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Implementation of the obligations of the

Convention on Nuclear Safety

The second Swiss report in accordance with Article 5

Contents

Foreword

Switzerland gave its signature to the Convention on Nuclear Safety on the 31st of October 1995 and ratified it on the 12th of September 1996. The first Swiss report in accordance with Article 5 of the Convention was produced and deposited with the IAEA in 1998. In 1999, a Swiss delegation attended the first Review Meeting of the Contracting Parties at the IAEA headquarters in Vienna.

The present second Swiss report provides updated information on the fulfilment of the obligations under the Convention. Further, the report attempts to give adequate consideration to the topics which aroused special interest at the first Review Meeting. Thus, the second Swiss report strives to give again a complete picture of the nuclear safety status in Switzerland as per the year 2001. It was produced by the Swiss Federal Nuclear Safety Inspectorate (HSK/DSN). Other public and private institutions were involved during the writing of the second Swiss report and contributed to the report with their expertise.

The introduction to the report provides general information about Switzerland, a brief political history of nuclear power and an overview of the nuclear facilities in Switzerland.

In the following sections, numbered after the Articles 6 to 19 of the Convention on Nuclear Safety, key aspects will be commented on in such a way as to give a clear indication on how the various obligations imposed by the Convention are fulfilled in Switzerland. A list of abbreviations used in the text appears as Appendix 1.

An overview of the contents of the report and the conclusions about the degree of compliance with the obligations, as set out in the Convention, is given in the "Summary and conclusions" section.

Summary and conclusions

Currently, the regulation processes applied to the licensing and safety surveillance of the Nuclear Power Plants (NPPs), the NPP types and systems and their operation are all at the state of science and technology in Switzerland.

Deterministic and probabilistic safety assessments for fuel and core design, for safety and safety-related systems are important for the supervisory authority, either to confirm the high standard of the NPPs safety or to identify any plant vulnerability. In addition, these assessments guide and prioritise inspections.

The surveillance of the NPPs operating, control and safety systems, their component performance and integrity, their organisational and human aspects as well as the goal to generate a minimum of radioactive waste, its conditioning and temporary storage are permanent features of the supervisory authority's activities. The assurance of low radiation doses to NPP workers and also to the general public is an additional goal that is directly associated with the safe operation of NPPs. These are also key features of the Convention on Nuclear Safety.

The Swiss national alerting system for cases of an accident in a nuclear installation is geared to rapid response. Contingency plans are in place and are continually updated. Emergency drills take place at regular intervals. The international alerting system is also in a mature stage and its efficiency is verified in regular exercises.

All these above-mentioned aspects are described and embedded in the Swiss legislation, which also forms the basis for the granting of operating licences for the Swiss NPPs.

It can be concluded that the Convention's articles, as described in this report, are satisfied when applied to the Swiss situation of nuclear safety regulation. Indeed, the requirements in the articles of the Convention, with the exception of Article 13, were already standard practice in Switzerland before the NSC came into force.

Improvements are aimed for in two areas:

- The independence of the Inspectorate (HSK/DSN) from other governmental bodies concerned with the use of nuclear energy is presently fulfilled on a technical level, but this independence is not guaranteed legally. A different subordination of the Inspectorate is in consideration within the frame of the current reform of the government and the administration.
- The present Inspectorate's quality assurance practices are in the process of being documented in a QM system at the time this report is written. The certification of the Inspectorate in accordance with the ISO 9001 standard is scheduled for the end of the year 2001.

In the following, a short summary of the detailed answers to the various articles in the Convention is provided.

Article 6: Existing nuclear installations

The general safety status of the Swiss NPPs is good. The first generation NPPs of Switzerland (Beznau I+II and Mühleberg) have been progressively backfitted to address the major on-going developments in NPP safety technology. Initial and periodic safety reviews (PSR) have been performed for these first generation NPPs and, based on the favourable results, they have been granted licences to continue operation.

The next PSR for the Mühleberg NPP has been submitted to the HSK for review in 2001. The next PSR for the Beznau NPP will be submitted to the HSK for review by the end of 2002.

The second generation of NPPs (Gösgen and Leibstadt) had, already from the design stage, inherent improvements in various aspects of safety and operation. A periodic safety review (PSR) was completed also for the NPPs Leibstadt and Gösgen in 1996 and 1999 respectively.

Accordingly, all Swiss NPPs underwent the safety review process as required by the Convention and have incorporated improvements indicated in the respective safety review reports. The Swiss legally binding policy of continuous improvements in NPPs, as indicated by the current state of science and technology, ensures a high level of safety.

The Swiss Party therefore complies with the obligations of Article 6.

Article 7: Legislative and regulatory framework

The legislation and nuclear installation regulatory framework is well established in Switzerland. It provides the formal basis according to which the safety of nuclear installations is governed. The main legal provisions for authorisations and regulation, supervision and inspection are established in the Atomic Energy Act, the Federal Order to the Atomic Energy Act and the Radiological Protection Act.

A complete revision of the Atomic Energy Act is currently in progress. The Federal Parliament started to deliberate a draft of a new Nuclear Energy Law in 2001.

The Swiss Party therefore complies with the obligations of Article 7.

Article 8: Regulatory Body

The Swiss regulatory body, composed of the Swiss Federal Nuclear Safety Inspectorate (HSK/DSN) as the supervisory authority and the Swiss Federal Nuclear Safety Commission (KSA/CSA) as an advisory committee, possesses the authority, competence and financial resources to fulfil its assigned responsibilities.

According to the increased responsibilities and tasks of the Inspectorate, its number of personnel has been successively increased in the last 20 years and its organisation has been adapted to new needs. This will also be the case in the future.

The functions of the regulatory body are separated from organisations concerned with the promotion or utilisation of nuclear energy. The requested effective separation of the supervisory authority from other governmental bodies concerned with the use of nuclear energy is fulfilled on a technical level.

At the request of the Swiss Government authorities, an IAEA team of eleven experts visited the Swiss Federal Nuclear Safety Inspectorate (HSK) in late 1998 to conduct an International Regulatory Review Team (IRRT) mission. The purpose of the mission was to review the effectiveness of the regulatory body of Switzerland and to exchange information and experience in the regulation of nuclear, radiation, radioactive waste and transport safety. The IRRT mission stated a number of recommendations, suggestions and good practices. The HSK has already undertaken measures to implement most IRRT recommendations and suggestions or is still in the process of doing so in some cases.

The Swiss Party therefore complies with the obligations of Article 8.

Article 9: Responsibility of the licence holder

The responsibility of the licence holder for the safe operation of a NPP is required implicitly by the Swiss Atomic Energy Act. This statement is in first place for each of the NPP's procedure rules. Each NPP has accepted this condition for operation.

The Swiss Party therefore complies with the obligations of Article 9.

Article 10: Priority to safety

The priority to safety has always been the first consideration for all organisations actively engaged with nuclear installations in Switzerland. The Inspectorate has explicitly set this down in its own Terms of Reference, appended to this document. As far as the NPPs are concerned, up to the year 2001 all of them have undergone Operational Safety Review Team (OSART) missions. The corresponding follow-up missions have already taken place or will be performed in the near future. The missions carried out so far have confirmed many commendable areas of performance, particularly a strong commitment to nuclear safety and excellent plant operation, but recommended also additional safety improvements.

In the forthcoming years, the Swiss electricity market will be gradually deregulated if the corresponding law passes the popular referendum. Already now, electricity prices have come under certain pressure. There is consensus that the high level of nuclear safety in Switzerland has to be maintained under deregulated electricity market conditions. The HSK is applying measures to ensure that priority to safety is granted in an open electricity market and during the transition phase.

The Swiss Party therefore complies with the obligations of Article 10.

Article 11: Financial and human resources

There are sufficient financial resources of the Swiss NPP operators to maintain a high safety level throughout the lifespan of the NPPs. Should a NPP no longer fulfil the regulatory safety requirements, it will have its licence revoked and will be prevented from operating. The financial aspects of decommissioning and waste disposal are ensured by means of dedicated funds. The human resources of the Swiss NPPs are sufficient, although the number of staff is below the international average. The competence and the capacity of the human resources have to be observed tightly, particularly in view of the electricity market deregulation.

The personnel of the NPPs is well educated and trained and regular retraining is available to keep up with advances in science and technology as well as with modifications to the plant.

Adequate measures are applied to plan in advance the replacement of retiring staff. Due care is dedicated to know-how transfer, also in the case of transfer from providers to NPP staff.

The Swiss Party therefore complies with the obligations of Article 11.

Article 12: Human factors

The Inspectorate has its own section which is concerned with human aspects, NPP organisation and safety culture. Considerable attention is paid to ergonomic aspects. Any weaknesses are identified and for improvements necessary arrangement are made. Modifications to the control rooms and the implementation of computerised plant information systems have been progressively carried out over the past few years.

Steps to further improve the safety culture are continuously made. The members of the Inspectorate as well as the plant management are both pursuing a way to further promote a broad safety philosophy and culture.

The Swiss Party therefore complies with the obligations of Article 12.

Article 13: Quality assurance

All Swiss NPPs have built up documented QM systems. Furthermore, QM systems have been established and approved for the transport of radioactive material.

A quality management system, the HSK Management System, has been established for the Inspectorate based on the ISO 9001, version 2000 standard, and is gradually being implemented since November 2000.

The HSK Management System contains the processes pertaining to all HSK activities.

The processes were derived from existing work procedures in a collaborative effort between teams of HSK personnel and an external consultant.

Certification according to the ISO 9001 standard is scheduled for the end of 2001.

The Swiss Party therefore complies with the obligations of Article 13.

Article 14: Assessment and verification of safety

The review and assessment procedure includes the evaluation of the safety analysis report (SAR), safety-relevant systems, design basis accident analyses, probabilistic safety analysis, ageing surveillance programmes, as well as any documents which are made available upon request by the Inspectorate. The results of the reviews and of assessments are documented. In the case of a licensing procedure, the documentation will take the form of a Safety Evaluation Report (SER). A periodic safety review (PSR) is documented as a Periodic Safety Review evaluation report. PSRs are to be conducted at an interval of about 10 years. As a rule, all plant documentation has to be regularly updated, including SARs and PSAs. Important conditions and prerequisites for operation are recorded as licence conditions.

Further requirements for assuring that the physical state of a NPP is in compliance with the licence are:

- Modifications to components essential for safety must obtain a permit;
- A plant review has to be carried out after each refuelling outage; and
- An efficient inspection activity has to be deployed by the Inspectorate for the verification of compliance with licence requirements.

The Swiss Party therefore complies with the obligations of Article 14.

Article 15: Radiation protection

The supervisory and control methods currently applied by the Inspectorate are in compliance with the Convention's requirement to keep radioactive doses to the public and the environment as low as reasonably achievable and also to limit, as far as possible, the generation of radioactive waste associated with the use of nuclear power. The low annual individual and collective doses prove the effectiveness of the methods based on the most recent recommendations of the International Commission on Radiation Protection (e.g. guidelines, job planning and supervision).

The Swiss Party therefore complies with the obligations of Article 15.

Article 16: Emergency preparedness

On- and off-site emergency organisations and plans are in place for each nuclear installation. The emergency planning zones around the NPPs are defined. Emergency protective measures such as sheltering and the availability of iodine tablets are also established.

The basic reporting procedure required is laid down in an Inspectorate's Guideline. The emergency preparedness and plans are regularly tested in the form of exercises. The channels for alerting the public, the National Emergency Operation Centre and any concerned neighbouring country are in place. Bilateral agreements exist between Switzerland and its neighbouring countries to deal with alerting in emergency situations.

For improving the on-site emergency preparedness, the HSK has required the Swiss licensees to implement severe accident management guidance (SAMG) by the end of 2003. In case of an accident provoking severe core damage, SAMG will support the different emergency organisation teams in taking accident mitigation measures based on predefined strategies.

The Swiss Party therefore complies with the obligations of Article 16.

Article 17: Siting

Steps and procedures for evaluating all relevant NPP site-related factors are established and implemented within the frame of the licensing procedure. In the periodical review of the safety analysis report, site-specific factors are also addressed.

In 1999, the HSK required the licensees to perform a new comprehensive probabilistic seismic hazard analysis (PSHA) for all Swiss NPP sites. In the ongoing work for a new PSHA, the use of experts and the assessment of epistemic and aleatory uncertainties receives high priority.

The Swiss Party therefore complies with the obligations of Article 17.

Article 18: Design and construction

The design and construction of the Swiss NPPs are such that the principle of defence in depth is obeyed. The various levels of defence are in place to ensure that safety limits and individual dose limits for the public are respected throughout the normal operation of the NPP and for all design basis accidents. In addition, the release of radioactive materials to the environment in the case of severe, beyond design basis accidents, is prevented or limited. The design, materials and components are subject to rigorous control and scrutiny and regular testing in order to verify their fitness for service. Backfitting is carried out when necessary. All Swiss NPPs possess a filtered containment venting system which has the potential to mitigate the radiological consequences to the environment in most severe accident scenarios.

The increased use of computer based control systems improves the man-machine interface and facilitates the operation of the NPPs in all operation modes.

The Swiss Party therefore complies with the obligations of Article 18.

Article 19: Operation

The requirements for the correct and safe operation of the Swiss NPPs are laid down in the operation licence of each NPP. The operation procedures and rules have to be followed for all operational conditions. The most important operation procedures are the Technical Specifications containing the limiting conditions of operation. The operational procedures of the NPP extend also to maintenance, testing and surveillance of the equipment. Comprehensive technical support is available. The reliable operation of the Swiss NPPs is reflected in the low annual number of reportable events.

In addition to its general inspection activities, the Inspectorate gains further insight into all aspects of the NPPs operation using a comprehensive system of report-gathering from the operator.

The Inspectorate and the operators collect operational experiences from domestic and foreign NPPs. The analysis of particular operating experiences have resulted in some cases in important safety-relevant backfitting and modifications in Swiss NPPs.

The generation of radioactive waste at NPPs is kept at a low level. The resulting waste is collected, segregated and conditioned as soon as practicable. Some temporary storage of waste takes place on site under appropriate conditions. In June 2001, the operation permit for a centralised interim storage facility was granted. This facility will host radioactive waste until the commissioning of final waste repositories.

The Swiss Party therefore complies with the obligations of Article 19.

Introduction

Country and State

With a total surface area of 41,285 km² and a population of roughly 7.5 mio inhabitants, Switzerland is a small State in the European context. Structurally, Switzerland has evolved as a federal State with twenty-six member States, known as cantons. Constitutionally delimited competencies and central tasks are given to the federal authorities. An important number of popular rights are guaranteed on a federal level, too. All other legislative power remains with the cantons, which have thus retained a high degree of autonomy. The municipalities and communes also enjoy considerable rights of self-government.

The Federal Council, composed of seven ministers of equal rank, acts a federal government. The Swiss Parliament consists of two chambers. The National Council represents the population as a whole. Its 200 members are elected for a term of four years. The Council of States has 46 members who represent the Swiss Cantons. Each Canton elects two members and each half-Canton (AI/AR, BL/BS, NW/OW) elects one, regardless of size.

The voting population has the constitutional right to sanction changes to the Federal Constitution and has a right of referendum on the level of federal laws. Changes or a new article to the Federal Constitution can be requested by means of a popular initiative signed by at least 100,000 voters. All constitutional changes must be submitted to a popular vote (obligatory referendum). If a minimum of 50,000 voters challenge a proposal for a new federal law, the proposal is put to the vote (facultative referendum). The cantonal constitutions contain similar rules on popular initiatives and referendums as on the federal level.

Background of nuclear power in Switzerland

Historically, electricity generated in Switzerland came exclusively from hydro power without any recourse to fossil fuels, the latter not being available as a natural resource in the country. In the mid 1950's, an interest in the relatively new nuclear energy technology was manifested to cover an increasing electricity demand. In accordance with the general policy concerning the production of electricity, the promotion and use of nuclear energy was left to the initiative of the private sector. It was recognised, however, that the implementation of any nuclear programme and project requires a legislative frame to ensure safety and radiation protection, and that such a legislation should be established exclusively at the federal level. Therefore, a corresponding article was introduced into the Swiss Constitution and approved by vote of the Swiss population in 1957. Based on this article, the Atomic Energy Act was put into force in 1959.

The Atomic Energy Act attributes to the Federal Council the exclusive competence to grant licences for the construction of, operation of and modification to nuclear installations. For geological waste repositories, cantonal laws have to be additionally obeyed. Licences are based on a detailed review and assessment of nuclear safety. The supervision of NPPs implies the legal competence to take, at any time, appropriate measures to enforce compliance with the licensing conditions.

Since nuclear power is within the realm of private industry, there is no "national nuclear programme" as such. During the 1960's, a series of projects for establishing NPPs were initiated, more or less, in parallel. Four of them reached the stage of realisation, leading to five currently operating units commissioned between 1969 and 1984. These five units contribute roughly 40 % of the total national electricity production, the rest being essentially covered by hydro power complemented by a still small amount from other energy sources.

Due to the increasing opposition to nuclear power during the 1970's, it has not been possible, however, to realise several other nuclear projects for which sites had already been approved. The situation at the end of the 1980's culminated in 1990 in a double decision taken by the Swiss population:

- to accept the further operation of the existing NPPs,
- to impose a ten years stop (moratorium) on granting licences for new NPPs (as well as other nuclear installations and reprocessing plants, with the exception of facilities for radioactive waste management).

Two recent popular initiatives concerning the prolongation of the moratorium and the gradual phase-out of the existing NPPs have been launched. Both initiatives will be submitted to the popular vote in the forthcoming years. Simultaneously, the Swiss population will have the possibility to vote on a new Nuclear Energy Law which has been elaborated by the Swiss legislator (see Article 7).

Swiss nuclear facilities

Nuclear power plants

There are today four different utilities producing electricity from nuclear energy in five units. The Swiss NPPs have four different reactor designs, four different containment designs and were delivered by three different reactor suppliers. Although there is no Swiss reactor supplier, there are local suppliers for civil engineering and buildings, and for mechanical and electrotechnical equipment.

The four NPPs in operation in Switzerland and the utilities which are responsible for them are the following:

- Beznau I+II Nordostschweizerische Kraftwerke AG
- Mühleberg Bernische Kraftwerke Energie AG
- Gösgen Kernkraftwerk Gösgen-Däniken AG
- Leibstadt Kernkraftwerk Leibstadt AG.

The main technical characteristics of the Swiss NPPs are compiled in Table 1.

Table 1: Main technical characteristics of the Swiss NPPs (June 2001)

	First generation NPPs			Second generation NPPs	
	Beznau - I	Beznau - II	Mühleberg	Gösgen	Leibstadt
Licensed thermal power P_{th} [MW_{th}]	1130	1130	1097	3002	3515
Nominal electrical power P_{el} [MW_{el}]	365	365	355	970	1145
Reactor type	PWR	PWR	BWR	PWR	BWR
Containment type	Large dry, free standing steel inside concrete building	Large dry, free standing steel inside concrete building	Pressure sup-pression, Mk I inside concrete building	Large dry, free standing steel inside concrete building	Pressure sup-pression, Mk III inside concrete building
Normal heat sink	river (Aare)	river (Aare)	river (Aare)	wet cooling tower (Aare)	wet cooling tower (Rhine)
Number of reactor coolant pumps	2	2	2	3	2
Number of turbine sets	2	2	2	1	1
Number of fuel assemblies	121	121	240	177	648
Fuel	UO_2 (+MOX)	UO_2 (+MOX)	UO_2	UO_2 (+MOX)	UO_2
Number of control assemblies	25	25	57	48	149
Reactor supplier	W	W	GE	KWU	GE
Turbine supplier	BBC	BBC	BBC	KWU	BBC
Site Licence	1964	1967	1965	1972	1969
Construction licence	1964	1967	1967	1973	1975
First operation licence	1969	1971	1971	1978	1984
Commercial operation	1969	1971	1972	1979	1984
Backfitted bunkered automatic shutdown and residual heat removal system since	1993	1992	1989	included in the original design	included in the original design
Filtered containment venting system since	1993	1992	1992	1993	1993

Abbreviations:

Mk I, Mk III	GE Containment Types Mark I and Mark III
PWR	Pressurised Water Reactor
BWR	Boiling Water Reactor
W	Westinghouse Co
GE	General Electric Co
KWU	Kraftwerk-Union (now Siemens)
BBC	Brown Boveri & Cie Ltd (now ASEA-Brown Boveri-ABB)
UO_2	Uranium oxide
MOX	Mixed oxides

Figure 1: Geographical position of the Swiss nuclear facilities. The sites of the NPPs are marked by triangles. Experimental and research installations are marked by stars. Facilities for nuclear waste management are marked by squares. Dots mark the major cities.

