Surveillance of nuclear fuel operation and performance

This Guide is in force as of 1st April 1991, until further notice. It replaces Guide YVL 6.6, issued on 19 June 1979.

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Authorisation

By virtue of section 55, second paragraph, point 3 of the Nuclear Energy Act (990/87) and section 29 of the Council of State Decision (395/91) on General Regulations for the Safety of Nuclear Power Plants, the Finnish Centre for Radiation and Nuclear Safety (STUK) issues detailed regulations concerning the safety of nuclear power plants.

The YVL Guides are regulations an individual licensee or any other organisation concerned shall comply with, unless STUK has been presented with some other acceptable procedure or solution by which the safety level set forth in YVL Guides is achieved.

Translation. Original text in Finnish.

1 General

The basic criterion for fuel design is that fuel may not fail in normal operating conditions or during anticipated operational transients, and that a coolable fuel geometry is maintained in postulated accidents.

To ensure the safe use of nuclear fuel, its operating conditions are monitored and its mechanical condition is controlled by inspections and examinations both during refuelling and after removal from service.

General procedures relating to the surveillance of fuel performance are presented in Guide YVL 6.1. Limits and design requirements relating to the prevention of fuel failures and to the coolability of fuel are given in Guide YVL 6.2. Matters to be taken into account when assessing the design criteria are also set forth in Guide YVL 6.3.

The requirements to be set for the surveillance of fuel operation and performance are presented in this Guide. Surveillance of the condition of spent fuel during storage is not within the scope of this Guide.

2 Fuel operation and performance surveillance programme

In the fuel operation and performance surveillance programme, the utility's measures and plans shall be stated concerning

- monitoring fuel operating parameters,
- inspection and examination of spent fuel, and
- collection of reference data.

This programme shall be submitted to the Finnish Centre for Radiation and Nuclear Safety for approval not later than one year prior to the commissioning of the plant unit in question. Any changes and additions to the programme are subject to the Centre's approval. The programme may be divided into sub-programmes.

2.1 Fuel operating conditions

The operating conditions of the fuel, the reactor core and the coolant must be known. Reactor power, the power of fuel assemblies, power changes, power distribution, safety margins (e.g. margin to critical heat flux ratio), burn-up, and also coolant activity and water chemistry shall be monitored. The essential safety requirements for the parameters to be monitored are given in the plant's Technical Specifications. Methods for monitoring the fuel operating conditions are stated in the surveillance programme.

Actions in provision for fuel leaks shall be planned in advance. These plans and the methods to assess the number and extent of fuel leaks shall be stated in the programme.

The utility's methods for reporting on and for inspecting the fuel operating conditions shall also be specified in the programme.

2.2 Inspection and examination of spent fuel

At every plant unit, visual inspections of fuel channels, assemblies and rods shall be systematically carried out during refuelling and, where necessary, also during other outages. In the fuel surveillance programme, requirements are set for these visual inspections (criteria, scope of inspection, methods, instructions etc.). On the basis of observations, more detailed inspections and examinations on the site or in a hot cell shall be undertaken, where necessary (e.g. an unexpected change in fuel assembly structure). The causes of fuel failures (leaks, mechanical defects etc.) shall be clarified, as far as possible.

Every plant unit must have facilities for carrying out fuel assembly leak tests. Leak testing shall be conducted during refuelling and, where necessary, also during other outages if observations made during operation

indicate that the reactor may contain leaking fuel assemblies. Fuel assemblies confirmed as leaking must be removed from service or repaired. The requirements for leak testing are stated in the fuel surveillance programme.

All plant units must subject their fuel assemblies, rods and channels to dimensional inspections and to other non-destructive testing, and, where necessary, to destructive testing and examinations. The requirements for such inspections and examinations are presented in the surveillance programme. In so far as the utility intends to base actions on data provided by the fuel manufacturer, the manufacturer's follow-up surveillance programme shall be included in the utility's fuel inspection programme.

In determining the scope of the inspections and examinations to be conducted on fuel, data about fuel of a similar type which has been used under equivalent conditions may be taken into account. Any modifications to the fuel design parameters and fabrication methods, and also facts observed during other inspections shall be taken into consideration.

