Radiation and Nuclear Safety Authority
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Guide YVL E.5, In-service inspection of nuclear facility pressure equipment with non-destructive testing methods

1 Introduction

The basis of the Finnish periodic inspection procedure was created by an expert workgroup that was active in 1974–1976. Its members included representatives of licensees, testing organisations, VTT and STUK (then the Department of Radiation Physics). The basic structure of the Guide created at that time and its basic concepts are still in use.

Guide YVL E.5 “In-service inspection of nuclear facility pressure equipment with non-destructive testing methods”, published on 20 May 2014 as a result of the previous Guide update process, has now been updated.

The update, as well as the current update needs, has been affected by the international development of procedures, the experiences from qualifications and risk-informed in-service inspection programmes and especially the experiences from the construction stage of the new OL3 nuclear power plant unit.

The preparation of the Guide has been greatly affected by the anticipation of new nuclear power plants.

In Finland, no nuclear power plants were built for decades after the 1970s. Many of the requirements of the Guide are from the time the operating facilities were built in the 1970s. The instructions of the construction stage worked back then, and no particular need for change was seen in decades. In those days, in-service inspection programmes were not part of the plant delivery. Instead, they were the responsibility of the licensee. This way, project technical conflicts between the licensee and the plant supplier were avoided, and no particular instructions were needed to avoid them.

During the construction of a nuclear power plant, it has become clear that the Guide needs to be supplemented with requirements for the stage before the construction licence and the requirements for the construction stage need to be specified.

2 Scope of application

Guide YVL E.5 presents the requirements for the planning, qualification, implementation, reporting and supervision of the in-service inspections performed on nuclear pressure equipment using non-destructive inspection methods:

- Inspections shall be performed on pressure equipment belonging to safety classes 1 and 2, other safety equipment that is considered significant in terms of safety and the flywheels of the main circulation pumps.
- The piping in-service inspection programme shall be performed in a risk-aware manner, analysing all of the nuclear facility’s systems in safety classes 1, 2, 3 and EYT as a single complex independently of the safety classifications and nominal dimensions of the piping.

- The inspection systems shall be qualified.

If qualifications are required for the manufacturing inspections of a nuclear facility's mechanical equipment and structures, such as the final disposal capsules of spent nuclear fuel, they will be performed by applying this Guide.

3 Justifications of the requirements

The justifications of the requirements of Guide YVL E.5 can be grouped as follows:

- Nuclear energy and other legislation
- IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Vienna, 2002
- WENRA Safety Reference Levels for Existing Reactors, September 2014, Issue K: Maintenance, In-service inspection and Functional Testing
- ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Division 1 (ASME Code, Section XI)
- Publications by the European Network for Inspection and Qualification, ENIQ
- Instructions and requirements by nuclear safety authorities of other countries, NRWG
- Research and development in Finland and abroad
- Experiences in Finland and abroad
  - Operating facilities
  - Facilities under construction
- Expectations for planned facilities, threat scenarios and opportunities
- Established, well-tried Finnish practice; the requirement that has proven its worth was already presented in the 1982 edition of Guide YVL 3.8
- The objective of Finland having a high level of radiation and nuclear safety and setting a trend for international development
- Other justifications

3.1 Chapter 1 Introduction

The introduction presents the obligations set by the Finnish nuclear energy legislation, the purpose of non-destructive in-service inspections and the coverage of the Guide.

3.2 Chapter 2 Scope

Requirement 201 is primarily based on the requirements of the Finnish nuclear energy legislation, WENRA's reference document WENRA Safety Reference Levels for Existing Reactors, September 2014, Issue K: Maintenance, In-service inspection and Functional Testing and the International Atomic Energy Agency's guide document IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Vienna, 2002.

The specification of requirement 201 "*Inspections shall be performed on pressure equipment belonging to safety classes 1 and 2 [and] other pressure equipment that is considered significant in terms of nuclear safety*" is based on an established, well-tried Finnish practice. The additional specification of requirement 201 "*and for the flywheels of the main circulation pumps*" is based on "U.S. NRC Regulatory Guide 1.14 Reactor Coolant Pump Flywheel Integrity". In practice, this has been required from currently operating plants from the beginning of their service life, although it has not been presented in previous YVL Guides.

The minimum requirement level for a risk-informed in-service inspection programme is presented in "ASME Code, Section XI, Nonmandatory Appendix R, Risk-informed Inspection Requirements for Piping". The standard would give the licensee the opportunity to choose the scope of the risk-informed in-service inspection programme for piping. However, the scope is presented in requirement 404 of the Guide: *The in-service inspection programmes for piping of systems in safety classes 1, 2, 3 and EYT shall be drawn up using risk-informed methods regardless of the nominal sizes of the piping and other deterministic exclusion principles of ASME Code, Section XI in order to ensure that the structural elements causing the greatest risk are included in the inspection scope.*

Paragraph 202 is based on the assumption that it is easier to observe other types of damage than crack-like defects, so the licensee is given an opportunity to handle them in a simpler way in accordance with the conditioning monitoring programmes presented in Guide YVL E.3 "Pressure vessels and piping of a nuclear facility".

Requirement 203 is based on the definition of a risk-informed in-service inspection programme.

Requirement 204 is based on the fact that in the documents published by the European Network for Inspection and Qualification (ENIQ), it is stated that the qualification principles presented in them also apply to manufacture and pre-service inspections as well as non-nuclear equipment whose damages have non-acceptable consequential effects. The qualification requirements presented in this Guide are based on documents published by ENIQ, which means that this Guide can be used as the basis of the qualification requirements of manufacture inspections.

Paragraph 205 states that licence applicants, licensees, plant suppliers, qualification bodies and testing organisations are the most important actors within the scope of the Guide.

Paragraph 206 is primarily based on WENRA's reference document WENRA Safety Reference Levels for Existing Reactors, September 2014, Issue K: Maintenance, In-service inspection and Functional Testing, section 1. Scope and objectives, subsection 1.1 and the International Atomic Energy Agency's guide document IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Vienna, 2002, section In-Service Inspection 2.13.

Paragraph 206a clarifies the word *inspection*, for which many different meanings can be defined. In addition, the Finnish Nuclear Energy Act (990/1987, Section 3) specifies that the word *testing* should be used for non-destructive testing methods. In Guide YVL E.5 and in-service inspections, however, the word *inspection* has been established for this purpose.

3.3 Chapter 3 In-service inspections

Subsection 3.1 In-service inspection requirements, documents and their updates

Paragraph 301 presents an introduction to subsection 3.1.

Requirement 302 is based on the fact that the "ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Division 1" (ASME Code, Section XI) is apparently the first, most profound, most extensive and best-known in-service inspection standard for pressure equipment of nuclear power plants in the world. It has been and still is the basis of the in-service inspection practice in many countries.

In Finland, the requirements of WENRA's reference document (*WENRA Safety Reference Levels for Existing Reactors, September 2014, Issue K: Maintenance, In-service inspection and Functional Testing*) and the International Atomic Energy Agency's guide document (*IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Vienna, 2002*) are complied with.

Requirement 303 is based on reference "U.S. NRC Regulatory Guide 1.14 Reactor Coolant Pump Flywheel Integrity", which provides justifications and instructions for the inspections. In practice, this has been required from currently operating plants from the beginning of their service life.

