



Safety criteria for siting a nuclear power plant

32 / 17

**PLEASE BE AWARE THAT
ALL OF THE MISSING PAGES IN THIS DOCUMENT
WERE ORIGINALLY BLANK**

Safety criteria for siting a nuclear power plant

1	General	3
2	Plant site and surroundings	4
3	Safety factors affecting site selection	5
3.1	External events affecting safety	5
3.2	Radioactive releases	5
4	Regulatory control by the Radiation and Nuclear Safety Authority	6
4.1	EIA procedure	6
4.2	Decision in principle	6
4.3	Construction licence and operating licence	6
5	References	7

This Guide is in force as of 1 January 2001 until further notice.

Helsinki 2001
Oy Edita Ab
ISBN 951-712-429-5
ISSN 0783-232X

Authorisation

By virtue of the below acts and regulations, the Radiation and Nuclear Safety Authority (STUK) issues detailed regulations that apply to the safe use of nuclear energy and to physical protection, emergency preparedness and safeguards:

- Section 55, paragraph 2, point 3 of the Nuclear Energy Act (990/1987)
- Section 29 of the Council of State Decision (395/1991) on the Safety of Nuclear Power Plants
- Section 13 of the Council of State Decision (396/1991) on the Physical Protection of Nuclear Power Plants
- Section 11 of the Council of State Decision (397/1991) on the Emergency Preparedness of Nuclear Power Plants
- Section 8 of the Council of State Decision (398/1991) on the Safety of a Disposal Facility for Reactor Waste
- Section 30 of the Council of State Decision (478/1999) on the Safety of Disposal of Spent Nuclear Fuel.

Rules for application

The publication of a YVL guide does not, as such, alter any previous decisions made by STUK. After having heard those concerned, STUK makes a separate decision on how a new or revised YVL guide applies to operating nuclear power plants, or to those under construction, and to licensees' operational activities. The guides apply as such to new nuclear facilities.

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

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

1 General

Section 6 of the Nuclear Energy Act (YEL 990/1987) stipulates that *the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property.*

In the siting of a nuclear power plant, the aim is to protect the plant against external threats as well as to minimise any environmental detriments and threats that might arise from it. Other factors to be considered include: impact on land use, socio-economic impacts, traffic arrangements, reliable electric power transfer to the national grid and specific factors relating to the security of supply of electric power.

Prior to the licensing procedure proper, the environmental effects of the nuclear power plant project are studied and evaluated by environmental impact assessment (EIA). The EIA procedure falls under the Act on Environmental Impact Assessment Procedure (EIA) (468/1994) and the Decree on EIA (268/1999). In addition, Finland's neighbouring countries shall be heard where deemed necessary by virtue of the Convention on Environmental Impact Assessment in a Transboundary Context [1].

The Nuclear Energy Act prescribes that there must be a decision in principle of the Council of State, approved by Parliament, stating that the nuclear power plant project is in the overall good of society. An application for the decision in principle is submitted to the Council of State; the Ministry of Trade and Industry submits it to the Radiation and Nuclear Safety Authority (STUK) for a preliminary safety evaluation and requests statements from the Ministry of the Environment, the municipal council of the candidate municipality and its neighbouring municipalities. The Nuclear Energy Decree (YEA 161/1998) stipulates that an environmental impact assessment report drawn up as a result of the EIA procedure shall be appended to the application for the decision in principle. The

Council of State can consider a positive decision in principle only in case the candidate municipality has issued a statement in favour of the facility's construction.

Detailed licensing requirements applicable to the construction and operation of nuclear power plants are stipulated in the Nuclear Energy Act and Decree. The granting of a licence in accordance with the Nuclear Energy Act requires that the project and its environmental impacts are reported to the Commission of the European Communities, not later than six months prior to the granting of the licence, as required in article 37 of EURATOM Treaty and in Commission Recommendation 99/829/Euratom [2], which supplements the Treaty.

The Land Use and Building Act (132/1999) and Decree (895/1999) prescribe planning pertaining to land use and construction. Regional plans and local master plans are, by nature, far-reaching, general land use plans. Detailed plans are drawn up for the detailed arrangement, construction and development of land use at local level. Construction is not allowed on shore zones belonging to the coastal area of a sea or of a water system unless the area is covered by a detailed plan (a detailed shore plan) or by a specific local master plan. When deciding about a land use plan and a construction permit the authorities consider the special requirements pertaining to construction work on the nuclear power plant site and in its surroundings. Section 58 of the Nuclear Energy Act decrees that before a town plan¹ or building plan¹ is drawn up for the area intended for the site of a nuclear facility, and prior to the approval of such a plan where a site is reserved for the construction of a nuclear facility, a statement must be obtained from the Radiation and Nuclear Safety Authority.

