Annex 5 to the Govt. Decree No. 118/2011 (VII. 11.)

Nuclear Safety Code

Volume 5

Design and operation of research reactors

5.1. INTRODUCTION

5.1.0.0100. The purpose of this regulation is to lay down the nuclear safety requirements related to design, commissioning, operation and operation related activities of research reactors.

5.1.0.0200. The requirements of this Volume relate to nuclear reactors as to facilities used for research, training purposes and operated or intended to be constructed within the territory of Hungary as well as to their safety related systems and system components.

5.2. DESIGN REQUIREMENTS FOR RESEARCH REACTORS

5.2.0.0100. The generic non-nuclear design and design related safety requirements shall also apply to research reactors.

5.2.1. Safety classification of systems, structures and components important to nuclear safety

Safety classification

5.2.1.0100. In order to ensure an appropriate level of nuclear safety the design shall provide for tools to fulfill the basic design safety functions.

5.2.1.0200. The set of design safety functions that shall be fully complied with by the systems, structures and components of the research reactor to meet the requirement for basic design safety functions in Para 5.2.1.0100 shall be determined.

5.2.1.0300. The safety functions together with the systems, buildings, structures and components shall be classified according to safety. The experimental devices shall also be covered by safety classification if their operation may affect any of the safety functions of the research reactor. The designer shall use deterministic methods to classify the systems, structures and components. Potential consequences of availability or unavailability of systems, structures and components in various reactor operation states considered in the

deterministic analyses, especially for anticipated operational occurrences and design basis accidents shall be taken into account.

5.2.1.0400. Safety class of buildings and their constituting building structures shall be determined according to the fulfilled safety functions and the system component of the highest class housed by the building. If the building structure element connects to a Safety Class 1 component, the building structure element shall be in Safety Class 2.

5.2.1.0410. The building structure within the last physical barrier shall be safety classified.

5.2.1.0500. Technical and quality requirements shall be graded according to the safety classes relevant for the systems, structures and components and the respective activities important to nuclear safety.

Seismic safety classification

5.2.1.0600. According to the safety functions to be fulfilled during an earthquake, the designer shall classify the systems, structures and components of the research reactor into seismic safety classes. The classification shall cover the experimental devices if they may affect the seismic safety of the research reactor.

5.2.1.0700. Active systems, structures and components to shut down, maintain in subcritical state and cool the research reactor, to monitor the critical parameters and to ensure that the radioactive releases remain within the regulatory requirements shall be classified into class 1, while passive systems providing the same functions shall be classified into class 2.

5.2.1.0800. Buildings and building structures fulfilling safety functions can be classified into seismic safety class 2 at most.

5.2.1.0900. Those system components shall belong to seismic safety class 3, which do not belong to seismic safety class 1 or class 2, and those building structures that do not belong to seismic safety class 2, but whose failure or consequences of failure during an earthquake might jeopardize the function of a class 1 or 2 system component or a seismic safety class 2 building structure. Considering the amount of radioactive material stored and consequences of the potential failure, those system components and building structures shall be classified into seismic safety class 3, at which the seismic robustness is important to be ensured due to the consequence of a potential failure.

5.2.1.1000. All other system components and building structures that are not classified in one of seismic safety classes 1, 2 or 3 shall belong to a fourth, i.e. a non seismic safety class.

5.2.2. Demonstration of safety

5.2.2.0100. The compliance with the generic design safety requirements, safety of the nuclear facility during the design, construction, commissioning and operation shall be assessed and demonstrated. The analyses shall be carried out with duly documented, proven and verifiable analysis tools and methods, based on a determined and representative database. The design and analysis tools and the input data shall be verified and validated, accordingly the analysis tools shall be demonstrated via benchmarking with real processes, appropriate experiment or inspection results. If this is not possible then benchmarking with different calculation methods is necessary. The verification and validation shall also be carried out by an analyzer or institute independent of the analyzer or institute of the original analyses and of the designer.

5.2.2.0200. Safety analyses shall be documented in such a way and to such a depth that ensures that they can be repeated or audited by independent technical experts throughout the whole lifetime of the research reactor, can be reviewed or modified if necessary, and the conservatism applied and the available margins can be reviewed and re-evaluated.

5.2.2.0300. Safety analyses shall cover the reactor, the fresh and spent fuel, the storage of radioactive wastes and radioactive sources, as well as the normal and accident states that are considered in the design and might occur during the service of or operations with these facilities.

Design basis

5.2.2.0400. Data and limits to determine the detailed design basis shall be derived from the theoretical or experimental analysis of consequences of design basis accidents, or from engineering judgment generally accepted in practice in order to ensure the compliance of the systems, structures and components with the functional requirements.

5.2.2.0500. Operating states of the nuclear facility shall be identified; the postulated initiating events shall be categorized. The categories shall cover normal service, anticipated operational occurrences and design basis accidents. Acceptance criteria shall be assigned to each category by observing the requirement that frequent initiating events may only entail very limited radiological consequences, while during design basis accidents of significantly lower frequency, the compliance with the release limits specified for accidents shall be ensured.

5.2.2.0600. Design basis shall be systematically determined and documented in such a way that the nuclear facility always complies with its current design basis.

5.2.2.0700. The postulated initiating events occurring at low power or in

shutdown state of the reactor shall be determined and analyzed separately within the design basis.

Postulated initiating events

5.2.2.0800. All such events compromising safety shall be considered as initiating event during the design, which are:

a) in relation with the site of the research reactor and its environment, including the natural phenomena;

b) occurring as consequences of intentional or unintentional on-site or off-site human activities;

c) originating from the operation of the nuclear facility, including all designed service states of the research reactor, so especially the shutdown state, activities related to maintenance and experimental devices, if their operation might affect any of the safety function of the research reactor.

5.2.2.0900. Individual loads and environmental conditions affecting the systems, structures and components initiated by the following internal events shall be considered in the design as a minimum:

a) flooding,

b) drop of load,

c) explosion,

d) fire and

e) hazards from experimental or training activities.

5.2.2.1000. Loads and environmental conditions induced by site-specific natural and artificial external events affecting the systems, structures and components shall be considered in the design. In compliance with the site-specific criteria the safety analyses shall contain the following external hazards as a minimum:

a) extreme wind,

b) extreme external temperature,

c) extreme precipitation,

d) lightning,

e) icy and ice-free flooding,

f) explosion,

g) missiles generated by wind,

h) effect of transport, industrial and mining activities in the vicinity of the site,

i) geological characteristics taken into account in the geological demonstration of the site (e.g. earthquake, soil liquefaction),

j) crash of military and civil aircraft,

k) disturbance of external electricity grid, including its lasting and total loss,

l) such facilities inside or in the vicinity of the site that may impose fire, explosion or other risks to the research reactor,

m) external fire effect,

n) electromagnetic interference, and

o) hazards of biological origin.

5.2.2.1100. When an initiating event occurs, at least one of the physical barriers designed to confine radioactive materials shall remain intact, or it shall be demonstrated that the radiation protection objectives are still complied with despite the failure of the barriers. The most severe single failure of the systems of the research reactor or a human error having identical effect shall be postulated in the analyses.

Deterministic safety analysis

5.2.2.1200. The deterministic safety analysis shall contain the response of the research reactor to the postulated initiating events that may lead to anticipated operational occurrences or accident conditions. These analyses shall be used to design the systems important to nuclear safety and to ground the operational limits and conditions.

5.2.2.1300. Deterministic safety analyses shall

a) specify and analyze the postulated initiating events;

b) analyze event sequences and consequences induced by the postulated initiating events, and the effect of event sequences on the processes of the nuclear facility;

c) compare the results with the radiation protection acceptance criteria and design conditions;

d) describe that the anticipated operational occurrences, design basis accidents and certain accident situations can be managed by automatic actuation of the systems important to nuclear safety and by prescribed operator interventions; and

e) determine the operational limits and conditions.

5.2.2.1400. Applicability of analyses methods shall be demonstrated.

5.2.2.1500. It shall be demonstrated concerning all hazards and hazard factors

that the safety aspects determined during the design and analyses have been taken into account by the designer and the relevant criteria have been complied with. Exclusion of events from the design basis shall be based on their frequency, or it shall be demonstrated that the given hazard factor is appropriately distant and no effect is reasonably expected on the research reactor.

5.2.2.1600. The most adverse operation of the systems important to nuclear safety shall be taken into account during design basis accidents.

5.2.2.1700. The anticipated operational occurrences and design basis accidents shall be analyzed with conservatism to ensure that the requirements are reliably complied with. It shall be demonstrated that

a) the structural materials have adequate safety margin in every operational state;

b) the parameters characterizing the conditions after a design basis accident remain within the required design limits in the cooling circuit of the nuclear reactor and in the service buildings housing its systems and components; and

c) adequate cooling and sub-criticality of the active core is ensured.

5.2.2.1800. Event sequences can be grouped for accident analysis purposes and a bounding case can be identified for each group. The bounding case shall be selected by considering the relevant physical and chemical processes, the actuation signals of the safety systems and components to provide that the consequences of the case selected is at least as severe as any of the group represented without assuming any further independent failure. It is adequate to perform the analysis for the bounding case.

5.2.2.1900. The deterministic safety analysis shall demonstrate that those harmful effects, which are induced by the consequences of event sequences, do not endanger the operability and performance of the systems and components important to nuclear safety.

5.2.2.2000. In shall be ensured that the probability of occurrence of nucleate boiling during anticipated operational occurrences and design basis accidents is appropriately low at any location of the active core. If according to the deterministic safety analyses nucleate boiling is probable to occur in certain fuel elements, then failure of these fuel elements as well as their leakage shall be assumed.

5.2.2.2100. Is shall be demonstrated concerning design basis accidents that the short and long term cooling of the fuel elements, if it is justified by the safety analyses of the research reactor, can be maintained.

5.2.2.2200. In respect of those event sequences, which lead to release of

radioactive materials, the internal and external radiation exposure to persons staying in endangered areas on-site and off-site shall be estimated.

5.2.2.2300. The radiation protection calculations shall address direct radiation, inhalation and ingestion of radioactive materials and shall take account of physical and chemical properties of the radioactive materials released.

5.2.2.2400. The deterministic safety analyses shall cover the experimental devices, in addition the construction and operation of these devices shall be analyzed from the aspect of their own safety and their effects on the research reactor.

5.2.2.2500. The analysis of operator interventions assumed to be performed during design basis accidents shall take into account the circumstances and time demand of service control and evaluation, evaluation of service state, decision-making and execution. The analyses shall demonstrate that the necessary operations can be performed within the available time frames.

5.2.2.2600. Accident analyses shall be duly realistic to serve as basis for the development of accident management strategies.

5.2.2.2700. All postulated initiating events, the emergencies induced by the combination of nuclear and conventional hazards and hazard factors, as well as the nuclear emergencies induced by conventional emergencies shall be analyzed. The analysis shall be appropriately detailed to ground the compliance with the nuclear emergency preparedness requirements and to preliminary plan the protective actions for the public living off the site. All such processes and activities shall be identified in the analysis, in the case of which the postulated emergency requires the introduction of on-site or off-site protective actions.

5.2.2.2800. Arrangements shall be made for the technological and radiological analysis of the emergency situation, to estimate the occurred or predicted source-term and to forecast the consequences of the release. The analysis, to the extent possible, shall be based on measured data.

Probabilistic safety analysis

5.2.2.2900. Fault-logic model of the research reactor shall be developed, which shall systematically include each possible operational states, system configuration and all the postulated initiating events, and which can serve as a basis for a future probabilistic safety assessment.

5.2.2.3000. Probabilistic safety assessment shall be performed, if a reliable database can be produced. The licensee of the research reactor shall endeavor to collect all the data, which may be utilized in a future probabilistic safety assessment.

Hazards and hazard factors

5.2.2.3100. Every hazard and hazard factor having external and internal origin affecting the research reactor shall be analyzed and evaluated. It shall be assumed that the hazards and hazard factors occur during the most adverse normal service conditions of the research reactor. The analysis shall take into account:

a) reasonably assumable combination of various, simultaneously occurring hazards and hazard factors, and

b) that the hazard or hazard factor occurs when a failure exists or maintenance is taking place.

5.2.2.3200. The design basis earthquake shall be taken into account in the design of the research reactor. The probability of occurrence of the largest earthquake that does not compromise the safety of the research reactor, depending on the power and purpose of use, shall not exceed the following values taken for the whole lifecycle:

a) in the case of a special research reactor: 5×10^{-3}

b) in the case of a research reactor having 0.1-10 MW thermal power: 5×10^{-2}

c) in the case of a research reactor having thermal power not greater than 0.1 MW: 10^{-1}

5.2.2.3300. The annual exceedance probability shall be calculated from the specific value determined in Para 5.2.2.3200 taking into account the whole lifetime.

5.2.2.3400. Other hazard factors of natural origin shall also be taken into account in the design basis depending on the power and purpose of use of the research reactor, according to the above considerations, with an exceedance probability calculated for the whole lifetime.

5.2.2.3500. It shall be demonstrated regarding all the potential hazards and hazard factors that the requirements for design specifications are adequately complied with according to the design, analysis and probabilistic principles. Only those hazards and hazard factors can be screened out without any further assessment, about which it can be demonstrated that no effect can reasonably be expected on the safety of the research reactor.

5.2.2.3600. In the determination of the severity of hazards and hazard factors, site-specific or, if it is not available, certified conservative data shall be applied.

5.2.2.3700. Stability and changes of external factors affecting the nuclear safety of the research reactor shall be forecasted for the whole lifespan of the nuclear facility.

Earthquake

5.2.2.3800.

5.2.2.3900. The research reactor shall be designed in such a way that the exceedance of the horizontal peak ground or spectral accelerations of the design basis earthquake shall not cause immediate failure and loss of function.

5.2.2.4000. The systems, structures and components of the research reactor shall be designed according to the respective safety and seismic-safety class and according to the classes of the selected design standard, by a graded approach with respect to the safety importance.

Strength analysis

5.2.2.4100. The results of strength analysis shall demonstrate that the structural components, the dimensions and materials, so the load bearing capacity of the components are appropriate for the loads and load combinations assumed in normal service, anticipated operational occurrences and design basis accidents of the research reactor.

5.2.2.4200. The content of the designs shall be supported by analyses with the consideration of the loads, ageing processes, environmental conditions and load cycles anticipated during the whole lifetime, and it shall be demonstrated that the lifetime of the examined load bearing component is appropriately long.

5.2.2.4300. In the design, the loads and load combinations shall be determined according to the safety and seismic safety class and function of the systems, structures and components, by considering the conditions of normal service, anticipated operational occurrences, design basis accidents and tests. Their particular combinations shall be determined in the design specification based on the coexistence and relevance of the loads.

5.2.2.4400. All load combinations taken into account in the design of the systems, structures and components important to nuclear safety shall be considered together with the respective occurrence frequencies.

5.2.2.4500. The change of material properties of the structural materials of the examined systems, structures or components caused by ageing effects shall be considered during the strength analysis. Where it is necessary the sensitivity of the obtained results to the selected analysis method shall also be examined.

Design data and models

5.2.2.4600. The data used for the analyses shall be corrected and certified by real benchmark data, experimental results or other way; this shall be ensured also for extrapolated data. Where uncertainty exists in the use of data, it shall be eliminated by appropriate conservatism to improve safety. If the data cannot be

duly grounded, extrapolation shall not be allowed. The initial and boundary conditions shall be determined conservatively.

5.2.2.4700. Models shall be applied to support the design and demonstrate its adequacy, as well as to describe the conditions related to the safety of the research reactor in normal service, anticipated operational occurrences and design basis accidents. Proven scientific interpretation shall support these models, and the necessary assumptions and applied approximations shall enhance safety in a certified manner.

5.2.2.4800. The analysis models, in their parts or in full scope, shall be certified by experiments that describe the anticipated conditions of the research reactor to the extent possible. Uncertainties appearing in the experimental analysis of conditions of the research reactor shall be taken into account. Where it is practical, an independent verification of the analyses shall be performed using different procedures or analytical models.

Final Safety Analysis Report

5.2.2.4900. The designer shall develop the Preliminary and Final Safety Analysis Report of the planned nuclear facility in due course of design.

