

Ventilation systems and components of nuclear power plants

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This Guide is in force as of 1 April 1994 until further notice.

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 Radiation and Nuclear Safety Authority (STUK) issues detailed regulations concerning the safety of nuclear power plants.

YVL Guides are rules 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 the YVL Guides is achieved. This Guide does not alter STUK's decisions which were made before the entry into force of this Guide, unless otherwise stated by STUK.

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1 General

The Radiation and Nuclear Safety Authority (STUK) regulates the safety of nuclear power plants in Finland. All nuclear safety related ventilation systems are covered which maintain circumstances at the plants acceptable for personnel safety or which restrict radioactive discharges into the environment.

This Guide presents the most important radiation and nuclear safety requirements for the design and manufacture of nuclear power plant ventilation systems and components. This Guide also explains STUK's regulatory activities as regards the ventilation systems and components; documents and data are presented in particular which shall be submitted to STUK during the various phases of the regulatory procedure relating to the design, construction, commissioning and operation of nuclear power plants.

Safety criteria for the ventilation systems of nuclear power plants are given in Guide YVL 1.0. Requirements relating to the design and regulation of individual mechanical components are also set in several other YVL Guides. Guide YVL 5.5 also covers the electrical and automation equipment and controls of ventilation systems. STUK's regulatory activities during the various phases of nuclear power plant construction and operation are described in Guide YVL 1.1. Requirements relating to the restriction of discharges are presented in YVL Guide group seven.

The rules and regulations issued by the Ministry of the Environment and the Ministry for the Interior about the design and operation of ventilation systems and the related fire protection design bases also apply to nuclear power plants. If compliance with any of these regulations compromises nuclear safety or is in disagreement with the radiation safety requirements, the ministry in question decides the matter case by case and requests the necessary comments from other authorities.

In accordance with the Council of State Decision (395/91), section 27, the licence-

holder shall systematically follow and assess nuclear power plant operating experience and the results of safety analyses. To further improve safety, all measures justified by operating experience, safety analyses and advances in science and technology shall be implemented. This requirement also applies to the ventilation systems and equipment of nuclear power plants.

In this Guide, ventilation systems mean all systems designed for the ventilation, circulation, cooling, humidification, warming or filtering of air and which control the quality of air in a nuclear power plant's areas and rooms or restrict radioactive discharges into the environment.

STUK defines, where necessary, whether a specific ventilation system or component is within the scope of this Guide.

Excluded from the scope of this Guide are exhaust gas treatment systems, condenser vacuum systems of BWR plants, leak collection systems or other systems transferring gases or steams potentially containing radioactive substances.

Most requirements in this Guide even apply to the design of other nuclear facilities. On the basis of the licence-applicant's submission, STUK decides about the detailed application of this Guide to other nuclear facilities.

2 Functions of ventilation systems

The general function of ventilation systems is to maintain working circumstances appropriate for the operating personnel in such a way that the purity, temperature, humidity and flow of room air meet the prescribed requirements.

As regards nuclear safety, the most important function of the ventilation systems is to maintain and secure such conditions at the nuclear power plant that components and

structures important to plant safety are maintained in a good condition and operate faultlessly.

In accordance with the Council of State Decision (395/91), section seven, radiation exposure arising from the operation of a nuclear power plant shall be kept as low as reasonably achievable. Furthermore, the nuclear power plant and its operation shall be so designed that the limits on radioactive substances prescribed in the above Decision are not exceeded.

The functions of the nuclear power plant's ventilation systems derived from these radiation exposure criteria shall ensure that:

- the amounts of radioactive substances entering the environment in the plant discharge air do not exceed the acceptable limits on environmental radiation exposure
- the concentrations of radioactive substances in the plant atmosphere do not exceed the acceptable limits on occupational radiation exposure.

The ventilation systems must accomplish these functions in such a way that safety requirements are met during normal operation and accident conditions.

3 Design of ventilation systems

3.1 Safety classification

Functions important to the safety of the systems, structures and components of a nuclear power plant shall be defined and the systems, structures and components classified according to their safety significance. The systems, structures and components important to safety shall be designed, manufactured, installed and operated so that their quality and the inspections and tests required to verify their quality are adequate considering any item's safety significance (Council of State Decision 395/91, section 21).