Requirement 304 on the risk-informed in-service inspection programmes for piping is based on the detailed justifications of the requirements of risk-informed in-service inspection programmes presented in chapter 4.

The basis of **requirement 305** is that the qualification requirement should be extended to also apply to surface detection systems because the faults detected in practical inspections are usually surface faults and may therefore have the worst consequential effects. ENIQ's procedures may be applied to all inspection methods.

Requirement 306 is based on Guide YVL E.12 "Testing organisations for mechanical components and structures of a nuclear facility", in which the requirement is presented.

Requirement 307 is based on experiences from facilities under construction and on an established, well-tried Finnish practice.

Requirement 308 is based on a good quality management practice and is presented in all reference instructions and standards.

Requirements 309–316 for the summary of justifications are based on experience, the Nuclear Energy Act (990/1987) and the definition of an argument [1]. The Guide uses established concepts to enable STUK to handle summaries of justifications systematically and in a way jointly understood by different parties.

The purpose of the summary of justifications is to verify that the licence applicant or licensee has performed its duty of inspecting the document at a sufficient depth and to a sufficient extent and to act as an argument on why an authority should approve the document. This increases the licence applicant's/licensee's responsibility and improves quality and safety.

The licence applicant/licensee draws up a summary of justifications as a natural part of its own document processing process, and submitting it to STUK is not an additional obligation.

The summary of justifications must be an argument. This demonstrates the acceptability of the document. The summary of justifications must present the YVL Guide requirements related to the document submitted to STUK, as well as a summary of the fulfilment of the requirements. This will make STUK's document inspection easier and quicker. The summary may also include explanations and descriptions, but they are not sufficient without an argument.

STUK will begin its document inspection by using argumentation analysis in its pre-inspection to make an assessment of whether or not the summary of justifications, as an argument, clearly and convincingly answers the question as to why the document should be approved.

If STUK, in its preliminary investigation, should, with reference to the summary of justifications, find the scope and depth of the licence applicant's/licensee's arguments and its own review and approval procedure inadequate, it will halt the processing of the document at this stage and require the licensee to add more content to its summary of justifications for the process to continue.

If the license applicant's/licensee's argumentation and approval procedure are adequate, STUK will continue the process by first comparing the summary of justifications to the content of the rest of the document, finally evaluating the acceptability of the entire document.

According to Section 7 e of the Nuclear Energy Act, *compliance with requirements concerning the safety of a nuclear facility shall be proven reliably*.

According to Section 9 of the Nuclear Energy Act, *it shall be the licensee's obligation to assure safe use of nuclear energy. This obligation cannot be delegated or transferred to another party.*

The most suitable synonyms for the term "*prove*" used in the Nuclear Energy Act are in this context the verbs "*demonstrate*", "*verify*" and "*confirm*".

The justifications for requirement 317 are presented in the justifications for the requirements of subsections 3.2 and 3.6 and chapter 4.

Subsection 3.2 Conceptual plan of in-service inspections

Requirements demanding a conceptual plan of in-service inspections (formerly known in YVL E.5 guide as "plan for principles of in-service inspections") are based on experiences from a new facility under construction. Good quality management practice and experience show that the focus of design should be moved towards the construction licence phase.

Both the readiness to prepare a pre-service inspection plan and the preparedness to commence qualifications must be demonstrated in the conceptual plan of in-service inspections. One condition of the construction licence is that the licensee and the plant supplier demonstrate that they have understood the resources required by these tasks and they have designed the in-service inspection practice along with its document systems so that the issuer of the construction licence can justifiably consider it proven that there is a readiness to perform the inspections with all their programmes and reporting in accordance with the YVL Guides in time before the start-up of the facility.

Experience has shown that it can take so long to achieve the readiness to start that the completion of pre-service inspections in accordance with the YVL Guides may be compromised.

The in-service inspection practice must not be unplanned. The conceptual plan of the construction stage must present for approval such procedures that prevent drifting into practices that weaken the quality level.

Section 36 of the Nuclear Energy Decree (161/1988) stipulates that *the applicant shall submit a summary programme for periodic inspections to the Radiation and Nuclear Safety Authority when applying for an operating licence.* In interpreting the Nuclear Energy Decree, the summary programme will only be available at the end of the construction stage, which is too late for pre-service inspections.

Because the summary programme does not exist while the pre-service inspection plans are being prepared, such extent and depth is required of the conceptual plan that pre-service inspection plans can be prepared based on it.

Requirement 319 is based on Section 35 of the Nuclear Energy Decree.

Requirement 320 is based on the fact that good design improves quality management and nuclear safety. The intention is that the licence applicant uses the conceptual plan to prove that it has, for example, the readiness to begin the preparation of the pre-service inspection plan and the qualification of the in-service inspection systems without delay after the granting of the construction licence.

Requirement 321 is based on the scope of this Guide defined in chapter 2.

Requirements 322–323 are based on the empirical need to design the in-service inspection practice even before the construction licence so that the readiness for preparing pre-service inspection plans and the summary programme will have been proven. In terms of its main principles, the required content of the conceptual plan is the same as that of the summary program, which is updated based on the conceptual plan in the construction stage.

Requirement 324 is based on the empirical need to design the in-service inspection practice so that it is known and controlled by all construction parties throughout the construction process and the tasks and responsibilities of all parties have been defined. It is connected to the management of the whole construction project.

Requirement 325 is based on the empirical need to pre-design an in-service inspection document system so that it is clear and unambiguous for all parties and all parties know in the construction stage what documents can be expected and what their content and purpose will be.

Requirement 326 is based on the empirical need to prove the readiness of the licence applicant and the plant supplier to begin the preparation of a pre-service inspection plan as well as the readiness of the licence applicant and the plant supplier for the qualifications of in-service inspection systems without delay after the granting of the construction licence.

Requirement 327 is based on the empirical need to prove the readiness in sufficient detail so that the proof can be assessed as credible and the construction licence can be granted.

Requirement 328 is based on the empirical need to update any information changed or updated during the construction stage.

Requirement 329 is based on the empirical need to update any information of the conceptual plan changed or updated during the construction stage. The term "document that corresponds to the conceptual plan in terms of content" is used here, because the actual conceptual plan already had to be submitted to STUK for the construction licence.

Requirement 330 is based on the empirical need to ensure that the document that corresponds to the conceptual plan in terms of content is updated and it is known by STUK and other parties in good time.

Subsection 3.3 Pre-service inspection plan

Requirement 332 is based on the complexity of the pre-service inspection plan of a nuclear plant unit and its processing, due to which STUK's processing is estimated to take at least six months. The pre-service inspection plan forms the basis for inspections throughout the life cycle of the plant unit, so particular attention must be paid to its correctness. For example, the assessment of detailed selection criteria of the inspection items of the risk-informed in-service inspection programme for piping requires processing by experts of several fields of nuclear engineering. In processing the extensive document, requirements and investigation requests must also be prepared for. These must be taken care of acceptably before beginning the pre-service inspection. The requirement is based on an empirical need.

Requirement 333 is based on "ASME Code, Section XI, Subarticle IWB-2200, Subarticle IWC-2200" and "Subarticle R-2200, IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants" sections 2.14 and 10.3 and an established, well-tried Finnish practice.

