

GUIDE YVL E.2

PROCUREMENT AND OPERATION OF NUCLEAR FUEL AND CONTROL RODS

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Definitions

Authorisation

According to Section 7 r of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority (STUK) shall specify detailed safety requirements for the implementation of the safety level in accordance with the Nuclear Energy Act.*

Rules for application

The publication of a YVL Guide shall not, as such, alter any previous decisions made by STUK. After having heard the parties concerned STUK will issue a separate decision as to how a new or revised YVL Guide is to be applied to operating nuclear facilities or those under construction, and to licensees' operational activities. The Guide shall apply as it stands to new nuclear facilities.

When considering how the new safety requirements presented in the YVL Guides shall be applied to the operating nuclear facilities, or to those under construction, STUK will take due account of the principles laid down in Section 7 a of the Nuclear Energy Act (990/1987): *The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience, safety research and advances in science and technology.*

According to Section 7 r(3) of the Nuclear Energy Act, *the safety requirements of the Radiation and Nuclear Safety Authority (STUK) are binding on the licensee, while preserving the licensee's right to propose an alternative procedure or solution to that provided for in the regulations. If the licensee can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority (STUK) may approve a procedure or solution by which the safety level set forth is achieved.*

With regard to new nuclear facilities, this Guide shall apply as of 16 September 2019 until further notice. With regard to operating nuclear facilities and those under construction, this Guide shall be enforced through a separate decision to be taken by STUK. This Guide replaces Guide YVL E.2 (15.11.2013).

Translation. Original text in Finnish.

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1 Introduction

101. According to Section 63(1)(3) of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority is authorised to require that the nuclear fuel or the structures and components intended as parts of the nuclear facility be manufactured in a manner approved of by the Radiation and Nuclear Safety Authority (STUK). STUK is authorised to oblige the licensee or licence applicant to arrange for STUK opportunity sufficiently to control the manufacture of the fuel or such structures and components.* [2019-09-02]

102. According to Section 63(1)(4) of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority (STUK) is authorised to receive all necessary information and be provided with the plans and contracts and their grounds concerning the fabrication, quality control or handling of nuclear materials, nuclear waste, the nuclear facility and its structures and equipment, as well as any material, device and equipment referred to in paragraph 5 of Section 2(1).* [2019-09-02]

103. According to Section 114 of the Nuclear Energy Decree (161/1988), *the Radiation and Nuclear Safety Authority (STUK) shall see to it that nuclear fuel is designed, fabricated, stored, handled and used pursuant to the relevant instructions and regulations. Nuclear fuel cannot be placed in the reactor until STUK has accepted the fuel for use.* [2013-11-15]

104. According to Section 25(2) “Ensuring safety by management, organisation and personnel” of the Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018), *organisations participating in the design, construction, operation and decommissioning of a nuclear facility shall employ a management system for ensuring safety and the management of quality. The objective of such a management system shall be to ensure that safety is prioritised without exception, and that quality management requirements correspond to the safety significance of the activity and function. The management system shall be systematically assessed and further developed.* [2019-09-02]

105. The structure of the nuclear fuel pellets and the fuel rod cladding provide the first barrier to the release of radioactive substances generated by nuclear fission to the reactor primary coolant. Therefore, stringent requirements are imposed on the quality of manufacture and the final products. [2013-11-15]

106. The present Guide specifies the requirements for the acceptance procedure for the procurement and operation of nuclear fuel and control rods. [2019-09-02]

107. Requirements concerning nuclear safeguards are presented in Guide YVL D.1 “Regulatory control of nuclear safeguards”. Requirements concerning the transport of nuclear materials and nuclear waste are presented in Guide YVL D.2 “Transport of nuclear materials and nuclear waste” and requirements concerning the handling and storage of nuclear fuel are presented in Guide YVL D.3 “Handling and storage of nuclear fuel”. General requirements concerning the quality management of nuclear fuel are presented in Guide YVL A.3 “Leadership and management for safety” and requirements concerning the design of nuclear fuel are presented in Guide YVL B.4 “Nuclear fuel and reactor”. [2019-09-02]

