

Guide YVL C.6, Radiation monitoring at a nuclear facility

1 Scope of application

Guide YVL C.6 shall be applied to the design of radiation monitoring systems of a nuclear facility. Criteria set for individual radiation monitoring instruments and methods are also discussed in the Guide. The Guide sets forth requirements for the design, manufacture, installation and commissioning of the stationary radiation monitoring systems and equipment of a nuclear facility as well as for their operation. The Guide also describes the regulatory control pertaining to these issues.

Some of the requirements concerning radiation monitoring in this Guide are only applicable to nuclear power plants, but similar principles may also be applied at other nuclear facilities.

2 Justifications of the requirements

The permanently installed (stationary) and portable radiation monitoring systems and equipment are used to ensure the radiation safety of a nuclear facility and its environment. Their purpose is to measure the radiation dose rates and radiation exposures within the plant as well as to monitor the concentrations of radioactive materials in the systems and the radioactive releases. High quality and operational reliability is required of all radiation monitoring systems and equipment of the nuclear power plant. The equipment may provide immediate information to protect the employees, the environment of the plant and the population.

Compared with other instrumentation and control systems, special requirements set by radiation measurements are due, e.g., to the different sensor types and their physical principles of measurement, sampling arrangements and protection from background radiation. The performance of radiation monitoring instruments is connected with the statistical phenomena linked with the physical implementation of radiation monitoring. Not all properties of the radiation monitoring instruments can be tested at the site of manufacture and operation but at an appropriate radiation monitoring standard laboratory.

In addition to Guide YVL C.6, especially the requirements of Guides YVL B.1 "Safety design of a nuclear power plant", YVL B.2 "Classification of systems, structures and components of a nuclear facility" and YVL E.7 "Electrical and I&C equipment of a nuclear facility" apply to radiation monitoring systems and equipment. The radiation exposure to employees is regulated with the Radiation Act and Decree, and more specific requirements are presented in STUK's regulations and other YVL Guides of the C series.

Experiences in Finland and other countries so far show that the assembly, amount and required measurement locations of stationary monitoring may vary considerably in terms of the approach to safety depending on plant design and the supplier's experiences. Therefore, the design bases of the plant supplier shall be assessed in conjunction with the project without setting too detailed requirements for

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measurement targets and possible control functions. In addition to the stationary and portable radiation monitoring equipment, there shall be a real-time occupational dose monitoring system based on electronic dosimeters available in the controlled area. Portable and mobile radiation monitoring equipment may be used to supplement the information on the radiation circumstances of the nuclear facility.

Radiation monitoring technology is mostly very established in terms of nuclear physical factors and sensors. On the other hand, the share of digital programming causes the need to apply safety requirements similar to those used in other I&C systems. In this regard, the requirements of the Guide and the supervision of their implementation are in accordance with Guide YVL E.7.

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", Chapters 7 and 8 of which concern the radiation monitoring of nuclear power plants. The requirements of the IAEA guide are more general than Guide YVL C.6, and for the most part, they only describe the places where radiation monitoring shall be performed at the plant. Guide YVL C.6 includes more detailed requirements on, for example, the application of the single failure criterion, the characteristics of radiation monitoring equipment, the submitting of plans to the authorities and the manufacture, installation, commissioning, operation, periodic tests and maintenance of the systems and equipment.

IAEA's requirement document SSR-2/1 "Safety of Nuclear Power Plants: Design" specifies the sufficient amount of stationary radiation monitoring at nuclear power plants for normal and accident circumstances. The requirements of Guide YVL C.6 are in line with the above-mentioned IAEA document.

The references of Guide YVL C.6 present radiation monitoring standards valid in April 2017 that are used in the justifications for the design and requirement specification of radiation monitoring systems. During the preparation of the project, the designer shall specify the requirements for achieving the characteristics required of the equipment.

WENRA does not present requirements for this topic in its reference levels for operating plants.

4 Impacts of the Tepco Fukushima Dai-ichi accident

In the Fukushima accident, one of the important issues was the obtaining of measurement data for the monitoring and management of the accident. Radiation monitoring to be designed for accident situations is discussed in requirement 302 of Guide YVL C.6. This requirement was already included in the Guide before the Fukushima accident.

The requirement concerning the redundancy of the power supply refers to subsection 5.4 of Guide YVL B.1, which presents specified requirements for the matter. This change was already included in the Guide published in 2013.

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5 Needs for changes taken into account in the update

The update takes into account the comments by licensees in conjunction with the preparation of implementing decisions. The references have been inspected and updated. New standards have been published after the previous update (2013), and they have been added to the references. Some standards have been removed from the references as obsolete.

The administrative burden has been reduced. Operating instructions and in-service inspection programme instructions do not need to be submitted to STUK for information any longer (requirements 501 and 505). STUK inspects these instructions at its discretion at plant sites. In the previous update in 2013, the administrative burden was reduced by, for example, adding discretion to the monitoring of commissioning inspections. The content and requirement level of the Guide have otherwise remained unchanged.

To improve the traceability of the requirements, the Guide has been updated with references to Guides with more detailed requirements. For example, Guide YVL C.3 is referred to in Guide YVL C.6 as regards the details concerning the analysis of emissions. Among other things, Guide YVL C.3 specifies what kinds of emission measurements shall be used, which emission measurements shall be duplicated and what measurement accuracy is required.

References to Guide YVL C.2 have been added to requirements 323 and 411.

The definition "essential accident instrumentation" is removed. As a result of this, requirement 402 of Guide YVL C.6 has been updated to cover that requirement base which, based on the previous definition, was required of stationary radiation monitoring equipment intended for accident situations.

In accident situations, it must be possible to receive information important to accident management on fuel integrity and containment leaktightness. For the radiation monitoring equipment to be used to acquire the above information, a type approval is required.

The requirement level has not been tightened. The previous definition, "essential accident instrumentation, allowed an interpretation whereby essential accident instrumentation would have also covered some monitoring equipment for which it would be impossible to require a type approval in practice.