Limitation of public exposure in the environment of and limitation of radioactive releases from nuclear power plants

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RADIATION AND NUCLEAR SAFETY AUTHORITY

Authorisation

The Radiation and Nuclear Safety Authority (STUK) issues detailed regulations concerning the safety and physical protection of nuclear power plants and safeguards by virtue of Section 55, paragraph 2, point 3 of the Nuclear Energy Act (990/87), Section 29 of the Decision of the Council of State on the General Regulations for the Safety of Nuclear Power Plants (395/91) and Section 11 of the Decision of the Council of State on the General Regulations for Emergency Response Arrangements at Nuclear Power Plants (397/91).

The YVL guides are rules an individual licensee or any other organization concerned shall comply with unless some other acceptable procedure or solution is presented to STUK by which the safety level laid down in an YVL guide is achieved.

Translation. Original text in Finnish.

1 General

The Nuclear Energy Act (990/87) and the Nuclear Energy Decree (161/88) issued by virtue of the Act prescribe for the use of nuclear energy. By virtue of Section 81 of the Nuclear Energy Act, the Council of State has issued the General Regulations for the Safety of Nuclear Power Plants (395/91).

The Radiation Act (592/91) and the Radiation Decree (1512/91) set forth the general regulations for the limitation of radiation exposure. The provisions of Section 2 (general principles) and Chapter 9 (radiation work) of the Radiation Act also apply to the use of nuclear energy.

In accordance with Section 2 of the Radiation Act, to be considered acceptable, the use of radiation and practices involving exposure to radiation shall meet the following requirements:

1) The benefits accruing from the practice shall exceed the detriment it causes (principle of justification).
2) The practice shall be organized in such a way that the resulting exposure to radiation hazardous to health is kept as low as is reasonably achievable (principle of optimisation); and
3) The exposure of individuals to radiation shall not exceed the maximum values prescribed by decree (principle of limitation).

This Guide presents the requirements for the limitation of public exposure in the environment of and limitation of radioactive releases from nuclear power plants.

The requirements concerning the dispersion of releases and the assessment of population doses in the environment of nuclear power plants are presented in Guides YVL 7.2 and 7.3. Guides YVL 7.6 and 7.7 address the measurement of radioactive releases from nuclear power plants and the monitoring of radioactivity in the environment of nuclear power plants. An overall description of transient and accident analyses for nuclear power plants is given in Guide YVL 2.2.

The requirements concerning the monitoring of radiation exposure of nuclear power plant personnel are presented in Guides YVL 7.9, 7.10, 7.11 and 7.18. Monitoring of personnel exposure is also addressed in the relevant ST guides. A reference is made in the YVL guides to the applicable portions of those ST guides.

Reports to STUK on the radiological safety of the environs of nuclear power plants and on radiation exposure of the personnel are described in Guides YVL 1.5 and 7.8.

For the purposes of this Guide

1) **effective dose** shall refer to the weighted sum of the equivalent doses in tissues and organs subjected to radiation, where the equivalent dose denotes the product of the mean energy absorbed per unit mass in the tissue or organ and of the radiation weighting factor;
2) **dose commitment** shall refer to the time integral of the dose rate covering a separately defined period of time;
3) **critical group** shall refer to a group of the population which is estimated to incur the highest doses based on its place of residence and ways of living;
4) **accident** shall refer to a deviation from normal operating conditions which is not an anticipated operational transient; accidents are grouped into two classes:
   a) **postulated accident** means an event which serves as a design basis for the engineered safety systems of a nuclear power plant. The nuclear power plant shall withstand a postulated accident without severe fuel damages and without radioactive releases that would require extensive measures for restricting the exposure of the general public; and
   b) **severe accident** means an event during which a considerable part of the fuel in the reactor is damaged;
5) **anticipated operational** transient shall refer to a deviation milder than an accident from normal operational conditions which can be expected to occur once or several times during any period of a hundred operating years.

2 Exposure and release limits

The Decision of the Council of State (395/91) has been issued by virtue of Section 81 of the Nuclear Energy Act. Regulations concerning exposure and releases of radioactive materials are contained in Chapter 3 of the Decision. The

aforementioned principles contained in Section 2 of the Radiation Act have been taken into account when making the regulations.