The safety classification criteria for ventilation systems are presented in Guide YVL 2.1. The Guide also gives examples of ventilation system classifications. STUK does not set binding classification requirements for various systems in advance but decides specific classifications plant by plant on the basis of the licence-applicant's submission and in connection with the review of the nuclear power plant's construction permit. No specific requirements are set for Class EYT (non-nuclear) ventilation systems not included in the Classification Document.

3.2 General design requirements

The nuclear power plant's buildings and rooms shall be classified into ventilation zones. Between these zones, pre-determined pressure differences that can be checked shall prevail so that air flows from the uncontrolled area towards the controlled area.

When classifying rooms into ventilation zones, the following facts shall be considered:

- amount, radiation risk posed by and form of occurrence of radioactive substances potentially released from systems and components located in various plant rooms
- room accessibility requirements during operational and accident conditions
- plant fire compartments.

Exhaust air from the controlled area shall be systematically extracted to the environment via ducts and the plant ventilation stack. When considering the leaktightness requirements for the ducts, the following facts in particular shall be considered:

- amount of radioactive substances in exhaust air
- areas and rooms via which the ducts are conducted
- pressure difference between the ducts and their surroundings.

If the plant exhaust air contains, or may contain, radioactive substances (in gaseous,

aerosol or particulate form) in amounts which have significance for environmental radiation exposure, the air shall be filtered efficiently enough. The intake air equipment shall be fitted with filtering devices to prevent the harmful accumulation of outdoor air impurities in plant quarters.

The flow of outdoor air shall be so designed that the concentrations of radioactive substances in the indoor air of manned plant quarters can be kept sufficiently low. The required periods of stay at the plant quarters shall be considered in the design. It shall be possible to remove heat loads emanating from equipment and components in such a way that there is sufficient confidence of the design basis ambient temperature of the components not being exceeded. If it is necessary to restrict the flow of outdoor air e.g. in case of an accident condition, provision shall be made, where necessary, to filtrate and cool air in the rooms in question by room-specific circulated air devices.

Actual conditions during operation (pressure, pressure difference, temperature, relative humidity, volume flow, radiation dose rate, consistency of fluid etc.) shall be the design bases for ventilation system components. As the design basis for systems designed to operate during or after accidents, conditions most demanding considering the required safety function shall be considered. The components shall be protected against the impact of the accident conditions and transients they are designed to manage. When the materials, surface treatment and geometry of ducts and components are designed, the decontaminability of their surfaces from potential radioactivity shall be considered.

The nuclear power plant's rooms shall be provided with ventilation systems to maintain appropriate, pre-determined room air conditions. Burning, poisonous or otherwise hazardous gases and steams shall be extracted by ventilation.

The nuclear power plant's control room, fallout shelter and emergency operations

rooms shall be provided with intake air filtering devices which, in the event of an accident condition, keep occupational radiation doses low enough for the personnel to work and stay in the rooms. Accidents at on-site or off-site storages containing poisonous or asphyxiating gases, or accidents during the transport of such gases, shall be analysed. If justified by the analyses, provision shall be made for the detection of poisonous and asphyxiating gases in the control room and for the elimination of the hazard posed by them.

Ventilation systems important to nuclear safety and radiation protection shall be so designed that they accomplish their functions reliably even during failures, maintenance and tests. Provision shall be made for continuous component condition monitoring. The prerequisites for repair, maintenance and testing shall be considered during design. To ensure the implementation of maintenance activities during or after an accident condition, occupational exposure shall be considered in the design of ventilation systems which provide against accident conditions. It must be possible to perform component repair and maintenance in such a way that other systems and components important to plant safety need not be made inoperational for the duration of the maintenance.

Control of the operation of the ventilation systems shall be reliably arranged. It is to be based on the monitoring of functional indicators most important for the operation and operability of the actual ventilation equipment. The controls of safety-related ventilation systems and the alarms and displays associated with the safety functions shall be available to the control room operators.

In accordance with Guides YVL 1.0 and YVL 2.7, diverse safety-related ventilation systems shall be used in such a way that safety functions can be accomplished even in the event of a single failure by means of on-site or off-site electrical power supply systems. The Radiation and Nuclear Safety

Authority defines safety-related ventilation systems plant by plant on the basis of the licence-applicant's submission and in connection with the review of the safety classification document.

