

Guide YVL E.12, Testing organisations for mechanical components and structures of a nuclear facility

1 Scope of application

Guide YVL E.12 sets forth requirements for testing organisations and testers performing non-destructive testing (NDT) and for those testing organisations performing destructive testing (DT) that verify the conformity of the integrity of the components and structures of nuclear facilities in safety classes 1, 2 and 3.

The guide is also applied to class EYT for in-service inspections performed under Guide YVL E.5 "In-service inspection of nuclear facility pressure equipment with non-destructive testing methods".

2 Justifications of the requirements

2.1 Chapter 1 Introduction

The introduction presents the key legislation concerning testing organisations that is behind the requirements of Guide YVL E.12:

- Approval of testing organisations – Nuclear Energy Act (990/1987), Section 60 a, and Nuclear Energy Decree (161/1988), sections 113 and 117b
- Service life of the nuclear facility – the Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018), Section 4, and the Radiation and Nuclear Safety Authority's Regulation on the Safety of Disposal of Nuclear Waste (STUK Y/4/2018), Section 5
- Requirements for the testing of conventional pressure equipment at nuclear facilities – Nuclear Energy Decree, Section 117(4 and 5); Nuclear Energy Act, Section 60; Government Decree (1548/2016), Section 7; and Pressure Equipment Directive 2014/68/EU, Annex I, Section 3.1.3.

Regulations concerning the materials testing of conventional pressure equipment at nuclear facilities are presented in the introduction, since STUK also controls conventional pressure equipment at nuclear facilities in accordance with the Section 60 of the Nuclear Energy Act and Section 117(4 and 5) of the Nuclear Energy Decree. Section 60 of the Nuclear Energy Act refers to the Pressure Equipment Act (1144/2016), which requires that pressure equipment is inspected such that it does not endanger anybody's health, safety or property, and the Government Decree (1548/2016) places requirements for NDT testers through the Pressure Equipment Directive.

In this guide, the term 'testing' always refers to non-destructive or destructive testing.

2.2 Chapter 2 Scope of application

The scope of application is in accordance with Section 60a of the Nuclear Energy Act and covers pressure equipment as well as mechanical components and steel and

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concrete structures. Direct visual testing was added to the scope of application in the 2013 YVL guide update.

Requirement 202: Condition monitoring includes in-service inspections of pressure equipment subject to registration and other condition monitoring (e.g. piping thickness measurements and MT/PT; in-service inspections of pressure vessels not subject to registration; in-service inspections of pumps and valves). Maintenance includes servicing and repairs of components and structures.

Requirement 203: EYT equipment is addressed on the basis of Section 117 of the Nuclear Energy Decree, and the licensee is obliged to set requirements concerning non-destructive and destructive testing in class EYT in the structural requirement specifications of the components.

Requirement 204: The scope of application of the guide has been updated regarding direct visual testing in accordance with implementing decisions 36/0010/2014 (OL1 and OL2), 38/0010/2014 (LO1 and LO2) and 40/0002/2016 (OL3).

According to the SFS-EN ISO 9712 standard (which replaced the SFS-EN 473 standard), confirmed on 13 August 2012, non-destructive testing methods include acoustic emission testing (AT), eddy current testing (ET), leak testing (LT), magnetic particle testing (MT), liquid penetrant testing (PT), radiographic testing (RT), ultrasonic testing (UT) and visual testing (VT). The abbreviations in parentheses are also defined in the standard.

Requirement 206: According to the Nuclear Energy Act (990/1987), *nuclear facilities shall refer to the facilities used for the generation of nuclear energy, including research reactors, facilities for the large-scale disposal of nuclear waste, and facilities for the large-scale production, use, processing or storage of nuclear material and nuclear waste. Nuclear facilities, however, shall not refer to:*

- a) *mines or milling facilities intended for the production of uranium or thorium, or premises and locations with their areas where nuclear waste from such facilities is stored or located for final disposal; or*
- b) *premises finally closed and where nuclear waste has been placed in a manner approved as permanent by the Radiation and Nuclear Safety Authority*
- c) *premises or parts of a nuclear facility that have been decommissioned in a manner approved by the Radiation and Nuclear Safety Authority.*

The guide is applied to all nuclear facilities.

