

# EMERGENCY POWER SUPPLIES OF A NUCLEAR FACILITY

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With regard to new nuclear facilities, this Guide shall apply as of 1 September 2014 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. The Guide replaces Guide YVL 5.1.

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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 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.*



## 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.

**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 that the Radiation and Nuclear Safety Authority (STUK) applies to control that the requirements are followed.

**103.** The legal basis of this Guide are the following decrees:

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.*

In accordance with Section 14(6) of Government Decree 717/2013 [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.*

According to Section 4(2) of Government Decree 717/2013 [3], *the systems, structures and components that implement or are related with safety functions shall be designed, manufactured, in-*

*stalled and used so that their quality level and the assessment, inspections and tests, including environmental qualification, required to verify their quality level, are sufficient considering the safety significance of the item in question.*

**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), the Act on the Safe Handling of Dangerous Chemicals and Explosives (390/2005), and Government Decree 855/2012 issued by virtue of the two Acts shall be applied in addition to the provisions of this Guide.

## 2 Scope of application

**201.** This Guide applies to safety class 2 and 3 systems, structures and components of emergency power supplies of nuclear facilities throughout their service lifetime. The requirements laid down in the Guide apply to licensees and the manufacturers of structures and components of diesel engine generators and gas turbine generators intended to be used as emergency power supplies in safety classes 2 and 3.

**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.

**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.

**204.** The requirements for electrical and instrumentation and control equipment of emergency power supplies are presented in Guide YVL E.7,

Electrical and I&C equipment of a nuclear facility.

**205.** The requirements set for the licensee's and suppliers' management system processes and functions are presented in Guide YVL A.3, Management system for a nuclear facility.

**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.

**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.

**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.

### **3. Safety analysis report and plan for principles**

**301.** The licensee shall draw up the descriptions laid down in the requirements of Guide YVL B.1 of the emergency power supply in the preliminary safety analysis report of a new nuclear facility. The descriptions shall be updated in the final safety analysis report.

**302.** The licensee shall draw up a plan for principles pursuant to the requirements of Guide YVL B.1 for modifications and renovations to the emergency power supply that involve altering the design bases of the structures or components of the emergency power supply, modifying its systems, or replacing the entire emergency power supply.

**303.** The preliminary safety analysis report and the plan for principles shall describe the system design of the emergency power supply in such a final form that there will be no need to essentially alter the design bases of the safety class 2 or 3 structures and components.

### **4 Manufacturer**

**401.** The manufacturer of the machine unit shall have in place an appropriate, certified or similar management system which has been independently audited by a third party. In addition, in safety class 2 the manufacturer of the machine unit shall meet the requirements set on the management system in Guide YVL A.3.

**402.** The manufacturer shall employ professional, experienced personnel, and the methods, tools and equipment required for the activities.

**403.** The manufacturer 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.

**404.** Whenever special processes are used in the manufacture of pressure equipment, 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.

**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 authorised inspection body may require that the applicability of the manufacturing procedures be verified using pre-manufacturing performance tests or production tests conducted as part of manufacturing.

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

assembly of the machine unit, the manufacturer shall ensure that the structures and components manufactured meet these requirements.

## 5 Design

**501.** The emergency power supply shall meet the design bases that have been set as the emergency power supply's requirements in normal operation and during anticipated operational occurrences, postulated accidents, design extension conditions and severe reactor accidents (design basis operational conditions). The requirements for the design bases and system design of emergency power supplies are presented in Guide YVL B.1.

**502.** In the nuclear facility's safety analysis reports, the plan for principles of the repair or modification work 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.

**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.

**504.** The machine unit's structural materials and coating shall withstand the stresses caused by design basis operational conditions. Choice of materials shall ensure that operability is not affected by corrosion, erosion or other similar detrimental phenomena.

**505.** The structural materials and coating of the machine unit's parts that are important in terms of operability shall be standardized 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.

**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.

**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.

**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.

**509.** The emergency power supply shall be able to generate continuous short-circuit current to meet the selectivity requirements of the electrical system.

**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.

**511.** If the emergency power supply uses commercial-grade parts, 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.

