIZATION

A description of the licensee's radiation protection program is reviewed during licensing of the facility. Licensee's are required to have a radiation protection program headed by a Radiation Protection Manager that reports to the Plant Manager independently of Plant Operations management. The number of health physics personnel and the organisation structure is left to the licensee and varies widely. In general, however, a radiation protection program at a nuclear power plant has an operations group (comprised of technicians that conduct routine health physics operations and surveillance), a rad-engineering group of professionals, an ALARA group, a dosimetry group, and an environmental effluents group that may or may not include radwaste processing operations.

ALARA MANAGEMENT

Licensees are required in 10 CFR 20 to use , to the extent practical, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses and doses to members of the public that are ALARA. Additional guidance on the implementation of an ALARA program are found in other documents such as Regulatory Guide 8.8. However the structure and organisation of a ALARA programs varies from facility to facility. In general the NRC expects the licensee to implement a program that reviews and plans radiologically significant activities (jobs that exceed one person-rem collective dose) and use a decision making process that may include a cost-benefit analysis to determine the practicality of implementing additional dose reduction measures. The NRC has endorsed the use of $2000 per person-rem ($200 per person-mSv) in these cost benefit analysis. However, many licensees use substantially larger values (e.g., $10,000 to $20,000 per person-rem or $1,000 to $2,000 per person-mSv) in their ALARA reviews. Other factors such as environmental conditions (e.g., heat stress) and worker confidence may also be considered in the decision process.

The three (3) year rolling average collective dose for the facility is used as a metric in the inspection procedures to judge the overall performance of the licensee's program and the relative significance of any ALARA related inspection issues.

OPERATIONAL RADIATION PROTECTION MEASURES

As discussed above, licensees are required to maintain an effective radiation protection program that maintains radiation doses within the limits in 10 CFR 20 and are ALARA. The NRC risked informed inspection program in this area is to verify that the licensees identify deficiencies in these programs and correct them in a timely manner. In addition the inspection is focused on those areas in the plant, and work activities in the plant, that can pose a large radiological risk. Control of access and work activities in plant areas that can have large changes in the ambient dose rates (e.g., can become a Very High Radiation Area with relatively minor changes to plant operations or configuration) are singled out for review.

RADIATION PROTECTION INSTRUMENTATION AND SAMPLING

In general, licensees are required to make surveys that may be necessary for them to comply with the regulations in 10 CFR 20. Additional guidance on the types, sensitivities and calibrations of radiation detection equipment, and the frequency and types of surveys or monitoring, are found in Regulatory Guides or other industry standards such as the ANSI standards.

Process and effluent monitoring generally can have their own specific requirements. Many process monitors are provided for the early detection of abnormal operational occurrences and mitigation the consequences of a reactor accident. The facility operating license generally has separate license conditions concerning the calibration and operability of these monitors. Other license conditions require licensees to monitor and quantify all paths of radioactive plant effluents during normal operations and anticipated operational occurrences. In addition environmental sampling, to quantify the presence of radioactive materials, is required for all identified exposure pathways to the public.

DOSIMETRY

Licensees are required to provide individual radiation monitoring if the individual is likely to receive more than 10 % of the dose limits in 10 CFR 20 from external sources or the intake of radioactive materials, or the individual enters a High Radiation Area (e.g., accessible dose rates in excess of 100 mrem/hour). Personnel dosimetry that requires processing is required to be processed and evaluated by a processor that is accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology to ensure accuracy of the results.

Licensee are required to report each year the results of individual monitoring (including dosimeter readings and any bioassay evaluations) to the individual monitored and to the NRC. Collective dose resulting from plant operations is also reported to the NRC on an annual basis.

MEASURES APPLIES OR PLANNED TO COPE WITH SITUATIONS AFTER INCIDENTS

The licensing of nuclear power plants is regulated by Part 50 to the Code of Federal Regulations (10 CFR 50) which contains sixteen planning standards that specify the scope and content of a licensee's Emergency Plan. Prior to receiving a full operating license, the plant's Emergency Plan must be reviewed and approved by the NRC, and the licensee must have successfully demonstrated that they can implement the Plan. The Federal Emergency Management Agency is responsible for evaluating the ability of off-site state and local governments to effectively respond to emergencies. The on-site Emergency Plans are focused on the need for the licensee to properly identify, classify, and notify the appropriate authorities of a wide spectrum of operational events. The classification of events are Unusual Event (the lowest level), Alert, Site Area Emergency, and General Emergency (which would include major reactor accidents). Depending on the potential radiological significance of the event the licensee also needs to make proper protective action recommendations to the state and local authorities who are responsible for conducting these actions. The recommendations are based on the Protective Action Guides developed by the US Environmental Protection Agency. Actions can include evacuation of areas surrounding the plant, sheltering of the effected public, or controlling potentially contaminated food stuffs.

The Emergency Plans are generally aimed at minimising the radiological consequences of an accident and is considered part of the NRC's defence-in-depth safety philosophy. Due to the potential rapid onset of an accident, protective action recommendations are generally based on plant conditions. However, the licensee's ability to perform radiation dose projections is a required element of the Plan. In addition, licensees are required to provide radiological emergency response training for individuals that may be called on to assist in an emergency. These individuals include members of offsite organisations (such as fire fighters) that may need to respond to the emergency. Offsite post accident recovery efforts, after the reactor facility has been stabilised, are generally under the jurisdiction of other US federal agencies. These agencies include the Environmental Protection Agency for standards dealing with the decontamination of the environment, and the Food and Drug Administration for issues dealing with contaminated food stuffs, in concert with agencies of the effected states.

The NRC inspection program for Emergency Preparedness is focused on determining whether the licensee's Plan meets the required planning standards and the licensee's ability to implement this Plan. One of the planning standards requires the licensee to conduct drills and exercises and to correct any identified deficiencies. The current risk informed inspection program in this area focuses on the licensee's performance in critiquing their own drills and exercises (particularly the most risk significant aspects of the Plan), in identifying deficiencies, and in correcting these deficiencies in a timely manner.

TRAINING IN RADIATION PROTECTION

All individuals that in the course of employment are likely to receive an occupational dose in excess of 100 mrem (1mSv) in one year, are required to be trained in the risks associated with working with radiation, the necessary precautions (including the provisions of the NRC regulations and the facility procedures) for safe radiological work, and the appropriate response to unusual occurrences or malfunctions. The level of this training must be commensurate with the potential radiological health protection problems present in the work place.

Provisions in 10 CFR 50 for the training and qualification of nuclear power plant personnel require that licensees conduct training necessary to provide qualified personnel (including Radiation Protection Technicians) to operate and maintain the facility in a safe manner. A systems approach to training, that includes a systematic analysis of the job, learning objectives derived from the analysis, training that addresses the objectives, evaluation of the trainees mastery of the objectives and periodic revisions to the training based on personnel performance in the job setting, must be provided. To meet this requirement, the nuclear power industry has developed training standards and an accreditation program administered by the Institute for Nuclear Power Operations (INPO). The NRC inspection program does not require a through review of licensees' training programs that meet these standards, and are accredited, unless specific job performance issues that indicate deficient training are identified in the inspection.

Questionnaire - Part B
REGULATORY INSPECTIONS REQUIRED FOR LONG SHUTDOWNS AND SUBSEQUENT RESTARTS

NOTES

- Only one response per country is required. If more than one person from your country is participating, please co-ordinate the responses accordingly.
- Please provide responses on separate sheet and clearly identify the questionnaire part and topic.
- Please provide Submittal prior to 31 March 2000. Submittals should be sent by email to: barry.kaufer@oecd.org

For the purposes of this topic, the term "long" refers to unusual outages, as opposed to scheduled refuelling outages or annual maintenance outages.

A number of nuclear power plants around the world are shut down, for various abnormal reasons, such as after abnormal events, serious safety problems or economic reasons, for prolonged periods of time. Licensees expect to restart some of these plants eventually. Restarting these nuclear power plants after prolonged shutdowns may reveal hazards which are greater or different in nature than those initially anticipated for. Regulatory agencies must plan the right and timely regulatory inspections to gain reasonable assurance that the plants are maintained in a safe state during the shutdown and subsequent restart.

1) ENVIRONMENT
   (a) *State whether "long" shutdowns (or lay-ups) deserve a special regulatory status or attention in your country.*
   (b) *State under what circumstances or criteria (such as anticipated shutdown length, no firm commitment to restart) the regulatory authority suggests or requires that a normal shutdown becomes a "long" shutdown.*

2) REQUIREMENTS
   (a) *Briefly describe the regulatory (legal and technical) requirements related to the status of "long" shutdown, if applicable.*
   (b) *Does the licensee submit shutdown and restart plans and does the regulatory authority approve the plans?*
   (c) *Does the regulatory authority expect commitments from the licensee during these periods?*
   (d) *Briefly describe the essential or important elements of such licensee plans, if applicable.*

3) INSPECTION PROGRAMME

(a) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements, related to "long" shutdowns, taking into consideration such areas as:

- *The licensee management organisation, and special configuration management features.*
- *Verification of licensee personnel abilities and training programme.*
- *Specific licensee training delivered, and its inspection by the regulatory authority.*
- *Verification of safety related systems and components*

(b) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements related to restarts after "long" shutdowns, as in 3a.

4) Please list or briefly describe any other issues you would like to be discussed at the meeting.

Responses to Questionnaire - Part B

BELGIUM

There is no specific programme for long outages inspections.

The inspections are adapted to the actual work performed during the inspections.

CANADA

1) Environment

(a) State whether "long" shutdowns (or lay-ups) deserve a special regulatory status or attention in your country.

Long shutdowns (or layups) do not receive special status or attention in Canada. The licensee is required to maintain their operating licence.

(b) State under what circumstances or criteria (such as anticipated shutdown length, no firm commitment to restart) the regulatory authority suggests or requires that a normal shutdown becomes a "long" shutdown.

There is presently no written criteria in Canada for the regulator to suggest or require that a normal shutdown become a "long" shutdown. The Canadian experience has been that the licensee announced the "long" shutdown (layup) with no firm commitment to restart. Licence conditions were then instituted by the Canadian regulator to require regulatory approval for restart.

2) Requirements

(a) Briefly describe the regulatory (legal and technical) requirements related to the status of "long" shutdown, if applicable.

The licensee is required to maintain an operating licence and meet the conditions set out within the licence.

If the reactor unit is to remain full of fuel during the long shutdown, the licensee is required to have one shutdown system poised (unless the moderator is drained), the other special safety systems must be available for recall in an emergency situation. The licensee is required to test these systems to ensure their reliability. All safety related systems are required to be available.

If the reactor unit is defuelled , special safety systems can be deposed. Safety related systems can be shutdown with the exception of emergency power supplies (standby generators, batteries), required to provide cooling to the irradiated fuel bays and emergency lighting. A reliable source of building heating is required.

(b) Does the licensee submit shutdown and restart plans and does the regulatory authority approve the plans?

The licensee submits both shutdown and restart plans. The Canadian regulator approves the restart plan and certain portions of the shutdown plan.

(c) Does the regulatory authority expect commitments from the licensee during these periods?

Certain commitments are expected to be completed (i.e. improvements in radiation protection), however commitments related to reactor unit operation are suspended. These suspended commitments are expected to be completed before the restart of the reactor unit.

(d) Briefly describe the essential or important elements of such licensee plans, if applicable.

Shutdown plans:

- a statement of intent to lay up
- the reason for the lay-up
- the planned time period for the lay-up
- a commitment to continued safety and security
- Status of fuel in the reactor
- Status of special safety systems and safety related systems
- Critical equipment maintenance
- Management organisation and staffing levels
- Status of periodic inspection and in-service inspection programs
- Status of training programs
- Regulatory commitments that are to be suspended until restart

Restart plans:

- Commissioning/testing plans for special safety systems and safety related systems
- Environmental Assessment report (required under Canadian law)
- Training programs
- Regulatory commitments to be completed
- Equipment to be refurbished or replaced
- Periodic inspection and in-service inspection program plans

3) Inspection programme

(a) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements, related to "long" shutdowns, taking into consideration such areas as:

- *The licensee management organisation, and special configuration management features.*

  The licensee management organisation is approved by the regulator. Human factors assessments are carried out on the management organisation. There is currently no set frequency for these assessments.

  Annual quality assurance audits are performed on the configuration management of the shutdown reactor unit.

- *Verification of licensee personnel abilities and training programme.*

  Audits and assessments of the licensee training programs are carried out on an annual basis.

- *Specific licensee training delivered, and its inspection by the regulatory authority.*

Audits and assessments of the licensee training programs are carried out on an annual basis. Control room operator and shift supervisor training programs must be approved by the regulator.

- *Verification of safety related systems and components*

  Safety related systems in plants that remain fuelled will have been available for operation and tested throughout the shutdown period. Regulatory inspections would be the same as for an operating reactor unit. These inspections are carried out on a regular basis.

  For defuelled units, regulatory inspections are not carried out on non-operating safety related systems. Safety related systems would require re-commissioning upon restart. The regulator would witness and review the re-commissioning tests before restart.

(b) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements related to restarts after "long" shutdowns, as in 3a.

The regulatory inspection program for "long" shutdowns is essentially the same as for operating units.

Field inspections
- cover all areas of the station once per year (~70 inspections)

Control Room Inspections
- One per month (12 inspections)

System Inspections
- In-depth review of systems - 3 special safety systems, 2 safety related systems per year.