2 Scope of application

201. The present Guide specifies the requirements for the acceptance of the design, manufacture, receiving and operation of nuclear fuel and control rods used in the reactor, as well the requirements for the inspections and repairs to be carried out during and after operation. [2019-09-02]

202. Additionally, the Guide presents a number of requirements to be complied with in the quality management of the procurement, design and manufacture of nuclear fuel and control rods used in the reactor. The present Guide, as applicable, shall also be complied with in the procurement of shield assemblies used in the reactor. [2019-09-02]

203. The Guide shall be applied to a nuclear facility at every phase of its life cycle, starting from the design until the decommissioning of the facility starts. [2013-11-15]

204. The requirements of the Guide apply to the licensee as well as, to the appropriate extent, to the license applicant, designer and manufacturer of nuclear fuel and other organisations whose activities affect the quality and operational safety of nuclear fuel and control rods. [2019-09-02]

3 Acceptance procedure for procurement of nuclear fuel and control rods

3.1 Quality management of design and manufacture

3.1.1 General

301. The licensee shall assume overall responsibility for the compliance of the design and manufacture of nuclear fuel and control rods to the official requirements and high quality requirements. [2019-09-02]

3.1.2 Licensee's quality management guidelines

302. The licensee is required to submit its effective quality management guidelines regarding the procurement of nuclear fuel and control rods to STUK for information before commencing the procurement of nuclear fuel. [2019-09-02]

303. The licensee shall, in quality plans concerning the procurement of nuclear fuel and control rods, specify procedures to ensure the quality management processes and quality objectives of the design and manufacture of nuclear fuel and control rods. The procedure shall also describe how the experience gained from the design, manufacture and operation of nuclear fuel and control rods is applied in the assessment of the supplier's quality management. [2019-09-02]

3.1.3 Selection and assessment of supplier

304. The licensee shall ensure that the nuclear fuel and control rod suppliers satisfy the requirements specified in Guide YVL A.3, where applicable. The requirements also apply to the design organisation and component and materials manufacturers. [2019-09-02]

305. Before the binding procurement contract is signed, the licensee shall assess the acceptability of the nuclear fuel supplier's quality management system. [2019-09-02]

306. The licensee shall submit to STUK for information a list of the suppliers, including their subcontractors, involved in the design and manufacture of any new type of nuclear fuel and control rods. The products for which the suppliers are responsible shall be specified in the list. [2019-09-02]

307. The licensee shall submit to STUK for information a plan describing how the quality management systems of a new supplier and its subcontractors, or a supplier of a new fuel or control rod type and its subcontractors, are to be assessed. The scope of the assessment procedures shall be in line with the safety significance of the product, taking into account whether or not the manufacturer's product is specific to a nuclear fuel delivery batch. Previous

assessments made by the licensee or by the supplier can be used in preparing the plan.

[2019-09-02]

308. A list of the products specific to a nuclear fuel delivery batch and products not specific to such a batch, according to fuel type, shall be submitted to STUK for approval, at the latest when submitting the plan described in requirement 307. [2019-09-02]

309. The licensee shall submit to STUK applications regarding the acceptability of the quality management of the design and manufacture of nuclear fuel and control rods, which include conclusions of the assessments carried out according to the plan in requirement 307. The application shall specify the criteria under which the quality management performance has been determined to be of an adequate level. [2019-09-02]

309a. The application according to the requirement 309 regarding nuclear fuel shall be approved by STUK before the manufacture of components specific to a delivery batch is commenced. [2019-09-02]

309b. The application according to the requirement 309 regarding control rods shall be approved by STUK before the manufacture of control rods is commenced. [2019-09-02]