**512.** It shall be possible to monitor, inspect and maintain the systems, structures and components of the emergency power supply that belong to safety classes 2 and 3 in order to detect any need for repair before failures occur, and to keep the duration of service and repair work short. During the design phase, this can be promoted by means of equipment design, placement design and process design, instrumentation, and choice of materials.

**513.** The emergency power machine unit 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.

**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.

**515.** The margins between the excitations (internal and external) and nominal frequencies and/or the damping of the structures of the machine unit shall be sufficient in order for the machine unit to remain reliably operable under all design basis operational conditions.

**516.** Opposite phase synchronisation of the machine unit shall be prevented, or the machine unit shall remain operable during opposite phase synchronisation.

**517.** Starting an emergency power supply and connecting loads shall be possible during any loss of external electric power after the machine unit has been repaired or replaced.

**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)

## 6 Construction plan

**601.** The licensee shall present a machine unit construction plan that includes the following:

- the licensee's summary of justifications
- a preliminary suitability analysis of the electrical and I&C equipment

- a manufacturer report
- the design bases
- the design data
- the design analyses and studies
- the operating experience
- the inspection plan and instructions
- an status summary of the construction plans of other structures and components of the emergency power supply.

A corresponding construction plan shall also be presented for spare part acquisitions that are significant in terms of the machine unit's operability if the structure or material of the spare part is changed.

**602.** The licensee shall seek approval for the construction plan before the manufacture of the machine unit is started.

**603.** If the construction plan is changed later, the licensee shall seek approval for the changes. Minor changes may be submitted for information.

**604.** The requirements for the approval of the construction plans of emergency power supplies' structures and components other than the machine unit are presented in the appropriate E series YVL Guides.

### 6.1 Summary of justifications

**605.** The machine unit construction plan shall contain a summary of justifications where the licensee presents the scope, results and acceptance criteria of its own inspection. The summary of justifications shall use the information contained in the construction plan to justify why:

- the manufacturer and its subcontractors have the readiness for a delivery
- the design bases correspond to the requirements posed by its service place and operating conditions
- calculations, operating experience and type tests demonstrate fulfilment of the design criteria
- manufacturing quality can be extensively verified by inspections and testing conducted on the structural materials, parts and the machine.

**606.** The justifications shall make reference to individual documents in the construction plan, and to their page numbers if the documents are extensive.

**607.** The summary of justifications shall name the testing organizations and third parties (or the planned alternatives, if they have not been selected yet) performing control of manufacturing or destructive or non-destructive testing on the machine unit's structural materials or components. A status summary of the approvals of testing organizations shall also be provided.

## 6.2 Preliminary suitability analysis of electrical and I&C equipment

**608.** A preliminary suitability analysis of the machine unit's electrical and I&C equipment pursuant to Guide YVL E.7 shall be included in the construction plan.

## 6.3 Manufacturer report

**609.** A manufacturer report that contains information concerning the machine unit manufacturer's organisation, operations, the qualifications of personnel and manufacturing methods, copies of valid certification decisions and the manufacturer's recent delivery references shall be appended to the construction plan.

**610.** A manufacturer report shall also be provided on subcontractors or optional 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.

## 6.4 Design basis

**611.** The construction plan shall present the machine unit'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 machine unit by the nuclear facility, service place and operational conditions.

## 6.5 Design data

**612.** The construction plan shall present the machine unit's design parameters and technical specification. This information shall make it possible to estimate whether the machine unit 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 machine unit.

**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.

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

## 6.6 Design analyses and studies

**615.** The construction plan shall present the generator-specific calculations of active and reactive power, including the house loads for the emergency power supply and the power losses in the system, in various connection configurations and under various loads. The results shall indicate the nominal power of the loads, and the input power of start-up and continuous operation.

**616.** The load calculations shall come with an analysis of the emergency power supply's load connection/disconnection automation.

**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.

**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.

**619.** An analysis of the machine unit's vibration (torsional and bending vibration of the rotor, vibration of the foundations) or a similar analysis that may be used to demonstrate the acceptability of the vibration behaviour shall be presented.

**620.** If opposite phase synchronization has not been reliably prevented, opposite phase synchronization shall be a design basis and strength analyses shall be used to demonstrate the operability of the machine unit after a possible event.

**621.** For commercial-grade parts, evidence of their operability being retained under design basis operational conditions shall be presented. This shall be accomplished by means of product data, dimensioning forms, operating experience or other reports confirming the conformity to requirements of the commercial-grade part.

