

GUIDE YVL E.10

EMERGENCY POWER SUPPLIES OF A NUCLEAR FACILITY

| | | |
|------|--|----|
| 1 | Introduction | 4 |
| 2 | Scope of application | 5 |
| 3 | Safety analysis report and plan for principles | 7 |
| 4 | Manufacturer | 8 |
| 5 | Design | 9 |
| 6 | Construction plan | 13 |
| 6.1 | Summary of justifications | 13 |
| 6.2 | Manufacturer report | 14 |
| 6.3 | Design basis | 14 |
| 6.4 | Design data | 15 |
| 6.5 | Design analyses and studies | 16 |
| 6.6 | Operating experience and type test data | 17 |
| 6.7 | Inspection plan and instructions | 17 |
| 6.8 | Status summary of the construction plans and suitability assessments of other structures and components part of the emergency power supply | 19 |
| 7 | Type test | 20 |
| 8 | Manufacture | 21 |
| 9 | Construction inspection | 22 |
| 10 | Installation | 24 |
| 11 | Commissioning | 25 |
| 12 | Operation, condition monitoring, and maintenance | 27 |
| 13 | Modifications | 29 |
| 14 | Regulatory oversight by the Radiation and Nuclear Safety Authority | 30 |
| 14.1 | General | 30 |
| 14.2 | Third-party approval | 31 |
| 14.3 | Safety analysis report | 31 |
| 14.4 | Construction plan | 31 |
| 14.5 | Control of manufacturing, and construction inspection | 31 |
| 14.6 | Oversight of the type test | 32 |
| 14.7 | Installation control and the construction inspection | 32 |
| 14.8 | Commissioning inspection | 32 |

| | | |
|-------|--|----|
| 14.9 | Operation, condition monitoring and maintenance | 32 |
| 14.10 | Modifications and replacement work | 33 |
| 15 | ANNEX A Scope of control and division of inspection responsibilities for emergency power supplies .. | 34 |
| 16 | References | 35 |

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 and 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 are binding on the licence holder, while preserving the licence holder's right to propose an alternative procedure or solution to that provided for in the regulations. If the licence holder can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority may approve the procedure or solution.*

With regard to new nuclear facilities, this Guide shall apply as of 3 February 2020 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.10 (15.08.2014).

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STUK • SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite / Address • Laippatie 4, 00880 Helsinki

Postiosoite / Postal address • PL / P.O.Box 14, FI-00811 Helsinki, FINLAND

Puh. / Tel. (09) 759 881, +358 9 759 881 • Fax (09) 759 88 500, +358 9 759 88 500 • www.stuk.fi

1 Introduction

101. Normally, a nuclear facility generates the electricity required for its house loads and safety systems using its main generator, or the electricity is supplied into the nuclear facility from the external electrical grid. However, provisions must be made for disturbances and accidents, during which electricity cannot be supplied to the nuclear facility's safety systems from these sources. For this reason, continuous availability of electricity at a nuclear facility shall be secured with reliable emergency power supplies with sufficient capacity. [2014-05-07]

102. This Guide presents requirements for the design, manufacture, installation, commissioning, operation, condition monitoring, and maintenance of the emergency power supply, and it describes the regulatory measures applied by STUK and an authorised inspection organisation (AIO) to verify compliance with the presented requirements. [2020-01-20]

103. The following legislation sets the legal basis for this Guide:

According to Section 63(1)(3) of the Nuclear Energy Act (990/1987) [1], *STUK is authorised to require that 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), and oblige the licensee or licence applicant to arrange for STUK opportunity sufficiently to control manufacture of the fuel or such structures and components.*

Under Section 11(6) of Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018) [3], *a nuclear power plant shall have off-site and on-site electrical power supply systems to cope with anticipated operational occurrences and accidents. It shall be possible to supply the electrical power needed for safety functions using either of the two electrical power supply systems.*

Under Section 4(2) of Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018) [3], *requirements set for and the actions taken to ascertain the compliance with the requirements of the systems, structures and components implementing safety functions and connecting systems, structures and components shall be commensurate with the safety class of the item in question.* [2020-01-20]

104. If the structures or components of the emergency power supply contain a dangerous liquid or gas, the requirements of the Chemicals Act (599/2013) [9], the Act on the Safe Handling of Dangerous Chemicals and Explosives (390/2005) [10], and Government Decree (855/2012) [11] issued by virtue of the two Acts shall be applied in addition to the provisions of this Guide. [2020-01-20]

2 Scope of application

201. The Guide is applied to safety class 2 and 3 emergency power supplies of nuclear facilities throughout their service lifetime. An emergency power supply comprises an emergency power machine, which is either a diesel engine or gas turbine, generator and the other related systems, structures and components that are needed in the emergency power generation of a nuclear facility in transient and accident situations. This Guide presents primarily requirements regarding emergency power machines set for licensees and manufacturers, while the requirements pertaining to the other systems, structures and components of an emergency power supply at the system or component level are presented in their dedicated YVL guides.

[2020-01-20]

202. The requirements concerning the design bases and system design of emergency power supplies are presented in Guides YVL B.1 “Safety design of a nuclear power plant” and YVL B.2 “Classification of systems, structures and components of a nuclear facility”. [2020-01-20]

203. The requirements for structures and components of emergency power supplies other than the diesel engine generators and gas turbine generators are presented in Guides YVL B.7 “Provisions for internal and external hazards at a nuclear facility”, YVL B.8 “Fire protection at a nuclear facility”, YVL E.3 “Pressure vessels and piping of a nuclear facility”, YVL E.6 “Buildings and structures of a nuclear facility”, YVL E.8 “Valves of a nuclear facility”, YVL E.9 “Pumps of a nuclear facility” and YVL E.11 “Hoisting and transfer equipment of a nuclear facility”.