Requirement 334 is based on the need to update the preliminary methodology description of the risk-informed selection process submitted with the construction licence documents. The approved methodology description of the risk-informed selection process is needed for pre-service inspection plans.

Requirement 335 is based on the fact that the results of the risk-informed selection process define the selection of risk-informed pre-service inspections for piping.

Requirement 336 is based on “ASME Code, Section XI, Nonmandatory Appendix R, Risk-informed Inspection Requirements for Piping”. Detailed justifications are presented in the justifications of the requirements of chapter 4.

Requirement 337 is based on “ASME Code, Section XI, Subsubarticle IWA-4530 and Subsubarticle R-2220” and “IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants” section 2.14.

Requirement 338 is based on a self-evident fact resulting from the definition of the pre-service inspection plan.

Requirement 339 is based on “ASME Code, Section XI and its Nonmandatory Appendix R, Risk-informed Inspection Requirements for Piping”, “IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants”, sections 10.46 and 10.47, an established, well-tried Finnish practice and an empirical need. Sections 10.46 and 10.47 of the Safety Guide particularly stress the need for drawings.

Requirement 340 is based on “ASME Code, Section XI, Subarticle IWB-2200, Subarticle IWC-2200” and “Subarticle R-2200 and an established, well-tried Finnish practice.

As concerns the pre-service inspections of pressure vessels performed after the pressure test, **requirement 341** is based on “ASME Code, Section XI, Subarticle IWB-2200” and “Subarticle IWC-2200”, according to which the pre-service inspections of pressure vessels are performed after the pressure test. The recommendation that supports, welded to the pressure-retaining parts of the vessels, should be inspected after loading with the operating pressure and temperature values is based on the following background factors: When the structure is loaded, faults may be observed more easily. Slag inclusions may open, or the stress clenching an internal fracture may ease off. In a pressure test, welded joints of the support may not necessarily be exposed to stresses as high as the heat stress caused by start-up and shutdown, the highest allowed value of which is 3Sm (double the yield point). STUK has experience from pressuriser support indications that increased to be observable after the heat test.

Requirement 342 is based on an established, well-tried Finnish practice and an empirical need.

Subsection 3.4 Summary programme for in-service inspections

Requirement 344 is based on Section 36 of the Nuclear Energy Decree.

Requirement 345 is based on the scope of this Guide defined in chapter 2 and justified in the justifications of chapter 2.

Requirement 346 is based on the fact that the requirements of a systematically implemented, risk-informed in-service inspection programme only concern piping but, when possible, risk-informed methods must also be applied to the planning of the inspection programmes of other equipment.

Requirements 347–348 are based on an established, well-tried Finnish practice.

Requirement 349 is based on the main purpose of the summary programme. As a whole, this is based on an established, well-tried Finnish practice.

Subsection 3.5 Individual in-service inspections

Subsection 3.5.1 Inspection programme for an inspection interval

Requirement 351 is based on experiences according to which the in-service inspection plans of the plant supplier might only emphasise operations during construction, including pre-service inspections, if the responsibility of the supplier ends when the plant is commissioned. In this case, pre-service inspection plans may, as practical tools, be unsuitable to be the basis for in-service inspections. For this reason, in-service inspection documents may have to be prepared again for in-service inspections.

In the design of in-service inspections, the results of pre-service inspections must be taken into account, the periodic in-service inspection programme must be updated using the risk-informed selection process for piping, and the other updates must be made applying the requirements of subsection 3.6 of the Guide.

The processing of the inspection programme for an inspection interval, including the related correspondence, may require a lot of resources, so one year must be reserved for it.

Requirement 352 is based on the fact that in designing in-service inspections, all the results of the inspections in the previous inspection interval must be taken into account, the inspection programme for an inspection interval must be updated using the risk-informed selection process for piping, and the other updates must be made applying the requirements of subsection 3.6 of the Guide.

The processing of the inspection programme for an inspection interval, including the related correspondence, may require a lot of resources, so one year must be reserved for it.

Requirement 353 is based on the definition of the inspection programme for an inspection interval and on the justified requirements presented for the pre-service inspection plan in subsection 3.3.

Requirement 354 is based on the justifications for the requirements of subsection 3.6 and chapter 4.

Requirement 355 is based on the fact that the updated results from the risk-informed selection process corresponding to the scope of the inspection programme for an inspection interval define the inspection interval for the selection of risk-informed inspections in the programme.

Requirement 356 is based on "ASME Code, Section XI, Nonmandatory Appendix R, Risk-informed Inspection Requirements for Piping".

Subsection 3.5.2 Inspection plan for operation period

Requirement 358 is based on the definitions of the summary programme for in-service inspections, the inspection programme for an inspection interval and the inspection plan for operation period.

Requirement 359 is based on the document processing time that STUK estimates it needs.

Requirement 360 is based on the definition of the pre-service inspection plan.

Requirement 361 is based on the definition of the in-service inspection plan for the operation period.

Requirement 362 is based on the justifications for the requirements of subsection 3.6.

Requirement 363 is based on the special need for monitoring and controlling flaw indications, which is one of the main objectives of in-service inspections.

Requirement 364 is based on the fact that STUK needs the information in question to perform its official duties. Information received during supervision visits is a condition for starting up the plant unit after a shutdown.

Subsection 3.6 Updating of the summary programme for in-service inspections and individual in-service inspection programmes

Requirement 366 is based on Section 24 of the Nuclear Energy Act, Section 36 of the Nuclear Energy Decree and Guide YVL A.1 "Regulatory oversight of safety in the use of nuclear energy".

Requirement 367 is based on experience and general knowledge.

Requirement 368 is based on "Nonmandatory Appendix R, Risk-informed Inspection Requirements for piping" and ENIQ's Discussion Document "Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN".

Requirement 369 is based on the general principle that updated documents are handled like original documents.

Subsection 3.7 Exceeding a threshold set in the acceptance standard

Requirement 371 is based on the requirements of "ASME Code, Section XI".

Requirement 372 is based on the need to prepare for other similar damages and take them into account, for example, in updates of risk-informed in-service inspection programmes for piping.

Requirement 373 is directly based on the requirements of “ASME Code, Section XI”.

Requirement 374 is based on the requirements of “ASME Code, Section XI” and standard “KTA 3201.4, Komponenten des Primärkreises von Leichtwasserreaktoren, Teil 4: Wiederkehrende Prüfungen und Betriebsüberwachung, Fassung 2016-11”.

Requirement 375 is based on the requirements of “ASME Code, Section XI”.

Requirement 376 is based on the requirements of “ASME Code, Section XI”.

Requirement 377 is based on the fact that the interface of the base material and the coating may affect crack growth.

Requirement 378 is based on experience, an established, well-tried Finnish practice and standard “KTA 3201.4, Komponenten des Primärkreises von Leichtwasserreaktoren, Teil 4: Wiederkehrende Prüfungen und Betriebsüberwachung, Fassung 2016-11”.

Requirement 379 is based on the requirements of “ASME Code, Section XI”.

Requirement 380 is based on experience.

Subsection 3.8 Reporting of results of in-service inspections

Subsection 3.8.1 Results of pre-service inspections

Requirement 382 is based on the Nuclear Energy Act, Section 20, Subsection 2, Paragraph 1 and on experience from a new plant under construction.

