SWITZERLAND

2012

1. GENERAL INFORMATION

1.1. Country overview

Switzerland is one of the most mountainous countries in Europe, with more than 70% of its area covered by the Alps and the Jura. It has 7,870,134 (2010 data) inhabitants, with an overall population density of about 191 people per km^2. The major language communities are: German, French, Italian, and Romansh. Foreign nationals and their families make up roughly 22% of the population.

Sources:
Federal Statistical Office, http://www.bfs.admin.ch, 11 April 2012

1.1.1. Governmental System

Switzerland is a federal state, with three political and legal levels: the communes (2551, 2011 data), the cantons (26) and the Confederation. The Swiss parliament, or Federal Assembly, is made up of two chambers: the National Council and the Council of States. Every four years, the people elect the 200 members of the National Council, most recently in October 2011. The government is made up of seven members, elected by the United Federal Assembly.

Sources:
The Federal Authorities of the Swiss Confederation, http://www.admin.ch, 11 April 2012

1.1.2. Geography and Climate

Switzerland covers an area of 41,285 km^2, comprising 31% forest and grove, 37% cropland and pastureland, 7% built-up and 25% un-productive land (situation in the mid-1990s). Around 4% of the country's surface area is covered by water. Climatic conditions, average temperature and precipitation patterns vary significantly across Switzerland, depending mainly on altitude and location.

Sources:
Federal Statistical Office, http://www.bfs.admin.ch, 11 April 2012
Federal Office for the Environment, http://www.bafu.admin.ch, 11 April 2012

1.1.3. Population

According to recent trends, the population is expected to grow to 8,162,000 by 2035. Afterwards, the positive population development is likely to reverse and begin to decrease. Switzerland's population is expected to be 8,061,000 in 2050.

TABLE 1. POPULATION INFORMATION

							Average annual growth rate (%)
Year	**1970**	**1980**	**1990**	**2000**	**2005**	**2010***	**2000 to 2010***
Population (millions)	6.19	6.34	6.75	7.20	7.46	7.87	0.89
Population density (inhabitants/km²)	150	159	169	180	186	191	0.59
Urban Population as % of total**	N.A.	74	74	73	73	74	0.14
Area (1000 km²)						41.285	

* Latest available data

** Population living in urban regions according to the definition of the Federal Statistical Office

Sources:
Federal Statistical Office, http://www.bfs.admin.ch, 11 April 2012

1.1.4. Economic Data

In spring 2012, the Federal Government's Expert Group on Economic Forecasts anticipated modest growth in GDP of +0.8% for 2012, which is likely to further strengthen in 2013 (+1.8%).

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

							Average annual growth rate (%)
	1970	1980	1990	2000	2005	2010**	2000 to 2010**
GDP (millions of current USD)	N.A.	109852	238220	249912	372477	527920	7.77
GDP (millions of constant 2000 USD)	N.A.	178231	221699	249912	258647	294741	1.66
GDP per capita (PPP* USD/capita)	N.A.	13748	24379	31094	35816	41950	3.04
GDP per capita (current USD/capita)	N.A.	17383	35490	34786	50084	67779	6.9

* PPP: Purchasing Power Parity

** Latest available data

Sources:
State Secretariat for Economic Affairs, http://www.seco.admin.ch, 11 April 2012
International Monetary Fund, http://www.imf.org, 11 April 2012

1.2. Energy Information

1.2.1. Estimated available energy

No available data

1.2.2. Energy Statistics

TABLE 4. ENERGY STATISTICS (in Exa-Joule)

	1970	1980	1990	2000	2005	2010*	Average annual growth rate (%) 2000 to 2010*
Energy consumption**							
- Total	0.665	0.848	1.009	1.104	1.138	1.188	0.73
- Solids***	0.027	0.014	0.015	0.006	0.006	0.006	0.93
- Liquids	0.515	0.521	0.523	0.532	0.542	0.532	0
- Gases	0.002	0.036	0.068	0.102	0.117	0.126	2.15
- Nuclear	0.020	0.149	0.243	0.272	0.240	0.275	0.1
- Hydro	0.113	0.121	0.110	0.136	0.118	0.135	-0.11
- Other Renewables	0.010	0.036	0.057	0.081	0.091	0.111	3.19
- Net electricity import	-0.022	-0.029	-0.008	-0.025	0.023	0.002	-
Energy production							
- Total	0.129	0.206	0.248	0.308	0.290	0.337	0.9
- Solids***							
- Liquids							
- Gases			0.000				
- Nuclear	0.007	0.049	0.081	0.091	0.080	0.092	0.12
- Hydro	0.113	0.121	0.110	0.136	0.118	0.135	-0.11
- Other Renewables	0.010	0.036	0.056	0.081	0.091	0.111	3.12
Net import (Import - Export)							
- Total	0.571	0.708	0.848	0.845	0.914	0.897	0.59

* Latest available data
** Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy
*** Solid fuels include coal, lignite

Sources:
Swiss Energy Statistics 2010, Swiss Federal Office of Energy SFOE

1.2.3. Energy policy

After the Fukushima accident, the Federal Council decided to phase out nuclear power. The five existing NPPs are to continue operating until the end of their lifetime (the first NPPs are likely to be shut down around 2020, the last one by 2034). The process of establishing permits for three new NPPs was halted. The phase-out decision stemmed from the fact that public opinion, which had been split 50/50 before Fukushima, had become overwhelmingly anti-nuclear. Approval of new NPPs in foreseeable referendums had therefore become impossible. The phase-out decision

has also been endorsed by the Swiss Parliament (National Council and Council of States).

The nuclear phase-out requires a new Energy Policy to be formulated to replace some 40% of current electricity supply which comes from nuclear power (assuming electricity demand growth can eventually be stabilized in the years to come). The gap is to be filled by a mix of options, including ambitious efficiency measures, accelerated promotion of new renewable energies and additional large hydro, and likely some gas-fired CCGT and combined heat-and-power plants, as well as increased electricity trade. Gas-fired power, a novelty for Switzerland, will be challenging for the national climate policy goal.

1.3. The electricity system

1.3.1. Electricity policy and decision making process

The Electricity Supply Act (StromVG, effective since 1 January 2008) creates the framework for a phased liberalisation of the Swiss electricity market. The market was partially opened for eligible customers[1] in 2008. Full liberalisation is foreseen for 2014, subject to an optional referendum.

In order to increase the share of electricity produced from renewable energy sources, an amendment was made to the Electricity Supply Act introducing compensatory feed-in remuneration to cover the cost of electricity from renewable energy sources.

1.3.2. Structure of electric power sector

Roughly 40% of Swiss electricity generation comes from nuclear power, with the remaining share mostly produced by large hydropower plants (see following section). Switzerland's electricity market is highly fragmented. The supply of electricity is assured by some 750 companies, including 7 generation and transmission companies and approximately 80 producers. Many tasks are undertaken by the communes, which also supply water and gas. In some cantons and cities, a single vertically-integrated company is responsible for the entire supply chain, while in other cantons these are provided by a variety of companies. The public sector stake in the capital stock of electricity supply companies is currently around 80%, while the remaining 20% is held by private-sector companies (domestically and abroad).

Switzerland regulated grid usage through the above-mentioned Electricity Supply Act. The Act stipulates that the high-voltage transmission grid should be operated by the national grid company, Swissgrid, which guarantees non-discriminatory access to the grid for all companies. The Act also stipulates the unbundling of previously vertically-integrated companies.[2]

[1] Corporations with an annual electricity consumption of more than 100,000 kWh.

[2] In the previously monopolised market, companies tended to be vertically integrated, i.e. they performed all tasks along the complete value chain (generation, transmission, distribution, selling and trading).

ElCom is Switzerland's independent regulatory authority for the electricity sector. It is responsible for monitoring compliance with the Swiss Federal Electricity Act, taking all necessary related decisions and pronouncing rulings where required. ElCom monitors electricity prices and rules as a judicial authority on disputes relating to network access and payment of cost-covering feed-in of electricity produced from renewable energy. It also monitors security of the electricity supply, and regulates issues related to international electricity transmission and trading.

1.3.3. Main indicators

In 2010, hydropower's share of total electricity production was 57%, while nuclear power contributed 38%. The remaining 5% is covered by fossil and renewable sources. Table 5 and 6 provide further information on electricity production, consumption and capacity.

