Translation

Repairs, modifications and preventive maintenance at nuclear facilities

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1 General

This Guide presents how the Finnish Centre for Radiation and Nuclear Safety regulates repairs, modifications and preventive maintenance of systems, components and structures at nuclear facilities during operation. The guide further describes the obligations related to this work imposed on power companies.

An approved Quality Assurance Programme and valid instructions and procedures shall be complied with during repairs, modifications and preventive maintenance performed during operation. The requirements set for a Quality Assurance programme which is valid during operation are set out in Guide YVL 1.4 /1/.

Regulatory procedures related to outages are given in Guide YVL 1.13 /2/ which describes the general arrangements for regulatory control during outages and the prerequisites for plant start-up. Requirements concerning individual repairs, modifications and preventive maintenance operations and related inspections are described in this Guide.

The documents required under this Guide shall be submitted to the Finnish Centre for Radiation and Nuclear Safety in accordance with Guide YVL 1.2 /3/.

2 Definitions

Modification

A modification denotes the alteration of a system, component or structure in such a way that it no longer meets all the requirements set for earlier designs.

Repair

A repair denotes the making operable of a failed component or structure by restoring it to a state which conforms to original design.

Urgent repair

An urgent repair denotes a repair carried out to create preconditions for the restoration of the plant to a safe state, and repairs by which the plant's status is made to correspond to the Technical Specifications after it has deviated from them.

Preventive maintenance

Preventive maintenance denotes measures carried out according to a pre-determined maintenance programme which are aimed at preventing any operational incidents or failures of a component or a structure.

Failure

Failure is an event during which a component's or structure's functional deficiency or structural weakness has exceeded established limit values or has brought about a deviation from the component's or structure's designed functioning.

Mechanical components and structures

Mechanical components and structures denote pressure vessels, pumps, fans, filters, valves, cranes, auxiliary hoisting equipment, fuel handling machines, pool linings etc and structural materials and test pieces required in their manufacture.

3 Scope

This guide applies to repairs, modifications and preventive maintenance of systems, components and structures at all nuclear installations subject to regulatory control by STUK after the issuance of operating licences.

Any exceptional procedures to be complied with in reviewing the plans for urgent repairs, in controlling the performance of work and in carrying out inspections may be agreed upon, case by case, with the Finnish Centre for Radiation and Nuclear Safety.

4 Obligations imposed on power companies

Before implementation, any structural modification plans shall, as a rule, be submitted to STUK for approval in the extent prescribed later in this Guide. If a modification is highly extensive and affects the bases of or the prerequisites for an issued operating licence, an application for the modification shall be filed with the Ministry of Trade and Industry.

The power company shall have clearly defined administrative controls and related instructions for the design, implementation and testing of repairs, modifications and preventive maintenance.

Competent personnel shall be employed for repairs, modifications and preventive maintenance. The power company shall make provisions for the execution of work such as the necessary training and job orientation, adequate instructions and appropriate working tools which facilitate work whether the personnel involved are utility or non-utility.

The power company shall arrange for the nuclear power plant's systems, components and structures to be regularly serviced and the associated tests to be duly conducted. The power company shall establish a programme for the preventive maintenance of safety-significant systems, components and structures in which system, component and structure specific preventive maintenance and periodic inspection procedures as well as their dead-lines are described system, component and structure wise. The programme shall be submitted to STUK for information if so requested. The preventive maintenance programme shall be based on guides and recommendations issued by the plant supplier and the suppliers of components and structures as well as on own experience. Its efficiency shall be periodically assessed based on experiences from own and foreign power plants of a corresponding type.

The power company shall have an established failure report and work request system. A failure report and a work request shall be drawn up of any detected failures and deficiencies to initiate the necessary repairs. A regular follow-up of the repair of defects presented in failure reports and work requests shall be arranged. Failure reports may also be filed on the work request form.

Repairs, modifications and preventive maintenance operations of systems, components and structures shall be carried out in compliance with the work order/work permit practice established within the power company. The work order/work permit practice shall be so designed that safety of workers is ensured. The work order/work permit practice shall be made to contain requirements and restrictions relating to the Technical Specifications, radiation protection, fire protection and industrial safety and health.