Requirement 383 is based on the Nuclear Energy Act, Section 20, Subsection 2, Paragraph 1 and on experience from a new plant under construction. The intention of the requirement is to ensure that STUK receives the summary report of the results of pre-service inspections for processing early enough so that it can use the report when performing the safety inspection of the nuclear facility in accordance with the Nuclear Energy Act, Section 20, Subsection 2, Paragraph 1.

Requirement 384 is based on experience and on an established, well-tried Finnish practice.

Subsection 3.8.2 Results of in-service inspections

Requirement 385 is based on an established, well-tried Finnish practice.

Requirements 386–387 are based on experience and on an established practice.

Requirements 388–389 are based on an established, well-tried Finnish practice.

Requirement 390 is based on "IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants" section 2.15.

Requirement 391 is based on experience and on an established practice. The summary and status report make decision-making easier and quicker and facilitate monitoring the overall situation. STUK does not have access to an IT based monitoring system of in-service inspections.

3.4 Chapter 4 Risk-informed selection process for the in-service inspections of piping

Subsection 4.1 General

As an introduction, **paragraph 401** describes the content and requirements of chapter 4.

Requirement 402 and specifying paragraph 402a are based on "ASME Code, Section XI, Nonmandatory Appendix R", the framework document published by ENIQ concerning risk-informed in-service inspections, ENIQ's recommended practices RP 9 and RP 11 and the Common Views report by the European Nuclear Safety Authorities on risk-informed in-service inspections.

Paragraph 403 refers to the diagram in annex A.

Subsection 4.2 Area of application of the risk-informed in-service inspection programme for piping

Requirement 404 is based on the opportunity, presented in "ASME Code, Section XI, Nonmandatory Appendix R" and ENIQ's framework document, to choose the scope of risk-informed methods in in-service inspections for piping. Experience has shown that hazardous components may be included in all safety-classified and class EYT piping systems, regardless of the nominal diameter of the pipe.

According to Guide YVL A.7 "Probabilistic risk assessment and risk management of a nuclear power plant", "*the PRA shall be used in the risk-informed development of the in-service inspection programmes of Safety Class 1, 2 and 3 as well as Class EYT system piping*".

Subsection 4.3 Risk-informed selection process documents

Requirement 405 is based on "ASME Code, Section XI, Nonmandatory Appendix R".

Requirement 406 is based on the justifications for the requirements of chapter 3.

Requirement 407 is based on "ASME Code, Section XI, Nonmandatory Appendix R" and ENIQ's framework document concerning risk-informed in-service inspections.

Requirement 408 is based on "ASME Code, Section XI, Nonmandatory Appendix R" and ENIQ's framework document concerning risk-informed in-service inspections.

Requirement 409 is based on the empirical need to design the in-service inspection practice even before the construction licence so that the readiness for preparing pre-service inspection plans and the summary programme will have been proven. In terms of its main principles, the content of the required document is the same as that of the document required with the pre-service inspection plan, and is updated in the construction stage.

Requirement 410 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections. The update is also discussed in ENIQ’s Discussion Document, “Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN”.

Requirement 411 is based on the fact that the results of the risk-informed selection process define the selection of pre-service inspections and inspections for an inspection interval for piping.

Subsection 4.4 Collection and analysis of input information

Requirement 412 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections. The update is also discussed in ENIQ’s Discussion Document, “Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN”.

As a self-evident fact, **requirement 413** is based on the requirements of Guide YVL A.7 “Probabilistic risk assessment and risk management of a nuclear power plant”. Related requirements have also been presented in “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document.

Subsection 4.5 Assessment of consequences of pipe failure

Requirement 414 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections.

Requirement 415 is based on Guide YVL E.4 “Strength analyses of nuclear power plant pressure equipment”.

Subsection 4.6 Specification and assessment of piping failure potential

Requirement 416 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s recommended practice “ENIQ RP 9”.

Requirement 417 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections.

Subsection 4.7 Risk categorisation

Requirements 418–419 are based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections.

Requirement 420 is based on “ASME Code, Section XI, Nonmandatory Appendix R”.

Subsection 4.8 Selection of inspection areas

Requirement 421 is based on “ASME Code, Section XI, Nonmandatory Appendix R”.

Requirement 422 is based on “ASME Code, Section XI, Nonmandatory Appendix R, Supplement 1”, ENIQ’s framework document concerning risk-informed in-service inspections and ENIQ’s recommended practice “ENIQ RP 11”.

Subsection 4.9 Assessment of risk effects posed by updates to the inspection programme

Requirement 423 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections. The update is also discussed in ENIQ’s Discussion Document, “Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN”.

Subsection 4.10 Long-term management of the risk-informed in-service inspection programme

Requirement 424 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document. The update is also discussed in ENIQ’s Discussion Document, “Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN”.

Requirement 425 is based on “ASME Code, Section XI, Nonmandatory Appendix R” and ENIQ’s framework document concerning risk-informed in-service inspections. The update is also discussed in ENIQ’s Discussion Document, “Updating of Risk-Informed Inspection Programmes, ENIQ Report No 37, 2009, EUR 23929 EN”.

3.5 Chapter 5 General requirements for inspection system qualifications, strategy plans and qualification body

Subsection 5.1 General qualification requirements

Requirement 501 is based on the Finnish nuclear energy legislation.

Paragraph 501a clarifies what is meant by a qualification body. The purpose of a qualification body is to qualify non-destructive inspection systems, not necessarily individual non-destructive inspections. The inspection system contains all factors contributing to the result of the inspection: equipment, software, inspection instructions and inspection personnel.

Requirement 502 is based on the definition of an inspection system presented in the definitions.

Requirement 503 is based on the main purpose of qualification, which is presented in ENIQ’s qualification methodology document, for example.

Requirement 504 is based on Section 7 e of the Nuclear Energy Act, according to which *compliance with requirements concerning the safety of a nuclear facility shall be proven reliably*.

According to Section 9 of the Nuclear Energy Act, *it shall be the licensee's obligation to assure safe use of nuclear energy. This obligation cannot be delegated or transferred to another party.*

An independent expert qualification body and testing organisation are needed in the qualifications.

Requirement 505 is based on ENIQ's qualification methodology document and the application of the definitions in its glossary.

Requirement 506 is based on ENIQ's definition of the scope of the qualification. The qualification may be applied to all non-destructive inspection methods. Qualifications have usually been started with volumetric inspection methods. Experience has shown that surface defects are most common and also most dangerous. It is not logically justifiable that surface inspection methods do not need to be qualified.

Requirement 507 is based on the recommendation by the European Nuclear Safety Authorities to use qualification practices created by ENIQ as the minimum requirement level. The objective of ENIQ is to harmonise the qualifications.

Requirement 508 is based on the Common Views report by the European Nuclear Safety Authorities, with special emphasis on

- the connection between nuclear safety and the qualification input information
- the connection between the radiation safety principles (ALARA) of practical inspections and qualifications

ENIQ's practices are intended to be applied to all industry, so they do not separately emphasise nuclear safety. In practice, however, ENIQ is lead by owners of nuclear power plants and the qualifications have been started from nuclear power plants.

Requirement 509 is based on ENIQ's qualification methodology document.

Subsection 5.2 Strategy plan for qualifications

Requirement 511 is based on a functioning practice that is established in Finland.

