STUK

GUIDE **YVL E.2** / 15 NOVEMBER 2013

PROCUREMENT AND OPERATION OF NUCLEAR FUEL

With regard to new nuclear facilities, this Guide shall apply as of 1 December 2013 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 Guides YVL 6.3 and YVL 6.7.

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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 deemed 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.*

Translation. Original text in Finnish.

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.*

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).*

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.*

104. According to Section 29 "Safety and quality management" of the Government Decree (717/2013), *organisations participating in the design, construction, operation, and decommissioning of a nuclear power plant shall employ a management system for ensuring the management of safety and quality.*

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.

106. The present Guide specifies the requirements for the acceptance procedure for the procurement and operation of nuclear fuel.

107. Requirements concerning nuclear safeguards are presented in Guide YVL D.1. Requirements concerning the transport of nuclear materials and nuclear waste are presented in Guide YVL D.2. Requirements concerning the handling and storage of nuclear fuel are presented in Guide YVL D.3. General requirements concerning the quality management of nuclear fuel are presented in Guide YVL A.3. Requirements concerning the design of nuclear fuel are presented in Guide YVL B.4.

2 Scope of application

201. The present Guide specifies the requirements for the acceptance of the design, manufacture, receiving and operation of nuclear fuel, as well the requirements for the inspections and repairs to be carried out during and after operation.

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. The present Guide, as applicable, shall also be complied with in the procurement of control rods and shield assemblies used in the reactor.

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.

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.

3 Acceptance procedure for procurement of nuclear fuel

3.1 Quality management of design and manufacture

General

301. The licensee shall assume overall responsibility for the compliance of the design and manufacture of nuclear fuel to the official requirements and high quality requirements.

Licensee's quality management guidelines

302. The licensee is required to submit its effective quality management guidelines regarding the procurement of nuclear fuel to STUK for information before commencing the procurement of nuclear fuel.

303. The licensee's quality management guidelines for the procurement of nuclear fuel shall specify a procedure according to which the experience gained from the design, manufacture and operation of fuel is applied in order to assess the fuel supplier in terms of quality management.

Selection and assessment of supplier

304. The licensee shall ensure that the nuclear fuel supplier satisfies the requirements specified in Guide YVL A.3, where applicable. The requirements also apply to the design organisation and component and materials manufacturers.

305. Before the final procurement contract is signed, the licensee shall assess the acceptability of the nuclear fuel supplier's quality management system.

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. The products for which the suppliers are responsible shall be specified in the list.

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

308. A list of the products specific to a 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.

309. The licensee shall submit to STUK an application regarding the acceptability of the quality management of the design and manufacture of nuclear fuel, which includes 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. The application shall be approved by STUK before the manufacture of components specific to a delivery batch is commenced.

310. The licensee shall prepare and submit to STUK for information a long-term programme that the licensee uses to regularly assess the performance of the quality management systems of the nuclear fuel 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, shall be taken into account. Revised programmes, which summarise the realisation of the assessments, shall be submitted to STUK for information annually.

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.

312. The experiences gained from the manufacture and operation of the nuclear fuel shall be utilised when planning and carrying out the assessment of the supplier's quality management performance.

3.2 Suitability study

313. The acceptability of the nuclear fuel design shall be specifically demonstrated by a suitability study on each individual fuel type.

314. Requirements for the design of nuclear fuel are presented in Guide YVL B.4.

315. As part of the suitability study, the licensee shall assess the comprehensiveness and acceptability of the design documentation. The licensee is required to submit the assessment to STUK for approval along with the suitability study.

316. The acceptance procedures for the quality management of the design and manufacture, and the suitability study of the nuclear fuel may be reviewed simultaneously.

3.3 Construction plan

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.

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.

319. The drawings and specifications shall include the inspection requirements for the nuclear fuel and its components as well as descriptions of the manufacturing methods used.

320. A manufacturing and inspection plan shall present the inspection processes carried out during manufacture in such a way that the manufacturing stages at which the inspections are conducted, the methods and scopes of the inspections are identified, as well as the acceptance criteria applied and the documentation created of the inspections.

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).

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

Submission of construction plan

323. The licensee shall submit the construction plan for each individual delivery batch to STUK for approval. A memorandum specifying the licensee's grounds for the acceptance of the construction plan shall be submitted for information in conjunction with the construction plan.

324. For recurring delivery batches of the same type of nuclear fuel, 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.

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 shall have STUK's approval before STUK starts reviewing the construction plan of the nuclear fuel. Approval of the suitability study is a necessary prerequisite for the approval of the construction plan.

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.

327. On submission of the construction plan for a new fuel type, 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, or to the documents already submitted to STUK.

328. The licensee shall promptly inform STUK of any amendments to a construction plan already submitted for approval. Approval from STUK is required for significant changes, whereas minor changes shall be reported to STUK for information.

