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In the event of any differences in interpretation of this guide the Finnish vesion shall take precendence over this translation

HEALTH PHYSICS PROGRAMMES IN NUCLEAR POWER PLANTS

1 GENERAL

The objective of radiation protection is to prevent the detrimental non-stochastic effects caused by radiation and to limit the probability of cancer, hereditary injuries and other stochastic effects as well as occurences causing radiation exposure to a level deemed to be acceptable. For this purpose, the function of the radiation protection at nuclear power plants is to ensure that the practices involving exposure to radiation are justified and that the occupational exposure of the plant personnel will be kept as low as reasonably achievable. Dose limits constitute the upper limits for the radiation exposure of an individual. Dose, as used in this guide, means dose equivalent.

Dose limits for persons exposed to radiation in the course of their work are given in the 2nd paragraph of the Resolution (594/68) of the Ministry of Social Affairs and Health. An exceptional situation, as referred to in the 8th clause of the 2nd paragraph, can at nuclear power plants only mean measures which can prevent or significantly reduce any serious harm that might be done to the health of the personnel or the population in the environment. Individual monitoring and reporting of results is described in Guide YVL 7.10. Matters related to overexposures are dealt with in Guide YVL 7.12.

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Collective doses received by any specific work group or resulting from any specific operation shall be monitored. Matters relating to radiation doses that are presented in the annual report are dealt with in Guide YVL 1.5.

The collective dose of the plant personnel should not exceed 5×10^{-3} manSv (0.5 manrem) for 1 installed MW of electric power per year. The Institute of Radiation Protection must be informed of the reasons for exceeding this limit and the measures that are planned to be taken to considerably increase the effectiveness of radiation protection.

2 SCOPE

This guide provides principles concerning organization of radiation protection at a nuclear power plant, controlled area of the plant, radiation work permits and training in radiation protection. This guide does not in detail deal with requirements set for radiation monitoring instruments or protective equipment. Nor does this quide describe the radiation protection principles adopted in the design phase of nuclear power plants or questions concerning plant modifications.

3 ORGANIZATION OF RADIATION PROTECTION

3.1 Manager Responsible for Radiation Safety

An approved manager, referred to in the 5th paragraph of the Statute on Radiation Protection, is responsible for the radiation safety of the personnel. He shall see to it that the above mentioned principle of keeping radiation doses low and the dose limits are adhered to in the radiation protection of the plant personnel. In adddition, he must create and maintain suitable circumstances for the proper and sufficient realization of radiation protection.

Responsibilities in effecting radiation protection shall be presented in guides or in other documents and the plant personnel shall be kept informed of these responsibilities.

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The manager responsible for radiation protection shall regularly supervise measures which aim at reducing doses and he must guarantee that the employees get sufficient training in radiation protection.

In matters relating to radiation protection, the responsible manager shall guarantee that the radiation protection personnel has enough authority to carry out actions aimed at keeping doses low. He must also work to prevent unsafe operations.

3.2

Radiation Protection Personnel

The duty of the radiation protection personnel is to effectuate radiation protection in such a way that the principle of keeping doses low and the dose limits are complied with.

The radiation protection personnel shall be familiar with the sources of radiation at the plant. Reasons for unanticipated exposures must be found out and measures to prevent recurrence of similar occurences must be initiated.

Guides controlling plant operation as well as operations in the controlled area must be regularly followed with respect to radiation protection. If it is detected that some operations cause avoidable radiation doses, these operations shall be modified without delay.

The radiation protection engineer shall see to it that a sufficient number of radiation monitoring instruments and protective equipment is available. In addition, he shall ensure that the instruments and equipment are operable and that they are used in accordance with given instructions.

The duties of the responsible plant manager, the radiation protection engineer and other radiation protection personnel are also described in Guide YVL 1.7.

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4

DIVISION ACCORDING TO THE RADIATION LEVELS OF THE PLANT

4.1

Controlled Area

If the external dose rate of an area might exceed 7.5 µSv/h (0.75 mrem/h) or if a 40-hour weekly staying in the area for one year might, during the year of the measurement, cause an internal radiation dose which exceeds one twentieth of the dose indicated by personal annual dose limits, then the area shall be defined as a controlled area.

4.2

Classification of Controlled Area

A controlled area shall be classified according to external dose rates, surface contamination and concentrations of radionuclides in the air. There shall be at least three zones.

The lowest zone shall be so defined that it is possible to work in the area for 40 hours a week without restricting working time or without any special protective equipment. The following conditions shall be fulfilled in the areas belonging to this zone:

- external dose rate $\leq$ 25 µSv/h (2.5 mrem/h)
- surface contamination:
  alfa emitters $\leq$ 3.7 kBq/m^2 (10^{-3} µCi/100 cm^2)
- beta emitters $\leq$ 37 kBq/m^2 (10^{-2} µCi/100 cm^2)
- concentration of radionuclides in the air $\leq$ 0.1 MPC_{40}

Areas where continuous working is not allowed and where only brief stays, which must be planned beforehand, are permitted shall be included in the highest zone. At least those areas where one of the following conditions is fulfilled belong to this zone:

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- external dose rate $\geq$ 1 mSv/h (100 mrem/h)
- surface contamination:
  alfa emitters $\geq$ 37 kBq/m^2 (10^{-2} uCi/100 cm^2)
  beta emitters $\geq$ 370 kBq/m^2 (10^{-1} uCi/100 cm^2)
- concentration of radionuclides in the air $\geq$ 10 MPC_{40}

The classification and the bases for it shall be clearly indicated, for example, by using signs of different colours. If the radiation conditions of an area are changed from what is indicated, the classification of the area shall be modified without delay to correspond with the real conditions. If the external dose rate, surface contamination or concentration of radionuclides in the air in one section of an area of a room exceeds the limit set in the calssification, the section in question must be provided with warning signs which specify the situation, potential access limitations or special equipment required. All specific sources of radiation in rooms shall be marked separately. An up-to-date chart showing the classification of rooms must be at hand at the nuclear power plant.