Requirement 512 is based on a functioning practice that is established in Finland. The accreditation and approval requirements of the qualification body are justified in the justifications of the requirements of subsection 5.3. The qualification body prepares a qualification procedure, which is then assessed by the accreditation body.

Requirement 513 is based on the fact that a preliminary qualification grouping is needed in order to control qualifications as early as the beginning of the construction stage. The qualification grouping is made using a technical justification, and the qualification body assesses the justification.

Subsection 5.3 Qualification body

Subsection 5.3.1 Fundamental requirements and tasks of qualification body

Requirements 514–515 are based on the Finnish nuclear energy legislation.

Requirement 516 is based on Section 60 a of the Nuclear Energy Act.

Requirement 518 is based on ENIQ's recommended practice "ENIQ RP 7".

Requirement 519 is based on Section 1 of the Act on Verifying the Competence of Conformity Assessment Services (920/2005).

Requirement 520 is based on Section 5 of the Act (920/2005), according to which accreditation is sought from FINAS, the Finnish Accreditation Service. Equivalent foreign accreditation bodies are not familiar with the Finnish qualification procedures or the special characteristics of the Finnish qualification practice, so accreditation by them is not sufficient by itself.

Requirement 521 is based on ENIQ's recommended practice "ENIQ RP 7" and standard "SFS-EN ISO/IEC 17020, General criteria for the operation of various types of bodies performing inspection". The qualification body may have to use considerable economic power in its solutions, so it must be a type 1 independent third-party organisation in accordance with ENIQ's recommended practice "ENIQ RP 7".

The nuclear safety authorities of Sweden and Switzerland, for example, specify in their instructions that the qualification body shall be a similar independent third-party organisation.

There is no standard for qualification bodies. Instead, the requirements are from ENIQ documents. The requirements are based on ENIQ's qualification methodology document and ENIQ's recommended practice "ENIQ RP 7". Because "ENIQ RP 7" does not have the status of a standard, its main content is written out in Guide YVL E.5. This way, the accreditation can be done against Guide YVL E.5 and the above-mentioned standards.

The qualification body is not a certification body, although Inspecta Sertifiointi Oy, which has so far functioned as the qualification body in Finland, is also the personnel certification body for historical reasons. The personnel must already be certified for level 2 or 3 before the qualification can be started. This certification does not belong to the tasks of the qualification body.

Inspecta Sertifiointi Oy has done pioneering work in creating the Finnish qualification practice. It complies with the requirements for personnel certification bodies set in standard "SFS-EN ISO/IEC 17024: Conformity assessment. General requirements for bodies operating certification of person".

A comparison has been made between standards "SFS-EN ISO/IEC 17020 (2012)" and "ISO/IEC 17024 (2012)". The independence requirements of the standards are very similar, but standard 17024 requires persons to sign commitments, which is not required by standard 17020. Unlike standard 17020, standard 17024 also includes confidentiality requirements and a qualification/certification requirement.

On these grounds, a requirement is presented to the qualification body that as an alternative to standard "SFS-EN ISO/IEC 17020", it must comply with the requirements for personnel certification bodies presented in standard “SFS-EN ISO/IEC 17024”.

Requirement 521a is based on Guide YVL A.3. Guide YVL A.3 “Management system for a nuclear facility”, chapter 2 Scope of application, paragraph 203: *The requirements of this guide apply, to the appropriate extent, to … safety-significant design and expert organisations, testing and inspection organisations.* A qualification body is an important expert organisation comparable to testing and inspection bodies in the nuclear energy legislation. The scope of application of Guide YVL A.3 has been defined so that it would cover the qualification body even if Guide YVL E.5 did not include a reference to Guide YVL A.3.

Requirement 522 is based on the European Qualification Methodology Document (EQMD) drawn up by the European Network for Inspection and Qualification (ENIQ), supplemented by ENIQ’s recommended practices “ENIQ RP 1, RP 2, RP 4, RP 5, RP 6, RP 7, RP 8” and “RP 10” and standards “SFS-EN ISO/IEC 17020” and “SFS-EN ISO/IEC 17024”.

There are no European standards on inspection qualifications of nuclear facilities, so the qualification body is assessed in the accreditation against this Guide YVL E.5 and the above-mentioned documents.

Paragraph 523 is based on ENIQ’s recommended practice “ENIQ RP 7”.

Requirement 524 is based on ENIQ’s recommended practice “ENIQ RP 7”.

Subsection 5.3.2 Personnel of the qualification body

Requirement 525 is based on ENIQ’s recommended practice “ENIQ RP 7”.

Requirement 526 is based on ENIQ’s recommended practice “ENIQ RP 7”. The tasks of the qualification body are demanding, so extensive practical experience is required of factors that may affect inspection reliability in the in-service inspection of a nuclear facility’s components and structures.

Requirement 527 is based on ENIQ’s recommended practice “ENIQ RP 7” and standard “SFS-EN ISO 9712”.

Requirement 528 is based on ENIQ’s recommended practice “ENIQ RP 7” and the practical experience that since it may be difficult to start a qualification body in Finland that employs enough competent staff, external experts have to be used for assistance.

Requirement 529 is based on ENIQ’s recommended practice “ENIQ RP 7” and on an established, functioning practice.

Requirements 530–532 are based on ENIQ’s recommended practice “ENIQ RP 7”.

Subsection 5.3.3 Qualification body’s quality manual

Requirements 533–534 are based on ENIQ’s recommended practice “ENIQ RP 7”.

Subsection 5.3.4 Approval of a qualification body

Requirement 535 for the licensee's obligation to submit an application is based on the fact that the licensee is obligated to take care of the qualifications. As business, qualification is unique, so it is possible that no organisation would choose to become a qualification body without the licensee's support. The specifications to the requirement are based on the accreditation guidelines by the Finnish Accreditation Service (FINAS) and STUK's established practice for the approval of testing and inspection organisations, which is comparable to the approval of a qualification body.

Requirement 535a is based on the fact that Section 60 a of the Nuclear Energy Act equates the qualification body with testing and inspection organisations. In terms of its subject matter, the requirement is the same as similar requirements concerning testing and inspection organisations in Guides YVL E.12 "Testing organisations for mechanical components and structures of a nuclear facility" and YVL E.1 "Authorised inspection body and the licensee's in-house inspection organisation".

3.6 Chapter 6 Qualification activities

Subsection 6.1 Qualification process

Requirement 601 is based on the tasks of the various parties involved in qualification and the key elements of the qualification system specified in ENIQ's qualification methodology document. The diagram of annex C presents the established Finnish qualification parties and their principal tasks.

Requirement 602 is based on the analysis of essential parameters in accordance with "ENIQ RP 1", which is part of the technical justification.

Requirement 603 is based on the fact that grouping the qualification targets is one of the starting points for qualifications. In the early stages, when all input information documents have not been finalised or approved by STUK, qualifications may have to be started based on the preliminary grouping. The grouping is based on the analysis of essential parameters, performed as part of the technical justification. The assessment of the technical justification is a responsibility of the qualification body. The grouping of qualification targets is one of the most important starting points for qualifications, so STUK's approval is required.

Subsection 6.2 Qualification dossier

Requirement 604 is based on ENIQ's recommended practice "ENIQRP 4". The licensee has the primary responsibility for the qualification documents, and it also draws up the qualification input information.