**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 machine unit's conformity to requirements.

**623.** The initial data for the calculations shall be the most unfavourable combinations of loads and conditions that the machine unit may encounter. The result acceptance criteria shall be values that allow the machine unit to remain reliably operable under design basis operational conditions.

**624.** The calculations shall indicate the standards applied, loads and material properties used as initial data, calculation methods, visualised results, acceptance criteria, and conclusions.

## **6.7 Operating experience**

**625.** The construction plan shall present the necessary delivery references that make possible the assessment of the manufacturer's and subcontractors' readiness to make the delivery and the suitability of the machine unit submitted for approval.

**626.** Acceptable delivery references shall include machine units whose design parameters, design bases and design solutions correspond to the machine unit submitted for approval. At a minimum, the construction plan shall present the machine units' 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.

## **6.8 Manufacturing procedures**

**627.** Whenever special processes are used in the manufacturing of the machine unit's pressure-bearing or load-bearing parts, the applicable manufacturing procedures and qualification information shall be appended to the construction plan. This requirement shall also apply to surface welding of sealing surfaces and guide surfaces.

## **6.9 Inspection plan and instructions**

**628.** An inspection plan concerning the inspections and testing performed during the manufacturing of the machine unit shall be appended to the construction plan.

**629.** The inspection plan shall list the inspections, tests and other supervision that the structural materials, parts and the machine unit are subjected to, such as:

- part identification information and references to drawings
- structural material (standard labelling and requirement for a material certificate)

- reference information for the instruction/standard followed during the inspection/test
- parties performing the inspection/test
- records for the inspection/test (reporting requirements)
- hold points and witness points (STUK, authorised inspection body, licensee, third party, others).

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

**631.** The procedures for the factory tests of the machine unit and the NDT testing performed during the manufacturing of the machine unit's parts shall be appended to the construction plan. NDT procedures shall be presented for the crankshaft, connecting rod, generator shaft and the shafts and vanes of the compressor and the turbine.

**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]. The results of the inspections and tests in Table 5-1 shall be confirmed [8] as follows:

- all parts of a safety class 2 diesel engine using 3.1 certificates
- for safety class 3 diesel engine parts, the certificate requirements are provided in the table; however, 2.2 certificates are required in lieu of 2.1 certificates (manufacturing method-specific test results must be indicated).

**633.** The structural material of a diesel engine generator shaft and body shall be verified with a 3.1 certificate [8] in safety class 2 and with a 2.2 certificate [8] in safety class 3.

**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).

**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.

**636.** The operation of each machine unit 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].

**637.** The inspection plan shall determine the extent to which the machine unit is disassembled after a factory test and which parts are available for visual inspection at this time.

**638.** Primarily, the type tests and factory tests shall be performed using the machine unit's own parts; in other words, the configuration in which it will be installed at the nuclear facility. If this rule is not followed, the test configuration shall be presented in the inspection plan; justification shall also be provided concerning how the conformity to requirements of the emergency power supply can be demonstrated using in the tests parts that are not the machine unit's own.

## **6.10 Status summary of the construction plans of other structures and components part of the emergency power supply**

**639.** If the construction plans of the emergency power supply's structures and components are not submitted in one batch, the machine unit's construction plan shall include a summary concerning the other structures and equipment of the emergency power supply for which a construction plan or a preliminary suitability analysis has already been submitted, or will be submitted, to STUK or an authorised inspection body. The summary that covers all the structures and components of the emergency power supply shall, at a minimum, list the safety class, service location, manufacturer, and the delivery time of the construction plan.

## 7 Type test

**701.** The conformity to requirements of the design solutions used in a machine unit shall be experimentally verified by means of a type test. A delivery-specific type test is not required if evidence of an earlier type test is provided in the construction plan of the machine unit. The type test requirements for the other structures and components of the emergency power supply are presented in the appropriate E series YVL Guides.

**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].

**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].

**704.** The machine unit which is/will be type-tested shall correspond to the machine unit submitted for approval in terms of its type, configuration, structure, materials and other design solutions.

**705.** A plan for the type test shall be drawn up and included in the construction plan or delivered separately. In both cases, the licensee shall seek approval for the type test plan before the type test is performed. The licensee shall submit the results report of the type test for information before the machine unit is installed.