Switzerland is a small and densely populated country. The number of suitable sites for NPPs is therefore limited. Two sites are situated near the German border, at a distance of 0.5 km (Leibstadt) and of 5 km (Beznau). The two other sites are about 40 km away from the French and 20 km from the German border respectively. The geographical position of all Swiss nuclear facilities is indicated on the map in Figure 1.

<u>Facilities for nuclear education, research and development</u>

The major part of nuclear research in Switzerland is performed at the Paul Scherrer Institute (PSI). Work is carried out at PSI in the following areas in collaboration with other national and international research institutes and with industry: elementary particle physics, biological sciences (including radiation protection), solid state research and material science, nuclear energy research, non-nuclear energy research and environmental research related to the production of energy, medical research and medical treatment (oncology).

At the PSI location there are several nuclear installations and accelerators of which the research reactor "PROTEUS" and the Hot Laboratory are the most important from the point of view of nuclear safety. The research reactors "DIORIT" and "SAPHIR" are in the state of decommissioning.

At the University of Basel (Uni BS) and at the Swiss Federal Institute of Technology Lausanne (EPFL) there are small research reactors (P< 1 kW_{th}) which are used mainly for teaching purposes.

The former Lucens experimental NPP (underground; D_2O moderated, CO_2 cooled; 30 MW_{th}; 8 MW_e) has been decommissioned and dismantled after it experienced a loss of coolant accident in 1969. With the exception of a small nuclear waste storage area, this site is declassified and released for non-nuclear activities since March 1995.

Nuclear waste

Each NPP has installations for the conditioning and temporary storage of radioactive waste resulting from its operation. The PSI also has such an installation for treating radioactive waste coming from medicine, industry and research. The Federal interim storage for radioactive waste is also located at the PSI. Furthermore, on the premises of the Beznau NPP, there is a temporary storage called "ZWIBEZ" for waste arising out of fuel reprocessing and for spent fuel elements.

In Würenlingen, a central interim storage facility for nuclear waste has been constructed by the utility-owned company ZWILAG. In addition to storage capacity for spent fuel, vitrified high-level waste and other intermediate and low-level radioactive waste, the facility also comprises installations for the conditioning of specific waste streams and the incineration or melting of low-level waste. The storage facility started active operation in June 2001. The facility relieves the time pressure for the realisation of final disposal facilities.

The application for the federal general licence for a repository for low and intermediate waste at the Wellenberg site in Canton Nidwalden was submitted in 1994. The cantonal legislation requests a mining concession for the construction permission of such a repository. The granting of this mining concession was rejected by the citizens of the canton in 1995, thereby blocking the project from advancing any further. A new application for a mining concession relating only to an exploratory drift was submitted in January 2001 which re-launches the Wellenberg project.

Article 6: Existing nuclear installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

The general safety status of the Swiss NPPs was satisfactory at the time the Convention entered into force. Major backfittings on first generation plants have been carried out in the period of 1980 through 1995 to improve their safety. All Swiss NPPs are reviewed at least annually on the occasion of refuelling. Profound reviews have been or are being carried out for all NPPs and their safety has been satisfactorily proven in both deterministic and probabilistic ways.

The Swiss NPPs of the **first generation** (Beznau and Mühleberg) went into operation from 1969 through 1972. The review and assessment of the application for the site, construction and operating licences was done by the Swiss Federal Nuclear Safety Commission (KSA/CSA). Mainly relied on at that time were US Regulations and Guides since the two reactor suppliers concerned were US-American, as well as on the inherent safety of the light water reactor type.

However, in those days, some principles of nuclear safety were not yet commonly acknowledged and were not taken into account, such as:

- separation criteria for electrotechnical and mechanical equipment to protect the NPP from common cause failures by e.g. fire or internal flood;
- rigorous application of the single failure criterion, also to supporting systems, for the case of loss of offsite power;
- protection of residual heat removal (RHR) systems against external events (aircraft crashes, earthquakes, floods, lightning and sabotage).
- a supplementary shutdown capability in a remote area for the case of loss of the main control room.

As early as 1980, two major backfitting projects were required by the safety authorities to improve the RHR systems in the first generation plants. These projects, extending over several years, were known under the name "NANO" for the PWR twin-unit at Beznau and "SUSAN" for the BWR at Mühleberg. Furthermore, in the late 1980's, a seismic requalification was carried out. The backfitting was performed mainly by adding one or two completely separated shutdown and RHR systems, including their support systems, taking care of the previously mentioned four points. For further backfitting activities see Article 18.

Periodic safety reviews (PSR) were performed after these major backfitting projects for both plants. The reviews were completed in 1992 for Mühleberg and in 1994 for Beznau. As a consequence of these backfittings, the two NPPs were granted new operation licences. The second PSR has started in 2001 for the Mühleberg NPP and the second PSR for the Beznau NPPs will start in 2002.

The **second generation** NPPs went into operation in 1979 (Gösgen) and in 1984 (Leibstadt). Their degree of redundancy was higher and their protection against external events was significantly improved compared to the first generation plants. Some further improvements were introduced during licensing and construction (in particular, inclusion of a special emergency heat removal system "SEHR", in the Leibstadt NPP).

Both second generation plants were subject of a PSR. For the Leibstadt plant, this review was performed together with the review of the 15% power uprate request of the utility. Based on this review, only minor requirements resulted mainly concerning better response to anticipated transients without scrams. The PSR for the Gösgen plant was finished in the year 1999.

In 1993, all plants were improved by installing a filtered containment venting system to mitigate the consequences of severe accidents (e.g. failure of RHR systems).

Conclusion

The Swiss Party complies with the obligations of Article 6.

Article 7: Legislative and regulatory framework

Clause 1
Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

The legislative and regulatory framework in Switzerland for governing the peaceful use of nuclear energy, the safety of nuclear installations and radiological protection is established on a four-level system:

- 1st level: Federal Constitution
- 2nd level: Federal Laws
- 3rd level: Federal Ordinances
- 4th level: Guidelines (Directives, Guides)

Federal Constitution (1st level):
Articles 90 and 118 stipulate that legislation on the use of nuclear energy and on radiological protection is enacted exclusively at the federal (national) level. According to this, the Federal Parliament and the Federal Council (government) have the competence to establish legislation in the field of radiation protection and the use of nuclear energy.

Federal Laws (2nd level):
The main legal provisions for authorisations and regulation, supervision and inspection are established with the following acts:

- Federal Act on the Peaceful use of Atomic Energy (Atomic Energy Act, approved in 1959).
- Federal Order concerning the Atomic Energy Act (approved in 1978).
- Radiological Protection Act (approved in 1991).

In addition to the federal legal provisions, the cantons retain competencies for granting various authorisations (in particular, the law on construction and land use planning, protection of the environment and landscape, protection of workers, forestry, fire and disaster prevention, water protection, use of river water for cooling purposes). The cantons retain, furthermore, sovereignty over their territory below ground. This has so far been irrelevant for NPPs, but becomes important for radioactive waste management.

<u>Atomic Energy Act</u>
Atomic installations under this act are NPPs, research reactors and installations for mining, processing, storing or conditioning nuclear fuels and radioactive waste.

The main features of the Atomic Energy Act are as follows:

- a licensing system describing authorisations (licences) for siting, construction (including design), operation (including commissioning), modifications to nuclear installations, decommissioning and the licence conditions (see Article 7 Clause 2 (ii));

- the definition of a regulatory body and the attribution of competence for ordering the application of all measures to protect persons and property and other important rights and to safeguard Switzerland's national security and ensure compliance with its international commitments (see Article 8);
- penal provisions.

A complete revision of the Atomic Energy Act is currently in progress. The Federal Parliament started to debate the new Nuclear Energy Law in 2001. It should be noted that the new law is intended to replace both the Atomic Energy Act and the Federal Order concerning the Atomic Energy Act (see below). The law can be subject to a national referendum.

<u>Federal Order concerning the Atomic Energy Act</u>
This order has been enacted as a complementary law to the Atomic Energy Act. The main features are:

- the introduction of a general licence and the procedure to obtain this licence;
- the need for a nuclear installation and for the energy produced has to be demonstrated;
- radioactive waste management aspects, including final disposal, and establishment of a fund for decommissioning;
- enhanced public participation for every new nuclear installation.

<u>Radiological Protection Act</u>
The Radiological Protection Act covers every aspect of the protection of the personnel in NPPs, the public and the environment against hazards caused by ionising radiation resulting from all activities, facilities, events and circumstances involving such radiation.

The Radiological Protection Act covers inter alia:

- fundamental principles (justification and limitation of exposure, dose limits);
- protection of persons occupationally exposed to radiation and of the general population;
- the taking into account of experience (feed back) and of the state of science and technology;
- permanent monitoring of the environment and, during periods of elevated radiation, protection of the public (emergency preparedness: emergency organisation outside NPPs);
- radioactive waste management.

Federal Ordinances (3rd level)
The following ordinances (lower levels of legislation) are relevant to nuclear energy legislation:

- Federal Ordinance on definitions and authorisations (licences) in the field of nuclear energy (Atomic Energy Ordinance) (1984);
- Federal Ordinance on Radiological Protection (Radiological Protection Ordinance) (1994);
- Federal Ordinance on Dosimetry (1999)
- Federal Ordinance concerning the Supervision of Nuclear Installations (1983);

- Federal Ordinance concerning the Swiss Federal Nuclear Safety Commission (KSA/CSA) (1983);
- Federal Ordinance concerning the Fees in the Area of Nuclear Energy (1985);
- Federal Ordinance on the Protection of the Population in the Vicinity of Nuclear Installations in the Case of an Emergency (Emergency Preparedness Ordinance) (1983);
- Federal Ordinance on the National Emergency Operations Centre (1990);
- Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity (1991);
- Federal Ordinance on the Distribution of Iodine Tablets to the Population (1992).

The most important of these ordinances are briefly commented on below.

Federal Ordinance on Radiological Protection

This ordinance is based on the Radiological Protection Act and takes full account of the latest International Commission on Radiological Protection (ICRP) recommendations (Publication No. 60). Together with the Radiological Protection Act, this ordinance regulates the radiological protection of all persons (individuals of the population and individuals working in radiation fields and with radioactive substances, including medical applications). Furthermore, the act and the ordinance on radiological protection also include all aspects of environmental protection associated with radioactive materials and ionising radiation.

Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity and the Federal Ordinance on the National Emergency Operations Centre

The Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity designates the competent authorities and rules over their organisation as well as their areas of intervention in emergency situations. One of the cornerstones of the Swiss emergency organisation is incorporated in the National Emergency Operations Centre. The Federal Ordinance on the National Emergency Operations Centre contains stipulations on the tasks of the Centre, its competencies, its organisational set-up and the instruments to fulfil its tasks.

Federal Ordinance concerning the Supervision of Nuclear Installations

This ordinance formally transfers governmental competencies in the licensing and supervision process specifically to the Swiss Federal Nuclear Safety Inspectorate (HSK/DSN) as supervisory authority. The ordinance formally establishes the Inspectorate as the competent authority for supervising nuclear installations at all stages of their life.

Federal Ordinance concerning the Swiss Federal Nuclear Safety Commission (KSA/CSA)

This ordinance specifies the Swiss Federal Nuclear Safety Commission (KSA/CSA) as the advisory committee on nuclear safety. The ordinance delineates the aspects for which the competent Ministry and the Federal Council can receive advice from its advisory committee on nuclear safety.

Lower level legislation in other areas with a link to nuclear energy

There exist other ordinances which are indirectly related to nuclear safety and cover areas such as land use planning, protection of the environment and landscape, forestry, water protection, fire protection and occupational safety as well as technical safety and radiological protection aspects of the transport of radioactive substances, including fuel assemblies. The latter regulations are based on the international transport regulations, in turn based on the IAEA regulations for the safe transport of radioactive materials.

Guidelines (4th level)
Guidelines are prepared and established by the safety authorities. Formally, guidelines are not part of the legislation. Their nature and use is explained in connection with Clause 2 (i) of this Article.

Clause 2 (i)
The legislative and regulatory framework shall provide for the establishment of applicable national safety requirements and regulations;

The Swiss policy for regulation and supervision of nuclear installations, as expressed in the legislation, is to keep regulations short (without entering into technical aspects), essentially indicating that nuclear safety and radiological protection have to be ensured.

The legislation and regulations are thus limited to the prescription of safety objectives. This puts the applicants/licensees under the obligation to propose and seek technical solutions reflecting the internationally recognised state of science and technology, as well as corresponding safety criteria. The necessary governmental review and assessment of these proposals (being essential parts of the application) is done by the safety authorities.

Although the applicants/licensees have the obligation to propose acceptable technical solutions, experience has shown that it is useful to make known to them how the safety authorities will review and assess the application for a licence. This is done by means of guidelines prepared and established by the safety authorities.

These guidelines indicate ways of implementing some of the safety requirements. They address particular aspects which the Inspectorate requires to be taken into account, as they are suggested by experience gained in Switzerland and abroad and the state of science and technology. In particular, the guidelines state in detail how the Inspectorate proposes to carry out its legal obligations.

Many guidelines are so-called "design guidelines": they are not mandatory; applicants may choose other solutions, but then they have to demonstrate that the same level of safety is attained. Other guidelines, called "procedure guidelines", prescribe (administrative) procedures that have to be followed. They are then mandatory.

In the course of the years, the safety authorities have established a number of guidelines among which more than 30 are in force. A list of the currently valid guidelines is given as Appendix 2.

Clause 2 (ii)
The legislative and regulatory framework shall provide for a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

The Swiss licensing system arises directly from the appropriate requirements of the legislative and regulatory framework described above as part of Clause 1 of this Article. This licensing system involves the establishment of a regulatory body (see Article 8), the definition of licences and the constitution of a licensing process; it also implies that it is forbidden to operate a nuclear facility without a valid licence.

Types of licences

Two main licence types are applied:

- **General Licence:** It is applicable to any new nuclear installation since 1978 and includes the site licence. The four NPPs (five units) currently in operation have no general licence since they were granted site and construction licences prior to that date. The general licence determines the site and the main features of the project. A valid general licence is a prerequisite to the subsequent granting of construction and operating licences.
- **Licences for construction, commissioning, operation, modification or decommissioning:** These licences are by nature primarily technical since the main requirements relate to nuclear safety. Under the Atomic Energy Act, the conditions to be met and the procedure are identical in all five cases.

Granting of both licence types is subject to the licensing procedure described below.

Licensing procedure

Licences are granted by the Federal Council. It makes its decision on the basis of:

- the application for a project, supported by a safety analysis report (SAR) and as far as possible a probabilistic safety analysis (PSA), all to be submitted by the applicant;
- a procedure of review and assessment of the application with the mission to verify that the project satisfies the safety objectives and takes account of experience and of the state of science and technology. This procedure leads to a safety evaluation report (SER), which is established by the Inspectorate and reproduces the results from the point of view of nuclear safety and radiation protection, including conclusions and, if necessary, proposals for licence conditions to be formulated in the licensing decision (see Article 14);
- a statement by the advisory committee on basic aspects of the application and on the SER, including, as far as appropriate, a proposal for licence conditions;
- comprehensive public consultation.

The licence will be denied, or made subject to appropriate conditions, in cases where this is necessary for safeguarding Switzerland's national security, for meeting its international commitments or for protecting persons, property and other important rights. The licence will also be denied if the applicant cannot provide evidence of insurance cover (civil liability) or cannot demonstrate that the operating staff have the necessary skills.

In addition to the licensing procedure described above, various requirements must first be met before the Federal Council can grant a general licence. Where necessary, the Federal Council may make the licence subject to appropriate conditions or requirements, in particular to ensure that the following legal requirements are met:

- the general licence must be approved by the Federal Parliament;
- the power to be generated from the installation has to be needed in the country. When determining such a need, account should be taken of possible financial savings, substitution of fossil fuels and the development of other forms of energy;
- moreover, the general licence is granted only if safe long-term disposal (final storage) of the radioactive waste from the installation is guaranteed, including radioactive waste arising from decommissioning and possible dismantling of the installation, after final shutdown.

An illustration of the licensing procedure appears in the two flow charts in Figure 2 and Figure 3.

Licence conditions are legally binding as soon as they are included in a granted licence; they constitute, therefore, a powerful tool for imposing requirements.

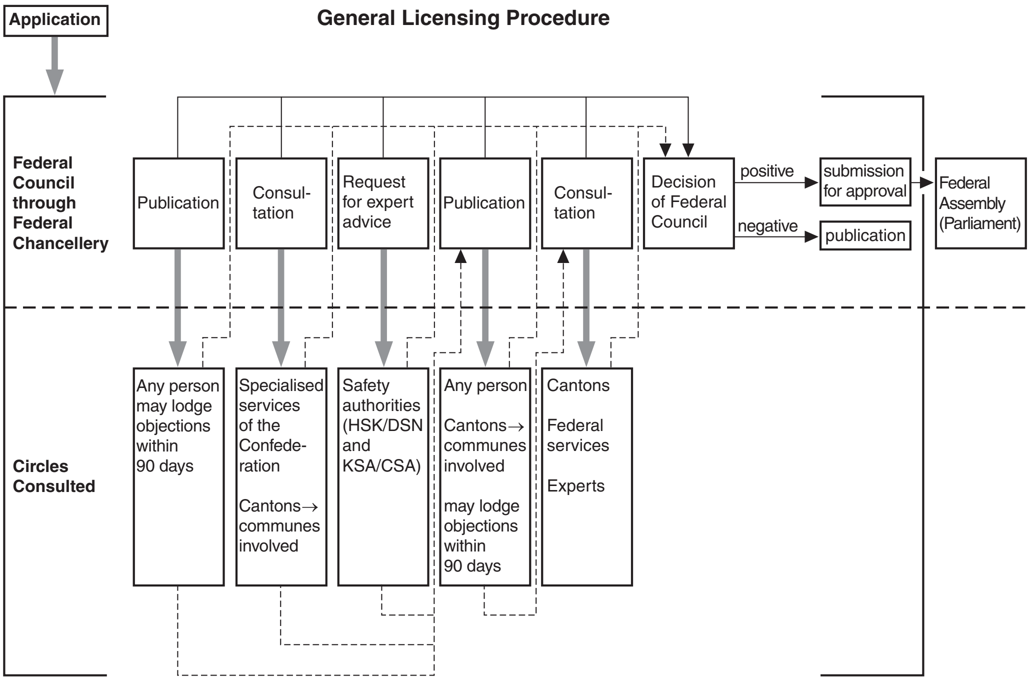


Figure 2: *Licensing procedure from application for, to granting of, the general licence. The procedure follows the solid lines. The dotted lines indicate the flow of documentation.*

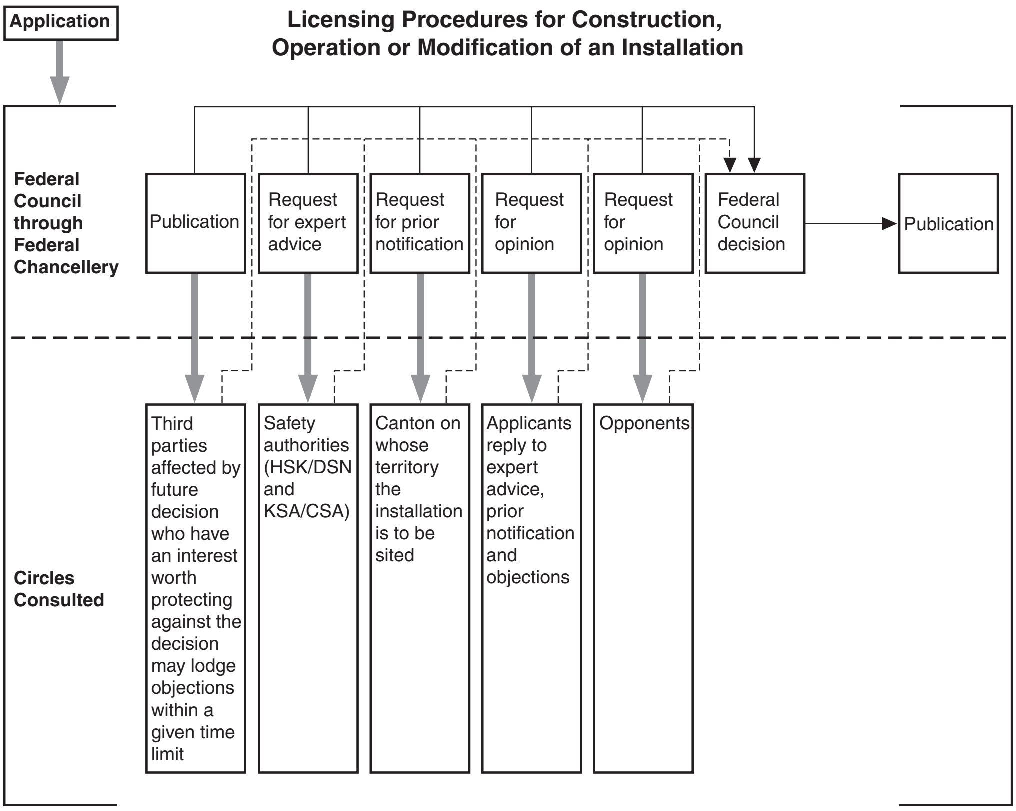


Figure 3: *Licensing procedure from application for, to granting of, the licence for, respectively, construction, operation, modification or decommissioning. The procedure follows the solid lines. The dotted lines indicate the flow of documentation.*

In its capacity as supervisory authority, and in order to facilitate control of the licensing process, the Inspectorate has introduced the permit procedure which can be used within the frame of a valid licence (see flow chart in Figure 4). The Inspectorate defines sets of licensee's activities (e.g. selected parts of construction work; manufacture of important components; assembling and wiring on site; sets of commissioning tests; start up after refuelling or after modification or repair; etc.) for which a permit is necessary. This "permit procedure" may also be considered as one of the means of enforcement under the control of the Inspectorate (see Clause 2 (iv) of this Article).