There shall be sufficient checks to ensure the resetting to their normal state of process, electrical and instrumentation systems after connections, disconnections and simulations related to repairs, modifications and preventive maintenance. These may include written instructions for various work phases, written acknowledgements of accomplished work and independent inspections.

The power company shall see to it that requirements approved by STUK as regards radiation, physical and fire protection are complied with in repairs, modifications and preventive maintenance during outages as well as during operation. If a deviation from these requirements is anticipated regarding a specific task, plans concerning the deviation in question shall be submitted to STUK for approval prior to the commencement of work.

The power company shall have a document updating system which ensures correctness of documents in later use. In connection with a modification, documentation describing plant layout and documents which affect plant operation, such as the Final Safety Analysis Report, systems descriptions, process, electrical and instrument diagrams, operating instructions and the Technical Specifications etc shall be updated without delay.

The power company shall have systems for the procurement, reception and storage of spare parts to ensure a sufficient supply of

spare parts and materials for repairs, modifications and preventive maintenance and to ensure that only approved spare parts and materials can be delivered to the plant for installation. Receiving inspections shall be a vital part of the system and they shall encompass, besides structures and components ordered from outside the power company, any such manufactured or repaired by the power company.

Information of failures and repairs of systems,components and structures shall be collected and stored at nuclear installations on the basis of which the adequacy of preventive maintenance programmes can be assessed and actions planned to improve the operational reliability of systems, components and structures important to safety.

5 System modifications

A system pre-inspection is carried out in the form of a review of the Preliminary and Final Safety Analysis Reports and the related topical reports during the construction phase. During the operation of a nuclear installation, a system pre-inspection can be conducted on the basis of separate system pre-inspection documentation before the Final Safety Analysis Report is changed. Pre-inspection documents shall be submitted to STUK for approval at least concerning the modification of systems in Safety Classes 1, 2 and 3 as well as the modification of systems STUK has earlier requested for inspection for other reasons. Modification of other systems inspected by STUK earlier shall be submitted to STUK at least for information. Also an individual component modification which remarkably changes a system's operation or its operating parameters is considered a system modification.

The pre-inspection documents of the system modification shall contain the following reports:

- causes and justification for the modification
- system design bases
- description of the operation of the system's modified part
- analysis of the system
- any other reports deemed necessary.

The causes for modifications shall always be stated and justified. In the system design bases, it shall be stated according to which guides and standards the system and its modification have been designed. The design bases shall also account for i.a. the following items:

- Safety Class
- design parameters (pressure, temperature, flow, chemical environment, requirements concerning leak tightness etc)
- ambient conditions
- requirements for structural materials.

In the description of the operation of a system's modified part, the system's operation during normal operational states as well as during anticipated operational transients and postulated accidents shall be described. The modification's impact on operation shall be described. The necessary diagrams and drawings as well as the design parameters of the most important components shall be included in the description of operation. The description shall be extensive enough to contain all information required for a system analysis.

The objective of a system analysis is to ascertain that the system operates in conformity with the design bases and that the modified system meets the requirements set forth in the guides and standards applied in system design. In connection with extensive modifications, disturbance and accident analyses for the installation as well as system reliability analyses shall be repeated in the extent deemed necessary if the conducting of such analyses for the system in question was required earlier.

Changes eventually proposed to the Tehnical Specifications shall be submitted for approval together with system pre-inspection documentation. The test run programme relating to a system modification shall be submitted for approval together with pre-inspection documentation, or, well in advance of the test run. STUK shall be informed of the test date well in advance. The report on the results of the system test shall be submitted

to STUK for approval within a month from the accomplishment of tests unless otherwise prescribed. The proposal containing the changes required in a system's operating instructions shall be submitted to STUK prior to the commissioning of the system. The proposal for changes in the Final Safety Analysis Report shall be submitted to STUK without delay after the implementation of a modification.

As regards work arrangements during a system modification, reports on radiation protection, fire protection and physical protection as prescribed in Chapter 4 shall be provided where necessary.