Where it is necessary for clarifying the effects of various fuel behaviour phenomena (e.g. fission gas release, swelling and densification of UO_2, changes in fuel assembly and in rod dimensions, and rod temperature distributions etc.), carefully pre-characterised fuel rods shall be manufactured. After irradiation, these rods are subjected to non-destructive and destructive tests according to a detailed plan.

2.3 Obtaining reference data

The fuel operation and performance surveillance programme defines utility actions for obtaining fuel data from organisations using similar fuel types under equivalent conditions.

2.4 Inspection programme for lead test assemblies

When a plant unit prepares to start operation of a new fuel type, or, when significant changes are planned in the design parameters or fabrication technique of a previously used fuel type, it is appropriate to start collecting operational data by using lead test assemblies. A programme for inspecting and examining such lead test assemblies shall be submitted to the Finnish Centre for Radiation and Nuclear Safety for approval in connection with the pre-inspection documentation of the fuel assemblies in question.

3 Reports to be submitted to the Finnish Centre for Radiation and Nuclear Safety

Reports shall be submitted to the Centre as required in Guide YVL 1.5.

Fuel inspection and examination programmes shall be sent to STUK for information in advance. Inspection and examination reports shall be submitted to the Centre not later than four months from the accomplishment of each examination. However, the Centre must be informed without delay about any exceptional observations.

YVL guides

General guides

YVL 1.0 Safety criteria for design of nuclear power plants, 1 Dec. 1982

YVL 1.1 The Finnish Centre for Radiation and Nuclear Safety as the regulatory authority in control of the use of nuclear energy, 27 Jan. 1992

YVL 1.2 Documents to be submitted to the Finnish Centre for Radiation and Nuclear Safety concerning the regulation of nuclear facilities, 22 May 1991 (in Finnish)

YVL 1.3 Mechanical components and structures of nuclear power plants. Inspection licenses, 25 March 1983

YVL 1.4 Quality assurance of nuclear power plants, 20 Sep. 1991

YVL 1.5 Reporting nuclear power plant operation to the Finnish Centre for Radiation and Nuclear Safety, 1 Jan. 1995 (in Finnish)

YVL 1.6 Nuclear power plant operator licensing, 3 March 1989

YVL 1.7 Duties important to nuclear power plant safety, personnel qualifications and training, 28 Dec. 1992 (in Finnish)

YVL 1.8 Repairs, modifications and preventive maintenance at nuclear facilities, 2 Oct. 1986

YVL 1.9 Quality assurance during operation of nuclear power plants, 13 Nov. 1991

YVL 1.11 Ydinvoimalaitosten käyttökokemusten hyödyntäminen, 22 Dec. 1994 (in Finnish)

YVL 1.13 Shutdowns at nuclear power plants, 9 Jan. 1995 (in Finnish)

YVL 1.15 Mechanical components and structures in nuclear installations, Construction inspection, 16 April 1984

Systems

YVL 2.1 Safety classification of nuclear power plant systems, structures and components, 22 May 1992

YVL 2.2 Transient and accident analyses for justification of technical solutions at nuclear power plants, 7 Oct. 1987

YVL 2.3 Preinspection of nuclear power plant systems, 14 Aug. 1975

YVL 2.4 Over-pressure protection and pressure control during disturbances in the primary circuit and steam generators of a PWR plant, 19 Sept. 1984

YVL 2.5 Pre-operational and start-up testing of nuclear power plants, 8 Jan 1991

YVL 2.6 Provision against earthquakes affecting nuclear facilities, 19 Dec. 1988

YVL 2.7 Failure criteria for the design of a light-water reactor, 6 April 1983

YVL 2.8 Probabilistic safety analyses (PSA) in the licensing and regulation of nuclear power plants, 18 Nov. 1987

Pressure vessels

YVL 3.0 Pressure vessels in nuclear facilities. General guidelines on regulation, 21 Jan. 1986

YVL 3.1 Nuclear power plant pressure vessels. Construction plan. Safety classes 1 and 2, 11 May 1981

YVL 3.2 Nuclear power plant pressure vessels. Construction plan. Safety class 3 and class EYT, 21 June 1982

YVL 3.3 Supervision of the piping of nuclear facilities, 21 May 1984

YVL 3.4 Nuclear power plant pressure vessels. Manufacturing license, 15 April 1981