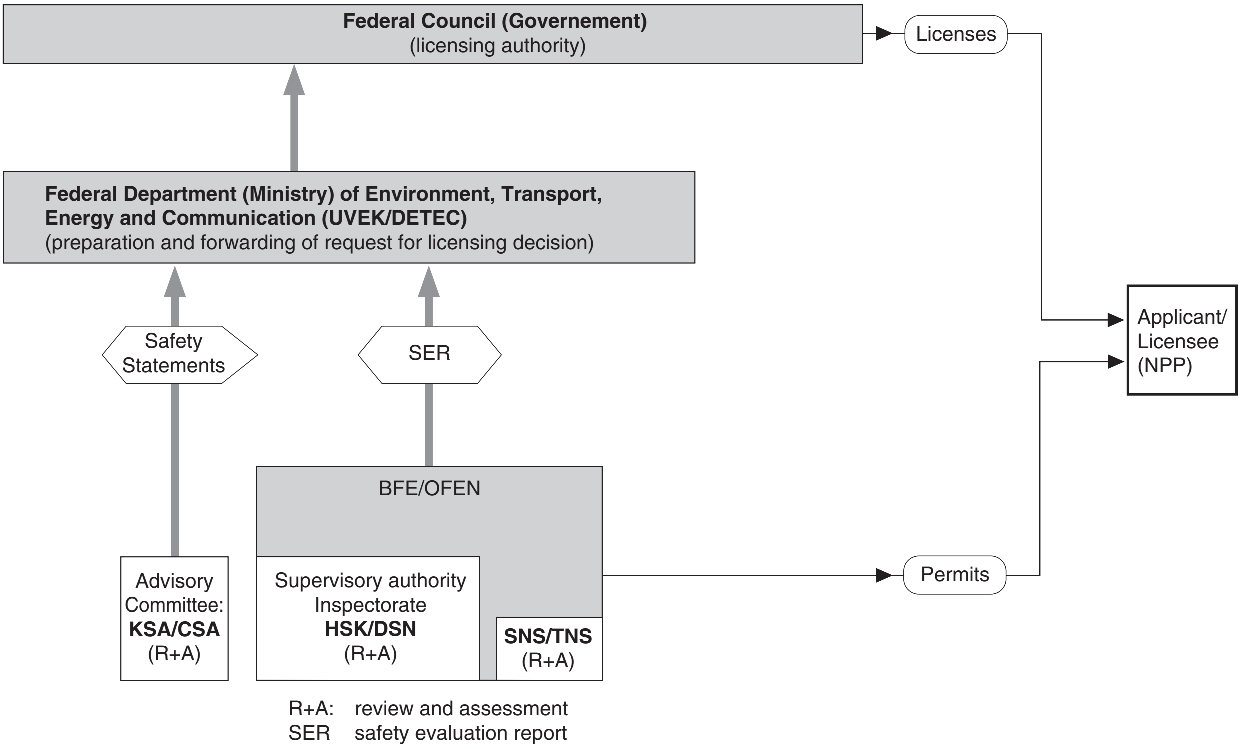


Figure 4: Licensing process: Preparation of safety evaluation reports and granting of licences and permits.

Clause 2 (iii)
The legislative and regulatory framework shall provide for a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

The legal basis for inspections by the Swiss regulatory body is given in the Atomic Energy Act, which prescribes supervision, hence implicitly inspection, by Federal authorities. The Federal Ordinance concerning the Supervision of Nuclear Installations designates the Inspectorate as the competent authority for supervising nuclear installations, including, therefore, inspection of NPPs.

The means and authority needed by the Inspectorate for carrying out inspections are derived from the Atomic Energy Act which states the right of access. This right of access extends to every part (locations, structures, components) of the NPP and to all relevant documentation, including the one at the works and at the offices of the suppliers of equipment. This right of access is given to all the Inspectorate's representatives (and/or external experts under contract with the Inspectorate).

The objectives of regulatory inspections are to give evidence to the Inspectorate of the quality of the licensee's activities and, in that respect, to ensure that the licensee fulfils its prime responsibility for safety. The Inspectorate, including its mandated experts, reviews the licensee's programmes, ensures for itself the licensee's adequate performance, by observing specific activities, and carries out measurements and controls of its own.

Clause 2 (iv)
The legislative and regulatory framework shall provide for the enforcement of applicable regulations and of the terms of the licence, including suspension, modification or revocation.

The Federal Council and Agencies designated by it have full power of enforcement on the basis of the Atomic Energy Act. They can order all measures necessary to protect persons and property and other important rights, to safeguard Switzerland's national security and to ensure compliance with its international commitments, as well as to check the application of measures.

Concerning licences, the Federal Council has to deny the granting of a licence (general licence, licence for construction, commissioning, operation, modification or decommissioning of NPPs) when the prerequisites enunciated in the law are not fulfilled. It can suspend or withdraw a licence that is already in force when these prerequisites are no longer fulfilled.

Concerning the permits, it is the Inspectorate which can suspend or withdraw them.

Conclusion

The Swiss Party complies with the obligations of Article 7.

Article 8: Regulatory body

Clause 1
Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

Organisation and competence of the regulatory body

The organisational chart (Figure 5) gives an overview of the organisation of the Swiss Regulatory Body. Beside the licensing authority, which is the Federal Council itself (see Article 7), it consists of the following elements:

- a supervisory authority,
- an advisory committee.

The supervisory authority and the advisory committee are hereafter called the nuclear safety authorities.

Other Federal authorities have duties associated with the operation of NPPs, but they have no authority over these plants and they are not involved in the licensing process.

Supervisory authority

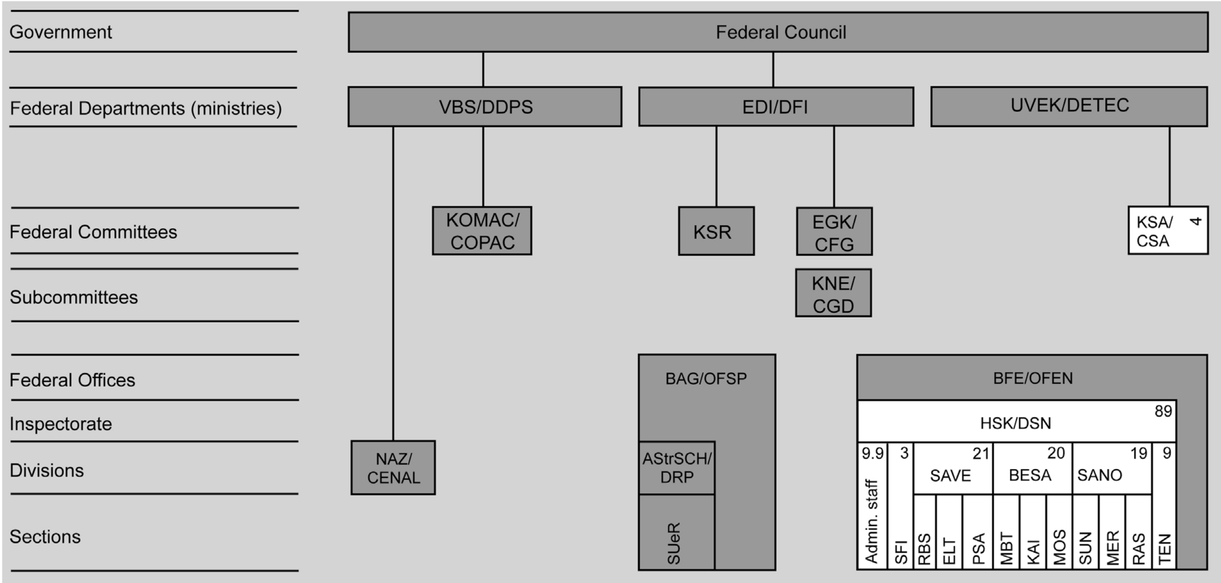
The Swiss Federal Nuclear Safety Inspectorate (HSK/DSN) is established by the Federal Ordinance concerning the Supervision of Nuclear Installations, as the competent authority for supervising nuclear installations at all stages of their life. It is part of the Federal Office of Energy (BFE/OFEN). The Section for Nuclear Energy (KE/EN) of the same Office covers the aspects of physical protection and safeguard.

The supervisory authority has the competence to:

- establish safety criteria and requirements taking into account experience (feedback) and the state of science and technology;
- prepare safety evaluation reports to support the decision of the licensing authority;
- supervise the fulfilment of regulations including inspections, reporting and request documentation on aspects of nuclear safety and radiological protection;
- grant, suspend or withdraw permits;
- order the application of all measures to protect persons and property and other important rights and to safeguard Switzerland's national security and ensure compliance with its international commitments, within the frame of a valid licence.

Advisory committee

The Swiss Federal Nuclear Safety Commission (KSA/CSA) is involved in the licensing process as it has to review and comment on the licence applications and the corresponding safety evaluation reports prepared by the Inspectorate and to forward its conclusions and recommendations to the Federal Council.



Abbreviations as of July 2001
(If the french abbreviation exists, it is given after the slash)

AStrSch/DRP	Radiation Protection Division, Bern
BAG/OFSP	Federal Office of Public Health, Bern
BESA	Division for Operational Safety and Inspection Management
BFE/OFEN	Federal Office of Energy, Bern
EDI/DFI	Federal Department of Internal Affairs, Bern
EGK/CFG	Federal Geological Committee
ELT	Section: Electrical and Control Engineering
HSK/DSN	Swiss Federal Nuclear Safety Inspectorate, Würenlingen
KAI	Section for Inspection Management
KE	Section: Nuclear Energy, Bern
KNE/CGD	Committee for Nuclear Waste Disposal
KOMAC/COPAC	Federal Committee for Radiological and Chemical Protection
KSA/CSA	Swiss Federal Nuclear Safety Committee
KSR	Swiss Federal Commission for Radiation Protection and Monitoring of Radioactivity
MBT	Section: Mechanical and Civil Engineering
MER	Section: Radiation Measurement Technology and Radioecology
MOS	Section: Personnel, Organisation and Safety Culture
NAZ/CENAL	National Emergency Operations Centre, Zurich
PSA	Section: Probabilistic Safety Analysis and Accident Management
RAS	Section: Occupational Radiological Protection
RBS	Section for Reactor, Fuel and Systems Engineering
SANO	Division: Radiation Protection and Emergency Preparedness
SAVE	Division for Safety Analysis, Systems and Electrical Engineering
SFI	Safety Research and International Programmes
SUeR	Section: Radiation Monitoring
SUN	Section: Accident Consequences and Emergency Preparedness
TEN	Section for Transport and Waste Management
UVEK/DETEC	Federal Department for Environment, Transport, Energy and Communication
VBS/DDPS	Federal Department for Defence, Civil Protection and Sport

Figure 5: Organisational chart of the Federal Authorities involved in supervision of, and environmental protection associated with, nuclear installations: organisation of the Regulatory Body in Switzerland.

Moreover, the commission observes operation of the nuclear installations, considering fundamental aspects of nuclear safety and proposes necessary measures. The Commission has the competence to

- comment on new or changed laws and the development of the regulations with respect to nuclear safety, and to recommend additional or modified regulations;
- recommend measures to increase the safety of nuclear installations or to improve the licensing procedure and the surveillance of operation;
- propose research work in the field of nuclear safety.

<u>Others</u>

The authorities listed below have duties associated with the operation of NPPs, but they are not involved in the licensing process and they have no authority over these plants:

- the National Emergency Operation Centre (NAZ/CENAL), as part of the General Secretariat of the Federal Department of Defence, Civil Protection and Sports (VBS/DPS), is in charge of all emergency situations, including those due to events at NPPs as far as protection of the public and the environment is concerned;
- the Division of Radiological Protection at the Federal Office of Public Health (BAG/OFSP), which is in charge of radiological monitoring of the environment (outside of facilities);
- a number of advisory committees to the government or governmental Departments covering aspects of radiological protection, emergency planning and waste disposal.

Financial and human resources

All expenses of the safety authorities (with exception of the work on the regulatory framework and the informing of the public), adding up to almost 30 mio SFr per year, are covered by fees from licence holders.

Nuclear safety research, as far as promoted and endorsed by the regulatory body, is endowed with a budget of 2.0 mio SFr and is covered by public funds. Additional 3.5 mio SFr are financed by the operators of NPPs and the Paul Scherrer Institute (PSI).

<u>Supervisory authority</u>

The Inspectorate, as part of the BFE/OFEN, has its own budget within the budgetary frame of the Federal Office of Energy. The budget covers the expenses for infrastructure, training, travel, communication and consultant fees.

The adequacy of the human resources of the HSK was reviewed during an IRRT mission in December 1998. During this review some areas were identified where a lack of resources existed. These areas were the Section for Reactor-, Fuel- and System Engineering (RBS) and the Section for Transport and Radioactive Waste Management (TEN). The IRRT recommended that a review of the resources of the HSK Sections should be performed taking into account the duties and responsibilities of those sections.

The recommended review of the resources has been carried out in the meantime and a formal request for reorganisation and additional five positions have been filed with the Federal Department of Environment, Transport, Energy and Communication. The reorganisation was sanctioned in autumn 1999 and the requested positions were granted.

The personnel of the Inspectorate consists now of 71 specialists. It is supported by an administrative infrastructure support staff of 14 people. The KE/EN section of the Federal Office of Energy consists of 7 people. The current organisational structure of the Federal Authorities involved in supervision of, and environmental protection associated with, nuclear installations, is shown in Figure 5.

Consultants are used in special fields of the supervision of the Swiss NPPs. The complete area of the surveillance of manufacturing, repair, replacement, modification and in-service inspections of pressure-bounding components has been outsourced to the Swiss Association for Technical Inspections (SVTI/ASIT), an independent private organisation. To cover special technical areas (e.g. civil engineering), an additional amount of money, corresponding to 16 full-time experts, is made available every year.

In Article 415 of the IAEA "Code on the Safety of Nuclear Power Plants: Governmental Organisations“, a minimum full-time regulatory staff of 80 to 100 professionals is suggested for a member state operating a few power reactors of the same type even when extensive use of consultants is made. Since Switzerland operates four different reactor types, the actual staffing of the Swiss regulatory body is below this suggestion. However, it is emphasised in Art. 415 of the IAEA Code that this figure may vary widely.

Advisory committee

The Commission consists of 13 part time members, supported by a secretariat with a staff of 4 full-time positions, and if necessary, by experts in specific fields of interest. The members are experts in fields relevant to nuclear safety; they perform their function in person and do not represent organisations or enterprises.

Clause 2
Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.

Swiss NPPs are operated by private companies. The public body holds, through Cantons and municipalities, a major part of the shares of these companies. That part of the Federal administration to which the regulatory body is attached does not hold shares in the nuclear industry. The regulatory body is effectively separated from any organisation concerned with the promotion or utilisation of nuclear energy.

Separation of the supervisory authority from other governmental bodies concerned with the use of nuclear energy

The BFE/OFEN is in charge of the execution of the energy legislation. It deals with questions of energy economics and energy politics and considers aspects of supply security. In addition, the BFE/OFEN also supports nuclear energy research.

The Inspectorate is part of the BFE/OFEN, but acts at the technical level independently from the rest of the Office and from the Federal Department of Environment, Transport, Energy Communication (UVEC/DETEC). The legally required review and assessment of applications through the Inspectorate is conducted solely on the basis of nuclear safety criteria and is exclusive of any other considerations. An assessment by the Management Commission of the

National Council in 1980 showed that there has never been a conflict of interest between the safety requirements formulated by the Inspectorate and the other duties of the BFE/OFEN. The assessment attested that the administrative subordination of the Inspectorate does not affect its technical independence. Although the Inspectorate acts on a technical level independently from the rest of the Office in its functions relating to nuclear safety, this independence is not explicitly stated in the relevant laws or ordinances.

Several parliamentary interventions demanded an administratively more independent position for the Inspectorate. As a consequence, a governmental project is considering the formation of a legally independent National Agency for Technical Safety in which the Inspectorate will be integrated together with other administrative entities exercising a technical safety control function. The elaboration of the corresponding legal basis is in progress.

Separation of the advisory committee from other governmental bodies concerned with the use of nuclear energy

The Commission is affiliated to the UVEK/DETEC and reports directly to the Federal Council. It is therefore independent from other governmental bodies concerned with the use of nuclear energy.

Conclusion

The Swiss Party complies with the obligations of Article 8.

Article 9: Responsibility of the licence holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

The Atomic Energy Act implements the principle that the safe use of nuclear energy rests with the private licence holder, but that this use has to be placed under the supervision of Federal authorities for all nuclear safety aspects. The prime responsibility for the safe operation of NPPs rests with the licence holder, even though this is not explicitly stated in the current Atomic Energy Act. The draft of the new Nuclear Energy Law explicitly states that the licence holder is responsible for the safety of the nuclear installation and its operation. This fact is also reflected in each of the NPPs' own plant regulations. The supervisory authority has to ensure that the licence holder fulfils its legal and regulatory duties and that the licence holder also implements all conditions and obligations stated in the licence.

Conclusion

The Swiss Party complies with the obligations of Article 9.

Article 10: Priority to safety

Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

Switzerland has from the beginning given top priority to the safety of NPPs, and will continue to do so. This is explicitly stated in the relevant legislation requiring that all reasonable measures be taken to protect persons, property and other important rights (including those relating to the environment, nature and the landscape and land use planning). Further, Switzerland’s national security must be safeguarded and compliance with Switzerland's international commitments must be ensured at all times. In its supervisory functions, the regulatory body is committed by law to give first priority to nuclear safety.

Furthermore, for the utilities safe and incident-free functioning of their NPPs has first priority, as a precondition to ensure their economical and long-term operation. The priority given here to safety is expressed in the operating rules of each of the NPPs, prepared by the plant management and submitted to the Inspectorate, as well as in other documents.

From a technical point of view (i.e. design and construction), the Swiss NPPs are in line with the state of science and technology due to their original design and due to backfitting. However, operation and maintenance may be influenced by economic and social changes. It is the responsibility of the authorities and the operators to ensure that economic and social changes do not result in a reduction of safety. In all plants, the personnel has a high awareness of the safety significance of their activities, continuously enhanced by training in safety issues. For maintenance personnel and contractors, special training programmes are conducted in the different NPPs in order to increase safety awareness.

In 1992, Switzerland started to invite Operational Safety Review Teams (OSART) to review the Swiss NPPs. Two such missions took place in 1994 and 1996 in the Leibstadt and Beznau NPPs. Both have already gone through the follow-up visit. Two other missions took place in the years 1999 and 2000 in the Gösgen and Mühleberg NPPs. The missions carried out so far have confirmed many commendable areas of performance, particularly a strong commitment to nuclear safety and excellent plant operation, but recommended also additional safety improvements. One of the findings was a tendency towards complacency. The NPPs concerned have initiated programmes to make the staff aware of this problem and to foster a better developed questioning attitude. The OSART missions are a valuable tool for the NPPs, helping them to question their safety performance during plant operation.

On several occasions, opinions on the necessity of certain regulatory requirements differed between the safety authority and the NPPs. In the ensuing discussions, cost aspects and the technical justification of regulatory requirements are weighed against each other. In order to make the decision process transparent, the Inspectorate uses the following graded approach to decide on the justification of safety measures:

- safety measures required by the legislation (this includes licence conditions);
- recommendable safety measures based on the state of science and technology;

- safety measures appearing desirable from the viewpoint of experience and the state of science and technology and simultaneously reasonable on the basis of the cost/benefit ratio.

The Inspectorate is aware of the fact that the impending deregulation of the electricity market is putting a high economic pressure on the utilities. This might affect nuclear safety over time. Discussions between the Inspectorate and the operators about this issue and related problems are ongoing. The operators of NPPs emphasise that the priority given to safety is not influenced by economic pressure. The development of organisational issues and the readiness of the operators to comply with safety requirements are followed closely by the Inspectorate.