4.3

Access and working limitations in the controlled area

Access to controlled area must be restricted. All rooms, except those belonging to the lowest zone, shall be locked.

Identification of personnel must be secured by some suitable means. Persons who are working in the controlled area must have personal dosimeters and wear protective clothing. Protective clothing shall as a rule consist of an overall and boot covers supplemented with additional equipment required in the job. In well-founded special cases (visitors etc.) a jacket and boot covers may be worn as protective clothing in the lowest zone.

Only those persons who have a work permit or other authorization are allowed access to controlled area.

In the lowest zone, 40 hours of work per week is permitted without time limitations. In the other zones working time shall be so limited that the dose limits are not exceeded.

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Operations that make demands on radiation protection must be rehearsed, and a supervisor from radiation protection personnel shall be appointed to supervise compliance with the protective procedures, instructions and working time limitations planned for the operation.

The hands and clothing of persons leaving the controlled area must be checked with a monitoring instrument for surface contamination.

Leaving is permitted if no contamination is detected. Otherwise necessary decontamination and investigation measures shall be taken.

5

RADIATION WORK PERMIT

A radiation work permit shall be prepared for all operations in the controlled area that entail exposure to radiation, excluding repeated routine calls. When necessary, the radiation work permit or the related documents shall provide the following information

- number of employees and their names
- radiation conditions based on measurement data
- monitoring requirements of the workplace
- assumed exposure time and predicted doses
- special instructions and equipment
- personal dosimeter requirements

In issuing the work permit, attention must be paid to the employee´s earlier dose data and potential limitations caused by it.

If it can be predicted, when making work plans, that the dose caused by the work exceeds 0.1 manSv (10 manrem), the document on work plans and radiation protection measures shall be submitted to the IRP for information well before commencement of the work.

On the basis of radiation work permits, the licensee shall prepare documents on operations which have caused a collective dose exceeding 2×10^{-2} manSv (2 manrem). The documents shall specify name of the operation, collective dose received, highest personal dose caused by the operation, number of workers, working hours and predicted dose. If it is detected that the dose has exceeded

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0.1 manSv (10 manrem), a short description of the work and radiation protection measures shall be included. Any other documentation related to the work shall be attainable.

6 TRAINING IN RADIATION PROTECTION

All regular and transient workers who work in the controlled area of a nuclear power plant shall be given training in radiation protection.

New employees of the radiation protection personnel shall undergo an examination in which they must be able to prove that they are familiar with the regulations and principles of radiation protection which their duties presuppose and know how to use the radiation measuring instruments needed in their work.

The training of occupationally exposed persons shall at least include applicable items in radiation protection legislation, in directives on radiation protection issued by the authorities and in radiation protection instructions of the plant, instructions on working in controlled area, basic information on radiation, its biological effects and radiation hazards and the use of radiation measuring instruments. The training of other groups of workers may be less extensive than above, depending on the nature and duration of their work.

The training in radiation protection shall begin before commissioning of the plant. Besides the introductory training of the workers, requalification training shall be given on a regular basis.

When applying for the operating permit, the applicant shall also notify the Institute of Radiation Protection of the contents of the training and of the time devoted to it. Each occupationally exposed person shall be able to manifest that he has sufficient knowledge of radiation protection when examined by the manager responsible for radiation safety or someone authorized by him. A certificate signed by both the examiner and the examinee shall be written after the examination. The certificate must be kept at the plant.

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RADIATION PROTECTION GUIDES

At the plant, there must be a guide describing the realization of radiation protection measures. The guide must include at least the following items:

- principles of radiation protection and the organisation responsible for their realization
- instructions about conduct in controlled area
- radiation measurements in controlled area
- permits required by operations entailing exposure to radiation
- monitoring and recording of personal doses
- health supersivion
- instructions for the use of personal protection equipment
- decontamination
- measures to be taken in case of overexposure or accident

The radiation protection instructions including any modifications shall have the approval of the IRP.

8

REFERENCES

1. General Principles of Monitoring for Radiation Protection of Workers, ICRP Publication 12 Pergamon Press, Oxford, 1969

2. Report on the Aplicability of International Radiation Protection Recommendations in the Nordic Countries. The Radiation Protection Institutes in Denmark, Finland, Iceland, Norway and Sweden. Liber Tryck, Stockholm, 1976 412821

3. Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as is Reasonably Achievable, Regulatory Guide 8.8, U.S. Nuclear Regulatory Commission, Revision 3, March 1978

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5. Recommendations of the International Commission on Radiological Protection, ICRP Publication 26 Pergamon Press, Oxford 1977.

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