Federal Nuclear and Radiation Safety Authority of Russia
(Gosatomnadzor of Russia)

FEDERAL STANDARDS AND RULES
IN THE FIELD OF USE OF ATOMIC ENERGY

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R U L E S
OF NUCLEAR SAFETY OF CRITICAL FACILITIES

(PBYa KS- 98)

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RULES OF NUCLEAR SAFETY OF CRITICAL FACILITIES

(PBYa KS-98)
Gosatomnadzor of Russia
Moscow, 1998

These federal rules (PBYa KS-98) are a regulatory document which establishes the requirements of nuclear safety for siting, designing, constructing, operating and decommissioning of critical facilities. The rules describe technical requirements for the equipment and systems of critical assemblies, organization of work, requirements for the experiment conduct, and safety during handling of nuclear fuel.

These rules substitute PBYa-02-78.

The Rules of Nuclear Safety of Critical Facilities PBYa KS-98 have been developed by the Scientific and Engineering Center for Nuclear and Radiation Safety by R.E. Bagdasarov, V.P. Gorbunov, V.S. Dikarev, P.G. Dushin, V.A. Lititski, V.V. Maklakov, R.V. Nikolski, G.I. Pavlov, D.M. Parfanovich, V.A. Petrov, B.G. Ryazanov, and G.S. Sherashev.

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TERMS AND DEFINITIONS

This document uses the following terms and definitions.

1. Accident at critical facility (CF) shall mean the violation of safe operation limits and (or) conditions of the critical facility where an unscheduled exposure of people or radioactive contamination of its premises, environment took place in excess of the values established by the Radiation Safety Standards for Normal Operation.

2. Emergency protection (EP) shall mean the CPS device designed to perform the safety function – fast automatic and remote manual termination of the nuclear chain fission reaction in the core.

3. Nuclear, radiation safety of CF (hereinafter the "**FC safety")** shall mean the CA capability of limiting in the event of pre-accident situations and accidents the radiation impact to the employees (personnel), population and environment by the established limits.

4. Safe state of critical facility shall mean the state of the critical facility where the effective neutron multiplicity factor in its core in any point of time is less than 0.98 with EP rods withdrawn.

5. Temporary (current) nuclear fuel storage facility shall mean the specially arranged place (places) in the critical assembly (assemblies) building as identified in the design and intended for the temporary storage of nuclear fuel required by the baseline experimental program.

6. Additional emergency protection system (AEP) shall mean the critical facility equipment designed to render the critical assembly subcritical and maintaining it as such when the CPS rod do not compensate for its reactivity margin.

7. CF loading device shall mean the systems, actuators and devices of CF (other than CPS) designed for remote measurement of reactivity of the critical assembly when the critical mass is being built up.

8. Critical assembly reactivity margin shall mean the maximum positive reactivity of the critical assembly, which occurs when all CPS rods are withdrawn along with all remotely moved experimental devices as regards the state of the core with the maximum effective multiplication factor.

Note. The withdrawal of CPS rods shall mean such change in their position which leads to an increase in reactivity.

9. Beyond design basis accident at CF shall mean the accident triggered by unanticipated initiating events or accompanied by additional, as compared to the design basis accidents, failures of safety systems in excess of the single failure, erroneous actions of the employees (personnel), which radiation consequences exceed the limits established for design basis accidents.

10. System, device actuator shall mean the layout (of a system, experimental, loading device) consisting of a rod, drive and connecting elements and designed for control of nuclear reaction in the core of the critical assembly and experiments.

In terms of performed functions CPS actuators are divided into:

* emergency protection rod actuators;
* control rod actuators;
* reactivity compensation rod actuators.

11. Initiating event shall mean the single failure in the systems (elements) of the critical facility, external event or an employee (member of personnel) error, which lead to an operational event and can lead to violation of safe operation limits and (or) conditions. An initiating event includes all dependent failures resulted from it.

12. Control channel shall mean the combination of sensors, signal transmission and processing and (or) parameter displaying lines designed to provide for monitoring over the design specified volume.

13. (Safety) system channel shall mean the part of the system performing a function of the (safety) system in the scope specified in the design.

14. Compensating rod shall mean the CPS rod designed to compensate for reactivity in the core and (or) rendering the critical assembly safe.