In addition to the above, the environmental permit procedure prescribed in the Environmental Permit Procedures Act (731/1991) applies to the construction and operation of nuclear power

¹ The terms "town plan" and "building plan" have been replaced with a "detailed plan" by virtue of the Land Use and Building Act (132/1999) and Decree (195/1999).

plants. Rescue plans with provision for nuclear power plant accidents are dealt with in the Act on Rescue Services (561/1999) and the Decree on Rescue Services (857/1999) as well as in the Ministry of the Interior Order 1/97 [3] and the associated Guideline A:57 [4].

Requirements applicable to the limitation of radioactive releases from nuclear power plants are presented in chapter 3 of the Council of State Decision (VNP 395/1991) on the general regulations for the safety of nuclear power plants. Section 20 of the Decision, for its part, requires that *the most important nuclear power plant safety functions shall remain operable in spite of any natural phenomena estimated possible on site or other events external to the plant*. Supplementary guidelines pertaining to safety functions can be found in Guides YVL 2.6 and YVL 2.8.

Guide YVL 2.6 concerns the effects of seismic events and how they should be considered in the structural concepts of nuclear power plants. Guide YVL 2.8 deals with probabilistic safety analyses (PSA) for nuclear power plants.

STUK Guides YVL 7.1–7.11 and YVL 7.18 deal with onsite and offsite radiation safety and with licensees' emergency response plans.

This guide sets forth requirements for safety of the population and the environment in nuclear power plant siting. It also sets out the general basis for procedures employed by other competent authorities when they issue regulations or grant licences. On request STUK issues case-specific statements about matters relating to planning and about other matters relating to land use in the environment of nuclear power plants.

Alternative candidate plant sites may be simultaneously examined during the EIA process and in the application for a decision in principle. In accordance with the Nuclear Energy Act, applications for a construction licence and an operating licence may only concern one plant site.

2 Plant site and surroundings

The normal operation of the nuclear power plant or anticipated operational transients do not limit land use offsite. In the environment surrounding the nuclear power plant, however, precautions in the form of land use and public protection plans shall be taken with a view to the possibility of a severe accident [5, 6]. This means, among other things, that in the plant's vicinity there may not be facilities or population centres where the necessary protective measures, such as sheltering indoors or evacuation, would be difficult to implement. In the plant's vicinity, no activities may be carried out that could pose an external threat to the plant.

The general principle in the siting of nuclear power plants is to have the facilities in a sparsely populated area and far away from large population centres. What justifies placement in a sparsely populated area is that emergency planning will then be directed at a smaller population group and will thus be easier to implement.

A nuclear power **plant site** extends to about a kilometre's distance from the facility. It is defined as an area where only power plant related activities are allowed as a rule. Permanent settlement is prohibited and only very limited employee accommodation or recreational settlement is allowed. The licensee responsible for the operation of the nuclear power plant shall have authority of decision over all activities in the area and shall be able to remove unauthorised individuals from the site, if necessary, or prevent such individuals from entering it. The plant site may contain other non-facility related activities provided that they do not pose a threat to plant safety. A traffic lane may traverse the site if the volume of traffic is small and if traffic can be directed elsewhere, if necessary. Visits onsite are allowed provided that the licensee has the possibility to control the movement of visitors.

The plant site is surrounded by a **protective zone** extending to about a five kilometres' dis-

tance from the facility. Land use restrictions are in force within the zone. Dense settlement and hospitals or facilities inhabited or visited by a considerable number of people are not allowed within the zone. The zone may not contain such significant productive activities as could be affected by an accident at the nuclear power plant. The number of permanent inhabitants should not be in excess of 200. The number of persons taking part in recreational activities may be higher, provided that an appropriate rescue plan can be drawn up for the area.

In accordance with a Ministry of the Interior Order [3], the nuclear facility is to be surrounded by an **emergency planning zone** extending to about 20 kilometres from the facility; the zone shall be covered by detailed rescue plans for public protection drawn up by the authorities. The authorities also bear responsibility for the implementation of the plans. In implementation, special attention shall be paid to the characteristics of the site's surroundings, such as archipelagos that are difficult to cross and recreational settlements, for example. The emergency planning zone may not contain such populations or population centres as would render impossible the efficient implementation of rescue measures applicable to them.