[2020-01-20]

204. The requirements for electrical and I&C equipment of emergency power supplies are presented in Guide YVL E.7 “Electrical and I&C equipment of a nuclear facility”. The preliminary and final suitability assessments of the electrical and I&C equipment are processed according to the submittal method and schedule specified in Guide YVL E.7. The compatibility of the emergency power machine (diesel engine or gas turbine) and generator shall, however, be demonstrated with an operability analysis to be appended to the emergency power machine’s construction plan. [2020-01-20]

205. The requirements set for the licensee’s and suppliers’ management system processes and functions are presented in Guide YVL A.3 “Leadership and management for safety”.

[2020-01-20]

206. The requirements related to the construction, commissioning and ageing management of emergency power supplies are presented in Guides YVL A.5 “Construction and commissioning of a nuclear facility” and YVL A.8 “Ageing management of a nuclear facility”. [2020-01-20]

207. STUK approves inspection organizations to perform inspections on the structures and components of emergency power supplies of nuclear facilities in accordance with Guide YVL E.1 “Authorised inspection organisation and the licensee’s in-house inspection organisation”. [2020-01-20]

208. STUK approves testing organizations to perform testing of the structures and components of emergency power supplies of nuclear facilities in accordance with Guide YVL E.12 “Testing organisations for mechanical components and structures of a nuclear facility”. [2020-01-20]

3 Safety analysis report and plan for principles

301. The licensee shall draw up the plans for principles, system-level pre-inspection documentation and descriptions of the preliminary and final safety analysis report for the emergency power supply according to Guide YVL B.1. [2020-01-20]

302. Removed. [2020-01-20]

303. Removed. [2020-01-20]

4 Manufacturer

401. The management system of an emergency power machine's manufacturer in Safety Class 2 shall be appropriately certified for the nuclear industry. If the management system has not been specifically certified for the nuclear industry, the management system shall be supplemented with a delivery-specific quality plan. The quality plan shall describe such quality control ensuring procedures that implement the requirements regarding quality control of Guide YVL A.3 in an emergency power machine's delivery. The quality plan shall be submitted in connection with a possible manufacturer approval or together with the construction plan of emergency power machine. [2020-01-20]

401a. The management system of an emergency power machine's manufacturer in Safety Class 3 shall be appropriately certified. Otherwise, the licensee may apply for approval for other management system assessment performed by an independent third party. [2020-01-20]

401b. The licensee shall audit the manufacturer of the emergency power machine.
[2020-01-20]

402. The manufacturer of the emergency power machine shall employ professional, experienced personnel, and the methods, tools and equipment required for the activities.
[2020-01-20]

403. The manufacturer of the emergency power machine shall have documented procedures in place for the qualification of manufacturing methods and personnel, for the validity of the qualifications, for the manufacturing, for testing, and for the processing of deviations.
[2020-01-20]

404. Whenever special processes are used in the manufacture of emergency power supply, the licensee shall apply for approval, as laid down in Guide YVL E.3, for the manufacturer and subcontractors of safety class 2 and 3 pressure equipment that is within the scope of delivery for the machine unit. [2020-01-20]

405. The manufacturing procedures for special processes used in the manufacturing of the machine unit shall be qualified by means of procedure tests before manufacturing is started. In demanding locations, STUK or an AIO may require that the applicability of the manufacturing procedures be verified using pre-manufacturing performance tests or production tests conducted as part of manufacturing. [2020-01-20]

406. In the delivery chain of the emergency power machine, the manufacturer shall ensure that the manufacturer's subcontractors are aware of the requirements related to the delivery; before the assembly of the emergency power machine, the manufacturer shall ensure that the

structures and components manufactured meet these requirements. [2020-01-20]

5 Design

501. The emergency power supply shall meet the requirements that have been set as the emergency power supply's design bases in normal operation and during anticipated operational occurrences, postulated accidents, design extension conditions and severe reactor accidents of the nuclear facility. The requirements for the design bases and system design of emergency power supplies are presented in Guide YVL B.1. [2020-01-20]

502. In the nuclear facility's safety analysis reports, the plan for principles of the repair or modification work of the emergency power supply and the requirement specifications for equipment, the licensee shall define the requirements for the design, dimensioning, quality, operability, operation, operating environment, inspectability and maintainability of the emergency power supply. [2020-01-20]

503. The systems, structures and components of the emergency power supply shall employ proven technology. The meeting of the design requirements of a system, structure or component must be demonstrated experimentally if conformity to requirements cannot be reliably demonstrated otherwise. [2014-05-07]

504. The structural materials and coating of systems, structures and components of the emergency power supply shall withstand the stresses caused by design basis service. Choice of materials shall ensure that their operability is not affected by corrosion, erosion or other similar detrimental phenomena. [2020-01-20]

505. The structural materials and coating of the emergency power supply's structures and components that are important in terms of performance shall be standardised materials that have been proven to be suitable for their intended location of use. Separate approval shall be sought as laid down in Guide YVL E.3 for materials that adhere to the material manufacturer's own standard. The result documentation of material manufacturing shall demonstrate the conformity to requirements of the materials to the extent required for testing in the material standard. [2020-01-20]

506. The peak power output capacity of the emergency power supply shall be at least 110% of the rated power defined for the emergency power supply. It shall be possible to overload the emergency power supply at peak power for at least one hour. [2014-05-07]

507. The emergency power supply shall have its own local control room or control station, from where it shall be possible to control the emergency power supply and monitor the information essential for its operation and availability. [2014-05-07]

508. When loads are connected, the voltage variations and frequency variations of the emergency power supply and their durations shall be small enough to make it possible for the electrical loads to start as determined by their starting sequences. [2014-05-07]

509. The emergency power supply shall be able to generate continuous short-circuit current to meet the selectivity requirements of the electrical system. [2014-05-07]

510. The emergency power supply shall have a technically justified service life estimate. If necessary, the service life may be revised on the basis of operability analyses. [2020-01-20]