5.2.2.5000. The Final Safety Analysis Report shall describe at least:

a) the site, including determination of the site boundary by EOV coordinates, the design of the nuclear facility and its normal service, and how the required level of safety is realized;

b) the safety functions, the systems, structures and components providing the aforementioned functions, the design basis for normal service, anticipated operational occurrences and design basis accidents;

c) the operating organization of the nuclear facility and the aspects of safe operation;

d) the applicable legislations, regulations and standards,

e) the evaluation of nuclear safety circumstances of the site;

f) general design principles for the nuclear facility and methods applied to fulfill the fundamental safety objectives;

g) safety analyses made to demonstrate the fulfillment of safety criteria and compliance with release limits for radioactive materials during the occurrence of postulated initiating events in order to evaluate the safety of the nuclear power plant;

h) the most important assumptions and input data used for seismic safety;

i) the commissioning programme of the nuclear facility and the considerations for the basis of the programme, and the presentation that the commissioning activity can sufficiently prove that the nuclear unit will operate according to plans and safety regulations;

j) requirements, conditions and limits for the design and operation of experimental devices, their operation during normal service, anticipated operational occurrences and design basis accidents;

k) emergency operating procedures, inspection and testing arrangements, training requirements and training for personnel, procedure of operating experience feedback, and the ageing management programme;

l) maintenance, testing, ageing management and in-service inspection programmes, and the considerations what they are based upon;

m) the technical grounding of operational limits and conditions;

n) radiation protection policy, strategy, methods and regulation;

o) the design basis and suitability of on-site nuclear emergency preparedness, cooperation and coordination with off-site organizations that play a role in nuclear emergency response;

p) on-site management system for radioactive waste, the respective requirements and their basis; and

q) how the aspects of final shut-down and decommissioning are considered during operation.

5.2.3. General design requirements

5.2.3.0100. The systems, structures and components important to nuclear safety shall be designed to ensure that the general nuclear safety objectives, the supplementing radiation protection and technical safety objectives set for the application of the nuclear facility can be realized. The design of the nuclear facility shall ensure that the nuclear safety of the nuclear facility can be maintained during the occurrence of hazards and hazard factors considered in the design basis by inherent design safety features to the extent possible without any active control system or intervention by any of the systems or system components important to nuclear safety.

5.2.3.0200. Principle of defense-in-depth shall apply for research reactors.

5.2.3.0300. Where appropriate standards are not available, the adequacy of the applied design or solution shall be demonstrated.

5.2.3.0400. Only such a research reactor shall be constructed and operated, the design of which is grounded on appropriate research and development. The

constructions shall be tested before operation and inspected during operation, with special attention to their features.

5.2.3.0500. The research reactor shall be designed to ensure that every safety function required for its safe operation is available on the site and the systems, structures and components important to nuclear safety can perform the intended safety function during normal service, anticipated operational occurrences, design basis accidents and beyond design basis accidents.

5.2.3.0600.

5.2.3.0700. The nuclear facility shall be designed to ensure that the sensitivity of the research reactor to potential failures is minimal. The priorities below shall be followed in the design basis following the occurrence of any initiating event:

a) a single failure or false intervention shall not lead to significant change in operation or, in the shutdown state of the research reactor, may induce only changes towards safer conditions;

b) after a failure or false intervention the research reactor shall remain in safe conditions via actuation of available passive instruments or design protection;

c) after a failure or false intervention the research reactor shall remain in safe conditions via active protections actuated by the failure.

5.2.3.0800. The design shall provide for:

a) inherent stability in each critical operational state by means of negative reactivity coefficients and other negative feedback mechanisms, and

b) intactness of the nuclear fuel cladding by such thermal properties that cannot cause significant temperature change during power operation or if disturbances occur in the coolant flow, which would lead to fuel cladding failure.

5.2.3.0900. Systems, structures and components important to nuclear safety shall meet the appropriate design, fabrication, structural, revision, inspection, maintenance and operational requirements that are graded according to safety and seismic safety classification.

5.2.3.1000. Fulfillment of the safety functions of systems, structures and components important to nuclear safety shall not be disturbed or impaired by any other non-safety function, or the planned or unplanned operation of any non-safety classified system.

5.2.3.1100. The system components important to nuclear safety shall be faultless but their tolerance to failures shall be demonstrated. The following methods can be applied for that purpose:

a) application of proven design methods and faultless design concept;

b) use of proven structural materials;

c) application of standards with high level requirements during design, purchase, fabrication, assembly and operation;

d) performance of pre-service and in-service inspections to reveal all such flaws which could lead to accident;

e) appropriate preparation of equipment inspection and material testing; and

f) instruments to indicate leak-before-break.

5.2.3.1200. The dimensions of a flaw described in Para 5.2.3.1100. *d)* shall be determined conservatively.

5.2.3.1300. The systems and components important to nuclear safety and their auxiliary systems shall be designed to minimize the effects of internal and external hazards and hazard factors, as well as the interactions between the failed systems and components.

5.2.4. Buildings and civil structures

5.2.4.0100.

5.2.4.0200. It shall be assessed whether the specific structures are able to withstand the loads that occur during normal service, anticipated operational occurrences and design basis accidents. The assessments shall comply with the relevant regulations and standards and shall contain model assessments, as appropriate.

5.2.4.0300. Loads originating from their functions shall be considered during the placement and structural design of buildings and civil structures. The interaction of loads, their effects on the environment, life, nuclear safety and on security of assets shall also be taken into account.

5.2.4.0400. Design of buildings shall take into account the environmental effects identified during site assessments. The buildings shall meet the demands required by the properties of radioactive materials and the need of a biological protection.

5.2.4.0500.

5.2.5. Lifetime

5.2.5.0100. During the selection of materials for systems, structures and components important to nuclear safety the service loads, ageing mechanisms, including irradiation, corrosion, erosion, change of dimensions, fatigue and chemical and physical effects of the environment as well as the combinations of

all these shall be taken into account. Evidence shall be provided that the materials selected do not impair the systems, structures and components in fulfilling their safety functions considering the original state, the anticipated ageing effects and their uncertainty.

5.2.5.0200. The allowed service lifetime of the systems, structures and components important to nuclear safety shall be analyzed, evaluated and determined already during the design stage, with special attention to those, the replacement of which is difficult or unreasonable to be performed. Appropriate limitations and conditions shall be required to slow down and reduce the time dependent degradation processes and withstand their adverse effects. Unambiguous service indicators, performance criteria shall be developed to determine the usage, allowed conditions and duration of operation of such systems, structures and components.

5.2.5.0300. Service lifetime of systems, structures and components important to nuclear safety in accident conditions shall be determined during the design period.

5.2.6. Reliability

5.2.6.0100. Systems, structures and components important to nuclear safety shall be designed, fabricated, and qualified for environmental loads and earthquakes; their degradation mechanisms shall be revealed during the qualification. The systems, structures and components shall be maintained during operation to provide that their quality and reliability are appropriate and are in harmony with their classification following the degradations assumed during operation.

5.2.6.0200. Required level of reliability of systems fulfilling nuclear safety functions shall be maintained by measures selected according to the design. Such measures can be the use of highly reliable, qualified system components, application of redundancy and diversity, physical and functional separation.

5.2.6.0300. If any of the initiating events of the design basis occurs, the systems, structures and components important to nuclear safety that are necessary for the management of the given initiating event, shall still be able to fulfill their functions even in the case of a single failure.

5.2.6.0400. Functional and physical separation of the redundant system components of safety classified systems, especially of the auxiliary system and electric power supply shall be ensured from all aspect of fulfillment of the function.

5.2.6.0500. Regarding systems and system components important to nuclear safety, the maximum allowed duration of inoperability as well as the cycle periods of their in-service inspection and testing shall be determined. For the

determination of the cycle period, the balance between the risks caused by the maintenance activity and the increase of reliability yielded by the maintenance shall be taken into account.

5.2.6.0600. Programmable systems used in a safety system, beyond the general requirements relevant for similar systems, shall comply with the following requirements:

a) hardware and software tools which fulfill the requirements for sufficient quality and references shall be applied,

b) the whole development process, including verification, testing and putting into use of design changes shall be systematically documented and evaluated,

c) in order to demonstrate their reliability the computer based systems shall be reviewed by technical experts, who shall be independent of the designer and the vendor,

d) if the necessary level of reliability of a system cannot be demonstrated, diverse means shall be provided to fulfill the assigned protection function, and

e) appropriate design shall provide that the workers cannot block automatic activations during normal service, anticipated operational occurrences and design basis accidents, but are able to implement the necessary interventions.

5.2.7. Structural materials

5.2.7.0100. The materials of systems, structures and components important to nuclear safety shall be selected by taking into account the conditions during normal service, anticipated operational occurrences and design basis accidents; it shall be demonstrated already during the design stage that the selected materials do not hinder the systems and system components in fulfilling their function under the specific environmental conditions.

5.2.7.0200. During the design of systems, structures and components important to nuclear safety the change of material properties of structural materials due to ageing effects shall be evaluated according to the methodology and criteria accepted by the nuclear safety authority.

5.2.7.0300. In the selection of structural materials of systems, structures and components, the following properties shall be considered in accordance with the intended function:

a) the physical-mechanical properties, the composition in line with the scope according to the requirements identified during the design stage, the structural, strength and other material properties at environmental and design temperature shall be taken into account;

b) processing requirements, including the application dependent ductility and welding properties;

c) the requirements for reliable operability, including the guaranteed tolerance of minimum and maximum service and design basis accident temperatures and maximum service pressure;

d) requirements for design lifetime, including ageing processes;

e) constructional features, compatibility of contacting structural materials;

f) performance of scheduled in-service inspections and tests, and requirements for repair and replacement;

g) characteristics of the technological process; and

h) environmental parameters.

5.2.7.0400. Beyond the requirements above, the application of such structural materials shall be considered during the design of systems and system components important to nuclear safety:

a) which are proven and whose compliance is demonstrated;

b) the properties of which are known and approach the design limit with an appropriate safety margin;

c) which, if subjected to radioactive irradiation, are not susceptible to activation and their structure is such that the activated particles remain in the place of generation;

d) which provide for such surface finishing, which can be decontaminated to the extent possible during operation and termination; and

e) which are fire resistant.

5.2.7.0500. The materials of systems, structures and components being in contact with the reactor coolant shall be selected to minimize the quantity of corrosion products and their activation in the coolant system.

5.2.8. Maintenance, surveillance and inspection

5.2.8.0100. The design shall ensure the possibility of periodic review of every system and component to determine their structural integrity and leaktightness, to execute their functional testing and in-service inspection and to determine the influence of irradiation on the ageing of structural materials.

5.2.8.0200. The frequency and performance requirements for functional testing, maintenance and inspection of systems and system components shall be determined during design to conform with the safety classification of systems,

structures and components important to nuclear safety.

5.2.8.0300. The design and construction of the systems and system components of the research reactor shall support the performance of revision, inspection, maintenance, modification, repair and replacement to maintain the safe condition of the nuclear facility throughout its whole lifetime.

5.2.9. Qualification of system components

5.2.9.0100. In order to demonstrate the safe condition of system components important to nuclear safety, a qualification procedure or other methods shall be applied to provide the necessary data on fabrication, inspection, revision, operation and maintenance throughout the lifetime.

5.2.9.0200. Testing, analysis and operating experience and combination of these can be applied for the qualification of system components. In the selection of the method, priority shall be given to testing, where it is possible.

5.2.9.0300. In the determination of the various levels of requirements in the qualification programme of system components, besides the safety classification and the environmental parameters at the location of installation, the sensitivity of materials of the system component to the changes of parameters shall also be taken into account.

5.2.10. Ageing management

5.2.10.0100. Designer requirements for ageing management shall be developed for systems, structures and components important to nuclear and seismic safety. The requirements shall address:

a) identification of ageing locations and ageing processes of systems, structures and components;

b) estimation of anticipated progress of ageing processes;

c) maintenance, material testing, testing and monitoring activities necessary for management of ageing processes and

d) measures to slow down and reduce the ageing and degradation process.

5.2.11. Pressure retaining components and piping

5.2.11.0100. Appropriate durability of the material of components fulfilling safety, pressure retaining function shall be ensured.

5.2.11.0200. The pressure retaining components and piping shall have a passport. The passport shall contain the basic technical and administrative data, which characterize the given system component.

5.2.12. Chemistry

5.2.12.0100. Water management of the research reactor coolant shall be designed; the limiting parameters of the coolant shall be justified. The following aspects shall be taken into account during the design:

a) the structural materials, constructions, the composition and conditioning of process mediums and accessory materials shall be harmonized and selected in order to limit the corrosion effects within the design values and to guarantee the integrity of systems and system components;

b) the process to remove the corrosion products and other radioactive contaminants shall be designed for every system; appropriate methods and tools shall be elaborated and installed;

c) operational measurement of water parameters shall be designed; the measurement frequency of the various parameters shall be determined from the continuous in-service measurements to sample type inspections based on the effect on nuclear safety; and

d) the sampling and analysis methods shall be developed to provide representative samples from the sampling system in a way that provides reaction free sampling from the aspect of safe operation.

5.2.12.0200. Water service of the nuclear facility shall be designed, the service parameters shall be determined, the systems and accessory materials shall be specified in order to minimize the amount of radioactive waste generated and to ensure the environmental protection and ALARA principles.

5.2.12.0300. The water and air purification systems shall be designed and constructed to address the following aspects:

a) the quantity and concentration of radioactive materials released to the environment in normal service, anticipated operational occurrences and design basis accidents shall remain within the authority limits;

b) the quantity of radioactive waste generated during the cleaning processes shall be kept as low as possible with the application of the ALARA principle;

c) the capacity of the cleaning systems shall guarantee that the quantity of corrosion products in the system is constant and acceptably low from nuclear safety point of view;

d) the cleaning process shall be designed and implemented to ensure that the passive protection layer on the surface of structural metals remains intact or will re-build; and

e) such cleaning process shall be designed and implemented, which is in compliance with the environmental protection requirements and aspects.

5.2.13. Human factor

5.2.13.0100. These requirements relate to the design of the main control room and other control stations of research reactors and to provision of maintenance and inspections. Special attention shall be paid to the design of the display system, control panels, accessibility of areas for maintenance work and to the physical environment.

5.2.13.0200. Principles of ergonomics shall be visible in the design of working areas and working environment of the workers.

5.2.13.0300. Human factor, human-machine interface shall be kept in view from the early stage of design and consistently addressed throughout the whole process.

5.2.13.0400. The design shall ensure that the duly trained workers are able to successfully intervene in the assumed physical environment, under the given psychical conditions, within the scheduled timeframes. Demands for short time interventions, which are to be accomplished within a few minutes, shall be reduced to the minimum.

5.2.13.0500. Tasks of the workers shall be determined in the design process. This determination shall cover the management of normal service, anticipated operational occurrences, design basis accidents, nuclear emergency response, in-service inspection and testing, tasks of the workers performing the inspections and trouble-shooting, as well as the definition of the tasks of workers performing maintenance, testing and calibration activities.

5.2.13.0600. All requirements influencing the human factor shall be considered in the design, including the human-machine interface. Tasks, systems and system components shall be designed to provide as simple as possible process for training of workers to perform the tasks and to develop the operational procedures. During the planning of operational tasks and in the determination of the operational procedures regulating the performance of the task, the circumstances of execution and the requirements for the worker who executes the task shall be considered.

5.2.13.0700. Displays of the process variables functionally connecting to each other and the status indicators of control devices of such parameters shall be placed in groups by taking into account the requirements for functionality, reliable handling and ergonomics. Signals providing information shall be linked with visual and audio signals.

5.2.13.0800. Adequacy of the documents describing operator interventions corresponding to safety of the research reactor shall be demonstrated.

5.2.13.0900. The effect of human relations on the activity of workers and those

staying on the site of the research reactor shall be evaluated during the design. First of all the effect of subordinations, cooperation and communication shall be addressed. These aspects shall be taken into account for the determination of the composition of and requirements for the workers staying on the site of the research reactor. It shall be ensured that the workers are not able to prevent any safety actuation, but are able to timely implement the necessary and anticipated interventions.

5.2.14. Arrangement

5.2.14.0100. Systems, structures and components and the auxiliary systems important to nuclear safety shall be designed to minimize the effect of internal and external hazards and hazard factors.

5.2.14.0200. The buildings and infrastructure within the site shall be designed that if any internal or external hazard or hazard factor, failure or design basis accident occur, then the following arrangements shall be available:

a) alternative opportunity to control the areas important to nuclear safety and to implement the necessary activities;

b) alternative access to personal protective equipment in the areas managed in normal situation and in design basis accidents; and

c) appropriate tools against the direct and indirect effects of normal operation, an anticipated operational occurrence or a design basis accident, to provide reasonably achievable protection for the persons staying on the site of the research reactor.