Requirements 605–612 for the summary of justifications are based on experience, the Nuclear Energy Act (990/1987) and the definition of an argument [1]. The necessity of justification summaries is justified in section 3.1 of this memorandum under requirements 309–316.

The justifications for **requirements 605–612** are the same as those for requirements 309–316.

Requirement 613 is based on ENIQ’s recommended practice ENIQ RP 4. The qualification body may need external experts for qualification. Information of their qualifications is needed.

Requirement 614 is based on the fact that STUK needs the information for regulatory control during qualifications.

Requirement 615 is based on STUK’s experience according to which the processing, along with the related correspondence, may take up to three months depending on the quality of the qualification material.

Requirement 616, like requirement 613, is based on ENIQ’s recommended practice “ENIQ RP 4”. Requirement 614 obliges the licensee to submit parts of the qualification material to STUK to enable regulatory control. Requirement 616 requires the entire final material to be put together and submitted to STUK.

Requirements 617–618 are based on the fact that eventually STUK will assess the qualification based on the entire material and may determine in a decision that the inspection procedure and equipment have now been qualified. The assessment report drawn up by the qualification body is one of the most important documents in this assessment. By nature, the assessment report is a summary statement of the qualification issued by the qualification body. The mere approval of the assessment report does not serve any purpose because the important thing is whether STUK approves the inspection procedure and equipment as qualified.

Subsection 6.3 Qualification input information

Requirement 619 is based on ENIQ’s qualification methodology document. Of the qualification parties, only the licensee is familiar with the plant to the extent that it can draw up the qualification input information. It is the most important starting point for the qualification, so STUK’s approval is required for it.

Requirement 620 is based on the fact that of the qualification parties, only the qualification body can independently and professionally assess the sufficiency of the input information from a qualification technical point of view.

Requirement 621 is based on ENIQ’s qualification methodology document.

Requirement 623 is based on ENIQ’s recommended practice “RP 8”. The use of the highest qualification level is a practical simplification so that qualification levels do not always need to be justified.

Requirement 624 is based on ENIQ’s recommended practice “RP 8”. The basic requirement is that the highest qualification level is used. This way, only the use of lower qualification levels needs to be justified.

Requirement 625 is based on ENIQ’s recommended practice “RP 8”.

Requirement 626 is based on ENIQ’s qualification methodology document.

Requirement 627 is based on ENIQ's qualification methodology document and "ASME Code, Section XI". The grouping is based on the analysis of essential parameters, performed as part of the technical justification.

Requirement 628 is based on ENIQ's qualification methodology document and ENIQ's recommended practice "RP 1". The report by J. Wåle, which characterises the morphology parameters of actual fractures created by various degradation mechanisms, is probably one of the most extensive publicly available reports of this kind.

Requirements 629–630 are based on ENIQ's qualification methodology document.

Paragraph 632 means that the information on the inspection system to be qualified, such as the equipment, procedures or personnel, submitted to STUK for information as part of the input data, may not be interpreted as tacitly approved by STUK before the start of the qualifications.

Subsection 6.4 Qualification procedure

Requirement 633 is based on the fact that the qualification procedure is of substantial importance for STUK's regulatory activities as well because it covers the entire qualification.

Requirement 634 is based on ENIQ's qualification methodology document and recommended practice "RP 4".

As a self-evident fact, **requirement 635** is based on recommended practice "ENIQ RP 8".

Requirement 636 is based on ENIQ's qualification methodology document. The report by J. Wåle, which characterises the morphology parameters of actual fractures created by various degradation mechanisms, is probably one of the most extensive publicly available reports of this kind.

Requirement 637 is based on ENIQ's qualification methodology document.

As a self-evident fact, **requirement 638** is based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 2".

Requirement 639 is based on ENIQ's qualification methodology document.

Subsection 6.5 Technical justification

Subsection 6.5.1 General

Paragraph 641 is based on recommended practice "ENIQ RP 2".

Requirements 642 and **642a** are based on recommended practice "ENIQ RP 2".

Requirement 643 is based on recommended practices "ENIQ RP 1" and "RP 2".

Requirements 644–648 are based on recommended practice "ENIQ RP 2".

Subsection 6.5.2 Essential parameters

Requirements 649–655 are based on recommended practice “ENIQ RP 1”.

Subsection 6.6 Practical trials

Requirement 656 is based on ENIQ’s qualification methodology document and the definition of a qualification body.

Requirement 657 is based on ENIQ’s qualification methodology document and recommended practices “ENIQ RP 5” and “ENIQ RP 7”. The actual correspondence between the qualification flaws in test pieces and the target defects of inspections set in the input information is a very important starting point for qualification.

Requirement 658 is based on ENIQ’s qualification methodology document and recommended practice “ENIQ RP 7”.

Requirement 659 is based on recommended practice “ENIQ RP 5”.

Subsection 6.6.1 Test pieces

Requirement 660 is based on ENIQ’s qualification methodology document. The licensee may use the qualification body as an intermediary.

Requirement 661 is based on ENIQ’s qualification methodology document and recommended practice “ENIQ RP 5”.

Requirement 662 is based on the fact that the inspection system cannot be qualified to detect undefined defects.

Requirement 663 is based on ENIQ’s qualification methodology document.

In accordance with ENIQ’s qualification methodology document, requirement 664 is based on the need to balance practical trials and technical justification.

Requirement 665 is based on ENIQ’s qualification methodology document. Using technical justification and assessment by a qualification body, it must be ensured that defects are not tailored for the benefit of a particular inspection system.

Requirement 666 is based on ENIQ’s qualification methodology document. This touches the justifications for requirement 665. Additional defects may increase statistical certainty.

Paragraph 667 is based on ENIQ’s qualification methodology document.

Requirement 668 is based on the fact that depending on the degradation mechanisms, defects may have different variables. Different manufacturing methods of defects produce defects that are different by nature and have their own advantages and disadvantages. These must be compared.

Requirement 669 is based on the fact that one of the most important starting points for qualification is that the manufacturer of the test piece defects demonstrates and the qualification body estimates that the defects manufactured correspond to the postulated defects or type defects in terms of their properties. The report by J. Wåle, which characterises the morphology parameters of actual fractures created by various degradation mechanisms, is probably one of the most extensive publicly available reports of this kind.

Requirement 670 is primarily based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 5". The assessment of the suitability of qualification flaws in test pieces is necessary when assessing the reliability of qualification.

Requirement 671 is based on ENIQ's qualification methodology document and recommended practices "ENIQ RP 5" and "ENIQ RP 7".

Subsection 6.6.2 Implementation of practical trials

Requirements 673–675 are based on ENIQ's qualification methodology document and recommended practice ENIQ RP 5.

Subsection 6.6.3 Assessment of the results of practical trials

Requirements 676–680 are based on ENIQ's qualification methodology document.

Subsection 6.7 Qualification of inspection personnel

Requirement 681 is based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 10".

Requirements 682–684 are based on recommended practice "ENIQ RP 10".

Subsection 6.8 Qualification assessment report

Requirements 686–687 are based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 4".

Subsection 6.9 Qualification certificates

Subsection 6.9.1 Issue of qualification certificates

Requirement 688 is based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 10".

Requirement 689 is based on ENIQ's qualification methodology document. Technical development causes update needs.

Requirements 690–692 are based on ENIQ's qualification methodology document and recommended practice "ENIQ RP 10".