15. Critical assembly (CA) shall mean the part of a critical facility, which contains nuclear materials in the components with variable constituents, location and geometry, which allows for having the controlled nuclear fission chain reaction and, with a low power release, provides for the possibility of studying neutronics of the simulated core while altering its parameters.

16. Critical facility (CF) shall mean the nuclear facility which includes a critical assembly, premises, a set of systems, devices and equipment with the necessary employees (personnel) designed to conduct experiments and control over the critical assembly in the modes pre-set by the design.

17. FC maximum possible reactivity shall mean the maximum reactivity that can be hypothetically achieved in the critical assembly in the course of standard and non-standard combining of capabilities and modes which are potentially provided for by the critical facility design, including:

- withdrawal of all CPS rods and other removable absorbers placed in the core and (or) reflector;
- use of experimental devices;
- refurbishment of the core moderator;
- refurbishment of the reflector;
- optimum positioning of fuel rods in a given charge;
- alteration of the CA coolant temperature and (or) pressure.

18. Supercritical nuclear chain reaction shall mean the inadvertent fission process of heavy nuclides in the conditions of progressing neutron multiplication which exceeds their absorption and leak (K_{eff} >1).

19. Nuclear fuel handling at CF shall mean the activity associated with reloading, transportation, storage and other operations with nuclear fuel, which may be a cause of accident at CF.

20. Refurbishment of CA shall mean the alteration of the composition, mutual arrangement, sizes of the core and (or) reflector up to the full replacement of the core and (or) reflector as provided for by the CF design and justified in TJS CF.

21. CA premises shall mean the part of the building (structure) of CF designed to house the critical assembly and isolated from other premises by a biological shielding.

22. CF Permanent nuclear fuel storage facility shall mean the especially furnished place for storage of nuclear fuel and arranged for as a separate (isolated) CF room.

23. Pre-accident situation at CF shall mean the condition of the critical facility which is characterized by a violation of safe operation limits and (or) conditions and which has not developed in the accident.

24. CF safe operation limits shall mean the process parameter values, as established in the design, which deviations can lead to an accident.

25. Single failure principle shall mean the principle in accordance with which the must perform the designated functions in any initiating event that requires it be operable and in case of a failure, independent from the initiating event, of any active or passive elements having mechanical moving parts.

26. CF design basis accident shall mean the accident for which the design determined initiating events, development paths, ultimate states and radiation consequences.

27. CPS rod shall mean the component which is used to change reactivity in the critical assembly core or reflector while being moved or in case of altering of its conditions.

Functionally, CPS rods are divided into EP rods, compensatory rods and control rods.

28. CPS controller shall mean the CPS device designed for automatic (AC) or manual (MC) reactivity control of the critical assembly.

29. Safety important systems (elements) shall mean the safety systems and elements as well as normal operation systems (elements) which failures disrupt normal operation of the CF or hinder elimination of operational events and can lead to design basis and beyond design basis accidents.

30. Control and protection system (CPS) shall mean the combination of the safety important devices designed to monitor intensity of the nuclear reaction (power) in the critical assembly core, control and termination in case of an emergency.

31. Technical Justification of Safety of Critical Facility (TJS CF) shall mean the document containing necessary information and justifications and confirming that its safety can be ensured at all planned life stages of the critical facility, corresponding to the design solutions, engineered means and organizational measures.

32. Safe operation conditions shall mean the minimum conditions as regards the quantity, performance, and maintenance of safety important systems (elements), as established in the design, when the operation limits and (or) safety criteria are met.

33. CF experimental device shall mean the device, arrangement designed for experimental studies and effecting the neutron flux and (or) reactivity of the critical assembly.

34. Operational limits shall mean the values of parameters and characteristics of the systems (elements) conditions and CF as a whole as pre-set by the design for normal operation.

35. CF operation shall mean all activities aimed at safe achieving of the objective the critical facility has been built for, including start-ups, shutdowns, gaining the critical mass, conduct of experiments, operation with a pre-set power density distribution, maintenance, repair and other operations which may influence safety.