**706.** The demonstration of conformity to requirements of the emergency power supply's electrical and I&C equipment shall meet the requirements set forth in Guide YVL E.7.

## 8 Manufacture

**801.** The machine unit shall be manufactured and the quality of manufacture supervised in accordance with an approved construction plan and an inspection plan part thereof.

**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.

**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.

**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.

**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 authorised inspection body for any non-conformities that remain in the structures and components of the emergency power supply 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.

**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.

**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.

## 9 Construction inspection

**901.** The licensee shall arrange for a construction inspection to be performed by STUK or an authorised inspection body; it shall be able to establish evidence that the materials, manufacturing, structures and operation of the machine unit are in compliance with the plans. In construction inspections performed on each machine unit, the manufacture result documentation is reviewed, visual inspections are performed, and factory tests are supervised.

**902.** During the construction inspection, an inspector from STUK or an authorised inspection body 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.

**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).

**904.** At the construction inspection, the licensee shall present the following:

- the necessary official approvals (testing organizations, manufacturer)
- systematically assembled result documentation that has been approved by the licensee and that includes the manufacture records (material certificates, testing, inspection and control protocols) to the extent defined in the inspection plan
- the processing status of the final suitability analysis of the electrical and I&C equipment pursuant to Guide YVL E.7

and, within the scope required under the inspection plan, arrange:

- a construction inspection (visual inspection, dimension inspections, verification of material identification markings)
- supervision of pressure tests, leak tightness tests, and functional tests.

**905.** The factory tests shall be performed by following approved procedures. The factory tests part of the construction inspection shall be conducted after the result documentation has been reviewed and the structure inspected when an inspector from STUK or an authorised inspection body has verified testing readiness.

**906.** After the factory tests, the machine unit 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.

**907.** If the machine unit or parts thereof that have a significant impact on the machine unit'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.

**908.** The final suitability analysis of the electrical and I&C equipment shall have been processed as laid down in Guide YVL E.7 before the construction inspection of the machine unit is concluded.

**909.** The construction inspection shall have been acceptably performed before the machine unit is moved to the site of installation, unless otherwise agreed during the processing of the construction plan.

**910.** The requirements for the construction inspections of the emergency power supplies' structures and equipment other than the machine unit are presented in the appropriate E series YVL Guides.

## 10 Installation

**1001.** The licensee shall perform a reception inspection on the machine unit prior to its storage and installation.

**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 parts lists required for the installation
- an inspection plan
- the inspection procedures.

The inspection plan shall cover the inspections used to reliably establish the conformity to requirements of the installation. Procedures shall exist for the inspections, and the procedure reference data shall be presented in the inspection plan.

The installation construction plan shall be submitted as a separate document or part of other documentation, such as the machine unit's manufacturing construction plan.

**1003.** The licensee shall seek approval for the installation construction plan before the machine unit is installed.

**1004.** The licensee shall arrange for an installation construction inspection to be performed by STUK or an authorised inspection body; it shall be possible to establish evidence that the installation of the machine unit and the quality control of the installation are in compliance with the installation construction plan.

**1005.** The licensee shall present an approved installation construction plan during the installation construction inspection. The construction plan's reference documents that have not been appended to the construction plan shall also be presented upon request.

**1006.** The installation construction inspection shall have been acceptably performed before the commissioning inspection of the machine unit.

**1007.** The installation-stage requirements for the emergency power supplies' structures and equipment other than the machine unit are presented in the appropriate E series YVL Guides.

## 11 Commissioning

**1101.** The licensee shall arrange for a commissioning inspection to be performed by STUK or an authorised inspection body used to establish, in two stages, the readiness of the machine unit for test run and operation.

**1102.** The first stage of the commissioning inspection shall verify the following:

- The machine unit's construction plans and construction inspections and the installation construction inspections have been approved, and the inspection history does not contain open issues that prevent commissioning testing.
- The machine unit's assembly and process connections follow the approved system design.
- Based on a visual inspection, placement is appropriate in terms of safe operation, inspectability and maintainability.
- The licensee has confirmed the conformity to requirements of the installation of the electrical and I&C equipment by providing an inspection report.
- The machine unit's test run plan has been approved.
- The operation and maintenance procedures are available.

