

Guide YVL C.4, Assessment of radiation doses to the public in the vicinity of a nuclear facility

1 Scope of application

Guide YVL C.4 gives the detailed requirements applicable to the licence applicant and licensee for meteorological measurements at a nuclear power plant, and the calculations for assessing the dispersion of radioactive substances and radiation doses to the population in its surroundings. The requirements in the Guide shall also apply to other nuclear facilities, where applicable. STUK will, if necessary, issue a separate decision regarding how the requirements in this Guide should be applied to other nuclear facilities.

The Guide applies to the design, construction, commissioning and operation of a nuclear facility. It relates to a plant's normal operation and operational occurrences and accident situations.

2 Justifications of the requirements by topic

2.1 Chapter 3 Meteorological measurements

Requirement 305: The meteorological measuring systems at a nuclear power plant shall have at least one sufficiently tall weather mast for the measurements. The Guide does not limit the number of additional masts and observation stations.

Requirements 306 and 323: The intention is that there shall be at least one mast in the vicinity of the nuclear power plant that is as high as the power plant's ventilation stack and that complies with all the requirements of Chapter 3. The additional masts are intended to reliably provide complementary data on the dispersion conditions in the vicinity.

Requirement 309: The nuclear power plant shall have in place a contingency plan for cases where the meteorological measurements are lost due to exceptional external events (DEC C), for example.

Requirements 321–322: The power supply shall be backed up by means of a secured system in the event of the loss of off-site power for 72 hours (Fukushima/emergency activities), and the measurement systems shall meet the single failure criterion at least for measurements of wind direction and speed and determining the stability of the lower-level atmosphere.

Requirement 328: The weather mast's structural condition shall be checked regularly in accordance with a programme drawn up in advance. This is important because the weather mast shall be operable in different environmental conditions throughout the entire life cycle of the mast.

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2.2 Chapter 4 Assessing the dispersion of releases

Requirement 403: The requirements of the chapter apply as such to nuclear power plants. For nuclear facilities, a simplified model that deviates from the detailed requirements in chapter 4 can be used. However, it shall then be justifiably demonstrated that the model used is conservative.

Requirement 409: A stability classification merely based on a temperature difference measurement may only be used temporarily should the priority classification method fail. According to the Finnish Meteorological Institute, a stability classification based on a temperature difference measurement is not sufficiently accurate. Because there is continuous development in methods relating to meteorology, requirement 409 states that "The stability classification shall be based on a classification method generally considered to be sound."

Subsection 4.3 includes specifications related to the dispersion of radioactive releases in the aquatic environment. Release dispersion shall be examined by means of hydrodynamic flow modelling (requirement 420). After detailed analyses, however, it is allowed to use more simple conservative models: "A simplified conservative model adapted to the receiving body of water or transport model, which takes account of the conditions in the water system more realistically, may be used in the dispersion calculation based on the results for hydrodynamic flow modelling."

2.3 Chapter 5 Radiation dose assessment

In the publication ICRP 101a (2006) and the 2007 recommendation (ICRP Publication 103), ICRP recommends the use of the concept of "representative person" (an individual representing the most exposed population group) instead of the previous concept of "critical group" in the radiation protection of the population. Subsection 5.2 of the Guide discusses the definition of a representative person.

Requirement 505: The requirement has been specified: *The analyses shall include studies on the sensitivity of the results regarding the main parameters used.* The mention of sensitivity studies regarding the analysis methods used has been left out. In accordance with requirement 502, the impact of the analysis method on the calculation result shall be analysed in the qualification of models, calculation methods and software, but sensitivity studies regarding analysis methods are not required in individual analyses.

Requirement 526: The requirement concerns the operation of a plant: *When examining radiation doses to individuals in the population in the surroundings of a plant while it is in operation, the actual population distribution can be selected as the basis for the distances of the individuals.* The requirement differs from dose assessment in connection with licence applications (subsection 5.6), regarding which requirement 534 states that *In individual dose analyses in the preliminary and final safety analysis report, the distance shall be assumed to be the closest place immediately outside the site where permanent settlement is possible.* During normal operation, the actual population distribution should be used in order not to overestimate the doses to the population during normal operation. Information on the actual population distribution shall be available when a plant is commissioned.

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Requirement 531: It does not serve any purpose to define the doses to the population in the whole of Finland and globally because at a sufficient distance from the plant, the doses cannot be calculated with reasonable accuracy. The shape of Finland also causes calculation problems. It is therefore sufficient that the doses to the population are calculated in an area extending at least 100 km from the plant.

Requirement 536: The requirement has been made clearer and more understandable. The requirement has been moderated so that the examination of the doses to different age groups is not required in transient and accident analyses in accordance with Guide YVL B.3 "Deterministic safety analyses for a nuclear power plant". The moderation does not change the aim of the requirement because the analyses shall be made for an individual in the most highly exposed population group. According to requirement 510, the representative person shall, if necessary, be chosen separately for analyses in accordance with Guide YV B.3.

2.4 Chapter 6 Documents to be submitted to STUK

The aim of the chapter is to clarify what the licence applicant or licensee shall do in different stages: during the design, the construction and operating licence process and the operation of the plant.

3 International provisions concerning the scope of the Guide

The IAEA Specific Safety Requirements essential for the Guide are the following:

- Series No. SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design (2016)
- Series No. SSR-2/2 (Rev. 1), Safety of Nuclear Power Plants: Commissioning and Operation (2016).

IAEA's general safety requirement:

- GSR Part 3: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (2014).

The equivalent Safety Guides are the following:

- NS-G-3.2, Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants
- RS-G-1.8, Environmental and Source Monitoring for Purposes of Radiation Protection
- WS-G-2.3, Regulatory Control of Radioactive Discharges to the Environment
- NS-G-2.7, Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants
- NS-G-4.6, Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors.

The ICRP (International Commission on Radiological Protection) publications and recommendations essential for the Guide are the following:

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- ICRP 101a. Assessing dose of the Representative Person for the Purpose of Radiation Protection of the Public and The Optimisation of radiological protection. ICRP Publication 101, Annals of the ICRP 2006; 36 (3)
- ICRP 103. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103, Annals of the ICRP 2007; Volume 37 (2–4)
- ICRP 108. Environmental Protection – the Concept and Use of Reference Animals and Plants. ICRP Publication 108. Annals of the ICRP 38 (4–6).

The Guide can be considered to comply with these requirements.

4 Impacts of the Fukushima Dai-ichi accident

The Fukushima nuclear power plant accident has affected the requirements on meteorological monitoring equipment, such as the 72 hour requirement in item 321.

5 Needs for changes taken into account in the update

The needs for changes due to changes made to international and national laws/regulations and the change proposals made in connection with the preparation of the YVL Guide implementation decisions (SYLVI) together with others recorded in STUK's change proposal database have been considered when updating the requirements. In addition, the possibilities to reduce the so-called administrative burden have been considered. The references to regulations have been updated.

In the implementing decisions of Guide YVL C.4 for the operating plants in Loviisa and Olkiluoto and for Olkiluoto 3, requirement 505 has been interpreted so that sensitivity studies regarding analysis methods shall be conducted when qualifying the methods but they are not required in individual analyses. Requirement 536 has been interpreted so that the examination of the doses to different age groups is not required in transient and accident analyses in accordance with Guide YVL B.3. Instead, the analyses shall be made for a representative person. According to requirement 510, the representative person shall, if necessary, be chosen separately for these analyses. Requirements 505 and 536 have been clarified to match these interpretations.

The requirements of the Guide do not contain any possibilities for administrative burden reduction.