TABLE 5. ELECTRICITY PRODUCTION, CONSUMPTION AND CAPACITY

							Average annual growth rate (%)
	1970	**1980**	**1990**	**2000**	**2005**	**2010***	**2000 to 2010***
Capacity of electrical plants (GWe)							
- Combustible Fuels	0.570	0.600	0.487	0.795	0.855	0.947	1.76
- Hydro	9.620	11.450	13.125	14.895	15.010	15.537	0.42
- Nuclear	0.350	1.940	2.950	3.200	3.220	3.253	0.16
- Wind			0.000	0.003	0.012	0.042	30.2
- Geothermal							
- Solar			0.002	0.015	0.026	0.111	22.16
- Total	10.540	13.990	16.564	18.908	19.123	19.890	0.51
Electricity production (TWh)							
- Thermal	1.763	0.957	1.014	2.371	2.933	3.131	2.82
- Hydro	31.273	33.542	30.675	37.851	32.759	37.450	-0.11
- Nuclear	1.850	13.663	22.298	24.949	22.020	25.205	0.1
- Wind				0.003	0.008	0.037	28.56
- Geothermal							
- other renewable			0.087	0.174	0.198	0.429	9.44
- Total (1)	34.886	48.162	54.074	65.348	57.918	66.252	0.14
Total Electricity consumption (TWh)	25.087	35.252	46.578	52.373	57.330	59.785	1.33

(1) Electricity transmission losses are not deducted.
* Latest available data

Sources:
Swiss Energy Statistics 2010, SFOE

TABLE 6. ENERGY RELATED RATIOS

	1970	**1980**	**1990**	**2000**	**2005**	**2010***
Energy consumption per capita (GJ/capita)	107.5	133.8	149.5	153.1	152.1	151.0
Electricity consumption per capita (kWh/capita)	4052.8	5560.3	6900.4	7272.0	7685.0	7596.4

Electricity production/Energy production (%)	97.4	84.2	78.5	76.4	71.9	70.8
Nuclear/Total electricity (%)	5.3	28.4	41.2	38.2	38.0	38.0
Ratio of external dependency (%) (1)	85.9	83.5	84.0	76.5	80.3	75.5

(1) Net import / Total energy consumption
* Latest available data

Sources:
Swiss Energy Statistics 2010, SFOE

2. NUCLEAR POWER SITUATION

2.1. Historical development and current organisational structure

2.1.1. Overview

Development of a nuclear programme

In November 1945, the Swiss government established the independent Atomic Energy Committee, with the mandate to advise the government in all civilian and military matters dealing with nuclear energy. In 1946, the Swiss government mandated the Atomic Energy Committee to investigate all aspects dealing with nuclear weapons, i.e. to prepare the necessary measures for protecting army and population against their impact, and also to study what would be required to develop such weapons. On 18 March 1957, parliament ratified the IAEA Statute, which entered into force on 29 July 1957. In 1969, Switzerland signed the Non-Proliferation Treaty, which was ratified by parliament on 9 March 1977.

As early as 1946, Brown, Boveri & Cie. (BBC), now ABB Group, took the first steps to build up a team of physicists and to launch a development programme. BBC was later joined by Sulzer Brothers and Escher-Wyss. Initial studies dealt with graphite-carbon dioxide reactor concepts, but from 1952 onwards, development concentrated on heavy water moderated reactors with the subsequent planning of the research reactor DIORIT. In 1955, more than 150 private companies joined forces and formed the company “Reactor Ltd” to build and operate the new, privately-owned research centre in Würenlingen, with two reactors on site: SAPHIR and DIORIT. In 1960, the federal government took over the research centre, known under its abbreviation EIR (Eidgenössisches Institut für Reaktorforschung). In 1988, the merger of EIR and SIN (Schweizerisches Institut für Nuklearphysik) led to the creation of the Paul Scherrer Institute (PSI).

In Switzerland, the nuclear age began on 30 April 1957, when the SAPHIR research reactor went critical under the responsibility of Swiss scientists and engineers. This pool reactor had been purchased in 1955 from the US Government, after being exhibited in Geneva during the First International Conference on the Peaceful Uses of Atomic Energy. SAPHIR was shut down permanently at the end of 1993.

DIORIT, the first reactor designed and constructed in Switzerland, reached criticality on 15 August 1960. It was moderated and cooled by heavy water. The fuel was initially natural uranium, and a special loop allowed for the testing of power reactor

fuel elements. DIORIT was shut down permanently in 1977. At the end of 2003, all radioactive material was removed from the reactor building.

In 1962, the construction of the experimental nuclear power reactor in Lucens was started. This was a 30 MW(th), 6 MW(e), heavy-water moderated, carbon dioxide cooled reactor, located in an underground cavern. Criticality was reached in late 1966, and commissioning in early 1968. In spite of numerous difficulties, the supply consortium, led by Sulzer Brothers, had demonstrated that Swiss industry was capable of building nuclear plants. The goal was the development of a small to medium-sized power reactor, fuelled with natural uranium, within a massive containment system. As enriched uranium became readily available during the mid-1960s, the unit size of commercially-offered light water reactor nuclear power plants (NPPs) increased drastically. Swiss utilities started construction of such plants very early on, while the interest in the Lucens reactor type decreased and further large expenses for such a development could not be justified. The decision was taken to operate the reactor until the end of 1969. However, on 21 January 1969, the plant was abruptly put out of service by a partial core meltdown that destroyed the integrity of the primary system and released radioactivity into the cavern. After decontamination, decommissioning and termination of intermediate storage of radioactive material, the whole site was prepared for unrestricted reuse in 2003.

Nuclear power plant projects

In August 1965, a turnkey contract was awarded by Nordostschweizerische Kraftwerke AG (NOK) to a consortium made up of Westinghouse International Atomic Power Co, Ltd. and Brown, Boveri & Cie. for the supply of a 350 MW(e) plant equipped with a pressurised water reactor and two turbo-generators (Beznau). In late 1967, NOK took the option of ordering a duplicate of the first unit. Beznau I reached criticality by the end of June 1969, and Beznau II in October 1972.

Also in 1965, Bernische Kraftwerke AG (BKW) chose a 306 MW(e) plant, equipped with a boiling water reactor manufactured by General Electric (GE) and twin turbo-generators from BBC (Mühleberg). In July 1971, full power was achieved, but on 28 July 1971, a turbine fire broke out. Sixteen months later, the plant was officially handed to the owner.

In 1973, a supply contract was signed by a consortium of Swiss utilities with Kraftwerk Union (Siemens) for the delivery of a 900 MW(e) pressurized water reactor and turbo-generator (Gösgen). Construction of the plant went very smoothly, with the first connection to the grid in February and the 80% power test in March 1979. However, the accident at Three Mile Island, on 29 March 1979, led to an 8 month delay in commissioning.

In December 1973, a consortium of Swiss utilities and one German utility awarded a turnkey contract to General Electric Technical Services Overseas (GETSCO) and BBC for the supply of a 940 MW(e) nuclear power plant equipped with a boiling water reactor (Leibstadt). Construction began in 1974, and the plant was commissioned in December 1984.

Political controversy and legal framework

The nuclear controversy began in Switzerland in 1969, with the first signs of local opposition to a nuclear plant project at Kaiseraugst, near Basel. For 20 years, the Kaiseraugst project was to remain centre stage in the nuclear controversy: site permit, local referenda, legal battles, site occupation by opponents in 1975, parliamentary vote in favour of construction in 1985, and finally parliamentary decision, in 1989, to end the project definitively. The Chernobyl accident of spring 1986 had a dramatic impact on the political climate. Although some of the necessary permits had already been issued for two planned NPPs at Kaiseraugst and Graben, their construction was subsequently abandoned, as were other projects in Verbois, Inwil and Rüthi.

The nuclear controversy led to several anti-nuclear initiatives at the federal level:

i. an attempt to forbid all nuclear plants, both new and already in operation – rejected by 51.2% of the vote in February 1979;

ii. aimed at forbidding future nuclear plants, leaving untouched the plants in operation (two initiatives differing only in the treatment to be applied to Leibstadt, then under construction) – rejected by 55% of the vote in September 1984;

iii. nuclear phase-out – rejected by 52.9% of the vote in September 1990;

iv. 10-year moratorium on the construction of new NPPs – accepted by 54.6% of the vote in September 1990;

v. two new initiatives organised in 1999, aimed at the ban of the construction of new NPPs until 2010 and the closure of all NPPs after a 30 year lifespan – both initiatives were rejected in May 2003 by 58.4% and 66.3% respectively.

A new Nuclear Energy Act came into force on 1 February 2005. It allowed the possibility of building new reactors, with the possibility of a referendum against their construction. No time limit is imposed on the life of existing nuclear power plant, and the general license is maintained. It introduces a 10 year moratorium on the export of nuclear fuel for reprocessing from 2006 to 2016. It also includes provisions for decommissioning, a concept of monitored long-term geological disposal of radioactive waste that combines elements of final disposal and reversibility, and a system for funding the costs of decommissioning and of radioactive waste management. It simplifies licensing procedures and introduces the general right of appeal. A new Nuclear Energy Ordinance came into force together with the Act.

During the 10 year moratorium regarding reprocessing, which began in July 2006, spent fuel is stored in Switzerland, with a view to later reprocessing or direct disposal. Plutonium and uranium gained from the reprocessing of spent fuel that was sent abroad before July 2006 is recycled in Swiss NPPs. The radioactive waste arising from reprocessing of spent fuel is returned to Switzerland.

Following the nuclear accident at the Fukushima NPP in March 2011, the Federal Council decided to gradually phase out nuclear power. In autumn 2011, the Swiss parliament subsequently confirmed the Federal Council's decision.