511. If the emergency power supply uses serially manufactured components, their properties and quality shall be suitable for their purpose of use such that the emergency power supply meets the operability requirements set for it. [2020-01-20]

512. The emergency power supply shall reliably maintain its operability over the maintenance interval. Overhaul needs or a failure shall be detectable before the weakening or loss of the emergency power supply's operability causes a safety risk. [2020-01-20]

513. The emergency power supply shall be equipped with systems that allow it to be maintained in a continuous standby state. These systems shall be dimensioned such that the operability requirements for the emergency power machine are met under all design basis environmental conditions. [2020-01-20]

514. The emergency power supply shall be equipped with monitoring systems that provide real-time information concerning the emergency power supply's readiness for start-up and operation, and its operability during operation. [2020-01-20]

515. The margins between excitations (internal and external) and natural frequencies and/or structural damping in the emergency power supply shall be large enough for the emergency power supply to maintain its operability in design basis service and conditions. [2020-01-20]

516. Opposite phase synchronisation of the emergency power machine shall be prevented with a technical solution or, alternatively, the emergency power machine shall be designed and dimensioned to endure opposite phase synchronisation without losing operability. [2020-01-20]

517. Starting the emergency power supply and connecting loads shall be possible during any loss of external electric power after possible repair or replacement of the emergency power supply. [2020-01-20]

518. The emergency power supply shall meet the design requirements set forth for its structures and components in the following standards and YVL Guides:

- KTA 3702 (diesel generator unit) [4]

- API 616 (gas turbine generator unit) [5]
- YVL E.7 (electrical and I&C equipment)
- YVL E.6, YVL B.7, and YVL B.8 (buildings and structures)
- YVL E.3, YVL E.8, YVL E.9, and YVL E.11 (piping and equipment).

[2020-01-20]

6 Construction plan

601. The licensee shall present the emergency power machine's construction plan that includes the following:

- the licensee's summary of justifications
- a manufacturer report
- the design bases
- the design data
- the design analyses and studies
- the operating experience
- the inspection plan and procedures
- a report on the construction plans and preliminary suitability assessments of other structures and components included in the emergency power supply.

A corresponding construction plan shall also be presented for spare part acquisitions that are significant in terms of the emergency power machine's operability if the structure or material of the spare part is changed. [2020-01-20]

602. The licensee shall seek approval for the construction plan before the manufacture of the emergency power machine is started. [2020-01-20]

603. In case the construction plan is updated before the construction inspection, the licensee shall apply for approval for the revisions. Minor revisions can be submitted for information. [2020-01-20]

604. The requirements for the approval of the construction plans of emergency power supplies' structures and components (other than the emergency power machine) are presented in the appropriate E series YVL Guides. [2020-01-20]

6.1 Summary of justifications

605. The licensee shall append to the construction plan a summary of justifications prepared on the conformity of the emergency power machine. It shall include justifications based on the construction plan data as to why:

- manufacturer and their subcontractors, testing organisations and third parties have readiness for a delivery, inspections and supervision
- emergency power machine design bases correspond to the requirements set for the emergency power machine during operational, transient and accident situations

- dimensioning calculations, analyses, type tests or operating experiences reliably demonstrate the fulfilment of the emergency power machine's design bases
- manufacturing quality can be verified by inspections and testing conducted on the structural materials, parts and finished emergency power machine.

[2020-01-20]

606. The justifications shall make reference to individual documents in the construction plan, and to their chapter and page numbers if the documents are extensive. [2020-01-20]

607. The summary of justifications shall name the testing organizations performing control of manufacturing or destructive or non-destructive testing on the emergency power machine's structural materials or components. [2020-01-20]

608. Removed. [2020-01-20]

6.2 Manufacturer report

609. The construction plan shall include a manufacturer report containing information on the manufacturer's organisation, operations, qualifications of the personnel and manufacturing procedures, copies of valid management system certification decisions and other assessments and the manufacturer's recent delivery references [2020-01-20]

610. A manufacturer report shall also be provided on subcontractors that manufacture the main components that are important in terms of the machine unit's operability. Pressure-retaining and load-bearing parts, such as the engine block, connecting rods, axles, the combustor and the guide vanes and rotary baffles, are considered to be main components. [2020-01-20]

6.3 Design basis

611. The construction plan shall present the emergency power machine's design bases:

- electrical power
- start-up time, startability, and availability
- number of start-ups and operating life
- the stresses and environmental conditions at the service place (seismic loads, temperature, moisture, impurities, air pressure etc.)
- other requirements placed on the emergency power machine by the nuclear facility, service place and operational conditions.

[2020-01-20]

611a. The emergency power machine's design bases shall be determined in the scope of the requirements that have been set for the emergency power machine's operability in normal operation, during anticipated operational occurrences, postulated accidents, design extension conditions and severe reactor accidents. [2020-01-20]

6.4 Design data

612. The construction plan shall present the emergency power machine's design parameters and technical specification. This information shall make it possible to estimate whether the emergency power machine has been designed to meet the requirements set by the nuclear facility and the service place:

- location code and safety class
- continuous power and peak power
- design values of auxiliary systems (need for combustion air and cooling water, temperature variation limits etc.)
- functional description (PI diagrams, logic diagram, load diagram and protection diagram attached)
- assembly and cross-section drawings of the main components (engine, generator, switches, gearbox, foundation)
- parts lists
- construction materials and surfacing materials
- other information defining the structural and functional characteristics of the emergency power machine.

[2020-01-20]

613. The construction plan shall contain PI diagrams covering the entire emergency power supply, including its systems for combustion air, fuel, exhaust gas, lubricant, cooling, and other auxiliary systems. [2014-05-07]

614. The emergency power machine's main dimensions, the marking of parts, part materials, surfacing, surface treatments and weld joints shall be included in the engineering drawings.