Audits
- One quality assurance audit per year
- One security audit per year
- One radiation protection/environmental performance audit per year

The responsibility lies with the licensee to prove to the regulatory that the reactor unit is safe to resume operation. A Periodic Safety Review will be required before the restart of reactor units from a "long" shutdown.

4) Please list or briefly describe any other issues you would like to be discussed at the meeting.

- Reactor Control Upgrades (Compatibility of old technology with new). This is an issue with the upgrade of the IBM 1800 Reactor Regulating System computers at Pickering NGS A.
- Modifications or Enhancements of systems to meet new regulations (i.e. Backfits).

FRANCE

1. Environment

In France, "Electricité de France" operates 58 PWRs on 19 NPP sites (each NPP being a licensee).

After each shutdown longer than 15 days, any PWR unit must submit to the regulatory authority (DSIN + regional DRIREs) the results of the main works done during this outage. A formal authorisation, delivered by the regulator, is necessary to restart the plant with two significant steps:

- the first one, just before the primary water temperature reaches 110°C (due to French pressure vessel regulation - new ministerial order of November 10th 1999)
- the second one, before the reactor goes critical (due to the French nuclear safety regulation from 1963)

This second authorisation is required since 1989, after having found out significant deficiencies during maintenance works on primary circuit safety valves of Gravelines NPP.

Before giving this permit to the utility, the regulator want to check that safety provisions have been implemented during the outage.

In fact, there is no difference between normal outage for refuelling or long shutdown for specific works such as safety system modifications or important maintenance program (Steam generators replacement, containment repair, ten yearly outages…).

But, during these long outages, more inspections are performed by the regulatory inspectorate to have a best idea of the quality of these works.

2. Requirements

In France, the regulator performs a supervision to ensure that the nuclear plant operator fully complies with its responsibilities and obligations with regard to safety. This supervision is carried out by spot check inspections during outages since 1982 at national and local levels.

This concerns:

- the shutdown plan submitted by utility 4 months before stopping the plant. For the main primary and secondary systems, this document describes the main maintenance works, repairs or examinations scheduled, the technical files needed for that, the list of vendors or subcontractors, radiation protection management…For other systems, the operator must describe and explain the differences between the local shutdown plan and the national one for this type of plant.
- during the shutdown, the implementation conditions of these technical works on site
- at the end of the shutdown and before giving the authorisation to restart, the results of the examinations made to know the safety state of the plant

There is no special regulation for shutdowns, expect for main primary and secondary systems (Nuclear steam supply system-NSSS) for which a new ministerial order of November 1999 (it replaces the previous one of 1974) defines special rules during operation and also during outages, to reinforce the regulatory supervision, for example :

- The NPP must describe the in service inspection program of NSSS and update it to take into account the operating experience feedback, and also every ten years;
- The maintenance and repair conditions for special or difficult works, such as welding, must be qualified before implementing them on site;
- Non destructive examinations must also be qualified, following the specific European methodology;
- Every ten year a special NSSS examination with a general hydro test, is required;
- After thirty years of operation, a thorough inspection program is required every five years.

But considering the safety importance of works carried out on the installation during these outages and the safety hazards incurred by certain shutdown situations, the regulator requires consistent informations from the operator in this respect, concerning mainly the works schedules involved and many non conformances observed during the outages.

Generally speaking, for all quality and safety related activities, the operator must implement the ministerial "Quality order" of august 10th 1984. This regulation provides frameworks for the provisions to be made by the operator to obtain a quality level of his installation and its operating conditions consistent with safety requirements. The required quality level for an activity is obtained and maintained by the action of those performing the activity and by suitable organisational and checking provisions.

More details will be given about three examples during the poster session:

- Defects found under the cladding on the pressure vessel of Tricastin unit 1
- The repair of the containment building of Flamanville unit 1
- The primary water leakage observed on the residual heat removal system piping of Civaux unit 1.

3. Inspection program

Safety authority inspection consist in ensuring that the operator complies satisfactorily with safety provision requirements. It is neither systematic nor exhaustive and uses spot-checking methods to detect specific deviations or non-conformances, together with any symptoms suggesting a gradual decline in plant safety.

An annual inspection program is determined by the regulator. It takes into account inspections already carried out, informations obtained on various plants and progress made on technical subjects under discussion between DSIN and EDF central services. It is based on priority topics such as:

- Inspections on NPPs to ensure that the licensee applies specified technical requirements
- Inspections regarding maintenance activities during outages
- Inspections focusing on a technical problem
- Inspections further to significant incidents related to plant safety

Some items are inspected every three years, others every five years on each plant.

Each year, additional priority topics may be selected after discussions between the DSIN and the regional DRIREs, in order to get on overview of safety provisions implemented by EDF on the NPP sites.

For example, priority topics chosen for the PWR 2000 inspection program, are the following :

- Application of the plan management scheduled by EDF for fuel assembly;
- Enforcement of the French code for in service inspection and maintenance of mechanical components;
- Provisions implemented by EDF to be sure that qualifications of safety related equipment during severe accidents are maintained after modifications;
- Plant compliance reviews (in different areas like external hazards).

GERMANY

1. ENVIRONMENT

a) All operational procedures for normal operation of the NPP, operation of systems, conditions for shutdown and outage periods and start-up after shut-down are contained in the operation manual (abbreviation in German: BHB). This manual is subject to regulatory approval and inspection. Procedures for operation modes during and after extended shut-down periods may be different from those described in the BHB and are subject for regulatory approval.

b) As long as the plant is operated according to the BHB, there is no precise distinction between short term and long term shut-down periods.

2. REQUIREMENTS

a) According to the operation license deviations from the approved operation procedures laid down in the BHB are not permitted. If they become necessary, approval by the regulatory inspection authority is mandatory before their application. The operator has to demonstrate that the safety of the plant is not jeopardised. Also, the specified requirements for the operational loads for the respective systems and components must be kept unchanged.

b) The licensee submits a "shut-down-plan" to the regulatory inspection authority for approval. Depending on the length of the envisaged shut-down period changes of the operational procedures may become necessary. The shut-down-plan will be revised as necessary and reviewed and approved by the authority.

For subsequent start-up, the licensee has to demonstrate that all systems and components comply with the prescribed operational requirements. The applied method for this demonstration is to be approved by the authority.

c) The licensee is obliged to follow the regulatory approved shut-down and start-up plans and procedures.

d) These approved plans and procedures cover:

- the operational mode of the individual systems,
- the conservation methods and means for individual systems and components,
- deviations from the BHB and from the approved testing and in-service inspection plan,
- deviations from prescribed maintenance procedures and schedules,
- additional commissioning / requalification tests if necessary.

3) INSPECTION PROGRAMME

a) The regulatory inspection authority is supported in most cases by experts (e.g., from TÜV). The experts are at the site on an daily basis. Their tasks cover regulatory inspection regarding compliance to the procedures of the BHB and the regulatory approved plans, in particular inspections regarding:

- operational mode of systems,
- conservation methods and means for systems and components,
- recurrent testing and in-service inspections,
- maintenance tasks,
- reportable events.

The regulatory inspection authority maintains close contact with their experts on site. Their officials themselves are at the site usually once a week.

- The organisational structure of the NPP may be adapted to the needs of the shut-down period and is described in the approved plans.
- The responsible personnel of the NPP has to demonstrate their qualification and knowledge in the same way as for normal operation of the plant.
- The training and retraining programme for all personnel continues as usual. As the normal NPP-operation is stopped, the shift personnel training at the simulator is enhanced substantially.
- Operation of systems and components important to safety and the results of their regular functional tests are inspected by the experts. Components and parts which have been dismantled, packed and stored are inspected by the experts before they will be remounted.

b) For start-up of the plant after a prolonged shut-down period a commissioning plan has to be elaborated and submitted for regulatory approval.

The following items must be contained in this plan:

- re-establishing of the organisational structure of the NPP according to the BHB as originally approved
- remounting, filling and commissioning of the individual systems and components according to the approved specifications,
- functional tests of systems and components which during shut-down have been operated in deviation to the approved BHB and recurrent testing plan
- additional functional tests required to demonstrate the safe operation of the entire plant.

JAPAN

1. ENVIRONMENT

a) Long shutdown

The Electric Utility Industry Law stipulates that Periodical Inspection shall be carried out within 13 months after previous Periodical Inspection, however there is no description about the duration.

b) Circumstances or criteria

See above

2. REQUIREMENTS

a) Regulatory requirements

About 80 inspections are normally carried out as Periodical Inspection during outage. The Completion of Periodical Inspection is defined as the last day of inspection among about 80 inspections. Even for long shutdown, the results of each inspection are evaluated as no problem if the final environmental condition of equipment is not changed compare to inspected condition before. Equipment, which was completed inspection once, should be re-inspected if the condition changed, such as suffering the fluctuation of water level during long outage.

b) Shutdown and restart plan

Licensee shall submit operating plan to Ministry of International Trade and Industry (MITI) according to The Law for the Regulations of Nuclear Sources Material, Nuclear Fuel Material and Reactors (RNNR). This operating plan is not permission matter.

(c), (d) Operating plan

MITI confirms the operating plan in wide-ranging view. Operating plan contains electricity generation plan, such as maximum electricity, mean electricity, load rate and consumption plan of nuclear fuel and so on. If the electric generation capability were expected to decrease or stop by re-fuelling, inspection and repairs, the operating plan would be reviewed.

3. INSPECTION PROGRAMME

a) Regulatory Inspection Programme

Even for long shutdown plants, regular inspection programme is to be applied.

b) Essential Elements related to restarts after long shutdown.

See (a) above.

THE NETHERLANDS

In the Netherlands only two nuclear power plants were built. One of them has stopped operation in 1997 and is in the process of decommissioning. The other will stop operation in 2004 and it is foreseen that the decommissioning process will start directly after.

In the past no long shutdowns occurred and it is not expected that it will happen in the future. There are no regulatory (legal and technical) requirements documented in the Netherlands. **The response on this questionnaire will therefore be hypothetical.**

1. Long shutdowns of nuclear power plants.

(a) Special regulatory status.

In the license, Safety Report and Technical Specifications of the nuclear power plant (NPP) requirements are set on (number of) shift personnel, frequency of testing and inspecting of equipment, organisational structure, training/qualification of plant personnel, etc.

When the NPP wants to alter "temporarily" (because of a planned long shutdown) the requirements set for operation, as specified in the license and associated Safety Report, a process for a new license application has to be followed, including the set up of a new Safety Report and Environmental Impact Assessment Report.

When the NPP wants to restart after a long shutdown, the licensing process must be followed again, thereby solving the reasons for the shutdown.

It is also to be expected that the reason for the long shutdown will require changes in operation and/or design, and therefore will result in a new license procedure.

(b) Declaration of a long shutdown

When the licensee has the intention to restart its NPP as soon as possible after a normal shutdown (normally 4 weeks; the last shutdown was only 15 days and the NPP wants to reduce the outage time even more!) and due to unplanned circumstances/events/etc. the restart is delayed for a considerable period the regulatory body might require additional commissioning tests and an agreement has to be made in the area of test-frequency of equipment as prescribed by the Technical Specifications. All other requirements (see 1 (a)) has to be met.

If the regulatory body gets the impression that the NPP does not want to restart after a normal shutdown no agreement on the test-frequency will be made and the NPP will be "enforced" to apply for a new "operating"-license.

(c) Acceptance criteria.

There are no regulatory authority acceptance criteria in the Netherlands.

2. Requirements/documents/plans related to the status of long shutdowns.

(a) Legal and technical requirements.

For each status of the NPP a dedicated license is needed. When the NPP wants to change its status from "operating" to "long shutdown" a new license is required and a new Safety Report, Technical Specifications (TS) an Environmental Impact Assessment Report must be made (see also 1 (a)).

(b) Shutdown and restart plans.

The transition from one status to another status of the NPP must be described in plans. These plans have to be approved by the regulatory body. An essential part of the restart plan will be the steps and procedures related to the (new) commissioning of the NPP.

(c) Commitments of NPP during long shutdown.

As stated in 2 (a) a new license and TS are set up for this period. In this license and TS commitments (focused on items as stated in 1 (a)) are described related to the "operation" of the NPP during the long shutdown. The license for the long shutdown will probably valid for a limited period and a decision (approved by the regulatory body) at the end of this period will be made in order to prolonged the situation, to start decommissioning or to restart operation.

(d) Important elements of licensee plans.

In the new Safety Report it is described which equipment (and instrumentation) is important and needed to reduce the risk on an event and/or to reduce possible consequences to the environment. When the NPP wants to mothball the not necessarily equipment in order to reduce costs (operating, testing, surveillance, etc.) the plan, describing the transition "operation to long shutdown" must clearly describe:

- the parts of the plant being mothballed and the methods how,
- the assurance that the mothballing doesn't have an impact on the safe storage of the fuel,
- the method how to remove liquids in order to reduce risk of radiological contamination, degradation
- of piping/equipment due to the water-chemistry/precipitation and to reduce the risk of fire,
- the humidity and ventilation conditions (condensation on abnormal positions/corrosion),
- control of bearings of non-used rotating equipment.
- the non-functional and/or disconnected instrumentation and
- the surveillance programme of these parts.

When the NPP wants to restart after a long shutdown the "normal" commissioning programme must be clearly described.