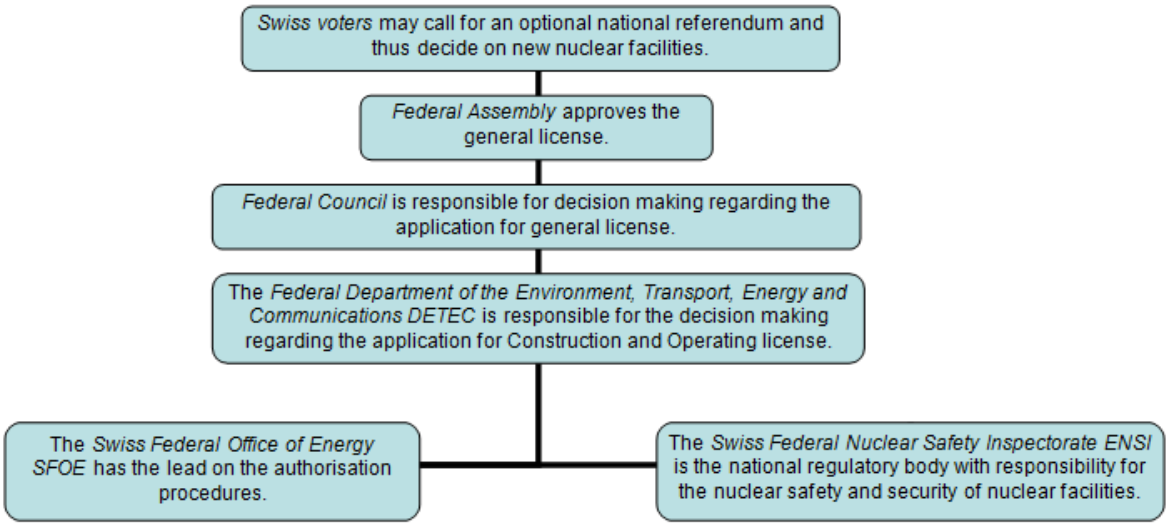
Radioactive waste management

The safe disposal of radioactive waste is the responsibility of those parties who produce it, namely the following nuclear power plant operators: BKW FMB Energie AG (Mühleberg), KKW Gösgen-Däniken AG, KKW Leibstadt AG, Nordostschweizerische Kraftwerke Baden – now Axpo (Beznau I and II), and Energie Ouest Suisse – now Alpiq. In 1972, the above operators established the National Co-operative for the Disposal of Radioactive Waste (Nagra), together with the federal government, which is responsible for the disposal of radioactive waste from the healthcare sector, industry and research, and is represented by the Federal Department of Home Affairs.

So far, there are no deep geological repositories in Switzerland. For both Low/Intermediate Level Waste (L/ILW) and High Level Waste (HLW) repositories, a site selection process is defined in a sectoral plan within the framework of the spatial planning legislation. The Federal Council adopted the conceptual part of the "Sectoral Plan for Deep Geological Repositories" in April 2008, thus initiating a three-stage procedure that will result in the designation of suitable sites for deep geological repositories.

The goal of the first stage was the selection of siting regions for geological repositories for HLW and for L/ILW, based on safety criteria. Nagra proposed six potential siting regions in October 2008. The Swiss Federal Nuclear Safety Inspectorate (ENSI), considering the input of a number of expert organisations, approved the six proposals. Following this review process, the Swiss Federal Office of Energy (SFOE) carried out a broad consultation on the first stage at the end of 2010 and submitted a report to the Federal Council. The Federal Council approved all six potential siting regions on 30 November 2011, thus concluding the first stage of the site selection process and initiating the second stage (see section 2.7).

2.1.2. Current organisational chart(s)



2.2. Nuclear power plants: Overview

2.2.1. Status and performance of nuclear power plants

Five NPPs at four sites are currently in operation in Switzerland (see Table 7). There are four research reactors and two central disposal facilities for radioactive waste. Disposal facilities for radioactive waste are situated in the vicinities of the NPPs. Switzerland's five NPPs have a total capacity of 3.3 GW, and an annual availability rate of approximately 90%. Figure 1 indicates the sites of the Swiss research reactors and NPPs.

TABLE 7. STATUS AND PERFORMANCE OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date+	Grid Date ++	Commercial Date	Shutdown Date	UCF* for 2011**
Beznau I	PWR	365	Axpo AG	in operation	WH[3]	1965-09-01	1969-07-17	1969-09-01	-	96.6
Beznau II	PWR	365	Axpo AG	in operation	WH	1968-01-01	1971-10-23	1971-12-01	-	86.3
Mühleberg	BWR	373	BKW FMB Energie AG	in operation	GETSCO[4]	1967-03-01	1971-07-01	1972-11-06	-	76.8
Gösgen	PWR	970	Kernkraftwerk Gösgen-Däniken AG	in operation	KWU[5]	1973-12-01	1979-02-02	1979-11-01	-	92.8
Leibstadt	BWR	1190	Kernkraftwerk Leibstadt AG	in operation	GETSCO	1974-01-01	1984-05-24	1984-12-15	-	92.4

* UCF (Unit Capability Factor) for the latest available year (only applicable to reactors in operation).

** Latest available data

+ Date, when first major placing of concrete, usually for the base mat of the reactor building is done.
++ Date of the first connection to the grid

Sources:

PRIS database, http://www.iaea.org/pris, 11 April 2012

Beznau I + II : http://www.axpo.ch

Mühleberg : http://www.bkw-fmb.ch

Gösgen : http://www.kkg.ch

Leibstadt : http://www.kkl.ch

2.2.2. Plant upgrading, plant life management and license renewals

Over time, all Swiss NPPs have upgraded their power capacity. At the end of 2011, the nominal net powers were twice 365 MWe for Beznau-, 373 MWe for Mühleberg-, 970 MWe for Gösgen- and 1,190 MWe for Leibstadt-NPP.

The power plants of Beznau (Unit 1 & 2), Gösgen and Leibstadt have unlimited operating licenses. In December 2009, the Federal Department of the Environment,

[3] WH: Westinghouse Electric Corporation

[4] GETSCO: General Electric Technical Services Corporation

[5] KWU: Siemens Kraftwerk Union AG

Transport, Energy and Communications DETEC granted an unlimited operating license for the operator of Mühleberg. This decision has been appealed and is currently pending before the Federal Supreme Court.

2.3. Future development of Nuclear Power

2.3.1. Nuclear power development strategy

The Swiss government announced a new energy policy in 2007, which included renewable energies, energy efficiency, energy foreign policy and new large-scale power stations, including the replacement of the existing five NPPs. In 2008, the three big electricity companies, Alpiq, Axpo and BKW, submitted general license applications for three new nuclear units at Goesgen, Beznau and Muehleberg, all three on existing nuclear sites (see section 2.3.5 for more information on these applications).

Following the nuclear accident at the Fukushima NPP in Japan, the head of the Federal Department of the Environment, Transport, Energy and Communications DETEC suspended the licensing procedure for the new Swiss NPPs. This decision was taken only three days after the nuclear accident in Japan, on 14 March 2011.

As a consequence of the events in Japan, the Swiss Federal Nuclear Safety Inspectorate ENSI immediately started carrying out a safety review of the existing NPPs. According to an ENSI ordinance, the Swiss NPPs had to participate in the EU-Stress tests. The European Nuclear Safety Regulators Group (ENSREG) in charge of this peer review process stated in the final report for Switzerland: "In general, the design and further development of the plants are based on the 'defence in depth' concept and in consequence results in good robustness of the plants against severe accidents". ENSREG recommends "that the regulator assesses the opportunity of requiring more reliance on passive systems for hydrogen management for severe accident conditions. It is also recommended that the regulator considers further studies on the hydrogen management for the venting systems". Based on the reviews carried out so far, several measures have been taken to optimize safety and security. They are included in the post-Fukushima action plan. This plan foresees that 45 open points will be dealt with until 2015.

On 25 May 2011, the Federal Council decided to phase out nuclear power. The Swiss parliament (National Council and Council of States) subsequently confirmed the Federal Council's decision by approving a stepwise phase-out of nuclear power: existing NPPs should be decommissioned at the end of their operational lifespan and should not be replaced by new NPPs, as was originally foreseen. The new Energy Strategy 2050 has been submitted to parliament for debate.

The owners and operators of NPPs are responsible for fuel cycle planning and decision-making. They make contracts in accordance with national legislation and international agreements. The strategy chosen by the NPP operators includes both the reprocessing and storage of spent fuel, the latter with a view to later reprocessing or direct disposal. The reprocessing takes place abroad (France and UK). Plutonium and uranium gained from reprocessing is used for fuel fabrication and is reused in Swiss NPPs. The radioactive waste arising from reprocessing is returned to Switzerland.

However, according to article 106, paragraph 4, of the Nuclear Energy Act (NEA, SR 732.1), spent fuel elements may not be exported for reprocessing for a period of ten years, with effect from 1 July 2006. During this period, they shall be managed as radioactive waste.

In accordance with the polluter-pays principle, producers of radioactive waste in Switzerland are responsible for ensuring its safe disposal at their own cost. The various ongoing costs (e.g. studies carried out by Nagra, construction of interim storage sites, site selection procedure for deep geological repositories) have to be paid as they arise. Decommissioning costs and expenditure associated with the management (including disposal) of radioactive waste after a nuclear power plant has been closed down are secured through contributions paid into two independent funds by the operator:

- Decommissioning fund
- Waste Disposal fund

The Nuclear Energy Act and the Ordinance on the Decommissioning Fund and the Waste Disposal Fund (7 December 2007) form the legal basis for these two funds.