3.3 Fire safety

Ventilation systems separated from each other shall be provided for areas and rooms containing components of various sub-systems of safety-related systems. If the ventilation ducts of rooms containing one sub-system's components are exceptionally conducted through another sub-system's area, the reliability of fire compartments as regards the ventilation systems concerned shall be separately justified. The rooms of separate sub-systems may have common equipment near the air inlets and outlets if it can be verified that this arrangement does not degrade the separation between the sub-systems concerned.

The ventilation systems shall be so designed that the air inlet and outlet side sub-systems required to manage a fire in some part of the plant can be separated without compromising the safety of the plant or the personnel in other respects.

Overpressure ventilation shall be provided for staircases or corresponding spaces serving as personnel escape routes in case of a fire or as main access routes for plant personnel performing measures to ensure radiation or plant safety.

When considering the location of supply air inlets, the possibility shall be taken into account that in consequence of a fire breaking out in some fire compartment, enough smoke and hot gases may be transported to the air inlets of other systems so as to endanger the safety of the plant or the personnel. This alternative shall be extremely unlikely and shall be given special attention in the design of ventilation systems for the control room area.

The possibility of a fire occurring in the filters of the ventilation systems shall be considered. Therefore,

- non-flammable materials shall be used where possible
- filters which may contain significant amounts of radioactive substances shall be equipped with the necessary fire detection devices, and provision shall be made for fire extinguishing
- provision shall be made to separate filters from the rest of the system and, in general, the harmful effects of a potential fire shall be mitigated by fire compartments.

3.4 Smoke extraction

According to the plant's fire loads and the analyses made, the rooms of the nuclear power plant shall be equipped with individual smoke extraction systems which usually are completely separate from the plant's normal ventilation systems. The smoke extraction function reduces the temperature of a room where a fire has occurred and extracts smoke and hot gases, thus preventing their spreading to other rooms and enabling efficient operational fire fighting. The efficiency of the smoke extraction systems shall be verified by tests.

Smoke extraction systems shall be provided for rooms containing considerable fire loads and which are located in the uncontrolled area. The entry of smoke into the control room if a fire breaks out in the adjacent rooms shall be reliably prevented using also appropriate smoke extraction or overpressurisation systems. Adequate provision shall also be made to extract smoke and hot gases released in case of a control room fire.

The smoke extraction system shall be so designed that smoke and hot gases are exhausted and that the system can be controlled and operated during an incident involving a fire. The system's impact on the operation and efficiency of the fire extinguishing system shall be considered during the design.

Automatic smoke extraction to the off-site atmosphere is not allowed from control room areas where radioactive substances may be released in consequence of a fire. If appropriate, rooms with heavy fire loads in the controlled area can be provided with manually operated smoke extraction systems which can be reliably controlled during a fire. Environmental releases arising from smoke venting and the consequent radiation doses shall be separately considered.

If an explosion is possible in some plant quarter, provision shall be made for it.

4 Regulatory control by the Radiation and Nuclear Safety Authority (STUK)

4.1 Construction licence phase

The nuclear power plant's Preliminary Safety Analysis Report and the supplementary topical reports shall present the methods and technical solutions which fulfil the ventilation system requirements set in the previous chapter. Below are the entities relating to ventilation systems descriptions which shall be submitted to STUK.

4.1.1 Regulations, guides and standards

A list of the regulations, guides and standards applicable to the design of ventilation systems shall be given. For extensive documents, also the scope of application shall be given. Foreign regulations and guides can be applied to include features specific to nuclear power plants. Any deviations from domestic regulations, guides and standards shall be specified and justified. Such deviations could be e.g. separation requirements relating to fire safety, air change rate of various rooms and smoke extraction arrangements.

4.1.2 Preliminary room condition classification

At least those rooms of the nuclear power whose ventilation systems belong to Safety Classes 2 or 3 or which are otherwise subject to control by the Radiation and Nuclear Safety Authority (STUK) shall be classified. Buildings and/or rooms shall be classified according to the data available at this stage and on the basis of factors most important to ventilation design, such as e.g. temperature, humidity, radiation (amount, quality), heat loads and the necessary pressure difference steps. Based on this classification, the air change rate of different rooms shall be tentatively given.