5.2.15. Fire protection

5.2.15.0100. Such systems, structures and components shall be designed for the operation of the research reactor that ensure timely detection of any potential fire or explosion and mitigation of its consequences.

5.2.15.0200. During the installation of systems, structures and components the physical separation of the systems, structures and components important to nuclear safety shall ensure the ineffectiveness of the consequences of a fire or explosion should such an event occur on the redundant systems, structures and component, or on other systems, structures and components important to nuclear safety.

5.2.15.0300. Considering the effect of a fire or explosion, the concerned process systems and the risk of fire-fighting, the equipment to detect fire or explosion shall be designed to automatically provide warning signal for the workers to be able to perform the necessary protection measures.

5.2.15.0400. In the case of inflammable solid and liquid wastes, the conditions

of effective fire alarm and fire-fighting shall be established in such a way that prevents, to the extent possible, any release of the radioactive materials contained in the system during the fire and fire-fighting.

5.2.15.0500. The consequences of the fire and fire-fighting, as well as the way how the generated waste can be collected shall be taken into account in the design.

5.2.15.0600. During the design and construction of the research reactor and its systems, structures and components, beyond the requirements of Sections 5.1.15.0100.-5.2.15.0500. the respective, effective fire protection regulations and technical requirements shall be observed.

Special design requirements

5.2.16. The reactor and the active core

5.2.16.0100. The design of the active core shall take account of each design basis state: normal service including the experimental and training activities, refueling, testing states, anticipated operational occurrences, shutdown and design basis accident states.

5.2.16.0200. The design of the structure of the core shall take into account each potential environmental effect including the effects of irradiation, chemical and physical processes, the static and dynamic mechanical loads, thermal deformations and stresses, the possible changes in the manufacturing process and any other identified, safety related factors.

5.2.16.0300. The core shall be safely supported and fixed to other parts of the reactor. The design shall ensure the mechanical stability of the whole structure of the core, the fuel element and the fuel assembly. The geometry of the structures shall be maintained in the design basis states by the limitation of the stresses and loads on the core and the fuel elements.

5.2.16.0400. The geometry of the active core shall be designed to ensure the necessary coolant flow for the removal of heat generated during normal service, anticipated operational occurrences and design basis accidents. Where it is justified, tools shall be provided to prevent any such loss of coolant flow-rate that could lead to overheating of and damage to the core.

5.2.16.0500. The structure of the core shall be designed in such a way that the mechanical failure, deformation, erosion, corrosion of the components and the physical or chemical behavior of the reactor coolant under the conditions of normal service, anticipated operational occurrences and design basis accidents do not impede shutdown of the reactor and reaching and maintaining of the subcritical state.

5.2.16.0600. The structures and elements of the fuel bundles shall be inspected before placing them into the core; tools shall be ensured to their periodical in-service inspection as well as to verify the behavior and condition of the fuel elements after being irradiated.

5.2.16.0700. Appropriate design shall exclude:

a) that any unplanned movement of any internal component of the reactor vessel could cause failure by the increase of reactivity or the loss of flow-rate;

b) overloading of the fuel elements, and such a change of the geometry of the fuel element, which would negatively affect the heat transfer process;

c) that placement or removal of fissile material, water displacing part, absorbent or experimental device into or from the core could increase the reactivity in such an extent that is greater than the worth of the reactor power control and protection tools calculated with an adequate safety factor; and

d) incorrect placement of parts into the active core.

5.2.16.0800. Appropriate selection of the nuclear characteristics of the active core shall ensure the inherent safety of the reactor, so loss of coolant, temperature change or core geometry change shall not cause uncontrolled reactivity increase in normal service, anticipated operational occurrences and design basis accidents.

5.2.16.0900. Sub-criticality of the active core shall be at least 0.01 ($k_{eff} \leq 0.99$) in unpoisoned reactor state, while the safety rods are withdrawn, the control rods are fully inserted and the reactivity reserve of the active core is maximum. Inserted reactivity of the experimental devices shall also be considered in the determination of sub-criticality.

5.2.16.1000. The design shall ensure that every fuel assembly can be removed via operational equipment from the nuclear reactor following any design basis accident.

5.2.16.1100. A startup neutron source can be installed in the nuclear reactor if necessary. The intensity and placement of the startup neutron source shall be selected so that power control of the nuclear reactor can be ensured throughout its insertion into the reactor core. Startup of the reactor shall be forbidden by due locking tools until the power control of the nuclear reactor is not ensured. Movement of the neutron source shall take place via remote control.

5.2.17. Shutdown of the reactor

5.2.17.0100. It shall be ensured that:

a) the protection system of the reactor has appropriate safety margin and is able to bring the reactor into sub-critical state during normal service, anticipated operational occurrences and design basis accidents even if maximum reactivity of the core is assumed and is able to maintain the sub-critical state in the whole temperature range of the nuclear reactor, and

b) the protection system of the reactor is able to bring the reactor into sub-critical state with sufficient safety margin and within sufficiently short period of time during normal service, anticipated operational occurrences and design basis accidents.

5.2.17.0200. The protection system shall automatically shutdown the reactor if

a) any of the safety parameters exceeds the determined operational limits according to appropriate number of measurements of the redundantly installed reactor protection system;

b) the power supply of the protection system is lost; or

c) several measurements of the redundantly installed reactor protection system become inoperable at the same time.

5.2.17.0300. Possibility of manual shutdown of the nuclear reactor shall be ensured.

5.2.17.0400. At least four measurements shall be available for the operation of the protection system according to the considerations below:

a) two independent power measurements, the lower limit of the measuring range of which is not higher than at least 1% of the rated power;

b) two independent period measurements, the lower limit of the measuring range of which is 10^{-3}% of the rated power.

c) The reactor protection system shall be designed to fulfill its safety function if a single failure is assumed, and if the loss of on-site and off-site power supply or any of them occurs and unavailability of one absorbent active component is also assumed.

5.2.17.0500. The components of the reactor protection system shall be equipped with end-position detectors and limit switches. The safety elements shall be able to react from any intermediate position when it is necessary. Once a protection intervention is commenced it shall be completed every time.

5.2.17.0600. The reactor protection system shall prevent uncontrolled criticality of the nuclear reactor. In the demonstration of compliance with this requirement, intentional activities potentially increasing reactivity and a single failure of the

reactor shutdown equipment shall be taken into account.

5.2.17.0700. If the experimental devices affecting the safety of the nuclear facility are connected with the reactor protection system, their design shall maintain the full functionality of the protection system of the nuclear reactor. The potential for harmful interaction of the experimental devices with the reactor protection system shall be evaluated.

5.2.18. Reactor control

5.2.18.0100. Manual and automatic control system of the nuclear reactor shall be designed to reliably control the reactivity and to ensure that a reactivity increase does not cause:

a) exceedance of the design limits related to cooling of the nuclear fuel;

b) such severe damage to the reactor vessel internals that would significantly corrupt the cooling of the active core;

c) exceedance of design conditions of the primary circuit of the nuclear reactor;

d) exceedance of reactivity increase limits.

5.2.18.0200. Connections between the protection and control systems shall not negatively influence safety.

5.2.18.0300. Intervention components of the control system shall be equipped with position indicators and end switches, which shall be actuated directly by the intervention components to the extent possible.

5.2.18.0400. The movement of the manually operated intervention components of the control system shall not induce more than 0.07 $/s reactivity change rate. Reactivity shall be increased in a step-by-step manner. Worth of one step shall not exceed 0.3 $.

5.2.19. Fuel

5.2.19.0100. The probability of fuel damage shall be kept low and cooling of the nuclear fuel shall be ensured during normal service, anticipated operational occurrences and design basis accidents. The design limits of the nuclear fuel shall be determined with appropriate safety margins.

5.2.19.0200. The fuel shall withstand all the effects caused by its usage.

5.2.19.0300. The fuel design limits determined in the design, including the allowed leakage of fission products shall not be exceeded during normal service, anticipated operational occurrences and design basis accidents. Leakage rate of fission products shall be kept as low as reasonably achievable.

5.2.19.0400. The fuel shall keep its position and shall not undergo such

deformation which would cause insufficient cooling of the reactor core following an anticipated operational occurrence or a design basis accident.

5.2.19.0500. The fuel elements shall be designed to provide for the inspection of their structure.

5.2.20. Cooling of the active core

5.2.20.0100. Every possible form of heat generation and heat transfer shall be characterized qualitatively and quantitatively with due considerations of the uncertainties. The heat transfer systems shall be designed for continuous operation and for transfer or removal of a given amount of heat per unit of time.

5.2.20.0200. In the determination of the characteristic temperatures of the nuclear fuel, cladding and coolant, appropriate heat capacity margins shall be ensured to cope with a possible disturbance of the heat transfer balance, which makes the avoidance of damages possible during normal service, anticipated operational occurrences and design basis accidents. In the determination of the margins the uncertainties in the calculations methods and in the input data shall be considered.

5.2.20.0300. Requirements for the properties, composition and cleanliness of the coolant shall be determined so that the thermal properties of the coolant do not degrade for the effect of interaction with other process components and radioactive radiation. Existence of the appropriate physical and chemical properties shall be permanently ensured and appropriate tools shall be available to keep them within the design limits.

5.2.20.0400. Indication shall be provided when significant loss of coolant or any other change degrading the cooling process occurs, if the process decreases the safety of the nuclear facility.

Design of the cooling system of the nuclear reactor

5.2.20.0500. Removal of the heat generated during normal service, anticipated operational occurrences and design basis accidents shall be ensured throughout the lifetime of the nuclear facility irrespective of the operability of the nuclear reactor or availability of external resources.

5.2.20.0600. Changes in the condition and composition of the coolant caused by nuclear effects shall be examined and identified. Such changes shall be mitigated to the extent possible using appropriate technical solutions or adequate selection of the design parameters of the active core.

5.2.20.0700. Appropriate measures shall be planned already in the design stage to minimize the leakage of the coolant, and keep it within the determined limits and to safely accumulate, process and store the medium.

5.2.20.0800. Protection of the cooling system of the nuclear reactor shall be ensured during normal service, anticipated operational occurrences and design basis accidents from all such effects, including those that change the geometry of the system, which might affect the heat transfer and cooling process. Any coolant release that would exceed the safety limits shall be prevented.

In-service inspection of the cooling circuit of the nuclear reactor

5.2.20.0900. The structural components of the cooling circuit of the nuclear reactor shall be designed so that examination and inspection of the systems, structures and components important to nuclear safety during the construction, commissioning and operation stage can be performed.

5.2.20.1000. Such an inspection and testing programme including surveillance of the materials of the reactor pressure vessel and the systems, structures and components important to nuclear safety shall be developed, the implementation of which provides information on the effect of radioactive irradiation, mechanical, thermal and chemical loads on the structural materials and so on the reliable service of the systems, structures and components important to nuclear safety.

Amount, make-up and cleaning of coolant

5.2.20.1100. The cooling system of the active core shall have a system dedicated to make-up the coolant that is able to maintain the quantity, volume and pressure within the design limits under normal service and is able to make-up a small coolant leakage allowing normal cooling of the nuclear reactor.

5.2.20.1200. The cooling system of the nuclear reactor shall have a cleaning system that is able to subtract radioactive materials from the coolant during normal service, anticipated operational occurrences and design basis accidents.

5.2.20.1300. The efficiency of the cleaning system shall be specified according to the design limits related to allowable leakage of the fuel and corrosion characteristics of the coolant including conservative safety margins.

Emergency core cooling

5.2.20.1400. If the safety analyses of the research reactor justifies it, such systems shall be designed and constructed within the nuclear facility to cope with design basis accidents which, through the make-up of the coolant or other way, ensure the effective cooling of the core so that the design limits related to cooling of the fuel is not exceeded, so:

a) the cladding temperature of the fuel does not exceed the design limits related to design basis accidents,

b) the possible chemical reactions are limited to an allowable level,

c) the changes of fuel and internal structures do not impair significantly the efficiency of the components performing emergency core cooling, and

d) the cooling of the core is ensured for a sufficient duration.

Inspection and testing of the emergency core cooling system

5.2.20.1500. The emergency core cooling shall be designed so that periodic inspection and testing of the systems and components important to nuclear safety can be ensured to demonstrate that:

a) the components of the systems important to nuclear safety are leaktight, and

b) operability and performance of the active system components are ensured.

5.2.20.1600. Inspection of the emergency core cooling system shall be carried out under such conditions that are as close as possible to the real service conditions. Operation of the system shall be tested for the occurrence of all postulated initiating events including the connecting parts of the emergency core cooling system, switching between the normal and emergency power supply and operability of the corresponding auxiliary systems.

5.2.21. Reactor building

5.2.21.0100. The reactor building and the connected systems shall reduce the quantity of radioactive materials released to the environment during normal service, anticipated operational occurrences and design basis accidents, and shall protect the research reactor from external impacts. Moreover, the reactor building and the connected systems shall be suitable to mitigate the consequences of beyond design basis accidents.

5.2.21.0200. Systems connected to the reactor building shall be designed so that their activation should not endanger the integrity of the reactor building.

5.2.21.0300. The reactor building shall be equipped with such systems and components important to nuclear safety that are able to remove the fission products from the reactor building which may be released to the reactor building as a result of anticipated operational occurrences, design basis accidents and beyond design basis accidents.

5.2.21.0400. The reactor building and connected systems shall be designed so that the reactor building, including passages, transporting corridors and penetrations, is able to withstand the circumstances occurring in normal service, anticipated operational occurrences and design basis accidents.

Venting systems

5.2.21.0500. Compartments of the research reactor shall be divided into physically separated zones. These zones shall be vented in such a way that

pressure differentials developing between the zones should prevent the dispersion of radioactive contamination. The venting system shall involve such devices whose duty is to limit the release of radioactive contamination.

5.2.21.0600. Venting system shall be developed and equipped with filters and other components for normal service, anticipated operational occurrences and design basis accidents, which:

a) ensures appropriate environment for the workers to operate systems and system components important to nuclear safety, especially in the main control room,

b) ensures appropriate circumstances to operate systems and system components including auxiliary and storage buildings,

c) maintains air flow from the less contaminated compartments to the more contaminated compartments,

d) controls the spread of contamination and contributes to reduce the airborne contamination concentration in the atmosphere of the research reactor compartments and in the released air,

e) controls the temperature and pressure of the reactor building atmosphere and reduces the concentration of radioactive materials,

f) separates and closes the different air flows that might be carriers of various dangerous substances such as toxic, explosive and radioactive gases, while they can be neutralized,

g) reduces dangers originating from toxic and other chemical characteristics of process materials and from explosive gas and vapor mixtures,

h) ensures that air flows inside the compartments of the nuclear facility classified into various zones can be released to the environment only through controlled release locations.

5.2.21.0700. At the design the possible wind speed and the pressure changing effects of natural and artificial objects in the environment shall be taken into account. Air filters shall be installed in the air intake routes if needed to prevent the intake of contaminated air from the environment.

5.2.21.0800. Filters of the venting system shall be placed so that the radiation exposure of the persons on-site of the research reactor is kept at the reasonably achievable lowest level and biological protection shall be installed where it is necessary. Safe replacement and safe storage of the contaminated filter cartridges shall be provided.

5.2.21.0900. Appropriate alarming and intervention possibility shall be available to provide for inspection and operation of the venting system.

5.2.22. Information management, instrumentation and control

5.2.22.0100. Such electric power supply shall be ensured for the system components important to nuclear safety, the reliability of which is in harmony with the importance and power needs of the supplied system components. Where the respective safety analysis justifies it, the electric power supply of the systems and components fulfilling instrumentation and control, alarm and communication purposes shall be ensured from uninterruptable power supply.

5.2.22.0200. Requirements for the quantity, duration, level and continuity of electric power supply shall be determined in harmony with the requirements related to the supplied systems and components important to nuclear safety.

5.2.22.0300. The design requirements shall be taken from such recognized prescriptions, guidelines and standards, which can ensure appropriate level of operability of the systems and system components important to nuclear safety.

5.2.22.0400. Loss of external, alternating power supply of the electric power supply systems shall not lead to unacceptable consequences.

5.2.22.0500. It shall be ensured that voltage harmonics generated by inverters or other not sinusoidal consumers cannot cause damage to the function of the supplied system.

