Radiation protection of nuclear power plant workers

This Guide is in force as of 1 January 1993, until further notice. It replaces Guide YVL 7.9, issued 21 April 1981.

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Authorisation

By virtue of section 55, second paragraph, point 3 of the Nuclear Energy Act (990/87) and section 29 of the Council of State Decision (395/91) on General Regulations for the Safety of Nuclear Power Plants, the Finnish Centre for Radiation and Nuclear Safety (STUK) issues detailed regulations concerning the safety of nuclear power plants.

YVL Guides are rules an individual licensee or any other organisation concerned shall comply with, unless STUK has been presented with some other acceptable procedure or solution by which the safety level set forth in the YVL Guides is achieved. This Guide does not alter STUK's decisions which were made before the entry into force of this Guide, unless otherwise stated by STUK.

Translation. Original text in Finnish.

1 General

The use of nuclear energy is prescribed in the Nuclear Energy Act (990/87) and in the Decree (161/88) given by virtue of the Act. The provisions of section 2 and chapter 9 (radiation work) of the Radiation Act (592/91) are also applied to the use of nuclear energy.

According to section 2 of the Radiation Act, to be considered acceptable, the use of radiation and practices involving exposure to radiation shall meet the following criteria:

1) The benefits accruing from the practice shall exceed the detriment it causes (principle of justification);
2) The practice shall be organised in such a way that the resulting exposure to radiation hazardous to health is kept as low as is reasonably achievable (principle of optimisation);
3) No person's exposure to radiation shall exceed the maximum values prescribed by decree (principle of limitation).

Dose limits in radiation work are enacted in sections 3 and 4 of the Radiation Decree (1512/91). In section 8 of the Decree, measures needed to restrict the radiation hazard in an accident situation are enacted.

This Guide applies to the radiation protection of nuclear power plant workers during plant operation. Guide YVL 7.10 applies to monitoring of occupational exposure at nuclear power plants, Guide YVL 7.11 applies to radiation monitoring systems and equipment in nuclear power plants, and Guide YVL 7.18 describes how occupational radiation protection is to be taken into account in the design and construction of plants. Guide ST 1.7 presents requirements for medical surveillance relating to radiation work.

2 General requirements

According to section 7 of Council of State Decision No. 395/91, radiation exposure arising from the operation of a nuclear power plant shall be kept as low as reasonably achievable. According to section 8 of the Decision, a nuclear power plant's design and operation shall be implemented so that radiation exposure to workers can be limited, as separately enacted. In section 3 of the Radiation Decree (1512/91), the following is prescribed about worker exposure:

— The effective dose caused by radiation work to a worker shall not exceed 20 millisieverts (mSv) per year as an average over five years, or 50 mSv in any single year. In addition, the annual equivalent dose in the lens of the eye shall not exceed 150 mSv, and the annual equivalent dose at any point on the skin, hands or feet shall not exceed 500 mSv.

Protection of a pregnant worker's foetus is prescribed in section 4 of the Radiation Decree.

Measures to restrict the radiation exposure arising in an accident situation are enacted in section 8 of the Radiation Decree as follows:

— Measures needed to restrict the radiation hazard and bring the radiation source under control in an accident situation shall be taken in such a way that the radiation exposure due to the situation is kept as low as possible.
— As far as possible, the measures referred to above in the first paragraph shall be taken in such a way that the effective dose of a person participating in them does not exceed 0.5 Sv and the dose at any point on the skin does not exceed 5 Sv.
— A pregnant woman shall not be ordered to take part in measures causing exposure to radiation referred to in this section.

Emergency response arrangements are dealt with in Council of State Decision No. 397/91.

Guide ST 1.7 describes measures to be taken in an accident or in other situations in which there is implication of exposure essentially higher than normal.

Radiation protection shall be taken into consideration in operation, maintenance and modification of nuclear power plants. Implementation of radiation protection and maintenance of low radiation doses shall be based on good planning of activities, appropriate work methods, up-to-date radiation protection

methods, instruments and protective equipment, utilisation of previous experience, and good cooperation between various organisational units.

Collective doses to workers shall be monitored by working area and work category. If, at a plant unit, the collective radiation dose to the personnel exceeds the value 2.5 manSv per 1 GW of net electrical capacity averaged over two successive years, the cause of the excessive dose and the necessary measures which may be required to improve radiation protection shall be reported to STUK.

Safe, high-quality operations require an attitude favourable to radiation protection and high individual motivation in keeping radiation doses low. In carrying out their duties, workers shall be aware of matters affecting radiation protection. All nuclear power plant personnel, from plant management to the individual worker, shall be committed to the implementation of radiation protection.