3 Safety factors affecting site selection

3.1 External events affecting safety

The applicant for a licence shall list those external events that could pose a threat to safety at the site in question and shall also assess the risks arising from these events. Effects on the supply of cooling water and on electric power grid connections shall also be considered.

Hazardous industry, traffic and exceptional natural phenomena shall be considered. Examples of exceptional natural phenomena include

- freezing or other clogging of the cooling water intake

- storms
- snow loads
- flood
- low sea level
- seismic events.

The risks arising from external events are assessed by analyses conducted in accordance with Guide YVL 2.8.

3.2 Radioactive releases

Sections 9–12 of the Council of State Decision (395/1991) set forth regulations for the limitation of population radiation exposure around nuclear power plants and for the limitation of radioactive releases under normal operating conditions, anticipated operational transients as well as postulated accidents and severe accidents.

Limits on radioactive releases are defined such that radiation doses to the population around the plant, calculated for the site in question on the basis of the release limits, do not exceed the dose limits set by Council of State Decision.

Guide YVL 7.1 sets out in more detail the Council of State's regulations for radiation exposure and release limits. It sets forth the general requirements for analysis methods, for exposure pathways to be examined by dose calculation and for the evaluation of individual and collective doses to the population.

Guide YVL 7.3 presents detailed requirements applicable to the conducting of analyses on the dispersion of radioactive releases and Guide YVL 7.2 sets forth detailed requirements for the calculation of individual and collective doses to the population.

When radiation doses to the surrounding population are calculated, the region's special characteristics—hydrological, geological and meteorological—as well as the living conditions and habits of the population shall be considered.

4 Regulatory control by the Radiation and Nuclear Safety Authority

4.1 EIA procedure

STUK issues statements to the Ministry of Trade and Industry on the EIA programme and on the environmental impact assessment report drawn up on the basis of the programme.

4.2 Decision in principle

Sections 23 and 24 of the Nuclear Energy Decree prescribe that the following documents, among others, shall be appended to the application for a decision in principle referred to in the Nuclear Energy Act:

- a general description of ownership and occupation of the planned nuclear facility site
- a description of settlement and other activities on the planned nuclear facility site and in its vicinity, including land use planning arrangements
- an assessment of suitability of the planned site for its purpose and of land use restrictions in plant surroundings caused by the siting of the nuclear power facility
- an assessment report drawn up in accordance with the Act on Environmental Impact Assessment Procedure and an account for the design criteria the applicant intends to apply in order to avoid environmental damage and to limit environmental burdens.

STUK requires from the applicant an illustrative assessment of the possible environmental effects of various accident situations.

STUK makes a preliminary safety evaluation of the application for a decision in principle for submission to the Ministry of Trade and Industry. STUK assesses the site, taking into consideration the documentation provided by the applicant, legislation and the requirements of YVL

guides. If there already is a nuclear power plant on the planned site, any relevant regulatory experience relating to its operation will be taken into account.

4.3 Construction licence and operating licence

The Council of State authorises the construction and operation of a nuclear power plant.

In accordance with the Nuclear Energy Act, the following site-related documents whose submission is decreed in section 32 of the Nuclear Energy Decree shall be appended to the construction licence application:

- proof of the applicant's right to use the planned facility site
- a description of settlement and other activities as well as planning arrangements on the planned facility site and in its vicinity
- a description of the nuclear facility's effects on the environment and a description of the design criteria the applicant aims to employ to limit environmental damage.

In accordance with section 35 of the Nuclear Energy Decree, the applicant is to submit to STUK a preliminary safety analysis report (PSAR) about the planned facility and its emergency response plans. The preliminary safety analysis report includes at least general design and safety criteria for the facility, a detailed description of the facility and site, a description of the facility's operation and behaviour under accident conditions as well as a detailed description of the effects of its operation on the environment.

Further, STUK requires that the applicant submits a preliminary probabilistic safety analysis in accordance with Guide YVL 2.8 for evaluation of the probability of possible accidents at the plant and of related events as well as the magnitude of consequent radioactive releases.

Correspondingly, an application for an operating licence for a nuclear power plant shall include the reports required in section 34 of the Nuclear

Energy Decree. Section 36 of the Nuclear Energy Decree prescribes that, when applying for an operating licence, the applicant shall send to STUK also the following documents, among others:

- a final safety analysis report (FSAR)
- a probabilistic safety analysis report (PSA)
- a description of emergency preparedness arrangements
- an environmental radiation monitoring programme for the nuclear power plant.