5.2.22.0600. Such instrumentation shall be installed, which can control safety parameters of the systems and components during normal service, anticipated operational occurrences and design basis accidents. Distinct attention shall be paid to the operating parameters of the systems and components that may affect reactivity, core cooling, decay heat removal and integrity of the fuel, core cooling circuit and reactor building. Certain portion of the instrumentation and measurement devices shall be suitable to provide information on the condition of the nuclear facility to be used for decision-making during nuclear emergency response.

5.2.22.0700. The instrumentation and control configuration of systems and components important to nuclear safety shall be in direct, known and unambiguous connection with the behavior and physical parameters of the research reactor.

5.2.22.0800. If the measurement of a physical parameter cannot be realized in practice, it shall be ensured in order to detect the anticipated operational occurrences and design basis accidents that the value derived instead of it is in a direct physical and time relation with the event to be detected. During transfer every disturbance and condition distorting the information shall be examined and measures shall be taken to limit the disturbance to the least possible.

5.2.22.0900. It shall be ensured that the modification of the instrumentation

and control configuration and activation logic of systems and components important to nuclear safety and the respective data can be performed only in a planned and tested manner or under rigorous administrative control.

5.2.22.1000. Adequate communication system shall be developed for information-flow between different locations and for forwarding operator commands. Communication connection shall be ensured with off-site organizations whose activity may be necessary in normal service, anticipated operational occurrences, design basis accidents and beyond design basis accidents. The communication systems shall not have any negative or disturbing impact on the instrumentation and control systems and components; however the systems shall be equipped with interference protection.

5.2.22.1100. The design and application of instrumentation and control systems shall ensure the measurement of parameters important to the safety of the research reactor, automatic registration of the commands given to the systems and components and of the measurement results, and the possibility to archive the records to track and, subsequently to the event, to analyze the normal service, anticipated operational occurrences and design basis accidents.

5.2.22.1200. Separation of instrumentation and control systems important to nuclear safety shall be ensured, and these systems shall be free of reaction.

5.2.22.1300. Appropriate control and regulation instruments shall be applied to keep the service parameters of systems and components within the required service limits.

5.2.22.1400. Signals belonging to activation of protection cannot be self-acknowledging independently of whether the initiating event occurs or not. Signals belonging to protection of the workers shall be acknowledged only with the intervention of the workers even after they have ceased to exceed the limit value.

5.2.22.1500. The instrumentation and control systems shall timely and reliably respond to any disturbance in the operation without activation of any protection operation.

5.2.22.1600. Every possible and foreseen manner of activation of protection by the instrumentation and control systems, even in consequence of multiple failures, shall be analyzed. The failures of the instrumentation and control system shall not lead to frequent activation of the protection system.

5.2.22.1700. If applied in connection with fulfillment of safety functions, the computer or other programmable devices shall meet all the safety requirements during their design, production and installation.

5.2.22.1710. The used components shall be validated and appropriately maintained, and shall be tested with a specified frequency.

5.2.22.1800. Instrumentation and control devices important to nuclear safety shall be designed so that if a failure of the device occurs or if the parameter exceeds its measurement range, then an appropriate warning signal is generated or the event is detected via any other reliable manner.

Control room

5.2.22.1900. A control room shall be designed to execute the activities to keep the research reactor in a safe condition during normal service, anticipated operational occurrences and design basis accidents. The control room shall be arranged so that the impacts of system component failures do not endanger activities in the control room.

5.2.22.2000. Appropriate working conditions shall be ensured in the control room and measures shall be taken for the safety of the personnel by providing the approachability of the control room even during design basis accidents and by keeping the radiation exposure to the workers under acceptable limits. If it is justified according to safety analyses, the possibility to shut down the reactor from other compartments shall also be ensured.

5.2.22.2100. The research reactor shall be designed and equipped with an earthquake indicator and registration system, which records the acceleration-response time signals induced by the quakes at designated locations of the nuclear facility for post-event analysis and provides indication for the control room personnel. If such a system is constructed, it shall be adjusted to the protection system with respect to redundancy, number of channels and reliability. It is not mandatory to construct individual earthquake instrumentation if the data required for the assessment of the impact of the earthquake can be obtained by other means.

5.2.22.2200. Sufficient displays, intervention and archiving equipment shall be available for the operator in the control room to manage any changes affecting safety during normal service, anticipated operational occurrences and design basis accidents and, if necessary, in beyond design basis accident situations:

a) to adequately keep track of the conditions of the systems, structures and components of the nuclear facility;

b) to unambiguously and timely indicate any changes affecting safety;

c) to ensure opportunity to identify, initiate and approve all protection interventions;

d) to obtain full picture of the processes of the reactor service, especially regarding safety;

e) to indicate any conditions deviating from normal service conditions; and

f) to install reliable data collector, processor and display devices, which support the operators in managing anticipated operational occurrences and design basis accidents.

5.2.22.2300. The most important data of experimental devices potentially affecting the safety of the nuclear facility shall be displayed in the control room and, if necessary, their signals shall be directed to the protection systems. The direction of the signals to the protection systems shall not impair the operability of the protection systems.

5.2.23. Auxiliary systems

5.2.23.0100. Necessary availability of the auxiliary systems important for the operation of systems and components important to nuclear safety shall be ensured.

5.2.23.0200. A failure of an auxiliary system, independently of its importance and role to safety, shall not risk the safety of the nuclear facility. In case of a failure of an auxiliary system containing radioactive materials the environmental release of the radioactive material shall be prevented by adequate measures.

5.2.23.0300. The supply of auxiliary services shall have backup solutions for the case of a failure. The reliability, performance and availability of each backup resource shall meet the same requirements as the systems and components supplied by them do. This backup shall operate until the research reactor reaches and is kept in a safe condition or until the basic auxiliary system activates.

5.2.24. Experimental devices

5.2.24.0100. Experimental devices shall be designed so that they do not adversely affect the safety of the nuclear facility under any service condition. Neither its operation nor its failure shall change the reactivity of the nuclear reactor in an inadmissible extent, impair the cooling of the active core, and moreover nor shall lead to unacceptable radiation exposure to the persons staying on the site of the research reactor and of the public.

5.2.24.0200. Design basis shall be developed for the experimental devices directly or indirectly connecting to the reactor. The radioisotope inventory of an experimental device and the possibility of energy generation and release shall be considered. Safety analysis shall be carried out to ground the use of such an experimental device.

5.2.24.0300. Mantling and dismantling of an experimental device shall be designed so that it cannot impair the components of the active core or other systems and components important to nuclear safety.

5.2.24.0400. If it is technically justified the experimental devices shall be

equipped with detectors to control the active core parameters and other necessary measurements.

5.2.25. Radiation protection

5.2.25.0100. In order to protect the personnel, population and environment against the harmful effects of ionizing radiation the following shall be ensured:

a) any activity by the personnel dangerous because of radiation shall be justified,

b) dose limits shall be complied with,

c) protection shall be optimized,

d) systems, structures and components important to safety shall be designed carefully to reduce human activity in places where radiation exists and to reduce the possibility of radioactive contamination of the persons being present on the site of the research reactor,

e) systems, structures and components containing radioactive materials and their shielding shall be adequately developed,

f) radioactive materials shall be managed safely,

g) appropriate solutions shall be applied to reduce the quantity and activity concentration of radioactive materials generated and to contain their dispersion inside the nuclear facility and their release to the environment on a reasonable level.

5.2.25.0200. At every part of the nuclear facility which is anticipated to be approached by the personnel, adequate protection against radioactive radiation and contamination shall be ensured in every design basis condition. The protection shall ensure adequate and safe access to and stay of the personnel in the compartments needed to reach and maintain the safe condition of the research reactor.

5.2.25.0300. Measurement and assessment of personal radiation doses shall be ensured with appropriate devices. Adequately placed instrumentation shall ensure periodic control and assessment of the radiation situation.

5.2.25.0400. Radiation exposure to persons being on the site of the research reactor and to the population shall be assessed with due margins to take account of the uncertainties existing in the calculation of internal and external radiation exposure. Where the dose calculations are influenced by the accumulation of radioactive materials resulting from radioactive contamination, the presumable maximum value occurring during the lifetime of the facility shall be considered.

5.2.25.0500. In the estimation of radiation exposure to the persons being on the site of the research reactor, the operational conditions and organization of work

shall be considered. The dose assessment shall present the highest individual annual dose value, the distribution, average and order of individual doses and the collective dose.

5.2.25.0600. Exposure to those who are not occupied in radiation dangerous functions shall be determined by estimation. Exposure to the population living off the site shall be determined from such source data, which relate to the critical reference group of the population and consider the radiation exposure resulting from all existing sources.

5.2.25.0700. Such design solutions shall be applied, which facilitate the reduction of radiation exposure during the decommissioning stage.

5.2.25.0800. The working activities shall be grouped by zones according to radiation, surface contamination and atmospheric activity levels. In every zone the control of entry and stay as well as the necessary protective equipment shall be ensured.

5.2.25.0900. Appropriate tools shall be used to limit the radiation exposure to those staying on-site of the research reactor, and operation of the research reactor shall be ensured by the personnel without staying and working in high dose-rate locations.

5.2.25.1000. The protection of personnel entering into and working in contaminated places and periodic control and assessment of airborne radioactivity, surface contamination and the spread of external radiation shall be adequately ensured within and between the individual zones. The solutions shall cover the venting of contaminated places to limit the spread of contamination and contain adequate measures to prevent the dispersion of contamination.

5.2.25.1100.

5.2.25.1200. Manipulation of high activity objects shall be carried out by remotely controlled equipment. The manipulation of highly contaminated pieces shall be under such circumstances that provide proper protection against spread of contamination.

5.2.25.1300. Coating of containers, piping network, equipment and structures in the reactor building exposed to contamination shall be designed so that it can be easily decontaminated.

Design of installation of dosimetry control devices

5.2.25.1400. Such devices shall be installed that can ensure the measurement of radiation levels during normal service, anticipated operational occurrences, design basis accidents and beyond design basis accidents.

5.2.25.1500. The gaseous and liquid releases of the research reactor and the

radiation conditions of the environment of the nuclear facility shall be monitored by permanently installed instruments.

5.2.25.1600. The instruments shall be made able to immediately, reliably and accurately indicate the radiation levels within service areas as well as the radioactive contamination of the air and shall be supplied with an alarm system to indicate any significant change of radiation levels. Each such equipment shall be able to display and alarm reliably under all the operating conditions involved in and beyond the design basis of the nuclear facility.

Biological protection, shielding

5.2.25.1700. Biological protection, shielding and equipment connected to them shall be designed so that the following items can be reduced reasonably:

a) radiation rate,

b) unplanned or uncontrolled shift of biological protection, shielding,

c) the number of parts and experimental devices requiring regular maintenance or approach, placed behind biological protection, shielding except when these are the radiation sources requiring the biological protection or shielding themselves,

d) unjustified high radiation dose to the personnel handling or accessing radioactive sources or experimental devices during operations with them,

e) number of unplanned or uncontrolled removal of any radioactive source from behind the biological protection or shielding that would involve significant exposure without shielding, and

f) the number of places where the accumulation of radioactive material is possible.

5.2.25.1800. If the existence of places defined in Para 5.2.25.1700 f) is unavoidable, such measures shall be taken during in the design that make it possible to detect the presence and accumulation of radioactive materials and facilitate the safe removal and disposal of them.

5.2.25.1900. Where liquid medium is used for biological protection and shielding, such tools shall be designed which can prevent or reduce any loss of the medium and measurements shall be provided to detect any change in the level of the medium.

5.2.25.3100. Solution shall be designed for the management of potentially dry-out and contaminated surfaces.

5.2.25.3200. Contaminated places and objects originating from contaminated places, which or whose environment the personnel may access to or pass by,

shall be decontaminated. Locally installed decontamination equipment shall be ensured for activities entailing significant radiation contamination or it shall be demonstrated that the main decontamination equipment can be effectively used under the given conditions.

5.2.25/A. Decontamination

5.2.25.2000. Controlled areas, persons entering and exiting the controlled areas, as well as objects exiting and entering the controlled areas shall be inspected and, if required, decontaminated.

5.2.25.2100. It shall be ensured that the material, design, and construction of system components that come functionally in contact with radioactive materials or are exposed to radioactive contamination allow for decontamination and complete removal of the decontaminating solution.

5.2.25.2200. The decontamination process shall be designed to ensure that the surface quality of the affected system components meet the requirements even after decontamination.

5.2.25.2300. The licensee shall prepare for the decontamination of potentially contaminated transport containers and other packaging materials.

5.2.25.2400. Where necessary, decontamination made by remotely operated devices shall be designed.

5.2.25.2500. The place and resource needs of decontamination shall not decrease the level of nuclear safety.

5.2.25.2600. A new decontamination technology or in the case of a chemical decontamination technology a new chemical agent shall be introduced only after justified by safety analysis. The safety analysis shall contain:

a) the treatment method of generation of radioactive waste;

b) justification that the decontamination can be performed without deteriorating the safety functions of the facility;

c) justification that the radioactivity can be removed, including the physical and chemical properties of the contamination;

d) in the case of introduction of a new chemical decontamination technology or new chemical agent

da) justification of its use;

db) results of corrosion analysis of structural materials including demonstration by tests and the evaluation of the results.

5.2.25.2700. The decontamination process shall be optimized at least in terms of:

a) amount of secondary wastes generated;

b) radiation exposure of the personnel; and

c) effectiveness of decontamination.

5.2.25.2800. Regarding decontamination of rooms and equipment of nuclear facilities, as minimum, the planned direction of dispersion of contamination between the rooms and equipment shall be taken into account and together with the limitations on use of chemicals and technologies in the given room.

5.2.25.2900. For those equipment and tools, which can be safely transported, a room shall be designed for the decontamination, where the process can be performed without impact on nuclear safety.

5.2.25.3000. In the case of those rooms, where release of contaminated water can occur, decontaminable surfaces shall be designed and the dispersion of contamination shall be prevented. In these rooms, appropriate boundary surfaces and solutions to direct the dispersion shall be applied to limit the contaminated surfaces, quick drainage and collection of the discharged medium.

5.2.26. Management of nuclear and radioactive material

5.2.26.0100. The design of the facility shall provide the capability of management, processing, transport, storage and inspection of all nuclear and radioactive material.

5.2.26.0200. Appropriate equipment shall be installed to provide the capability

a) to monitor nuclear materials in order to prevent excessive heat generation and occurrence of uncontrolled criticality, and

b) to separate nuclear materials from other incompatible materials, whose potential interaction, because of its physical and chemical form, fire hazard, specific radioactivity, half life, decay characteristic and emitted radiation, can adversely affect the subsequent storage, processing, conditioning and disposal during normal operation, anticipated operational occurrences and design basis accidents.

5.2.26.0300. Nuclear materials shall be produced on a site or transported there, only if the appropriate equipment is available for their safe transport, management, processing and storage.

5.2.26.0400. The nuclear or radioactive materials that may contain or leak gases or liquids shall be stored in such a container, which has adequate ventilation and pressure relieve capability.

Radioactive releases

5.2.26.0500. Appropriate systems important to safety shall be installed for the management of radioactive gases and liquids in order to keep the discharged quantity of radioactivity below the prescribed limit values.

5.2.26.0600. Systems important to safety shall be designed and installed for the regular, instrumental control of the fluid flow on each designed discharge route during normal operation, anticipated operational occurrences, design basis accidents and beyond design basis accidents in order to measure and register the radioactive materials discharged to the environment.

5.2.26.0700. Systems important to safety shall be designed and installed for the environmental and radiological control of radioactive discharges occurring during normal operation, anticipated operational occurrences, design basis accidents and beyond design basis accidents.

5.2.26.0800. The location and layout of discharge points shall take into account the environmental terrain conditions, the most adverse weather conditions, the effect of surrounding buildings, civil structures on the aerodynamics of releases, the effect of activities performed in nearby buildings, as well as the characteristics of the receiving medium in the case of liquid discharges in order to minimize the consequences of anticipated operational occurrences, design basis accidents and beyond design basis accidents and to reduce the consequences of discharges.

Radioactive wastes

5.2.26.0900. The potentially contaminated fluids and surfaces shall be considered as radioactive, unless measurements justify their non-contaminated condition.

5.2.26.1000. For efficient waste management, radioactive waste shall be classified and separated according to the states of matter. During the determination of classification aspects, the requirement to keep the amount of waste at a minimum shall be considered. Further aspects shall include half-life, physical and chemical properties, radionuclide composition, activity concentration and volume.

5.2.26.1100. The activity, quantity of radioactive wastes generated during commissioning, operation and termination, including secondary wastes, shall be kept at minimum.