Requirement 208: The requirements of Guide YVL A.3 "Leadership and management for safety" for suppliers apply to testing organisations in safety classes 1 and 2 as specified in the requirement. Testing organisations that are testing mechanical components and steel structures important to safety must understand the safety significance of the item tested as well as its installation site and the significance of the installation site in terms of materials testing. Regardless of whether the parts to be manufactured are new or whether the testing concerns an installation or finished mechanical components and steel structures already in use, Guide YVL A.3 shall be applied in accordance with the requirement.

Requirement 209: The obligations set forth in the guide also apply to the licence applicant in cases where materials testing within the scope of application of the guide is performed before the construction licence is granted (e.g. components and structures taking long to manufacture).

2.3 Chapter 3 General requirements for testing organisations

The chapter presents functional and financial independence requirements based in Section 60a of the Nuclear Energy Act, requirements for the acceptability of the accreditation decision and the scope of accreditation, as well as requirements for the subcontracting and external services of testing organisations.

Requirement 302: In accordance with decision T120/25, a testing organisation performing indirect visual testing shall have been accredited and the licensee shall apply for STUK's approval for indirect visual testing in all safety classes. Accreditation is required to ensure that the operations of the testing organisation are systematic and have high quality. Qualification for indirect visual testing is not yet a practice, even though the SFS-EN ISO 9712 standard would allow this. Requirement 426 supplements requirement 302.

If the testing organisation has been accredited for indirect visual testing, it is sufficient in safety class 3 that the licensee submits to STUK the accreditation decision with the appendix specifying the scope of accreditation, the list of testers and the licensee's assessment of the independence of the testing organisation.

Requirement 305: In this requirement, external services refer to services essentially related to testing, such as equipment servicing and calibration.

Requirements 306–307: The testing organisation may only use subcontractors (independent actors) that have been approved by STUK. A testing organisation that uses hired external testing personnel (external resources) does not require testing organisation approval, since the external resources do not act independently but under the supervision of a testing organisation approved by STUK.

Requirements 309–310: According to Section 60a of the Nuclear Energy Act, testing organisations must be functionally and financially independent. However, manufacturers often have their own testing organisations that are better qualified to perform non-destructive or destructive testing of their products. While the manufacturers' own testing organisations cannot be required to be fully financially independent of the item tested, functional independence and impartiality are required. Financial pressure or incentives must not affect the conformity assessment performed by any testing organisation belonging to the scope of application or the results of the assessment. Remuneration or comparable personnel benefits must not be dependent on the number of tests performed or the results of the tests.

Requirement 311: When the testing organisation is independent of the manufacturer, accreditation is always required. In safety class 3, and in safety class 2 whenever justified, it is possible to use a testing organisation that is part of the licensee's organisation or the organisation performing the conformity assessment of the item tested, provided that the independence and impartiality requirements are met. Justified reasons for using the aforementioned testing organisation in safety class 2

may include, for example, cases in which testing of sudden but minor repairs during use is required, or if the testing organisation has a special method or equipment designed for the testing in question.

Requirement 312: The manufacturer's own testing organisation may be approved for a justified reason, and it may be either accredited or non-accredited. Examples of justified reasons for using the manufacturer's own testing organisation:

- The manufacturer has a special method or equipment designed for the testing in question.
- Materials testing performed by the manufacturer's own testing personnel only concerns a certain equipment type and uses standardised, tried and tested methods.
- The manufacturer performs routine testing as part of the manufacturing process.

Third-party supervision relating to materials testing is specified in component-specific guides and presented in component-specific plans. The licensee must present further specified requirements for assessing the technical competence and independence of the manufacturers' own testing organisations in assessment instructions to be approved by STUK (requirements 418d and 512d).

2.3.1 Section 3.1 Obligations of the licensee

Obligations have been set for the licensee to specify in its management system the procedures for using and supervising testing organisations, ensuring the validity of their approval and maintaining it. The aim of this is to ensure systematic maintenance of testing organisations approvals.