3 Radiation protection organisation

3.1 Responsible manager and operating organisation

According to section 124 of the Nuclear Energy Decree, the responsible manager has a duty to see to it that the provisions of the Nuclear Energy Act, the rules and regulations issued by virtue of it, and the licence conditions concerning the safe use of nuclear energy, the arrangements for physical protection and emergencies, and the safeguards control referred to in section 118, are complied with. He shall also see to it that the provisions of section 2 and of chapter 9 of the Radiation Act are observed when implementing radiation protection for those working at the facility.

The responsible manager shall ensure that personnel implementing radiation protection have sufficient resources and authority. The responsible manager shall specifically monitor actions to keep radiation doses low. He shall also create and maintain prerequisities for correctly and adequately implementing radiation protection within the whole organisation.

Duties and responsibilities relating to the implementation of radiation protection shall be specified in documents concerning plant operation.

3.2 Radiation protection personnel

There shall be a unit in the facility's operating organisation whose duty it is to attend to practical radiation protection work; the plant's radiation protection officer is to act as head of this unit.

The radiation protection officer is responsible for directing the implementation of the plant's radiation protection programme. He shall also attend to the development of the radiation protection programme, and he shall see to it that experience gained in this field abroad is utilized.

The radiation protection unit shall be familiar with the sources of radiation at the plant and it shall monitor the radiological condition at the plant by measurements. The unit shall oversee work done in the plant's controlled area with respect to radiation protection.

This unit shall see to it that a sufficient number of radiation monitoring instruments and protective equipment is available. It shall also be ensured that these instruments and equipment are operable and that they are used according to instructions.

The radiation protection personnel shall be entrusted with sufficient authority to implement measures aimed at keeping radiation doses low, and, especially, they must have the authority to halt work activities on radiation protection grounds.

Requirements concerning the training of the responsible manager, the radiation protection officer and the rest of the radiation protection personnel can be found in Guide YVL 1.7.

4 Classification into zones according to plant radiation conditions

Regular dose rate measurements and determinations of airborne activity concentrations shall be conducted on the plant site. The controlled area and the areas contained therein shall be defined based on the results of these measurements.

4.1 Controlled area

An area shall usually be defined as a controlled area at least if the external dose rate in the area may exceed 2.5 µSv/h, or, if a 40-hour weekly stay in the area could cause an internal radiation dose exceeding 1 mSv in any one year.

4.2 Classification of the controlled area

The controlled area is to be divided into zones according to external dose rate, surface contamination and concentration of airborne activity. The minimum number of zones shall be three.

The lowest zone comprises areas where radiological conditions generally do not require restrictions in working time. The following conditions shall be fulfilled in areas belonging to this zone:
— external dose rate ≤ 25 µSv/h
— surface contamination:
  — beta emitters ≤ 40 kBq/m^2
  — alpha emitters ≤ 4 kBq/m^2
— concentration of airborne activity ≤ 0.3 DAC (Derived Air Concentration /2/).

The highest zone comprises areas where only brief stays, carefully planned in advance, are allowed. At least those areas where one of the following conditions is fulfilled belong to this zone:
— external dose rate ≥ 1mSv/h
— surface contamination:
  — beta emitters ≥ 400 kBq/m^2
  — alpha emitters ≥ 40 kBq/m^2
— concentration of airborne activity ≥ 30 DAC /2/.

External dose rate, surface contamination or concentration of airborne activity may locally exceed the classification limit if the sub-area in question is separated by access barriers and is marked by signs indicating radiation condition, potential access limitations and protective equipment required. Deviating radiation sources shall be visibly marked.

The classification of an area and the grounds for it shall be clearly indicated by signs at the entrance /3/. If the radiation condition of an area changes, signs indicating the area's classification must be changed without delay to correspond to the new conditions.

Up-to-date records of area classification and of radiation conditions shall be maintained at nuclear power plants.

4.3 Access to the controlled area

Access to the controlled area must be controlled. Areas other than those belonging to the lowest zone shall be locked or separated by access barriers. Personnel entering the controlled area must carry a visible identification badge for right-of-access checking. A dosemeter must always be worn. If individual dose that can be received in a working area during one week exceeds 0.5 mSv, a dosemeter permitting continuous dose monitoring must be carried. A dosemeter with an alarm (preferably a dose rate alarm) must be worn if the dose rate at working distance may exceed 1 mSv/h.

As protective clothing, at least a coverall and shoe covers are required, supplemented with additional equipment required in the job (protective gloves and shoes, and respirators). In special cases where the risk of contamination is minimal (for example in the case of visitors), lighter protective clothing, such as a protective coat and shoe covers, may be worn in the lowest zone.