36. CF operating organization shall mean the organization (legal entity) set up in accordance with the legislation of the Russian Federation and acknowledged by the relevant authority responsible for the use of atomic energy and capable of operating the critical facility and conduct by own means or with involvement of other organizations the activities associated with siting, designing, constructing, operating and decommissioning the critical facility as well as the activities related to handling of nuclear materials and radioactive substances.

37. Nuclear accident at CF shall mean the accident triggered by the supercritical nuclear chain reaction in the core or during handling of nuclear fuel at CF.

38. Nuclear hazardous operations at CF shall mean the operation at the critical facility, which can lead to a nuclear accident.

1. GENERAL PROVISIONS

1.1. The Rules of Nuclear Safety of Critical Facilities (PBYa KS-98) (hereinafter “the Rules”) establish conditions and requirements for nuclear safety of critical facilities as relates to the design solutions, construction, operation and conducting experiments at the critical facility.

1.2. These Rules cove all critical facilities which are under operation, construction and design in the Russian Federation irrespectively of their agency pertinence and type.

1.3. The Rules have been developed considering the General Safety Provisions of Research Reactors (OPB IR-94).

They incorporate the experience in design and operation of the critical facilities as well as the features critical facilities which make them different from research reactors, namely:

- a great variety of critical assemblies;

- nearly full accessibility of the critical assembly core;
- presence of experimental devices requiring the accounting of their parts' impacts to reactivity of the critical assembly;
- frequent refurbishment of the core or its replacement necessary for experimental studies;
- frequent gaining of the critical mass;
- frequent start-ups and shutdowns of the critical assembly;
- low power levels which do not require special systems for cooling of the core and which practically do not create conditions for accumulation of fission products.

1.4. Any activity associated with siting, constructing, operation and decommissioning of a critical facility shall meet the requirements of regulatory documents for nuclear, radiation, technical and fire safety of nuclear facilities, which cover critical assemblies.

1.5. The operating organization shall ensure physical protection of the critical facility as well as physical protection, control and accounting of nuclear materials and radioactive substances.

1.6. The operating organization shall develop and implements measures to improve the critical facility safety.

2. TECHNICAL REQUIREMENTS TO CRITICAL FACILITY DESIGN AND SAFETY IMPORTANT SYSTEMS

2.1. GENERAL REQUIREMENTS

2.1.1. The main technical objective of safety ensurance at all life stages of a critical facility is the prevention of supercritical nuclear chain reaction in any design basis and beyond design basis initiating events at CF, when monitoring and control in the critical assembly core is disrupted, forming of the critical mass during refueling and nuclear fuel handling.

2.1.2. The critical facility safety shall be ensured through the implementation of the defense-in-depth strategy which provides for application of: a system of physical barriers on the path of ionizing radiation and radioactive substances into the environment; a system of technical and organizational measures to protect the barriers and maintaining their effectiveness; protection of the employees (personnel), population and environment.

2.1.3. The physical barriers shall be described in the CF design.

2.1.4. The system of technical and organizational measures to protect the barriers shall comprise the multi-layer defense-in-depth arrangement that includes the following levels.

Level 1. Prevention of operational events at CF through:

- siting the critical facility on site having the appropriate characteristics;
- establishing its controlled area;
- developing the critical facility design and draft changes to it basing on the conservative approach and primarily using the tested solutions including provisions for the premises and structures' stability to internal and external impacts;
- provisions for required quality of systems (elements) of CF, its experimental devices and operations being conducted;
- reliable power supply;
- operation of the critical facility in compliance with the regulatory documents and procedures;
- maintaining in working order the safety important systems and elements by timely detection of defects, preventive maintenance, replacement of equipment exhausted its service life and organization of the effective system of documenting the results of work and inspections;
- recruiting of the CF employees (personnel) and maintaining their skill level, building the safety culture.

Level 2. Prevention of design basis accidents through:

- revealing of deviations from normal operation and their correction;
- preventing development of initiating events into design basis accidents.

Level 3. Prevention, mitigation of consequences of beyond design basis accidents through:

- preventing development of design basis accidents into the beyond design basis ones;
- mitigating the accident consequences;
- confining radioactive substances.

Level 4. Emergency planning:

- development and implementation (if necessary) the emergency action plans on the critical facility site and off-site.

2.1.5. The critical facility shall be equipped, along with the normal operation systems and elements, with the safety systems and elements commonly divided into the protecting, controlling, supporting and confining.