3. Regulatory inspection programme related to long shutdown.

During the period that the NPP is getting mothballed the frequency of regulatory inspections will be the same as during normal operation. The objectives and type of the inspections however will change. More attention will be paid to human performance (good house keeping, radiological protection and witnessing activities) and less to reactor safety.

After the mothballing-period the frequency of regulatory inspections will drop to about 25% of the normal frequency. The objectives and type of inspections will change again. Items as alertness of the organisation, requalification and training of craftsmen, (more) simulator training of operators, safety culture, motivation of personnel will be assessed when possible during the inspections. In the area of "reactor safety inspections" most of the attention will go to availability of redundant systems (cooling, electricity and ventilation) and emergency preparedness.

4. Regulatory inspections programme related to restart after long shutdown.

In order to restart after a long shut down the NPP has to set up a commissioning plan (see also 2 (b)). To execute this plan the NPP shall install a start-up organisation in order to keep track of the progress, to deal with deviations, etc. During the assessment of the regulatory body to approve this plan an audit will also take place on the start-up organisation in order to check that proper procedures are available, a good communication system is in place between the start-up organisation and the normal operating organisation and that the personnel of start-up and the normal operating organisation are sufficiently trained and qualified.

During the commissioning inspections will be performed every day (when necessary also at night). Specified hold- and witness-points in the commissioning plan will be attended.

5. Normal restart versus restart after long shutdowns.

In essential the difference at the restarts will be the implementation of the commissioning plan, comparable with a large modification project, where all components and systems are systematically checked and tested from cold to hot operation. When the commissioning-period is completed successfully a "normal" restart according to the normal procedures and inspection-regime will take place.

SPAIN

INTRODUCTION

The Spanish Government decided in the 80´s to stop 2 nuclear power plants under construction for several years. It was called a "nuclear moratoria". During this period special plans for maintenance of equipment and structures were designed and carried out by the licensees. The Nuclear Safety Council stated special inspection programs to ensure that the plants were remained in a good condition to restarts the construction if so was decided. Finally the Government decided that the number of Spanish plants under operation were enough to get nuclear energy and these plants were left.

In 1989 an important fire destroyed part of Vandellos I NPP. After the accident there was not any decision whether restart the plant or non. For several months the licensee and the CSN studied the plant situation and the requirements to restart the plant. Finally in May of 1990 a decision to decommissioning the plant was taken. During this period (about 6 mounts) a resident inspector was placed in Vandellos to make sure that the plant remained in safe conditions, but not special requirements or inspection programs were carried out by CSN. Only to apply the technical specifications according to the plant situation was required.

The only situation in Spain for a plant stopped for a long period (more than 1 year) and subsequent restarted was in José Cabrera NPP in 1994.

José Cabrera is a PWR-Westinghouse reactor (150 MWe). It is the smallest and oldest plant in Spain. José Cabrera was stopped from January 1994 to June 1995 due to a structural problem on the top of the vessel.

During this period a lot of inspection test were carried out on the top of the vessel to see the real problem of the cracks. Then, a lot of studies were made about the situation and the CSN decided to establish a very strong program of inspections to continue the plant under operation. Finally, the licensee decided to change the top of the vessel and put a new one because it was the best way to accomplish the CSN conditions. During this period the plant remained in refuelling shutdown according Technical Specifications. They removed the fuel from the vessel to the spent fuel pool.

Apart from the activities related to the outage causes, the plant remained the status of a plant under refuelling. The operational teams in control room and the rest of plant personnel were following their responsibilities as usual. All surveillance test procedures according Technical Specifications and maintenance activities related to structures, mechanical and electrical equipment was carried out as the same way that during a normal outage. The resident inspector from the CSN remained at plant according to his function.

The licensee did not ask to the CSN any exemption to relax the Technical Specification requirements during this period. At the end of repair works, the plant restarted following the start up test procedures and the sequence of power increasing was as usual.

Additionally, several shutdowns for a period of about 3 months have been occurred in several plants. The outage causes were to change the steam generators or other important equipments as turbine, electric generator etc. In all of these situations the special requirements and inspection programmes were related to the activities on the plants more than to remain the plants in a safe condition.

1. ENVIRONMENT

There are not any specific codes and standards for "long" shutdowns in Spain. The nuclear regulations do not deserve a special regulatory status for this kind of situation.

None. Until now, the concept of "long" shutdown has never been applied for Spanish nuclear power plants. May be in the future some abnormal situation might require actuation of the regulatory body in that way.

2. REQUIREMENTS

As was stated at the first point, there are not special requirement related to the status of "long" shutdown. During the shutdown the licensees have to accomplish the requirements of Technical Specifications (refuelling mode) independent of its extension.

The licensees submit plans about the activities that will be carry out in the plant during the shutdown but not specifically about how to maintain the plant in a safe condition. In some cases due to special activities may be necessary to put "inoperable" any safety systems required as available by Technical Specifications. Then, the licensees submit exemptions to Technical Specifications for approval by the CSN.

We can say that the regulatory requirements and the licensee commitments for a "long" shutdown are the same than for a normal outage.

3. INSPECTION PROGRAMME

During an unusual outage the inspection efforts of the regulatory body are related to the activities carried out at the plant and not specific inspections are required to the shutdown itself. The surveillance program, required by Technical Specifications in refuelling mode, is available during this period. The resident inspector follows the actions of licensee to maintain the plant in accordance with Technical Specifications as the same way than normal operation.

The CSN approves the refuelling safety study as other outages and the licensee has to accomplish the restart requirements and to carry out the start up test as usual.

Sometimes, additional tests have been required by CSN depending on major changes carried out in the plant. So, licensee activities and regulatory requirements depend on the activities related to the shutdown causes.

Until now, we do not have experiences of "long" shutdowns which particular decisions should be taken by the regulatory body in order to preserve the systems and equipment in an operational status.

The new Spanish nuclear power plant regulation from 1999 states conditions for shutdowns before decommissioning processes but we have not planned anything for restarts processes after a long period stopped by abnormal reasons.

SWEDEN

1. Environment

(a) State whether ”long” shutdowns (or lay-ups) deserve a special regulatory status or attention in your country.
(b) State under what circumstances or criteria (such as anticipated shutdown length, no firm commitment to restart) the regulatory authority suggests or requires that a normal shutdown becomes a ”long” shutdown.

a) In Sweden we don’t have any special regulatory status for long shutdowns. We only have experience from one case (Oskarshamn 1, se below) of ”long” shutdowns, so no special needs have been identified to develop special action plans or inspection programs. SKI will develop additional requirements if we find it necessary for safety. Today SKI can apply a combination of existing requirements with respect to the case of a “long” shutdown if needed. Some major modifications (100-150 days) have taken place on some Swedish plants like exchange of steam generators, modifications in the primary systems. However, SKI has found these situations or outages as deserving special attention, but the authority has not defined these major plant modifications as “long” shutdowns with special requirements.
b) No needs have been identified so far.

2. Requirements

a) Briefly describe the regulatory (legal and technical) requirements related to the status of ”long” shutdowns, if applicable.
b) Does the licensee submit shutdown and restart plans and does the regulatory authority approve the plans.
c) Does the regulatory authority expect commitments from the licensee plans, if applicable.

a) In Sweden there is no special requirements related to the status of ”long” shutdown. The requirements for normal operation are also valid for “long” shutdown. Thus, the basic Safety Regulations, SKIFS 1998:1, are valid even for these situations.

The act (1984:3) on Nuclear Activities - requires the licensees to take all measures necessary to achieve safety (technical, operational, organisational and administrative). Based on this statement the basic Safety Regulations, SKIFS 1998:1, for example requires that nuclear accidents shall be prevented through a basic facility-specific design which shall incorporate multiple barriers as well as a facility-specific defence in depth system.

Other examples of requirements from the Basic Safety Regulations that could be used in inspection activities for “long” shutdowns are:

The licensee of a nuclear facility shall:

- establish documented guidelines for how safety shall be maintained at the facility as well as ensure that the personnel performing duties which are important to safety are well acquainted with the guidelines.
- ensure that the activity carried out at the facility is controlled and developed with the support of a quality system, which covers those activities, which are of importance for safety.
- ensure that adequate personnel is available with necessary competence and of the suitability otherwise needed for those tasks which are of importance for safety as well as ensure that this is documented.
- ensure that responsibilities and authority are defined and documented with respect to personnel carrying out work, which is important to safety.
- ensure that the personnel is provided with the necessary conditions to carry out work in a safe manner.
- ensure that safety, through these and others measures, is maintained and continuously developed.

Relevant for this topic are also the regulations for competence follow-up(SKIFS 2000:x) (new version from 2001-01-01) with requirements of a competence system for operation personal and operation management.

- During a situation of “long” shutdowns special attention will be focused on some areas like:
- Requirements on a quality system to control plant modifications.
- Requirements on safety review.
- Requirements on competence of operators and competence in ordering sub-contractors on adequate personnel available.
- Operability control.

b) There are no requirements for the licensees to submit shutdown and restart plans but in the situation of a long shut down the Inspectorate can decide that additional or other requirement or conditions shall apply.

c) There are also requirements in the Basic Safety Regulations (SKIFS 1998:1) that modifications (for example technical, organisational, safety protection, technical specification, and safety analysis report) shall be notified to SKI.

3. Inspection Programme

a) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements, related to ”long” shutdowns, taking into consideration such areas as:

- *The licensee management organisation, and special configuration management features.*
- *Verification of the personal training delivered, and its inspection by the regulatory authority.*

- *Specific licensee training delivered, and its inspection by the regulatory authority.*
- *Verification of safety related systems and components.*

b) Briefly describe the regulatory inspection programme (type, objectives, and frequency) and its essential elements related to restarts after "long" shutdowns, as in 3a.

a) SKI practising control compliance with requirements by supervision focusing on activities.

Inspections are primarily activity-oriented. The aim of activity-oriented inspections is to examine and evaluate whether the licensee has the ability to adopt a prevention-based approach i.e. whether the licensee systematically examines and evaluates work and actively aims to improve its activities on the basis of this analysis.

The inspections are primarily based on criteria from the regulations, mostly SKIFS 1998:1.

The regulatory body does not use established inspection program with special areas and frequencies, it can vary depends on indications on actual safety topics. For "long" shutdowns can inspection areas (under part two) like below be actual:

- Inspection of the utilities competence program focus on the method the utility uses to ensure those adequate personnel is available with the necessary competence. For a long shut down period special training program for operational personnel shall (i.e. extra simulator training) be developed as compensation that can be a target for an inspection.
- Inspection of a operability program focusing on the process of how the utility identify, and ensure, that safety related systems and components are verified.

b) As mentioned before no special inspection program is developed for long shutdowns but we have some experience from similar situations. The experience in Sweden of long shutdowns is mainly based on Oskarshamn 1.

Oskarshamn 1 (BWR, in commercial operation since 1972) was shot down between 1993 and 1995 because of a deviation consisted of several technical deficiencies, which together were seen as a deviation from the assumed safety level. The main causes were deficiencies in the management and organisation of the plant. The utility developed improvement plans in order to correct the organisational deficiencies e.g. goals and strategies to assure a more long-term perspective, competence development of staff measures to improve safety reviews, quality assessments, and corporate safety culture.

SKI appreciated the ability of the utility to recognise and analyse the relation between management and organisational factors and the technical quality of the plant. The regulator followed closely the implementation of the improvement plans through a package of inspections in order to get a clear view of the process made its direction and sustainability. The plant was also required to present periodic progress report.

As foundation to the final restart permit several inspections were made i.e.:

- Reviewing the organisation improvement program.
- Inspections to make sure that the program was implemented in the plant organisation, and needed resources at the plant were allocated. After that inspection were made to follow the development process, push for further improvements if necessary and make assessments according to criteria defined for assessing the process and its results. SKI ensured that the plant had the ability to

recognise its problems, analyse and understand their nature, the ability of plant and top management to present a comprehensive improvement plan, demonstrate a clear commitment, allocate the resources needed together with an understanding and commitment through the whole organisation. Even so it was regarded essential to get evidence that the organisational improvement plan was successfully implemented and monitored. When the regulator had a clear trend it was decided to abandon the requirements for progress reports on the organisational improvement plan (1999).

- After all fuel were placed in the spent fuel pool the utility developed a new Technical Specifications for the situation with a minimum of requirements of the safety systems (mainly cooling systems for spent fuel and fire safety). This made way for the modification work in the reactor building and containment.
- An inspection was made of the quality system and quality audits related to the modification work.
- An inspection was also made of the safety review function.
- Inspection of the operability program with focus on the process how the utility identified, and ensured, that safety systems and components were verified. The inspection was also focused on integrated tests for safety functions.
- Deviations from competence requirements were admitted for operational personnel with a compensation program in a new build identical full-scale simulator.

UNITED KINGDOM

1. ENVIRONMENT

(a) State whether "long" shutdowns (or lay-ups) deserve a special regulatory status or attention in your country.
(b) State under what circumstances or criteria (such as anticipated shutdown length, no firm commitment to restart) the regulatory authority suggests or requires that a normal shutdown becomes a "long" shutdown.

(a) In the UK, the regulatory regime does not ascribe special regulatory significance to shutdowns according to the length of outage. However, it is recognised that where a statutory outage, or other unplanned absence from service, extends significantly beyond routine expectation, special consideration by the licensee is required to ensure that the reactor and its systems retain their safety functionality and integrity.