The hands and protective clothing of those leaving the controlled area must be checked with a surface contamination measuring instrument. The worker contamination levels presented in Guide ST 1.5 may not be exceeded when leaving the controlled area. If the limits are exceeded at exit, the necessary decontamination measures must be carried out. If traces of contamination are left on the skin despite the cleanup, the extent and location of the contamination must be determined and essential details relating to the event must be recorded.

On leaving the controlled area, if surface contamination measurements indicate possible internal contamination, the person in question shall be measured for internal contamination at the plant site without delay. If the activity of a nuclide in the body is assessed to exceed 0.4% of the annual limit of intake /2/ based on this measurement, the contaminated person must be sent to STUK without delay for further measurements.

Items removed from the controlled area shall be measured for surface contamination. Guide ST 1.5 sets limits which may not be exceeded when removing items from the controlled area.

5 Radiation work permit

There shall be a radiation work permit for work performed in the controlled area. A permit of a more permanent nature can be provided for repeated, routine calls. A radiation work permit can be issued by persons assigned this duty in the administrative rules or in other plant procedures.

The radiation work permit or related documents shall provide at least the following information:

— names of employees (or the name of the foreman and the number of employees)
— radiation conditions in the working area
— requirements concerning measurement of dose rate, surface contamination and airborne activity
— exposure assessment and
— special instructions and equipment.

The work permit shall be displayed in the working area. The radiation protection personnel shall have the right and the duty to inspect that work performed in any work area complies with the radiation work permit.

On the basis of the radiation work permits and work surveillance, records shall be kept of work during which significant doses are incurred.

6 Radiation protection training

Radiation protection training is intended to provide workers with the prerequisites to work in the controlled area, and it also aims to contribute to the accomplishment of radiation protection objectives. This training shall be given to permanent and temporary nuclear power plant workers working in the controlled area. Furthermore, special training in radiation protection shall be given to anyone whose work has bearing on the outcome of the radiation protection programme.

The radiation protection personnel shall undergo an examination in which they must be able to show that they understand the radiation protection regulations and procedures presupposed by their duties and that they know how to use the instruments needed in their work.

Training provided for employees working in the controlled area shall include at least applicable parts of radiation legislation and of the regulations issued by virtue of it, fundamentals of radiation and radiation risk, instructions for work in the controlled area and information on dose monitoring. The employees must demonstrate in a written examination that they have sufficient knowledge of radiation protection. This examination shall be documented, including the name of the individual who conducted the assessment and the name of the employee concerned.

Training to carry out radiation protection shall be given before plant commissioning already. Besides introductory training, also refresher courses shall be arranged at regular intervals.

7 Radiation protection procedures

At the plant, there must be procedures describing the implementation of radiation protection measures. At least the following items shall be included:

— radiation protection fundamentals and the organisation responsible for their implementation
— instructions about conduct in the controlled area
— radiation measurements to be conducted in the controlled area
— the procedure for issuing radiation work permits
— monitoring of personal doses
— real-time job-specific and personal dose monitoring
— health surveillance
— instructions for use of personal protective equipment
— decontamination of individuals.

Radiation protection instructions shall be kept up-to-date and shall be revised in a manner defined in the nuclear power plant's quality assurance manual.

These instructions shall be sent to STUK for information.

8 Regulatory control

STUK regulates the operation of nuclear power plants as prescribed in Guide YVL 1.1. As part of the regular inspection programme, the Centre also oversees the implementation of radiation protection at the plant site. Furthermore, the Centre inspects items important to radiation protection and conducts separate inspections during outages.

If it is anticipated that the dose incurred from a planned work activity exceeds 0.1 manSv, or that it entails a significant risk of internal radioactive contamination, a document describing the work plans and the radiation protection measures shall be sent to STUK for information well in advance of starting the work.

Guide YVL 1.13 discusses regulatory control of outages in general terms. Control of modifications, repairs and maintenance is addressed in Guide YVL 1.8.

Guide YVL 1.5 describes what operational reports shall be submitted to STUK by nuclear power plants.

STUK shall be informed about the contents of and the plans for radiation protection training. The Centre inspects this training as part of inspections of the radiation protection programme during outages and along with inspections of the training function during the regular inspection programme.

9 References

1 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, Annals of the ICRP Vol 21 No. 1—3, Pergamon Press, Oxford 1991.

2 ST 1.5 Maximum values and classifications of radionuclides, 26 November 1991.

3 ST 1.3 Caution signs for radiation sources, 9 April 1992.

4 ST 1.7 Health surveillance of persons engaged in radiation work, 19 December 1991.

5 Provision of Operational Radiation Services at Nuclear Power Plants, Safety Series No. 103, Vienna 1990.