2.1.6. The critical facility with its safety systems, their characteristics, design engineered features shall ensure confining of design basis accident consequences within the correspondingly established limits in any initiating event attributed to initiating events of design basis accidents involving the overlapping with one failure

independent from the initiating event (including that undetected) in the safety system (device) or one employees (personnel) error.

2.1.7. The critical facility design including its systems, devises and units and their constituting elements shall be analyzed with regard to possible failures or faulty functioning to reveal a conditioned possibility of their violating safe operation limits and (or) conditions.

The most probable and hazardous failures shall be identified. The most safety important systems, devices and units shall be equipped with the means of monitoring and made redundant, as necessary.

An analysis shall be done of the critical facility actuators' design and their control schemes as regards an inadvertent change of position (conditions) of the reactivity controls leading to its increase.

2.1.8. The critical facility safety important systems, devices and units shall not be permitted for multi-purpose use if it is not proven that the associated combining of functions would not lead to violation of the safe operation limits and (or) conditions.

2.1.9. The critical facility design shall exclude a possibility of rendering the critical assembly critical from the subcritical state conditioned by a reduction of neutron leak from the core, for example, when a piece of equipment or an employee is getting closer to it.

2.1.10. The impact of flooding of the critical assembly with water shall be analyzed and the measures shall be in place to ensure nuclear safety. If nuclear safety is not ensured in cases where the critical assembly is located below the zero elevation, the critical assembly compartment shall be equipped with a water ingress alarm and automatic water evacuation device, as well as other measures shall be in place to ensure safety.

2.1.11. For the cases of loss of external power supply there shall be engineered means and (or) organizational measures allowing for the unambiguous judgment as to establishing the fact of the critical assembly having been rendered subcritical.

2.1.12. The engineered means shall exclude a possibility of water ingress into the critical assembly compartment when the CA is critical.

The reactivity build-up controlled by remote devices shall be provided for only when the critical assembly compartment door is closed.

2.1.13. The engineered means shall exclude a possibility of remote reactivity build-up simultaneously by two or more ways (except for the cases of heat-up and cooldown of high-temperature critical facilities), from two or more working places, by two and more individuals.

A possibility shall be ruled out of the generation of the controlling signal to build-up reactivity of the critical assembly from another working place if its control board shows the corresponding rods out of the position, which permits such signal.

2.1.14. The critical facility and main critical assembly system control shall be done from the control board equipped with a two-way loud-speaking communication with the critical assembly compartment and with other critical facility premises, as necessary.

The possibility of direct or TV observation of the critical assembly compartment shall be provided for from the critical assembly control board.

The control board shall be equipped with telephone communication.

2.1.15. The critical facility safety important systems shall be designed, manufactured and assembled considering additional loads possible due to natural and man-induced impacts.

A possibility of the accident at the near-by critical facility shall be considered.

2.1.16. The critical facility safety important systems, devices and units shall be inspected and tested in the course of manufacturing, assembling and alignment and they shall be subjected to compliance checks against design characteristics during operation.

The design documentation shall include programs, methodologies and devices for these inspections and their frequency indicated.

2.1.17. The critical facility shall include a permanent and (or) temporary nuclear fuel storage facility.

2.2. REQUIREMENTS FOR CRITICAL ASSEMBLY DESIGN

2.2.1. The critical assembly design and equipment shall exclude a possibility of unauthorized alteration of the composition and configuration of the core and (or) reflector, which lead to changes in reactivity.

All units and parts of the critical assembly shall have anchoring excluding a possibility of their inadvertent movement.

2.2.2. The critical assembly design shall exclude a possibility of jamming of CPS rods and remotely moved experimental devices, which change reactivity of the critical assembly.

2.2.3. All elements of the core and reflector, which periodically retrieved or moved, as well as those temporary installed (fuel rods, fuel rod simulators, experimental devices, etc.) shall have a distinct marking.

2.2.4. The nuclear fuel characteristics, arrangement of fuel rods, control rods, experimental devices affecting reactivity shall exclude unauthorized initiation of local criticality.

2.2.5. The critical assembly design shall provide for the possibility of rendering and maintaining it in the safe state including in that in conditions of total blackout (for example, control rod insertion, partial removal of nuclear fuel, moderator, reflector, etc.).