(b) Where a shutdown departs significantly from routine practices, the licensee must provide a safety case to justify the management of safety approach to ensure that the reactor is always maintained with a safe envelope. Where it is anticipated that a reactor is expected to restart in the future, the safety case must identify additional safety issues and the licensee must then make and implement adequate arrangements under the nuclear site licence to address them. It is normal practice for the regulatory authority to prevent the restart of a reactor after a long outage until it is satisfied that the licensee has adequately considered all relevant safety issues for the next planned period of operation.

2. REQUIREMENTS

(a) Briefly describe the regulatory (legal and technical) requirements related to the status of "long" shutdown, if applicable.
(b) Does the licensee submit shutdown and restart plans and does the regulatory authority approve the plans?
(c) Does the regulatory authority expect commitments from the licensee during these periods?

(d) Briefly describe the essential or important elements of such licensee plans, if applicable.

(a) Long shutdowns are likely to arise in order to carry out maintenance, inspections or modifications, including alterations to safety cases. All such activities are controlled by site licence conditions which require licensees to make and implement adequate arrangements for these activities no matter how long the activities take. Thus, the regulatory requirements for long shutdowns are no different to those for normal statutory shutdowns for the purposes of inspection.

(b) It is customary for normal statutory shutdowns that licensees submit shutdown and restart plans to the regulatory authority for consideration, but these plans are not approved. The practice for long shutdowns would be similar.

(c) The licensee is required to produce a safety case to justify the operational status of the plant. There will, therefore, be associated commitments that are needed from the licensee.

(d) The licensee's safety case must satisfy, wherever possible, the requirements of the NII Safety Assessment Principles. Where this is not possible , additional specific consideration should be provided under the special case procedure.

3. INSPECTION PROGRAMME

(a) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements, related to "long" shutdowns, taking into consideration such areas as:

- *The licensee management organisation, and special configuration management procedures*
- *Verification of licensee personnel abilities and training programme*
- *Specific licensee training delivered, and its inspection by the regulatory authority.*
- *Verification of safety related systems and components.*

(b) Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements related to restarts after "long" shutdowns, as in 3a.

(a) Where necessary, following an extended shutdown, the regulatory body may consider it necessary to carry out an inspection of the site and its arrangements in preparation for restart. Relevant areas typically include:

i. station staffing issues, and particularly control room staffing;
ii. operator refresher training and directed reading of revised operational procedures;
iii. licensee's arrangements for additional training requirements, where identified by them; and
iv. confirmation of operability and demonstration of required function for reactor systems, particularly safety systems and MCR alarms, etc.

(b) The requirement for a regulatory inspection programme would be assessed on consideration of the licensee's safety case for the prolonged outage. The programme, as necessary, would be designed to address the specific issues identified in the safety report.

4. Please list or briefly describe any other issues you would like to be discussed at the meeting.

i. Shutdowns extending through the winter period: effect of very low temperature on plant and equipment.
ii. Effect of maintenance activity suspensions, including safety related work.

iii. Core reactivity issues, and non-standard start-up conditions.
iv. Pressure circuit water content for gas cooled reactors and potential safety consequences of excessive condensation.
v. Approach to equipment standing alarms from long shutdown effects and discrimination during start-up and early operation.

UNITED STATES

1. ENVIRONMENT

State whether "long" shutdowns (or lay-ups deserve a special regulatory status or attention in your country.

Absent performance problems or other special license conditions, the United States Nuclear Regulatory Commission (NRC) does not give special regulatory status to plants in long shutdowns. Plants that are in shutdown for long time periods must continue to meet the regulations where applicable throughout the duration of the shutdown, such as complying with the plant's technical specifications (TS). Prior to a licensee performing plant activities that would change the status of the plant (i.e., a TS mode change), the licensee must perform certain safety system operational tests, surveillances, and inspections to provide assurances that plant systems important to safety are operational and can perform their safety function. The regulatory inspection and assessment programs provide routine inspection and oversight of anticipated licensee refuelling and shutdown activities to ensure regulatory requirements are being met. The NRC inspection program requires NRC resident inspectors to monitor and perform appropriate shutdown and refuelling inspections, as well as routine oversight activities. These inspections are performed during shutdown conditions, or as permitted by plant operating conditions and licensee activities.

Currently, the NRC is revising its reactor regulatory oversight processes. On April 1, 2000, the revised reactor oversight process (RROP) was initially implemented at all US plants. This revised process utilises performance indicators in conjunction with inspection to maintain adequate oversight and assessment of licensee performance. However, a long plant shutdown condition would render certain performance indicators unreliable due to a lack of operational data. In this circumstance, the NRC would perform additional inspections to provide adequate assurance during the absence of reliable performance indicators. This special regulatory attention is warranted in order for the NRC to complete its periodic regulatory oversight assessment of licensee performance and also to allow the staff to be able to assess whether the licensee is ready to operate their plant.

State under what circumstances or criteria (such as anticipated shutdown length, no firm commitment to restart) the regulatory authority suggests or requires that a normal shutdown becomes a "long" shutdown.

Absent performance problems, the NRC does not place restrictions on licensees regarding the duration or length of a plant shutdown. As described in (a), above, the licensee must continue to meet the regulations where applicable throughout the duration of the plant shutdown. However, if a licensee is voluntarily or involuntarily shutdown due to performance problems, and depending on the specific performance circumstances that may warrant issuance of a NRC order or other similar action, the licensee may then be required to obtain NRC permission before restart approval is granted.

Currently, the RROP contains objective criteria on determining the threshold for determining when to give special regulatory status to plants with performance problems and are in a shutdown condition. The length of the plant shutdown is determined primarily by the length of time required for the licensee to fix and resolve their performance problems and whether or not the NRC agrees with the licensee's assessment.

The NRC will perform a safety assessment of the licensee's actions and will make a determination of the licensee's readiness for restart of the plant. This special assessment status involves increased monitoring and oversight of licensee corrective actions involving risk significant issues or events, increased inspection, and increased public and external stakeholder communications.

2. REQUIREMENTS

Briefly describe the regulatory (legal and technical) requirements related to the status of "long" shutdown, if applicable.

Absent significant licensee performance problems, the NRC does not apply different legal or technical requirements related to long plant shutdowns. However, if the reason for the long shutdown was due to performance problems, the NRC can then impose additional regulatory and oversight requirements. Examples of these additional requirements are special inspections focused in the areas of root cause identification, problem identification, and corrective action. The NRC may use confirmatory action letters and orders to mandate or convey actions required of the licensee.

In addition to those actions described above, and where significant safety issues or problems exist, the NRC takes action to ensure that the licensee recognises and resolves significant safety issues in a timely manner. Following an extended shutdown period due to performance problems, and after the NRC has approved restart of the plant, the NRC continues to provide regulatory oversight of the licensee's efforts in resolving any risk significant issues for an appropriate period of time.

Does the licensee submit shutdown and restart plans and does the regulatory authority approve the plans?

Absent any significant performance issues, shutdown and restart plans are not specifically "approved" by the NRC unless there are extenuating circumstances, such as damage from external events (i.e., hurricanes, floods, and tornadoes). However, the NRC has the regulatory authority to request any and all documentation related to public health and safety, including plant operation, shutdown and outage activities, and restart plans as may be necessary to provide adequate assurance of public health and safety.

Does the regulatory authority expect commitments from the licensee during these periods?

Absent any significant performance problems, the NRC does not place additional requirements (i.e., commitments) on licensees during a long plant shutdown. However, the NRC will impose additional regulatory oversight for plants that are shutdown due to significant performance problems in order to assure public health and safety. This may include the issuance of an NRC order or confirmatory action letter requiring additional actions from the licensee as a condition for NRC approval of restart of the plant. Further, the NRC may requiring the licensee to correct risk-significant performance problems and their underlying root causes. Although it is expected that the licensee will perform extent-of-condition reviews and identify the root causes of poor performance issues prior to restart of the plant, it may not be necessary to fully resolve and implement all of the associated corrective action(s) for all related performance issues prior to restart. For example, it may be satisfactory to implement certain programmatic corrective action(s) after a plant has restarted for those issues that are of lower risk significance and may require a longer time to complete.

The NRC has broad discretionary powers to order actions and takes action when existing regulations are not met, or, based on an inspection finding or condition, may require a licensee to take remedial action if there is an unacceptable risk to the public. However, the NRC refrains from imposing requirements on licensees beyond their licensing basis without a significant risk impact to the public.

Briefly describe the essential or important elements of such licensee plans, if applicable.

Normally, the NRC does not provide guidance or comment on what are the important elements of a licensee's restart plan. However, for plants that are shutdown for extended periods due to performance problems, the NRC expects that risk-significant issues or problems be corrected and their root causes identified prior to restart of the plant. If there are programmatic weaknesses or breakdowns associated with the significant performance problems, the NRC expects that an improvement plan be developed and implemented, but not necessarily completed prior to restart of the plant. The NRC may issue an order or confirmatory action letter that specifies the actions necessary for the licensee to restart the plant. In this situation, the NRC's attention would be focused on addressing the performance problems and their underlying root causes and corrective action; not necessarily all of what the licensee needs to accomplish before restart can occur (i.e., critical path items, work planning co-ordination, etc.).

3. INSPECTION PROGRAMME

Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements, related to "long" shutdowns, taking into consideration such areas as:

- ❑ *The licensee management organisation, and special configuration management features.*
- ❑ *Verification of licensee personnel abilities and training programme.*
- ❑ *Specific licensee training delivered, and its inspection by the regulatory authority.*
- ❑ *Verification of safety related systems and components*

The objective of the NRC inspection program is to provide adequate assurance of licensee activities to ensure public health and safety during all aspects of plant operation, including long shutdown. The NRC inspection program includes performing inspections during shutdown activities, observing maintenance and refuelling activities, and providing oversight of plant support activities, such as radiation protection and plant security. The frequency of these regulatory oversight activities is designed to coincide with the licensee's schedule for planned shutdowns, as well as any unplanned shutdowns. The inspection program also is required to meet certain program requirements, such as a minimum number of back shift inspection hours (i.e., approximately 50 hours/year during off-normal or holiday hours), and completing the required number of hours performing verification of safety related systems and components.

The NRC conduct specific observation and oversight of the licensed reactor operator requalification program, the emergency preparedness drills and exercises, and observation and inspection of licensee security response training (or drills). These regulatory activities are routinely conducted and are independent of a plant's operational or shutdown status.

Briefly describe the regulatory inspection programme (type, objectives, frequency) and its essential elements related to restarts after "long" shutdowns, as in 3a.

The NRC inspection program provides for routine inspection of licensee activities during shutdown. The amount of inspection resources expended during shutdown is a function of how long the plant remains in shutdown, and the type of shutdown activities performed by the licensee. Typical of the types of inspection activities by the NRC include being cognisant of ongoing activities involving TS mode changes and any hold points from modes 6 (refuelling) through mode 1 (power operation), providing oversight of required TS surveillances, valve lineups, and other off-normal plant activities that have the potential to impact safe plant operation. In addition, the NRC inspection program provides for on-hand inspector control room observation of plant start-up through power operations. These activities, in conjunction with the remainder of the NRC inspection program, provide the minimum regulatory oversight necessary to assure adequate public health and safety.

Additional shutdown inspection and regulatory guidance is currently under development to supplement the NRC's new risk-informed Revised Reactor Oversight Process's Baseline Inspection Program. Since long shutdowns usually involve a large amount of maintenance work, the NRC has new regulatory requirements that require licensees to perform special configuration risk management when performing risk-significant maintenance activities. The new NRC regulation is described in 10 CFR Part 50.65(a)4, Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which becomes effective at all U.S. operating reactors after September, 2000.

4. PLEASE LIST OR BRIEFLY DESCRIBE ANY OTHER ISSUES YOU WOULD LIKE TO BE DISCUSSED AT THE MEETING.

A discussion on the use of risk insights in regulatory oversight for plants in extended shutdowns due to performance or due to other reasons.

Questionnaire - Part C

USE OF OBJECTIVE INDICATORS BY THE REGULATORY AUTHORITY IN EVALUATING THE PERFORMANCE OF PLANTS

NOTES

- Only one response per country is required. If more than one person from your country is participating, please co-ordinate the responses accordingly.
- Please provide responses on separate sheet and clearly identify the questionnaire part and topic.
- Please provide Submittal prior to 31 March 2000. Submittals should be sent by email to: barry.kaufer@oecd.org

BACKGROUND: The Regulator must obtain information about licensee performance to ensure that plants are operated safely and in accordance with regulatory requirements. This performance information is obtained in many ways, including audits and direct inspection by the Regulator, and by licensee event reports and self-assessments. Certain performance characteristics may be defined well enough to allow objective and consistent "counting". If such information is related closely enough to factors that affect nuclear safety, it may serve as a useful indicator of the level of safety contributed by those factors.

QUESTIONNAIRE

Countries participating in the workshop are requested to:

1) Please identify any plant performance characteristics associated with nuclear reactor safety for which quantitative information is maintained, monitored, or trended by the Regulator. These may include the WANO indicators (i.e., industrial safety accident rate, unplanned scrams, unplanned capability loss factor, etc.) or other performance characteristics defined by the Regulator.