4.1.3 Preliminary systems descriptions

Preliminary systems descriptions and the related preliminary process and instrumentation drawings of ventilation systems in Safety Class 3 and higher shall be presented. Guide YVL 2.3 about systems pre-inspection contains detailed instructions concerning the system level information required. As regards safety-related ventilation systems, the following data in particular shall be presented: process and instrumentation plans, backup provided for power supply units, necessary auxiliary systems, provision made for on-site and off-site factors which may damage plant systems, operating conditions of systems and mutual physical separation of redundant sub-systems. If a system's safety function is to restrict discharges or occupational radiation exposure, design data most important for the operation of the filtering devices used (filter type and retention efficiency) shall be given.

4.1.4 Structural design bases

The rooms and buildings shall be mentioned for whose ventilation technology specific tightness and isolation requirements are set, such as e.g. the control room, the fallout shelter, the containment and the reactor building. The tightness requirements for these rooms shall be defined and presented.

4.1.5 Fire protection design bases

Guide YVL 4.3 requires a preliminary description to be submitted of the operation of the ventilation systems in case of a fire and, also i.a. a description of smoke extraction. A description shall be submitted giving the location of the inlet and exhaust air openings of various ventilation systems, the location of the exhaust air openings of the smoke extraction systems, and an overall description of the procedures to prevent the harmful effects of smoke and hot gases and their spreading at the plant and on the plant site.

The location of the air intakes of safety-related equipment which require combustion air shall be indicated.

If the smoke extraction systems and conventional ventilation systems have ducts, fans or other components in common, the systems and their most important design data shall be given.

4.1.6 Preliminary maintenance, repair and inspection programme

The report shall present what provision has been made for maintenance, repair and inspection in the design of ventilation systems. An analysis shall be conducted of the accessibility during and after an accident condition of components of the ventilation systems required to operate during an accident condition. This applies in particular to filters which must operate during accident conditions.

The retention efficiency measurement and test methods to be employed in the periodic tests of the particulate and gas filters of the ventilation systems shall be presented. As regards the cooling systems, procedures relating to the periodic inspection of the heat transfer capability of the heat exchangers shall be presented. Continuous component condition monitoring during plant operation shall be accounted for in broad outline and by component group.

4.1.7 Quality control

The general quality control arrangements to be observed in the design, manufacture, installation and commissioning of ventilation system components shall be presented.

4.2 Inspections during construction

After the construction licence has been granted, the control of ventilation systems includes a review of the final versions of the preliminary reports presented in sub-section 4.1, an assessment of the design documents drawn up during the design process and a detailed inspection of actual ventilation components and systems.

During construction, the descriptions relating to ventilation referred to in sub-section 4.1 shall be finalised. They can be presented as part of the Final Safety Analysis Report or as separate system-specific documents. Furthermore, the requirements set in Guide YVL 4.3 concerning the submission of fire ventilation and smoke extraction descriptions shall be considered.

The control of individual ventilation equipment includes review of construction plans, control and construction inspections during manufacturing, commissioning inspections of the equipment and/or a system, control of start-up testing and review of the system's preoperational and start-up test report. The scope of the control applied depends on the safety-significance of a system or component. Since the major part of the ventilation systems subject to control by STUK are Safety Class 3, the requirements for pre-examination documentation in the below chapter are set according to Safety Class 3. Further requirements for the pre-examination of and regulatory procedures relating to Safety Class 2 systems and components are set case by case by STUK.

The manufacture of Safety Class 2 components shall not be commenced before STUK has approved the construction plan of the components.

STUK decides case by case what pre-examination reports for Class EYT (non-nuclear) systems and components are required in the Classification Document.

4.2.1 Construction plan requirements

Later in this Guide, the components of ventilation systems are divided into the following groups: fans, ducts, closing and control devices, filters, heaters/coolers and moisture separators. The requirements for components covered in the construction plan which do not unambiguously belong to these groups shall be presented separately. The requirements concerning the contents of construction plans are partly guidelines as regards the technical specifications of the components. Any of the design data below can be omitted if they appear obviously unnecessary considering e.g. the component's location, mode of operation or function.

For the purpose of reviewing a component's construction plan, the below documents or descriptions relating to the component shall be submitted to STUK:

Manufacturer

The manufacturer's expertise shall be accounted for. An explanation of the organisation confirmed by the company's management shall be given, showing among other things, the allocation of jobs, the areas of responsibility and the general arrangements relating to quality assurance. The description shall also include data on all sub-contractors and consultants who have a significant role in the design or manufacture of a component.