2.3. REQUIREMENTS FOR MONITORING, CONTROL AND PROTECTION SYSTEM

2.3.1. The CPS shall provide for power monitoring, control and emergency termination of the nuclear chain fission reaction over the whole range of power changes in the critical assembly as established (permitted) by the design.

2.3.2. The critical facility shall be equipped with a remotely (from the critical assembly control board) moved neutron source.

For the critical assemblies that have the permanent neutron source (radionuclide, spontaneous fission, photo-neutron, etc.) it is permitted not to have the remote source moving device if TSJ CF demonstrates that this source provides for the necessary monitoring of the critical assembly conditions.

The engineering means shall exclude a possibility of withdrawal of EP rods when the neutron source is absent in the core.

2.3.3. To control power and it build-up rate the critical facility CPS shall have at any power value not less than three independent neutron registering channels:

- two channels for power measurements;
- one channel for measuring the power doubling period.

The channels' sensitivity, locations of their sensors and neutron source intensity shall be selected such that the introduction of the neutron source in the critical assembly in any loading, including that without nuclear fuel, be accompanied by an increase in readings by the magnitude not less than 2% of the scale of the analogue reading instrument.

Where the monitoring channels operating within limited ranges are used the working ranges shall be overlapped within at least one decade.

The measurement range of the monitoring channels shall cover the whole range of the critical assembly power changes as established (permitted) by the design.

2.3.4. Each parameter signal from the power and power doubling period measurement channels shall be displayed by a reading instrument in the analogue form. The continuous recording by analogue recorder shall be arranged for at least from one power monitoring channel.

2.3.5. The power change over the whole power range of the critical assembly, as determined by the design, shall be indicated by an audible signal. The signals generated by the audible indicator of the power change shall be heard in the critical assembly compartment, control room and, if necessary, in other critical facility premises as determined in the CF design.

2.3.6. The critical assembly EP shall be designed such that during the gaining criticality and at any power level the signal in the actuator train of CPS is provided for EP to actuate by at least three independent neutron recording channels:

- two channels with regard to safety;
- one channel with regard to the power doubling period.

In case the protection channels operating in limiting ranges are used the working ranges of channels shall be covered at least within one decade limits.

The EP shall actuate when the emergency set point is reached in any EP channel. The switch-over of sub-ranges of the EP measurement channels shall not hinder the generation of the EP signal.

2.3.7. It is permitted to combine measuring sections of the control channels and EP channels. At this, a damage or failure of the element or device in the combined channel shall not affect EP capability of performing the protective function. The TJS KS shall justify whether such combining is allowable.

2.3.8. The control channel and EP channels shall be equipped with the means of monitoring of the channel performance as well as the alarm to signal on its unavailability. The scope and techniques of the channel performance monitoring shall be justified in the CPS design documentation.

2.3.9. The CPS measurement hardware shall be supported in term of metrology.

2.3.10. The implementation of EP signals shall be the priority against other types of signals.

2.3.11. The EP system shall be built in accordance with the "safety in case of failure" principle which means that any failure in the system, which disrupts its operation, results in a protective action.

2.3.12. The CPS shall have not less than two independent EP rods (EP rod groups) which automatically introduce negative reactivity at the emergency signal.

2.3.13. Positioning and worth of EP rods (EP rod groups) shall be such as that in case of a failure of one EP rod (EP rod group) with the highest worth, negative reactivity of not less than 1 β_{eff} is introduced into the critical assembly. The time of introduction of such reactivity shall not exceed 1 s starting from the moment the emergency signal is generated by any of EP channels.

2.3.14. The EP rods' worth shall be not less than that the total worth of AC rods and MC rods.

2.3.15. In the critical facilities where the total worth of EP rods does not cover the whole reactivity margin, an additional emergency protection system (AEPS) shall be provided for which cover the critical assembly reactivity margin jointly with EP rods.

The AEPS actuation can be done automatically or by the operator from the critical assembly control board.

Rate and time of reactivity introduction by AEPS shall be justified in TJS KS.

2.3.16. When the emergency signal is generated the EP rods shall be actuated being in any position, including the intermediate one, and the started protective action shall continue until full completion.