[2020-01-20]

6.5 Design analyses and studies

615. Removed. [2020-01-20]

616. Removed. [2020-01-20]

617. In safety class 2, a strength analysis shall be presented of the crankshaft of the diesel engine in order to demonstrate the acceptability of the part's design and dimensioning. [2014-05-07]

618. In safety class 2, strength analyses shall be presented of the gas turbine shaft, the compressor blades and the turbine blades in order to demonstrate the acceptability of their design and dimensioning. [2014-05-07]

618a. An operability analysis shall be presented on the emergency power train (diesel engine/gas turbine, coupling, gear, generator, supports, foundations) which includes the machine's vibration and play analysis and possible strength analysis in an exceptional connection situation of the generator's supply voltage (opposite phase synchronisation). The analyses shall demonstrate that the vibrations from internal or external excitations and changes caused by thermal expansion on the operational clearances do not weaken the performance of the machine in design basis operational conditions. If the design bases of the machine include opposite phase synchronisation, a strength analysis shall also be presented to demonstrate the maintenance of the machine operability in such a situation. [2020-01-20]

619. Removed. [2020-01-20]

620. Removed. [2020-01-20]

621. Removed. [2020-01-20]

622. It is recommended to attach other strength calculations and flow calculations and analyses to the construction plan, insofar as they provide additional proof of the emergency power machine's conformity to requirements. [2020-01-20]

623. The initial data for the calculations shall be the most unfavourable combinations of loads and conditions that the emergency power machine may encounter. The result acceptance criteria shall be values that allow the emergency power machine to remain reliably operable under design basis operational conditions. [2020-01-20]

624. The calculations shall indicate the standards applied, loads and material properties used as initial data, calculation methods, visualised results, acceptance criteria, and conclusions. [2014-05-07]

6.6 Operating experience and type test data

625. The construction plan shall present the necessary delivery references and type test records that make possible the assessment of the manufacturer and subcontractors' readiness to make the delivery and the suitability of the emergency power machine submitted for approval. [2020-01-20]

626. Acceptable delivery references shall include emergency power machines whose design parameters, design bases and design solutions correspond to the emergency power machine submitted for approval. At a minimum, the construction plan shall present the emergency power machines' type markings, design parameters, numbers, years of delivery, and clients. The inclusion of start-up and operating statistics, operating conditions and other similar operating experience history in the information is recommended. [2020-01-20]

626a. Acceptable type test records are those that present the testing results of an emergency power machine that is similar in terms of the design values and solutions. With the report results, it shall be possible to unambiguously confirm the conformity of the emergency power machine to be accepted. [2020-01-20]

627. Removed. [2020-01-20]

6.7 Inspection plan and instructions

628. An inspection plan concerning the inspections and testing performed during the manufacturing of the emergency power machine shall be appended to the construction plan. [2020-01-20]

629. The inspection plan shall present the inspections and testing conducted on the emergency power machine's structural materials, parts and the finished emergency power machine. The following shall be presented for each inspection/testing target:

- identification data (heat, serial and part number, drawing number, structural material, etc.)
- description of the inspection or testing
- inspection or testing procedure reference
- reporting procedure (inspection report, certificate, etc.)
- supervisory parties (witness or hold point).

[2020-01-20]

630. The reference instructions shall define the scope of inspection and testing, the result acceptance criteria, and the methods, equipment and tester qualification requirements.

[2014-05-07]

631. The scope and acceptability criteria of the functional tests (factory tests) to be conducted on the emergency power machine shall be presented in the construction plan. [2020-01-20]

632. The inspection and testing scope of a diesel engine generator's parts shall correspond to Tables 5-1 and 5-3 of standard KTA 3702 [4]. [2020-01-20]

633. Removed. [2020-01-20]

634. The inspections and tests of a gas turbine generator's structural materials and parts shall be based on the requirements of standard API 616 [5] (turbine) and Table 5-3 of standard KTA 3702 [4] (generator). [2014-05-07]

635. The inspection and testing scope of a gas turbine generator's structural materials and parts shall be in proportion to the part's significance for the operability of the gas turbine generator. The inspections and tests of the shafts, guide vanes and rotary blades shall be confirmed [8] with a 3.1 certificate in safety class 2 and with a 2.2 certificate in safety class 3. [2014-05-07]

636. The operation of each emergency power machine shall be tested at the factory prior to transport. The factory tests of diesel engine generators shall be based on standard KTA 3702 [4], while the tests of gas turbine generators shall be based on standard ASME PTC 22 [6]. [2020-01-20]

637. The inspection plan shall determine the extent to which the emergency power machine is disassembled after a factory test and which parts are available for visual inspection at this time. [2020-01-20]

638. Factory tests shall be primarily conducted with the emergency power machine's final installation assembly. When deviating from this requirement, the use of some other test assembly shall be justified in order to achieve corresponding certainty on the conformity of the emergency power machine. [2020-01-20]

6.8 Status summary of the construction plans and suitability assessments of other structures and components part of the emergency power supply

639. If the construction plans and preliminary suitability assessments of the emergency power supply's other (than the emergency power machine's) structures and components are not submitted at the same time, their submittal plan shall be included in the construction plan of the emergency power machine. The plan including all structures and components of the emergency power supply shall present the service place, safety class, manufacturer and the delivery time of the construction plan or preliminary suitability assessment to STUK or an AIO. [2020-01-20]

7 Type test

701. The conformity of the emergency power machine's design solutions shall have been demonstrated with a type test that allows confirming the emergency power machine's required performance. A new type test is not needed if conformity can be demonstrated with a previously conducted type test. [2020-01-20]

702. The type test of a diesel engine generator shall be performed according to the type test requirements laid down in standard KTA 3702 [4]. [2014-05-07]

703. The type test of a gas turbine generator shall be performed as an endurance test of at least 100 hours using the power levels that are the design basis of the gas turbine generator. The test scope shall be based on standard "ASME Performance Test Codes 22" [6]. [2020-01-20]