Instructions concerning the pre-inspection, structural plans and quality assurance of the various parts of a system are given in Chapter 6.

6 Repairs, modifications and preventive maintenance

6.1 Mechanical components and structures

Control of repairs, modifications and preventive maintenance of mechanical components and structures is carried out in accordance with the relevant YVL Guides /4/, in the extent prescribed in STUK's decisions. An application shall be filed for the approval of a construction plan for repairs and modifications of mechanical components and structures according to the appropriate YVL guides. As regards repairs and modifications, information and reports required in the YVL guide in question of a new structure, or, sufficient reference to designs approved earlier, shall be included in the construction plan. Furthermore, the grounds for a repair or a modification shall be stated and justified. STUK's inspector may approve a minor repair and modification plan if the system's operational parameters are not changed and the assignment in question is conventional. In decisions relating to construction plans, STUK's inspector may present requirements concerning work-related permits as well as control of work and inspections. A special construction plan is not required for the carrying out of preventive maintenance operations if they can be carried out in compliance with regular maintenance instructions and if approved spare parts and accessories are used.

Repair and modification of mechanical components and structures may be commenced only after their construction plans have been approved and the requirements concerning the commencement and control of work, as provided in decisions, have been met.

The repair, modification and preventive maintenance of mechanical components and structures shall be subject to inspection. The inspection is usually conducted by STUK's inspector. On application, STUK may authorize a utility-employed individual to carry out inspections in an extent approved by STUK. Inspection of repairs, modifications and preventive maintenance shall be conducted in compliance with YVL Guide 1.15 /5/.

The power company is responsible for maintaining a component specific register of the repairs and modifications of mechanical components and structures, individual components replacements included. The power company shall come forth with a report summary of any extensive preventive maintenance actions such as the maintenance of diesel generators, control rod drives and main circulation pumps in which any observations and maintenance work are accounted for.

After maintenance or modification, a component or a structure shall be subjected to a performance test which corresponds to at least a periodic test and by which its operability is ensured. The performance test plan and its result documents shall be submitted to STUK for approval on request. In connection with system modifications, the test run programme and its result document shall be submitted to STUK for approval according to Section 5.

If the performance of a preventive maintenance operation has required a partial or full-scale dismantling of a component or

structure, STUK's inspectors shall, where necessary, be presented with a record or any other document accounting for tests by which operability, leak tightness and/or load bearing capacity are assessed.

Permits relating to the commissioning of a mechanical component or structure shall be reviewed as part of the construction inspection of repairs, modifications and preventive maintenance. A prerequisite for the commissioning of a mechanical component or structure is that it has been ascertained ready for operation.

6.2 Steel and concrete structures

Inspection of the repairs and modifications of steel and concrete structures is carried out in compliance with Guide YVL 4.1 /6/ and Guide YVL 4.2 /7/, where applicable.

Repair and modification plans for Safety Class 1, 2 and 3 concrete and steel structures shall be submitted to STUK for approval. Work may be started after STUK's approval of the plans in question has been obtained. Upon completion of work, STUK's inspector conducts a combined construction and commissioning inspection.

6.3 Electrical and instrumentation equipment

General requirements for the repair, modification and preventive maintenance of electrical and instrumentation equipment are given in Section 4 of this Guide and in Guide YVL 5.5. Radiation measuring systems are also addressed in Guide YVL 7.11 /9/.

The above general requirements apply to all Safety Class 1, 2 and 3 electrical and instrumentation equipment. Component-specific pre-inspection documentation shall be submitted to STUK for approval. This, however, only applies to repairs and modifications of such electrical and instrumentation equipment as are covered by component-specific pre-inspection as specified in Guide YVL 5.5. In such a case, STUK's approval of the pre-inspection documents shall be obtained prior to the commencement of repairs and modifications. Requirements concerning the contents of pre-inspection documentation are given in Guide YVL 5.5. Inspection of work and installations relating to modifications and repairs of electrical and instrumentation equipment shall be performed according to Guide YVL 5.5. A commissioning inspection shall be conducted for such repairs and modifications the component-specific pre-inspection documentation of which STUK has inspected. The inspection shall be conducted within a month from the accomplishment of installation unless otherwise prescribed in the pre-inspection decision. An application requesting a commissioning inspection shall be filed with STUK well in advance of the inspection date.