2.3.2. Project management

Licensing procedures are divided in three stages: i) the general license procedure, ii) the construction license procedure and iii) the operating license procedure. The time needed from submitting the application for a general license till granting the operating license is estimated at approximately 15 years.

The *Federal Council* is responsible for decision making regarding the application for general license. The decision of the Federal Council will be brought before parliament. It is then subject to an optional referendum. The Swiss government consists of the seven members of the Federal Council who are elected by the United Federal Assembly for a four-year term.

The *Federal Department of the Environment, Transport, Energy and Communications DETEC* is responsible for the decision making regarding the application for Construction and Operating license. Its decisions can be appealed to the Federal Administrative Court, and at a later stage to the Federal Supreme Court. More than 1900 people work within DETEC (including its agencies like SFOE).

The *Swiss Federal Office of Energy SFOE* has the lead on all three authorisation procedures. The SFOE employs almost 200 staff members. As of the beginning of 2012, the SFOE comprises five divisions and two operational sections.

The *Swiss Federal Nuclear Safety Inspectorate ENSI* is the national regulatory body with responsibility for the nuclear safety and security of Swiss nuclear facilities. In the licensing procedures it is also responsible for safety-related examination and assessment of the facilities. Most of ENSI's expenses are covered by fees which license holders have to pay to the federal government. ENSI currently employs around 150 staff members: physicists, mechanical, electrical and civil engineers, geologists, chemists, biologists and psychologists, in addition to technical and administrative personnel.

Other public entities involved in the above mentioned authorisation procedures are the *Swiss Federal Nuclear Safety Commission NSC*, the *Federal Office for the Environment FOEN*, the *Federal Office for Spatial Development ARE* and the *cantons*.

2.3.3. Project funding

No governmental financial support is granted for the construction of new NPPs. Some public entities such as the cantons nevertheless have considerable shares in some of the relevant companies.

2.3.4. Electric grid development

The transmission and distribution networks need to be modernized and expanded. To cope with the increasing fluctuations in electricity production (like wind and photovoltaic), electricity systems have to become more flexible. The continuous balance between production and consumption needs to be guaranteed under increasingly dynamic conditions, and grids need to become more automated. Smart grids offer one possible solution to these challenges.

Switzerland is closely integrated into the European electricity system. Close integration is of mutual benefit for Switzerland and its neighbouring countries, with respect to security of supply. A national strategy for energy networks, including aspects of international integration, will be defined to this end. This strategy will also include measures to accelerate the approval process and address aspects concerning the costs of grid expansion and renovation, as well as the development of the electricity grids towards smart grids.

2.3.5. Site Selection

On 9 June 2008, Kernkraftwerk Niederamt AG, a subsidiary of Atel Holding AG (now known as Alpiq Holding AG), submitted an application to the Swiss Federal Office of Energy (SFOE) for a general license for a nuclear power plant with a maximum output of 1,600 MW. The plan for the new facility is to be constructed in Niederamt (canton of Solothurn), near the existing Gösgen NPP.

On 4 December 2008, on behalf of Axpo Holding AG and BKW FMB Energie AG respectively, Ersatz Kernkraftwerk Beznau AG and Ersatz Kernkraftwerk Mühleberg AG each submitted an application to the SFOE for a general license for the construction of new NPPs to replace the existing Beznau I, Beznau II and Mühleberg facilities. The plan is for these new NPPs, each with a maximum output of 1,600 MW, to be constructed at the locations of the existing facilities, namely in Beznau (canton of Aargau) and Mühleberg (canton of Bern).

All three applications have been examined in detail by the Swiss Federal Nuclear Safety Inspectorate ENSI. It attested, on 15 November 2010, that the data provided by the applicants is scientifically correct. The reviewed applications satisfy the legal requirements. The Nuclear Safety Commission NSC released its opinion on 10 January 2011. It states that ENSI delivered an in-depth safety review. The NSC has also made a number of recommendations.

All three procedures have been suspended as a consequence of the nuclear accident in Japan, on 14 March 2011.

2.4. Organisations involved in construction of NPPs

Not available.

2.5. Organisations involved in operation of NPPs

The following organisations operate a nuclear power plant:

- KKG AG
- KKL AG
- Axpo AG
- BKW FMB Energie AG

Major Switzerland-based vendors / supporting organisations are:

- ABB AG
- Alstom AG
- AF-Colenco AG
- CCI Schweiz AG

More information can be found at http://www.nuclearindustry.ch

2.6. Organisations involved in decommissioning of NPPs

No commercial NPP is under decommissioning.

2.7. Fuel cycle including waste management

Fuel supply

Switzerland has no domestic nuclear fuel cycle industry. Enrichment is provided by the USA, Russia and countries of the European Union. The fuel elements are manufactured in the USA, countries of the European Union and Russia.

Legal framework

In 2003, the parliament decided to introduce a 10 year moratorium on the export of spent fuel for reprocessing, which started in July 2006. Before the start of the moratorium, the utilities were free to choose between reprocessing and direct disposal of the spent fuel. The Nuclear Energy Act states a series of conditions which must be fulfilled for authorization of the export of spent fuel for reprocessing to be granted.

The conditions include an agreement with the country of destination, the existence in that country of an adequate facility corresponding to international standards and the fact that the country of destination has ratified the Convention on Nuclear Safety and the Joint Convention. The management (handling and storage) of radioactive waste is governed by the provisions of the Nuclear Energy Act and the Nuclear Energy Ordinance, both of which entered into force on 1 February 2005. The management of radioactive waste originating from medicine, industry and research is governed by the Radiological Protection Act and the Radiological Protection Ordinance, both of which entered into force on 1 October 2004.

All radioactive waste is to undergo storage in repositories situated in suitable geological formations; near-surface disposal is not allowed. Since no repository is yet available, all radioactive waste is stored in interim storage facilities.

Storage facilities

At present, the following spent fuel and radioactive waste management facilities exist in Switzerland:

- NPPs:

  All Swiss NPPs have on-site installations for the conditioning and storage of their own operational waste.
- ZZL/Central Storage Facility:

  This facility, operated by the company ZWILAG in Würenlingen, is comprised of an interim storage facility for spent fuel and all kinds of radioactive waste, conditioning installations, and a plasma furnace for melting and incineration of low-level waste.
- Separate storage facility ZWIBEZ at Beznau nuclear power plant:

  This consists of a hall for low-level operational waste and a hall for the dry storage of spent fuel.
- Wet storage facility at Gösgen nuclear power plant:

  This facility storage is an additional spent fuel pond on the site of the Gösgen nuclear power plant. It is intended for independent operation over several years, after the future shutdown of the Gösgen nuclear power plant.
- National Collection Centre and Federal Storage Facility:

  These installations for radioactive waste from medicine, industry and research are operated by the Paul Scherrer Institute (PSI), in Würenlingen.

Deep geological repositories and site selection process

The responsibility for radioactive waste management lies with the waste producers. Legislation requires in principle that radioactive waste produced in Switzerland be disposed of in Switzerland. The option for the disposal of radioactive waste within the framework of a bilateral or multilateral project is kept as an option, but is not actively pursued.

Two repositories are proposed, one for short-lived low- and intermediate-level waste (L/ILW) and one for high-level waste and spent fuel, as well as long-lived intermediate-level waste mainly from reprocessing (HLW). The site selection process has to follow a sectoral plan procedure within the framework of spatial planning legislation. The site selection process, according to the sectoral plan procedure for

deep geological repositories, was started with the promulgation of the "Sectoral Plan for Deep Geological Repositories", on 2 April 2008, by the Federal Council.

The SFOE is in charge of this procedure, which will lead to the designation of sites for each waste category in around ten years. The procedure allows the coordination of a broad range of actors, and is divided into three stages. With regard to the first stage of the site selection process, the National Co-operative for the Disposal of Radioactive Waste (Nagra) submitted its proposals for suitable geological siting areas for the repositories for HLW and L/ILW to the SFOE on 17 October 2008. ENSI has reviewed Nagra's entire documentation and concluded, on 26 February 2010, that the procedure followed by Nagra in preparing the proposals for the geological siting areas was transparent and reproducible.

In conclusion, ENSI approved the six geological siting areas proposed for L/ILW: Jura Ost (canton Aargau), Jura-Südfuss (canton Solothurn and canton Aargau), North of Lägern (canton Zurich and canton Aargau), Südranden (canton Schaffhausen), Zürich Nordost (canton Zurich and canton Thurgau) and Wellenberg (canton Nidwalden and canton Obwalden). All these sites have clay-rich sediments as potential host rocks. These include the Opalinus clay, the Brauner Dogger, the Effingen Beds, and the marl formations of the Helveticum.

ENSI also approved the three geological siting areas proposed for HLW: Jura Ost, North of Lägern and Zürich Nordost. All the potential HLW sites have Opalinus clay as host rock. ENSI's review has been commented by the Nuclear Safety Commission (NSC).