704. The type-tested emergency power machine shall correspond in view of performance characteristics, structure and materials to the emergency power machine being approved with the type test. [2020-01-20]

705. When a type test is conducted on the emergency power machine in connection with procurement, a type test plan shall be prepared to describe the test arrangements and conditions, to set the acceptability criteria for the results and to present the control scope of STUK or an AIO. The licensee shall apply for approval for the type test plan before the type test is conducted and submit the type test results report for information before the emergency power machine is installed. [2020-01-20]

706. The demonstration of conformity to requirements of the emergency power machine's electrical and I&C equipment shall meet the requirements set forth in Guide YVL E.7. [2020-01-20]

8 Manufacture

801. The emergency power machine shall be manufactured and the quality of manufacture supervised in accordance with an approved construction plan and an inspection plan part thereof. [2020-01-20]

802. Prior to commencement of manufacturing, the licensee shall ensure that the manufacturer has the administrative and technical preparedness to operate in conformity to all requirements, and that the manufacturer has available an approved construction plan and the decision pertaining to it. [2014-05-07]

803. The machinery and equipment used for manufacturing shall support the achievement of the required quality level. The machinery and equipment shall be tested at regular intervals and calibrated in a manner required under the manufacturer's quality management system. The test results shall be recorded and presented upon request. [2014-05-07]

804. Structural materials for which a batch-specific material certificate is required shall be identifiable and traceable from their individual melting batches up to the completed structure. [2014-05-07]

805. The manufacturer shall identify non-conformities discovered during manufacturing, determine their causes, estimate their significance, and perform the corrective actions. The licensee shall seek approval from STUK or an AIO for any non-conformities that remain in the structures and components of the emergency power machine and that have a significant impact on operability. Requirements for the management of non-conformities are set forth in Guides YVL A.3 and YVL A.5. [2020-01-20]

806. The manufacturer shall create manufacture result documentation by compiling the testing, inspection and supervision protocols that have been prepared according to an approved inspection plan during manufacturing. The reception certificates of the materials and welding consumables, the qualification certificates of the personnel, the non-conformity reports processed, and other records created during manufacturing, the supervision of manufacturing, and testing shall be included in the result documentation. [2014-05-07]

807. The licensee shall ensure that the manufacturer assembles and submits to the licensee the manufacture result documentation and the installation, operating, and maintenance instructions before the emergency power supply is taken into use at the nuclear facility. [2014-05-07]

9 Construction inspection

901. The licensee shall request from STUK or an AIO a construction inspection to establish the acceptability of the emergency power machine's manufacturing documentation, to conduct the inspections and to witness the tests in the scope of the approved inspection plan. [2020-01-20]

901a. The construction inspection shall establish evidence that the emergency power machine's materials, manufacturing, structures and operation are in compliance with the construction plans. The construction inspection shall be conducted on each emergency power machine of the delivery batch. [2020-01-20]

902. During the construction inspection, an inspector from STUK or an AIO shall have access to an approved construction plan, any modification documents, and the approval decisions pertaining to them. The construction plan's reference documents that have not been appended to the construction plan shall also be presented upon request. [2020-01-20]

903. In the construction inspection, the inspectors shall be provided with the necessary prerequisites to perform the inspection (accessibility, lighting, calibrated measuring instruments and auxiliary devices as well as the necessary assisting personnel). [2014-05-07]

904. At the construction inspection, the licensee shall present

- the necessary regulatory approvals (testing organisations, manufacturer)
- systematically compiled and licensee-approved documentation, including the manufacturing records in the scope specified in the inspection plan

and arrange in the scope specified by the inspection plan

- structural inspection (visual quality inspection, dimension inspections, verification of part identification markings)
- supervision of factory tests.

[2020-01-20]

905. Factory tests shall be conducted in accordance with the approved procedures.

[2020-01-20]

905a. Factory tests belonging to the construction inspection cannot begin until an inspector of STUK or an AIO has confirmed testing readiness. [2020-01-20]

906. After the factory tests, the emergency power machine shall be disassembled in order to inspect the condition of the parts within the scope that has been approved during the

processing of the construction plan. [2020-01-20]

907. If the emergency power machine or parts thereof that have a significant impact on the emergency power machine's operability are repaired or modified, or if any parts other than disposable wearing parts are replaced after the factory tests, the conformity to requirements of the machine unit shall be verified by repeating the factory tests. [2020-01-20]

908. Removed. [2020-01-20]

909. The construction inspection shall have been acceptably performed before the emergency power machine is moved to the site of installation, unless otherwise agreed during the processing of the construction plan. [2020-01-20]

910. Removed. [2020-01-20]

10 Installation

1001. The licensee shall perform a reception inspection on the emergency power machine upon its arrival to the nuclear facility. [2020-01-20]

1002. The licensee shall present a construction plan for the machine unit's installation. The installation construction plan shall present the following:

- the procedures, drawings, and part lists required for the installation
- an inspection plan
- the inspection procedures.

[2020-01-20]

1002a. The emergency power machine's installation inspection plan shall contain the inspections and their procedures that enable reliable verification of the conformity of the installation. [2020-01-20]

1003. The licensee shall seek approval for the installation construction plan before the emergency power machine is installed. [2020-01-20]

1004. The licensee shall request from STUK or an AIO an installation construction inspection of the emergency power machine to establish the acceptability of the installation documentation and to conduct the inspections in the scope of the approved inspection plan. [2020-01-20]

1004a. The installation construction inspection shall establish evidence that the emergency power machine's installation work and its quality control have been performed according to the installation construction plan. [2020-01-20]

1005. The licensee shall present an approved installation construction plan and the processing status of the preliminary suitability analysis of the electrical and I&C equipment at the installation construction inspection event. The construction plan's reference documents that have not been appended to the construction plan shall also be presented upon request.