Requirement 314: Guide YVL E.5 refers to Guide YVL E.12 with respect to the approval of testing organisations and inspection personnel (= testers) to perform in-service inspections in accordance with Guide YVL E.5. The approval of testers is part of the approval of the testing organisation. However, the *applicability of the additional qualifications of testers to the item tested in the in-service inspection* shall be approved separately. The testers specified in these approvals are entitled to perform in-service inspections of the items for which they have special qualifications.

Requirement 316: The annual evaluation reports, accreditation decisions and notifications of changes that are required when the prerequisites for the approval of testing organisations change must be submitted using separate letters for each testing organisation, so that the approvals and annual monitoring remain specific to the testing organisation and can be managed better.

2.4 Chapter 4 NDT testing organisations

The delimitation of testing organisations approved on the basis of an approval application is based on Section 60a of the Nuclear Energy Act and Section 113 of the Nuclear Energy Decree. In addition to the other documents required, the approval application must include the licensee's summary of justifications concerning the acceptability of the testing organisation as well as the appendix to the decision of the accreditation body, which indicates the scope of accreditation by test method. In addition to the testing organisation's references, the application must also indicate

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the experience that the person responsible for technical matters has with nuclear facilities or the nuclear industry.

Requirement 402g: The description of the tester qualification system and organisation must indicate the persons with different levels of qualification. This makes it possible to assess whether there is a person employed by or available to the organisation who has qualifications corresponding to level 3 of the SFS-EN ISO 9712 standard or an equivalent qualification system.

One equivalent qualification system is the ASNT (American Society for Nondestructive Testing) standard "ANSI/ASNT CP-106, Nondestructive Testing - Qualification and Certification of Personnel".

Requirement 409: The person responsible for technical matters must ensure that the qualification information of testers is up to date and can be checked on the site as necessary.

2.4.1 Section 4.2 Non-accredited testing organisations

The requirements for the assessment and approval of non-accredited NDT testing organisations are presented in detail. Non-accredited testing organisations are only approved for a justified reason, and the approval only applies to manufacturers' own testing organisations for which this opportunity is considered necessary.

Non-accredited testing organisations must be approved by STUK through application in all safety classes. This is because the assessment practices are not established and the assessment process is not regulated in the same manner as in the accreditation.

When applying for approval of the manufacturer's own non-accredited testing organisation, licensees can make use of assessments performed by each other in all safety classes. The assessment must be agreed beforehand, and the assessment instructions of all licensees that will make use of the assessment must be taken into account in the assessment. The assessment instructions must be approved by STUK.

In safety classes 2 and 3, an assessment conducted by another licensee can be utilised afterwards in special cases, if it can be justifiably demonstrated that the assessment in question meets the needs of the licensee and the delivery.

2.4.2 Section 4.3 Requirements concerning testers

This section includes the requirements for testers and their qualifications. The requirements for testers performing in-service inspections under Guide YVL E.5 are presented in their own section, and the requirements follow the established practice.

Requirement 425b: Use of the testing organisation's internal qualification system can be approved for a justified reason, and it must be externally and independently assessed. The external independent assessment may be, for example, ASME Stamp, an internal qualification system within the scope of accreditation, Nadcap accreditation or other reliable assessment.

Requirement 426: Indirect visual testing does not require external independent assessment of the internal qualification system, but requirement 302 must be met.

Requirement 428: The scope of application of the guide does not include the qualification requirements for those testers performing replacing or complementary inspections as part of the in-service inspections of pressure equipment subject to registration in class EYT. The qualification requirements are set by the licensee in the equipment's structural requirement specifications, whose requirements are set in the component-specific E-series guides. With safety-classified pressure equipment subject to registration, the testing organisation approval and tester's qualification are required for the aforementioned inspections.

For non-destructive testing in connection with condition monitoring, the tester's qualification is considered sufficient and the testing organisation need not be approved. For non-destructive testing relating to maintenance (servicing and repairs) and modifications, the testing organisation approval is required in accordance with the guide.