2) For each of the above performance characteristics, please identify the following: 1) the organisation (Licensee or Regulator) responsible for collecting and maintaining the information, 2) how often the information is updated, 3) to whom the information is transmitted or made available, 4) any decision processes that make use of the information and how the information is used, and 5) any thresholds that the Regulator uses to judge acceptable performance. Responses to questions 1 and 2 may be made in the format of a Table, as shown below.

3) Please provide any examples of performance areas that you believe cannot be effectively monitored by the Regulator through the use of performance indicators, and briefly describe the important reasons why.

4) Please identify the criteria that you believe performance indicators must meet to be a useful indicator of the level of safety.

Performance Characteristic	Responsible Organisation (licensee/regulator)	Information Update Schedule	Information Recipients	Regulatory Decision Processes Using Information	Regulatory Threshold for Acceptability
Scrams	Regulator	Each event	Public		
Number of licensee event/condition reports	Licensee	Annual Report to Regulator	Regulator		

Etc.					

Responses to Questionnaire - Part C

ARGENTINA

During 1997/1998, the Regulatory Authority began a Performance Safety Indicator project with the purpose of defining and implementing a performance indicator system for NPPs.

The project involved the following steps:

- Gathering information from other nuclear organisations, particularly other regulatory bodies.
- Definition of specific characteristics and scope.
- Work structure to define the parameters to be used as indicators, covering all the important areas from the regulatory point of view.
- Definition of parameters to be evaluated in each area.
- Determination of a ponderable indicator for each selected parameter.
- Definition of a set of performance safety indicators.
- Pilot implementation.
- Assessment of its results, improvements and modifications.
- Final set of performance safety indicators.

At the beginning of 1998, the first set of indicators, listed below, were defined. Their pilot implementation is being carried out by applying the following methodology:

- Indicators will be calculated and reported on a quarterly basis by the power plants.
- Audits will be performed to verify reported values.
- Data will be analysed, verified if necessary, and incorporated into a database to facilitate the assessment of their variation in time.
- Even though the interrelation between the different indicators should ensure that the whole set be self-sufficient for data interpretation purposes, their register will enable full information retrieval whenever needed.
- In view of the limitations and cautions involved when using a Performance Indicator Program, nuclear power plants will not be compared and any single indicator should be interpreted in terms of the whole set.
- As this is a pilot implementation, constant supervision is to be exercised.

As part of this project, the nuclear power plants were asked to appoint the staff to be in charge of the drafting and reporting of indicators. Meetings were afterwards held with the purpose of submitting the set of indicators and their respective definitions for their consideration, so that suggestions could be made as to their interpretation and data collection feasibility. The indicators obtained are analysed and stored in a database to allow the assessment of their changes during time. All other related information was also stored to facilitate the data interpretation in the future.

Because of the objective of this pilot implementation, during this period the ARN kept a continuous communication with the NPPs personnel involved in the elaboration of the indicators. The feedback obtained was sometimes useful to improve and modify some former definitions. Some indicators are still under review, besides the already mentioned modifications that are being considered new indicators are going to be incorporated after this testing period.

Performance Characteristics	Responsible Organisation (licensee/regulator)	Information Update Schedule	Information Recipients	Regulatory Decision Processes Using Information	Regulatory Threshold for Acceptability
				General: Performance Indicators System is used jointly with other regulatory tools. When an indicator shows any singularity, special inspections, audits or stronger routinary inspections over affected area should be planned.	General: No threshold had been set yet. Indicators are stored in a database in order to observe their temporal variation and evaluate the occurrence of any singularity.
Forced power reductions	Regulator	Quarterly	Regulator	These indicators are used to evaluate plant operation stability.	In order to obtain reference values, a statistic over the last eight years of operation had been done. No threshold had been set.
Forced outages	Regulator	Quarterly	Regulator		
Individual maximum dose	Regulator	Quarterly	Regulator	These indicators are meant to evaluate performance of radiation protection of workers and public. The indicators are analysed considering the factors which can affect them (forced outages, maintenance, events, etc.).	In order to obtain trends of this indicator, a statistic over the last eight years of operation had been done. No threshold (lower than standards limits) had been set.
Total equivalent dose	Regulator	Quarterly	Regulator		In order to obtain trends of this indicator, a statistic over the last eight years of operation had been done. No threshold had been set.
Liquid effluent discharges	Licensee	Quarterly	Regulator		No threshold (lower than standards limits) had been set.
Gaseous effluent discharges	Regulator	Quarterly	Regulator		
Radioactive wastes	Licensee	Quarterly	Regulator		No threshold had been set.
Corrective work orders issued for safety and safety related systems	Licensee	Quarterly	Regulator	These indicators are used to evaluate surveillance activities performance (preventive and corrective maintenance and testing). In particular, reworking indicator allows the detection of deficiencies on failure evaluation or maintenance task quality.	No threshold had been set.
Corrective work orders issued for safety and safety related systems, which are pending	Licensee	Quarterly	Regulator		
Corrective work orders issued for safety and safety related systems, which are pending because of lack of supplies	Licensee	Quarterly	Regulator		

Performance Characteristics	Responsible Organisation (licensee/regulator)	Information Update Schedule	Information Recipients	Regulatory Decision Processes Using Information	Regulatory Threshold for Acceptability
Reworking	Regulator	Quarterly	Regulator		
Overdue preventive or predictive routine inspections and maintenance tasks	Licensee	Quarterly	Regulator		
Overdue repetitive tests	Licensee	Quarterly	Regulator		
Failures discovered by testing	Licensee	Quarterly	Regulator		
Number of test procedures whose revision or issuance is overdue	Licensee	Quarterly	Regulator	These indicators are meant to evaluate performance of the organisation on some safety culture aspects.	No threshold had been set.
Training	Regulator	Quarterly	Regulator		In order to obtain reference values, a statistic over the last eight years of operation had been done. No threshold had been set.
Feedback from Operational Experience	Licensee	Quarterly	Regulator		No threshold had been set.
Internal Control	Licensee	Quarterly	Regulator		
Pending Regulatory Requirements	Regulator	Quarterly	Regulator		
Violations to the Mandatory Documents	Licensee	Quarterly	Regulator		
Relevant events	Regulator	Quarterly	Regulator	A plant safety degradations can be showed trough these indicators.	Considering the indicator definition, zero is the only acceptable value.
Safety Systems actuations	Licensee	Quarterly	Regulator		
Pressure limit degradations *(under development)*	------	------	------		------
Unavailability of Safety Systems *(under revision)*	Licensee	Quarterly	Regulator	These indicators allow the evaluation of safety system reliability level and the impact of operational incidents over the plant risk.	Under revision

Performance Characteristics	Responsible Organisation (licensee/regulator)	Information Update Schedule	Information Recipients	Regulatory Decision Processes Using Information	Regulatory Threshold for Acceptability
Impact of reported events on core damage frequency *(under revision*	Licensee	Quarterly	Regulator		

BELGIUM

1. Overall

The Belgian Philosophy is that Objective indicators cannot *measure* the licensees' performances, but only be element for the *triggering* of additional investigations.

All the safety aspects are complex and inter-reacting, and therefore the "measure" in a selected set of areas is subject to "adjustments" by the people as well as to interpretation of significance. Besides fixing a predefined set of indicators may reduce safety culture by letting believe that safety can be achieved only by satisfying some criteria related to indicators.

As a result there is no set of indicators systematically used to assess the licensees' performances, but only a informal set of parameters used to question the operational safety and the engineering capability of the licensees. There is neither threshold values for actions. These ones are triggered more on the basis of estimated "abnormal" evolutions. Examples of such parameters is given below.

2. Inspection triggering characteristics

Hereafter some specific inspection triggering characteristics, which are dealt with off the routine inspections.

A significant set of other characteristics, such as the doses rates, the problems during outage, the incidents,… are analysed during the normal inspection process and give rise to comments, requests for explanations, and eventually corrective actions.

PI	Collecting Organisation L=Licensee RB= Reg Body	Update Schedule	Information recipient	RB decision Process	Threshold of acceptability
Scrams	RB/L	Year	OECD-PWG1	First analysis of each scram; significant trending difficult.	NA
Unavailability rate of safety systems in TS	L	Year	L/RB	Analysis of minimisation of safety system unavailability ➔ discussion with licensee	NA
Fraction of allowable outage time of TS used for interventions	L	Each intervention	L/RB	Analysis of minimisation of safety system unavailability ➔ discussion with licensee	NA
Backlog of unanswered requests of RB	RB	Year	L/RB	Discussion with upper management on safety culture	NA
Backlog of incident reports	RB	Year	L/RB	Discussion with management at appropriate level	NA
Backlog of the updating of documents after plant modifications	RB	Year	L/RB	Discussion with management at appropriate level	NA

FINLAND

General

The YTO Indicator System is developed by the Nuclear Reactor Regulation Department (YTO) at the Radiation and Nuclear Safety Authority (STUK). The purpose of the YTO Indicator System is to be a complementary tool in the nuclear safety regulation in addition to inspections and safety reviews. It makes possible to follow on the other hand the status of the factors which has influence on the safety of nuclear power plants and on the other hand the performance of STUK operations.

Development project for safety related indicators

The project to develop a set of indicators for nuclear safety regulation was established in the middle of 1990. The project was included in the Finnish contribution to the research programme ”Collection and classification of human reliability data for use in PSA” co-ordinated by the IAEA.

The goal of the project was to develop an indicator system, which could be used:

- To illustrate levels and trends of nuclear safety in a quantitative manner
- To identify weaknesses at nuclear power plants
- To focus and optimise the use of YTO’s resources
- To evaluate and develop YTO’s review and inspection activities
- To develop co-operation between STUK and other organisations.

Development of a set of safety related indicators included several steps, such as:

- Determination of areas to be monitored
- Determination of existing data sources
- Nomination of candidate indicators for each interest area
- Data collection
- Data validation and test calculations
- Screening and updating of candidate indicators
- Development of an information system for indicators.

Objectives and areas to be monitored were defined during the winter 1995 - 1996. Initial data collection, data analysis and test calculations were performed during summer 1996. A decision to adopt the indicator system as a managerial tool was made in 1997. Some new projects were initiated in 1997 to develop additional indicators for certain areas. During 1998 and 1999 the system was changed; some new indicators were included into the system and some were dropped out based on the information obtained form test

Description of the present indicator system

The YTO Safety Indicator System is divided into two principal groups; the safety of nuclear facilities and the regulatory activities. The safety of nuclear facilities is divided into three areas based on the concept of defence in depth; safety and quality culture, operational events and physical barriers. The regulatory activities is also divided into three areas; working processes, resource management, and regeneration and ability to work. All these areas are measured using several indicators. 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. At the moment 10 indicator areas are included in YTO's internal goals and these areas are followed annually. In other areas follow-up has not been so systematic.

The review period of the indicators relating to the safety of nuclear facilities will be mostly the operating cycle from the beginning of the refuelling outage to the beginning of the next refuelling outage. The indicators relating to the regulatory operations, which are not discussed here, are determined every calendar year. The indicators concerning safety of nuclear facilities are presented in the table.

Source of data

Data for indicators is collected from the regular reports submitted by the utilities to STUK, such as:

- daily, monthly, quarterly and annual reports
- outage reports
- environmental radiation safety reports
- reports on individual doses
- report on the utilisation of operational experience

and event reports, such as:

- special reports
- report on reactor scram
- report on operational transient.

At the moment the data needed for all indicators is not regularly submitted to STUK and it is received "unofficially" from the licensee, which in the case of most indicator areas is responsible for collecting and maintaining the information.

3) Provide any examples of performance areas that you believe <u>cannot</u> be effectively monitored by the Regulator through the use of performance indicators, and briefly describe the important reasons why.

Development of specific safety related indicators

PSA-based indicators

A few PSA-based indicators are set up in order to identify the safety significance and to follow up and monitor the risk development of specific events in NPP operation as follows:

- Exemptions from the Technical Specifications
- Failures of devices covered by the Technical Specifications
- Preventive maintenance and other disconnection of devices covered by the Technical Specifications
- Operating events.

Each indicator is given as the annual sum of core damage frequency contributions from respective type of events, divided by the average annual core damage frequency from the PSA study. Each sum contains all respective events that reduce the reliability of some safety function, and thus cause a temporary risk increase above the basic risk level. Basic risk level prevails when no deviations from faultless plant condition are known to exist. One should recognise that the basic risk level already contains the risk contribution from majority of the aforementioned events that reduce the safety systems reliability. At a plant performing properly, a low indicator value demonstrates that the risk contributors which can be measured have a minor impact to the total risk. The majority of risk comes from infrequent significant initiators such as LOCAs, Loss of offsite power etc. The associated plant configurations necessary for PSA based indicators are calculated using plant specific living PSA-programs.

While developing the risk based indicators, we are aware of the limitations of PSA such as completeness problem, modelling uncertainty, shortages in human error analysis and CCF analysis etc., which result in uncertainty into the PSA figures. These uncertainties however are found rather insignificant as concerns the use of indicators.

The main problem within the PSA based indicators is that some issues are difficult or even impossible to model with the current PSA-model. Hence it is required that a sophisticated Living PSA system including extensive and detailed system models, with a well established data collection and processing system to provide plant specific data, and an efficient, user friendly PSA code are available. If these conditions are met, the determination of PSA based indicators is quite straightforward.