Minor repairs and modifications may be made to electrical and instrumentation components covered by pre-inspection, provided that a component's technical quality level and its performance characteristics are not adversely affected. Such repairs and modifications could include e.g. the following items:

- replacement of an original with a spare part equal to the original
- adjustment of measurements, limit switches or similar operating parameters
- mechanical work which has no effect on the functioning of components, e.g. repairs of doors, locks and fittings of electronics cubicles and repairs of cable clamps.

Regulatory inspection of such repairs and modifications is implemented in the form of audits relating to the periodic inspection programme conducted by STUK. Failure reports and work orders concerning electrical and instrumentation components shall be made available to STUK to facilitate control.

On accomplishment of all repairs and modifications, the component shall be subjected to a performance test to ascertain its fault-free functioning. The performance test shall correspond to at least the periodic test of the component in question. The test results will be presented in connection with the commissioning inspection. The power company shall review and approve the results of performance tests on accomplishment of

repairs and modifications of Safety Class 1, 2 and 3 components prior to their commissioning. In connection with system modifications, the test run programme and its result document shall be submitted to STUK for approval according to Section 5.

Only spare parts equal to the originals may be used in repairs of Safety Class 1, 2 and 3 electrical and instrumentation components. A spare part is not considered equal to the original e.g. in the following cases:

- performance characteristics relating to the spare part's safety function have deteriorated significantly
- the spare part deviates from the original by way of functioning or structure
- the spare part does not equal to the original as regards ability to withstand ambient conditions
- the spare part's quality control level does not equal to that of the original.

Furthermore, as regards pre-inspected components, a spare part is, in the main, not considered equal to the original if its manufacturer has changed. Regulatory control over the use of spare parts which equal to the originals is exercised by STUK in conjuction with its audits.

Regulatory control of the preventive maintenance of electrical and instrumentation components important to safety is exercised by STUK in connection with its audits.

7 References

1 STUK Guide YVL 1.4 Quality assurance programme for nuclear power plants

2 STUK Guide YVL 1.13 Regulatory inspections related to shutdowns at nuclear power plants

3 STUK Guide YVL 1.2 Formal requirements for the documents to be submitted to the Institute of Radiation Protection

STUK Guide YVL 1.3 Mechanical components and structures of nuclear power plants. Inspection licences

4 STUK Guide YVL 3.0 Pressure vessels in nuclear facilities. General guidelines on regulation

STUK Guide YVL 3.1 Nuclear power plant pressure vessels. Construction plan. Safety classes 1 and 2

STUK Guide YVL 3.2 Nuclear power plant pressure vessels. Contruction plan. Safety class 3 and class EYT

STUK Guide YVL 3.3 Supervision of the piping of nuclear facilities

STUK Guide YVL 3.4 Nuclear power plant pressure vessels. Manufacturing licence.

STUK Guide YVL 3.7 Start-up inspection of nuclear power plant pressure vessels

STUK Guide YVL 3.8 Nuclear power plant pressure vessels. Inservice inspections

STUK Guide YVL 3.9 Nuclear power plant pressure vessels. Construction and welding filler materials

STUK Guide YVL 5.3 Inspection of nuclear power plant valves

STUK Guide YVL 5.4 Supervision of safety relief valves in nuclear facilities

STUK Guide YVL 5.7 Pumps at nuclear facilities

5 STUK Guide YVL 1.15 Mechanical components and structures in nuclear installations. Construction inspection

6 STUK Guide YVL 4.1 Nuclear power plant concrete structures

7 STUK Guide YVL 4.2 Nuclear power plant steel structures

8 STUK Guide YVL 5.5 Supervision of electric and instrumentation systems and components at nuclear facilities

9 STUK Guide YVL 7.11 Radiation monitoring systems and equipment in nuclear power plants