Subsection 6.9.2 Withdrawal or review of qualification certificates

Requirements 693–696 are based on ENIQ's qualification methodology document.

Subsection 6.9.3 Licensee's obligations

Requirement 697 is based on an established need.

Requirement 698 is based on ENIQ's qualification methodology document.

Subsection 6.10 Archiving of qualification documentation and storage of test pieces

Requirement 699 is based on Section 63 of the Nuclear Energy Act, ENIQ's qualification methodology document and recommended practice "ENIQ RP 5".

3.7 Chapter 7 Regulatory oversight by the Radiation and Nuclear Safety Authority

Subsection 7.1 Control in general

Requirements 701–702 are based on legislation: Constitution of Finland (731/1999), Section 118; Nuclear Energy Act, Sections 7 e and 9.

Requirements 703–704 are based on legislation: Nuclear Energy Act, Sections 55 and 63.

The Guide uses established concepts of argumentation analysis to enable STUK to handle summaries of justifications systematically and in a way jointly understood by different parties. Argumentation and argumentation analysis are discussed in detail in reference [1].

Subsection 7.2 Conceptual plan of in-service inspections

Requirements 705–707 are based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Sections 35 and 108; STUK Y/1/2018, Sections 3, 5 and 10.

Subsection 7.3 Control of pre-service inspections

Requirements 708-709 are based on legislation: Nuclear Energy Act, Sections 7 e, 20 and 55; Nuclear Energy Decree, Sections 109 and 110.

Subsection 7.4 Summary programme for in-service inspections

Requirements 710–713 are based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Sections 36 and 110; STUK Y/1/2018, Sections 3, 5 and 10.

Subsection 7.5 Control of individual in-service inspections

Requirements 714–719 are based on legislation: Nuclear Energy Act, Sections 20 and 55; Nuclear Energy Decree, Section 111; STUK Y/1/2018, Sections 5 and 23.

Subsection 7.6 Control of the risk-informed selection process

Requirement 720 is based on legislation: Nuclear Energy Act, Sections 7 e, 9 and 55; Nuclear Energy Decree, Sections 35 and 108; STUK Y/1/2018, Section 3.

Requirement 721 is based on legislation: Nuclear Energy Decree, Section 109.

Requirement 722 is based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Sections 109 and 111; STUK Y/1/2018, Sections 5, 10 and 23.

Requirement 723 is based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111; STUK Y/1/2018, Sections 5, 10 and 23.

Requirement 724 is based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111; STUK Y/1/2018, Sections 5, 10 and 23.

Subsection 7.7 Control of qualifications

Requirements 726–727 are based on legislation: Constitution of Finland, Section 118; Nuclear Energy Act, Sections 7 e and 9.

The Guide uses established concepts of argumentation analysis to enable STUK to handle summaries of justifications systematically and in a way jointly understood by different parties. Argumentation and argumentation analysis are discussed in detail in reference [1].

Requirement 728 is based on legislation: Nuclear Energy Act, Sections 60 a and 55; Nuclear Energy Decree, Sections 111, 113 b and 117 b.

Requirement 729 is based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111; Act on Verifying the Competence of Conformity Assessment Services (920/2005), Section 6. The role of STUK's representatives has been clarified so that it is consistent with the requirements of Guide YVL E.1. The requirement has been specified with a training requirement in order to justify the right of STUK's representatives to participate in the accreditation.

Requirements 730–731 are based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111.

Requirement 732 is based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111. STUK has participated in the preparation of the Common Views report by the European Nuclear Safety Authorities and thus approved it. It is natural that STUK uses the report as the basis for its assessment.

Requirements 733–736 are based on legislation: Nuclear Energy Act, Section 55; Nuclear Energy Decree, Section 111.

Requirement 737 is based on legislation: Nuclear Energy Act, Sections 55 and 63; Nuclear Energy Decree, Section 111.

Subsection 7.8 Control of document updates

Requirement 738 is based on legislation: Nuclear Energy Act, Sections 7 a and 55; Nuclear Energy Decree, Section 112; STUK Y/1/2018, Section 3.

3.8 Definitions

The Guide includes more than 50 definitions.

Qualifications and risk-informed in-service inspection programmes, in particular, are new fields of technology for which it has been necessary to develop special terminology. The terms, as used in the bibliographic references, have been created in English and then translated into Finnish for the original version of this Guide. The preparation of the Guide has thus necessitated the creation of Finnish special terms whose meaning might differ from their standard meaning. Before the preparation of the definitions, the discussions were constantly impaired by the lack of jointly understood concepts.

For the most part, the definitions are based on the glossary of “ASME Code, Section XI” and the following mutually complementary glossaries published by ENIQ, the European Network for Inspection and Qualification: the separate ENIQ Glossary (EUR 18102 EN), the glossary at the end of the European Qualification Methodology Document (EQMD) “European Methodology for Qualification of Non-Destructive Testing – Third Issue, August 2007, ENIQ Report nr. 31 (EUR 22906 EN)” and the glossary of the “European Framework Document for Risk-Informed In-service Inspection, March 2005, ENIQ Report nr. 23 (EUR 21581 EN)”.

Certain definitions are based on an established, well-tried Finnish practice. The intention has been to use internationally known definitions of concepts whenever possible. The established international definitions used in this special field may differ from general definitions used in the pressure equipment field.

3.9 Guide Annexes A–F

Annex A Document diagram for in-service inspections is based on the main content of Guide YVL E.5.

Annex B Evaluation of inspection results is based on standard “KTA 3201.4, Komponenten des Primärkreises von Leichtwasserreaktoren, Teil 4: Wiederkehrende Prüfungen und Betriebsüberwachung, Fassung 2016-11”.

Annex C Qualification process for inspection system is based on ENIQ’s qualification methodology document, recommended practice “ENIQ RP 2” and practical experience.

Annex D Qualification body. Requirements D01 and D02 of Annex D are based on ENIQ’s qualification methodology document, recommended practice “ENIQ RP 7”, practical experience and the entire content of chapters 5 and 6.

Annex E Contents of the qualification procedure. Requirement E01 of Annex E is based on ENIQ’s qualification methodology document and ENIQ’s recommended practices “ENIQ RP 2, RP 4” and “RP 5”.

Annex F Contents of the technical justification. Requirement F01 and the diagram in Annex F are based on ENIQ’s qualification methodology document and ENIQ’s recommended practices ENIQ RP 1, RP 2 and RP 6.

4 International provisions concerning the scope of the Guide

The key requirements of Guide YVL E.5 are based on the following procedures and provisions:

- ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Division 1 (ASME Code, Section XI)
- IAEA Safety Standards Series No. NS-G-2.6, Safety Guide, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants, Vienna, 2002
- U.S. NRC Regulatory Guide 1.14 Reactor Coolant Pump Flywheel Integrity Revision 1, August 1975
- Reports published by ENIQ, the European Network for Inspection and Qualification
- Report on the Regulatory Experience of Risk-Informed Inservice Inspection of Nuclear Power Plant Components and Common Views, Prepared by The Nuclear Regulators' Working Group, Task Force on Risk-Informed Inservice Inspection, Final Report – August 2004, 2004 EUR 21320 EN
- Common position of European regulators on qualification of NDT systems for pre- and in-service inspection of light water reactor components, EUR 16802 EN

The basic requirement level of in-service inspections shall be standard "ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, Division 1 (ASME Code, Section XI)". Deviations from the Code shall be justified and it shall be demonstrated that a corresponding level of safety and reliability can be achieved.