[2020-01-20]

1006. The installation construction inspection shall have been acceptably performed before the commissioning inspection of the emergency power machine. [2020-01-20]

1007. Removed. [2020-01-20]

11 Commissioning

1101. The licensee shall request from STUK or an AIO commissioning inspections to demonstrate the readiness of the emergency power machine for a test run and operation. The licensee is responsible for the availability of the documents and records required in the inspection. [2020-01-20]

1102. The first phase of the commissioning inspection verifies that

- the emergency power machine's construction plans and , construction inspections and installation construction inspections have been approved
- the preliminary and final suitability assessments of the electrical and I&C equipment have been processed according to the submittal method specified in Guide YVL E.7
- the licensee has successfully conducted the licensee's installation inspection of the electrical and I&C equipment
- the emergency power machine's test run plan has been prepared
- the operating and maintenance procedures of the emergency power machine are available for use
- the emergency power machine's process interfaces comply with the approved system design
- there are no obstacles to the safe operation, inspection and maintenance of the emergency power machine.

[2020-01-20]

1102a. The test run requires a test run plan which enables the performance of the test run in a manner yielding evidence on the required performance of the emergency power machine. The test run plan, which may be a separate document or it can be included in a process system's commissioning plan, shall present the test and measurement arrangements, test phases and result acceptance criteria. [2020-01-20]

1103. In the second phase of the commissioning inspection, the test run of the emergency power machine is conducted in compliance with the test run plan. It is verified from the test run records and by witnessing the test run that

- the licensee has acceptably completed the licensee's commissioning inspection of electrical and I&C equipment
- the test run has been completed in a scope complying with the test run plan and the results are acceptable

- there are no non-conformances preventing the commencement of operation.

[2020-01-20]

1104. The test run of a diesel engine generator at the nuclear facility shall be based on the testing requirements of standard KTA 3702 [4]. The test run of a gas turbine generator shall apply the principles of the same standard. [2020-01-20]

1105. Removed. [2020-01-20]

1106. The first stage of the commissioning inspection shall have been acceptably performed before commissioning testing is started. [2014-05-07]

1107. Both phases of the commissioning inspection shall be acceptably conducted before an emergency power machine operating licence is granted. An operating licence can be granted for a fixed period, if the operation of the emergency power machine is safe regardless of the shortcomings preventing the granting of a permanent operating licence. [2020-01-20]

1108. Removed. [2020-01-20]

12 Operation, condition monitoring, and maintenance

1201. The emergency power machine's operating parameters and load, process and environmental conditions shall be monitored, and they shall be maintained within the limits of design basis operational conditions. Unnecessary loads and unfavourable operating conditions shall be avoided. [2020-01-20]

1201. The emergency power machine shall reliably maintain its operability over the maintenance interval in all design basis operation. Overhaul need or failure shall be detected before any significant safety risk is caused by debilitation or loss of emergency power machine operability. [2020-01-20]

1203. The fuel of the emergency power machine must not react in such a way or contribute to such chemical, biological and other mechanisms that may impair the operability of the emergency power machine or other structures and components. [2020-01-20]

1204. The manufacturer of the emergency power machine shall define the requirements for the chemical analysis and other characteristics of the fuels and lubricants that are suitable for the emergency power machine. The licensee shall separately seek approval from the manufacturer of the emergency power machine for the applicability of a fuel or lubricant that deviates from these requirements. [2020-01-20]

1205. The impact of the storage conditions at the site location and the storage time on the properties of the fuel shall be known. If properties of the fuel can be altered by the storage conditions or storage time, samples shall be collected from the fuel at regular intervals to test its suitability. The tests (scope, intervals) shall be implemented in a manner that makes possible the retention of the fuel's properties within acceptable limits until next sampling takes place. [2020-01-20]

1206. Programmes shall be prepared for the condition monitoring and maintenance of the emergency power machine. These programmes (maintenance work, inspections and tests) shall be based the manufacturer's recommendations or the licensee's own operating experiences or experiences gained from other nuclear facilities. They shall be regularly assessed and any observed needs for changes shall be analysed. [2020-01-20]

1207. The programmes for the condition monitoring and maintenance of the emergency power machine shall define the following:

- periodic maintenance, inspections and tests
- acceptance limits for inspections and tests

- need for spare parts and materials.

[2020-01-20]

1208. Removed. [2020-01-20]

1209. If a maintenance work is not part of the emergency power machine's maintenance programme, it shall be considered to be a repair work that requires a repair plan prepared by the licensee. However, no repair plan shall be required for such repair work that only includes replacing parts with approved spare parts and that involves no special processes.

[2020-01-20]

1209a. The repair plan shall include justifications for the acceptability of the repair method and all data related to the completion of the work and quality control that are needed to verify the conformity of the repaired emergency power machine and that typically include a description of the repair method, illustrative drawings and an inspection plan covering manufacturing, installation and commissioning. [2020-01-20]

1210. The licensee shall seek approval for the repair plan of a structure or component of the emergency power machine before the repair work is started. [2020-01-20]

1211. The licensee shall request from STUK or an AIO a repair work construction inspection to establish the acceptability of the repair work documentation, to conduct the inspections and to witness the tests in compliance with the approved construction plan. The repair work construction inspection shall be acceptably conducted before the operation (setting into standby) of the emergency power machine. [2020-01-20]

13 Modifications

1301. No modification of the emergency power machine shall negatively affect the safety of the nuclear facility or the prerequisites for the condition monitoring or maintenance of the emergency power machine. The acquisition of a spare part that is significant in terms of operability is also considered a modification whenever the structure or material of the spare part differs from the original. [2020-01-20]

1302. Removed. [2020-01-20]

1303. The licensee shall draw up an emergency power machine modification construction plan. The construction plan shall include justifications for the acceptability of the modification and all data related to the implement and quality control that are needed to verify the conformity of the modified emergency power machine and that typically include a description of the modification, applicable calculations, illustrative drawings and an inspection plan covering manufacturing, installation and commissioning. [2020-01-20]