A broad consultation was carried out, between 1st September and 30th November 2010, by the SFOE, which compiled the comments and submitted a report to the Federal Government. The Federal Government approved all six potential siting regions (see Figure 2) on 30 November 2011, thus concluding the first stage of the site selection process and initiating the second stage.

In stage 2, the proposed siting regions have an opportunity to co-determine the content of storage site projects and participate in studies on the socioeconomic effects and spatial planning impacts. The various sites have to be compared from the point of view of safety before Nagra can propose at least two sites per waste category. Stage 2 is expected to last about four years.

In stage 3, the remaining sites are studied in greater detail from the point of view of site selection and submission of a license application, and the site-specific geological information is intensified by carrying out further geological studies. With input from the siting region, the various storage site projects are defined in greater detail at this stage, and socioeconomic studies are intensified. The waste producers finally submit applications for a general license (one each for HLW and L/ILW or one for a combined repository).

Parliament's decision concerning the government's approval of the general license for deep geological repositories is expected around 2022. That decision is subject to an optional national referendum.

A deep geological repository for L/ILW is expected in 2035, and a deep geological repository for HLW in 2045.

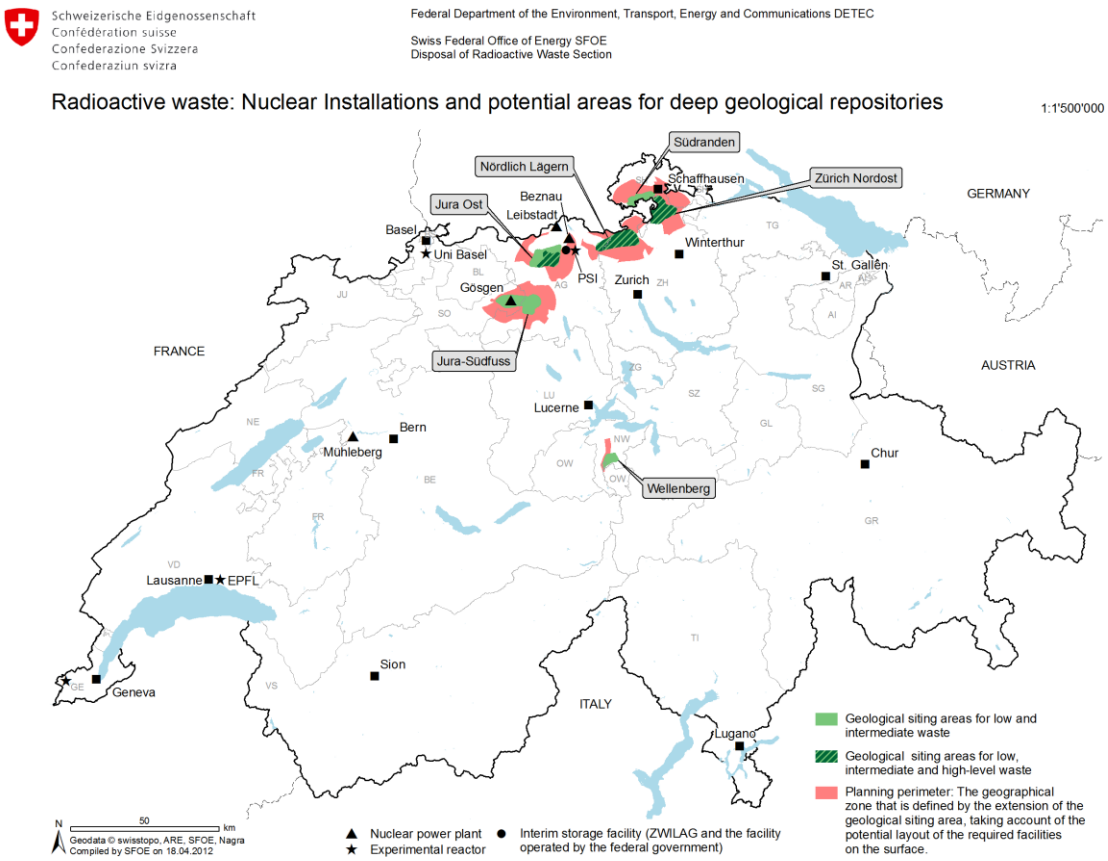


Figure 1

2.8. Research and development

2.8.1. R&D organizations

The Paul Scherrer Institute (PSI) is the largest research centre for natural and engineering sciences in Switzerland. Approximately 400 scientists at the Institute perform high-level research into a large variety of scientific questions that can be grouped into three main fields: Matter and Material, Human Health, and Energy and Environment. By conducting fundamental and applied research, PSI works on long-term solutions for major challenges facing society, industry and science.

PSI operates several large-scale facilities that allow experiments to be performed which would be impossible in smaller laboratories. The facilities are unique in Switzerland, and some of them are the only ones of their type or scale in the world. The Institute provides access to the facilities within the framework of a User Service to researchers from universities, other research centres and industrial companies. Each year, about 2,300 researchers in these categories perform experiments at the facilities.

Matter and Material

The manifold characteristics of the matter making up the world around us are determined by what kinds of atoms they are made of, how these atoms are arranged, and how they move. Most researchers in the “Matter and Material” field at the Paul Scherrer Institute are trying to clarify the link between the internal structure and the observable properties of various materials. At the Laboratory for Particle Physics, researchers investigate the fundamental structures of matter.

Energy and Environment

The goal of PSI's energy research is the development of technologies for sustainable use of energy. This includes environmentally friendly energy production, the application of renewable energy sources, and low-loss energy storage. In addition, technologies are investigated which will contribute to the safe use of nuclear energy. Environmental research is concentrated on the study of processes taking place in the atmosphere.

Nuclear Energy Research

In 2009, about 10% of the PSI's annual government funding of CHF 240 million was earmarked for nuclear energy research. The PSI's government-funded nuclear energy research activities have been reduced by more than half over the past two decades. To a large extent, this reduction was compensated by external funding. With the current staffing quota of about 185 person/year (plus about 30 PhD students) and about CHF 7m to 8m for operations, maintenance and investment costs, a balance has been reached. More than 50% of the overall direct costs of nuclear energy research are externally funded by the Swiss Nuclear Power Plant Operators, the National Cooperative for the Disposal of Radioactive Waste (Nagra), the Swiss Federal Nuclear Safety Inspectorate (ENSI) and other national and in particular international agencies (inter alia EU and OECD/CSNI). Most of this support is for long-term research contracts.

About 50% of the nuclear energy research at PSI concentrates on reactor safety and safety-related operational aspects of Swiss NPPs and on nuclear waste disposal. With nearly 20% of resources, future reactor concepts, in particular their safety features, which rely on inherent safety mechanisms and on passive system layouts, are investigated, to a limited extent through an active partnership of PSI in the Generation IV International Forum (GIF).

The main objectives of nuclear energy research carried out in the "Nuclear Energy and Safety" (NES) research department at the PSI are as follows:

- to contribute to the safe and economic operation of the existing NPPs in Switzerland and to the safe geological storage of radioactive waste, by reinforcing the scientific bases of the technologies in the appropriate areas
- to support the reactor operators and safety authority in Switzerland, as well as the securing of stand-by functionality in key areas, particularly those requiring the services of a Hot Lab
- to prepare inputs to 'stakeholders' for decision-making purposes
- research and development in nuclear energy in terms of increased sustainability, safety and economy
- to train young nuclear specialists over a broad spectrum of disciplines, including those with experience of other energy systems

The NES department is structured into five research laboratories according to its specific scientific and technical areas of competence. It operates the only Hot Lab in the country, and the Reactor School offers education and training programmes for present and future reactor operators.

The following provides a brief description of the programmes currently carried out within the NES department:

Operating reactors

The STARS programme is a long-standing project aimed at the development, maintenance and application of a complex code and database system, to be used for investigations into the behaviour of the Swiss nuclear reactors. Focus areas include combined system transient and uncertainty analysis, fuel modelling and neutronics.

The main focus in the HRA (Risk and Human Reliability) is related to the solution of current and future issues concerning the handling of human factors in the context of Probabilistic Safety Assessment (PSA).

The Nuclear Fuels programme involves micro-structural/micro-mechanical examination of the ageing of core internals (fuel rods, structural materials), and the development of associated theoretical models. In particular, investigation of fuel damage and identification of possible causes of failure are also being carried out. Methods for the production of Gen IV fuels are also under consideration, as are their associated fuel cycles.

The Component Safety programme (INTEGER) involves the experimental characterisation of important ageing mechanisms (stress corrosion cracking, thermal fatigue and irradiation embrittlement) in primary pressure boundary components, the development and validation of advanced mechanistic material ageing models and probabilistic methods for improved integrity assessments and lifetime predictions, as well as the evaluation of advanced non-destructive techniques for the early detection of fatigue and stress corrosion crack initiation, and for the characterisation of the actual degree of embrittlement in components.