As a result of a PSR (Periodic Safety Review) of a Swiss NPP, several safety measures resulted. The plant accepted most issues raised by the regulatory body and implemented corresponding safety measures. However, for 15 items the regulatory body had to issue a decree. Against this decree, the utility filed a civil appeal arguing that none of the above mentioned criteria to decide on the implementation of safety measures applies. In the opinion of the regulatory body, the second criterion is applicable and thus justified the measures ordered. In the meantime, all of the controversial issues have been resolved.

Conclusion

The Swiss Party complies with the obligations of Article 10.

Article 11: Financial and human resources

Clause 1
Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

Apart from the decommissioning fund (see below), the current legislation on nuclear energy does not explicitly require special financial guarantees from the licence holders to cover the costs of necessary measures for maintaining the safety of their NPPs.

The licence holders are well established companies with good financial records. They have so far covered all the costs of construction, operation and maintenance (including replacement of obsolete or worn components) of their NPPs as well as the fees of the regulatory body (see Article 8). They also have implemented voluntarily many modifications or backfitting measures shown necessary by the state of science and technology in addition to those required by the safety authorities (see Articles 6 and 18).

If, for any reason, (e.g. inadequate financial resources), backfitting measures considered necessary and required by the safety authorities could or would not be implemented, the licensing authority would suspend or revoke the operating licence. An operating organisation facing such a licence suspension or withdrawal has obviously an interest in implementing the requirements, should it intend to continue normal operation.

The decommissioning fund is established according to the Federal Order to the Atomic Energy Act. It covers the costs arising from decommissioning, including later dismantling, and it is financed by regular contributions from the licence holder. In the case that the means of the fund are not sufficient to cover the costs of decommissioning of a NPP, the owners of the other NPPs are also liable for the amount in debt.

Clause 2
Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.

Personnel requiring an approval or a licence

The Atomic Energy Act implicitly requires the availability in sufficient number of qualified staff with appropriate expertise for the management and the control of NPPs. Should, for any reason, these requirements not be fulfilled, the licensing authority would suspend or revoke the operating licence.

Staffing

In the early times of the nuclear industry in Switzerland, the staffing at NPPs was low compared to today. A considerable number of tasks were carried out by external sub-contractors. For example, a NPP of the 350 MWe class of the first generation started with a minimum of about 100 persons per plant. Later, the utilities recognised the advantage of in-house competence for maintenance and engineering. This, as well as increased requirements from the Inspectorate, has had the consequence that the number of staff increased to 290 for the Mühleberg NPP and to 460 for the twin unit NPP Beznau. The second generation plants of the 1000 MWe class started already with a higher number of personnel (325 to 350) and increased to slightly higher numbers (375 to 400) in 1997. Since 1997, the number of staff has remained almost constant. These staffing levels are still below the international average, even considering that the working time in the Swiss industry is in the order of 42 hours per week.

The fluctuation of NPP personnel is low. The replacement of retiring staff is planned well in advance. The know-how transfer from providers to NPP staff is assured and takes place. This ensures that the necessary knowledge and experience to operate the NPPs is maintained.

Education and training

The professional scientific and engineering training and education available in Switzerland has reached a high quality level and is open to all qualified persons. This leads to a satisfactory basis for the recruitment of qualified personnel.

The following HSK Guidelines are mandatory concerning the education and training of NPP personnel:

- R-17: Organisation and personnel of nuclear power plants (1986);
- R-27: Selection, training and examination of NPP staff requiring a licence (1992);
- R-37: Recognition of courses for radiation protection controllers and chief controllers; examination regulations (1990).

Staff members for which a professional licence is not mandatory are selected from applicants with appropriate education and experience. Adequate training with regard to the tasks assigned to these individuals comprises courses and "on the job" training.

The selection of personnel to be authorised for key functions in NPPs as field operators, control room operators, shift supervisors, stand-by safety engineers or radiation protection experts requires the successful completion of a technical training of three to four years and a minimum of two years experience in their profession (the latter is not compulsory for radiation protection experts). For safety engineers, an engineering or university degree is required. The selection procedure for all licensed control room personnel includes aptitude tests.

In the following, the education and training for licensed personnel is summarised.

- **Field operators**: Employees who intend to become licensed control room personnel start as field operators. There is no mandatory licensing at this level. However, an examination is common. Courses and "on the job" training lead to a good knowledge of the NPP and also to basic knowledge in radiation protection, physics and engineering.
- **Control room operator:** This function requires a formal licence. To become a control room operator, a candidate must have one to two years of field operator experience. A thorough theoretical education (of 59 weeks) at the reactor school of the Paul Scherrer Institute (PSI) or an equivalent institution is required. Following this basic education, a set of courses at the NPP, "on the job" training and simulator training complete the plant-specific education. The professional licence is granted after an examination by experts from the NPP concerned and from the Inspectorate.

- **Shift supervisors:** Applicants for this level have to be experienced control room operators (one to three years of experience). They receive additional education and training in leadership, specific plant behaviour, procedures and full scope simulator training with their team. The examination procedures mentioned above are also applied for the licensing of shift supervisors.
- **Stand-by safety engineers:** Shift supervisors with an engineering or university degree can apply to be stand-by safety engineers. Leadership under adverse conditions, as well as extended and detailed knowledge of emergency procedures, are particularly important aspects of the additional training needed for this job. The professional licence is granted after an examination by experts from the NPP concerned and from the Inspectorate.
- **Radiation protection experts:** Radiation protection specialists and radiation protection technicians are trained at the radiation protection school of the PSI or at equivalent institutions. Final examination of candidates for these two functions takes place under the supervision of the Inspectorate. The licence of high level radiation protection experts is granted upon successful completion of high level courses (e.g. the post-graduate radiological protection course, National Radiation Protection Board (NRPB), Harwell, UK).

For each of the above functions, there is adequate retraining. It comprises simulator training (except for radiation protection experts), plant-specific courses and theoretical courses, usually at the reactor and radiation protection schools of the PSI.

The simulator training, which is also used for requalification, is specific for each NPP. Plant-specific full scope simulators are operating at the Leibstadt, Mühleberg and Gösgen NPPs.

At the Beznau NPP, a compact simulator with a plant-specific full scope model has been operating for individual training since 1987. Team training takes place at a full scope simulator in Pittsburgh (USA).

Conclusion

The Swiss Party complies with the obligations of Article 11.

Article 12: Human factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

In the early 1990's, the Inspectorate set up the Section for Human and Organisational Factors (MOS) in which three human-factor specialists and a psychologist deal with the man-machine interface (MMI), ergonomics, organisational aspects and human factors in the safety context of a NPP. Recently, an additional position for a specialist has been created in order to cope with the expected increased workload in the organisational area due to the deregulation of the electricity market.

Man-machine interface and ergonomics

MMI issues, especially in the control room, have been considered since very early on in Switzerland, as human factors play an important role in the safe operation of a NPP. Although the four Swiss NPPs are of different design, the basic ergonomical principles used in the design of the control rooms are very similar. All plants use schematics of the systems on the control desks and panels in order to guide the operators in their manipulations. The real instruments and controls are part of these schematics and allow immediate surveillance of the results of operator actions.

The Beznau, Leibstadt and Mühleberg NPPs have a safety parameter display system (SPDS) which helps the operators to get a quick overview on the status of the plant. Based on the insights from the periodic safety review, the Gösgen NPP started a project for a SPDS to be implemented in the near future.

Nowadays, the utilities are even more aware of the importance of human factor issues. That is the reason why three Swiss NPPs have proceeded to make major modifications to their control rooms in order to improve, among other elements, the illumination, ventilation, visibility and legibility of instruments. They have also taken into account their own experience regarding collaboration within the shift and this has resulted in a rearrangement of the different working places. The fourth NPP has started a similar project to backfit its control room.

The Beznau NPP has installed a sophisticated computerised plant information system. Based on this, an advanced system called "Alarm System and Computerised Procedures in the Control Room" was installed in both units. The system went through a detailed verification and validation process including a dynamic Human Factor Validation on the full scope simulator. The Inspectorate granted the permit for the system in 2000.

After each event in which human factors have played a role and which is reported to the Inspectorate, the involved MMI, ergonomical and organisational aspects are investigated. Any ergonomical weaknesses discovered by such investigations lead to an assessment of similar situations in all other NPPs. Many events have their root causes in an insufficient consideration of ergonomical aspects, as has been shown by the analysis of past events.

Organisation and safety culture

The importance of organisational and human aspects for safety in NPPs is reflected in the HSK Guideline R-17. This guideline covers the safety aspects of NPP organisation. To date, this guideline is under revision in order to take account of recent developments in organisational aspects and safety management. A new chapter will be devoted to Management of Change for addressing expected repercussions of the electricity market deregulation. The HSK Guideline R-27 is under revision as well. It covers the recruitment, the qualification, the training and the requalification of NPP personnel as well as the licensing of persons whose duties have an immediate bearing on safety. All licensed members of the operating staff have to be examined at the time of recruitment and if necessary at appropriate times thereafter. This is done to ensure that their psychological and physical condition are compatible with the duties and responsibilities assigned to them (for training and requalification, see Article 11).

Beside these rather traditional staffing aspects, human factors also comprise organisational and individual attitudes relating to safety. These factors have become important issues over the last couple of years and gathered under the heading of "safety culture". Safety culture is a relatively new concept, which is drawing increased attention in Switzerland.

Numbers of steps to systematically improve safety culture have been taken, e.g. a seminar of the Commission (KSA/CSA) on "Safety Culture in a Nuclear Installation, Reflections on its Assessment and Promotion", a workshop of the Swiss Association for Atomic Energy (SVA/ASPEA) on "Human factor in NPP organisation", HSK's active promotion of pertinent IAEA and NEA workshops, and several NPP programmes, initiated following the OSART missions (see Article 10).

The members of the Inspectorate as well as the plant management are increasingly aware of the significance of this broader approach to safety and are eager to apply safety culture concepts to day-to-day NPP operation. Consequently, the development and promotion of this concept continues to draw close attention.

An example of a practical approach to monitor the safety culture at the NPPs is the so-called MOSAIK inspection procedure, which has been developed at the HSK during the past three years. MOSAIK is used during normal technical inspections. Up to now, the inspections in Switzerland were strongly oriented towards engineering and radioprotection. In order to be better informed about organisational issues and the effectiveness of management, the HSK developed a catalogue of questions which are intended to be raised during technical inspections by inspectors without specific HF-expertise.

The inspection areas of MOSAIK cover mainly maintenance work which includes work preparation, execution and finalisation. Additionally, housekeeping issues are also included.

The MOSAIK catalogue is not intended to be used as a checklist, but rather as a set of possible questions that could be incorporated into the inspection plan in the preparation phase of an inspection. The findings from MOSAIK inspection components do not lead to a direct HSK intervention (except in the case of serious findings) but are collected in a database. The latter allows to detect an accumulation of weak points in a certain area. This will trigger a deeper analysis of the affected area, additional specific inspections or a meeting with the plant management.

The HSK inspectors have been trained in the use of the MOSAIK catalogue, complemented by interview and negotiation technique training. Since mid 2000, MOSAIK is included in inspections on a 'as applicable' basis.

Conclusion

The Swiss Party complies with the obligations of Article 12.

Article 13: Quality assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

Nuclear power plants

a) Operational Safety

Following the Inspectorate's (HSK/DSN) requirement, the NPPs have developed QM systems based on international standards and guidelines such as the "IAEA Safety Standards and Guides on Quality Assurance for Safety in Nuclear Power Plants and other Installations" which also covers standards in the ISO 9000 Series.

The Inspectorate approves and supervises the completeness and the proper function of the whole QM system of the NPPs on the basis of IAEA QA code and guides. This is done by checking basic QM documents and the periodic reports of NPPs on that subject. Inspections are performed periodically on specific topics (e.g. quality documentation and records etc.) or for the whole QM system on the results of the NPP-independent assessment methods (results of internal and external audits, non-compliance etc.) and the derived actions taken for improvement. In cases of larger QM system changes, which have to be notified to the Inspectorate, specific inspections are performed.

Further, the Inspectorate requires the implementation of a documented self-assessment function in the QM System. The NPPs have created a working group to co-ordinate and harmonise efforts to comply with this requirement. Special attention, which goes further than the related IAEA safety guide, will be paid to the control of contractors by the NPP's. The Inspectorate has released a letter with requests on that issue. This letter sets a basis for inspections.

The main internal regulations and working documents related to safety at the NPPs have to fulfil legislative or regulatory requirements. In cases where no specific Swiss regulatory requirements exist, internationally accepted standards from the IAEA, IEC, ICRP etc. are applied. Regulations of other countries are enforced, such as life regulations of the Nuclear Regulatory Commission (US NRC) or German Guides (Kerntechnischer Ausschuss, KTA).

Main activities in NPPs and their outcome have to be reported to and assessed by the Inspectorate. This includes the definition of applicable standards. All plant activities outside normal operation such as backfitting, replacement and modifications of systems and components etc., need a permit. For certain specific areas, aspects of quality assurance activities are defined in corresponding HSK Guidelines, or quality plans are required.

b) Transport of radioactive material

The Inspectorate requires that all Swiss NPPs have, as part of the operation quality management system, a special QM-system covering the transport of radioactive materials. These systems are based on the IAEA transport quality assurance requirements. They are well developed and were approved by the Inspectorate after positive audit results. Regular follow-up audits take place at intervals of about 2-3 years.

The following is a summary of developments and of specific aspects of QM systems in Swiss NPPs:

- **Beznau NPP:** The documented QM system is in place since 1985; it is based on IAEA standards and also embodies the ISO standards. Since then, it has been updated continuously, taking into account newer developments. The plant intends in the coming years to change the QM system from the elements or chapter version to a modern process version.

  Recently, the Beznau NPP also obtained an ISO 14001 environmental certification.
- **Leibstadt NPP:** The existing system is based on IAEA standards (embodies also ISO standards) in element or chapter version and was approved by the Inspectorate in 1995. It will be transformed to a modern process version.
- **Mühleberg NPP:** The QM system, based on the IAEA standards in process version (also embodying ISO standard), has been developed and was approved by the Inspectorate in 1999. Some areas for improvement have been identified. A recently performed OSART mission found no significant shortcomings in the QM system.
- **Gösgen NPP:** Following a requirement of the Inspectorate, the plant is now in the final stage of implementing a complete QM system. An OSART mission in 1998 has stated that the plant is on the right way but has to improve the number of working documents and procedures. The system is based on the IAEA standard in process version and will have to be approved by the Inspectorate.

Other nuclear Installations

For operational safety, the nuclear central interim storage facility (ZWILAG) has established a Quality Assurance programme which is based on the IAEA QA standard. For transport of radioactive material, the same standards as for NPPs are required by the Inspectorate. Other nuclear installations have a specialised, simplified or partial QA programme, depending on their radioactive inventory and according to the risk impact. All systems are acknowledged by the Inspectorate.

Nuclear Safety Authority: HSK

A quality management system, the HSK Management System, has been established based on the ISO 9001, version 2000 standard, and gradually implemented since November 2000.

The HSK Management System contains the processes pertaining to all HSK activities.

These processes are described as follows:

- main process descriptions: using text and flow charts
- sub-process descriptions: using flow charts only
- work sheets: for descriptions, tables etc.

The processes were derived from existing work procedures, in a collaborative effort between teams of HSK personnel and an external consultant. The members of the teams were carefully selected to efficiently use the available experience within HSK.

The HSK Management System has four process groups:

management activities	principal activities	support activities	radiation measurement
system implementation & enforcement	work initialisation	QM system maintenance	measurement equipment
organisation & information	emergency preparedness	information technology	activity & dose rate measurements
finance	regulatory guidelines	health & safety	MADUK system (see chapter 16)
personnel	inspections	infrastructure & logistics	laboratory
continual improvement	incident review	administrative	
purchasing	assessment & approval		
	refuelling outage		
	licensing of plant personnel		

The HSK director is committed to implement and enforce the management system. For continued support, the so-called quality manager is responsible. For every process, a process responsible person has been assigned and, likewise, a process-group-responsible person for each process group. The responsibilities of all these persons are as follows:

director	quality manager	process-group-responsible (PGR)	process-responsible (PR)
accountable for the system as a whole	managing continual improvement	supporting the PR	maintaining the process
defining responsibilities and authorities	maintaining the documentation of the management system	responsible for the compatibility of all processes within the process group	supporting the personnel in employing the process
performing the yearly management review	assisting the director in the yearly management review	assisting the director in the yearly management review for the group	responsible for the continual improvement of the process
	provide support to the PGR/PR for process improvement		process-related training of personnel
			assisting the director in the annual management review for the process

By means of recurrent audits, performed by an internal group of auditors, the effective implementation and maintenance of the management system is periodically assessed.

The HSK intends to submit the management system for certification by November 2001. To this end, a pre-certification audit was performed in May 2001 by an external consultant. The audit demonstrated that the HSK Management System is generally well established and implemented. A number of issues were identified which need to be resolved prior to the final certification.

Conclusion

The Swiss Party complies with the obligations of Article 13.

Article 14: Assessment and verification of safety

Clause (i)
Each Contracting Party shall take the appropriate steps to ensure that comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

Background

The licensing process includes a detailed review and assessment by the Inspectorate (HSK/DSN) of the appropriate safety analyses that must be submitted with the application. These analyses are recorded in the deterministic Safety Analysis Report (SAR) and in the Probabilistic Safety Assessment (PSA). The objective of the regulatory assessment is to verify compliance with the applicable regulations and guidelines (see Article 7).

The HSK documents all results and insights of this assessment. For major applications, such as a new installation, a safety evaluation report (SER) is issued which lists the applied regulations/guidelines and criteria and commonly includes a safety assertion by the Commission. The final licensing decision is based on the conclusions from this safety assessment.

Typically, conditions or restrictions are imposed when granting a license. One such condition is that the SAR and the PSA shall correspond to the actual licensing basis. Thus, appropriate revisions are to be submitted periodically for HSK review and approval. Instant revisions are mandatory in the case of major plant changes or in conjunction with a plant license renewal. A Periodic Safety Review (PSR) has to be performed at least every ten years. This PSR may be combined with a safety review associated with plant license renewal applications. An HSK guideline (ref. Article 7) defining the scope and process of PSRs (see below) is scheduled to be issued in 2001.

Items Reviewed

For the review and assessment process, new and existing installations are treated differently. For new installations, the following items are included:

- site characteristics (see also Article 17)
- design, quality and condition of structures, systems and components relevant to safety and operational radiation protection (see also Article 18)
- plant operation (see also Article 19)
- fuel and core design, fuel performance during normal operation and transients
- design basis accidents (DBA)
- beyond design basis accidents
- organisation and personnel (see also Article 12)
- emergency preparedness (see also Articles 16 and 17)
- waste management and decommissioning

Additional items pertain to existing installations, for which a renewal of the plant license is necessary from time to time (Beznau unit 2 and Mühleberg), or within the framework of a PSR:

- operational experience (see also Article 19)
- backfitting, modification(s) and ageing of plant systems/components

Assessments of backfitting actions or modifications relative to safety (related) systems / components within the current license (i.e. no new license necessary) are covered by the HSK permit procedure. This procedure entails that, of all items listed above, those affected by the modifications must be addressed. The results of such assessments are documented in specific reports or directly in the letter of approval. As in the case of a license, conditions or restrictions may be imposed in conjunction with the permit.

Insights of the review and assessment process

Some selected Swiss regulatory processes for the review and assessment of both new and existing installations are described in the following sections.

<u>Review and assessment of safety systems, safety related systems and their components:</u>
This process is described in a number of HSK Guidelines (R-06, R-18, R-23, R-31, R-35). The licensee must submit an appropriate application which encompasses all safety-relevant aspects and describes the measures taken to ensure safety. The HSK review covers (but is not limited to) the following issues:

- quality assurance of manufacturing, assembling and commissioning
- personnel qualification (e.g. for welders)
- specifications of systems and components, system and instrumentation and control (I&C) equipment drawings, construction drawings
- impact on safety concepts and on result of safety analyses, safety analysis as appropriate
- operating experience from licensee and from other plant operators
- implementation and test plan

The depth of the review depends on the safety significance of the systems/components concerned.

<u>Review of design basis accident analysis:</u>

This review aims at verifying the expected behaviour of the plant under postulated abnormal conditions. Based on a set of accident scenarios, the licensee has to demonstrate that the relevant plant and core specific parameters stay within their safety limits. In addition, the licensee must show that the individual dose limits for the public, as defined in the HSK Guideline R-11, are not violated.

The HSK review covers at least the following aspects:

- qualification, validation and state-of-the-art of the computer programs used
- compatibility of assumptions with systems and components design
- conservatism of simplifications and assumptions
- adequacy of postulated single failures
- compliance with pertinent operational and safety limits

Appraisal of Periodic Safety Review (PSR):

The PSR is an additional control mechanism for the HSK, aiming to identify and assess the actual safety condition of the plant. To this end, the actual plant status and the past operating experience is compared against the current level of science & technology and the operating experience of other plants. The licensee is responsible for carrying out the PSR, whereas the HSK evaluates the PSR as submitted by the licensee, adding its own experience from previous inspections, assessments and reviews.