1304. The need for any updates to drawings, procedures, and other documents that are required due to the modification of the emergency power machine shall be established, and the updates shall be made without delay after the modification work. It shall be ensured that the operation and maintenance organization is aware of any impact of the modification on the operation, condition monitoring and maintenance of the emergency power machine. [2020-01-20]

1305. Removed. [2020-01-20]

1306. The licensee shall seek approval for the modification construction plan of the emergency power machine before the modification is started. Approved system-level design bases, if they are changed in connection with the modification of the emergency power machine, are a prerequisite for the processing of the construction plan. [2020-01-20]

1307. The licensee shall request from STUK or an AIO a modification construction inspection to establish the acceptability of the modification documentation, to conduct the inspections and to witness the tests in compliance with the approved construction plan. The construction inspection of the modification shall have been acceptably performed before the operation (setting into standby) of an emergency power machine. [2020-01-20]

14 Regulatory oversight by the Radiation and Nuclear Safety Authority

14.1 General

1401. The regulatory oversight by STUK or an AIO shall comprise the approvals of the plans for the emergency power supply at a system and component level, and the inspections performed during manufacturing, installation, commissioning and operation in the manner described herein. [2020-01-20]

1402. STUK may grant inspection rights in accordance with Guide YVL E.1 to an AIO it has approved. Appendix A defines the principles for the division of inspection responsibilities between STUK and an AIO, which can be supplemented by STUK's decisions. The same party shall inspect all emergency power parts regardless of, e.g., a possible part-specific classification based on its safety significance. [2020-01-20]

1403. STUK or an AIO shall make a decision concerning its processing of a plan. Approving decisions may also present requirements and deadlines for the responses required in them. [2020-01-20]

1404. Removed. [2020-01-20]

1405. The licensee shall invite STUK or an AIO to the plant or factory inspections at least 7 days prior to the inspection, however, so that there is sufficient time to prepare for the inspection and to make the necessary travel arrangements [2020-01-20]

1405a. The licensee shall justify and ensure to STUK or an AIO the acceptability of the submitted documents in advance with the help of its own inspections. In the same way, the licensee shall ensure preconditions for the performance of the inspections in accordance with the inspection invitation at the plant and factory inspections. [2020-01-20]

1406. STUK or an AIO draws up a record of their inspections describing the inspection object and itemising the inspections and tests conducted. Potential requirements presented in connection with the inspections are entered in the record together with the due dates or times of the measures given in the requirements. [2020-01-20]

1407. The record is closed and the inspector hands over the signed record to a representative of the licensee once all the specified inspections have been completed and any requirements entered in the record have been resolved. [2020-01-20]

14.2 Third-party approval

1408. A notified body or a recognised third-party organisation pursuant to the Pressure Equipment Directive [12] may, within the scope of their areas of qualification without separate approval, operate as a third party that witnesses and confirms sampling, destructive and non-destructive testing and qualifications. In addition to these, also other accredited certification bodies shall be accepted. In such a case, the accreditation shall be covered by the Multilateral Agreements (MLA) or Mutual Recognition Arrangements (MRA) entered into by FINAS and the accreditation shall be conducted against the requirements of Standard EN ISO/IEC 17020, 17021, 17024 or 17065. [2020-01-20]

1409. The expertise of a third-party performing manufacturing control is evaluated on the basis of an analysis appended to the construction plan. [2014-05-07]

14.3 Safety analysis report

1410. STUK processes the preliminary and final safety analysis report of a new nuclear facility. The preliminary safety analysis report includes the initial data for the further design of the emergency power supply's emergency power machine and other structures and components as well as descriptions for the safety-classified systems of the emergency power supply. The requirements regarding the content and delivery time of the safety analysis reports are presented in Guide YVL B.1. [2020-01-20]

14.4 Construction plan

1411. STUK or an AIO processes the construction plan of the emergency power machine and makes a decision on it. Approved emergency power machine design bases at system level are the prerequisite for a construction plan review. [2020-01-20]

14.5 Control of manufacturing, and construction inspection

1412. STUK or an AIO can oversee emergency power machine manufacturing by means factory visits during manufacturing before the emergency power machine's final construction inspection. [2020-01-20]

1413. STUK or an AIO conducts a construction inspection, as specified in this Guide, on completed emergency power machines. [2020-01-20]

14.6 Oversight of the type test

1414. If a type test is conducted on an emergency power machine in connection with procurement, STUK or an AIO reviews the type test plan, witnesses the performance of the type test and assesses the test results. [2020-01-20]

14.7 Installation control and the construction inspection

1415. STUK or an AIO processes the emergency power machine's installation construction plan submitted by the licensee, which shall include the documents specified in this Guide. [2020-01-20]

1416. STUK or an AIO performs the emergency power machine installation construction inspection in the manner defined in this Guide. [2020-01-20]

1417. Removed. [2020-01-20]

14.8 Commissioning inspection

1418. Removed. [2020-01-20]

1419. STUK or an AIO performs the two-stage commissioning inspection on the emergency power machine as specified in this Guide. [2020-01-20]

1420. Removed. [2020-01-20]

14.9 Operation, condition monitoring and maintenance

1421. STUK supervises the operation, condition monitoring and maintenance of an emergency power machine of a nuclear facility during the inspections that are part of its in-service inspection programme, and during other inspections it performs. This supervision shall also apply to related procedures and plans. [2020-01-20]

1422. STUK or an AIO reviews the emergency power machine's repair plan submitted by the licensee and issues a decision on it. A plan for a minor routine repair work under the responsibility of STUK may be submitted for approval by a STUK inspector at the plant site. [2020-01-20]

1423. STUK or an AIO performs the repair work construction inspection within the scope defined in the repair work inspection plan. [2020-01-20]