2.5 Chapter 5 DT testing organisations

In accordance with Section 60a of the Nuclear Energy Act, concrete and reinforcement steel testing organisations were added to the scope of application in the 2013 YVL guide update. These testing organisations perform destructive testing and are approved on the basis of accreditation in accordance with Section 113 of the Nuclear Energy Decree, like accredited testing organisations performing destructive testing of metals.

Concrete and reinforcement steel testing organisations can also be approved if they are materials testing organisations approved by the Ministry of the Environment. The certificate of approval and the licensee's assessment of the independence of the testing organisation must be submitted to STUK in the same manner as for accredited testing organisations.

2.5.1 Section 5.2 Non-accredited testing organisations

The requirements set for non-accredited DT testing organisations correspond to those set for non-accredited NDT testing organisations. As with NDT testing organisations, non-accredited testing organisations are only approved for a justified reason, and the approval only applies to manufacturers' own testing organisations for which this opportunity is considered necessary.

Non-accredited DT testing organisations must be approved by STUK through application in all safety classes based on the same grounds as non-accredited NDT testing organisations. Assessments conducted by another licensee can be utilised in the same manner as for non-accredited NDT testing organisations.

2.6 Chapter 6 Testing related to material manufacturing

The requirements for testing related to material manufacturing were made significantly more specific in the 2013 YVL guide update based on decisions T120/5 and T120/9 as well as the pressure equipment workgroup's memorandum, and the

requirement level was specified on the basis of the equipment's significance. Annex A to the guide presents the division of components into groups 1, 2 and 3, each with their own requirement level. The requirements apply to both non-destructive and destructive testing.

Requirement 603: The material manufacturer can be approved to manufacture materials in accordance with the following standards, for example: "ASME Section III, RCC-M M100, AD 2000 Merkblatt W0, SFS-EN 764-5" and KTA. The application of these standards has been approved by the pressure equipment workgroup. The assessment and approval of the material manufacturer is a total package that includes matters relating to materials testing in addition to other matters assessed.

2.7 Chapter 7 Documents required for supervision

In order to clarify the practices, the chapter describes when the licensee must apply for STUK's approval for changes concerning the testing organisation's operations as well as the contents of the annual evaluation report to be submitted by the licensee.

Requirements 703–704: The annual evaluation report which is prerequisite for the testing organisation's approval means a summary of the testing organisation's operations compiled by the licensee. In the evaluation report, the licensee must also present its own assessment of the testing organisation's operations in accordance with the obligations specified in this guide. The annual evaluation ensures that the operational preconditions of the testing organisation remain intact at all times.

Requirement 412 specifies that the testing organisation shall annually submit to the licensee a report on the implementation and the results of the periodic assessments by the accreditation body. This report is part of the evaluation report. For non-accredited testing organisations, requirement 412 is referred to in requirements 424 (NDT) and 517 (DT).

2.8 Chapter 8 Regulatory oversight by the Radiation and Nuclear Safety Authority

Regulatory oversight by STUK is based on Section 63 of the Nuclear Energy Act and Section 117 of the Nuclear Energy Decree.

The chapter compiles the regulatory oversight performed by STUK and specifies when documents are approved by decision, when they must be submitted for information and when they are reviewed in another context.

2.9 Definitions

New definitions added in the 2013 YVL guide update were direct visual testing and indirect visual testing.

Before the 2013 YVL guide update, the definition of 'mechanical component' included pressure equipment, steel structures and mechanical components. With the guide update, separate definitions were written for pressure equipment, steel structures and mechanical components.

The quality vocabulary follows ISO 9000:2015.