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.

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 delivery batch, 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.

331. The licensee shall arrange the opportunity for STUK to witness the manufacture of the nuclear fuel 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).

332. The construction plan for products specific and not specific to a delivery batch shall be approved by the licensee and STUK before commencing the manufacture of products specific to a delivery batch. The manufacturer shall ensure and prepare documents demonstrating that products not specific to a delivery batch have been manufactured in accordance with an approved construction plan.

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.

334. The licensee shall review the qualifications of the methods related to the manufacture of a new fuel type before commencing the production. In response to an application, a less rigorous procedure may be adopted for test fuel assemblies. The review results shall be submitted to STUK for information.

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.

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.

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. Reports on minor nonconformities shall be submitted to STUK for information, at the latest when submitting the application for the operation permit of the nuclear fuel.

4 Receiving inspection and start of operation of nuclear fuel

401. The licensee shall perform the receiving inspections of nuclear fuel and prepare inspection procedures for the receiving inspections. The procedures shall be submitted to STUK for information. A summary of the inspections conducted shall be submitted to STUK for information.

402. The licensee shall submit to STUK for approval an application for the operation permit of the nuclear fuel. In the application, references shall be made to documents already submitted to STUK by the licensee and to STUK's decisions related to that specific delivery batch:

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

403. Approval by STUK shall be obtained for the start of operation before the nuclear fuel is loaded into the reactor.

5 Operation control of nuclear fuel

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.

502. In the operation control programme, the licensee shall explain how the power of the reactor and fuel, power changes, power distribution, safety margins, burn-up, as well as coolant activity and water chemistry are to be monitored.

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.

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.

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.

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.

507. The licensee shall submit to STUK for approval an operation control programme ensuring the reliable behaviour of the control rods. The annual inspection plans in accordance with the operation control programme shall be submitted to STUK for information.

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

509. The licensee shall submit the results of the inspections required by the operation control 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.

510. The licensee shall confirm that the fuel supplier submits to both the licensee and STUK an annual up-to-date record of operating experience regarding the fuel types delivered to the licensee, including information on any observed fuel failures and their causes. Additionally, the licensee shall regularly report the results of experimental studies to STUK for information.

511. The requirements concerning the long-term interim storage of spent nuclear fuel are presented in Guide YVL D.3. The results of the inspections carried out according to the condition monitoring programme for spent fuel presented in Guide YVL D.3 shall be submitted to STUK for information within six months of the completion of each inspection, as stated in requirement 509.

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

601. Plans concerning repairs of nuclear fuel and inspections requiring disassembly of fuel assemblies in deviation from the suitability study or construction plan, shall be submitted to STUK for approval before the commencement of the work.

602. Schedules concerning repairs 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.

603. Spare parts used for repairs are subject to the same requirements as the original parts.

604. Written instructions shall be drawn up for all repairs, inspections, work supervision and reporting of the nuclear fuel and control rods.

605. The licensee shall ensure that any work on nuclear fuel is conducted according to the plan and in conformance to a high level of quality. The results of the inspections shall be submitted to STUK for information.

7 Regulatory oversight by the Radiation and Nuclear Safety Authority

Quality management

701. STUK will review the application regarding the acceptability of the quality management of nuclear fuel design and manufacture and, at the same time, assess the suitability of the proposed suppliers and subcontractors.

702. STUK will review the licensee's guidelines for quality management in the procurement of nuclear fuel.

703. STUK will participate in the licensee's assessments of nuclear fuel manufacturers and their subcontractors at its discretion.

704. STUK will assess the licensee's fuel procurement and the performance of the related quality management system through STUK's Periodic Inspection Programme (KTO).

Suitability study

705. STUK will review the suitability study of the nuclear fuel in accordance with Guide YVL B.4.

Manufacturing

706. STUK will review the construction plan for the nuclear fuel and oversee the manufacturing surveillance exercised by the licensee, along with participating in the manufacturing surveillance visits at its discretion.

Start of operation

707. STUK will review application for the operation permit of the nuclear fuel, such permission being a necessary prerequisite for loading the nuclear fuel into the reactor.

Operation control

708. STUK will review the operation control programmes for the nuclear fuel and control rods.

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).

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.

Definitions

Quality vocabulary

The quality vocabulary follows standard SFS-EN ISO 9000:2005.

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 plan for nuclear fuel

Construction plan for nuclear fuel shall refer to the written documentation defining the detailed requirements for the structure and manufacturing of fuel, and the inspections taking place during manufacturing.

References

1. Nuclear Energy Act (990/1987).
2. Nuclear Energy Decree (161/1988).
3. Government Decree on the Safety of Nuclear Power Plants (717/2013).
4. SFS-EN ISO 9000:2005. Quality management systems. Fundamentals and vocabulary.
5. SFS-EN 10204:2004. Metallic products. Types of inspection documents.