STUK assesses the manufacturer's competence and the adequacy of the quality assurance procedures of the manufacturer by conducting audits to the manufacturer's premises, if necessary.

Design data

The design bases for the ventilation system of which the component under inspection is part

of shall be given in the description. The location and functions of the component and also the meaning of its operation for the whole system's operation shall be described. Any deviations from the data given in the Preliminary Safety Analysis Report shall be presented and justified. The design data shall include all the plant's design-basis operating conditions, transients and accident conditions.

Of the **fans** of the ventilation systems, the following data shall be given:

- component designation
- safety class
- mode of operation (continuous operation, other)
- quality of medium (temperature, pressure, humidity etc.)
- required operating point and performance curve
- tightness requirements
- ambient conditions
- mode of installation (groundwork; ducts and motor)
- power supply demand within the operating range, during start-up and with the highest possible loading
- possible auxiliary systems required (cooling, sealing of shafts etc.)
- types of bearings, allowable temperatures and vibrations
- structural data on the sealing of shafts if specific tightness requirements have been set for the component
- maintenance items and ranges recommended by the manufacturer; the preliminary maintenance programme.

Drawings shall be presented of fans, motors, their coupling, installation and the couplings of possible auxiliary systems connected to the fans. In the drawings, data required to assess the acceptability of the design, manufacturing, installation and operation of the fans shall be given, such as:

- composition plus component and structural material lists
- component dimensions and geometry plus surface treatment types, location and dimensions of joints and fixtures

- welds and surface treatments
- clearances, fits and passes essential for operation
- groundwork and installation.

As regards coupling fan to motor, connecting fan to ducts and the data required about the motor, Guide YVL 5.7 shall be complied with for applicable parts.

Of the **filters** of the ventilation systems, the following details shall be given:

- component designation
- safety class
- operating mode (continuous flow, other)
- fluid medium quality (temperature, pressure, humidity, etc.)
- volume flow
- pressure losses (clean filter, max. allowable)
- retention efficiency (reference to be made to the test standard)
- tightness requirements for filter casing and mounting frame
- filter section material.

Furthermore, a detailed account of the quality of filter material shall be given, e.g. :

- general quality and strength properties of the paper or material of particle filters
- data about the material of possible separators of filter folds
- coupling agents or other mounting accessories employed for assembly
- quality of coal in gas filters (base material, particle size distribution, BET area, hardness, impregnation material and its amount, volume weight, ignition temperature)
- amount of coal and number of filter sections in the system and the mean retention times
- general structure of and the tightness requirements for filter casings
- possible type approvals and operational experience feedback
- ambient conditions.

Drawings shall be given of filters, filter casings and filter chambers and of how these

are coupled to ducts. The following details, among other things, shall be given in the drawings:

- composition of the filtering unit with component and structural materials lists
- dimensions, geometry and surface treatment of filter section and casing
- sealing arrangements to prevent leaks between filter sections and casings
- assemblies installed for testing purposes, and potential flow controllers and mixers
- location of fixed air flow measuring elements
- installation mode (groundwork, mounting on ducts, flow direction).

Of the **closing and control devices** of the ventilation systems, the following details shall be given:

- component designation
- safety class
- component type (shutoff, flow control, back draft prevention, other) and size
- mode of operation
- quality of fluid medium (temperature, pressure, purity, etc.)
- tightness requirements (tightness outward and downstream)
- actuator and its operating principle (type of actuator, operation if auxiliary force is lost, etc.)
- ambient conditions.

Drawings of the closing and control devices shall be presented with main dimensions and geometry, component and structural materials lists and mode of installation to the ducts.

As regards isolation valves of the containment ventilation systems, Guide YVL 5.3 shall be complied with for applicable parts.

Of the **ducts** of the ventilation systems, the following details shall be presented:

- component designation and location in the system (intake and exhaust ducts, other)
- safety class
- duct type (welded, spiral-weld, other)

- types of duct joints (welded, flanged, other)
- tightness requirements
- how ducts are mounted on the structures
- surface treatment requirements (inside and outside, decontaminability)
- main dimensions and structural materials
- fire insulation (class)
- ambient conditions (outside and inside the plant, other).