The Source-Term Evaluation programme activities are centred around the ARTIST test facility, which reproduces, at reduced scale, aerosol deposition behaviour during a severe accident following a postulated steam generator tube rupture. General considerations of iodine chemistry are being investigated, with specific application to NPPs. The experimental programme is balanced by the development and validation of numerical models, the overall theme being aimed at replacing the existing empirical models by mechanistic modelling using CFD. All activities are directed towards source-term evaluation relevant to the Swiss NPPs.

Waste management

The programme is an ongoing commitment, overseen by the federal government, to ensure the safe disposal of radioactive waste from the medical and nuclear industries, including that arising from nuclear research. The activities cover fundamental waste-disposal chemistry, the physics and chemistry of radio nuclides, and investigation of the geological boundaries for radionuclide transport. Results will ultimately find use in the comprehensive application of safety criteria. This R&D programme is carried out in close co-operation with Nagra, the organisation charged with the disposal of all Swiss radioactive waste.

Energy systems analysis

These activities are carried out within the Laboratory for Energy System Analysis (LEA), which is an interdisciplinary laboratory supporting both NES and the General Energy Department (ENE). The Laboratory aims to contribute to effective decision-

making on long-term technology strategies in energy supply and demand by ensuring the full integration of all environmental, economic and social factors. LEA also develops methodologies and carries out the associated risk analyses within the framework of the Human Reliability Assessment (HRA). The programme is also part of LEA.

The Technology Assessment (GaBE) programme involves analyses of fossil, nuclear and renewable energy technologies. It is based on an interdisciplinary framework, thus enabling comparisons to be made between current and future options for the electricity, heating and transport sectors.

In the Energy Economics programme, analyses are undertaken of energy systems and associated technological changes at the Swiss, European and global levels, all aimed at improving understanding of available options for the realisation of more sustainable energy mixes for the future.

Hot Laboratory Division (AHL)

The Hot Laboratory (Hot Lab) is the largest nuclear research facility under the supervision of the Swiss Federal Nuclear Safety Inspectorate (ENSI), and the only Swiss research facility capable of examining large quantities of radioactive materials. The two main tasks of the Hot Laboratory Division are to ensure safe and efficient utilisation of the Hot Lab infrastructure, and to conduct state-of-the-art service work for the Swiss nuclear industry. Accordingly, AHL offers Hot Lab users modern analytical tools for the manipulation and investigation of radioactive materials. In particular, the laboratory is very well equipped for structural and chemical analyses of the materials used in NPPs and accelerator facilities.

2.8.2. Development of advanced nuclear technologies

Research on future reactors (generation III and IV) at PSI

The ALPHA programme provides confirmation of the characteristics of passive safety systems for advanced LWRs, and is centred around the large-scale, integral test facility PANDA. More recently, the experimental base has been broadened to incorporate investigations of fundamental phenomena in both the primary circuit and containment, and includes the study of two-phase flow phenomena (such as bubbly flows), the prediction of critical heat flux, and mixture/stratification phenomena. A number of additional small- and medium-scale single-effect test facilities are now also included under the project heading. At all three scales, experimentation is accompanied by the development and application of novel instrumentation techniques, able to measure the distributed parameters characteristic of 3D flow fields. In parallel, there is an ongoing development and validation programme for the accompanying numerical tools, particularly CFD (Computational Fluid Dynamics), but including also multi-scale modelling approaches to basic phenomena such as boiling.

In the appropriately named FAST programme, activities are aimed at the development and implementation of a code system representing state-of-the-art safety analyses of nuclear systems incorporating fast neutron spectra.

The High-Temperature Materials programme activities involve characterisation of materials to be used in the future Generation IV reactors (particularly gas-cooled reactors), which will operate at significantly higher temperatures and are subject to a

more intense radiation environment than current Gen II reactors. Mechanistic models are being developed for the prediction of material behaviour, from the atomic level up the scale of the continuum. Experimental validation of the models is also undertaken, using advanced spectroscopic methods and, in particular, synchrotron radiation.

2.8.3. International co-operation and initiatives

The European Atomic Energy Community (Euratom) was established in 1957, by the Treaty of Rome. In 1978, Switzerland and Euratom (comprising 15 member states) signed a co-operation agreement in the field of controlled thermonuclear fusion and plasma physics. Based on this agreement, Switzerland is participating in the European effort to develop fusion power. This effort includes the participation in the operation of the Joint European Torus JET, the ITER project and other international activities related to plasma and material research.

Since 2004, Switzerland has been fully associated with the Sixth and Seventh Framework programmes of Euratom. This has enabled Switzerland to extend its co-operation with Euratom into the fields of general research in the fission domain and the nuclear activities of the European Joint Research Center JRC.

ENSI supports research into nuclear safety, and is represented in more than 70 international commissions and specialist groups working in the field of nuclear safety. It therefore makes an active contribution to new international safety guidelines. Through its network of contacts, ENSI is in touch with current developments in science and technology, and discharges its regulatory remit on the basis of global experience in nuclear energy.

In the field of radioactive waste management, international research programmes are carried out in the Mont Terri rock laboratory (Canton of Jura; investigation of the Opalinus Clay; operator: Swisstopo) and the Grimsel test site (Canton of Bern; investigation of crystalline rocks; operator: Nagra).

The Mont Terri rock laboratory provides a platform for international collaboration and the exchange of know-how among researchers, technicians, engineers and scientists. The Federal Office of Topography (Swisstopo) operates the rock laboratory and runs the Mont Terri Project. Today, 15 organisations from Belgium, Germany, France, Japan, Canada, Spain, Switzerland and the USA are involved in the underground research project. Various other countries are also considering argillaceous rocks like Opalinus Clay as possible host rocks for deep geological disposal. The allocated investments in the Mont Terri rock laboratory, from 1996 to 2011, amount to CHF 61.3 million. Swiss partners contributed one third and the other partners two thirds.

The Mont Terri rock laboratory serves research purposes only. There is no question of disposing of radioactive waste there, due to geological reasons, on the one hand (folded Jura mountains), and because, on the other hand, the disposal of any such waste is excluded by the contractual agreement with the Canton of Jura.

The Grimsel Test Site (GTS) was established over 25 years ago, as a centre for underground research and development (R&D) supporting a wide range of research projects on the disposal of radioactive waste, with 25 partners from 11 nations coming

to work at this location (2010 data). The GTS provides an environment which is analogous to that of a repository site, thus allowing for the development and testing of equipment, methodology and models under fully realistic conditions.

2.9. Human resources development

A Master of Science in Nuclear Engineering degree is offered jointly by EPF Lausanne and ETH Zurich, two of Europe's leading science and engineering universities, in order to qualify multidisciplinary professionals in industry, research and national authorities. The PSI supports the programme by offering its research infrastructure for scientific projects of the students and by assisting in lecturing (for further information on human resources development at PSI, refer to section 2.8 above). The programme was launched in 2008, and is currently in its fourth year. The duration of the programme is four semesters, which is compatible with European requirements. The number of graduates has stabilised at around 15 per year. Areas covered include the safe and reliable operation of existing and new reactors, the development of novel reactor types, the sustainable supply of nuclear fuel, the closure of the fuel cycle, the disposal of radioactive waste, and many others. The curriculum provides in-depth knowledge of reactor physics, thermal-hydraulics and nuclear materials.

The Institute of Physics of the University of Basel provides a small research reactor. It allows for certain experiments which are not feasible with the reactors of PSI or EPFL. Furthermore, the University of Basel is the only institution in Switzerland with an infrastructure for neutron activation analysis.

The organisation "Nuclear Forum Switzerland" published an overview on Switzerland's human resources development in the field of nuclear energy (2010 data). It concludes that there are generally enough nuclear specialists trained for current Swiss requirements. However, Switzerland lacks sufficient educational offers in the fields of radiobiology and nuclear physics.

2.10. Stakeholder Communication

The accident at the Fukushima NPP and subsequent suspension of the licensing procedure for new Swiss NPPs have triggered great interest and public debate on the subject of nuclear power. This is likely to be closely followed by the media over the next years.

Governmental communication is focusing on radioactive waste disposal, where efforts to keep the public, stakeholders and neighbouring countries informed has been intensified in the context of the ongoing procedure to identify sites for deep geological repositories. Governmental communication in this field is committed to ensuring a high level of transparency and public participation.

3. NATIONAL LAWS AND REGULATIONS

3.1. Regulatory framework

3.1.1. Regulatory authority(s)

Licensing

The Federal Council is the authority that grants general licenses. The Federal Department of the Environment, Transport, Energy and Communications (DETEC) grants construction licenses and operating licenses for nuclear facilities. The Federal Office of Energy is responsible for the co-ordination of the licensing procedures, and issues licenses for the handling of nuclear materials and radioactive waste.

Supervision

The Swiss Federal Nuclear Safety Inspectorate (ENSI) is the national regulatory authority in Switzerland with responsibility for nuclear energy. It is supervised by an independent board, the ENSI Board, which is elected by the Swiss Federal Council and reports directly to it.