For a PSR and the evaluation thereof, the present 'defence in depth' plant safety concept of having several layers of protection (preventive measures to warrant reliable plant operation, to prevent operational occurrences, to curb limited faults and accidents, and finally to limit the effects of severe accidents) plays a central role. The licensee is thus required to:

- explain the plant-specific implementation of the 'safety policy'
- assess plant operational performance and management
- perform a deterministic safety status evaluation
- perform a probabilistic safety analysis

and, on this basis, to demonstrate that typical safety objectives (controlling reactivity, core cooling, containment of radioactive materials, and limiting radioactive releases) effectively apply to normal and abnormal plant operation.

Not only the present safety status must be reviewed, but also an assessment of the future safety status must be included in the PSR. For this assessment, the trend analyses from e.g. component performance and non-availability of safety equipment, as well as results from currently implemented ageing surveillance programs, may be used.

The HSK appraisal comprises an assessment of the licensee's safety culture, integrating all safety-related information supplied with the PSR.

Review of PSA:

The HSK review aims at developing a thorough understanding of plant features, vulnerability to potential severe accidents, and plant-specific operating characteristics. Also, the general applicability of PSA models as a tool for risk-informed regulation is assessed. The review focuses on:

- general appreciation of the PSA models, assumptions, analytical methods, data and numerical results
- understanding the range of uncertainties in core damage frequencies, containment performance, and releases of radioactive effluents

A two-step evaluation process has been developed for this review:

- **Preliminary qualitative review:** this review is aimed at performing a quick qualitative evaluation of PSA findings and major conclusions, PSA approach and analytical methods, and plant design features for preventing and mitigating potential severe accidents. This preliminary review also generally verifies the PSA documentation for completeness, and identifies areas for more comprehensive assessment and analysis in the next review stage.
- **Detailed quantitative review:** this review aims at a detailed quantitative evaluation of the PSA models, assumptions, data, and analysis techniques and verifies the adequacy of the PSA models for representing the actual plant design and operational characteristics.

As part of this review phase, a detailed re-analysis is performed, often using alternative methods. For the Level 1 part of the analysis, a fault tree linking technique is used; the Level 2 portion of the PSA is evaluated based on state-of-the-art computer codes, assessing severe accident behaviour, containment loads, containment performance, containment failure modes, and accident source terms. In addition, site audits including plant walkdowns of several days are conducted, focusing on the review of the external events analysis.

PSA review guidance documents have been prepared to support the assessment process. These documents contain specific instructions for PSA review, applications, and review documentation.

Review of ageing:

In 1991, the HSK required the implementation of an ageing surveillance programme (ASP), for both first and second generation NPPs. The aim of this programme is to ensure that the safety of components would be maintained throughout the life of the NPPs. In 1992, a utility working group was formed to set up a programme for a joint approach on ageing management. The main target of this group is to fulfil the HSK requirements and, in addition, to provide a technical basis for optimising maintenance and improving the reliability of components.

The ASP is part of the overall maintenance strategy for the Swiss NPPs. It addresses the fields of civil engineering, electrical and mechanical components and focuses on safety-related components, systems and structures. More specifically, the ASP aims at providing information on the relevant ageing and degradation mechanisms for component materials, environmental effects, operation history, etc. For every safety-relevant component, it will be possible to make an assessment of the existing maintenance programme while indicating possible deficiencies therein. Should deficiencies occur, possible remedies have to be submitted to the HSK. So far, no ageing mechanism has been identified that could critically reduce safety margins of components in the foreseeable future. To date, some amount of electrical equipment (e.g. cables, transmitters, drive units) has been replaced in view of the fact that the remaining time of safe operation could not reliably be established, or because stable performance under accident conditions could not be demonstrated.

Clause (ii)
Each Contracting Party shall take the appropriate steps to ensure that verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

As already mentioned in the response to Clause (i), appropriate safety analyses have to be submitted to the HSK in support of a permit request for each modification or backfitting to safety (related) systems or components. For granting such a permit the following is needed: proof of qualification for manufacturing, assembling and commissioning; evidence of meeting safety limits; definition of special start-up tests as necessary, and a procedure for periodic inspections and audits. All this is needed to ensure that each modification or backfitting action is in concord with the previously approved safety requirements, and that the applicable safety margins and operational limits are maintained.

For the verification of the safe condition and operation of the nuclear installations, the following activities play a central role.

Refuelling and outage activities

During each refuelling outage, the plant is subjected to a review, covering many aspects as illustrated by the following examples:

- In-service inspections, preventive maintenance and repairs/modifications relative to safety-related mechanical equipment, undertaken by the licensee to maintain or enhance the safety of the plant, are monitored by the HSK and supervised and verified by its mandated expert, the Swiss Association for Technical Inspections (SVTI/ASIT). The SVTI/ASIT covers this whole range of activities by a combination of selective supervision and random checks, whereas the HSK focuses on special topics.
- Review of mandatory periodic functional testing of systems and components, including switchover tests of the electric power supply, are carried out by the licensee. These tests are performed according to written procedures, and all test results are documented. The HSK attends selected tests, and also reviews the results of the whole test programme.
- The cycle-specific fuel and core-related issues are reviewed in conjunction with the "Reload Licensing Submittal" which the licensee submits at the beginning of the plant refuelling outage. Approval of fuel and core loading by the HSK is a prerequisite for cycle start-up. Fuel handling and inspection are also reviewed by the HSK, and selected fuel inspection campaigns are attended.

The HSK issues a letter of permit to restart plant operation after the maintenance/refuelling outage. In this letter the HSK passes judgement on the outage maintenance and refuelling activities, the radiological status of the plant and cycle-specific safety analyses. This permit may also include conditions for plant operation, or requirements and recommendations for maintaining or improving plant safety. The HSK documents its own activities during the outage in a separate outage report.

Backfitting and replacement

Safety related electronic/electrical equipment that no longer satisfies today's standards, and safety I&C equipment that has become obsolete with time, has to be replaced by modern and higher performance equipment. The installation and the commissioning of such new equipment largely occur during the plant outage. The HSK reviews the process for such activities, and subsequently follows this process very closely. Specific examples of implementing such new equipment are (a) the replacement of the conventional reactor protection system (RPS) by a computer-based system for both units of the Beznau NPP, and (b) the implementation of computer-based operator support systems (process computer, process visualisation, on-line operating procedures) at the Gösgen, Mühleberg and Beznau NPPs.

Inspection, reporting and information meetings

Inspection:

The purpose of regulatory inspections (announced and unannounced) is to provide the basis for an independent judgement on safety-related issues such as:

- quality measures taken during construction, plant modifications and operation
- availability of documentation (e.g. operating instructions, technical specifications, emergency instructions, emergency plans)
- adherence to operating instructions and technical specifications
- judicious plant operation and recording of safety performance
- adequacy of PSA models to represent the current plant configuration and operational characteristics
- housekeeping practices to prevent or mitigate fire and seismic hazard consequences
- availability and training of operating personnel
- radiation protection
- human factor problems and man-machine interface
- organisational aspects and safety culture

The yearly *periodic* inspection plan is controlled by an outline, the so-called Basic Inspection Programme (BIP), which contains a systematic and comprehensive basis for selecting and scheduling periodic inspections. By establishing the BIP, the HSK complied with one of the recommendations from the IRRT review of 1998 (see also Article 8). The inspection intervals suggested in the BIP are based on the safety significance of the objects (components/systems/processes) to be inspected, national and international experience with these objects, public interest issues as well as the amount of the HSK internal resources available for inspections. In particular, the inspection intervals account for the 10-year PSR cycle (see above), within which all important safety-related domains must be subjected to inspection. These inspections are a valuable part of the PSR assessment. In the BIP, both result-oriented (aiming at reviewing the process outcome) and process-oriented inspections (aiming at reviewing the process itself) are included in a balanced manner.

In addition to the *periodic* inspections described above, *topical* inspections focusing on special issues are defined by the HSK management on a case-to-case basis. Obviously, *reactive* types of inspections are also carried out, meaning that the HSK acts in response to e.g. events that happen during plant operation/during the outage or plant modifications proposed by the licensee.

For each nuclear installation, the HSK designates a co-ordinator in charge of assuring constant communication, exchange of information and documents between the licensee and the HSK, and adequate dissemination of such information and documents within the HSK. The co-ordinator is also responsible for record-keeping as well as for updating a list of "pending matters".

All HSK inspectors are staff members, based at the HSK headquarters. There are neither site resident inspectors nor regional offices. Basically, each HSK staff member is a specialist in his/her particular field, and fulfils duties in three main areas of activities:

- review and assessment
- preparation of regulations and guidelines
- inspection and enforcement

The amount of time spent on the various activities depends on the actual workload and associated priorities. The activities in the first two areas take place at the HSK headquarters, while in the latter area of activity the staff member represents the HSK as an inspector at the NPP site.

On average, 80 inspections per plant and per year are carried out.

Reporting:

The HSK Guideline R-15 prescribes in detail which data on plant operation have to be reported by the licensees. Data related to general plant performance, including radiological characteristics and plant modifications for which no HSK permits are required, must be reported on a periodic (monthly or yearly) basis. However, events such as equipment failures, scrams and failed mandatory tests have to be reported within a fixed (short) period of time.

Such licensee reporting may result in regulatory requirements and/or recommendations for improvement. Moreover, the HSK reviews information on international events as well as insights from safety research. This review may also result in regulatory action and, as appropriate, in requirements and/or improvement recommendations to the licensee.

Information meetings:

Information meetings with each licensee are held twice per year during the operating cycle. At these meetings, the licensee reports on plant operation, special issues and ongoing/planned projects. The HSK takes position on the various topics and clarifies current or forthcoming requirements (as a rule, safety-related requirements are presented to the licensee before they are enforced.). Furthermore, each designated HSK plant co-ordinator (see above) conducts an inspection meeting with the respective licensee about once per month, in order to obtain the latest information on the plant status and its performance.

Meetings between the HSK and the licensee top level management are held at least once per year. In these meetings, special safety issues, such as the consequences of electricity market deregulation and increased competition, are discussed. In addition to all these periodic information meetings, special meetings may be arranged at any time on topical/pending matters and ongoing projects, as appropriate.

Conclusion

The Swiss Party complies with the obligations of Article 14.

Article 15: Radiation protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

Based on the recommendations of the International Commission on Radiological Protection (ICRP) (mainly Publication No. 60), the Radiological Protection Act as well as the Radiological Protection Ordinance have been revised and came into force in 1994. The Inspectorate (HSK/DSN) has subsequently issued revised and adapted versions of most of the relevant HSK Guidelines:

- R-07: Guideline for radiation protection zones in nuclear installations and in the Paul Scherrer Institute (1995)
- R-12: Determining and reporting of doses of occupationally radiation exposed personnel in nuclear installations and the Paul Scherrer Institute (1997)
- R-41: Calculation of the radiation exposure in the vicinity of nuclear installations due to emissions of radioactive materials (1997)
- R-47: Testing of radiation measuring instruments (1999)

In January 2000, the Radiological Protection Ordinance has been revised and new dose factors complying with the IAEA safety series No. 115 have been included.

Dose limits

The Radiological Protection Ordinance limits the general maximum individual total dose for NPP personnel (plant personnel and contractors) as a rule to 20 mSv per year. Exceptionally, a limit of 50 mSv per year, but not exceeding 100 mSv in five years, can be authorised by the Inspectorate. A guideline value of 4 Person·Sv per year for the plant annual collective dose is given in the HSK Guideline R-11. This value will be lowered in the revised Guideline which will come into force in the course of the year 2002. The collective dose for each NPP has to be kept below this guide value for normal operation, including refuelling and outage activities.

Since 1994, no individual dose exceeding 20 mSv per year has been accumulated by any plant personnel or contractors during their work in the Swiss NPPs. Since 1987, all annual collective doses remained well below 4 Person·Sv per unit and all have been kept below 2 Person·Sv per year since 1995. These facts are illustrated in Figure 6, showing annual collective doses going back to 1969 (note: the NPP Beznau consist of two units I and II both located on the same site).

The dose due to non-natural sources, for the general population, is limited to 1 mSv per year by the Radiological Protection Ordinance. The HSK Guideline R-11 defines a source-related dose guideline value of 0.3 mSv per year for each NPP site (in this particular context, the two units I and II of the Beznau NPP are considered as one single NPP). Emissions (air and water paths combined) shall not cause a corresponding dose of more than 0.2 mSv per year, leaving thus a maximum of 0.1 mSv per year due to direct radiation. The HSK Guideline R-41 defines the rules for the calculation of doses due to emissions. Based on the characteristics of the NPP and on the results of the dose calculations, the Inspectorate defines the maximum allowed emissions for each NPP site.

Doses calculated on the base of annual emissions are illustrated in Figure 7. The annual doses calculated for a virtual most exposed group of the population, including the exposure due to deposition from former years, have always been well below the authorised maximum admissible value of 0.2 mSv per year. Since 1994, values due to annual releases are below about 0.01 mSv per year for all Swiss NPPs.

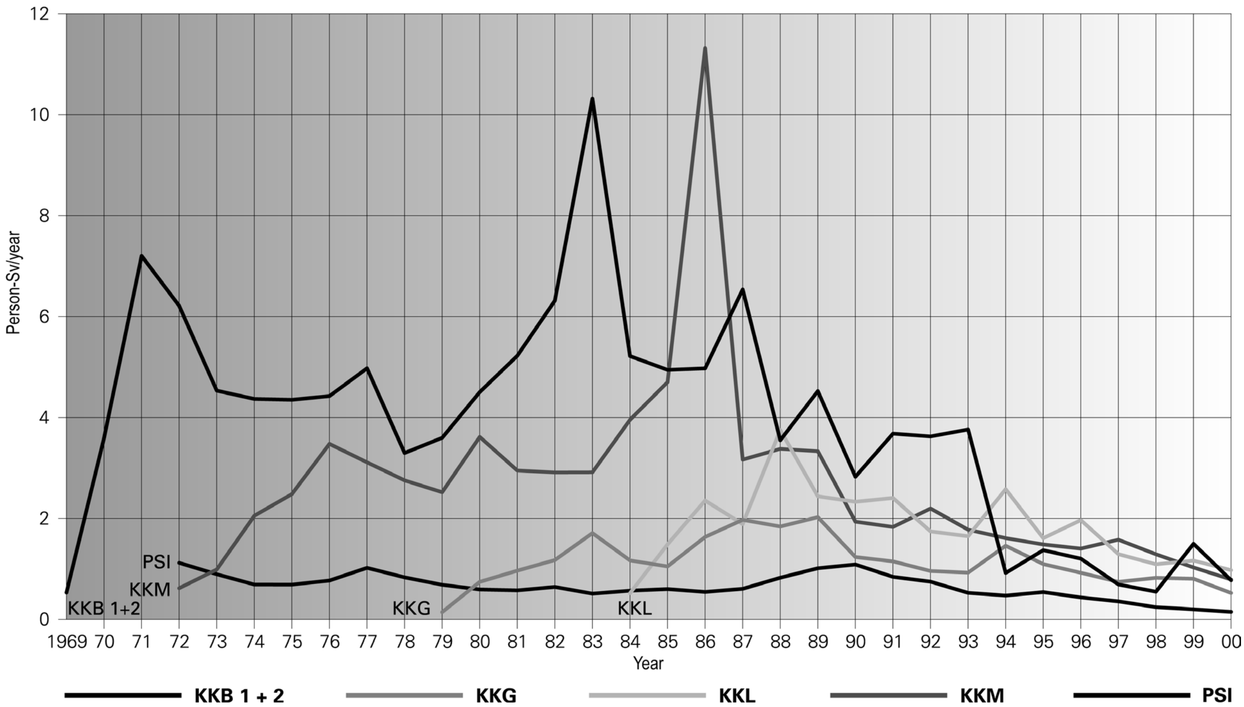
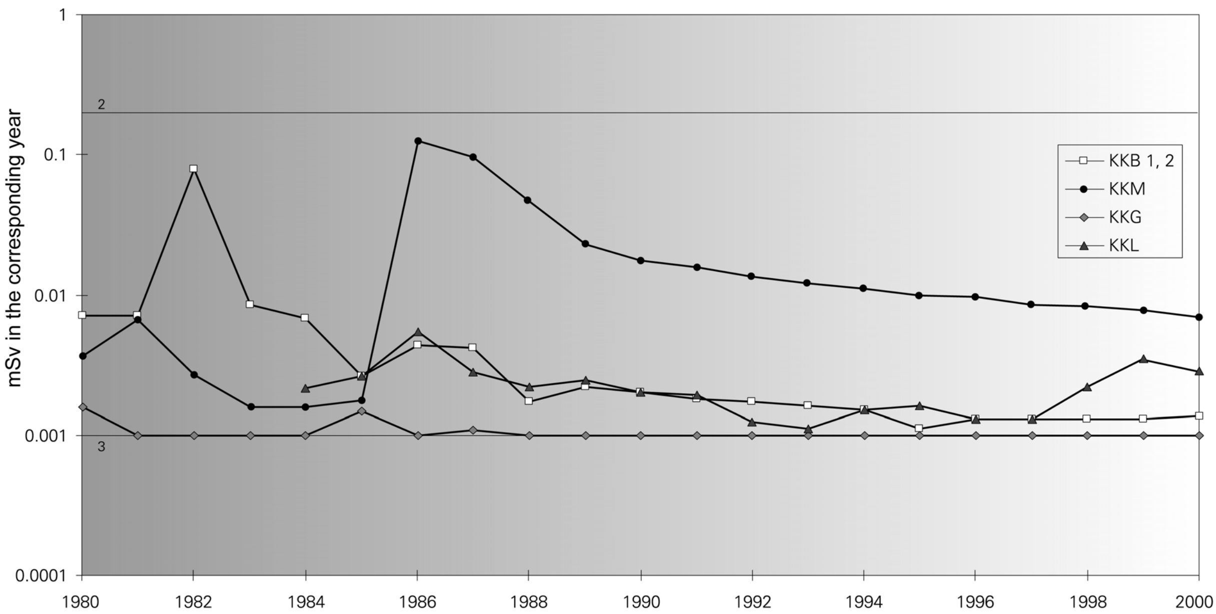


Figure 6: Annual collective doses for the Swiss NPPs and the research institute PSI. The two peaks are related to extraordinary work carried out in 1983 (Beznau NPP: Replacement of anti-vibration bars in the steam generators of one unit) and 1986 (Mühleberg NPP: Replacement of the re-circulation pipes due to stress corrosion cracking). In 1993, the steam generators of the NPP Beznau I were exchanged with a collective dose of 1.2 Pers.-Sv. In 1999, the same work was performed at the NPP Beznau II with a collective dose of 0.64 Pers.-Sv. This dose reduction can be largely attributed to "lessons learned" from earlier similar operations and to optimisation of radiation protection. (KKB=Beznau NPP, KKG=Gösgen NPP, KKL=Leibstadt NPP, KKM=Mühleberg NPP)



[1] Fictitious person, permanently located at the critical place, obtaining all food from the area and all drinking water from the river downstream of the nuclear power plant in question.

[2] Source-related dose guideline (StSV Art. 7, HSK-Guideline R-11).

[3] Values below 0.001 mSv are not shown as such on the figure.

Figure 7: Doses calculated on the base of annual emissions from the Swiss NPPs. The annual doses are calculated for a virtual most exposed group of the population, including the exposure due to deposition from former years. The peak is related to an emission of radioactive particles in 1986 (a malfunction of the waste treatment system of dry resin in the Mühleberg NPP).

Steps taken to ensure that radiation exposure is kept as low as reasonably achievable.

NPP-specific methods have been progressively used, over the years, to keep radiation exposure arising from the operation and maintenance work of NPPs as low as reasonably achievable. Since the year 1994 when the new dose limit of 20 mSv came into force, no plant or contractor personnel reached this limit. The mean individual doses for plant personnel and contractors (see Figure 8) show a decreasing trend over the last couple of years in all Swiss NPPs indicating the significant efforts made particularly since 1988. However, the mean dose for NPP personnel is generally higher than the doses for contractors. This indicates that sensitive work, in high dose rate areas, is preferably carried out by the plant internal personnel as opposed to contractors.

The most significant dose reduction measures undertaken at the Swiss NPPs during the last years are compiled in Table 2.