Drawings shall be presented of the ventilation system ducts showing in detail how they are conducted from room to room at the plant. Also the location and types of fire dampers and duct insulation derived from the fire compartment requirements shall be shown.

Of the **heating and cooling units** of the ventilation systems, the following data shall be presented:

- component designation
- safety class
- type and operating principle (water, electricity; downstream, upstream, etc.)
- cooling/heating capacity and other essential design values (water and air flow, temperature differences, conductance)
- design pressures (applies to pressure vessels, see YVL Guide group three)
- the necessary auxiliary systems (cooling water, disposal of condensation water, other)
- mode of installation to the system, location in the system
- measuring assemblies required for condition monitoring, and instrumentation (temperatures, pressure difference, flow).

Drawings shall be presented of the heat exchangers giving their most important dimensions and structural materials.

Of the **moisture separators** of the ventilation systems, the following details shall be presented:

- component designation
- safety class
- efficiency (as dependent on droplet size)
- the necessary auxiliary systems
- mode of coupling to the ducts
- tightness requirements.

Drawings of the moisture separators shall be presented showing their main dimensions and structural materials.

Quality control programme

The quality control programme shall present the systematic quality control measures to which a component or a system is subjected and also the inspection and test plans and instructions to be complied with when carrying out these measures.

In the inspection and test programmes, the quality control measures to which the component is subject to and which cover the component's actual manufacturing, tests during manufacturing, installation and commissioning shall be presented. The performer and supervisor of the most important measures shall be indicated in the plan.

The inspection and test instructions for the measures most important for the component's operation which are mentioned in the inspection and test programme shall be presented. The manner, scope, requirements and reporting of the inspections and tests shall be indicated in the instructions. The requirements can be made more explicit, if necessary, by referring to applicable standards.

4.2.2 Control and inspections during manufacturing

The Radiation and Nuclear Safety Authority (STUK) controls the manufacture of Safety Class 2 components by conducting audits to the manufacturer's premises in the scope deemed necessary. In connection with the audits, STUK's representative shall be given an opportunity to view the manufacturer's organisation, the component's manufacturing method and the quality control arrangements relating to manufacturing. For the purpose of the audits, the manufacturing schedule of the components shall be submitted to STUK in good time indicating the dates of the inspections and tests in accordance with the quality control programme.

STUK conducts audits to the manufacturing plant of Safety Class 3 components for a specific reason only, mostly as regards ventilation system fans and filters with high retention efficiency.

STUK conducts construction inspections of Safety Class 2 and 3 components. An inspection shall be requested from STUK well in advance of the preferred inspection date. The inspection is conducted at the manufacturing plant or at the plant site. Depending on the inspection item, the inspection is performed on a dismantled or re-assembled component or, if necessary, on both. If specific requirements have been set on a component's strength or tightness a construction inspection shall be conducted before the component's surface treatment is applied. The scope and technique of the construction inspection is decided case by case in connection with the review of the construction plan.

STUK grants the right to carry out the construction inspections of individual components or of a group of components to a utility inspector or a special inspection and testing body.

Construction inspection includes

- review of the quality control programme documentation
- review of the implementation of the construction plan design data
- inspection of general work quality
- witnessing any additional tests.

4.2.3 Commissioning inspection

The Radiation and Nuclear Safety Authority (STUK) mainly conducts commissioning inspections of entire, installed ventilation systems. All Safety Class 2 and 3 ventilation systems and components are inspected whose construction plan STUK has approved. In the inspection, i.a. the following factual entities are reviewed:

- quality control documentation
- approvals granted as regards construction plans and inspections

- reminders issued during previous inspections and how these have been acted upon
- quality of the system's installation work, unless checked in connection with previous inspections
- approvals granted as regards the startup test programme.

In a commissioning inspection, a system is first granted a preoperational and startup test licence. The inspection can be performed simply as part of the preoperational and startup test process and as a preparatory measure to it. A representative of STUK witnesses the tests as deemed necessary. After tests in accordance with the startup test programme have been performed, an operating licence is granted to the system or component, unless essential shortcomings in system or component operability are detected in the tests. The preoperational and startup test report shall be submitted to STUK within the agreed time.