310. The licensee shall prepare and submit to STUK for information a long-term programmes that the licensee uses to regularly assess the performance of the quality management systems of the nuclear fuel and control rod suppliers and their subcontractors. In the assessments the general requirements concerning quality management, manufacturing and inspection methods, and the qualifications of the personnel, as specified in subsection 4.1 of Guide YVL E.3 "Pressure vessels and piping of a nuclear facility", shall be taken into account. Revised programmes, which summarise the realisation of the assessments, shall be submitted to STUK for information annually. [2019-09-02]

311. The licensee shall inform STUK about the dates of the audits in advance (invitations and agendas). Records of the audits shall be submitted to STUK for information. [2013-11-15]

312. The experiences gained from the manufacture and operation of the nuclear fuel and control rods shall be utilised when planning and carrying out the assessment of the supplier's quality management performance. [2019-09-02]

3.2 Suitability study

313. The acceptability of the nuclear fuel and control rod design shall be specifically demonstrated by a suitability study of each individual fuel and control rod type. [2019-09-02]

314. Requirements for the design of nuclear fuel and control rods are presented in Guide YVL B.4. [2019-09-02]

315. The licensee shall assess the comprehensiveness and acceptability of the suitability study. The licensee is required to submit the assessment to STUK for approval along with the suitability study. [2019-09-02]

316. Moved to para 705a. [2019-09-02]

3.3 Construction plan

3.3.1 Contents of construction plan

317. The construction plan is specific to each individual delivery batch and comprises the following documents:

1. parts lists
2. drawings
3. specifications
4. manufacturing and inspections plans

or the construction plan shall otherwise present equivalent requirements. [2013-11-15]

318. The parts lists shall identify all the parts and components, as well as the applicable specifications and drawings, that may be used in the manufacturing of the delivery batch in question. [2013-11-15]

319. The drawings or specifications shall specify requirements for the manufacture, inspections and product properties of nuclear fuel, control rods and their parts. [2019-09-02]

320. The manufacturing and inspection plans shall present the manufacturing and inspection methods, most important manufacturing parameters, scopes of inspection, acceptance criteria and documentation of nuclear fuel and control rods. [2019-09-02]

321. Design drawings and other documents applied in the manufacture of the nuclear fuel, the control rods and their components shall disclose the input data used in the computational analyses of the suitability study (such as the required dimensions and shapes, tolerances of the

dimensions, and the types, locations and dimensions of the joints). [2013-11-15]

322. The construction plans for nuclear fuel and control rods, or the memorandum accompanying them, shall demonstrate that the characteristics and parameters of the nuclear fuel and control rods to be manufactured conform to the approved feasibility study.

[2019-09-02]

3.3.2 Submission of construction plan

323. The licensee shall submit the construction plan for each individual delivery batch to STUK for approval. A summary of justifications specifying the licensee's grounds for the acceptance of the construction plan shall be submitted for information in conjunction with the construction plan. [2019-09-02]

324. For recurring delivery batches of the same type of nuclear fuel or control rods, the licensee shall provide a description of any amendments and additions to a previously-approved construction plan and suitability study, and justify such amendments and additions. All amended documents shall be submitted to STUK for approval; for unchanged documents submitted earlier, however, a reference is sufficient. [2019-09-02]

325. As a rule, both the application for the acceptability of the quality management of the design and manufacture, and the suitability study of the nuclear fuel and control rods shall have STUK's approval before STUK starts reviewing the construction plan of the nuclear fuel and control rods. Approval of the suitability study is a necessary prerequisite for the approval of the construction plan. [2019-09-02]

326. However, STUK may, at its discretion, decide to review such parts of the construction plan that it deems to be unaffected by any pending parts of the suitability study, even before the approval of the suitability study. [2013-11-15]

327. On submission of the construction plan for a new fuel type and control rods, the licensee shall make references to the decisions issued by STUK regarding the quality management of the design and manufacture and the suitability study of the nuclear fuel and control rods, or to the documents already submitted to STUK. [2019-09-02]

328. The licensee shall inform STUK in time of any amendments to a construction plan already submitted to STUK for approval. Significant changes shall be approved by STUK before commencing the manufacture of products specific to a delivery batch. If the changes to the construction plan are minor, the changed documents shall have the licensee's approval before commencing the manufacture of the products specific to a delivery batch. In such cases, the

documents shall be promptly submitted to STUK for information. [2019-09-02]