5.2.26.1200. The generation of such types and forms of radioactive wastes shall be prevented, which are incompatible with the available short and long term storage and disposal technologies.

5.2.26.1300. The safety aspects of all future on-site and off-site processing

methods shall be taken into account during the design of on-site radioactive waste management.

5.2.26.1400. Such form of the on-site radioactive storage shall be applied, which:

a) provides the possibility of retrieval, as well as any subsequent storage, transport and disposal solution;

b) provides the possibility of the regular instrumental inspection of the safe condition of stored radioactive wastes as well as of the maintenance of the safe condition;

c) makes possible to determine and document each important characteristic of radioactive wastes; and

d) makes possible to estimate the quantity of waste generated and to be transported, and to determine the rate of volume change during conditioning, the volume and activity of radioactive wastes stored in each storage location.

5.2.26.1500. The documentation required in *Para 5.2.26.1400. c)* shall be available until the end of the transport and disposal, or processing.

5.2.26.1600. Storage location having sufficient volume and quality shall be provided within the building containing the nuclear reactor in order to allow the short term storage of fluids, component parts, assembly materials and other parts produced during maintenance and refurbishment in a way that the level of their contamination, physical and chemical characteristics can be verified, and their decontamination and repair can be performed.

Management and storage of nuclear materials

5.2.26.1700. Such facilities and systems shall be established, which are able to manage and store fresh and irradiated nuclear fuel during normal operation, anticipated operational occurrences and design basis accidents of the research reactor. Their design shall comply with the following requirements:

a) physical equipment or principles shall be applied to maintain the sub-criticality of nuclear fuel managed or stored outside the core at least at 0.05 ($k_{eff} \leq 0.95$),

   and application of appropriately constructed storage systems and components shall get priority, the safety of which is assured by their geometry properties;

b) any potential damage to the nuclear fuel shall be kept at minimum;

c) appropriate safety systems and components shall be installed to verify the nuclear material received in the nuclear facility;

d) the nuclear fuel shall be physically protected by technical and administrative means;

e) the identification of nuclear fuel assemblies shall be assured at any location;

f) a system shall be established to prevent loss of nuclear fuel assemblies;

g) the residual heat shall be removed during spent fuel management during normal operation, anticipated operational occurrences and design basis accidents;

h) sufficient storage capability shall be available on the site to accommodate all nuclear fuel of the core in a transient situation;

i) the occurrence of impermissible mechanical stresses shall be prevented in the nuclear fuel elements;

j) storage capability shall be available for the storage of nuclear fuel elements or bundles having assumable or detectable defects; and

k) in the case of research reactors having wet storage system:

ka) means for water chemistry and radiation protection control of waters, in which spent fuel assembly manipulation or storage is performed, and

kb) water purification, leakage collection and control systems, and systems controlling and monitoring the water level and temperature as well as controlling the leakage of the storage pool shall be available.

5.2.27. Planning of nuclear emergency preparedness and response

5.2.27.0100. The threat sources identified during design shall be categorised into emergency threat categories based on their potential severity. During preparation the ability to eliminate the most severe emergency situation defined by analyses shall be achieved. It shall be demonstrated that the preparation ensures the timely execution of appropriate actions (i.e. classification, notification, activation and implementation of nuclear emergency response measures) in every postulated initiating event and possible emergency situation.

5.2.27.0200. An emergency response centre shall be established for personnel taking part in emergency response. Sufficient instrumentation and tools shall be available for the management of necessary actions during the emergency situation, and for the communication with the on-site organizational units and locations as well as with off-site organisations responsible for nuclear emergency response.

5.2.27.0300. Personnel in the emergency control centre shall be protected against hazards induced by the nuclear emergency situation. The option to regularly check the functioning of the emergency control centre shall be ensured.

5.2.27.0400. Shelters shall be established which conform to the regulations of civil protection for personnel taking part or involved in the implementation of nuclear emergency response actions.

5.3. OPERATIONAL LIMITS AND CONDITIONS OF RESEARCH REACTORS

5.3.1. General requirements

5.3.1.0100. In order to use the scope of authority and perform the tasks in compliance with the safety regulations, the commitment to nuclear safety shall be considered as an essential aspect during the assignment of the management of the research reactor. The responsibility covers the products made and activities performed by the own organization of the licensee, as well as those needing the involvement of contractors.

5.3.2. Structure of the organization responsible for safety of the research reactor

Structure of the licensee's organization

5.3.2.0100. The applicability of the organizational structure shall be demonstrated and documented in order to safely and securely operate the research reactor and properly respond to emergency situations.

5.3.2.0200. The licensee is responsible for the safe operation of the research reactor in compliance with every legal and nuclear safety regulatory requirement, whether own or external workers are employed.

5.3.2.0300. The structure of organization units shall take into account the functions of the organization. The workers shall be selected and entitled according to the performance of these functions. The management of the research reactor is responsible for the safety aspects of the actions performed by the organizational units. The most important aspect of the establishment of the organization is the safe operation of the research reactor in every possible operating state.

5.3.2.0400. The responsibilities, rights, organizational relations and reporting lines shall be clearly defined and documented for every employee working in a job position important to safety.

5.3.2.0500. The personal responsibility for the safety of the research reactor shall rest with the top leading officer of the research reactor.

5.3.2.0600. The establishment of the appropriate organizational structure and the selection of the management of the research reactor shall be the task of the top leading officer of the research reactor. If an organizational unit is responsible for the supervision of the compliance with nuclear safety requirements, then the leader of this organizational unit, as well as the leader responsible for radiation protection shall work under the direct leadership of the top leading officer of the

research reactor.

5.3.2.0700. The below listed functions shall be adequately separated during the establishment of the organizational structure:

a) management functions,

b) executive functions of operation,

c) independent supervisory functions, and

d) functions supporting operation.

5.3.2.0800. The licensee shall establish and maintain appropriate relations with:

a) authorities, for the clarification of and compliance with safety requirements;

b) operators of other research reactors and other organizations having interest in the use of atomic energy, for collection and analysis of experiences;

c) national and international scientific and research institutes, other organizations having interest in the use of atomic energy, for the deployment of up to date scientific and technical information, and

d) public organizations, organizations and persons representing the public opinion, for the public acceptance of the use of atomic energy and for the fulfilment of legal public reporting obligations.

5.3.2.0900. The operational processes shall be properly controlled to ensure that the nuclear safety related decisions are based on sufficient and reliable information.

5.3.2.1000. The organizational structure shall comply with the requirements of *Para 3.2.0100, 5.3.2.0800 and 5.3.2.0900*, if nuclear safety significant changes are introduced. The effect of such changes on nuclear safety shall be justified and carefully planned in advance, and evaluated after realization.

5.3.2.1100. The systems and components important to nuclear safety shall be inspected by an organizational unit having adequate competence; a system of formal liaison to the authority shall be established.

5.3.2.1200.

5.3.3. Requirements for workers

Suitability and training of workers

5.3.3.0100. Only those qualified workers shall take a job position important to nuclear safety, who have the necessary professional knowledge, skills and commitment to safety. The licensee shall take care of the proper training and

qualification of the workers.

5.3.3.0200. The licensee shall determine and document the professional knowledge requirements for workers.

5.3.3.0300. Training records as well as records justifying the fulfilment of the qualification requirements shall be established and maintained for every employee working in job positions important to safety.

5.3.3.0400. The work on systems and components important to nuclear safety performed by an employee of a contractor shall be approved and checked by an employee of the licensee, who has appropriate professional knowledge.

5.3.3.0500. Training programme shall be developed for employees working in job positions important to nuclear safety. The training programme shall include basic trainings for the preparation of the workers for the given job position, as well as refresher trainings.

5.3.3.0600. The technical workers shall have nuclear safety, radiation protection, fire protection, on-site nuclear emergency response and industrial safety knowledge.

5.3.3.0700. The refresher training of the control room personnel shall especially include:

a) actions to be performed for the safe operation of the research reactor during normal operation, anticipated operational occurrences and design basis accidents;

b) cooperation of the control room personnel;

c) operational experience, technical and procedural modifications; and

d) practicing of the operation if it has not been performed before and if it is justified.

5.3.3/A. Radiation protection training of employees

5.3.3.0710. Besides the training requirements laid down in the government decree on radiation protection the specific attributes of the nuclear facility shall also be covered during the radiation protection training.

Activity of the employees

5.3.3.0800. Any work performance shall be planned and achieved in compliance with the effective regulations, standards, requirements, practice and administrative procedures during the entire service life of the nuclear facility. The work shall be performed under controlled conditions by the application of approved and valid operating, maintenance, testing and emergency response

instructions, procedures, plans, drawings or other rules, which shall be regularly and systematically reviewed for the sake of adequacy and effectiveness.

5.3.3.0900. Only those workers can make changes in the operation mode of the research reactor, who are entitled to perform this action and have the necessary qualification, unless the research reactor that is suitable for this purpose is used for educational purposes; however, the requirement of *Para 5.3.7.0500* shall be complied with even in this case. Other persons shall not intervene in the nuclear safety related decision making, development and achievement of actions.

5.3.3.1000. The top leading person of the research reactor shall be responsible for the necessary revision of the Operational Limits and Conditions and for the compliance with effective instructions. The revision of the Operational Limits and Conditions shall take into account the own and international experience, the scientific and technological development, the performed modification and the changes in the safety analyses of the nuclear facility.

5.3.3.1100. The licensee shall maintain the systems and components taking account of manufacturer instructions, operational experience and the results of in-service inspections.

Requirements for the users of the research reactor

5.3.3.1200. The users of the research reactor shall have the knowledge necessary for the safe operation of the experimental device in their use, and shall comply with the work related radiation protection and other professional knowledge related legal requirements.

5.3.3.1300. The users of the research reactor shall be aware of the Nuclear Emergency Preparedness and Response Plan. The users shall comply with the rules on the site of the nuclear facility even if they do not belong to the licensee of the research reactor.

Safety culture

5.3.3.1400.

5.3.4. Commissioning of a new research reactor

Commissioning activity

5.3.4.0100. It shall be demonstrated through analyses, observations, operational tests and scene inspections, during the commissioning activity subsequent to the completion of the assembly works that the physical condition and operation of research reactor systems and components are in compliance with their design, the relevant nuclear safety requirements and the Operational Limits and Conditions.

5.3.4.0200. Every such operational limit and condition shall be finalized during commissioning, which is important for the safe operation of the nuclear facility.

Organization and completion of commissioning

5.3.4.0300. In order to comply with the above requirements, the commissioning organization, with the involvement of designers, shall elaborate a detailed programme, which shall include and control activities and responsibilities of the participants from the preparation for the commissioning, through the individual system and component tests, to the completion of the test operation.

5.3.4.0400. The "0" state of systems and components important to nuclear safety shall be examined and documented during commissioning in a way that the modifications during the operational period shall be identifiable and data shall be comparable to later examination results.

Documentation

5.3.4.0500. The commissioning shall be performed based on work programmes elaborated by the commissioning organization. Prior to the commencement of commissioning, as a minimum, work programmes shall be developed with regard to the activities listed below:

a) preliminary tests;

b) official tests;

c) commissioning of technology systems;

d) commissioning of experimental device;

e) circulation washing;

f) warm running;

g) physical start-up and

h) test operation.

5.3.4.0600. As a minimum, the work programmes shall include:

a) the description of the task to be completed, the examinations to be performed, their expected values and acceptance criteria, and their relation to design operating parameters,

b) arrest points,

c) the procedure, sequence and documentation of examinations,

d) organizational questions and responsibilities,

e) the minimum number of workers, their necessary professional qualifications,

f) fire and labour safety requirements and radiation protection requirements for radiation hazardous activities, which shall be complied with during the work, and

g) the management of deviations between the parameters defined in the work programme and those experienced during practical performance, with the consideration of the relevant quality management requirements.

5.3.4.0700. The completion of tasks identified in the commissioning work programmes and the authenticity of the collected information shall be confirmed by the responsible workers taking part in the activities.

5.3.4.0800. The appropriateness of the operating instructions of research reactor systems and components shall be verified during commissioning.

5.3.4.0900. The experience gained during commissioning and the further specification of research reactor data shall be included in the Final Safety Analysis Report.

5.3.5. Operational limits and conditions

General requirements

5.3.5.0100. The Operational Limits and Conditions basic document shall be developed during the design phase of the research reactor, with the consideration of design principles, the design basis and the specifics of planned experiments. Additionally, the parameter changes induced by the experiments shall also be taken into account.

5.3.5.0200. In the case of each experimental device, it shall be justified in advance that the given device will not induce such a change in the core parameters or of the components of the research reactor important to nuclear safety, which may lead to violation of the Operational Limits and Conditions.

5.3.5.0300. It shall be justified by appropriate analyses that the compliance with the Operational Limits and Conditions ensures the safe operation of the research reactor, in harmony with the design assumptions and intentions recorded in the Final Safety Analysis Report.

5.3.5.0400. The Operational Limits and Conditions of the nuclear facility with regard to systems, structures and components and experimental devices shall be finalized on the basis of the analyses of the Final Safety Analysis Report, commissioning tests and the operational experience, as well as those requirements for employees and activities shall be finalized, which are necessary for:

a) preventing the occurrence of situations inducing accident conditions and

b) mitigating the consequences under accident conditions.

5.3.5.0500. The Operational Limits and Conditions shall be categorized as follows:

a) safety limits,

b) limit values for actuation of nuclear safety systems, or

c) limits and conditions for normal operation.

5.3.5.0600. Such limit values shall be specified within the Operational Limits and Conditions, which cannot be exceeded by the actual values of parameters characterizing the processes being in connection with the operation. The scope of operational conditions, in addition to those related to systems and components of the research reactor shall cover the limitations on the operation of experimental devices. Operational Limits and Conditions shall be specified for normal operation, anticipated operating occurrences and design basis accidents.

5.3.5.0700. The Operational Limits and Conditions shall be specified in such a way to allow interventions between the normal service values and those actuating systems important to nuclear safety by taking account of the transient operation of the system, the delay and start-up times, as well as the uncertainties of measurement instruments.

5.3.5.0800. In order to bring the nuclear facility to a safer state, instructions shall be developed for the case, if the research reactor it out of the scope of the Operational Limits and Conditions. The permissible periods for the completion of such measures shall be specified.

5.3.5.0900. The maximum unavailability periods, cycle times of in-service tests and inspections of systems and components important to nuclear safety shall be determined for normal operation, anticipated operating occurrences and design basis accidents.

5.3.5.1000. The requirements for the availability of systems and components important to nuclear safety shall be determined for normal service mode.

5.3.5.1100. The exceedance of the Operational Limits and Conditions during completion of modifications, tests and experiments shall be limited to the extent verified and approved in the safety analysis report substantiating the modification.

5.3.5.1200. The necessary number and tasks of the personnel having tasks in various service states, including the control room personnel, shall take into account that such tasks shall be performed during potential design basis accidents and beyond design basis accidents.

5.3.5.1300. The documents of the Operational Limits and Conditions shall be at the disposal of the control room personnel. The control room personnel shall

have high level of knowledge of these documents, as well as the technical reasons of the requirements. The high level operational decision makers shall be aware of the significance of the Operational Limits and Conditions to the safety of the research reactor.

Revision

5.3.5.1400. The procedure of modification, revision or temporary change of the Operational Limits and Conditions shall be established. The substantiation of modifications shall be justified by safety analysis.

5.3.6. Operation

Normal operation

5.3.6.0100. The operation, maintenance, reviews and tests of the research reactor shall be made in accordance with detailed procedures and operating rules, which takes into account the design and manufacturer instructions, the requirements for the establishment of work places and that the Operational Limits and Conditions can be complied with reasonable safety margins, and which guarantees the maintenance of the qualified state of components having qualification.

5.3.6.0200. If the workers doubt whether the nuclear reactor operates within the operational limits, or if the nuclear reactor does not operate as designed, then the nuclear reactor shall be brought to the possible safest state without any delay.

5.3.6.0300. The operating document shall be compiled with in a way that any designated worker shall easily complete them in the required sequence.

5.3.6.0400. The operating documents shall be developed, reviewed, issued, revised, modified and withdrawn according to a written procedure.

5.3.6.0500. The operating documents and procedures shall be elaborated in such a way that the nuclear facility be in compliance with the operational limits and conditions during their implementation.

5.3.6.0600. The start and end of the operation of experimental device shall be reported to the control room personnel by the user; additionally, if the safety of the research reactor makes it necessary, the experimental parameters shall be temporarily presented in the control room.