STUK draws up safety evaluations of the applications for the construction licence and subsequently the operating licence and submits statements to the Ministry of Trade and Industry. When reviewing relevant sections of the safety analysis report and making the safety evaluation concerning the facility site and its environment, STUK checks that the report includes sufficient and clear descriptions of

- geography in the region as well as prevailing and predicted population distributions
- use of land and water area as well as sources of livelihood in the region
- site climate and meteorological dispersion conditions
- hydrological factors onsite and in the environment
- geology and seismology onsite and in the environment.

The holder of an operating licence for a nuclear power plant shall update the final safety analysis report (FSAR) also during the plant's operation. Reviewed FSAR descriptions of the facility site and its environment shall be submitted to STUK for approval.

5 References

- [1] Convention on Environmental Impact Assessment in a Transboundary Context, 25 February 1991.
- [2] European Commission Recommendation (1999/829/Euratom) on the Application of Article 37 of EURATOM Treaty.
- [3] Protective measures for radiation situations - planning and communicating, Ministry of the Interior, SM 1/97.
- [4] Instructions for action in a radiation accident situation, Ministry of the Interior, A:57, 10/011/98, 16 April 1998.
- [5] IAEA Safety Series 50-C-S, Code on the Safety of Nuclear Power Plants: Siting, 1988.
- [6] International Nuclear Safety Convention (Decree 725/1996).

YVL Guides

General guides

YVL 1.0 Safety criteria for design of nuclear power plants, 12 Jan. 1996

YVL 1.1 Finnish Centre for Radiation and Nuclear Safety as the regulatory authority for the use of nuclear energy, 27 Jan. 1992

YVL 1.2 Documents pertaining to safety control of nuclear facilities, 11 Sept. 1995

YVL 1.3 Mechanical components and structures of nuclear power facilities. Inspection licenses, 22 Oct. 1996 (in Finnish)

YVL 1.4 Quality assurance of nuclear power plants, 20 Sep. 1991

YVL 1.5 Reporting nuclear power plant operation to the Finnish Centre for Radiation and Nuclear Safety, 1 Jan. 1995

YVL 1.6 Nuclear power plant operator licensing, 9 Oct. 1995

YVL 1.7 Functions important to nuclear power plant safety, and training and qualification of personnel, 28 Dec. 1992

YVL 1.8 Repairs, modifications and preventive maintenance at nuclear facilities, 2 Oct. 1986

YVL 1.9 Quality assurance during operation of nuclear power plants, 13 Nov. 1991

YVL 1.10 Requirements for siting a nuclear power plant, 11 July 2000

YVL 1.11 Nuclear power plant operating experience feedback, 22 Dec. 1994

YVL 1.13 Nuclear power plant outages, 9 Jan. 1995

YVL 1.14 Mechanical equipment and structures of nuclear facilities. Control of manufacturing, 4 Oct. 1999 (in Finnish)

YVL 1.15 Mechanical components and structures in nuclear installations, Construction inspection, 19 Dec. 1995 (in Finnish)

YVL 1.16 Control of nuclear liability insurance policies, 22 March 2000 (in Finnish)

Systems

YVL 2.1 Nuclear power plant systems, structures and components and their safety classification, 26 June 2000

YVL 2.2 Transient and accident analyses for justification of technical solutions at nuclear power plants, 18 Jan. 1996

YVL 2.3 Preinspection of nuclear power plant systems, 14 Aug. 1975

YVL 2.4 Primary and secondary circuit pressure control at a nuclear power plant, 18 Jan. 1996

YVL 2.5 Pre-operational and start-up testing of nuclear power plants, 8 Jan. 1991

YVL 2.6 Provision against earthquakes affecting nuclear facilities, 19 Dec. 1988

YVL 2.7 Ensuring a nuclear power plant's safety functions in provision for failures, 20 May 1996

YVL 2.8 Probabilistic safety analyses (PSA), 20 Dec. 1996

Pressure vessels

YVL 3.0 Regulatory control of pressure vessels in nuclear facilities. General guidelines, 11 Sep. 1996

YVL 3.1 Construction plan for nuclear facility pressure vessels, 27 May 1997 (in Finnish)

YVL 3.3 Nuclear power plant pressure vessels. Control of piping, 4 December 1996

YVL 3.4 Nuclear power plant pressure vessels. Manufacturer's competence, 16 December 1996 (in Finnish)