ENSI is responsible for the supervision of Swiss nuclear facilities, i.e. the nuclear power stations, the interim storage facility for radioactive waste, the nuclear research facilities at the Paul Scherrer Institute (PSI) in Villigen, the Ecole Polytechnique Fédérale in Lausanne and the University of Basel. Its regulatory remit covers the entire life of a facility, i.e. from initial planning, through operation, to final decommissioning, including the disposal of radioactive waste. Its remit also includes the safety of staff and the public, and their protection from radiation, sabotage and terrorism. ENSI is also involved in the transport of radioactive materials to and from nuclear facilities and in the continuing geoscientific investigations to identify a suitable location for the deep geological disposal of radioactive waste.

ENSI monitors the operation of nuclear plants:

- ENSI reviews reports by the operators, holds regular supervisory discussions, and monitors the nuclear plants (including their organisation and operation) by means of more than 400 on-site inspections each year.
- Each year in summer, every nuclear power plant carries out an inspection lasting several weeks, during which maintenance work and repairs are undertaken in the plant.
- In order to protect staff, the population and the environment, ENSI monitors compliance with the radiation protection regulations and dose limits.
- ENSI collates all the data obtained during the year into one comprehensive safety assessment, from which it derives any measures that may be required as well as its future supervision plans.

ENSI assesses nuclear plants:

- The assessment and monitoring of nuclear power plants are based on laws, guidelines and underlying technical and scientific documentation, which transparently set out the safety requirements and criteria that ENSI applies for its assessments. ENSI continues to develop the underlying documentation and guidelines in accordance with the latest status of science and technology.

- ENSI draws up safety assessments when operators of nuclear power plants submit applications which go beyond the scope of their existing operating.

- Applications for modifications to nuclear plants that are covered by existing operating licences are dealt with by ENSI, which issues a permit if the decision is positive.

Advisory committee

The Federal Nuclear Safety Commission is designated as an advisory committee to the Federal Council and the DETEC. It is involved in the licensing process as it reviews and comments on the safety evaluation reports prepared by the supervisory authorities.

Others

In the nuclear field, the supervisory authority, with respect to nuclear safety and radiation protection, is ENSI. In the non-nuclear field, the supervisory authorities are the Federal Office of Public Health (FOPH) and the public sector insurer SUVA (formerly Swiss National Accident Insurance Fund). The FOPH manages the licensing procedures in the non-nuclear field according to the radiological protection legislation. It is responsible for waste produced from the healthcare sector, industry and research.

The National Emergency Operations Centre – part of the Federal Office of Civil Protection in the Federal Department of Defence, Civil Protection and Sport – is in charge of all emergency situations, including those arising from events at NPPs and relating to the protection of the public and the environment.

Several advisory committees to the government or governmental departments covering aspects of radiological protection, emergency planning and waste disposal have responsibilities associated with the operation of NPPs. However, they are not involved in the licensing process and have no authority over the plants.

3.1.2. Licensing Process

Figure 2 shows the different stages of the licensing process for a NPP:

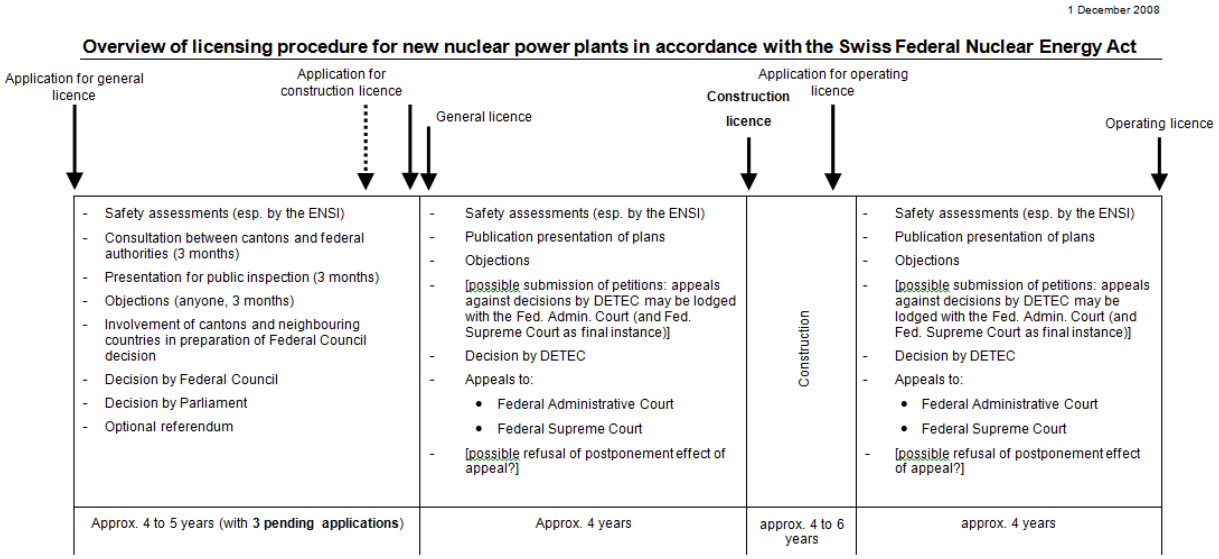


Figure 2

3.2. Main national laws and regulations in nuclear power

- Nuclear Energy Act of 21 March 2003 (SR 732.1)
- Nuclear Energy Ordinance of 10 December 2004 (SR 732.11)
- Ordinance of 7 December 2007 on the Decommissioning Fund and the Waste Disposal Fund for Nuclear Installations (SR 732.17)
- Radiological Protection Act of 22 March 1991 (SR 814.50)
- Radiological Protection Ordinance of 22 June 1994 (SR 814.501)
- Federal Nuclear Energy Liability Act of 18 March 1983 (SR 732.44)
- Federal Nuclear Energy Liability Ordinance of 5 December 1983 (SR 732.441)
- Ordinance of 12 November 2008 on the Federal Nuclear Safety Commission (SR 732.16)
- Federal Act of 22 June 2007 on the Swiss Federal Nuclear Safety Inspectorate (SR 732.2)
- Ordinance of 12 November 2008 on the Swiss Federal Nuclear Safety Inspectorate (SR 732.21)
- Safeguards Ordinance of 21 March 2012 (SR 732.12)

- Ordinance of 20 October 2010 on the Emergency Organisation in case of ABC or natural events (SR 520.17)
- Ordinance of 20 October 2010 on Emergency Protection Measures in the Vicinity of Nuclear Installations (SR 732.33)
- Ordinance of 17 October 2007 on the National Emergency Operations Centre (SR 520.18)
- Ordinance of 23 August 1978 on Additional Agreements to the Non-Proliferation Treaty Safeguards Agreement (SR 732.91)
- Federal Act of 13 December 1996 on the Control of Dual-Use Goods and of Specific Military Goods (SR 946.202)
- Ordinance of 25 June 1997 on the Export, Import and Transit of Dual-Use Goods and Specific Military Goods (SR 946.202.1)
- Ordinance of 18 August 2010 on Issuing Warnings and Alerting (SR 520.12)

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www.uvek.admin.ch
Federal Department of the Environment, Transport, Energy and Communications

www.bfe.admin.ch
www.radioactivewaste.ch
Swiss Federal Office of Energy SFOE

www.ensi.ch
Swiss Federal Nuclear Safety Inspectorate ENSI

www.entsorgungsfonds.ch
www.stilllegungsfonds.ch
Decommissioning and waste disposal funds

www.are.admin.ch
Federal Office for Spatial Development

www.kns.admin.ch
Federal Nuclear Safety Commission

www.swisstopo.admin.ch
Federal Office of Topography

www.bfs.admin.ch
Federal Statistical Office/Swiss Statistics

www.bafu.admin.ch
Federal Office for the Environment

www.nagra.ch
National Co-operative for the Disposal of Radioactive Waste Nagra

www.admin.ch/ch/d/sr/index.html
Index of Swiss national law

Appendix 1: International, Multilateral and Bilateral Agreements

International Organisations

- Statute of the International Atomic Energy Agency dated 26 October 1956
- Agreement dated 1 July 1959 on the Privileges and Immunities of the International Atomic Energy Agency
- Agreement dated 28 February 1972 between the International Atomic Energy Agency, the Government of Switzerland and the Government of the United States of America for the application of safeguards
- Statute of the OECD Nuclear Energy Agency dated 20 December 1957
- Protocol dated 20 December 1957 on the Tribunal established by the Convention on the Establishment of a Security Control in the Field of Nuclear Energy
- Rules of Procedure of the European Nuclear Energy Tribunal dated 11 December 1962
- Convention dated 20 December 1957 on the Establishment of a Security Control in the Field of Nuclear Energy

Safety of Spent Fuel and Nuclear Safety

- Convention dated 17 June 1994 on Nuclear Safety
- Joint Convention dated 5 September 1997 on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

Physical Protection of Nuclear Material

- Convention dated 26 October 1979 on the Physical Protection of Nuclear Material

Terrorism Suppression

- International Convention dated 13 April 2005 for the Suppression of Acts of Nuclear Terrorism
- European Convention dated 27 January 1977 on the Suppression of Terrorism

Radiation Protection

- Convention dated 22 June 1960 concerning the Protection of workers against Ionising Radiations