5.3.6.0700. The change of external effects and site characteristics, especially the change of human activities and relating parameters (especially the change of demography distribution, built environment and industrial activities) shall be monitored throughout the service life, and shall be regularly evaluated for the maintenance of the risk at a constant level.

5.3.6.0800. The licensee shall have updated Final Safety Analysis Report, which

shall serve as a basis for safe operation.

Deviation from normal operation

5.3.6.0900. Any action out of the normal operational regime shall be performed pursuant to temporary operating procedures, which are prepared on the basis of detailed advance plans and safety analysis made in the necessary extent, and which shall be approved by the responsible management of the licensee. The operating procedures shall include the way how the action shall be terminated and how the nuclear reactor shall be brought to a safe state, if the operating parameters exceed the Operational Limits and Conditions.

5.3.6.1000. If a modification is not a final one and this is recorded in the documentation describing the modification, then such modification shall be considered as temporary modification. The temporary modifications shall be described in regular reports together with the identification of the method and deadline of their final management.

5.3.6.1100. The temporary modifications shall be reviewed annually; their number shall be limited to be manageable by the workers.

5.3.6.1200. The safety conditions of the research reactor shall not be modified by the workers, not even for a temporary period.

Design basis accidents

5.3.6.1300. Emergency operating procedures shall be developed for potential design basis accidents that are analysed in the Final Safety Analysis Report of the nuclear facility or recognized later, the compliance with which allows the workers to safely manage the design basis accidents. The workers shall follow the emergency operating procedures during accident management. The emergency operating procedures shall include the basic criteria for the recommencement of normal operation.

5.3.6.1400. The emergency operating procedures shall be systematic, and shall be substantiated by purpose oriented analyses. The emergency operating procedures shall be in harmony with other operating procedures.

5.3.6.1500. The emergency operating procedures shall support the workers in the selection of the proper procedure and in navigation between instructions.

5.3.6.1600. If a design basis accident occurs, after shutting down and bringing the nuclear reactor to a safe state, the cause of the event shall be investigated and then eliminated; corrective measures shall be implemented to prevent the recurrence of similar events.

5.3.6.1700. The nuclear reactor, if shut down in a way that has not planned in

advance, shall not be restarted until the realization of a safe start-up is not justified.

5.3.6.1800. The nuclear reactor shall be restarted only after the implementation of the necessary measures described in the emergency operating procedures and the issuance of the permits identified in procedures.

Beyond design basis accidents

5.3.6.1900. Procedures shall be prepared for the implementation of measures that are necessary for the management of beyond design basis accidents. The most important objectives of the procedures shall be the restoration of the fundamental safety functions, the support of long term recovery and the limitation of radiological consequences. The workers being at present on the site of the research reactor shall be prepared for their tasks to be completed during design basis accidents.

Documentation

5.3.6.2000. The rule of documentation of research reactor parameters shall be regulated in the operating rules and procedures for the case if an operational or an environmental parameter or both deviate from the normal value. The use of automatic registration results of the instrumentation and control data collection system shall make it possible to follow the anticipated operational occurrences and design basis accidents, as well as to evaluate the results in a later time.

5.3.6.2100. The operating personnel shall keep an operator log in the control room. The operator log shall include the nuclear safety related facts, activities, parameters, as a minimum:

a) the changes in the operating mode;

b) the protection actuations;

c) the implementation and results of tests;

d) the operational interventions;

e) the measures, their implementation and results;

f) the repairs and replacements, and

g) the change of the shift personnel.

5.3.6.2200. The operating documentation shall be drawn up according to uniform content and formal requirements, which are clear and well known by the workers.

5.3.6.2300. Prior to the issuance of operating documentation, their harmony and consistency shall be justified.

5.3.6.2400. The experimental device connected to the research reactor shall be operated according to written operational documentation. The operational documentation shall require who, with which kind of qualification and experimental permit, based on which licensing procedure can operate the experimental device. The notification of the workers and the log recording on the operation of the experimental device shall be regulated.

5.3.6.2500. The workers shall be well aware of the content of operational documentation, including their actual modifications.

5.3.6.2600. The effective versions of the operational documentation shall be available for the workers.

5.3.6.2700. The management of the licensee shall be responsible for preparing, approving and maintaining the operational documentation, and for committing the workers to comply with them, as well as for verifying the compliance.

5.3.6.2800. If a worker deviates from the approved rules and procedures, then the deviation shall be recorded, together with the reason for deviating and with the identification of the worker ordered the deviation; furthermore, the deviation shall be investigated as an event.

5.3.7. Use of research reactors

5.3.7.0100. The research reactors are operated to satisfy the needs of use, research and education. Various modes of use exist as follows:

a) experiments and measurements at the research reactor;

b) irradiation of materials and samples for isotope production, activation analytics or other purpose;

c) operation of experimental device in the core or the reflector; and

d) deployment of neutron radiation beams led from the core.

5.3.7.0200. The requirements for the operation of the research reactor shall be enforced to experimental device and activities performed on the demand of the users. The general labour safety, radiation protection and nuclear safety rules shall be complied with by the activities of the users.

5.3.7.0300. The experimental device having effect on any nuclear safety function of the research reactor shall be categorized to nuclear safety classes; the same nuclear safety class relevant requirements apply to such equipment as to other systems and components of the research reactor that have the same safety classification.

5.3.7.0400. It shall be justified at the commissioning of the experimental device that it does not jeopardize the safe operation of the research reactor; or the adverse effect induced by the experimental device shall be reduced to an acceptable level by appropriate technical means.

5.3.7.0500. If the research reactor is used for educational purposes, then the workers and the teachers shall be responsible for the compliance with nuclear safety requirements; the educational programmes shall not induce unacceptable risk to the operation of the nuclear facility.

5.3.8. Component qualification

5.3.8.0100. A qualification programme shall be operated to guarantee that the systems and components of the research reactor, throughout their service life and under the environmental conditions occurring at the request of their actuation, comply with the requirements for the performance of their safety function. The programme shall include every activity, which is necessary for the establishment and maintenance of the qualified state.

5.3.8.0200. In the case of a new research reactor, the scope of those systems and components shall be identified, which have role in accident management and mitigation of radiological consequences. Their qualification process shall be developed and conducted by taking account of the most extreme conditions that can be assumed during an accident.

5.3.8.0300. In the selection of the qualification procedures the environmental impacts and parameters at the location of installation of the system component shall be taken into account. That lifetime while the safety functions can be fulfilled under the expected operating and even accident conditions shall be determined for the system component designed or selected for the known environmental conditions. A mild environment can be taken into account from the aspect of qualification if the environmental conditions and parameters in normal operation do not change significantly, while harsh environment shall be taken into account of the environmental impacts and parameters in accident conditions substantially differs from those in normal operation.

5.3.8.0400. It shall be verified whether the conditions applied during component qualification covers the environmental conditions occurring during normal operation, anticipated operational occurrences and design basis accidents, in order to guarantee that the environmental resistance of the component as assumed during the design has not changed adversely during the operation.

5.3.8.0500. In the case of a new research reactor, the seismic resistance of components shall be qualified. The seismic resistance of passive structures and

pressure boundary components shall be guaranteed by adequate design. The seismic resistance of active technical engineering technology systems and components and of electric, instrumentation and control components shall be qualified by tests or empiric methods. The qualification is appropriate, if the test spectrum applied during qualification covers the floor spectrum identified for the installation location of the given component.

5.3.9. Ageing management

5.3.9.0100. The research reactor, during its entire service life, shall have a comprehensive ageing management programme which:

a) identifies every potential ageing mechanism of systems and components important to nuclear safety;

b) determines the potential consequences of the mechanisms;

c) determines and implements the actions needed for preventing the occurrence of ageing mechanisms, mitigating their consequences and for monitoring the progress of the degradation; and

d) shall be operated throughout the service life of the research reactor and shall be in harmony with the procedures of operation, maintenance, repair, inspection activities and tests, as well as with the component qualification procedures.

5.3.9.0200. The licensee shall take into account environmental conditions, conditions of processes, service cycles, maintenance plans, design service life, schedule of tests and the spare part management strategy during the establishment and operation of the ageing management programme.

5.3.9.0300. The licensee shall conduct such testing, sampling and inspection activities for the evaluation of ageing effects, which guarantee the timely identification of unanticipated processes and degradations during operation, as well as the implementation of the necessary preventive and corrective actions.

5.3.9.0400. Such database shall be operated for the effective ageing management programme, which is applicable to collect, store, analyse the information in connection with systems and components belonging to the scope of the programme, as well as to support the identification, optimization and coordination of the implementation of the necessary actions.

5.3.9.0500. The ageing management programme shall be regularly revised and maintained in an up-to-date state. Accordingly, any new information revealed in the meantime shall be managed, the tools and methods developed further in the meantime shall be taken into account, and the effectiveness of the maintenance practice applied during the operation of the research reactor shall

be evaluated. The previously assumed effects of degradation processes shall be compared with the monitoring results during the revision; corrective actions shall be implemented, if appropriate.

5.3.9.0600. The licensee shall assess and justify during the Periodic Safety Reviews that the ageing and wearing mechanisms were properly considered, and that the previously unexpected, ageing induced problems were revealed.

5.3.10. Maintenance and repair

Preventive maintenance and repair programmes

5.3.10.0100. The technical maintenance of systems, structures, components and experimental devices shall be performed in such a way, extent and with such frequency, which guarantee that their reliability and effectiveness complies with the design values, and excludes degradation of the safety during their operation.

5.3.10.0200. The licensee shall establish a preventive maintenance and repair programme with the consideration of manufacturer and design requirements, which includes in-service inspections as well as inspections during shutdown, repairs and replacements of parts, revisions and general maintenance, replacements, tests and adjustments.

5.3.10.0300. The list of systems and components covered by the preventive maintenance programme shall be compiled by taking account of their safety classification; it shall be revised, if appropriate.

5.3.10.0400. The requirements for the frequency and scope of preventive maintenance shall be regularly updated and modified if appropriate during the operation, based on the safety classification, manufacturer requirements, and the analysis of operational experience and defects.

5.3.10.0500. The development of the preventive maintenance strategy shall take account of the design and expected service life of systems and components.

Implementation, responsibility

5.3.10.0600. The licensee can implement the maintenance programme or its certain parts with the involvement of contractors; however, the licensee shall take full responsibility for the contracted activities as well.

5.3.10.0700. The regular testing, maintenance, inspection and monitoring of the integrity and functionality of systems and components important to nuclear safety shall be planned in such a way that they do not induce unjustified risk to the workers and do not reduce significantly their availability.

5.3.10.0800. The licensee shall take responsibility for administrative, technical

engineering and inspection activities during maintenance; special attention shall be paid to:

a) the maintenance of the operability of systems required to operate if the reactor is in shutdown state;

b) the organization of maintenance activities in compliance with radiation dose limits with the consideration of the as low as reasonably achievable principle; and

c) meeting the requirements for clean assembly.

d)

5.3.10.0900. Work posing the risk to induce a nuclear accident shall be made when the nuclear reactor is in shutdown state. If the work is to be performed in disconnected state of safety components, then additional safety components shall be installed in the core during the work, and the sub-criticality of the nuclear reactor shall be at least 0.02 ($k_{eff} \leq 0.98$) during the work (i.e. considering potential defects). The measurement chains used for safety purposes shall be operable during the work.

Documentation

5.3.10.1000. The licensee shall establish documentation rules for maintenance and repair activities, with the consideration of the minimum aspects listed below:

a) identification, classification and registration of defects occurring during operation or revealed during inspections;

b) conditions for taking systems and components scheduled for maintenance out of service, the methods of preparation and approval of such activities;

c) taking account of ageing processes, the maintenance of the qualified state of systems, structures, components and experimental devices shall be an objective during the scheduling of the maintenance and repair activities; and

d) the details of documentation of maintenance and repair activities shall make possible the subsequent evaluation and the subsequent assessment of responsibilities.

5.3.10.1100. The components important to nuclear safety shall be repaired by the application of programmes that are approved according to an internal procedure.

5.3.11. Inspections and tests

5.3.11.0100. The licensee shall develop and implement inspection and testing programmes for the inspection, analysis and evaluation of degradations of

systems, structures, components important to nuclear safety and experimental devices (i.e. embrittlement, fatigue, generation and evolution of cracks, ageing) induced by operational effects (i.e. stressors, temperature, irradiation, corrosion, erosion, vibration).

5.3.11.0200. The inspection and testing programme shall be compiled based on the nuclear safety classification of systems and components, and on the analysis of potential defects.

5.3.11.0300. The evaluation criteria shall be specified by taking account of design requirements and standards.

5.3.11.0400. The programme shall include the inspection of the technical condition for visual inspection and measurements, and the application that takes account of the continuous development of destructive and non-destructive material testing methods.

5.3.11.0500. If the documentation pursuant to *Para 5.3.4.0500* was not prepared during commissioning, then the "0" state of systems, structures, components and experimental devices shall be assessed for the effective execution of the tests; the ability to compare test results shall be ensured.

5.3.11.0600. The evaluation of inspection results, the process of the identification, implementation and inspection of the necessary repair and preventive measures shall be regulated in writing.

Inspection of pressure retaining components and pipelines

5.3.11.0700. The pressure retaining components and pipelines belonging to the scope of regulatory licensing can be put into operation and operated, only if they have valid and successful in-service technical-safety tests. The pressure retaining components and pipelines cannot be put into operation and operated, if its repair, modification or extraordinary test was not performed as designed.

5.3.11.0800. If a pressure retaining component or pipeline has unsuccessful in-service test, then it can be put into operation, only if the cause of the unsuccessful test is eliminated and the repeated test is successful.

5.3.11.0900. The requirements for conduct, method of execution and the documentation conditions of the manufacturer tests, the tests prior to first putting to operation, and the necessary in-service and extraordinary tests, like

a) the structural test,

b) the integrity and strength pressure test,

c) the opening pressure and leaktight closure pressure test,

d) the functionality and operability test,

e) the in-service inspection, and

f) the extraordinary tests and programmes

of pressure retaining components and pipelines of the nuclear facility shall be determined in procedures by the licensee.

5.3.11.1000. Subsequent to any extraordinary event, the licensee shall demonstrate the ability of performing the safety function and the integrity of the affected systems and components, and shall execute the necessary corrective measures, including inspections, tests, maintenance and repair, as appropriate.

5.3.11.1100. If such an event inducing the shutdown of the nuclear reactor occurred, which may have effect on leaktightness, then the pressure boundary of the coolant system of the nuclear reactor shall be inspected by a leaktightness test.

5.3.11.1200. Every pressure retaining component and pipeline shall have a passport. The passport shall include the basic technical and administrative data, which characterize the given component and pipeline and justify its operability.

5.3.11.1300. The passports shall be updated subsequent to inspections, modifications and repairs.

5.3.11.1400. The licensee shall ensure all personal, material, labour safety and technical conditions for the undisturbed, professional and appropriate conduct of the inspections and tests of the inspection organization; the representative of the licensee shall be at present on tests and inspections.

5.3.12. Spare part management

5.3.12.0100. In order to be prepared for component replacements, the licensee shall determine the quantity of the necessary spare parts and take care of sparing components under appropriate storage conditions, with the consideration of the design and manufacturer requirements, and commissioning, operation and maintenance experience of components important to nuclear safety.

5.3.12.0200. The licensee shall continuously monitor the availability of the spare parts, and operate such a procedure, which guarantees the usability of the spared components, thus the prevention and monitoring of potential ageing mechanisms.

5.3.12.0300. Only such properly stored, inspected and documented spare parts can be used, which comply with the requirements for the original components.

5.3.13. Execution of modifications

5.3.13.0100. The licensee can execute, for the stability of operation, a modification of the components important to nuclear safety, technical and

regulating documentation and organization only if it is justified.

5.3.13.0110. The modification shall not decrease the level of nuclear safety.

5.3.13.0200. The recommendations on the execution of modifications are included in a regulatory guideline.

Classification of modifications

5.3.13.0300. The licensee, by the application of a procedure fitting to its management system, shall classify those modifications to Category 1, which can be characterized by at least one of the following features:

a) the modification has significant effect on the radiation risk to the personnel being at present on the site of the research reactor and the public;

b) the modification changes those principles and conclusions, which serve as a basis for the design and licensing of the nuclear facility;

c) the modification changes the scope of design basis accidents or their evolution;

d) the modification changes such technical solutions, which are necessary for the fulfilment of the safety objectives defined in the Nuclear Safety Code;

e) the modification may lead to change in operational instructions, which have relevant role in the operation of the nuclear facility;

f) the modification makes necessary to change the construction or operational licenses of the nuclear facility or to issue a new license.