The licensee shall make the documents and records required for the inspection available to the inspector.

**1103.** During the second stage, the operability of the machine unit shall be demonstrated by means of test run; a test run plan shall be in place that includes the following:

- the test arrangements and measurements
- the description and stages of test run
- the result acceptance criteria.

The test run plan may be a separate document, or it may be included in the commissioning plan of the process system (emergency power supply).

**1104.** Commissioning testing must be based on the requirements of standard KTA 3702 [4] concerning commissioning testing of a machine unit at the site location.

**1105.** The second stage of the commissioning inspection shall verify the following by means of records and supervision of commissioning testing:

- The licensee has confirmed the conformity to requirements of the commissioning of the electrical and I&C equipment by providing an inspection report.
- No non-conformities that prevent operation are discovered during the supervision.
- Commissioning testing has been completed within the scope indicated in the commissioning testing plan, and its results are acceptable.

**1106.** The first stage of the commissioning inspection shall have been acceptably performed before commissioning testing is started.

**1107.** Both stages of the commissioning inspection shall have been acceptably performed before an operating licence for the machine unit can be granted. The operating licence may also be granted for a fixed period of time when not all planned commissioning testing phases can be performed consecutively and the machine unit can be safely operated until the next commissioning testing stage.

**1108.** The commissioning-stage requirements for the emergency power supplies' structures and equipment other than the machine unit are presented in the appropriate E series YVL Guides.

## 12 Operation, condition monitoring, and maintenance

**1201.** The emergency power supply's load conditions, process conditions, and environmental conditions shall be monitored, and they shall be maintained within design basis operational conditions.

**1202.** The emergency power supply shall remain reliably operable in all design basis operational conditions during the service interval. Any need for maintenance shall be reliably detectable before a defect occurs, and defects shall be on-line monitored.

**1203.** The fuel of the emergency power supply must not react in such a way or contribute to such chemical, biological and other mechanisms that may impair the operability of the machine unit or other structures and components.

**1204.** The manufacturer of the machine unit shall define the requirements for the chemical analysis and other characteristics of the fuels and lubricants that are suitable for the machine unit. The licensee shall separately seek approval from the manufacturer of the machine unit for the applicability of a fuel or lubricant that deviates from these requirements.

**1205.** The impact of the storage conditions at the site location and the storage time on the properties of the fuel must be known. If properties of the fuel can be altered by the storage conditions or storage time, samples shall be collected from the fuel and the properties of the fuel tested at regular intervals. 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.

**1206.** Procedures shall be provided for the operation, condition monitoring and maintenance of the emergency power supply. The procedures (operating instructions as well as programmes and procedures for service, inspection, testing and sampling) shall be based on manufacturer recommendations, the licensee's own operating experience or operating experience from other nuclear facilities, and they shall be regularly evaluated. Any needs for change that are observed shall be analyzed.

**1207.** The procedures for the condition monitoring and maintenance of the emergency power supply shall define the following:

- work performed during periodic service

- condition monitoring methods
- the sequence of maintenance work, inspections and tests
- the acceptance limits for inspections and tests
- need for spare parts and materials.

**1208.** If special processes are used in the maintenance of pressure equipment of emergency power supplies, the operator shall have location-specific approval from STUK under Guide YVL E.3.

**1209.** If maintenance work is not part of the service programme or it does not merely consist of replacing a structure, component or part of the emergency power supply with an approved spare part, the maintenance work shall be considered to be a repair, and the licensee will be required to draw up a repair plan. The repair plan shall comprehensively include the information that is needed to perform and inspect the work and that is required to evaluate the acceptability of the repair work; typically, such information includes the manufacturing and inspection procedures, illustrative drawings, and an inspection plan covering the manufacturing stages, installation and commissioning.

**1210.** The licensee shall seek approval for the repair plan of a structure or component of the emergency power supply before the repair work is started.

**1211.** The licensee shall arrange for a construction inspection of the repair work. The construction inspection of the repair work shall have been acceptably performed before the operation (setting into standby) of the structure or component of the emergency power supply.

## 13 Modifications

**1301.** No modification of the emergency power supply shall negatively affect the safety of the nuclear facility or the prerequisites for the condition monitoring or maintenance of the emergency power supply.