In accordance with Section 7 of the Decision of the Council of State, radiation exposure arising from the operation of a nuclear power plant shall be kept as low as reasonably achievable. A nuclear power plant and its operation shall also be designed so that the limits presented in this Decision are not exceeded. Thus, adherence to the limits does not suffice alone but radioactive releases shall be kept as low as reasonably achievable.

2.1 Limits to be employed in design

2.1.1 Normal operational conditions and anticipated operational transients

In Sections 9 and 10 of the Decision of the Council of State (395/91) the following is enacted:

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

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

The limits concern the dose commitment of and effective dose to an individual of the critical group of the population. The dose commitment is calculated over a period of fifty years.

To limit the overall exposure of the population, the Radiation and Nuclear Safety Authority requires the following:

The limit for the global collective dose commitment to the population truncated at 500 years arising from the normal operation of a nuclear power plant for any period of one year is 5 manSv/GWe (per net electrical power).

When calculating the collective dose commitment, all on-site activities shall be taken into account, treatment and storage of reactor waste and operation of the disposal facility as well as intermediate storage and transport of spent fuel in the Finnish territory included.

Also the effect of the nuclide C-14 on the dose shall be examined in the analyses pertaining to the collective dose commitment. An up-to-date C-14 release estimate based on theoretical and practical knowledge shall be employed for the analyses.

2.1.2 Postulated accidents

In Section 11 of the Decision of the Council of State (395/91) the following is enacted:

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

The limit concerns the effective dose incurred by an individual of the critical group of the population.

The collective doses arising from a postulated accident shall also be analysed.

2.1.3 Severe accidents

In Section 12 of the Decision of the Council of State (395/91) the following is enacted:

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

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

Apart from analysing the effective dose from a severe accident to an individual of the critical group of the population and the extent and duration of contamination of areas of land and water, also the resulting collective doses shall be analysed.

2.2 Limitations during operation

2.2.1 Release limits

Plant-specific release limits shall be derived on the basis of the limits on individual dose and collective dose presented in sub-section 2.1.1. The licensee shall present the release limits in the Technical Specifications drawn up for the plant units. In accordance with Guide YVL 1.1, the Technical Specifications are subject to approval by the Radiation and Nuclear Safety Authority (STUK).

Release limits shall be separately determined for the most important radionuclides or groups of radionuclides. All the important radionuclides and release pathways shall be taken into account when deriving the release limits, and up-to-date models and parameters based on theoretical and practical knowledge, as well as sufficient safety margins, shall be employed.

The release limits shall be determined for releases taking place over a period of one year. The release limits shall be determined anew if environmental monitoring indicates that radiation doses to the population may exceed the limits presented in sub-section 2.1.1.

2.2.2 Releases requiring action

If the release rate exceeds the following threshold values measures to limit the releases shall be taken. The fact that the threshold value has been exceeded and its cause shall be mentioned in the daily report communicated to STUK. If an operational error or other safety-significant event relates to the event, a special report, as referred to in Guide YVL 1.5, shall also be forwarded to STUK.

Reporting Threshold:

The Reporting Threshold is 5 × Reference Release Rate (averaged over a week at most). The Reference Release Rate is an even release rate corresponding to the Release Limit.

Release Threshold Requiring Corrective Action:

The Release Threshold requiring corrective action is 3 × Reference Release Rate (averaged over a month at most).

Release Limit Requiring Restriction on Operation:

There shall be a restriction on the operation of a nuclear power plant if, based on releases or environmental monitoring measurements, it becomes evident that the Release Limits determined in the Technical Specifications would be exceeded.

2.2.3 Planned releases

STUK shall be notified in advance of any planned, temporary releases which would be in excess of the Reporting Threshold referred to in sub-section 2.2.2.

3 References

1 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, 1990

2 Basic Principles and Standards for the Limitation of Releases of Radioactive Substances from Nuclear Power Stations, Chapter 19 of the Report on the Applicability of International Radiation Protection Recommendations in the Nordic Countries, The Radiation Protection Institutes in Denmark, Finland, Iceland, Norway and Sweden, 1976

3 Application in the Nordic Countries of ICRP Publication 26, The Radiation Protection Institutes in Denmark, Finland, Iceland, Norway and Sweden, 1984

4 Principles for Limiting Releases of Radioactive Effluents into the Environment, Safety Series No 77, IAEA, Vienna 1986