5.3.13.0400. The licensee, by the application of a procedure fitting to its management system, shall classify those modifications to Category 2, which are not classified either Category 1 or 2.

5.3.13.0500. The licensee, by the application of a procedure fitting to its management system, shall classify those modifications to Category 3, which can be characterized by at least one of the following characteristics:

a) the modification shall not have adverse safety consequences, thus the assessment of its potential consequences is not required;

b) the systems, structures and components belonging to the scope of the modification are not important to safety and individual regulatory licences do not contain requirements for them;

c) the modification, even in the case of a design or execution defect, neither can entail significant increase in the fuel damage frequency, nor can entail significant increase in the radiation exposure to people being at present on the site of the research reactor and to the public.

Preparation and execution of modifications

5.3.13.0600. The licensee shall establish the procedural system guaranteeing the technical and safety adequacy of modifications and the compliance with nuclear safety requirements according to the life cycle of modifications as well as its significant phases, with the consideration of the following aspects:

a) the adequacy of activities connecting to a modification shall be assessed and justified both as a condition of execution and subsequent to the execution;

b) Modification Form shall be prepared regarding the decided modification;

c) Modification Substantiating Documentation shall be prepared for the substantiation of the modification;

d) the Documentation Substantiating the Commencement of the Operation subsequent to the Modification shall be submitted to the nuclear safety authority, subsequent to the execution of the modification, but at least 10 days prior to the commencement of its putting into operation;

e) in the case of modification of the organizational structure, management system, technical and regulating documents, a summary description shall be prepared and submitted to the nuclear safety authority, at least 10 days prior to the introduction of the modification;

f) Modification Evaluation Report shall be prepared within 3 months after the execution of every modification or within a period determined by the nuclear safety authority, which shall present and evaluate the design, purchase, assembly, training, putting into operation, initial operation, etc. experience gained with regard to preparation for and execution of the modification, as well as the modification process as a whole; and

g) the documentation substantiating the application for the modification of the operating license of the research reactor shall be prepared in parallel to the Modification Evaluation Report for a modification belonging to Category 1 by taking account of *Para 1.2.5 of Annex 1*.

5.3.13.0700. Recommendations on the structure and content of the Modification Form, the Documentation Substantiating the Modification, the Documentation Substantiating the Commencement of the Operation subsequent to the Modification, the summary description and the Modification Evaluation Report are provided in a guideline.

5.3.13.0800. The leader of the independent organizational unit established for this purpose or an independent worker of the licensee shall supervise the modifications and enforce the compliance with the modification related individual nuclear safety regulatory requirements. The structure of the organization or the

scope of authority of the nominated worker shall be determined based on the work to be done and the safety risk of the nuclear facility.

5.3.13.0900. The licensee shall execute the modification by the analysis of nuclear safety consequences and justification of the compliance with the modification related requirements. These requirements are as follows:

a) the nuclear safety consequences shall be assessed in the mirror of the purpose and scope of and the related requirements for the modification, and then the preliminary safety assessment substantiating the categorization shall be based on the results;

b) the adequacy of the planned modification and the compliance with the modification related requirements shall be justified by analyses, with the consideration of the substantiating design documents of execution and purchase for modifications belonging to Category 1 and 2;

c) a comprehensive safety evaluation having different content in harmony with the nature of the modification shall be made for the substantiation of the Documentation Substantiating the Modification for modifications belonging to Category 1 and 2, which shall take into account every such safety effect of the modification that will occur during the modification and after its execution; and

d) it shall be justified that the concept of the modification is in compliance with the legal requirements, and that the full meeting of the internal regulations of the nuclear facility makes the execution of the modification and the operation of the modified system, structure, component, and organization, as well as the application of the modified document and management system safe.

5.3.13.1000. In addition to analyses, the adequacy of the modified system, structure and component, and the safe operability of the nuclear facility with the modified system, structure and component shall be justified by examinations, tests and evaluation of the operational experience.

5.3.13.1100. The licensee shall guarantee the technical and nuclear safety adequacy, the compliance with the nuclear safety requirements by the system of consecutive inspections.

5.3.13.1200. The modification related actions shall be performed in accordance with rules fitting into the management system of the license.

5.3.13.1300. The modified system shall be put into operation only after the completion of the modification related training programme, the actualization of the modification related operational and regulating documents, analysis of the effects induced by the modification; the workers shall be aware of the above mentioned programme, documents and effects.

5.3.13.1400. The users of the research reactor can modify the experimental device or their biological shielding only after the approval of the component management of the licensee.

5.3.13.1500. The information flow shall be continuous between the workers and the management in order to evaluate the introduced modification and to prepare for the corrections, if appropriate. The concerned organizations shall be involved into this process.

5.3.14. Radiation protection

Radiation protection activity

5.3.14.0100.

5.3.14.0200.

5.3.14.0300.

5.3.14.0400.

5.3.14.0500.

5.3.14.0600. Radiation exposure of the persons on the site of the research reactor, amount of radioactive materials discharged to the environment and the excess radiation exposure of the public associated with the operation shall be kept at the reasonably achievable lowest level.

5.3.14.0700. Radiation exposure of the persons on the site of the research reactor, amount of radioactive materials discharged to the environment and the excess radiation exposure of the public associated with the operation shall not exceed the regulatory limits.

5.3.14.0800. The research reactor, in addition to optimization of radiation exposure of the employees, applying the ALARA principles, shall be operated in line with the radiation protection aspect.

5.3.14.0900. Justification of radiation hazardous works shall be demonstrated.

5.3.14/A Radiation protection programme

5.3.14.1000. In addition to the provisions of the government decree on radiation protections, the radiation protection programme of the licensee shall take into account the provisions of this Code.

5.3.14.1100. The operating organization shall ensure the correct implementation of and compliance with the radiation protection programme by supervision, inspection and audits of fulfilment of the radiation protection methods and procedures.

5.3.14.1200. The radiation protection programme shall ensure that in each operating condition in the facility the dose from ionizing radiation and all planned radioactive discharges are kept below the allowed limits and as low as reasonably achievable.

5.3.14.1300. Besides the requirements of the government decree on radiation protection, the employees shall be aware of the obligations relevant for him/her from the radiation protection programme and his/her personal responsibilities in the practical realization.

5.3.14.1400. In addition to the application of authority personal dosimeter, all employees, including the contractors, who perform work within the controlled area or those who are regularly present in the supervised area shall be monitored for occupational radiation exposure according to the respective requirements. Personal doses shall be registered and shall be made available for the employees and the authority.

5.3.14.1500. All employees, including the contractors, who performs work within the controlled area or those who are regularly present in the supervised area shall be monitored for occupational radiation exposure according to the respective requirements. Personal doses shall be registered and shall be made available for the employees and the authority.

5.3.14.1600. The radiation protection programme shall contain the health examination to justify applicability of the employee exposed to radiation and the advice to be provided in case of an emergency exposure situation.

5.3.14.1700. Dose rates shall be monitored based on the radiation protection programme at the locations where systems, structures and components may emit radiation, especially during inspection, maintenance and fuel handling activities. The radiation protection programme shall cover the exposure during activities performed in the facility with chemical liquids, coolant medium and liquids of the auxiliary systems. The radiation protection programme shall contain provisions that ensure compliance of the above exposure situations with ALARA principle.

5.3.14.1800. The licensee shall develop the Workplace Radiation Protection Rules (hereinafter referred to as: WPRPR) within the radiation protection programme. The WPRPR shall contain as a minimum:

a) description and operation of the radiation protection organization, within that

aa) the name of the radiation protection officer and his/her deputy, his/her job, required professional education and radiation protection education;

ab) structure and tasks of the radiation protection organization, tasks of the radiation protection officer(s);

ac) radiation protection related tasks of the licensee and description of radiation protection related tasks (obligations) of the management of the operator of the facility;

ad) list of the responsibilities;

ae) determination of frequency of necessary review of the WPRPR;

af) name and address of the occupational health service contracted by the licensee, order of radiation health examinations (i.e. frequency, mode of organization, management of inhibitions);

b) provisions for the employees, within that

ba) requirements for internal and external radiation exposure monitoring of employees, its frequency and mode;

bb) if the personal radiation exposure is estimated based on measurement results performed on other employees, description of the calculation methods used for the estimation;

bc) list of radiation protection rights and responsibilities of the employees working at radiation hazardous workplace;

bd) description of radiation hazardous work areas and jobs, radiation protection classification of the employees;

be) professional and radiation protection education requirements of the employees working at a radiation hazardous workplace, the order of internal and external radiation protection trainings;

c) provisions for supervision of radiation protection workplace, within that

ca) determination of controlled and supervised areas, system of requirements (measures to control access), measure to supervise for radiation protection of particular areas;

cb) order of control and elimination of surface contamination;

cc) mode of collection and management and order of registration of radioactive waste at the workplaces and facility;

cd) description of radiation protection monitoring systems, description of personal protective equipment, provisions for their use, description of radiation protection devices and dosimeters, provisions on the use, management, maintenance, calibration;

ce) radiation protection organization measures necessary at the particular workplaces;

cf) regulation of radiation protection supervision tasks, with special attention to the monitoring and measurement of ionizing radiation;

cg) all those radiation protection knowledge, that shall be known for safe work performance;

d) management of registers, reports, and events, within that

da) order of keeping radiation protection registers (personal dose measurement, training, medical examinations, radiation protection monitoring and assessment, accountancy of radioactive sources and wastes) and retention of certificates, order of compliance with authority reporting obligations;

db) tasks to be performed in case of abnormal events;

e) management of sealed radioactive sources, within that

ea) in case of use of Category 1, 2 and 3 radioactive sources the WPRPR contains the rules for their use, storage and accountancy;

eb) action plan to search for and recovery of missing radioactive or nuclear material.

5.3.14/B. Radiation protection service

5.3.14.1900. The tasks of the radiation protection officer shall be performed by the facility radiation protection organization established within the licensee's organization. The organization shall consist of professionally educated employees of the licensee who are well aware of the current licensing documentation and the radiation protection implications of hazards imposed by the operation and the activities carried out in the facility.

5.3.14.2000. The management of the radiation protection organization shall directly report to the senior management of the licensee.

5.3.14.2100. The radiation protection officer and his/her deputy shall hold a license to conduct radiation protection expert activity.

5.3.14/C. Classification of workplaces

5.3.14.2200. The area of the facility shall be divided to controlled, supervised and free areas taking into account the anticipated and measured dose rates, radioactive contamination and the anticipated doses.

5.3.14.2300. The classification of workplaces and rooms within the controlled areas, and the work conditions shall be reviewed regularly and in the case of changes related to radiation protection..

5.3.14.2400. The potentially contaminated areas and the areas imposing radiation exposure risk shall be identified and indicated such a way that the persons entering and staying in the area are aware of the radiation conditions and their effects.

5.3.14.2500. In the case of facility areas, where a radiation exposure can be anticipated up to a significant portion of the limits specified either in the laws, regulatory resolutions or internal regulation documents, technical solutions and administrative measures shall be applied to control, regulate and limit the entrance and stay. The control, regulation and limitation shall be proportional to the risk of radiation exposure.

5.3.14.2600. Spread of radioactive contamination shall be monitored, regulated and kept as low as reasonably achievable.

5.3.14/D. Optimization of radiation hazardous works

5.3.14.2700. During the optimization of radiation protection the type of the facility, design aspects and those operational changes, events, modifications shall be considered that may influence the radiation protection arrangements.

5.3.14.2800. All radiation exposure shall be kept as low as achievable, considering the aspects of the radiation protection requirements and the environmental conditions.

5.3.14/E. Dose constraint

5.3.14.2900. In addition to the provisions of the government decree on radiation protections reference levels shall be used for the employees for the optimization of radiation protection.

5.3.14.3000. The occupational dose constraint shall be determined for employees exposed to occupational radiation and used as a planning value for personal dose received from a given facility or activity during an appropriately determined length of time, and shall be specified in personal effective or equivalent dose.

5.3.14.3100. The dose constraint shall be determined according to the following aspects:

a) type and nature of the radiation and the equipment for its prevention,

b) regional factors,

c) consideration of the expected benefits.

5.3.14.3200. Considering the ALARA principle, to comply with the relevant dose limits and constraints, the licensee shall determine dosimetry and technology

investigation levels under the permitted limits. These alarm levels shall be specified in the WPRPR. The licensee shall investigate the exceedance of the investigation level and shall determine and implement corrective actions accordingly.

5.3.14.3300. Investigation levels shall be applied for external and internal hazards based on individual dose, and for work place monitoring system for quantities determined based on dose rates, contamination or on operating experience.

5.3.14/F. Shielding

5.3.14.3400. The reasonably achievable level of radiation shielding shall be provided to decrease doses.

5.3.14.3500. 4.10.4.1000. The licensee shall ensure shielding devices of different type and material, which are to be used as temporary shielding for various special works.

5.3.14/G. Personal protective equipment

5.3.14.3600. The licensee shall check and regulate the use of protective equipment, take care of their appropriate condition, and ensure that the users are aware of their intended use.

5.3.14/H. Dose planning

5.3.14.3700. Dose planning shall be performed to optimize occupational radiation exposure from work processes significant from radiation protection aspects.

5.3.14/I. Limiting of radioactive materials and sources

5.3.14.3800. Unnecessary radioactive materials shall be removed from the workplaces to optimize radiation protection.

5.3.14/J. Significant radiation hazardous work

5.3.14.3900. Those rooms, tools and equipment of the nuclear power plant shall be identified, where the performed work, occasionally or always, qualified as significant radiation hazardous work. The classification shall be regularly reviewed and updated.

5.3.14.4000. Those significant radiation hazardous works (hereinafter referred to as: KISUM), the performance of which is repeated under the same technical and personal conditions, typically under the same circumstances, can be managed as

permanent KISUMs. In this case, a permanent KISUM work programme can be used to perform the work, if it can be justified according to the safety aspects.

5.3.14/K. Personal dosimetry monitoring

5.3.14.4100. The licensee shall ensure that personal radiation protection monitoring of the individuals within the controlled area takes place by passive and continuously readable, electronic dosimeters and, as needed, by beta and neutron dosimeters, and by accredited procedures for internal radiation exposure.

5.3.14.4200. The licensee shall ensure equivalent protection for the contractors and the authorities during their work at radiation hazardous workplaces in the same way as it is provided for its own employees.

5.3.14.4300. The personal radiation protection monitoring results:

a) shall be made available for the authority and the employer of external employees;

b) shall be made available for the employees of the facility;

c) shall be handed over to the occupational health service for evaluation.

5.3.14.4400. The personal dosimeters shall be worn by the employees at the radiation hazardous workplaces.

5.3.14.4500. The licensee shall provide an appropriately trained employee with due skill in the local radiation protection rules to accompany the visitors of the facility. The accompanying employee shall inform the visitors about the appropriate conduct and provide them with appropriate protective equipment.

5.3.14/L. Discharge monitoring

5.3.14.4600. The licensee shall develop and operate a programme to monitor the discharges and environmental radiation. The objective of the programme is to ensure the compliance with the regulatory requirements, including the conditions that existed during the derivation of the discharge limits. The environmental monitoring programme shall be suitable, with due reliability, to determine the radiation exposure of the critical group.

5.3.14.4700. The discharge and environmental monitoring system shall be designed to be able to detect, in near real time, any significant increase of discharge. The system shall provide a near real time notification of the detection.

5.3.14.4800. The radiation protection and the environmental monitoring systems shall be designed that the loss of one of their components shall not influence the operability of the other components of the system.

5.3.14.4900. Before commissioning the facility, the radiation protection and the environmental monitoring systems shall be tested via a test programme that shall be as close as possible to the real situation. Meanwhile, consequences of accident situations shall be simulated, including failures and environmental conditions (temperature, overpressure, humidity, vibration, radiation).

5.3.14.5000. Effectiveness and efficiency coefficient of the filter equipment used during the operation of systems and components shall be regularly inspected and maintained.

5.3.14/M. Decontamination

5.3.14.5100. The potential for decontamination shall be provided at all locations, where radiation exposure of the personnel can be reasonably decreased. The need for decontamination shall be minimized by preventing leakages of radioactive media, closed design of the discharge, deaeration and overflow lines t.