329. Test fuel assemblies shall be included in the introduction of a new type of nuclear fuel, if necessary. As a rule, the acceptance procedure for test fuel assemblies is identical to that applied to actual delivery batches. A less rigorous acceptance procedure may be adopted for test fuel assemblies in response to a well-founded application by the licensee. [2013-11-15]

3.4 Manufacturing surveillance

330. The licensee shall submit to STUK for information a plan for the manufacturing surveillance of products specific and not specific to a nuclear fuel delivery batch and control rods, identifying the dates, surveillance objectives and the individuals performing such surveillance. In the surveillance, special attention shall be paid to the assessment of the processes employed in the manufacture of the products not specific to a delivery batch. [2019-09-02]

331. The licensee shall arrange the opportunity for STUK to witness the manufacture of the nuclear fuel and control rods as provided in Section 63(1) of the Nuclear Energy Act. STUK shall be informed about the manufacturing surveillance visits in advance (invitations and agendas). [2019-09-02]

332. The construction plan for products specific and not specific to a nuclear fuel delivery batch shall be approved by the licensee and STUK before commencing the manufacture of products specific to a delivery batch, with the exception of the procedure described in requirement 328. The manufacturer shall ensure and compile documents demonstrating that products not specific to a delivery batch have been manufactured in accordance with an approved construction plan. [2019-09-02]

332a. The construction plan for control rods shall be approved by STUK before the construction inspection of the control rods takes place. The suitability study shall be approved by STUK before commencing the manufacture of the control rods. [2019-09-02]

333. The licensee shall ascertain that the most important manufacturing and inspection methods sufficiently confirm the fulfilment of the requirements imposed on the products. STUK shall be informed about the most significant changes of the manufacturing and inspection methods. [2013-11-15]

334. The licensee shall review the qualifications of the manufacture and inspection methods connected to the manufacture of the nuclear fuel and control rods. The review of the results and the grounds for approval shall be submitted to STUK for information, at the latest when

submitting the application for the operation permit of the fuel. [2019-09-02]

335. The manufacturing surveillance exercised by licensee shall verify that the requirements and criteria specified in the construction plan for nuclear fuel are met. The results of the surveillance visits and reviews carried out in accordance with the surveillance plan shall be submitted to STUK for information, at the latest when submitting the application for the operation permit of the fuel. [2019-09-02]

335a. The licensee shall verify through the manufacturing surveillance and construction inspection of the control rods that the requirements and criteria specified in the construction plan for the control rods are fulfilled. [2019-09-02]

336. Certificate 3.1 in accordance with SFS-EN 10204, or an equivalent certificate, is sufficient for the approval of steels and nickel-based materials compliant with known standards. [2019-09-02]

337. Reports on any major nonconformities and the licensee's description of the approval criteria of such nonconformities shall be promptly submitted to STUK for approval. [2019-09-02]

338. Reports on minor nonconformities regarding nuclear fuel shall be submitted to STUK for information, at the latest when submitting the application for the operation permit of the nuclear fuel. [2019-09-02]

339. Reports on minor nonconformities related to control rods shall be submitted to STUK, at the latest during the construction inspection of the control rods. [2019-09-02]

4 Receiving inspection and start of operation of nuclear fuel and control rods

401. The licensee shall perform the receiving inspections of nuclear fuel and control rods in accordance with the applicable inspection procedures. Summaries of the inspection results shall be submitted to STUK for information. [2019-09-02]

402. The licensee shall submit to STUK for approval an application for the operation permit of the nuclear fuel and control rods. In the application, references shall be made to documents submitted to STUK by the licensee and to STUK's decisions related to the nuclear fuel and control rods at issue:

1. assessments of the quality management systems of the nuclear fuel and control rod suppliers and their subcontractors
2. suitability study
3. construction plan
4. manufacturing surveillance/ construction inspection
5. nonconformities
6. receiving inspections
7. manufacturing certificates for the fuel assemblies and control rods
8. list of identification for fuel assemblies, fuel channels and control rods.