YVL 3.7 Pressure vessels of nuclear facilities. Commissioning inspection, 12 Dec. 1991

YVL 3.8 Nuclear power plant pressure vessels. Inservice inspections, 13 Dec. 1993

YVL 3.9 Nuclear power plant pressure vessels. Construction and welding filler materials, 6 April 1995 (in Finnish)

Buildings and structures

YVL 4.1 Concrete structures for nuclear facilities, 22 May 1992

YVL 4.2 Steel structures for nuclear facilities, 19 Jan. 1987

YVL 4.3 Fire protection at nuclear facilities, 1 Nov. 1999

Other structures and components

YVL 5.1 Nuclear power plant diesel generators and their auxiliary systems, 23 Jan. 1997 (in Finnish)

YVL 5.2 Nuclear power plant electrical systems and equipment, 23 Jan. 1997 (in Finnish)

YVL 5.3 Regulatory control of nuclear facility valves and their actuators, 7 Feb. 1991

YVL 5.4 Supervision of safety relief valves in nuclear facilities, 6 April 1995 (in Finnish)

YVL 5.5 Supervision of electric and instrumentation systems and components at nuclear facilities, 7 June 1985

YVL 5.6 Ventilation systems and components of nuclear power plants, 23 Nov. 1993

YVL 5.7 Pumps at nuclear facilities, 23 Nov. 1993

YVL 5.8 Hoisting appliances and fuel handling equipment at nuclear facilities, 5 Jan. 1987

Nuclear materials

YVL 6.1 Control of nuclear fuel and other nuclear materials required in the operation of nuclear power plants, 19 June 1991

YVL 6.2 Design bases and general design criteria for nuclear fuel, 1 Nov. 1999

YVL 6.3 Supervision of fuel design and manufacture, 15 Sept. 1993

YVL 6.4 Transport packages for nuclear material and waste, 9 October 1995

YVL 6.5 Supervision of nuclear fuel transport, 12 October 1995 (in Finnish)

YVL 6.6 Surveillance of nuclear fuel performance, 5 Nov. 1990

YVL 6.7 Quality assurance of nuclear fuel, 23 Nov. 1993

YVL 6.8 Handling and storage of nuclear fuel, 13 Nov. 1991

YVL 6.9 The national system of accounting for and control of nuclear material, 23 Sept. 1999 (in Finnish)

YVL 6.10 Reports to be submitted on nuclear materials, 23 Sept. 1999 (in Finnish)

YVL 6.11 Physical protection of nuclear power plants, 13 July 1992 (in Finnish)

YVL 6.21 Physical protection of nuclear fuel transports, 15 Feb. 1988 (in Finnish)

Radiation protection

YVL 7.1 Limitation of public exposure in the environment of and limitation of radioactive releases from nuclear power plants, 14. Dec. 1992

YVL 7.2 Evaluation of population doses in the vicinity of a nuclear power plant, 23 Jan. 1997 (in Finnish)

YVL 7.3 Evaluation of models for calculating the dispersion of radioactive substances from nuclear power plants, 23 Jan. 1997 (in Finnish)

YVL 7.4 Nuclear power plant emergency preparedness, 23 Jan. 1997

YVL 7.5 Meteorological measurements of nuclear power plants, 28 Dec. 1990

YVL 7.6 Monitoring of discharges of radioactive substances from nuclear power plants, 13 July, 1992

YVL 7.7 Radiation monitoring in the environment of nuclear power plants, 11 Dec. 1995

YVL 7.8 Environmental radiation safety reports of nuclear power plants, 11 Dec. 1995 (in Finnish)

YVL 7.9 Radiation protection of nuclear power plant workers, 14 Dec. 1992

YVL 7.10 Monitoring of occupational exposure at nuclear power plants, 29 Aug. 1994

YVL 7.11 Radiation monitoring systems and equipment in nuclear power plant, 20 Dec. 1996

YVL 7.18 Radiation protection aspects in the design of NPPs, 20 Dec 1996

Radioactive waste management

YVL 8.1 Disposal of reactor waste, 20 Sept. 1991

YVL 8.2 Exemption from regulatory control of nuclear wastes, 19 March 1992

YVL 8.3 Treatment and storage of radioactive waste at a nuclear power plant, 20 Aug. 1996

The YVL guides without any language marking are available both in English and Finnish. The guides are on the Internet at <http://www.stuk.fi/english/yvl.html>