Supplementary guidelines concerning the procedures are provided in the International Atomic Energy Agency's guide document "IAEA Safety Standards Series No. NS-G-2.6, Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants".

The flywheels of main coolant pumps shall be inspected. Justifications and instructions for the inspections are provided in reference "U.S. NRC Regulatory Guide 1.14 Reactor Coolant Pump Flywheel Integrity".

The minimum requirement level for risk-informed in-service inspection programmes for piping shall be "ASME Code, Section XI, Nonmandatory Annex R, Risk-informed Inspection Requirements for Piping". Supplementary instructions are presented in the European Network for Inspection and Qualification's (ENIQ) framework document concerning risk-informed periodic inspections, the ENIQ Recommended Practices "ENIQ RP 9" and "RP 11" and the Common Views report by the European Nuclear Safety Authorities concerning risk-informed in-service inspections.

The minimum requirement level for the qualification of inspection systems used for in-service inspections shall be the European Qualification Methodology Document (EQMD) drawn up and published by the European Network for Inspection and Qualification (ENIQ), supplemented by ENIQ's Recommended Practices "ENIQ RP 1, RP 2, RP 4, RP 5, RP 6, RP 7, RP 8" and "RP 10".

STUK shall also use, when overseeing and inspecting qualifications, as assessment criteria the Common Views report by the European Nuclear Safety Authorities, with special emphasis on

- the connection between nuclear safety and the qualification input information
- the connection between the radiation safety principles (ALARA) of practical inspections and qualifications

Guide YVL E.5 complies with the requirements of the known international provisions in the field. It complies with the requirements of WENRA and, for example, the equivalent Swedish, German and Swiss guidelines. The mode of presentation of Guide YVL E.5 is usually more detailed and extensive. The guidelines in question are the following:

- WENRA Safety Reference Levels for Existing Reactors, September 2014, Issue K: Maintenance, In-service inspection and Functional Testing
- SSMFS 2008:13 Strålsäkerhetsmyndighetens föreskrifter om mekaniska anordningar i vissa kärntekniska anläggningar
- KTA 3201.4, Komponenten des Primärkreises von Leichtwasserreaktoren, Teil 4: Wiederkehrende Prüfungen und Betriebsüberwachung, Fassung 2016-11
- Methodik für das Vorgehen bei der Qualifizierung von zerstörungsfreien Prüfungen, VGB-ENIQ-Richtlinie, VGB-R 516, VGB Powertech e.V., Essen, 2010
- Richtlinie für die schweizerischen Kernanlagen B07/d, Sicherheitstechnisch klassierte Behälter und Rohrleitungen: Qualifizierung der zerstörungsfreien Prüfungen, Ausgabe September 2008

J. Laube et al [2] has made a comparison between the qualification and in-service inspection practices of the Flamanville EPR plant in France and the OL3 plant in Finland, both under construction. The comparison shows that the requirement level is higher in Finland.

In accordance with its strategy plan for 2007–2011, STUK commissioned an assessment of the Finnish qualification system from an external, independent expert organisation. The result of the assessment by a development organisation of European qualification activity, the British Serco Assurance Inspection Validation Centre (IVC), was good (R. Booler [3, 4]).

Finland is or will be the first country in the world where

- the entire NDT inspection of a new plant has been qualified in accordance with ENIQ guidelines (OL3 pre-service inspections)
- a risk-informed pre-service inspection programme has been prepared for piping (OL3)
- risk-informed periodic in-service inspection programmes for piping concerning all systems of the plant have been prepared (O. Hietanen, et al [5])

5 Impacts of the Tepco Fukushima Dai-ichi accident

The Fukushima accident has no direct effect on this Guide. If the Fukushima accident affects probabilistic risk assessment (PRA), it might have an effect on the risk-informed in-service inspection programme for piping. The effect of PRA on risk-informed methods used in the preparation of the risk-informed in-service inspection programme is generally examined in the Guide.

6 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.

Experiences have been obtained from the accreditation of a qualification body. These experiences have been taken into account by changing the requirements. Qualification management may become lighter from the point of view of STUK and the licensees when assessment tasks of the qualification body are transferred to the accreditation body.

Numerous needs for clarifications and small changes have been observed in the requirement texts. These clarifications and changes have been made.

The changes to Guide YVL E.5 were mostly grammatical changes, clarifications of requirements, divisions of requirements, changes of the requirement's attribution from description to requirement and updates of references.

Two new requirements, 521a and 535a, concerning the qualification body of inspection systems were added to the Guide. Requirement 207, found to be unclear, and requirements 510 and 631, found to be incorrect, were removed.

New requirements

To improve readability and remove repetition, the texts of description 401 and requirement 402 have been restructured by adding description 402a. The factual content has not changed.

Requirement 521a specifies that the requirements of Guide YVL A.3 shall be complied with in the operation of the qualification body. This results from the definition of the scope of application of Guide YVL A.3 (item 203). Section 60 a of the Nuclear Energy Act equates the qualification body with testing and inspection organisations. In terms of its subject matter, the requirement is the same as similar requirements concerning testing and inspection organisations in Guides YVL E.12 and YVL E.1.

Requirement 535a states that the prerequisites for the validity of the approval of the qualification body are valid accreditation and annually submitted descriptions of periodic evaluations by an accreditation body with accreditation decisions and their appendices. Section 60 a of the Nuclear Energy Act equates the qualification body with testing and inspection organisations. In terms of its subject matter, the requirement is the same as similar requirements concerning testing and inspection organisations in Guides YVL E.12 and YVL E.1.

In addition, two definitions were moved to items 206a and 501a of the Guide text because these definitions are slightly different in this particular Guide (YVL E.5) than in the YVL Guide definitions. These definitions are *inspection* in item 206a and *qualification body* in item 501a.

It was added into requirement 627 that the target defect size shall be justified by means of a standard, strength calculation, fracture mechanism or some other similar justification. This matter, based on ENIQ's qualification methodology document, is essential information when examining the sufficiency of the input information in order to begin qualification.

Changed requirements

*Organisatio*n has been removed from the title of Chapter 5 concerning qualifications because it is assessed by the accreditation body. Qualification organisation and procedures have been removed from subsection 5.2 because they belong to the qualification body and the accreditation body assesses them.

Removed requirements

Requirement 207 has been removed because it only caused confusion. The scope of application is sufficiently indicated by the name of Guide YVL E.5 and the rest of the description of the scope of application.

Requirement 510, concerning a qualification management and support group, has been removed. The management and support groups include representatives of licensees. Therefore, they compromise the independence of the qualification body and thus weaken the conditions for accreditation.

Requirement 631 has been removed. The requirement was questionable to start with.

7 References

1. Argumentti ja kritiikki. Lukemisen, keskustelun ja vakuuttamisen taidot. Ed. Marja-Liisa Kakkuri-Knuuttila. 447 p. Gaudeamus. Tampere. 1998.
2. J. Laube, Y. Bouveret, S.W. Glass, J.M. Tchilian, Preparing for EPR Reactor Vessel Inspection, 8th International Conference on NDE in Relation to Structural Integrity for Nuclear and Pressurised Components, 2010, Berlin.
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