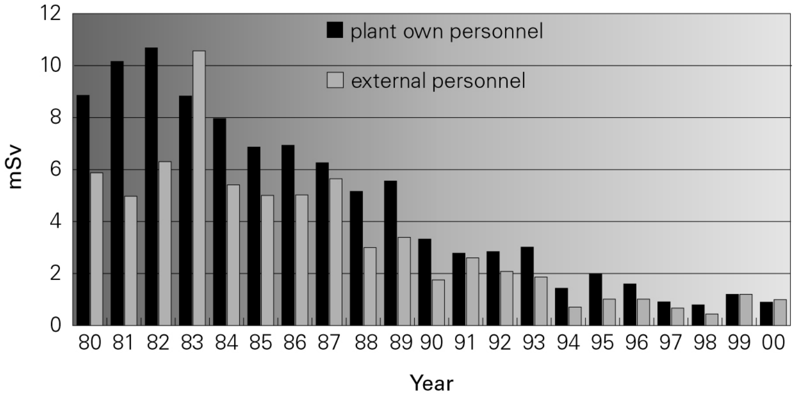
The Inspectorate has to be informed if jobs with an anticipated collective dose of more than 50 Person·mSv are planned. A detailed radiation protection optimisation proposal has to be submitted to the Inspectorate well in advance before the work starts. According to the Radiological Protection Ordinance, radiation protection is deemed to be optimised as soon as the following conditions are met:

- different possible solutions have been individually assessed and compared;
- the sequence of decisions that led to the particular solution is traceable;
- due consideration has been given to the possible occurrence of incidents and the safe storage of radioactive sources which are no longer in use.

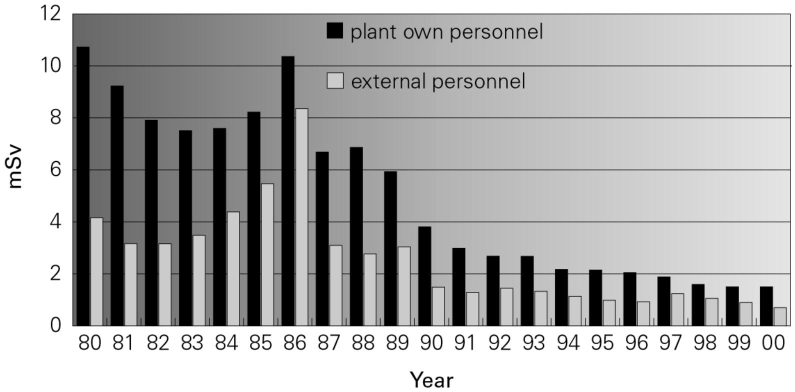
Table 2: Main dose reduction measures in Swiss LWRs.

Plant	Typical shutdown collective dose [Person·mSv]	Main dose reduction measures
Beznau NPP	500	Temporary lead shielding (70 tons). Low dose rate areas for personnel (< 0.005 mSv/h). Individual acoustic dose and doserate warning. Strong emphasis on training and motivation. Daily job-specific follow up of doses vs. planning. New steam generators. Remote tools for primary system inspection. Zn-64-depleted zinc feed in primary water.
Mühleberg NPP	900	Temporary lead shielding (85 tons). Permanent racks for supporting removable lead sheets. Replacement of components with "Stellite" parts by components made from a cobalt-free alloy. Daily follow up of job specific actual doses vs. planning doses. Zn-64-depleted zinc feed in primary water.
Gösgen NPP	600	Temporary lead shielding (20 tons). Highly compartmentalised containment with compartments made out of concrete. Daily follow up of total and selected job specific actual doses vs. planning doses. Zn-64-depleted zinc feed in primary water.
Leibstadt NPP	900	Temporary lead shielding (32 tons). Temporary shielding with water bags. Job tickets (bar code) with on-line follow up. Very detailed job planning for jobs implying doses > 50 mSv. Job planning for jobs implying doses > 10 mSv. Decontamination of re-circulation loops. Zn-64-depleted zinc feed in primary water. Extensive mock-up training.

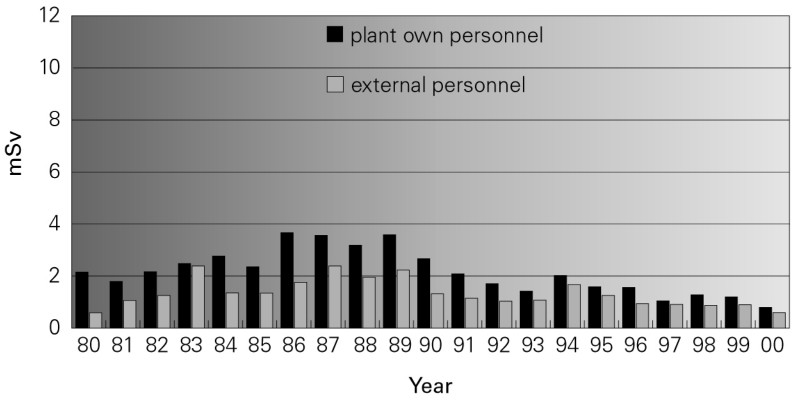
Beznau I+II NPP



Mühleberg NPP



Gösgen NPP



Leibstadt NPP

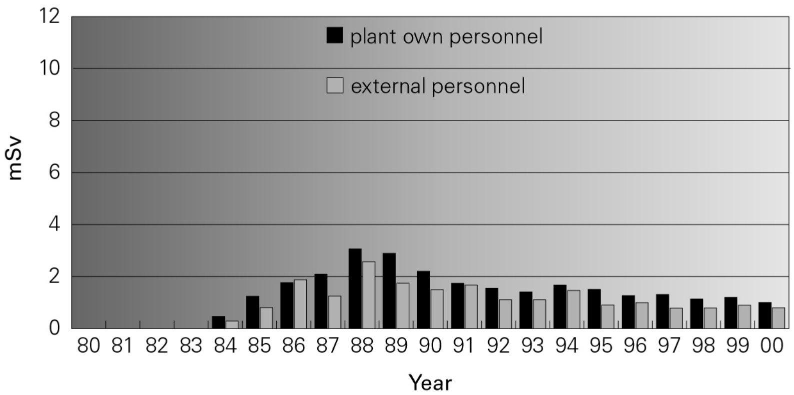


Figure 8: Mean individual dose of Swiss NPP personnel (plant personnel and contractors).

Environmental radiological surveillance

The Radiological Protection Act establishes the legal basis for the radiological surveillance of the environment to be also in accordance with the corresponding legislation for foodstuff. More detailed requirements are laid down in the Radiological Protection Ordinance. On this basis, the Inspectorate, in collaboration with the Federal Office of Public Health, has established the programme for the environmental surveillance of every plant in the plant-specific procedures on the emission and the surveillance of the radioactivity.

The Inspectorate defines requirements for the measuring devices as well as how the measurements have to be carried out. It monitors the correct maintenance of the devices and audits the measurement book-keeping during annual inspections. In addition, it performs its own quarterly comparative measurements.

The environmental surveillance programme has three main aspects:

- Measurement of the emissions from the plant and comparison of the actual emissions with the limits laid down in the licence for the operation of the NPP. The limits are chosen in such a way that the dose for persons living in the vicinity of the plant remains well below the source-related dose guideline value (see Section "Dose limits" above).
- Calculation of the dose from the measured emissions for the most exposed persons living in the vicinity of the NPP. The calculated values are compared directly with the source-related dose guideline value. The models and parameters used for the calculation are defined in the HSK Guideline R-41.
- Programme for the radiological surveillance of immissions. The environment is monitored nation-wide by the Federal Office of Public Health. The vicinity of the NPPs is additionally monitored by the Inspectorate. The programme includes online measurements of the dose rate around the plants (MADUK, see Article 16), as well as regular sampling and measurements of air, water, soil, plants and foodstuff.

The results of the first two stages are published in the annual report of the Inspectorate. A summary of the results of the entire environmental radiological surveillance is published in the annual report of the Federal Office of Public Health.

Regulatory control activities

Inspections concerning radiation protection matters are focused on the shutdown phases. Normally, these inspections are planned together with radiation protection experts of the plant several weeks in advance and they are centred around activities for which a collective dose of more than 50 Person·mSv can be anticipated. Other routine inspections are performed in every plant during operation in addition to specific inspections focused on special topics, like radiation instrumentation, contamination control etc.

Conclusion

The Swiss Party complies with the obligations of Article 15.

Article 16: Emergency preparedness

Clause 1

Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

Prior to the start-up of a new NPP, on-site and off-site emergency plans, which must be approved by the Inspectorate (HSK/DSN), are required. The general requirements for emergency preparedness are based on the following Concept, Ordinances and HSK Guidelines:

- Federal Concept on the Emergency Planning and Preparedness for the Vicinity of Nuclear Power Plants (1998);
- Federal Ordinance on the Protection of the Population in the Vicinity of Nuclear Installations in the Case of an Emergency (Emergency Preparedness Ordinance) (1983);
- Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity (1991);
- Federal Ordinance on the National Emergency Operations Centre (1990);
- R-42: Responsibilities for decisions to implement particular measures to mitigate the consequences of a severe accident at a nuclear installation (1993);
- R-45: Planning and execution of emergency exercises in Swiss nuclear power plants (1997);
- Federal Ordinance concerning iodine prophylactics in the case of a nuclear accident (1992).

On-site emergency organisation

Each NPP is in possession of a plant-specific emergency preparedness documentation which includes the following information:

- operating procedures for abnormal situations;
- emergency procedures;
- reporting procedure to the Inspectorate and for radiological events also to the National Emergency Operations Centre (NAZ/CENAL);
- reporting procedure to the district police for fast growing accidents.

Furthermore, in late 2000, the HSK required the Swiss licensees to implement severe accident management guidance (SAMG) by the end of 2003. In case of an accident with a severely damaged core, SAMG will support the different emergency organisation teams in taking accident mitigation measures based on predefined strategies. The Beznau NPP was able to implement SAMG already in the year 2001. The emergency documentation of the NPPs is inspected every year.

For communication in the case of an emergency, dedicated telephone and fax lines are installed between the NPPs, the Inspectorate and the NAZ/CENAL. The communication system is tested once a month. An automatic dose rate monitoring and emergency response data system (MADUK) has been installed at all NPPs in Switzerland. The system continuously monitors the dose rate at about 12 locations in the vicinity of each NPP. In accident situations, the system provides the Inspectorate with on-line access to approximately 25 important plant parameters. With the help of these parameters, a computer model generates a diagnosis and prognosis of the plant state.

Off-site emergency organisation

The off-site emergency organisation is based on the resources that have been built up within the frame of Switzerland's general defence concept. These resources consist of a well developed shelter infrastructure and well trained troops for fire and disaster intervention. In the case of a radiological emergency, the so called Emergency Organisation in Case of Increased Radioactivity (EOR/OIR) co-ordinates the use of civil and military support at the federal, cantonal and communal levels.

The legal basis for the EOR/OIR is given in the Swiss legislation on nuclear energy, radiation protection and in special emergency regulations. The link to the Federal Council (government) is established by the Radiological Emergency Management Board (LAR/CODRA) consisting of the directors of all relevant federal offices. The EOR/OIR has a permanent team, the NAZ/CENAL, responsible for alerting, instructing and informing the public and for the initiation of early countermeasures in all cases of radiological accidents.

The responsibilities of the major organisations involved in emergency preparedness are as follows:

- The NPP staff is responsible for the detection and assessment of an accident, for the implementation of on-site countermeasures to control it and for the immediate and continuous transmission of information to the relevant off-site authorities.
- The Inspectorate is responsible for judging the adequacy of the on-site countermeasures implemented by the NPP staff. The Inspectorate also advises the NAZ/CENAL regarding potential off-site radiological consequences for the public.
- The NAZ/CENAL is responsible for the transmission of warning and alerting orders to the cantonal authorities and also for initial countermeasures for the protection of the public.
- The LAR/CODRA is responsible for proposing appropriate measures to the government for issuing corresponding instructions to cantonal authorities and to the population.
- The cantonal and communal authorities are responsible for the execution of protective countermeasures issued for the public.

An important responsibility consists in the preparation and the distribution of information and of instructions to the public, given directly or through the media. Each of the above authorities has responsibilities for information in its own area of competence.

Emergency planning zones

In accordance with the Emergency Protection Ordinance, three emergency planning zones have been defined for each NPP in Switzerland:

- Zone 1 comprises the area around a NPP in which acute danger to the population could arise during an accident and, consequently, in which immediate protective measures are required. Depending on the power and the exhaust height of the stack of the NPP, Zone 1 extends to a radius of about 3 - 5 km.
- Zone 2 adjoins Zone 1. It encloses an area with an outer radius of about 20 km and is divided into 6 overlapping sectors. Alerting of the public can be performed in the specific sectors concerned.
- The rest of Switzerland, (outside Zones 1 and 2) is referred to as Zone 3. Measures to protect the public in Zone 3 during the passage of the radioactive plume are not expected to be necessary. It is assumed that any measures actually required can be implemented without any detailed pre-planning.

Emergency protective measures

The primary objective of emergency protective measures for the vicinity of NPPs is to prevent acute radiation sickness resulting from the accidental release of radioactive materials. Besides this primary objective, the emergency protective measures aim to minimise the number of long-term and genetic radiation damages.

The designated protective measures for the population are based on the concept of emergency reference levels of dose quoted in the Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity. The concept describes which protective measures are to be adopted for an expected radiation dose (see Table 3).

Table 3: Emergency reference levels according to the Federal Ordinance on the Emergency Organisation in Case of Increased Radioactivity. For every potential protective measure a lower and upper dose intervention level is given. If the expected dose is above the lower intervention level, optimised protective measures are taken considering negative side-effects. If the expected dose is above the upper intervention level, the protective measures have to be taken under most circumstances.

Protective measures	Dose acquired in the first year after the accident	Lower dose intervention level	Upper dose intervention level
Staying inside houses	Effective dose from external radiation and inhalation	1 mSv	10 mSv
Staying inside cellars or shelters	Effective dose from external radiation and inhalation	10 mSv	100 mSv
Evacuation	Effective dose from external radiation and inhalation	100 mSv	500 mSv
	Thyroidal dose from inhalation of radioactive iodine	30 mSv	300 mSv
Restriction of certain foodstuffs	Effective dose from ingestion	1 mSv	20 mSv

Protective measures to be applied during the cloud phase must be prepared in such a way that they can be prophylactically implemented already in the initial phase of the accident. The primary actions to be taken in the cloud phase include sheltering, taking of iodine tablets and possibly evacuation before any release has occurred. The following points are noted:

- The solid construction of Swiss houses and the high availability of private and public fallout shelters, sheltering in houses, cellars or fallout-shelters offer sufficient protection against radioactive cloudshine in the cloud phase of an accident and this is therefore considered the most important protective measure. In order to prevent infiltration of radioactive materials, windows and outside doors should be closed and air-conditioning systems shut off.
- Iodine tablets are distributed to all houses in Zone 1 and to the communities in Zone 2.
- Evacuation of parts of the population (especially in Zone 1) during the initial phase of an accident may be taken into consideration if a release of radioactive materials is not to be expected during the evacuation time.

Protective measures during the ground phase are applied according to the actual radiological situation in the environment as indicated by the results of measurements. Important protective measures are: staying inside houses, evacuation after cloud passage, restriction of access to certain areas, restriction of certain foodstuffs, countermeasures in agriculture, decontamination and medical support.

Alert procedures

At the onset of an accident, the NPP personnel immediately informs the Inspectorate and the NAZ/CENAL. If the accident poses a threat to the public and the environment, a three-stage warning and alert procedure is set in motion: warning, general alert, radiation alert NPP. For efficiency reasons, protective measures for the public should be implemented before radioactivity is actually released from the plant. Therefore, the criteria for warning and alert are primarily based on the situation in the NPP.

- A **warning** is at latest issued when a high dose-rate is monitored inside the containment. The warning (by telephone) puts the federal, cantonal and community organisations (within Switzerland) on stand-by for a possible alert. The NAZ/CENAL also informs foreign organisations such as the IAEA and authorities in neighbouring countries.
- A **general alert** is issued when an accident evolves in such a way that it could possibly lead to a dangerously high release of radioactive materials to the environment. The general alert (given by activating sirens) ensures that the population at risk is made aware of the emergency situation, so that it can take countermeasures. Instructions are given over the radio.
- The **radiation alert NPP** is given if a dangerously high release of radioactive materials is imminent or has already occurred. The radiation alert NPP (given by activating sirens) alerts the population and the emergency personnel to take immediate shelter in the nearest cellar or fallout-shelter.

The siren signals for general alert and radiation alert NPP, and their meanings, are described in the Swiss telephone directories.

As an addition to the regulation for core melt accidents, which has a warning time long enough to set up the national emergency organisation, a regulation has been set up for the initiation of countermeasures for accidents involving auxiliary systems like off-gas system. In such accidents a release can start immediately.

The assessment of the dose to the public must be made by the NPP-operator. The decision to alert the public depends on the timing and amount of releases. If the annual limit for the release of noble gases (E15 Bq) will be released in less than 1 hour, which gives a dose in the immediate surroundings of the plant of about 1 mSv, then the public within the emergency planning zone 1 (about 5 km) will be alerted by sirens and advised to stay inside houses for the next few hours. This is initiated by the plant operator directly in co-operation with the regional public authority (responsible for the countermeasures for the emergency planning zone 1) and without waiting of an order from the national organisation.

Emergency exercises

Emergency training is periodically checked within the frame of emergency exercises, to be performed once per year in every NPP. Co-operation between the different teams involved and co-operation with external organisations are aspects that are specially exercised and practised in a combined exercise every two years. In addition, each of the emergency teams, e.g. the fire brigade, has to perform its own specific exercises.

Clause 2
Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

The population in the vicinity of the Swiss NPPs has received a leaflet from the cantonal authorities describing possible dangers associated with a nuclear accident and explaining the prepared countermeasures to cope with the consequences. The warning and alerting of the population in case of accidents is described in Clause (i) of this Article.

Notification abroad, in the case of an emergency in Switzerland, is performed by the NAZ/CENAL, in accordance with bilateral agreements with the neighbouring countries Germany, France, Italy and Austria as well as in accordance with the Early Notification Convention of the IAEA. The NAZ/CENAL is furthermore connected to the European Community urgent radiological information exchange (ECURIE) reporting system. In the case of an accident with a rating of 2 or higher on the international nuclear event scale (INES), notification to the IAEA and the EC is mandatory.

In addition to the general emergency preparedness for nuclear accidents in the countries concerned, special plans have been drawn up for those Swiss NPPs situated near the border. The objective of all these efforts is to provide adequate emergency protection on both sides of the border. Bilateral agreements on these matters exist between the Swiss Government and the governments of Germany, France and Austria. The international emergency exercise INEX-2-CH combined specific Swiss and German objectives. In addition to Swiss response organisations, more than 30 countries and international organisations participated. The objectives focused on the ability of international organisations and countries to deal with the various aspects of communication, decision-making and public information.

The INEX-2-CH exercise provided a very useful and successful test of the systems and procedures established to inform the international community about a NPP accident. Other benefits include experience with bilateral agreements and a realistic display of public and media concerns and needs for information.

On a regular basis, German authorities participate in emergency exercises for the two Swiss NPPs which are in the vicinity of the German border (Leibstadt and Beznau NPPs). Switzerland itself participates regularly in international IAEA and NEA exercises such as for example in the INEX-2 exercise series.

Clause 3
Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

Does not apply to Switzerland.

Conclusion

The Swiss Party complies with the obligations of Article 16.

Article 17: Siting

Clause (i)
Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

According to the Federal Order to the Atomic Energy Act, the suitability of the site is part of the general licence. The established and implemented procedures for the general licence, as well as the various requirements associated with its issuing, are discussed in Article 7.

With the application for the licence, all relevant factors related to the sites (natural characteristics and human activities) have to be included in the safety analysis report (SAR) and in the probabilistic safety analysis (PSA), in particular:

- geology, seismology, hydrology (including flooding) and meteorology;
- population distribution (in SAR only), neighbouring industrial plants and installations;
- routes and frequency of transport by air, waterways and on the ground, as well as aviation flight corridors.

The Inspectorate (HSK/DSN) evaluates all relevant site-related factors likely to affect the safety of a nuclear installation by external events (e.g. earthquake, flood, lightning, fire or explosion due to neighbouring industrial plants or installations) and defines additional requirements on the design of the plant, if necessary.

Specific siting criteria do not exist but the relevant factors for the safety have to be evaluated each time when a new feature (e.g. a gas pipeline or industrial building) is planned to be built in the vicinity of a NPP.

Clause (ii)
Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

Switzerland is a small and densely populated country. The number and size of suitable sites for NPPs is limited. The concept of safety by distance encounters natural limitations in the Swiss case. The existing NPPs are nevertheless sited in areas where the population density is relatively low compared to the mean value for the industrialised regions of Switzerland.

The likely safety impact of nuclear installations on individuals, society and the environment, is evaluated in the SAR described in Article 14.