2.3.17. The EP system shall be arranged so that when the EP rods are inserted to perform protective functions the introduction of negative reactivity is ensures at any section along their route.

2.3.18. Emergency signal which shall automatically trigger EP shall be determined by the design and justified in TJS KS. At this, the following shall be considered mandatory signals:

- reaching of the emergency set point of the power doubling period;
- reaching the emergency set point of power;
- unavailability of any of EP channels as regards power and duration;
- loss of power in CPS trains including in the power supply units of monitoring and protection channels.

If necessary, EP shall actuate at the process parameter signals (pressure, temperature, etc.) or other signals requiring the critical assembly trip.

Also, EP shall actuate at pressing EP buttons located at the critical assembly control board, in the critical assembly compartments and (if necessary) in other locations as determined in the critical facility design.

2.3.19. The AC, MC and compensating rods can be used also to render the critical assembly safe.

It is not permitted to use EP rods for functions other than the designated ones.

2.3.20. The CPS rods shall be furnished with indicators of their intermediate position (state) and stop switches, which (possibly) actuate triggered by the rods.

For EP rods the indicators of their intermediate position is not mandatory.

2.3.21. There shall be interlocks which exclude a possibility of reactivity increase by any remotely controlled device in the event of loss of power at least in one of the trains:

- indicators of the intermediate position of the reactivity control rod;
- emergency and warning alarm;
- emergency notification (about initiation of the nuclear accident).

2.3.22. There shall be interlocks inhibiting:

- an increase of the critical assembly by AC, MC and compensatory rods and other reactivity controls (see para 2.4.7 of these Rules) until EP rods are not placed in the working position (state);
- withdrawal of EP rods if AC and MC rods are not fully inserted in the core.

The EP rods' withdrawal with compensatory rods partially inserted in the core shall be justified in TJS KS.

2.3.23. When worth of one or several simultaneously moved CPS rods is less than 0.7 β_{eff} the rate of the positive reactivity increase shall not exceed 0.07 β_{eff}/s.

2.3.24.. When worth of one or several simultaneously moved CPS rods is over 0.7 β_{eff} the actuators and their control schemes shall provide for step-up reactivity increment with the step pitch of not more than 0.3 β_{eff} and the reactivity increase rate of not more than 0.03 β_{eff}/s.

Note. The step-up reactivity increase is characterized by alternation of rod movement of their automatic halt. At this, each subsequent movement is triggered by the control board operator.

2.3.25. The reactivity increase rate while withdrawing EP rods shall not exceed 0.07 β_{eff}/s.

2.3.26. For CPS rods with worth higher 0,7 β_{eff} there shall be an additional possibility of termination of reactivity increase by them through breaking their drives' power supply circuit initiated from the critical assembly control room if these CPS rods are not equipped with electromagnetic release mechanisms.

2.3.27. At the EP signal (see para 2.3.18 of these Rules) the compensatory, AC and MC rods shall be automatically inserted into the core. The MC and AC rods shall be fully inserted.

2.3.28. When a pulse neutron generator, fast moving neutron source and the like, which change the neutron flux and can lead to EP actuation as regards the duration but in fact do not change reactivity, are used at the critical facility, it is permitted to temporary switch off (interlock) the emergency signal as regards the power doubling period provided the requirements below are met simultaneously:

- switching off (interlocking) is done from the critical assembly control board by the button (key) which inhibits the increase in reactivity by any means;
- the monitoring of the CA power doubling period monitoring as regulated by para 2.3.3 of these Rules;
- at the critical assembly control board there is the alarm of switching off (interlocking) of EP signal as regards the power doubling period.

2.3.29. The following alarms are mandatory at the critical facility:

- emergency (light and sound) which shall actuate at all signals requiring EP action; the light signals shall be located within the control board operator's visual range and provide for prompt decoding of the EP actuation cause;
- warning (light and sound) which shall actuate at the parameters which approach EP set points and when normal functioning of the critical facility systems and equipment is disrupted and the employees' (personnel) actions are required to restore the normal process;
- information (indicator) which displays position and state of the critical facility systems, elements and equipment;
- emergency notification (light and sound) which actuates in the event of nuclear reaction at the critical assembly; the sound shall differ greatly from other audible alarm sounds.