Among the individual indicators, the risk importance of exemptions from the Technical Specifications and of preventive maintenance are the most straightforward ones. Most of the deviations in the process are modelled with PSA-programs. Indicators describing the risk importance of failures are also applicable in most cases but all devices are not modelled in detail. Indicators describing operating events often need further development of the PSA model.

Calculation of these indicators continues at STUK, and the aim is to have on-line calculation so that the risk level can be followed and monitored, and the most significant risk sources in operation identified.

Indicators based on plant specific fault data statistic

Useful indicators can also be extracted from fault data records, such as indicators for the common cause failures and the quality of maintenance. The idea is to examine the usability of fault data records in calculation and screening of different types of failures.

The analysis of common cause failures was based on a method jointly developed by STUK and VTT (STUK's main contractor for nuclear safety research). These indicators have been developed and defined only for Olkiluoto nuclear power plant. The indicators are simply the numbers of different failure types. The screening of the plant specific fault data covered years 1995-1996 (about 2800 cases). Failures at Loviisa NPP are currently being analysed in a new project contracted to VTT.

Common cause failures were divided to two categories - to human or technical failures. These were further divided to critical or non-critical failure classes according to their influence on system or devices. In the screening of failures, also individual human errors and multiple technical failures were identified.

The results of this part of the study showed clearly that hidden CCFs can be found from detailed examination of fault data history. The number of occurred human originated CCF's (2,3/y) corresponded well to earlier studies done at STUK and VTT.

It was concluded that there are many good ways to utilise the information in failure records as indicators. Based on the study carried out for Olkiluoto nuclear power plant, the indicators from failure statistics are already applicable for safety assessment. The monitoring of before mentioned indicators continues, and the aim is to focus on safety related systems.

Safety Culture indicators

Evaluation of the current level of safety culture by quantitative means is a complex task. Instead of direct measurement of safety culture, the evaluation could be carried out by identification of features of safety culture and measuring their values. A project to develop such a methodology was started at the beginning of 1999 in co-operation with VTT.

As another project, it was decided to study the NPP staff opinions on quality and outcome of work carried out by the regulatory body. These opinions or attitudes depend on individuals' experience and also on the overall atmosphere within the NPP organisation. Based on the assumption that the perception by the NPP staff corresponds to the real situation, an attempt was made to find out factors causing a certain attitude. Furthermore, it would be interesting to clarify what are the assumptions of the regulatory staff about the same factors and finally make a comparison between those two. This project was initiated in 1997 by interviewing NPP staff. Quantitative indicators are so far not developed.

4) Identify the criteria that you believe performance indicators must meet to be a useful indicator of the level of safety

Experience from the development project

Development of the indicator system has given experience and ideas. Some of them are listed below:

- The limited number of data sources already in existence restricts the possibilities for determination of specific indicators. This should be noted at an early stage of the project. In practice, the areas to be monitored may be examined on a theoretical basis, whereas the specific indicators should not be nominated before getting familiarised with the data sources.
- The acceptability and usefulness of the indicator system within the regulatory body can be improved by asking for needs and opinions of the staff. Furthermore, participation of the staff in the data collection and analysis should improve the commitment throughout the organisation.
- Interpretation of the results (figures) should be carried out carefully. The focus of the analysis should lie on the trends and reasons for changes instead of numbers.

Future activities

To complete the YTO indicator project and to form a well functioning indicator system, following issues should be determined and decided:

1. Each indicator should have a responsible person, who calculates values and evaluates the indicator according to the following criteria:

    - Practicality
    - Relevance to NPP safety / regulatory activities
    - Absence of negative impacts
    - Accuracy.

2. Requirements on the licensee reporting should be assessed according to the information needed for calculation of indicators. The information for some indicators is not regularly submitted to STUK.

3. Information and reporting system for the indicators should be developed. The goal is that indicators are available for all inspectors for example in the internal net. One should be able to easily make queries and form reports.

4. Reporting methods and criteria for reporting should be established for each indicator, and the reporting period should be decided. The reasons for the changes in the indicators should be analysed by the responsible persons in the following two cases:

   - The value of the indicator does not meet the given target.
   - The value of the indicator deteriorates during two consecutive years even though it does meet the given target.

5. Development of an overall safety index based on all other indicators. For example, if the indicator value deteriorates it could get value –1 and if it gets better +1. The sum of all these values could be the safety index.

Table: The YTO Indicator system, Safety of nuclear facilities

Performance characteristics	Responsible organisation	Information update schedule	Information recipients	Regulatory decision processes using information	Regulatory threshold for acceptability
Safety and quality culture					
Failures and their repairs Failures of Tech.Spec. (TS) equipment (number of failures that caused unavailability) Preventive maintenance of TS equipment (number of preventive maintenance works in relation to a total number of failure repairs and preventive maintenance works) Repair of TS equipment (a real time in relation to the repair time allowed in Tech. Spec.) Failure types (human single failures, human common failures, technical common failures, multiple failures)	Licensee	Operating cycle Data collected from the daily reports submitted by the utilities; from failure data bases and from maintenance reports, which are unofficially submitted to STUK. Failure data related to operating cycles is available from operating cycle and monthly reports of NPPs' Maintenance Units.	Regulator	These indicators are used to follow number and type of failures, elimination of failures by means of preventive maintenance and attitudes towards repair times allowed in Tech. Spec.	Tech. Spec. thresholds for repair times The annual overall risk from operations (preventive maintenance, failures, operational disturbances and allowable deviations from Tech. Spec.) shall be less than 5 % of the annual reactor core damage probability.
Number of deviations from TS Number of violations against TS Number of exemptions granted by STUK	Licensee	Operating Cycle Data collected from event reports issued by the utilities and from applications for the exemption orders	Regulator	These indicators track and describe a number of violations against Tech. Spec. and the number of exemption orders granted by STUK	
Availability of safety systems The plant specific WANO-indicators: 321, 327 (BWRs)	Licensee	Operating cycle Data collected from utilities, not delivered officially to	Regulator	The indicator illustrates the availability of safety systems. By the means of the indicator it is possible to supervise the conditions of safety systems and changes of condition	None Criteria of WANO-index

Performance characteristics	Responsible organisation	Information update schedule	Information recipients	Regulatory decision processes using information	Regulatory threshold for acceptability
diesel generators (PWR)		STUK			
Radiation doses Total amount of collective radiation doses mean value of ten highest annual individual radiation doses	Licensee	Operating cycle Data for cumulative radiation doses is received from the annual reports. The mean value of ten highest annual personal doses is not officially submitted	Regulator/ Public	The purpose of the indicator is to supervise and chart radiation doses. The mean value of ten highest annual personal doses illustrates how close the average limit of 20 mSv is.	Regulatory Guides (Guide YVL 7.9) ICRP 60
Radiation releases The radioactive releases and discharges (TBq),utility specific.	Licensee	Operational cycle Data collected from monthly and annual reports submitted by utilities	Regulator/ Public	Supervise the amount and trends of radioactive releases	Releases shall be small, and the annual radiation doses calculated from the releases shall be < 5 % of the limit set in the Council of State Decision (0,1 mSv/a)
Documentation A number of modifications, which documentation was not updated until the next refuelling outage	Regulator	Operational cycle Data collected from the plant modification register and from the site inspections conducted by STUK	Regulator	Supervise quality management of utilities and ability to maintain plant documentation	None
Operational events					
Number of operational events	Licensee/ Regulator	Data collected from the data base Nuclear Safety Register	Regulator/ Public	Track number of operational events. The indicator illustrates a number of safety significant events	None

Performance characteristics	Responsible organisation	Information update schedule	Information recipients	Regulatory decision processes using information	Regulatory threshold for acceptability
		(YTR) on the bases of reported operational events			
Significance of operational events applications for TS exemptions failures of TS equipment preventive maintenance and other planned separations of TS equipment operational events according to the Guide YVL 1.5	Licensee	Operating cycle Data collected from the utility reports and applications for TS exemptions	Regulator / Public	Track risk significance of selected operational events and parallel to it to monitor lengths of planned separations and preventive maintenance action	Tech.Spec. repair times The annual overall risk from operations shall be less than 5 % of the annual reactor core damage probability
Causes of operational events Based on their origin the direct causes of operational events are roughly divided to technical and human failures. The indicator is defined by calculating the mutual proportions of the aforementioned cause types within the reported operational events. Basically, the direct cause in assessment is assumed to be either technical or human. When needed, an influence of the aforementioned factors can be assessed in percentages.	Licensee/ Regulator	Operating cycle Data is determined on the basis of operational events that are reported according to the Guide YVL 1.5	Regulator/ Public	Track changes in mutual proportions of operational events that cut across the reporting limit	None
Number of fire alarms A number of fire alarms is tracked within this indicator area. Tracking is utility–specific. Based on their origin fire alarms are divided as follows: automated failures	Licensee	Operating cycle Data collected from the utilities. Olkiluoto NPP reports the data in the annual report. From Loviisa NPP	Regulator	Supervise and track operations of fire alarm systems and fire brigades follow-up of trends	None

Performance characteristics	Responsible organisation	Information update schedule	Information recipients	Regulatory decision processes using information	Regulatory threshold for acceptability
actual automated alarms actual fires other alarm operations.					
Structural integrity					
Integrity of nuclear fuel A maximum iodine isotope activity of the primary circuit equivalent to I-131 (Loviisa NPP, at the Olkiluoto NPP purely I-131) (kBq/m^3) during the operating cycle	Licensee	Operating cycle Collected from the monthly and annual reports issued by the utilities	Regulator/ Public	Describe the integrity of the nuclear fuel during operation cycle	Tech. Spec.
Integrity of the primary circuit An overall amount of identified and non-identified leakage of the primary circuit.	Licensee	Operating cycle Data collected from utilities; not submitted officially to STUK	Regulator	Track the amount of identified and non-identified leakages that describe the integrity of the systems inside the plant containment	Tech. Spec.
Integrity of the containment The following matters are tracked within this indicator area: overall leakage of isolation valves compared with the highest allowed overall leakage of the isolation valves percentage of isolation valves at each plant unit that passed the leakage test at the first attempt an overall leakage of containment's entrance and other holes in relation to the highest allowed overall leakage of these holes at each plant unit.	Licensee	Data submitted officially to STUK	Regulator	Track the tightness of isolation valves, penetrations and entrance holes follow-up of trends assessment of test methods surveying of problematic areas allocation of supervision	Tech. Spec.

FRANCE

Note: A brief introduction provides general information on the French practices, which make specificity and outstanding evolution more understandable.

1. *Introduction*

Generally speaking, the French nuclear power plants (NPP) are similar. Even if some new technologies have been introduced as the following series were designed and constructed, the safety requirement reference is standardised. Therefore, the activities of the regulator related to NPP follow, at the present time, a subject logic: most of the time, affairs examined concern all the reactors of a series and events are analysed by difference with the reference.

However, it has been noted, for a few years, increasing disparities between reactors caused, in particular, by the decentralisation of responsibilities towards the nuclear facilities and by the general ageing of the plants. In addition, expectation of the public, both at the national and local levels, is getting more and more precise on each site. That is why the Safety Authority got involved in the development of tools for evaluating the performance of individual plant.

With this aim, information resulting from inspections, declared events or incidents, waiver requests, refuelling outage supervision, release and waste outputs or from all other control activities of the regulator is collected and synthesised in site evaluations: they are called “monographs”.

QUANTITATIVE INFORMATION

The monographs collect most of quantitative information, which can be associated with nuclear reactor safety. It concerns:

- Gaseous and liquid releases : value of most of main regulated parameters
- Solid waste: amount produced, stored and evacuated
- Nuclear activity of the primary coolant
- Primary / secondary side leakage (rate)
- Containment leakage (rate)
- Spent fuel pool availability
- Collective dosimetry
- External and internal contamination
- Radiological cleanness : number of points discovered by level of activity
- Waivers
- Incidents

But monographs also cover other topics:

- General information about the site
  - Location
  - Technical characteristics
  - Applicable regulatory rules
- Qualitative information
  - Organisation
  - Management

- Quality of work undertaken by the utility and subcontractors
- Any difficulty encountered
- Relations between the utility and the Safety Authority
- Communication towards the public

All this information is reported to finish by a reasoned judgement on the status of the nuclear power plant (technical aspects), operation quality (organisation, management) and conclude by submitting some priorities for the regulator to control the site.

2. SOURCE, AVAILABILITY AND USE OF THE INFORMATION

Information is collected through refuelling outage supervision, inspections, and any other control activities of the regulator through reports of the utilities intended for the regulator (incidents, waste production…) or specifically by asking the utilities. The monographs are updated each year. The quantitative data are available for the public through annual report of the utility or of the Safety Authority.

However, monographs are documents elaborated by the regulator for its own use. More than a collection of information, they intend to give the point of view of the inspectors on the safety of the reactors and priorities in the control activities of the regulator towards the site. An external diffusion could involve a self-censorship of the redactor, which would be harmful to the good progress of the operation.

Acceptability of the results is principally evaluated on the basis of the safety requirement reference for quantitative indicators and on documents such as the ministerial order on quality in the case of qualitative parameters.