Additionally, the Radiation Protection Ordinance prescribes that the licence holder has to adopt suitable measures to prevent the occurrence of events leading to accidents and to mitigate their consequences. The mentioned ordinance gives dose guideline values for the public during normal operation and for design basis accidents .The dose guideline values are graded as a function of the incident probability. The methodology and boundary conditions for dose assessment in normal operation and accident analysis are established in the HSK Guideline R-41 (see Article 15).

Clause (iii)
Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented for re-evaluating as necessary all relevant factors referred to in subparagraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

For re-evaluating the relevant factors, basically the same procedures as those applied for initial review and assessment (see Clauses (i) and (ii) above) are followed. As the reporting procedures include the relevant site factors, any modifications of the latter are known (e.g. establishment of a new industrial plant in the vicinity of the NPP). The notification of such modifications by the licensee normally includes an assessment of their possible consequences. Together with a PSR, site-related factors are re-evaluated, e.g. by reviewing both the design basis accident analysis and the probabilistic safety analysis.

The re-evaluation processes contribute essentially to ensuring the continued safety acceptability of the NPP by confirming the validity of earlier assessments or by indicating the impact of changes in site-specific factors on the safety. The applicability and effectiveness of the HSK re-evaluation process are illustrated by means of two examples originating from the PSA review process and resulting in appropriate measures being adopted:

- In mid 1999, the HSK required the licensees to perform a new comprehensive probabilistic seismic hazard analysis (PSHA) for all Swiss NPP sites. In the new PSHA, the use of experts and the assessment of epistemic and stochastic uncertainties will receive high priorities.
- In all Swiss NPPs seismic backfits were performed as a result of the on-site inspections carried out by the HSK as part of the PSA review process. In early 2001, the HSK required one plant to backfit a significant number of masonry walls of an electrical building. The inspection had revealed that the risk-significant walls were not included in the PSA model.

Clause (iv)
Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

The population of the adjoining areas of a proposed NPP (including areas of neighbouring countries) is included in the comprehensive public consultation within the frame of the licensing procedure.

The German-Swiss Nuclear Safety Commission for Nuclear Installations (DSK), including its working groups, and the French-Swiss Nuclear Safety Commission (CFS) meet annually for consultation, exchange of information and experience. They also define adequate mandates for working groups; for example exchange of operational experiences, emergency protection planning and exercises, radiation protection, surveillance of ageing and waste disposal.

Agreements concerning the exchange of information have been signed with Austria, France, Germany and Italy.

Conclusion

The Swiss Party complies with the obligations of Article 17.

Article 18: Design and construction

Clause (i)
Each Contracting Party shall take the appropriate steps to ensure that the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

The design and construction of the Swiss NPPs is based on the US-American (Beznau I+II, Mühleberg, Leibstadt) and the German (Gösgen) standards as applicable at the time of their construction. These were, and still are, internationally recognised standards that incorporate the principle of defence in depth. The various levels of defence are in place to ensure that for all design basis accidents the plant remains within the safety limits and that individual dose limits for the general public are not exceeded (see also Article 14). In addition, the release of radioactive materials to the environment in the case of severe, beyond design basis accidents is prevented or at least limited.

Within the **licensing procedure**, the design and construction of the Swiss NPPs are thoroughly assessed. The results of this assessment are part of the safety evaluation report (SER) and they play an important role in the licensing decision (see Articles 7 and 14). The basic requirements of the safety authorities for design and construction are the IAEA design criteria and the HSK Guideline R-101: "Design criteria for safety systems of nuclear power plants with light water reactors" (1987). Other important HSK Guidelines for the licensing process are listed in Appendix 2.

After the granting of a license, the design and construction of the existing NPPs are reassessed periodically (see Article 14). Deficiencies in the NPP, as compared to the current state of science and technology, are identified. If these have a major safety impact, they have to be settled by means of appropriate backfitting.

The **first generation** of the Swiss NPPs (Beznau I+II, Mühleberg) were constructed using designs from the late 1960's, before the establishment of the "General Design Criteria" (GDC), in 1972, by the US Atomic Energy Commission (now the US-NRC). The comparison between the Swiss first generation NPP designs and the GDC revealed that the most important design criteria had already been recognised and incorporated. These NPPs also included several unique features in their designs, which were not standard at the time of construction:

- two turbines per plant;
- double containment (free-standing leak-tight steel plus concrete outer shell);
- load rejection and/or turbine trip without scram;
- continuous emergency power supply from a nearby hydro-electric plant;
- pump back system from secondary to primary containment (Beznau);
- ground water as emergency feedwater system (Beznau);
- pressure retaining secondary containment with self-acting, passive pressure relief in an additional circumferential water pool (Mühleberg);
- containment size doubled in relation to reactor power (Mühleberg);
- hilltop reservoir to flood the core (Mühleberg).

However, two important deficiencies were identified:

- the insufficient protection from external events, especially earthquakes and flooding;
- the lack of separation of safety-relevant systems.

For the first generation NPPs the seismic risk was determined on a deterministic basis by experts of the utilities in the middle of the 1960's.

Since 1974, the design of a NPP is based on the Safe Shutdown Earthquake (SSE) and the Operating Basis Earthquake (OBE) principles. The former is defined as an earthquake with a peak horizontal acceleration at the rock surface of 0,15 g corresponding to a median frequency of about 10^{-4}/year (based on the seismic risk map developed in 1977 by HSK experts).

As Switzerland is a mountainous country with hundreds of dams, the most probable cause for flooding a NPP site is a dam break. This can result in the loss of the hydro-electric plant providing emergency power for the NPPs of the first generation. The impact of external flooding was analysed on a deterministic basis, assuming the sudden disappearance of the dam. To mitigate the consequences of the flood special equipment was installed in the NPPs. As an example, in the case of the Beznau NPP, special diesel generators and auxiliary feedwater pumps are located in flood-proof areas; in the case of the Mühleberg NPP a hilltop reservoir can be manually aligned to the plant to flood the core. Originally, only the reactor building was designed as flood-proof. The backfitted shutdown and RHR-systems for the Mühleberg and Beznau plants (SUSAN and NANO projects, see Article 6) are both installed in flood-proof buildings.

In conclusion, in all first generation NPPs a comprehensive analysis and backfitting programme has been carried out and improvements realised. The backfitting projects included adding one or two completely separated shutdown and residual heat removal systems, including their support systems as well as protection against external events (see Article 6).

The **second generation** plants were based on US-American and German design criteria. Contrary to the first generation plants, the design of the second generation plants includes the protection against an aircraft crash.

The sites of the second generation plants, the Leibstadt NPP and the Gösgen NPP, were chosen such that they cannot be flooded even by an upstream dam break. Some special measures have been taken against the loss of cooling water. Both plants have special well water sources to cope with the loss of normal water intake from the rivers. At the Leibstadt NPP, three (small) cooling towers were installed as an emergency heat sink in case of a loss of cooling water. The US-American design of the Leibstadt NPP had to be adapted to Swiss specific requirements, according to the HSK Guideline R-101, with regard to external events and third party intervention. To fulfil these additional requirements, a special emergency heat removal system, which uses ground water as ultimate heat sink, was added to the plant design during the construction period. In addition, a steel construction was installed at the interface between the nuclear island and the turbine island to protect the nuclear island from the effects of multiple pipe breaks in the seismically lower qualified turbine island. In the case of the Gösgen NPP, a special emergency heat removal system, again using ground water as ultimate heat sink, was already included in the original design.

To mitigate the radiological consequences for the environment in the case of a severe accident, a filtered containment venting system was backfitted in the early 1990’s in all Swiss NPPs. The use of the venting system will be included in the severe accident management guidance (SAMG) to be implemented by the end of 2003 (see article 16).

Clause (ii)

Each Contracting Party shall take the appropriate steps to ensure that the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

The design, materials and components are subject to rigorous control and scrutiny and regular testing to verify their fitness for service. The legal requirement that the Swiss NPPs have to comply with the state-of-the-art in science and technology, ensures that the technologies incorporated in the constructions are proven by experience or qualified by testing or analysis.

All four NPPs used the US-American ASME-Code for the design of the primary circuit, the containment, and the safety systems. Also in the case of the Gösgen NPP, which is of German design, compliance with the ASME-Code was demanded by the HSK.

For civil engineering aspects, the Swiss SIA-Code was used. For faulted loads, such as loss of coolant accidents, earthquakes, and aircraft crash, special load combinations with special safety factors had to be developed and incorporated into the design.

The various components, systems and structures are classified into internationally recognised nuclear Safety Classes. These classifications reflect the relevance to the safety importance. Safety-classified components have to fulfil high requirements in design, materials, fabrication processes, maintenance and inspection. Nevertheless, some material and design deficiencies have appeared in the course of time. Important examples of such deficiencies together with steps taken by the Swiss NPPs to control, eliminate or mitigate deficiencies are described below:

- In the late 1960's, the nickel-based material Alloy 600 was used extensively in primary circuits of NPPs since its manufacturing, corrosion and mechanical properties appeared favourable for the operational conditions and service requirements at that time. However, despite earlier experience, this material suffered from stress corrosion cracking in the LWR coolant. In Switzerland, the steam generator tubing of the NPP Beznau (Units I and II) experienced stress corrosion cracking after only a few years in service. After years of sleeving and plugging, the problem was resolved by replacing the steam generators (Beznau I: in 1993 and Beznau II: in 1999). The new steam generators contain tubing material which is much more resistant to stress corrosion cracking.
- The re-circulation piping in the Mühleberg BWR NPP was made from stainless steel, corresponding to the normal practices and standards for this type of component. However, after 14 years in service, and in common with some other BWRs of similar design and construction, some areas of the welds experienced stress corrosion cracking. The issue has been addressed by replacing the re-circulation piping with improved material.
- In 1990, after 18 years of operation, the Mühleberg NPP was the first BWR world-wide to report the appearance of horizontal cracks in the stainless steel core shroud. These were discovered during the annual in-service inspection. Until then, stainless steel (Type 304) was deemed adequate for this application. However, the special environment and fabrication methods used lead to the long-term initiation and growth of cracks. The design does not allow for a simple replacement. As a precautionary measure, tie rods have been put in place. Some 30 BWRs are now reported to be affected by core shroud cracking.

  In 2000, hydrogen injection and NMCA (Noble Metal Chemical Addition) have been introduced at the NPP Mühleberg to protect the reactor internals against stress corrosion cracking.

Strategies for managing ageing-related problems, as an integrated part of a comprehensive ageing surveillance programme (ASP) are described in Article 14.

Clause (iii)

Each Contracting Party shall take the appropriate steps to ensure that the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

As mentioned in Clause (i) of this Article, the Swiss NPPs were constructed using US-American or German designs and correspond therefore to the requirements of these countries concerning reliable, stable and easily manageable operation as well as human factors and the man-machine interface (MMI).

However, in the case of NPP control rooms, which are most important from a MMI point of view, improvements compared to the original design have been implemented in three Swiss NPPs. Corresponding to the European view of an ergonomic control room, synoptic representations for piping systems and push button technology to activate valves and motors were used (see also Article 12).

Newly developed technologies such as computerised visualisation techniques to present processes in the NPPs, including abnormal conditions, have been introduced to enhance the easiness of operational control. The degree of automation has been increased to reduce the need for manual action for a period of 30 minutes dealing with design basis accidents (DBA) and of 10 hours in the case of external events.

The Beznau plant has installed two computerised systems to improve the MMI. The first system is a computerised alarm system with a prioritisation scheme for displaying the most important message within a safety function. The second is a computerised "emergency operating procedures" (EOP) system based on the written EOPs. It guides the shift supervisor step by step through the EOPs. A paper-based backup system which is based on classified instrumentation is used to cope with possible computer failures. The NPP Mühleberg has introduced a computerised visualisation system including SPDS (Safety Parameter Display System) to support the operating staff and to improve the presentation of plant information. The Leibstadt NPP installed an SPDS shortly after the beginning of its commercial operation. Also the Gösgen NPP is currently implementing such a system.

Conclusion

The Swiss Party complies with the obligations of Article 18.

Article 19: Operation

Clause (i)
Each Contracting Party shall take the appropriate steps to ensure that the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

Each of the five units of the four Swiss NPP sites have a legally granted and valid licence for operation. The initial licence for operation includes the licence for commissioning. Essentially, the basis for granting an operational licence comprises the following elements:

- the safety analysis report (SAR), submitted by the applicant/licensee together with the formal application;
- the safety evaluation report (SER), prepared by the Inspectorate (HSK/DSN) as a conclusion of its review and assessment;
- the Statement on the safety review issued by the Commission (KSA/CSA).

Wherever appropriate the latter two reports propose the wording of directives to be combined with the requested licence for operation. For further information see Article 7.

The operation licence includes the authorisation for commissioning. The commissioning programme, which has to be approved by the Inspectorate, comprises the pre-operational and start-up test programme as well as procedures for testing all equipment important to safety. Usually, the licensee proceeds to a design review to verify that the "as built state" reflects correctly the intended design according to safety requirements (safety criteria and licence conditions) and the function/operability of this equipment. The commissioning itself and all steps of the start-up tests are kept under regulatory control by means of the permits granted by the Inspectorate.

Within the frame of the operation licence, a permit is granted by the Inspectorate for each new operational cycle after shutdown for maintenance and refuelling. This permit is also the regulator's substantiated opinion that the safety of the NPP for the next operation cycle is in accordance with the requirements. It is based on the Inspectorate's assessment of the operational performance including radiation protection, the events of the last cycle and on the results of the maintenance and refuelling activities during the shutdown period.

In October 1998, the Leibstadt NPP received the operation license for a power uprate of 14,7 % of rated power upon the application of the licensee. The Power was increased by 6 % in 1998 and then by subsequent steps of at most 3 % of the rated power in 1999 and 2000, respectively. For each step a permit was granted by the Inspectorate after completion of an adequate test program.

Clause (ii)

Each Contracting Party shall take the appropriate steps to ensure that operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

Clause (iii)

Each Contracting Party shall take the appropriate steps to ensure that operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

These two clauses are closely linked; as a consequence they are both simultaneously considered in the following text.

The operation of a NPP has to be in accordance with an appropriate set of limiting conditions of operation (LCO) approved by the Inspectorate. The LCO are derived from the safety analysis and test results and are included in the so-called Plant Technical Specifications (Tech Specs). The Tech Specs (including also so-called Improved Technical Specifications which followed older Tech Specs) contain also the plant-specific surveillance requirements. Concerning the structure of the Tech Specs, the licensees follow the formal set up by the reactor supplier. The LCO constitute boundary conditions for the procedures and instructions for normal operation.

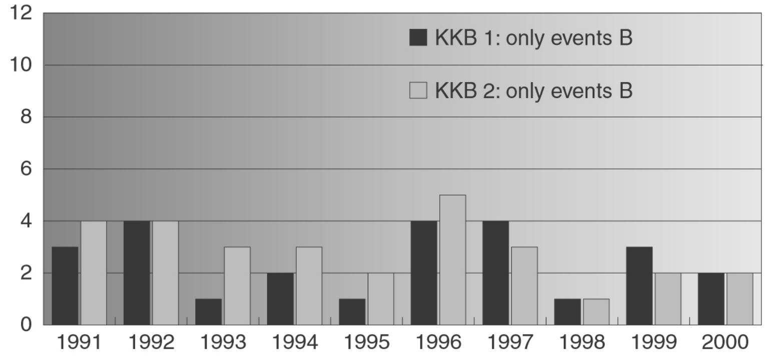
For putting into force this plant-specific document, and any change to it, a permit has to be granted by the Inspectorate. The Tech Specs have to be revised according to plant modifications, operational experience and new knowledge. This is regularly performed by the licensee, and the modified wording needs again a permit by the Inspectorate. In this way, the Tech Specs have achieved through the many operational periods a mature state of content and usefulness.

Compliance with the operating procedures is controlled by the licensee’s staff according to its own rules. Further procedures are provided by the licensees to ensure safe operation of the plant. They are based on regular verification of the operability of safety-related equipment. These procedures are used as elements of extensive surveillance programmes that cover maintenance, inspection and testing. They encompass in-service inspection by non-destructive examination of passive components, periodical examinations of electronic, electrotechnical and mechanical equipment, periodic functional testing of systems and components as well as an ageing-surveillance programme. Recently, several non-destructive testing qualification pilot projects were conducted or started in Swiss NPPs.

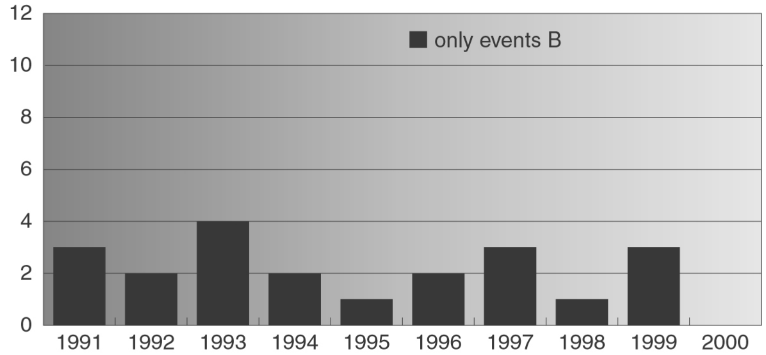
The regulatory surveillance of plant operation relies on the information obtained from the operating organisations by means of a reporting system (according to HSK-Guideline R-15, see Article 14) and on the information collected within the frame of the Inspectorate's inspection activities and on its own measurements. Since 1992 (since the INES classification is operational in Switzerland) only 4 INES-1 events occurred in Swiss NPPs and the annual number of reportable events according to the HSK Guideline R-15 is low (see Figure 7 for B events). In accordance with the reporting system, the operating organisations report periodically (monthly, annually, after refuelling outage) on the operational performance and on activities related to safety, among which modifications to plant equipment, procedures and organisation and doses to the personnel and the public are the most important. Particular emphasis is put on event reporting and investigation. Lessons learned and feedback from events are an essential contribution to operational experience. Safety-relevant plant modifications require a permit by the Inspectorate.

As a consequence of increased price competition on the electricity market, all licensees invest in efforts to optimise plant operation. Such optimisation programs included initiatives for yearly alternating short and long outages, where the short outages are mainly used for fuel element changes. This entails test and maintenance intervals of two years for part of the safety-related equipment. The corresponding changes in plant Technical Specifications have already been reviewed and approved by the HSK for some licensees, and are still under review for others. With regard to the future electricity market deregulation, the utilities also work out plans for so-called risk-informed projects. This concerns mainly maintenance and testing. Pilot projects in the field of in-service testing have already been worked out and are carefully assessed by the regulator.

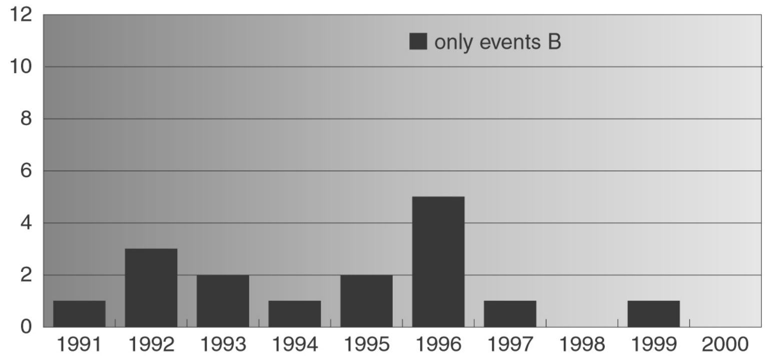
Beznau I+II NPP



Mühleberg NPP



Gösgen NPP



Leibstadt NPP

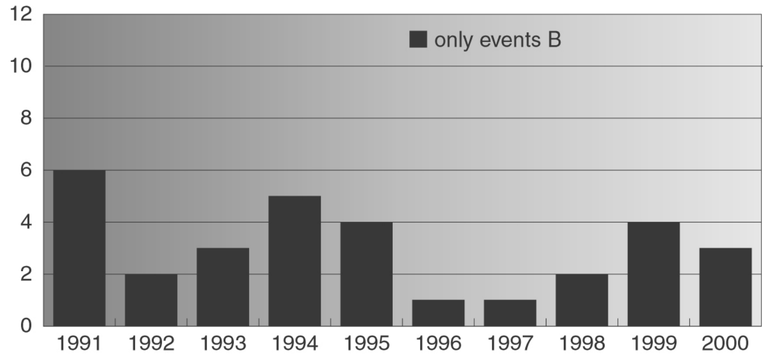


Figure 7: Annual number of reportable events in Swiss NPPs.

Clause (iv)
Each Contracting Party shall take the appropriate steps to ensure that procedures are established for responding to anticipated operational occurrences and to accidents;

In addition to the operating procedures for all modes of normal operation, each NPP uses dedicated procedures in cases of operational anomalies and emergency conditions, called emergency operation procedures (EOPs). The EOPs have become a requirement by the Inspectorate. They specify the measures to be taken to manage incidents and accidents up to the time of core damage. However, to date the EOPs provide only partial support in order to mitigate a severe accident. Therefore, the HSK has required from the licensees an extension of the EOPs by adding severe accident management guidance (SAMG, see Article 16).