**1302.** The licensee shall draw up plans for the modification as laid down in the requirements of Guide YVL B.1; they shall describe the design bases of the modification.

**1303.** The licensee shall draw up a construction plan for the modifications of the structure and component of the emergency power supply, and a preliminary suitability analysis for electrical and I&C equipment. The modification construction plan shall present the design information and design bases, dimensioning calculations, manufacturing procedures, inspection plan and inspection procedures. The inspection plan and the procedures pertaining to the inspections shall cover all stages of the modification, from manufacturing to commissioning.

**1304.** The need for any updates to drawings, procedures, and other documents that are required due to the modification of the emergency power supply shall be established, and the updates shall be made without delay when completing 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 supply.

**1305.** If special processes are employed in the modification work of the pressure-retaining structures and components of an emergency power supply, the operator shall have location-specific approval from STUK under Guide YVL E.3.

**1306.** The licensee shall seek approval for the modification construction plan of a structure or component of the emergency power supply before the modification is started. Design bases approved in connection with the plan for principles are a prerequisite for the processing of the construction plan.

**1307.** The licensee shall arrange for a construction inspection of the modification. The construction inspection of the modification shall have been acceptably performed before the operation (setting into standby) of the structure or component of the emergency power supply.

# 14 Regulatory oversight by the Radiation and Nuclear Safety Authority

## 14.1 General

**1401.** The regulatory oversight by STUK or an authorised inspection body 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.

**1402.** STUK may grant inspection rights to an authorised inspection body it has approved in accordance with Guide YVL E.1. Annex A defines the principles of inspection area division between STUK and authorised inspection bodies; these principles may be supplemented by issuing separate decisions.

**1403.** STUK or an authorised inspection body shall make a decision concerning its processing of a plan. Approving decisions may also present requirements and deadlines for the responses required in them.

**1404.** The licensee shall ensure that the prerequisites for the acceptability of the plan are met by performing its own inspections in advance.

**1405.** The licensee shall request an inspection from STUK or an authorised inspection body approximately two weeks before the intended inspection date (construction inspections, commissioning inspections and other oversight). The manufacturer, the plant supplier (in plant deliveries), a third party and the licensee shall ensure in advance using their own inspections that the conditions for the requested inspections exist.

**1406.** STUK or an authorised inspection body shall draw up an inspection record specifying the item inspected and the inspections made. The record shall list any requirements and deadlines for the responses required.

**1407.** The inspection shall end and the record shall be closed when all the required inspections have been performed and when all the requirements have been cleared. The record shall be signed by the inspector, and a representative of the licensee shall acknowledge its receipt.

## 14.2 Third-party approval

**1408.** A notified body pursuant to the Pressure Equipment Directive [7] or an approved third party and an authorised inspection body that has been approved under STUK's Guide YVL E.1 may operate as a third party that oversees and confirms sampling, destructive and non-destructive testing and qualifications within the scope of their areas of qualification without separate approval. If an authorised inspection body that has been approved by STUK acts as a third party, it cannot operate as the public administration's inspection organisation for the same structure or component.

**1409.** The expertise of a third party performing manufacturing control is evaluated on the basis of an analysis appended to the construction plan.

## 14.3 Safety analysis report

**1410.** STUK processes the preliminary and final safety analysis report of a new nuclear facility. The safety analyses include the design bases of the structures and components of the emergency power supply and descriptions of the safety-classified systems of the emergency power supply. The requirements for the content and delivery time are presented in Guide YVL B.1.

## 14.4 Construction plan

**1411.** STUK or an authorised inspection body processes the construction plan of the machine unit and makes a decision on it. The approval of the design bases of the structures and components during the review of the nuclear facility's preliminary safety analysis report is the prerequisite for the processing of the construction plan of the machine unit and another structure or component of the emergency power supply.

## **14.5 Control of manufacturing, and construction inspection**

**1412.** STUK or an authorised inspection body may oversee machine unit manufacturing by means of separate factory visits during manufacturing.

**1413.** STUK or an authorised inspection body performs the construction inspection on the machine unit in the manner defined in this Guide. The requirements for the construction inspection of the other structures and components of the emergency power supply are presented in the appropriate E series YVL Guides.