5.3.14.5200. Remotely operated decontamination devices shall be provided at the necessary location.

5.3.14.5300. Monitoring and, if necessary, decontamination of controlled areas, individuals entering and leaving the areas, protective clothes and the objects taken in and out shall be provided.

5.3.14.5400. The room and resource needs of decontamination shall not decrease the level of nuclear safety.

5.3.14.5500. During decontamination, the initial and final state to be achieved shall be determined and the actual final state shall be documented.

5.3.14.5600. The decontamination process shall be optimized, at least, as follows:

a) amount of generated secondary wastes;

b) personal radiation exposure;

c) effectiveness of decontamination.

5.3.14.5700. An appropriate room shall be provided for the equipment and tools that can be safely transported, where the decontamination can be performed without influencing nuclear safety.

5.3.14.5800. Appropriately trained personnel shall be ensured for conducting decontamination including a professional to direct the task who is skilled in decontamination.

5.3.15. Radioactive waste management

5.3.15.0100. The management of the licensee shall approve the operational documentation and procedures covering the entire scope of radioactive waste management. The rules and procedures shall regulate the activities and responsibilities serving for the compliance with the following requirements:

a) minimization of the quantity and activity of radioactive waste generated during operation;

b) selective collection and storage of radioactive wastes based on activity concentration and physical state;

c) keeping the quantity of radioactive materials discharged from the nuclear facility to the environment below the regulatory limits; and

d) keeping the radioactive waste related activities of the nuclear facility in harmony with the national programme for radioactive waste management.

5.3.15.0110. The activities related to management of radioactive wastes shall be implemented in accordance with the parliament resolution on the national policy for spent fuel and radioactive waste management and the government resolution on the national programme for spent fuel and radioactive waste management, considering the plans regarding the future off-site management of the waste.

5.3.15.0200. In order to comply with the requirements, the following actions shall be performed in line with appropriately approved written procedures:

a) control of radioactive waste generation;

b) collection, classification, storage of radioactive wastes, and the inspection thereof;

c) transport of radioactive wastes, and its inspection within the controlled zone;

d) transport of radioactive wastes, and its inspection out of the controlled zone;

e) management of solid radioactive wastes;

f) qualification of low and intermediate level radioactive waste packages to be transported from the site of the nuclear facility;

g) documentation of the above listed actions, including instrumentation and workers; and

h) development of the necessary procedures, technologies and requirements.

5.3.15.0300. Larger accumulation of radioactive wastes waiting for management or conditioning shall be avoided as justified.

5.3.15.0400. Isolation of radioactive wastes from the environment shall be ensured by the container types used for interim storage and final disposal of radioactive wastes for the determined storage duration.

5.3.15.0500. In the annual report, the amount of radioactive wastes generated in and transported from the facility during the year, and the amount of the radioactive waste stored in the facility at the beginning and end of the subject half year shall be reported by waste types.

5.3.15./A. Airborne radioactive wastes

5.3.15.0600. An appropriate procedure shall be developed for the operation of systems, structures and components suitable to manage airborne radioactive wastes to comply with the relevant limits and minimize the discharges. The parameters that are critical to the effective operation of the system shall be regularly monitored.

5.3.15.0700. Volatile radioactive materials shall be removed from gaseous radioactive wastes to the extent reasonably achievable.

5.3.15./B. Liquid radioactive wastes

5.3.15.0800. In the operation of the liquid waste processing systems, the composition and properties of the liquid shall be taken into account.

5.3.15.0900. The different types of wastes shall be separated, and the most effective processing shall be applied considering the principle of justification.

5.3.15.1000. The barrel or container suitable for conditioning the waste shall be filled, closed and labelled in a way that the packages be suitable for further management, transportation and disposal.

5.3.15./C. Solid radioactive wastes

5.3.15.1100. In the case of solid radioactive wastes, effort shall be made to provide representative sampling because of unhomogeneity when justifying the compatibility of the planned process.

5.3.15.1200. In the case of using mobile conditioning equipment measures shall be taken to prevent spread of contamination.

5.3.16. Nuclear fuel management

5.3.16.0100. Approved requirements, rules and procedures shall be applied during the performance of any nuclear fuel related activity, including especially those listed below:

a) purchase,

b) transport to the site,

c) movement of fresh nuclear fuel within the site of the nuclear facility,

d) verification of nuclear fuel received,

e) storage of fresh nuclear fuel,

f) intake of fresh nuclear fuel,

g) regular refuelling,

h) movement of spent nuclear fuel within the site of the nuclear facility,

i) short term storage of spent nuclear fuel,

j) interim storage of spent nuclear fuel, and

k) transport of spent nuclear fuel from the site of the nuclear facility.

5.3.16.0200. The licensee shall operate a comprehensive accountancy and control system, which is in compliance with every requirement of the nuclear fuel related international treaties and national legislations.

5.3.16.0300. The nuclear fuel movement plans shall be substantiated by detailed physical calculations in order to prevent any violation of the Operational Limits and Conditions.

5.3.16.0400. The core calculations shall be performed by such computer software, which makes possible the retrieval of information and the parallel verification of the results by independent tools.

5.3.16.0500. It shall be justified that the calculation models and tools used for load planning are validated, compared to similar models and continuously maintained. The loads differing from the usual ones shall be verified by independent tools. Special attention shall be paid to the qualification of such models, which handles higher burn-ups, new materials, design modifications and power uprate.

5.3.16.0600. Prior to start-up with a new core the adequacy of the load-plan shall be verified by measurements.

5.3.16.0700. The licensee shall have effective procedures for guaranteeing the integrity of fuel elements, inspecting fuel elements as well as for managing leaking fuel elements.

5.3.17. Nuclear emergency preparedness and response

5.3.17.0100. In the case of an emergency having effect on the site, the nuclear emergency preparedness of the nuclear facility shall provide the necessary conditions for the coordinated and effective management at the appropriate time and place, with appropriate command and control; the licensee shall be able to utilise the available resources in a trained and practiced manner.

5.3.17.0200. The licensee together with the competent central, regional and local organisations shall prepare for the response to accidents resulting in significant radioactive release and the mitigation of the consequences.

5.3.17.0300. The licensee shall establish an organisational unit with appropriate responsibilities and competencies that is prepared to act in emergency situations and is able to fulfil its tasks from decision making to operative activities in all phases of an emergency situation. The manager of the emergency response organization is the top manager of the nuclear facility or his/her fully authorized representative. Persons shall be designated in advance to each position of the organization. The number of staff for the emergency response organisation shall be defined in a way that guarantees a sufficient number of trained personnel available for performing the emergency response activities. The operation of the organisation as well as its certain actions shall be regulated in properly approved documents.

5.3.17.0400. During the period of nuclear emergency preparedness, the licensee shall be responsible for the maintenance of tools, facilities and documentation necessary for nuclear emergency response activities, the regular inspection of their suitability, the planning and conduct of emergency response trainings and drills, as well as for the communication with external institutions.

5.3.17.0500. The licensee, with the consideration of effective regulations and the lessons learned from operation and exercises, shall develop and continuously update the Nuclear Emergency Preparedness and Response Plan for the site of the facility while ensuring its consistency with legislations, national, regional and local nuclear emergency preparedness and response plans, international recommendations, and with the fire protection plan of the nuclear facility as well as with plans relating to the protection against other catastrophes.

5.3.17.0600. The Nuclear Emergency Preparedness and Response Plan shall include response actions to each emergency resulting in radioactive material discharge or radiation exposures that are identified in safety analyses. The Nuclear Emergency Preparedness and Response Plan and the subordinated documents shall regulate the activities required to be performed in any operational phase of the emergency response organization.

5.3.17.0700. The nuclear emergency preparedness activities of the nuclear facility shall be in harmony with the preparation for the response to conventional emergencies.

5.3.17.0800. The licensee shall be prepared to identify nuclear emergency situations and immediately start nuclear emergency response activities. Accordingly, it shall develop an emergency classification system. A guideline including recommendations on the establishment of the emergency classification

system is available.

5.3.17.0900. If the nuclear reactor is in operating state, then on the site of the nuclear facility, while if the nuclear reactor is in shutdown state then in a duty system a worker shall always be available with the authority and responsibility to promptly classify the nuclear emergency, and upon classification to announce the nuclear emergency and its termination, to initiate nuclear emergency response actions and to notify off-site organisations. Additionally, this worker shall be responsible for the prompt performance of these tasks; the information necessary for effective action shall be at his/her disposal; he/she shall have commanding competencies as well as tools necessary for the execution of aforementioned tasks.

5.3.17.1000. The licensee shall be prepared for the cooperation with the organizations responsible for off-site nuclear emergency response.

5.3.17.1100. The licensee shall be prepared to protect the people being at present on the site of the nuclear facility. On site alarm system shall be operated; rescue routes shall be designated that are in compliance with labour safety, radiation protection, fire protection and industrial safety requirements, simply, clearly and permanently marked and reliably enlightened; the other conditions for their use shall be provided; assembly points shall be designated. The licensee shall prepare for the mustering of persons being at present on the site, the identification of actions to be implemented on the site, the provision of the protective tools required for the implementation of the protective actions, the protection of the people involved in emergency response, as well as for the assistance of persons contaminated or exposed to radiation in the extent possible under emergency conditions.

5.3.17.1200. The necessary tools for the execution of nuclear emergency response activities shall be placed closed to the location of their expected use in a way that ensures their efficient use under the expected conditions.

5.3.17.1300. The licensee shall prepare to record the occurrences of the emergency situation, the executed measures and the contents of emergency communications; the licensee shall prepare to inform the public and the media as required by legislation.

5.3.17.1400. Regular training and exercises shall be organized for workers performing tasks in the emergency response organisation in order to make them familiar with and practice the emergency tasks assigned to them.

5.3.17.1410. It shall be ensured that the employees identified in the Nuclear Emergency Response Plan receive appropriate and regularly updated information about the health risks of their interventions, and about the

protective actions to be taken in such a case. The information shall cover the full scale of potential emergencies and the type of interventions. When an emergency occurs, the information shall immediately and appropriately be updated considering the circumstances of the given special case.

5.3.14.1420. The licensee shall provide emergency training to the employees, which shall include practical training, as appropriate.

5.3.17.1500. Regular drills and exercises shall be organized to verify the preparedness of the emergency response organisation. The lessons learned from emergency drills and exercises shall be utilized during emergency preparedness. A full scope exercise involving the entire emergency response organization shall be organized at least once every two years, in which the off-site emergency response organizations shall also be involved. The licensee shall prepare long-term and annual plans for emergency response trainings and drills/exercises.

5.3.17.1600. The licensee shall provide basic nuclear emergency response training for all persons who are authorized to be present at the site of the nuclear facility without supervision; the scope of the training shall include the emergency actions to be performed.

5.3.17.1700. The emergency preparedness organisation of the licensee shall immediately commence its activities after the announcement of the nuclear emergency situation; its activities shall be so organised and managed to avoid detaining or endangering the performance of safety functions and emergency related actions.

5.3.17.1800. The emergency classification of the event shall immediately be followed by the implementation of the necessary on-site protective actions. The licensee shall provide appropriate and consistent information to the public throughout the elimination of the nuclear emergency situation.

5.3.18. Fire protection

5.3.18.0100. The licensee shall comply with the fire protection legislations. The licensee, in cooperation with competent national, regional and local organizations, shall prepare for the protection against fire and the technical rescue.

5.3.18.0200. The workers shall support the fire fighters to commence, as soon as possible, the fight against the fire on the spot of the fire. Consequently, fire protection rules and a fire alarm plan shall be developed for the entire site of the nuclear facility.

5.3.19. Operational experience feedback

5.3.19.0100. The licensee shall develop and implement a systematic programme for the regular and continuous collection, screening, analysis and

documentation of operational data, experience and operational events of the nuclear facility throughout the commissioning, operating and termination life cycle phases of the nuclear facility. Operational experience and operational events reported by other operators, if relevant to the facility, shall also be considered.

5.3.19.0200. Based on the above information, the state of the nuclear facility shall be analysed, the operational experience shall be evaluated in order to maintain and improve the level of operational safety by identification and implementation of corrective actions, if appropriate. Every hidden safety related defect and precursor event or deviation shall be revealed and assessed for recognizing tendencies towards decreasing safety performance, the reduction of the safety margin and for substantiating the decommissioning plans.

5.3.19.0300. During the analysis and evaluation of operational experience, primary attention shall be paid to the investigation and root cause analysis of nonconformities and safety related events experienced during operations (including maintenance, repair, inspections and reviews), as well as to the determination of the severity of their actual and potential consequences, and to the identification of the necessary measures to avoid similar nonconformities.

5.3.19.0400. In order to identify nonconformities, the operator shall regularly review the actual design, and if the operational experience changes or a new safety related information rises by the application of both deterministic and probabilistic approaches, in the mirror of the effective requirements and practice. The significance of the identified nonconformities shall be determined in the mirror of the properly substantiated potential design improvements, corrections or other measures.

5.3.19.0500. The licensee shall appoint suitable workers to implement the programmes, to distribute new safety important information, and if appropriate for the development of recommendation on actions. The more significant opinions and trends shall be reported to the top management of the licensee.

5.3.19.0600. The workers responsible for the evaluation of operational experience and investigation of events shall receive appropriate training and resources. Their work shall be supported by the top management.

5.3.19.0700. The licensee shall ensure that results are produced, the necessary conclusions are deducted, the measures are implemented, good practices are contemplated and appropriate and timely corrective actions are executed to prevent recurring problems and evolving occurrences that are adverse to nuclear safety.

5.3.19.0800. The effectiveness of the operational experience feedback process shall be regularly reviewed based on performance criteria and shall be

documented in the frame of the self-assessment programme of the licensee or an independent review requested by the licensee.

Gathering the experience of other research reactors

5.3.19.0900. The licensee shall request information on experience of other facilities and from other national and international organizations interested in the application of atomic energy. This information shall be utilized after appropriate evaluation.

Operational experience feedback

5.3.19.1000. Such process shall be developed, which guarantees the appropriate utilization of operational experience regarding events occurred in the research reactor or in other facilities in the training programme of the workers.

5.3.19.1100. The new data, scientific results and reports on operational experience of other facilities shall be continuously assessed and utilized in the entire service life of the nuclear facility.

5.3.19.1200. The design and residual lifetimes of systems and components important to nuclear safety shall be compared based on the analysis of safety indicators and trends; the results shall be taken into account during the planning of in-service inspections, replacements and reconstructions.

5.3.19.1300. All available operational data and experience shall be utilized when making decisions on modifications as well as during the planning of modifications.

5.3.19.1400. The probabilistic based analysis shall take account of the operational experience to better specify the input data.

5.3.19.1500. The safety indicators applied to the operation of the nuclear facility shall be regularly assessed, and then corrective measures shall be identified, if appropriate.

5.3.19.1600. The operational experience shall be taken into account during the review of operational documents.

5.3.19.1700. The licensee shall take care of the systematic analysis and application of the relevant operational experience, the international evolution of safety standards and of new results of R&D projects, in order to further improve the operational activity.

Documentation

5.3.19.1800. The licensee shall have appropriate rules regarding the content, scope and methodology of the collection, analysis and documentation of operational data and experience. The information shall be stored in such a way

that provides easy access, systematic searching, screening and evaluation possibilities for those assigned.

5.3.19.1900. The list of safety issues revealed shall be continuously maintained, together with the methods of solution and the planned actions.

5.3.19.2000. The top management of the licensee shall continuously monitor the list and deadlines of planned actions. The planned actions shall be modified, if appropriate, by taking account of new experience.

5.3.19.2100. The information learned from operational experience shall be available for the workers and the competent national and international organizations.

5.3.20. Operational documentation

5.3.20.0100. The licensee shall have written procedure on the management of the operational documentation relating to the whole service life of systems, structures and components and experimental devices important to nuclear safety.

5.3.20.0200. The documents prepared in relation to operation shall be gathered, archived and stored until the end of the service life of the research reactor in compliance with the relevant requirements.

5.3.20.0300. The rules of documentation management shall cover:

a) technical scope: list of systems, structures components and activities concerned by the regulation;

b) scope of the document: list of and reference to documents concerned by the regulation;

c) identification of documents;

d) rules of preparation, checking, approval and issuance;

e) rules of modification and withdrawal;

f) rules of use and archiving, and

g) rules of regular review of the document.

5.3.20.0400. If more than one organizational unit is concerned by the preparation, use and archiving of an operational document, then the rules of harmonization among documents of various organizational units and the transfer of documents between organizational units shall be defined.

5.3.20.0500.