[2019-09-02]

403. The application for the operation permit for the nuclear fuel and control rods shall be approved by STUK prior to transfer of the nuclear fuel and control rods into the reactor.

[2019-09-02]

5 Operation control of nuclear fuel and control rods

501. The licensee shall prepare an operation control programme to ensure the safe use of nuclear fuel. In accordance with the programme, the operation conditions and performance of the nuclear fuel shall be monitored and controlled during operation, and, after the operation, by means of post-irradiation inspections and examinations. Such monitoring and control shall be extensive enough to enable the detection of any unexpected phenomena. The operation control programme shall be submitted to STUK for approval concurrent with the application for the plant's operating licence. [2013-11-15]

502. The licensee shall represent in the operation control programme how the power of the reactor and nuclear fuel, power changes, power distribution, safety margins and burn-up as well as coolant activity, its chemical state and the amount of radioactive materials in it are to be monitored. [2019-09-02]

503. The operation control programme shall provide a description of the methods to be used in the evaluation of nuclear fuel leakage and how such occurrences will be reported to STUK. [2013-11-15]

504. The licensee shall – in accordance with the operation control programme – submit to STUK for information an annual inspection programme specific to each plant unit and type of nuclear fuel. The purpose of the inspection programme is to ensure that the nuclear fuel behaves according to its design basis requirements. [2013-11-15]

505. The licensee shall submit to STUK for information an inspection and examination plan for test fuel assemblies. The plan shall be submitted, at the latest, in connection with the application for the operation permit of the test assemblies. [2019-09-02]

506. The licensee shall make an effort to identify the causes of any nuclear fuel failure and unpredictable fuel behaviour. If any signs of fuel leakage are detected during an operating cycle, inspections shall be carried out during refuelling outages to ensure that no leaking fuel is left in the reactor. [2019-09-02]

507. The licensee shall submit to STUK for approval, in connection with the nuclear facility's operating licence application, an operation control programme for the control rods, ensuring their reliable operation. The annual inspection plans for control rods in accordance with the operation control programme shall be submitted to STUK for information. [2019-09-02]

508. STUK shall be informed about the dates of the inspections, specified in requirements 504, 507 and 511, before the inspections are commenced. The inspection plans shall be submitted

to STUK for information. [2019-09-02]

509. The licensee shall submit the results of the inspections required by the operation control and condition monitoring programme and other inspections of the nuclear fuel and control rods to STUK for information within six months of the completion of each inspection. Any observations of anomalies shall be reported to STUK without delay. [2019-09-02]

509a. The licensee shall submit to STUK the preliminary results on the visual inspections of fuel assemblies and control rods carried out during the annual outages for the permission to close the reactor pressure vessel cover. [2019-09-02]

510. The licensee shall confirm that the nuclear fuel and control rod suppliers submit to the licensee and STUK an annual up-to-date record of operating experience, including information on any observed failures and their causes. Additionally, the licensee shall regularly provide to STUK for information the results of experimental studies carried out for fuel . [2019-09-02]

511. The holder of an operating licence for a spent nuclear fuel storage facility shall have a monitoring programme for tracking any changes in the properties and storage conditions of spent nuclear fuel. This programme shall define the scope and frequency of the periodic inspections of the nuclear fuel and storage conditions as well as the inspection methods and equipment to be used. The monitoring programme shall be submitted to STUK for approval in connection with the facility's operating licence application. The other requirements for the long-term interim storage of spent nuclear fuel are specified in Guide YVL D.3. [2019-09-02]

6 Repairs of nuclear fuel and control rods and inspections requiring disassembly of fuel assemblies

601. Plans concerning repairs of nuclear fuel and control rods as well as plans concerning inspections requiring disassembly deviating from the design documentation shall be submitted to STUK for approval before the commencement of the work. In this context, the design documentation refers to the written documentation consisting of the suitability study and construction plan. [2019-09-02]