3. PERFORMANCE HARD TO BE APPRECIATED WITH QUANTITATIVE INDICATORS

Three types of topics show this difficulty. It concerns:

- Especially qualitative topics: human factors, management, and organisation…
- Topics for which quantitative data are available but which need a supplementary analysis to be well-interpreted (number of incidents, dosimetry…)
- Topics which should be analysed in relation with an other one to be interpreted (waste / nuclear activity, gaseous / liquid releases and solid waste)

Nevertheless it is possible to define also qualitative indicators (good, medium, bad, unacceptable). A reflection to homogenise appreciation of monograph redactors in these areas is underway at the present time by the Safety Authority.

4. CRITERIA REPRESENTATIVE OF THE LEVEL OF SAFETY

In France, judgement on the safety level of a reactor or a site is not only limited to quantitative indicators, which are not representative enough for real assessment or evaluation. To these indicators, qualitative elements have to be considered.

Under these conditions, monographs would more and more tend to be a real tool for control allowing to form a global judgement on safety of a plant and to define priorities for the Safety Authority’s work on weak points identified both generic and individual potential.

GERMANY

1/2. Plant performance characteristics to be reported to the regulator

For some of the major performance characteristics see answers in the following table.

The licensees are obliged to prepare monthly and yearly reports on the operational performance of their plants. The format and content of these reports is to be agreed by the competent inspection authority. The data to be submitted complement the regular inspection results by which a timely information on all safety related operational results is already known to the authority.

Typical data within these reports, depending of the inspection philosophy and programme of the authority, are for example:

- Dosimetry results (collective doses, individual doses, job doses)
- amount of radioactive effluents by vent air and water
- Radioactivity inventory of systems and cooling circuits
- Chemical parameters of circuits
- Transients and loads and their accounting (fatigue measurement)
- Non-availability of systems important to safety
- Backlog of repair, modifications and backfitting measures.

These data are reviewed by the inspection authority to identify trends rather than being judged on prescribed quantitative limit values.

Supplementary comment: The regulatory inspection authority is supported by an independent expert organisation.

3. Performance areas that cannot be effectively monitored through the use of performance indicators

- Ability of leadership of licensee’s management and connected to it the motivation of staff (safety culture): Cannot be measured in quantities and is not explicitly regulated in the legal framework
- Commercial pressure of licensee, including manpower:
  Is not explicitly regulated in the legal framework
- Health (including alcohol, drugs) and personal surroundings of the operators: Data privacy protection

Criteria that performance indicators must meet.

The criteria are:

- Performance indicators must fit into the set of objectives of the regulatory inspection programme
- Each individual performance indicator must give a meaningful conclusion to judge on the safety status of the plant as a whole or of individual systems important to safety
- Performance indicators must be available in an objective manner
- Performance indicators must be measurable preferably in quantities, for example:
- probability of severe events
- number of real events
- number of findings at inservice inspections and inspections on site
- number of repairs in safety systems
- emissions and pollutants
- time for qualification of personnel (expertise and its actuality)
- Some Performance indicators are available in a more qualitative form, for example:
- documentation of the hardware of the plant
- documentation of the technical administration of plant operation

WGIP - International Workshop Baltimore May 15-17, 2000
Use of objective indicators by the regulatory authority in evaluating the performance of plants
Germany
Questions 1 and 2

Performance characteristic	Responsible Organisation (licensee/regulatory)	Information Update Schedule	Information Recipients	Regulatory Decision Process Using Information	Regulatory Threshold for Acceptability
Inspections and periodic tests, in-service inspections	Licensee/regulator (Conducted either by licensee alone and/or involving an independent expert organisation)	normally: reports quarterly & annually additionally: immediately in case of important findings	Licensee/regulator	yes: measures of various degrees depending on the safety-relevance of categorised findings	yes: included in inspection manuals and operation manuals
Periodic site Inspections	Regulator (Conducted by regulator and independent expert organisation)	normally: reports every 6 months; additionally: immediately in case of important findings	Licensee/regulator	yes: measures of various degrees depending on the safety-relevance of categorised findings	yes: included in operation manual
Reportable events class N, E, S	Licensee/regulator	class N: within five workdays by formula class E: within 24 hours by phone or fax, additionally within five workdays by formula class S: immediately after recognising by phone or fax, additionally within five workdays by formula	regulator additionally: German federal ministry of the environment, GRS, BfS, also parliament in special cases additionally: short information of the public via Internet	yes: depending on the cause and the safety relevance of the reported event	yes: included in the operation manual and in the KTA safety standards
Scrams	Licensee	Normally: monthly report additionally: reportable event, if criteria are met additionally: (not a must, but usually done) within 1 day notice by phone	Licensee/regulator	If the scram was a reportable event: yes, measures of various degrees depending on the cause and the safety-relevance of the scram otherwise (no reportable event): in general no	Yes : specified maximum number of scrams for the life period of the NPP is included in the operation manual.
Repair	Licensee	Indication of every repair with relevance to safety and additional annual reports	Licensee/regulator	yes: evaluation whether the repair meets the technical specifications	yes: included in technical specifications
Periodical safety review (PSR)	Licensee/regulator	Every ten years	Licensee/regulator	yes: measures of various degrees of improvements, depending on the results of assessment	yes: included in the KTA safety standards and the guide lines of RSK etc. and in the safety goals

Supplementary comment: Regulator is supported by an independent expert organisation

JAPAN

Licensee shall submit the report including objective performance indicators periodically or in every events according to the related Laws. MITI, however, does not use these indicators as a tool of evaluating plant performance so as to change inspection frequency and methods according to scores of the PIs.

Performance Characteristic	Responsible Organisation (licensee/regulator)	Information Update Schedule	Information Recipients	Regulatory Decision Process Using Information	Regulatory Threshold for Acceptability
Results of Electric Generation (Required by EUIL)	Licensee	Periodical Reports to MITI (Annual, Quarter, Monthly)	MITI (Open to Public)	MITI does not use Performance Indicators to reflect these data on Inspection.	Nothing
Results of Nuclear Fuel Consumption (Required by EUIL)	Licensee	Periodical Reports to MITI (Annual, Quarter, Monthly)	MITI (Open to Public)		Nothing
Events (Electric shock, Fire, Damage, Radiation) (Required by EUIL)	Licensee	Each events	MITI (Open to Public)		Nothing
Outage by event (Required by RNNR)	Licensee	Each events	MITI (Open to Public)		Nothing
Event threatening to effect operation (Required by RNNR)	Licensee	Each events	MITI (Open to Public)	MITI does not use Performance Indicators to reflect these data on Inspection	Nothing
Density of discharge liquids/gases radioactive material (Required by RNNR)	Licensee	Every half year	MITI (Open to Public)		Values determined by Notification
Leakage of liquids/gases radioactive material from control area (Required by RNNR)	Licensee	Each events	MITI (Open to Public)		Nothing
Radiation Dose of Employee (Required by RNNR)	Licensee	Monthly	MITI (Open to Public)		Values determined by Notification

EUIL; The Electric Utility Industry Law
RNNR; The Law for the Regulations of Nuclear Sources Material, Nuclear Fuel Material and Reactors (RNNR)

THE NETHERLANDS

1./2. Plant performance characteristics associated with nuclear safety.

The Regulatory Body KFD (nuclear safety department) uses characteristics of (the only) nuclear power plant to monitor and to trend the performance of the plant. Most of these characteristics are collected by the nuclear power plant and are presented in a quantitative way to the KFD in a monthly report. In the following list the quantitative information of the monthly report is described. The information in **bold** is carefully monitored and listed in table 1.

- Production figures (this month; cumulative of this year and cumulative since start-up)
- WANO figures (**performance indicators of safety related systems**),
- Risk monitor (**increase of the actual core melt frequency**),
- Tests prescribed by the Technical Specifications (**number of failed tests**),
- Radioactive waste production (**gaseous effluents**),
- Number of temporarily modifications and
- **Dose rates to personnel and others**.

Also by KFD-inspections quantitative information is gathered which are used in evaluating the performance of the plant. The significant ones, and listed in table 1, are:

- Repetitive malfunctions of instrumentation/equipment.
- Number (and nature) of inspection findings.
- Back-log in completing inspection and audit findings.
- No resolving of accepted alarms (in control room) of non-safety related situations.

3. Monitoring performance areas through performance indicators.

The KFD uses the quantitative information as described in table 1 to decide if a specific inspection at the nuclear power plant is necessarily. **The information on its one is not regarded as a performance indicator.**

The specific inspection will lead to qualitative and sometimes new quantitative information.

Table 1. Monitored quantitative information.

Performance Characteristic	Responsible Organisation	Informant Recipients	Regulatory threshold for acceptability	Actions by Regulatory Body
Reported incidents (inclusive INES 0)	Licensee	Regulatory Body and Public (Press informed by licensee)	Not applicable	- Inspection of incident - Yearly review sent to Parliament
System unavailability of one line-up for - high pressure injection. - emergency feedwater supply - emergency electricity supply	Licensee	Regulatory Body	Acceptable when unavailability is due to planned maintenance and remaining redundancy is within Tech. Specs (TS).	If not, it will be considered as an incident.
Increase actual core melt frequency.	Licensee	Regulatory Body	Cumulative increase of more than 2% (baseline = 1.35 E-6; excl. Foreseen maintenance)	Inspection of cause. Evaluation of operations and safety culture.
Number of failed TS-tests	Licensee	Regulatory Body	0 (after re-testing); the number of re-tests / month below 5%.	Inspection of causes / repetitiveness and check of test-procedures.
Gaseous effluents	Licensee	Regulatory Body	Below 10% of licensed value applicable for the period.	- Assessment of cause. - Figures are published in yearly report of KFD.
Dose rate to personnel and others.	Licensee (values are also registered by another governmental body)	Regulatory Body	Below 2.5 mSv in one month	- Assessment of cause. An unplanned dose of more than 10 mSv is an incident.
Repetitive malfunctions of instrumentation/equipment	Regulatory Body (gathered from monthly report / inspection logbook)	Not applicable.	C.a. 3 times in two months	- assessment of cause; if safety related and no clear cause is known further investigation. Event will be discussed with management of licensee
Back-log in completing inspection and audit findings.	Regulatory Body	-	Not defined	Back-log is used in discussion with licensee management regarding safety culture
No resolving of accepted non-safety related alarms	Noticed by inspectors over a period of time	-	C.a. one week	Findings are reported in inspection report and discussed with licensee

				management regarding safety culture

SPAIN

1. *Please identify any plant performance characteristics associated with nuclear reactor safety for which quantitative information is maintained, monitored, or trended by the Regulator. These may include the WANO indicators (i.e., industrial safety accident rate, unplanned scrams, unplanned capability loss factor, etc.) or other performance characteristics defined by the Regulator.*

CSN runs a Performance Indicators (PI) Program that is an application to Spain of the US NRC one, so that it allows to compare Spanish plants performance vs. American ones, Spanish plants among them, mid term trends of Spanish plants, etc.

CSN Program is in place since 1994

The set of Performance Indicators is:

- Automatic scrams while critical,
- Safety system actuations,
- Significant events,
- Safety systems failures,
- Forced outage rate (%),
- Equipment forced outages/ 1000 commercial critical hours,
- Collective radiation exposure

2. *For each of the above performance characteristics, please identify the following: 1) the organisation (Licensee or Regulator) responsible for collecting and maintaining the information, 2) how often the information is updated, 3) to whom the information is transmitted or made available, 4) any decision processes that make use of the information and how the information is used, and 5) any thresholds that the Regulator uses to judge acceptable performance. Responses to questions 1 and 2 may be made in the format of a Table, as shown below.*

the organisation (Licensee or Regulator) responsible for collecting and maintaining the information,

CSN, through a contractor, is responsible for collecting and maintaining the information. The information is obtained from the Licensee Event Reports, plus the Monthly Operating Report submitted to CSN by each licensee.

how often the information is updated,

The Performance Indicator Report is issued annually

to whom the information is transmitted or made available,

To CSN and licensees. In year 2000, for the first time, it is planned to provide an excerpt of the report to the Parliament, containing global information, not detailed information of each plant.

any decision processes that make use of the information and how the information is used, and whom the information is transmitted or made available,

> The usage of the information provided by the PI Program is not formalised. It is widely spread through CSN and it is considered one more input to evaluate plant, licensees behaviour.

any thresholds that the Regulator uses to judge acceptable performance.

> Thresholds have neither been defined nor presently planned to be defined.

3. *Please provide any examples of performance areas that you believe* cannot *be effectively monitored by the Regulator through the use of performance indicators, and briefly describe the important reasons why.*

4. *Please identify the criteria that you believe performance indicators must meet to be a useful indicator of the level of safety.*

In Spain it has been set up recently a working group made of Regulator and Licensee's experts that will try to agree on a set of Performance Indicators to be used in Spain. The initial criteria for candidates to become an indicator shall be indicative of:

- Stability of plant performance
- Reliability of main safety systems
- Barriers integrity
- Radiological impact

In addition, those indicators shall meet the following characteristics:

- Objective and not redundant
- Based on information already available or needing very little effort to retrieve
- There should be a hard-core of indicators universally accepted as such, that allow international comparisons, long term series. E.g. Scrams, collective radiation exposure.
- They should make use of public available information, so that the PI results should be public.

SWEDEN

Use of objective indicators by the regulatory authority in evaluating the performance of plants.

The Swedish Nuclear Power Inspectorate (SKI) does not use objective indicators in evaluating the safety performance of the plants. However SKI has identified a need for a systematic approach to evaluate the performance of safety of the plants. SKI are going to develop a systematic model for safety evaluations based on the concepts of barriers and defence-in-depth and how well the licensees are pro-active and take preventive measures in keeping the plants safe and not degrading.

