

Guide YVL C.1, Structural radiation safety at a nuclear facility

1 Scope of application

In conjunction with the clarification (905/2017) of the Nuclear Energy Act, the authorisation granted to STUK to give orders on the structural radiation safety of the nuclear facility and the managing of the releases of radioactive substances was added to Section 7 q(20) of the Act. Amended by Act 905/2017, Paragraph 20 entered into force on 1 January 2018.

During the update of 2018, the requirement concerning the means of limiting radiation exposure and releases was added to the Radiation and Nuclear Safety Authority regulations on the safety of a nuclear power plant and the safety of disposal of nuclear waste. Section 7 of Regulation STUK Y/1/2018 and Section 9 of Regulation STUK Y/4/2018 present the main means that can be used to limit public and worker radiation exposure and emissions of radioactive substances. STUK's YVL Guides present detailed requirements relating to these.

Guide YVL C.1 shall be applied to the design of the structural radiation safety of a nuclear facility. The Guide defines the detailed structural principles linked with radiation safety to be considered in the design of a nuclear facility. The design principles presented in the Guide shall also be used in the design of the modifications of the nuclear facility.

2 Justifications of the requirements

In the design of a nuclear facility, one of the fundamental principles is to ensure the radiation safety of the workers and the environment over the entire service life of the facility (commissioning, operation and decommissioning) and in different operational conditions (normal operation, operational transients and potential accidents). At the nuclear facility, the size of the personnel's radiation doses can be affected, for instance, by design of the rooms and systems and by the planning of work procedures for operation.

The requirement level mostly corresponding to the requirements of Guide YVL C.1 is found in IAEA guide NS-G-1.13 "Radiation Protection Aspects of Design for Nuclear Power Plants" (see "International provisions concerning the scope of the Guide" below).

Requirement 306 of Guide YVL C.1 concerns the design objective of the collective radiation dose. The design objective for the annual dose has been set as 0.5 manSv per the net electric power of 1 GW, averaged over the designed operational life of the plant. An almost equivalent requirement is presented in EUR, in which the design objective of the collective radiation dose is presented as 0.5 manSv/year, averaged over the designed operational life of the plant. Binding the collective radiation dose objective to net electric power in Guide YVL C.1 is justified by virtue of the principle of justification presented in the Radiation Act (the gain achieved through operations is greater than the harm caused by it). IAEA guide NS-G-1.13 states that in the design

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phase, a target value in manSv/GWe should be set for the collective radiation dose. The guide, however, does not directly recommend any target level.

In addition to the achievement of the design limit value of the collective radiation dose, Guide YVL C.1 emphasises the use of the principle of optimisation in plant design. The Guide includes, for example, the sentences “Even if the dose limits and constraints were not exceeded, it is not justifiable to not implement a design option that would essentially reduce occupational or public dose” and “During the various design phases, collective doses shall be looked at and optimised by working tasks and worker groups.”

3 International provisions concerning the scope of the Guide

For the work related to the Guide, the key IAEA guide is Safety Guide NS-G-1.13 “Radiation Protection Aspects of Design for Nuclear Power Plants”. The requirements of Guide YVL C.1 cover the part of the content of the IAEA guide concerning personnel radiation protection. The radiation protection outside the plant described in the IAEA guide (releases, limiting the doses to the population) and radiation measurements are presented in STUK’s other C series Guides, and requirements concerning waste management are presented in the D series Guides. Guide YVL C.1 presents the most essential matters of the IAEA guide comprehensively, and there are no differences in the requirement level. Instead, the IAEA guide is much more detailed in terms of the design recommendations relating to radiation protection.

Also, IAEA’s requirement document SSR-2/1 “Safety of Nuclear Power Plants: Design” requires that nuclear safety be taken into account in the design of nuclear power plants so that occupational doses remain under the limits and as low as reasonably achievable. The requirements of Guide YVL C.1 are in line with the IAEA requirements.

WENRA does not present requirements for this topic in its reference levels for operating plants. Paragraph O6 of WENRA’s safety objectives for new nuclear power plants presents a general objective for the reduction of occupational doses to be observed in the design phase, which is in line with the requirements of Guide YVL C.1.

4 Impacts of the Tepco Fukushima Dai-ichi accident

In the Fukushima accident, one of the important issues was the accessibility of the rooms of the plant and the habitability of the control room. The matter has been addressed in Guide YVL C.1, Chapter 4, section “Accidents”, which presents as a requirement for the plant’s design phase the analysis of the feasibility of any operation, maintenance or repair measures or preparedness tasks in accident situations. A similar requirement is included in IAEA guide NS-G-1.13. In Finland, the accessibility of nuclear power plants has already been examined for years because of the special characteristics of the Loviisa plants. The examinations have traditionally been more extensive than in other countries. In other countries, the examination is often limited to the habitability of the control room. The guide includes the requirement that it shall be assumed in the design that an accident can happen simultaneously at several nuclear facilities in the area.

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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 most significant changes to the legislation and provisions after the publication of the previous Guide YVL C.1 are the clarification of the Nuclear Energy Act, the ongoing total renewal of the Radiation Act, the replacement of earlier Government Decrees concerning nuclear safety with the Radiation and Nuclear Safety Authority Regulations in the beginning of 2016 and the update of the regulations in 2018. Requirements concerning structural radiation safety have been added to Nuclear Energy Act and, issued under it, the Radiation and Nuclear Safety Authority regulations on the safety of a nuclear power plant and the safety of disposal of nuclear waste. However, these have not affected the requirement level of Guide YVL C.1. Because of provision references, changes have been made to requirements 101, 102, 103, 203, 301 and 424 of the Guide and the list of references.

Requirement 424 presents the target value 50 mSv to be observed in the design of the management and preparedness measures of accident situations. According to the current requirement, the design target value is the normal annual dose limit for a radiation worker. The change aims to keep the design requirement level unchanged although the annual dose limit of a radiation worker decreases from 50 mSv to 20 mSv as a result of the reform of the Radiation Act. In the design of measures needed in an accident situation, a dose exceeding the normal annual dose may be considered acceptable in terms of the principle of limitation, because the probability of an accident is low and it is very unlikely that a worker might be involved in a radiological emergency more than once. The reference level of a dose caused by a radiological emergency for emergency workers and helpers is 100 millisieverts per year as an effective dose. In a situation involving measures to save lives, the prevention of severe health effects due to radiation or the prevention of the aggravation of an accident, the reference level of emergency workers and helpers is 500 mSv per year as an effective dose.

Otherwise, the changes are mostly clarifications of the requirements (303a, 410, 412, 425, 502, 505, 519), corrections of typing errors (409, 424) and divisions of long requirements into parts (422, 303).

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