## **14.6 Oversight of the type test**

**1414.** When a type test is performed on a machine unit under approval, STUK or an authorised inspection body processes the type test plan, oversees the type tests and processes the type test result report.

## **14.7 Installation control and the construction inspection**

**1415.** STUK or an authorised inspection body processes the machine unit's installation construction plan submitted by the licensee, which shall include the documents specified in this Guide.

**1416.** STUK or an authorised inspection body performs the machine unit installation construction inspection in the manner defined in this Guide.

**1417.** The requirements for the installation supervision of the emergency power supply's other structures and equipment are presented in the appropriate E series YVL Guides.

## **14.8 Commissioning inspection**

**1418.** STUK processes the commissioning testing plan of the machine unit.

**1419.** STUK or an authorised inspection body performs the two-stage commissioning inspection in the manner defined in this Guide.

**1420.** The requirements for the supervision of the commissioning of the emergency power supply's other structures and equipment are presented in the appropriate E series YVL Guides.

## **14.9 Operation, condition monitoring and maintenance**

**1421.** STUK supervises the operation, condition monitoring and maintenance of a machine unit 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.

**1422.** STUK or an authorised inspection body processes the machine unit repair plan submitted by the licensee and makes a decision on it.

**1423.** STUK or an authorised inspection body performs the repair work construction inspection within the scope defined in the repair work inspection plan.

**1424.** STUK or an authorised inspection body reviews the inspection and testing protocols and feedback information of the machine unit's maintenance work (service, overhaul and repairs). If a machine unit is disassembled during maintenance, STUK or an authorised inspection body performs a visual inspection of the parts before it is reassembled.

**1425.** The requirements for the supervision of operation and maintenance of the emergency power supply's other structures and components are presented in the appropriate E series YVL Guides.

## **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 design bases for the modified structures and components of the emergency power supply, and the system-specific pre-inspection documentation. The requirements for the content and delivery time are presented in Guide YVL B.1.

**1427.** STUK or an authorised inspection body processes the construction plan of the machine unit modification submitted by the licensee and makes a decision on it. The design bases of the structures and components approved in con-

nection with the plan for principles are a pre-requisite for the processing of the modification construction plan.

**1428.** STUK or an authorised inspection body performs the modification construction inspection within the scope defined in the modification inspection plan.

**1429.** The requirements for the supervision of modifications to the emergency power supply's other structures and components are presented in the appropriate E series YVL Guides.

## Definitions

### 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.

### Commercial-grade product

Commercial-grade product shall refer to a standard-quality product (seal, bearing, bolt etc.), for which the part manufacturer has defined design parameters, and the conformity to requirements of the design and manufacture of which can be established when necessary.

### Machine unit

Machine unit shall refer to a diesel engine/gas turbine and generator without the other systems, structures and components of the emergency power supply.

### Operability

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

### 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.

### 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.

### 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.

## 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. KTA 3702 (06/2000), Emergency Power Generating Facilities with Diesel-Generator Units in Nuclear Power Plants.
5. API Standard 616 5th Edition, Gas Turbines for the Petroleum, Chemical and Gas Industry Services.
6. ASME Performance Test Codes 22, Gas turbines.
7. Pressure Equipment Directive 97/23/EC.
8. SFS-EN 10204 Metallic products. Types of inspection documents.

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

Approval or control IO=authorised inspection body, TP=third party	Safety class	
	2	3
<b>Design</b>		
Design bases <sup>1)</sup>	STUK	STUK
Systems design	STUK	STUK
Manufacturer analysis <sup>2)</sup>	STUK	IO
Construction plan <sup>3)</sup>	STUK	IO
<b>Manufacture</b>		
Supervision during manufacture	STUK	IO
Construction inspection	STUK	IO
Supervision of type tests and factory tests	STUK	IO
<b>Installation and commissioning</b>		
Installation construction plan	STUK	IO
Installation construction inspection	STUK	IO
Commissioning testing plan, and results report for commissioning testing	STUK	STUK
Commissioning inspection	STUK	IO
<b>Maintenance, repairs and modifications</b>		
Maintenance work inspection	STUK	IO
Plan for repairs and modifications	STUK	IO
Inspection of repairs and modifications	STUK	IO

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

2) On the basis of the manufacturer analysis of the construction plan.

3) Including the preliminary suitability analyses of the electrical and I&C equipment.