1424. STUK or an AIO reviews the inspection and testing protocols and feedback information of the emergency power machine's maintenance work (service, overhaul and repairs). If an

emergency power machine is disassembled during maintenance, STUK or an AIO performs a visual inspection of the parts before it is reassembled. [2020-01-20]

1425. Removed. [2020-01-20]

14.10 Modifications and replacement work

1426. STUK processes the plan for principles of any modifications or replacement work of the emergency power supply. The plan for principles includes the initial data for the further design of modification or replacement work for the emergency power supply's emergency power machine and other structures and components. The requirements for the content and delivery time are presented in Guide YVL B.1. [2020-01-20]

1427. STUK or an AIO reviews the emergency power machine's modification construction plan and issues a decision on it. Approved system level design bases of the emergency power machine are a prerequisite for the processing of the modification construction plan.
[2020-01-20]

1428. STUK or an AIO performs the modification construction inspection within the scope defined in the modification inspection plan. [2020-01-20]

1429. Removed. [2020-01-20]

15 ANNEX A Scope of control and division of inspection responsibilities for emergency power supplies

| Approval or control AIO=authorised inspection organisation | Safety class | |
|---|--------------|------|
| | 2 | 3 |
| Design | | |
| Design bases ¹⁾ | STUK | STUK |
| Systems design | STUK | STUK |
| Construction plan | STUK | AIO |
| Manufacture | | |
| Supervision during manufacture | STUK | AIO |
| Construction inspection | STUK | AIO |
| Supervision of type tests | STUK | AIO |
| Installation and commissioning | | |
| Installation construction plan | STUK | AIO |
| Installation construction inspection | STUK | AIO |
| Commissioning inspection | STUK | AIO |
| Maintenance, repairs and modifications | | |
| Maintenance work inspection | STUK | AIO |
| Plan for repairs and modifications | STUK | AIO |
| Inspection of repairs and modifications | STUK | AIO |

¹⁾ Together with the preliminary safety analysis (new construction project) or plan for principles (modification).

[2020-01-20]

16 References

1. Nuclear Energy Act (990/1987). [2014-05-07]
2. Removed. [2020-01-20]
3. Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018). [2020-01-20]
4. KTA 3702 (2014-), Emergency Power Generating Facilities with Diesel-Generator Units in Nuclear Power Plants. [2020-01-20]
5. API Standard 616 5th Edition, Gas Turbines for the Petroleum, Chemical and Gas Industry Services. [2014-05-07]
6. ASME Performance Test Codes 22, Gas turbines. [2014-05-07]
7. Pressure Equipment Directive 2014/68/EU. [2020-01-20]
8. SFS-EN 10204 Metallic products. Types of inspection documents. [2014-05-07]
9. Chemicals Act (599/2013). [2020-01-20]
10. Act on the Safe Handling of Dangerous Chemicals and Explosives (390/2005). [2020-01-20]
11. Government Decree on the control of handling and storage of dangerous chemicals (855/2012). [2020-01-20]

Definitions

Authorised inspection body (AIO)

Authorised inspection body shall refer to an independent inspection organisation approved by the Radiation and Nuclear Safety Authority under Section 60 a of the Nuclear Energy Act to carry out inspections of the pressure equipment, steel and concrete structures and mechanical components of nuclear facilities in the capacity of an agency performing public administrative duties. (Nuclear Energy Decree 161/1988, in Finnish). Authorised inspection body and authorised inspection organisation have same meaning in YVL Guides.

Special process

Special processes shall refer to manufacturing processes, the results of which cannot be directly verified by means of a product inspection or testing after manufacture; instead, any shortcomings in the process may only appear later while the product is in use. Special processes include, for instance welding, forming and heat treatment.

Service life

Service life shall refer to the period of time beginning from the commissioning of the SSC fulfilling its operability requirements and ending when the degraded operability is not restored to the required level anymore.

Operability

Operability shall refer to the integrity and performance of SSC in conformance with its design bases.

Low energy equipment

Low energy equipment shall refer to Safety Class 2 equipment with a design pressure of up to 20 bar(g) and a design temperature of up to 120 °C and to which the design, dimensioning and quality-control requirements of a corresponding equipment from Safety Class 3 can be applied with technical justifications without having a risk to lose the operability of the equipment.

Modification (emergency power supply)

Modification shall refer to the alteration of an emergency power supply in such a manner that it no longer corresponds to the earlier designs. The acquisition of a spare part that is significant in terms of operability is also considered a modification whenever the structure or material of the spare part differs from the original.

Serially manufactured component

Serially manufactured component shall refer to a component which has not been designed particularly based on the customer's specification but it is procured from an existing product line of the manufacturer. Typically one is manufactured in large quantities, and can be used for other applications, too. Functionality, structure, dimensions, materials, manufacturing process and quality of the component do not essentially differ within and between production lots.

Type test

Type test shall refer to a test whose results can be used to ensure that the machine unit, or a part thereof, has been designed to meet the usage location-specific operability requirements.

Witness point

Witness point shall refer to an inspection for which advance invitations have been sent to the parties defined in the inspection plan but whose supervision is not a condition for proceeding with the work. Having received the invitation, the invited parties may, however, separately require that they be present in order for the work to be continued.

Spare part

Spare part shall refer to a back-up part for an SSC that can be used to restore the reduced or lost operability to the required level.

Varavoimakone (emergency power machine)

Emergency power machine shall refer to a diesel engine or gas turbine without a generator.

Emergency power supply

Emergency power supply shall refer to a system consisting of a diesel engine or a gas turbine and a generator and all systems, structures and components required for its start-up and operation. Whenever a specific part of an emergency power supply is discussed in this Guide, it is mentioned separately.

Hold point

Hold point shall refer to an inspection for which advance invitations have been sent to the parties defined in the inspection plan and whose supervision is a condition for proceeding with the work unless the parties have given written permission to proceed without their presence.