YVL 3.7 Pressure vessels of nuclear facilities. Commissioning inspection, 12 Dec. 1991

YVL 3.8 Nuclear power plant pressure vessels. Inservice inspections, 3 Dec. 1993 (in Finnish)

YVL 3.9 Nuclear power plant pressure vessels. Construction and welding filler materials, 6 April 1995 (in Finnish)

Buildings and structures

YVL 4.1 Nuclear power plant concrete structures, 22 May 1992 (in Finnish)

YVL 4.2 Steel structures for nuclear facilities, 19 Jan. 1987

YVL 4.3 Fire protection at nuclear facilities, 2 Feb. 1987

Other structures and components

YVL 5.3 Regulatory control of nuclear facility valves and their actuators, 7 Feb. 1991

YVL 5.4 Supervision of safety relief valves in nuclear facilities, 6 April 1995 (in Finnish)

YVL 5.5 Supervision of electric and instrumentation systems and components at nuclear facilities, 7 June 1985

YVL 5.6 Ventilation systems and equipment for nuclear power plants, 23 Nov. 1993 (in Finnish)

YVL 5.7 Pumps at nuclear facilities, 23 Nov. 1993 (in Finnish)

YVL 5.8 Hoisting appliances and fuel handling equipment at nuclear facilities, 5 Jan. 1987

Nuclear materials

YVL 6.1 Control of nuclear fuel and other nuclear materials required in the operation of nuclear power plants, 19 June 1991

YVL 6.2 Fuel design limits and general design criteria, 15 Feb. 1983

YVL 6.3 Supervision of fuel design and manufacture, 15 Sept. 1993

YVL 6.4 Supervision of nuclear fuel transport packages, 1 March 1984

YVL 6.5 Supervision of nuclear fuel transport, 1 March 1984

YVL 6.6 Surveillance of nuclear fuel performance, 5 Nov. 1990

YVL 6.7 Quality assurance of nuclear fuel, 23 Nov. 1993

YVL 6.8 Handling and storage of nuclear fuel, 13 Nov. 1991 (in Finnish)

YVL 6.9 The national system of accounting for and control of nuclear material, 23 Nov. 1993 (in Finnish)

YVL 6.10 Reports to be submitted on nuclear materials, 23 Nov. 1993 (in Finnish)

YVL 6.11 Physical protection of nuclear power plants, 13 July 1992 (in Finnish)

YVL 6.21 Physical protection of nuclear fuel transports, 15 Feb. 1988 (in Finnish)

Radiation protection

YVL 7.1 Limitation of public exposure in the environment of and limitation of radioactive releases from nuclear power plants, 14. Dec. 1992

YVL 7.2 Evaluation of population doses in the environment of nuclear power plants, 12 May 1983

YVL 7.3 Evaluating the dispersion of radioactive releases from nuclear power plants under operating and in accident conditions, 12 May 1983

YVL 7.4 Nuclear power plant emergency plans, 12 May 1983

YVL 7.5 Meteorological measurements of nuclear power plants, 28 Dec. 1990

YVL 7.6 Monitoring of discharges of radioactive substances from nuclear power plants, 13 July, 1992

YVL 7.7 Programmes for monitoring radioactivity in the environment of nuclear power plants, 21 May 1982

YVL 7.8 Reporting radiological control of the environs of nuclear power plants to the Institute on Radiation Protection, 21 May 1982

YVL 7.9 Radiation protection of nuclear power plant workers, 14 Dec. 1992 (in Finnish)

YVL 7.10 Monitoring occupational exposure at nuclear power plants, 29 Aug. 1994 (in Finnish)

YVL 7.11 Radiation monitoring systems and equipment in nuclear power plants, 1 Feb. 1983

YVL 7.14 Action levels for protection of the public in nuclear power plant accidents, 26 May 1976

YVL 7.18 Radiation protection in design of nuclear power plants, 14 May 1981

Radioactive waste management

YVL 8.1 Disposal of reactor waste, 20 Sept. 1991

YVL 8.2 Exemption from regulatory control of nuclear wastes, 19 March 1992

YVL 8.3 Treatment and storage of radioactive waste at the nuclear power plants, 1 July 1985

The YVL-guides without any language marking are available both in English and Finnish.