602. Schedules concerning repairs nuclear fuel and control rods and inspections requiring disassembly in deviation of the suitability study or construction plan shall be submitted to STUK for information well before the commencement of the work. [2019-09-02]

603. Substitute parts used for repairs are subject to the same requirements as the original parts. [2019-09-02]

604. Written instructions shall be drawn up for all repairs, inspections, work supervision and reporting of the nuclear fuel and control rods. [2013-11-15]

605. The licensee shall ensure that any work on nuclear fuel and control rods are conducted according to the plans and in conformance to a high level of quality. The results of the inspections shall be submitted to STUK for information. [2019-09-02]

606. The licensee shall request that STUK open a protocol for repairs of nuclear fuel and control rods. Repaired and inspected fuel assemblies and control rods shall be approved by STUK for start of operation as referred to in requirement 402 as well as protocol approval for reactor operation by STUK concerning the repairs and inspections. [2019-09-02]

7 Regulatory oversight by the Radiation and Nuclear Safety Authority

7.1 Quality management

701. STUK will review the applications regarding the acceptability of the quality management of nuclear fuel and control rod design and manufacture and, at the same time, assess the suitability of the proposed suppliers and subcontractors. [2019-09-02]

702. STUK will review the licensee's guidelines for quality management in the procurement of nuclear fuel and control rods. [2019-09-02]

703. STUK will participate in the licensee's assessments of nuclear fuel and control rod manufacturers and their subcontractors at its discretion. [2019-09-02]

704. STUK will assess the licensee's activities related to the procurement of nuclear fuel and control rods and the performance of the related quality management system through the Periodic Inspection Programme (KTO). [2019-09-02]

7.2 Suitability study

705. STUK will review the suitability studies of the nuclear fuel and control rods in accordance with Guide YVL B.4. [2019-09-02]

705a. STUK may review applications described in requirement 309 submitted by the licensee for approval concurrently with the suitability study. [2019-09-02]

7.3 Manufacturing

706. STUK will review the construction plans for the nuclear fuel and control rods and oversee the manufacturing surveillance exercised by the licensee, along with participating in the manufacturing surveillance visits at its discretion. [2019-09-02]

706a. STUK will perform a construction inspection of the control rods and prepare a protocol on the inspection. [2019-09-02]

7.4 Start of operation

707. STUK will review applications for the operation permit of the nuclear fuel and control rods, such permissions being a necessary prerequisite for transferring the nuclear fuel and control rods into the reactor. [2019-09-02]

7.5 Operation control

708. STUK will review the operation control and condition monitoring programmes for the nuclear fuel and control rods. [2019-09-02]

709. STUK will monitor the attainment of the operational parameters approved for the nuclear fuel in the suitability study in connection with STUK's Periodic Inspection Programme (KTO). [2019-09-02]

710. STUK will review plans for the repairs of nuclear fuel and the control rods, as well as for inspections requiring disassembly, and oversee their execution at its discretion. A protocol shall be drawn up of the inspections. [2013-11-15]

8 References

1. Nuclear Energy Act (990/1987). [2013-11-15]
2. Nuclear Energy Decree (161/1988). [2013-11-15]
3. Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018). [2019-09-02]
4. SFS-EN ISO 9000:2015. Quality management systems. Fundamentals and vocabulary. [2019-09-02]
5. SFS-EN 10204:2004. Metallic products. Types of inspection documents. [2013-11-15]

Definitions

Products specific to a delivery batch

Products specific to a delivery batch shall refer to products (materials, parts, components) that have been allocated to a nuclear fuel delivery batch at the time of their manufacture. Other nuclear fuel products are not considered allocated to a delivery batch.

Construction plans for nuclear fuel, control rods and dummy elements

Construction plans for nuclear fuel, control rods and dummy elements shall refer to the written documentation defining the detailed requirements for the structure and manufacturing of fuel, control rods and dummy elements, and their inspections taking place during manufacturing.