Information Exchange and Assistance in Case of an Emergency

- Agreement dated 30 November 1989 between the Government of Switzerland and the Government of France on information exchange in case of incidents or accidents with possible radiological consequences

- Agreement dated 10 August 1982 between the Government of Switzerland and the Government of Germany on mutual information in case of construction and operation of nuclear facilities near the border
- Agreement dated 15 December 1989 between the Government of Switzerland and the Government of Italy on quick information exchange in case of nuclear accidents
- Convention dated 26 September 1986 on Early Notification of a Nuclear Accident
- Convention dated 26 September 1986 on assistance in the case of a nuclear accident or radiological emergency
- Convention dated 31 May 1978 between the Government of Switzerland and the Government of Germany on the radioprotection in case of an alert
- Exchange of notes dated 25 July 1986 between Switzerland and Germany concerning the application of the Convention dated 31 May 1978/15 February 1980/25 July 1986 on the radioprotection in case of an alert
- Agreement dated 19 March 1999 between the Swiss Government and the Austrian Republic on quick information exchange in the field of nuclear security and radioprotection
- Exchange of letters dated 5/20 November 2008 between the Swiss Federal Council and the Government of France concerning the field and the modalities of alert and/or of transmission of information in case of minor event or of accidental situation in the nuclear power plant of Fessenheim or in the Swiss nuclear power plants of Beznau, Gösgen, Leibstadt and Mühleberg (with annex)
- Agreement dated 10 August 1982 for the reciprocal provision of information concerning the construction and operation of nuclear installations in frontier areas (with annex)

Nuclear Liability

- Agreement dated 22 October 1986 between the Government of Switzerland and the Government of Germany in the field of nuclear liability

Nuclear Research

- Convention dated 1 July 1953 for the Establishment of a European Organisation for Nuclear Research
- Financial Protocol dated 1 July 1953 Annexed to the Convention for the Establishment of a European Organisation for Nuclear Research
- Juridical Statute of the European Organisation for Nuclear Research on Swiss Territory
- Agreements with France concerning the extension in French territory of the domain of the European Organisation for Nuclear Research
- Cooperation Agreement dated 14 September 1978 in the Field of Controlled Thermonuclear Fusion and Plasma Physics between Switzerland and the European Atomic Energy Community
- Agreement dated 28 November 2007 in Form of an Exchange of Letters between the Swiss Government and the European Atomic Energy Community on the Application of the Agreement on the International Organisation ITER

- Agreement dated 28 November 2007 in Form of an Exchange of Letters between the Swiss Government and the European Atomic Energy Community on the Adhesion of Switzerland to the common European venture for ITER and the Development of the Fusion Energy
- Association Contract dated 8 February 2008 between the Swiss Government and the European Atomic Energy Community in the Field of Controlled Thermonuclear Fusion and Plasma Physics
- Agreement dated 11 October 2005 concerning the Staff Mobility in the Field of Controlled Thermonuclear Fusion and Plasma Physics and the Partners
- Exchange of letters dated 6 November 1986 between the Swiss Government and the European Atomic Energy Community concerning the Swiss Association to the Cooperation Agreement between EURATOM and the United States of America

Non-Proliferation and nuclear Weapons

- Treaty dated 5 August 1963 banning nuclear Weapon Tests in the Atmosphere, in outer Space and under Water
- Treaty dated 1 July 1968 on the Non-Proliferation of Nuclear Weapons
- Agreement dated 6 September 1978 between the Swiss Government and the International Atomic Energy Agency for the application of safeguards in Connection with the Treaty of Non-Proliferation of Nuclear Weapons
- Protocol additional to the Agreement dated 6 September 1978 between the Swiss Confederation and the International Atomic Energy Agency for the application of safeguards in Connection with the Treaty of Non-Proliferation of Nuclear Weapons
- Treaty dated 11 February 1971 on the Prohibition of the Emplacement of nuclear Weapons and other Weapons of mass Destruction on the Seabed and the Ocean Floor and in the Subsoil thereof

Bilateral Agreements concerning peaceful uses of nuclear energy

- Cooperation Agreement dated 28 January 1986 between the Government of Switzerland and the Government of Australia concerning peaceful uses of nuclear energy
- Cooperation Agreement dated 22 December 1987 between the Government of Switzerland and the Government of Canada concerning peaceful uses of nuclear energy
- Cooperation Agreement dated 12 November 1986 between the Government of Switzerland and the Government of China concerning peaceful uses of nuclear energy
- Cooperation Agreement dated 5 December 1988 between the Government of Switzerland and the Government of France concerning peaceful uses of nuclear energy
- Cooperation Agreement dated 14 February 1968 between the Government of Switzerland and the Government of Sweden concerning peaceful uses of nuclear energy

- Exchange of letters dated 30 November 1989 between the Government of Switzerland and the Government of France for the creation of a mixed commission on nuclear safety
- Cooperation Agreement dated 31 October 1997 between the Government of Switzerland and the Government of the United States of America concerning peaceful uses of nuclear energy
- Cooperation Agreement dated 6 April 1990 between the Government of Switzerland and the Government of Russia concerning peaceful uses of nuclear energy
- Additional Protocol dated 25 April 1990 to the Cooperation Agreement between the Government of Switzerland and the Government of Sweden concerning peaceful uses of nuclear energy

Appendix 2: main organisations, institutions and companies involved in nuclear power related activities

a) National Nuclear Energy Authorities

Federal Department of the Environment, Transport, Energy and Communications DETEC
Bundeshaus Nord
Kochergasse 10
CH-3003 Bern
Phone: +41 31 322 21 11
Fax: +41 31 322 26 92
info@gs-uvek.admin.ch
www.uvek.admin.ch

Swiss Federal Office of Energy SFOE
Mühlestrasse 4
CH-3003 Bern
Phone: +41 31 322 56 11
Fax: +41 31 323 25 00
contact@bfe.admin.ch
www.bfe.admin.ch

Swiss Federal Nuclear Safety Inspectorate ENSI
Industriestrasse 19
CH-5200 Brugg
Phone: +41 56 460 84 00
Fax: +41 56 460 84 99
info@ensi.ch
www.ensi.ch

Federal Nuclear Safety Commission NSC
Gaswerkstrasse 5
CH-5200 Brugg
Phone: +41 56 462 86 86
www.bfe.admin.ch/kns

b) Main Power Utilities

Kernkraftwerk Gösgen-Däniken AG
Postfach
CH-4658 Däniken
Phone: +41 62 288 20 00
Fax: +41 62 288 20 01
www.kkg.ch

Kernkraftwerk Leibstadt AG
CH-5325 Leibstadt
Phone: +41 56 267 71 11
www.kkl.ch

Alpiq AG
Bahnhofquai 12
4601 Olten
Schweiz
Phone: +41 62 286 71 11
Fax: +41 62 286 73 73
info@alpiq.com
www.alpiq.com

Axpo Holding AG
Corporate Communications
Zollstrasse 62
Postfach
CH-8023 Zürich
Phone: +41 44 278 41 11
Fax: +41 44 278 41 12
info@axpo.ch
www.axpo.ch

BKW FMB Energie AG
Marketingkommunikation
Viktoriaplatz 2
CH-3000 Bern 25
Phone: +41 31 330 51 11
Fax: +41 31 330 56 35
info@bkw-fmb.ch
www.bkw-fmb.ch

c) Radioactive Waste Management

National Co-operative for the Disposal of Radioactive Waste Nagra
Hardstrasse 73
CH-5430 Wettingen
Phone: +41 56 437 11 11
info@nagra.ch

www.nagra.ch

ZWILAG Zwischenlager Würenlingen AG
Industriestrasse Beznau 1
CH-5303 Würenlingen
Phone: +41 56 297 47 11
Fax: +41 56 297 47 22
info@zwilag.ch
www.zwilag.ch

Grimsel Test Site
Nagra
Hardstrasse 73
CH-5430 Wettingen
Phone: +41 564 371 310
Fax: +41 564 371 317
doa@nagra.ch
www.grimsel.com

Mont Terri Rock Laboratory Project
Federal Office of Topography (swisstopo)
Seftigenstrasse 264
CH-3084 Wabern
Phone: +41 79 414 04 59
info@swisstopo.ch
www.mont-terri.ch

d) Nuclear Research

Paul Scherrer Institute
CH-5232 Villigen
Phone: +41 56 310 21 11
Fax: +41 56 310 21 99
info@psi.ch
www.psi.ch

Centre de Recherches en Physique des Plasmas CRPP
EPFL SB CRPP
Station 13
CH-1015 Lausanne
Switzerland
Phone: +41 21 693 5474
Fax: +41 21 693 5176
http://crpp.epfl.ch/

Laboratory for Reactor Physics and Systems Behaviour
EPFL SB IPEP LRS
Station 3
CH-1015 Lausanne
Phone: +41 21 693 33 75

Fax: +41 21 693 44 70
lrs.epfl.ch

Laboratory for Nuclear Energy Systems
ETH Zürich
ML K 13
Sonneggstrasse 3
CH-8092 Zurich
Phone: +41 44 632 60 25
Fax: +41 44 632 16 57
hprasser@ethz.ch
www.lke.mavt.ethz.ch

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