The licensee of nuclear facility are responsible for monitoring the performance of safety and are to some extent using objective indicators for trending the performance of the plants.

SKI requires (the Swedish Nuclear Power Inspectorate's Regulations Concerning Safety in Certain Nuclear Facilities, SKIFS 1998:1) for example that: nuclear accidents shall be prevented through a basic facility-specific design which shall incorporate multiple barriers as well as a facility-specific defence in depth system, and events which have occurred and conditions which are detected which have an essential impact on the safety of a facility shall, without delay, be reported to the Swedish Nuclear Power Inspectorate .

SKI gets all event-reports (LERS) from the plants and the inspectors evaluate the safety significance of the event and if needed SKI carry out an inspection. Also, SKI has a screening-meeting regularly where one purpose is to look for trends of safety problems and the information of the events and analysis are stored in a database at SKI. In this database the information in the LERS is registered in parameters such as type of plant, the chapters of the Technical Specification and systems of the plants. Trends of safety performance are followed over the years and over plants and systems.

Thus, the event reports are one source that SKI has used over a long period of years looking for trends of safety performance and has initiated inspections based on these trends. Recurred events and the analysis of trends of safety performance within the area of human factors so called man – technology – organisation interaction have resulted in several inspections over the last decade.

However, some indicators of safety performance have been used over the years by SKI such as:

- an increase of event reports (LERS),
- recurrence of events and an increase of recurrence of events,
- an increase in human factor-related events,
- degraded quality of safety reviews or analysis of events and
- an increase of applications of short term exemptions of regulations.

SKI aims at being more pro-active

SKI aims at being more pro-active in the future by inspecting the licensees' self-assessment activities before any events gives signals of poor safety performance.

SKI is now, with the support of new regulations i.e., The Swedish Nuclear Power Inspectorate's Regulations Concerning Safety in Certain Nuclear Facilities, SKIFS 1998:1, focusing on the licensees' self-assessment of safety. SKI will carry out inspections with support of the regulations to make sure that licensees take their safety responsibility. According to the requirements of the regulations the licensees of a nuclear facility shall, for example:

- *evaluate and classify any deficiency in a barrier or in the defence-in-depth* taking into account its importance for safety and be investigated without delay. Any safety-related measures considered necessary shall subsequently be implemented without delay, and a safety review shall be conducted of the investigations and measures implemented;

- *investigate events*, which have occurred and conditions which are detected and are important to safety, in a systematic manner in order to determine sequences and causes as well as in order to establish the measures required to restore the safety margins and to prevent recurrence. The results of the investigations shall be disseminated within the organisation as well as shall contribute to the development of safety at the facility;

- establish *documented guidelines for* how *safety* shall be maintained at the facility as well as ensure that the personnel performing duties which are important to safety are well acquainted with the guidelines;

- ensure *that the activity carried out at the facility is controlled and developed with support of a quality system* which covers those activities which are of importance for safety (chapter 2, 3§, point 2) also, the quality system shall be kept up-to-date and documented in a quality manual or similar document. Routines and procedures necessary for the control of those activities which are important for safety shall be added to this document;

- *systematically and periodically investigate* the applicability, suitability and the effectiveness *of the quality system* by a quality assurance function which shall have an independent position in relation to those activities which are to be audited;

- ensure that *adequate personnel is available with the necessary competence* and of the suitability otherwise needed for those tasks which are of importance for safety as well as ensure that this is documented;

- ensure that *the responsibility and authority are defined and documented* with respect to personnel carrying out work which is important to safety;

- ensure that *the personnel is provided with the necessary conditions* to carry out work in a safe manner;

- ensure that *experience* from the facility's own and from similar activities *is continuously utilised and communicated* to personnel concerned;

- have implemented measures at the facility to maintain *physical protection* and be documented in a plan;

- inspect and test on a continuous basis building components as well as other components, systems and other devices of importance for safety at a facility in order to control that they function in a safe manner and that there are no sign of damage. In order to prevent abnormal events, incidents and deficiencies of importance for the safety of the facilities, such parts and devices shall be maintained in accordance with special maintenance programmes which shall be documented. *The maintenance programmes* shall be updated on a continuous basis, in the light of experience gained, at the facility in question as well as at other facilities;

- keep *the safety analysis and safety report* up-to-date;

- carry out *a safety review of engineered or organisational modifications* to a facility which can affect the conditions specified in the safety report as well as essential modifications to the report. Before the modification may be introduced, the Swedish Nuclear Power Inspectorate shall be notified and the Inspectorate can decide that additional or other requirements or conditions shall apply with respect to the modifications;

- have prepared measures *(emergency preparedness)* in case of abnormal events, incidents or accidents which can lead to radiological accidents. The measures shall be *documented in a plan* and be kept up-to-date and its suitability shall be evaluated through exercises on a regular basis.

These requirements could be looked upon as safety indicators, not objective but qualitative.

The quality (or degradation of quality) of reported e.g. safety reviews of planned plant modifications, event investigations, safety analysis, event reports and the recurrence of events, emergency plans, competence and staffing analysis, maintenance programmes, and so forth can be looked upon as safety performance indicators. These reports can give information about the safety performance and the results of a review of the reports can trigger inspections within these areas. However, most of the requirements mentioned above have to be inspected to get a deep and systematic knowledge about the performance of the licensees.

UNITED KINGDOM

1. *Identify plant performance characteristics associated with reactor safety for which quantitative information is maintained, monitored or trended by the regulator.*

Whereas information about prescribed events is reported to and collected by the regulatory authority, no quantitative information is collected or trended. There is no systematic collection of performance indicators by the regulatory authority.

There is no proactive gathering of such data. Only if there were specific purposes related, for example, to evidence gathering or after perceived difficulties uncovered by Inspectors, would the regulatory authority gather such data. For example, licensees historical dose rate trends might be used during a targeted inspection on radiation protection practices. In such circumstances the information would have to be sought from licensees own data and the regulatory authority has powers to require any such records to be furnished to it at any time.

The following are examples of events which are prescribed for statutory reporting: dangerous occurrences, radiation over exposure events, INES reporting, radiation releases, findings of MITS, reactor trips and specified conventional safety events.

2. *For each of the performance characteristics, identify 1) the organisation responsible for collecting and maintaining the information, 2) how often it is updated, 3) to whom it is transmitted, 4) decision processes that make use of the information, 5) thresholds to judge acceptable performance.*

As stated above, with the exception of prescribed events which have to be reported by the licensee to the regulatory authority, there is at present no systematic collection of information by the regulatory authority. Most UK licensees collect such information (for example, BE maintains WANO indices and other information), but it is not used in systematic fashion by the regulatory authority except as part of an investigation.

An overall, subjective measure of performance has been used by the regulatory authority, but its use has been discontinued. This was because of several difficulties:

- the scheme involved the translation of subjective insights into a numerical scale. Even with careful guidelines it was subject to variability between inspectors;
- it was too resource intensive to justify, given its limited fidelity;
- trending was unreliable as site inspectors are rotated about every three years.

There is a great variety in sites and types of installation in the UK which makes it difficult to find indicators which are universally applicable, very few NPPs are identical (WANO indicators are only applicable to power reactors) and in addition there are, for example: waste storage facilities, reprocessing plants, enrichment plants, fuel fabrication plants, isotope production facilities, research reactors. Additionally, the UK regulatory authority has a policy of public accountability and it is felt that confidence in the fidelity and comparability is needed if indicators are to be released to the public.

3. *Examples of performance areas that you believe cannot be effectively monitored by the regulator through performance indicators, and briefly describe the important reasons why.*

Effective quantitative monitoring is difficult for "soft issues" which are increasingly recognised as being of substantial importance to safety. Examples are:

- adequacy of staffing levels;
- safety management;
- safety culture;
- adequacy of organisational structures;
- QA systems;
- Emergency arrangements and exercises.

Difficulties arise because of the subjective nature of judgements made in these areas. While judgements of adequacy can be made by experienced and trained inspectors the marking indices will vary considerably with the samples chosen for detailed examination and the inspectors making the judgements. Thus no meaningful trends will be discernible. In addition indices in these areas are likely to "lag", so actions based on them are not likely to be timely.

4. *Criteria that indices need to meet to be reliable indicators of safety.*

To identify criteria for indicators it is necessary to establish what indicators are to be used for. The following is not necessarily an exhaustive list of uses:

- to inform inspection or regulatory action;
- to report to the public
- to serve to influence licensees in seeking improvements

The following are suggested criteria listed under these uses:

<u>To inform inspection or regulatory action</u>

The regulatory authority must know what an appropriate response is - it must relate to a legally enforceable action;

- direct relationship to safety (risk);
- applicable to identifiable and specific reactions.

<u>To report to the public</u>

- Agreed by everyone and used for all sites;
- applicable to all types of installation;
- not dependent on sampling, which introduces noise;
- repeatable;
- quantitative;
- not dependent on personal judgement;

<u>To influence licensees in seeking improvement</u>

- Direct relationship to safely (risk);
- quantitative;
- as little lag as possible (no matter how close the relationship to safety), preferably proactive.

UNITED STATES

1. *Identify any plant performance characteristics associated with nuclear safety for which quantitative information is maintained, monitored, or trended by the Regulator.*

2. *For each of the above characteristics, identify the following: 1) the organisation responsible for collecting and maintaining the information, 2) how often the information is updated, 3) to whom the information is transmitted or made available, 4) any decision processes that make use of the information and how the information is used, and 5) any thresholds that the Regulator use to judge acceptable performance.*

Performance Characteristic

Responsible Organisation	Information Update Schedule	Information Recipients	Regulatory Processes Using Information	Regulatory Threshold for Acceptability	Unplanned Scrams per 7,000 Critical Hours, automatic & manual while critical
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ3 per 7000 critical hours	Scrams With Loss of Normal Heat Removal, automatic and manual
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ2 per 12 quarters	Unplanned Power Changes per 7,000 Critical Hours
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ6 per 7000 critical hours	Safety Systems Unavailability (4 per plant)
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	Varies by system	Safety system Functional Failures - events or conditions that could prevent fulfilment of safety function
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	PWRs ÿ5 BWRs ÿ6 per 4 quarters	Reactor Coolant System Specific Activity (fuel cladding integrity)
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ50% of Technical Specification limit	Reactor Coolant System Leakage
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ50% of Technical Specification limit	Emergency Preparedness Drill Performance, accurate and timely classification, notification and protective action recommendations
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ90%	Emergency Response Organisation Drill Participation, key personnel participation in drills or exercises
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ80%	Alert and Notification System Reliability, percentage successful tests
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ94%	Occupational Exposure Control Effectiveness, loss of radiological control occurrences
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ2 per 4 quarters	Radiological Effluent Occurrences, offsite radiological effluent releases resulting in excess assessed dose
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ1 per 4 quarters	Protected Area Security Equipment Performance Index, unavailability of protected area security equipment
Licensee	Quarterly	Regulator and public	Performance assessment	ÿ0.050 per 4 quarters	Personnel Screening Program Performance,

Responsible Organisation	Information Update Schedule	Information Recipients	Regulatory Processes Using Information	Regulatory Threshold for Acceptability	Unplanned Scrams per 7,000 Critical Hours, automatic & manual while critical
			and enforcement		reportable program failures
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ2 per 4 quarters	Fitness-For-Duty Program Performance, reportable program failures
Licensee	Quarterly	Regulator and public	Performance assessment and enforcement	ÿ2 per 4 quarters	Industry average Safety System Actuations
Regulator	Licensee event reports	Industry and public	Performance assessment - maintaining safety	None	Industry average Significant Events
Regulator	Licensee event reports	Industry and public	Performance assessment - maintaining safety	None	Industry average Forced Outage Rate
Regulator	Monthly operating reports	Industry and public	Performance assessment - maintaining safety	None	Industry average Equipment Forced Outages
Regulator	Monthly operating reports	Industry and public	Performance assessment - maintaining safety	None	
Accident Sequence Precursors, events or conditions that increase the conditional core damage probability by ÿ10^{-6}	Regulator	As required	Industry and public	Performance assessment - maintaining safety	ÿ1 10^{-3} event per year

Note: Although the above indicators for which licensees are responsible were developed for use in the NRC's Revised Reactor Oversight process, they may in the future prove useful in other applications, such as license amendment requests

3. Provide any examples of performance areas that cannot be effectively monitored by the Regulator through the use of performance indicators and briefly describe the reasons why.

The performance areas listed below cannot be directly measured by performance indicators because they are not quantifiable. However, performance indicators can provide an indirect measure of weaknesses in these areas when the problems become significant enough to cause plant performance to decline. If the indicator thresholds are then established to call attention to declining performance before the problems become severe.

a) Organisation and management effectiveness
b) Human performance
c) Safety-conscious work environment (performance indicators are not identifying performance problems, it can be assumed that any weaknesses in these areas are not significant enough to warrant increased attention.)
d) Problem identification and resolution

4. Identify the criteria that you believe a performance indicator must meet to be a useful indicator of the level of safety.

e) Have a logical relationship to nuclear safety performance
f) Not susceptible to manipulation
g) Represent a worthy goal for licensees
h) Comparable among licensees
i) Reflect a range of performance
j) Quantifiable
k) Able to be reported in a timely manner