4.3 Operating licence phase

In addition to the data contained in the Final Safety Analysis Report and the Technical Specifications, the following documents relating to the ventilation systems shall be submitted to STUK for information:

- operating instructions
- preventive maintenance programmes
- periodic test programmes.

The functioning and modes of operation of the ventilation systems during plant abnormal occurrences (fires, accidents, transients and emergencies) shall be considered in the respective plant procedures. These procedures shall be submitted to STUK for information before the plant's start-up.

4.3.1 Final Safety Analysis Report

As regards the ventilation systems, the design bases, systems descriptions, final mode of installation and, in a suitable form, the data required in sub-sections 4.1 and 4.2 shall be accounted for in the Final Safety Analysis Report.

4.3.2 Technical Specifications

The operational requirements for safety-related ventilation systems under all plant operational states shall be given in the plant's Technical Specifications. The Tech Specs shall also include periodic tests to verify the validity of the operational requirements for safety-related ventilation systems and components.

4.3.3 Operating instructions

The measures to ensure the faultless, design-basis operation of systems under various plant operational states shall be presented in the operating instructions.

The instructions shall be submitted to STUK for information.

4.3.4 Preventive maintenance programme

The preventive maintenance programme shall present the pre-determined, regular system and component specific maintenance measures relating to condition monitoring which ensure the reliable, design-basis operation of the systems and components during the operating cycle.

The preventive maintenance programme shall be submitted to the Radiation and Nuclear Safety Authority (STUK) for information.

4.3.5 Periodic test programme

The periodic test programme shall present the system and component specific tests required to verify the preservation of performance figures essential for the operation of the systems, and the date and scope of the tests. Such tests include e.g. measurement of heat exchanger capacity and system air flow and monitoring of filter retention efficiency and structural tightness.

The periodic test programme shall be submitted to STUK for information.

4.4 Regulatory control during plant operation

The Radiation and Nuclear Safety Authority (STUK) controls the implementation of the ventilation system preventive maintenance and periodic test programmes by witnessing actual on-site measures and also by reviewing records relating to these measures. The ventilation systems, their modes of operation and the procedures to be complied with during operation are also inspected as part of the nuclear power plant's periodic examination programme in accordance with Guide YVL 1.1.

STUK may request the submission of certain periodic test reports for review. The obligation to submit the reports is decided case by case.

4.4.1 Periodic inspections

As it deems necessary, the Radiation and Nuclear Safety Authority (STUK) conducts periodic inspections of certain systems, entities of systems, or components, and reviews the procedures to be complied with in plant operation and maintenance. STUK decides the items and dates of inspection every year. The operation and maintenance of the ventilation systems falls within the scope of this control. The items of inspection are chosen on the basis of their topicality at the time of the inspections.

4.4.2 Modifications, repairs and preventive maintenance

In modifications, repairs and preventive maintenance during plant operation, Guide YVL 1.8 shall be applied.

5 References

- 1 Indoor air and ventilation of buildings, The Finnish Building Code, D2
- 2 Structural fire safety, The Finnish Building Code, E1
- 3 Fire Safety of Ventilation Installation, The Finnish Building Code, E 7
- 4 Ventilation techniques, SFS handbook 103
- 5 Design, testing and maintenance criteria for post-accident engineered-safety-feature atmosphere clean-up system air filtration and adsorption units of light-water-cooled nuclear power plants, U.S.NRC Regulatory Guide 1.52, 1978
- 6 Design, testing and maintenance criteria for normal ventilation exhaust system air filtration and adsorption units of light-water-cooled nuclear power plants, U.S.NRC Regulatory Guide 1.140, 1979
- 7 Pressurized water reactor containment ventilation systems, ANSI 56.6, 1986
- 8 Boiling water reactor containment ventilation systems, ANSI 56.7, 1987
- 9 Nuclear power plant air cleaning units and components, ANSI/ASME N509, 1989
- 10 Testing of nuclear air-cleaning systems, ANSI/ASME N510, 1989
- 11 Lüftungstechnische Komponenten in kerntechnischen Anlagen, DIN 25414, 1990
- 12 Lüftungstechnische Komponenten in kerntechnischen Anlagen, DIN 25496, draft 1989
- 13 Design of off-gas and air cleaning systems at nuclear power plants, IAEA Technical Report Series No. 274, 1987.