The emergency procedures of the NPP include steps related to the alerting of the NPP stand-by safety engineer. Also documented are the stand-by safety engineer's duties, in particular the obligation to determine whether an emergency condition actually exists, to alert the plant's emergency staff and to inform the Inspectorate in the case of any event requiring immediate reporting. The on-site criteria to be fulfilled before declaring an emergency and for alerting and alarming are described in the NPP emergency procedures. Further information on alerting and alarm procedures is given in Article 16.

Clause (v)
Each Contracting Party shall take the appropriate steps to ensure that necessary engineering and technical support in all safety related fields is available throughout the lifetime of a nuclear installation;

The NPPs have developed their own on-site technical support, which takes care of the surveillance test programme, reactor engineering and fuel management, operational experience feedback, plant modifications and safety-related computer applications. These functions are carried out by different technical departments at the NPPs. In most cases, a department at the NPP's headquarters is responsible for core and cycle design and for fuel procurement. If ever knowledge in very specialised areas of nuclear safety is required, each plant can subcontract its reactor supplier for technical support.

Furthermore, there are local suppliers and consultants at hand. Nevertheless, as it is necessary that the plant on-site personnel has enough knowledge and experience to establish correct contracts on clearly defined safety issues, the plant management seeks an equilibrium between on-site and off-site technical support.

In view of the electricity market deregulation and under the actual increased economic pressure, the conservation of corporate knowledge becomes an important issue. The HSK is aware of this fact and the issue is discussed in the regular management meetings between the HSK and the NPPs. A problem to ensure technical support may arise in Switzerland in the future if the nuclear know-how and capacity continues to thin out and research activities are reduced at research institutes and universities. The Inspectorate is aware of this problem and follows the international activities and trends concerning this issue.

Clause (vi)
Each Contracting Party shall take the appropriate steps to ensure that incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

The mandatory procedure Guideline R-15 on reporting for NPPs and R-25 for other nuclear installations is the tool of the Inspectorate used to enforce the timely and comprehensive reporting of all abnormal events. The purpose of this notification is threefold:

- Notification of events to allow early recognition of deviations and their correction.
- Notification of incident/accident conditions to alert the HSK emergency organisation and other authorities.
- Notification of events of public interest to allow the Inspectorate (HSK/DSN) to make an independent assessment and to rapidly give official information to the public.

For practical reasons, the HSK reporting Guideline R-15 defines three classes of safety significance. They are related to reporting time and content requirements (S emergency, A significant, B low significance). Two additional classes are used for special purposes: class Ö events of public interest, for example smoke or noise at the plant site (immediate reporting) and class U events, which are lower than B and only for safety interest of the Inspectorate. A catalogue of consequences is used as classification criteria in the guideline, which has to be applied to the real event situation in the NPP. The guideline also requires the Inspectorate to be provided with a preliminary INES rating of the event, based on the INES User Manual.

To be sure that the Guideline will be utilised properly by the NPP, the classification is a formal part of the process for the license and requalification of shift supervisor and on-call engineer. During periodic emergency drills, the event classification is also an important objective for the NNP staff and the regulatory body. A workshop between NPP staff and HSK experts has recently been held to train and discuss problems with event classification. This will be periodically repeated.

The Inspectorate has established as part of its quality management system (see Article 13) an internal process of event investigation which includes the independent assessment and classification of all reported events. A special advisory working group, consisting of experts in nuclear, mechanical, electrical and system engineering, human factors and radiation protection, gives advice to the director of the HSK. The final classification is then decided by the director.

It has been the Inspectorate's practice for several years to summarise these events and their classification in the publicly available HSK annual report.

Clause (vii)
Each Contracting Party shall take the appropriate steps to ensure that programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;

The four managers of the Swiss NPPs have initiated and are monitoring the exchange of operating experience. Supporting the managers are several working groups that deal with issues such as licensed personnel, nuclear safety performance, surveillance of ageing, radiological and chemical plant performance, fire brigades and industrial safety.

A nuclear plant safety review committee or dedicated working groups at each site are in charge of the assessment of consequences of safety-relevant events, plant modifications, special testing and for issues concerning quality management.

Every NPP is a member of a working group (or owners group) of the reactor supplier. In these working groups, even minor problems are discussed. In the case of a reportable event, it is necessary that the reactor supplier and his contractors are quickly informed and solutions are prepared, should the same problem occur in other plants. Examples are the cracking of the core shroud of BWRs, the break of a PWR reactor coolant pump shaft, the failure and incorrect testing of a PWR reactor trip breaker and coolant temperature stratification in a BWR feedwater line.

For more exchange of operational experience, the licensees are also members of the World Association of Nuclear Operators (WANO). The operational experience feedback of WANO and of the reactor suppliers is screened and given to the appropriate technical departments. The latter analyse the reports, determine corrective actions for use in maintenance activities and for any further improvement of general operational performance. In addition, the licensees use the WANO performance indicators. For root cause analysis of event investigation, each licensee makes use of an appropriate method. The applied methods are therefore different from NPP to NPP.

Each NPP in Switzerland has been reviewed by an Operational Safety Review Team of the IAEA (see Article 10). Switzerland contributes to the IRS, according to the IAEA reporting rules, by submitting, for information, reports on relevant events that have occurred in Swiss NPPs.

The Inspectorate delegates members of its staff to the OECD/NEA/CSNI "Working Group on Operational Experience" (WGOE) as well as to the "Special Experts Group on Human and Organisational Factors" (SEGHOF). The Inspectorate also participates in the regular IAEA meetings which co-ordinate the activities of the IRS.

IRS events from abroad are systematically followed by the Inspectorate staff and evaluated in terms of relevance for Swiss NPPs. Information on incidents that may be of some interest to the Swiss nuclear industry is circulated for comments and, if appropriate, for further consideration and possibly proposals for preventing similar incidents in the Swiss NPPs.

Switzerland applies the INES for the publication of information on abnormal occurrences and follows the reporting rules established by the IAEA. The Inspectorate takes part in the regular IAEA meetings on the INES system.

The following two examples of operational experience feedback from abroad had repercussions in Switzerland.

- Based on the Generic Letter 89-10 of the US-NRC, the Inspectorate required from all Swiss licensees a re-evaluation of the functional analysis of motor-operated valves in safety related systems. As a consequence, certain gate valves were modified at each Swiss NPP.
- After the incident in Barsebäck 2 (Sweden) on July 28, 1992, which basically consisted in the clogging of the suction line strainers in the suppression pool, the Inspectorate started an action programme of short-term actions and measures for final resolution of the problem in all NPPs. Short-term actions included inspections and a detailed review of thermal insulation types employed, clogging analysis of the strainers and the preparation of accident management measures for BWR plants. The solution of the problem consisted in the replacement of all emergency core cooling system suction strainers in the BWRs (Mühleberg and Leibstadt) during their shutdown periods in 1993, by new ones with a considerably enlarged strainer area. For the PWRs, retrofitting actions were found to be not necessary.

Clause (viii)
Each Contracting Party shall take the appropriate steps to ensure that the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and that any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

The Federal Order to the Atomic Energy Act implements the principle that the originator of the radioactive waste is responsible for the safe management of the waste. It is further mandatory that, as a prerequisite for licensing a NPP, the safe and permanent management and disposal of the waste generated by the facility are ensured. The legislation on radiological protection (i.e. the Radiological Protection Act and the Radiological Protection Ordinance) also requires that the production of radioactive waste is kept as low as possible. By law, the radioactive waste originating in Switzerland shall, as a general rule, be disposed of domestically.

The critical review of projects for nuclear installations by the nuclear safety authorities during the licensing phase and the supervision by the Inspectorate of the construction and the operation of such installations ensure that the legal requirements are complied with.

Spent fuel discharged from the reactor is stored on site for a few years at each NPP. The present legislation neither prescribes nor prohibits the reprocessing of spent fuel. The operators of the NPPs have contracts with foreign companies for reprocessing approximately 1000 t of heavy metal which represents about one third of the total amount of spent fuel expected to arise from 40 years' operation of the NPPs. The rest of the spent fuel will be stored at a centralised interim storage facility for which the operation permit was granted in June 2001. The decision on the further management steps (later reprocessing or direct disposal) will be taken later.

The generation of radioactive waste at NPPs is kept at a low level. This is made possible by virtue of fuel quality and cleanliness. The resulting waste is collected and segregated. As a general rule, radioactive waste is conditioned as soon as practicable, partly on site, partly externally. Temporary storage of waste takes place on site under appropriate and adequate conditions. Waste with such low activity levels that the radiation protection legislation does not apply is cleared from regulatory control under the supervision of the Inspectorate. The clearance conditions are defined in Annex 2 of the Radiological Protection Ordinance. The procedure for clearance will be prescribed in detail in the Regulatory Guide R-13 scheduled to come into force in 2002.

Conclusion

The Swiss Party complies with the obligations of Article 19.

Outlook

The Swiss Party to the Convention on Nuclear Safety is committed to closely follow and implement any new developments enhancing nuclear safety. Best practices will be received with due attention and considered for operating the Swiss nuclear power plants more safely or for improving the regulator's work. Efforts are underway in Switzerland to improve the legal basis by introducing a new Nuclear Energy Law. Simultaneously, a project was started to enhance the independence of the regulatory body. In the radioactive waste disposal area, several activities are ongoing to advance waste repository projects.

In a spirit open for international technical co-operation, Swiss authorities maintain close relationships with partner regulatory bodies and engage actively in know-how transfer. Thus, several co-operation projects are currently ongoing to promote the use of modern safety assessment methods in order to improve the technical capabilities of partner regulatory bodies.

The continued active Swiss participation in the IAEA and the OECD NEA underlines the important role Switzerland attributes to these organisations. Further, the close bilateral co-operation with our neighbouring countries in all nuclear safety matters will remain a feature which the Swiss Federal Nuclear Safety Inspectorate takes very seriously.

In the future, considerable efforts need to be undertaken to improve communication in nuclear safety matters. Both domestically and internationally, an open, understandable and adequate information policy is of paramount importance to establish a sound basis for an open dialogue across borders and between stakeholders. Such transparency includes in our opinion also the work processes and methods used by the regulatory body.

The reporting under the Convention on Nuclear Safety plays an important role in this context. Creating transparency creates trust.

Switzerland will thus engage in maintaining and improving its high standard of nuclear safety, assist other countries in attaining a high level in nuclear safety, support international organisations and participate in nuclear safety activities. In the international community, the Swiss regulator wishes to be a reliable and transparent partner.

Appendices

- Appendix 1: List of abbreviations used in the present report
- Appendix 2: List of the Inspectorate's (HSK/DSN) Guidelines presently in force
- Appendix 3: List of annexes

Appendix 1: List of abbreviations used in the present report

ASME	American Society of Mechanical Engineers
ASP	Ageing surveillance programme
BAG/OFSP	Federal Office of Public Health
BFE/OFEN	Federal Office of Energy
BIP	Basic inspection programme
BWR	Boiling water reactor
CFS	French-Swiss Nuclear Safety Commission
CSNI	Committee on the Safety of Nuclear Installations (NEA/OECD)
DBA	Design basis accident
DSK	German-Swiss Nuclear Safety Commission for Nuclear Installations
ECURIE	European Community urgent radiological information exchange
EOP	Emergency operating procedures
EOR/OIR	Emergency Organisation Radioactivity
EPFL	Swiss Federal Institute of Technology Lausanne
GDC	General Design Criteria
GSKL	Swiss Society of NPP Managers
HSK/DSN	Swiss Federal Nuclear Safety Inspectorate
R-xy	Reference number of guidelines prepared and established by the HSK/DSN
I&C	Instrumentation and control
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IEC	
INES	International nuclear event scale (NEA and IAEA)
INEX	International emergency exercise
IRRT	International Regulatory Review Team
IRS	Incident reporting system (NEA and IAEA)
ISO	International Standards Organisation
KSA/CSA	Swiss Federal Nuclear Safety Commission
LAR/CODRA	Radiological Emergency Management Board
LCO	Limiting conditions of operation
LWR	Light water reactor
MADUK/ANPA	Automatic dose rate monitoring and emergency response data system
MMI	Man-machine interface
NAZ/CENAL	National Emergency Operation Centre
NEA	Nuclear Energy Agency of the OECD
NMCA	Noble Metal Chemical Addition
NPP	Nuclear power plant
NRPB	National Radiological Protection Board, Harwell (UK)
OBE	Operating Basis Earthquake
OECD	Organisation of Economic Co-operation and Development

OSART	Operational Safety Review Teams (IAEA)
PSA	Probabilistic safety analysis
PSHA	Probabilistic seismic hazard analysis
PSI	Paul Scherrer Institute
PSR	Periodic safety review
PWR	Pressurised water reactor
QA	Quality assurance
QM	Quality management
RHR	Residual heat removal
RPS	Reactor protection system
SAMG	Severe accident management guidance
SAR	Safety analysis report
SEGHOF	Special experts group on human and organisational factors
SER	Safety evaluation report
SIA	Swiss Society of Engineers and Architects
SNS/TNS	Section for Nuclear Technology and Security (since 2001 re-named into KE: Nuclear Energy and Law)
SPDS	Safety parameter display system
SSE	Safe shutdown earthquake
SVA/ASPEA	Swiss Association for Atomic Energy
SVTI/ASIT	Swiss Association for Technical Inspections
Tech Specs	Plant technical specifications
US-NRC	United States Nuclear Regulatory Commission
Uni BS	University of Basel
UVEK/DETEC	Federal Department of Environment, Transport, Energy and Communication
VBS/DPS	Federal Department of Defence, Civil Protection and Sports
WANO	World Association of Nuclear Operators
WGOE	Working group on operational experience

Appendix 2: List of the Inspectorate's (HSK/DSN) Guidelines presently in force

Status: as of June 30, 2001

Languages: All guidelines originally written in German; guidelines noted /e or /r have been also translated into in English or Russian. For guidelines denoted with " * ", only the title has been translated into English.

Guideline	Title of Guideline	Date of current issue
R-04/d *	Supervisory procedures governing the construction of nuclear power plants: Design of buildings (Aufsichtsverfahren beim Bau von Kernkraftwerken: Projektierung von Bauwerken)	December 1990
R-05/d *	Supervisory procedures governing the construction of nuclear power plants: Mechanical equipment (Aufsichtsverfahren beim Bau von Kernkraftwerken: mechanische Ausrüstungen)	October 1990
R-06/d *	Safety classification, interface between classes and construction regulations concerning equipment of light water reactor nuclear power plants (Sicherheitstechnische Klassierung, Klassengrenzen und Bauvorschriften für Ausrüstungen in Kernkraftwerken mit Leichtwasserreaktoren)	May 1985
R-07/d *	Guideline for radiation protection zones in nuclear installations and in the Paul Scherrer Institute (Richtlinie für den überwachten Bereich der Kernanlagen und des Paul Scherrer Institutes)	June 1995
R-08/d R-08/e	Sicherheit der Bauwerke für Kernanlagen, Prüfverfahren des Bundes für die Bauausführung Safety of buildings for nuclear installations: Federal supervisory procedures for the construction	May 1976 May 1976
R-11/d *	Objectives of the protection of persons from ionising radiation in the vicinity of nuclear power plants (Ziele für den Schutz von Personen vor ionisierender Strahlung im Bereich von Kernkraftwerken)	May 1980
R-12/d R-12/e	Erfassung und Meldung der Dosen des strahlenexponierten Personals der Kernanlagen und des Paul Scherrer Institutes Determining and reporting the doses of occupationally radiation exposed personnel of nuclear installations and the Paul Scherrer Institute	October 1997 October 1997
R-14/d R-14/e	Konditionierung und Zwischenlagerung radioaktiver Abfälle Conditioning and Interim Storage of Radioactive Wastes	December 1988 December 1988
R-15/d *	Reporting guideline concerning the operation of nuclear power plants (Berichterstattung über den Betrieb von Kernkraftwerken)	December 1999
R-16/d *	Seismic plant instrumentation (Seismische Anlageninstrumentierung)	February 1980
R-17/d *	Organisation and personnel of nuclear power plants (Organisation und Personal von Kernkraftwerken)	August 1986
R-18/d *	Supervision of repairs, modifications and replacement of mechanical equipment in nuclear installations (Aufsichtsverfahren bei Reparaturen, Änderungen und Ersatz von mechanischen Ausrüstungen in Kernanlagen)	December 2000
R-21/d R-21/e	Schutzziele für die Endlagerung radioaktiver Abfälle Protection Objectives for the Disposal of Radioactive Waste	November 1993

Guideline	Title of Guideline	Date of current issue
R-23/d *	Revisions, testing, replacement, repair and modification of electrical equipment in nuclear installations (Revisionen, Prüfungen, Ersatz, Reparaturen und Änderungen an elektrischen Ausrüstungen in Kernanlagen)	December 1993
R-25/d *	Reporting guideline concerning the Paul Scherrer Institute and the nuclear installations of the Swiss Confederation and the cantons (Berichterstattung des Paul Scherrer Institutes sowie der Kernanlagen des Bundes und der Kantone)	June 1998
R-27/d *	Selection, training and examination of NPP staff requiring a licence (Auswahl, Ausbildung und Prüfung des lizenzpflichtigen Betriebspersonals von Kernkraftwerken)	May 1992
R-30/d *	Supervisory procedures for construction and operation of nuclear installations (Aufsichtsverfahren beim Bau und Betrieb von Kernanlagen)	July 1992
R-31/d *	Supervisory procedures governing the construction of nuclear power plants: 1E classified electrical equipment (Aufsichtsverfahren beim Bau von Kernkraftwerken, 1E klassierte elektrische Ausrüstungen)	January 1994
R-32/d *	Guideline for meteorological measurement on sites of nuclear installations (Richtlinie für die meteorologischen Messungen an Standorten von Kernanlagen)	September 1993
R-35/d *	Supervisory procedures governing the construction of nuclear power plants: System engineering (Aufsichtsverfahren beim Bau und Änderungen von Kernkraftwerken, Systemtechnik)	May 1996
R-37/d *	Appreciation of education and training in radiation protection within the supervisory domain of HSK (Anerkennung von Strahlenschutz-Ausbildungen und –Fortbildungen im Aufsichtsbereich der HSK)	July 2001
R-39/d *	Registration of radiation sources and material testers on a nuclear installation site (Erfassung der Strahlenquellen und Werkstoffprüfer im Kernanlageareal)	January 1990
R-40/d *	Filtered containment venting for light water reactors: design requirements (Gefilterte Druckentlastung für den Sicherheitsbehälter von Leichtwasserreaktoren, Anforderungen für die Auslegung)	March 1993
R-41/d R-41/e	Berechnung der Strahlenexposition in der Umgebung aufgrund von Emissionen radioaktiver Stoffe aus Kernanlagen Calculation of the radiation exposures in the vicinity of nuclear installations due to emissions of radioactive materials	July 1997 July 1997
R-42/d R-42/e	Zuständigkeiten für die Entscheide über besondere Massnahmen bei einem schweren Unfall in einer Kernanlage Responsibility for decisions to implement particular measures to mitigate the consequences of a severe accident at a nuclear installation	February 2000 March 1993
R-45/d R-45/e	Planung und Durchführung von Notfallübungen in den schweizerischen Kernanlagen Planning and Execution of Emergency Exercises in Swiss Nuclear Power Plants	July 1997 February 1998
R-47/d *	Testing of radiation measuring instruments (Prüfung von Strahlenmessgeräten)	October 1999

Guideline	Title of Guideline	Date of current issue
R-49/d *	Technical safety requirements for the securing of nuclear installations (Sicherheitstechnische Anforderungen an die Sicherung von Kernanlagen)	March 2001
R-100/d *	Nuclear power plant conditions (Anlagezustände eines Kernkraftwerks)	June 1987
R-101/d	Auslegungskriterien für Sicherheitssysteme von Kernkraftwerken mit Leichtwasser-Reaktoren	May 1987
R-101/e	Design Criteria for Safety Systems of Nuclear Power Plants with Light Water Reactors	May 1987
R-102/d	Auslegungskriterien für den Schutz von sicherheitsrelevanten Ausrüstungen in Kernkraftwerken gegen die Folgen von Flugzeugabsturz	December 1986
R-102/e	Design criteria for the protection of safety equipment in NPPs against the consequences of airplane crash	December 1986
R-103/d *	Plant internal measures against the consequences of severe accidents (Anlageinterne Massnahmen gegen die Folgen schwerer Unfälle)	November 1989

Appendix 3: List of annexes

Inspectorate's (HSK/DSN) annual report for 1999.

Inspectorate's (HSK/DSN) annual report for 2000.

Inspectorate's (HSK/DSN) descriptive booklet.

Inspectorate's (HSK/DSN) Terms of reference.

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