3 International provisions concerning the scope of the Guide

The requirements set in Guide YVL E.12 have been compared with the following IAEA and WENRA requirement documents:

IAEA safety instructions

- Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants, Safety Guide, Series No. NS-G-2.6, October 2002
- Safety of Nuclear Power Plants: Design, Specific Safety Requirements No. SSR-2/1, January 2012
- Safety of Nuclear Power Plants: Commissioning and Operation, Specific Safety Requirements No. SSR-2/2, July 2011

WENRA

- Reactor Safety Reference Levels for Existing Reactors, September 2014
 - Issue C: Quality Management
 - Issue I: Ageing Management
 - Issue K: Maintenance, In-Service Inspection and Functional Testing
 - Issue Q: Plant Modifications

Report “Benchmarking the European inspection practices for components and structures of nuclear facilities, March 2012”

EUR (European Utility Requirements for LWR Nuclear Power Plants)

- October 2012
 - Chapter 2.13: Constructability and Commissioning
 - Chapter 2.14: Operation, Maintenance and Procedures
 - Chapter 2.15: Terms of Reference

The IAEA and EUR guidelines do not include any detailed requirements that would need to be added to Guide YVL E.12. The guidelines are clearly more general, and the requirements are already included in the current guide. Section 4.4 of the WENRA report, “Accreditation, authorisation and surveillance of independent inspection, testing and certification organizations”, specifies that the accreditation should be based on the applicable regulations and standards. This is indicated in requirement 302, which specifies the scope of accreditation.

Guide YVL E.12 meets the WENRA, IAEA and EUR requirements but takes them to a clearly more detailed level.

4 Impacts of the Tepco Fukushima Dai-ichi accident

The Fukushima accident has no impact on the contents of the guide.

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

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of the YVL Guide implementation decisions (SYLVI) together with other change proposals 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 guide has been updated with the changes caused by the changes in the Nuclear Energy Act, STUK regulations STUK Y/1/2018 and STUK Y/4/2018 as well as the pressure equipment legislation.

The scope of application has been updated regarding direct visual testing in accordance with implementing decisions 36/0010/2014 (OL1 and OL2), 38/0010/2014 (LO1 and LO2) and 40/0002/2016 (OL3).

The application of Guide YVL A.3 for testing organisations has been further specified in the guide, and demonstration of the fulfilment of YVL A.3 requirements for suppliers has been added to the information to be enclosed with the approval application. (requirement 208)

On the basis of the experience gained, the opportunity to use the manufacturers' own accredited testing organisations has been added to the guide, whereas it was earlier restricted to the manufacturers' own non-accredited testing organisations. (requirements 311 and 312)

The content requirements for the summary of justifications are specified in requirement 402, which concerns the approval application.

Requirements 414 and 502, which concern the approval of testing organisations approved on the basis of accreditation and the period of validity of the approval, have been further specified in accordance with the practice.

Regarding the assessment of non-accredited NDT and DT testing organisations, requirements 418b and 512b have been further specified, indicating that the assessment training and experience of the assessor working for the notified body must be related to quality systems. In addition, requirements 420 and 513 have been supplemented with the previously missing requirement regarding demonstration of the conformity of the assessor working for the notified body. Requirements are set for the notified body, its assessor and the technical assessor, and the fulfilment of these must be demonstrated in connection with the approval application.

Requirements 425a and 425b for the certification body providing tester qualifications and for the approval of the testing organisation's internal qualification system have been added to the guide.

The requirement concerning the certification decision or certificate from an audit of the material manufacturer's quality management system to be enclosed with the construction plan has, in requirement 605, been restricted to only apply to pressurised main components in group 3 of Annex A.

The delivery time of the first annual evaluation report after the testing organisation's approval has been changed such that it shall be delivered after the first full operating year. (requirement 703)

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The “Pressure vessels and heat exchangers” section of Annex A has been further specified as regards the division of parts. The internals and the supports of the primary coolant circuit main components have been moved onto their own row and divided into groups. These supports include both the supports inside the main components as well as any external supports (not welded to the pressure retaining body). In addition, SC 3 parts have been considered more clearly in the table.

The term ‘testing’ has been replaced with ‘non-destructive and destructive testing’ on several occasions to distinguish non-destructive and destructive testing of materials from other testing of components.

Other further specifications have also been made that do not significantly influence the contents.

The administrative burden has been reduced by the postponement of the delivery of the first annual evaluation report (requirement 703). Previously, the first evaluation report had to be delivered in the year following the approval, but now it is not required until after the first full operating year. The administrative burden is also reduced by the opportunity to use manufacturers’ own accredited testing organisations, which was not possible earlier without a deviation (requirement 312).