The light alarm shall be arranged for on the critical assembly control board and in other critical facility rooms as determined by the design.

2.3.30. The possibility shall be provided for the on-line check of performance of all types of light and sound alarms.

2.3.31. The critical facility can be equipped with the system for automated power control (maintaining) which satisfies the safety requirements.

2.4. REQUIREMENTS FOR LOADING AND EXPERIMENTAL DEVICES

2.4.1. The design of equipment of loading and experimental devices and their control schemes shall exclude a possibility of unauthorized changes of the critical assembly reactivity.

2.4.2. The design of loading and (or) experimental devices, mutual arrangement of equipment and utility lines used for loading the nuclear fuel shall exclude a possibility for the critical mass to build up in them.

2.4.3. If the use of experimental devices may change reactivity of the critical assembly by 0.3 β_{eff} and more, the step-up (discrete) reactivity increase shall be provided for with the increment value (pitch) which does not exceed 0.3 β_{eff} and the increment rate of not more than 0.03 β_{eff}/s.

2.3.4. The filling of the CA core and (or) reflector with the liquid (including that containing nuclear fissile materials) and its draining, which lead to changes in the effective neutron multiplicity factor, shall be done remotely from the critical assembly control room.

In the course of such operations the requirement of para 2.4.3 of these Rules shall be met.

A metering device and level meter with the corresponding characteristics shall be used to meet this requirement (both during the filling and draining).

2.4.5. The design and locations of utility lines, metering device and other equipment designed to supply the nuclear fuel solution into the critical assembly shall exclude a possibility of the solution release into the attended premises during normal operation and pre-emergency situations.

2.4.6. Locations of the utility lines, tanks and other equipment used in the liquid filling (draining) systems shall exclude a possibility of their spontaneous filling (draining) due to siphon or other effects, e.g., temperature effect.

2.4.7. The engineered means shall exclude a possibility of reactivity increase by loading and (or) experimental devices if EP rods are not withdrawn to their working position (state).

2.4.8. At the EP signal the increase in reactivity due to loading and (or) experimental devices shall stop, and when necessary the automatic decrease of reactivity due to influence of loading and (or) experimental devices shall be arranged for. In the liquid filling lines there shall be a device of visual jet break, which terminates reactivity increase at the EP signals.

2.4.9. The automated control over operation of loading devices as regards the reactivity increase in the critical assembly shall be excluded.

2.4.10. It is permitted that the functions of loading and experimental devices be performed by one device provided the requirement of para 2.1.8 of these Rules and requirements of this subsection are met.

2.4.11. Actuators of loading and (or) experimental devices shall be equipped with indicators of intermediate position and stop switches if the loading and (or) experimental devices are used for changing reactivity due to elements (fuel rods, FAs, etc.) being placed into (retrieved from) the critical assembly.

The engineered means shall exclude operation of such devices in the event of loss of power at the position indicators.

2.4.12. When the nuclear fuel is in the critical assembly and it is necessary to carry out alignment operations at actuators of loading and (or) experimental devices, which does not exclude a possibility of the critical assembly reactivity, the control of their movement from the critical assembly compartment is permitted when all of the below conditions are met at the same time:

- EP rods are withdrawn in the working position (state);
- the critical assembly in the safe state and its violation is excluded by technical and organizational measures;
- the monitoring of the critical assembly state is arranged for through the neutron flux monitoring channels;
- the signal authorizing the control has been sent from the critical assembly control board and the control over movement of loading and (or) experimental devices is impossible from other working place.

3. CRITICAL FACILITY DESIGN AND ITS AMENDMENT PROCEDURE

3.1. The operating organization shall provide for development of the critical facility design in accordance with established procedure.

3.2. The design documents package shall include a special file “Technical Justification of Safety of CF (TJS KS), which contents requirements are determined by Gosatomnadzor of Russia.

3.3. The critical facility design, TJS KS shall contain a justified list of initiating events; they shall determine the design basis accidents' development paths and radiation consequences, as well as that of the beyond design basis accidents including consequences of accidents with maximum power density.

3.4. The critical facility design and TJS KS shall list computer codes used to justify safety along with their scopes of applicability. The codes in use shall be certified.

3.5. In designing the critical facility the limiting timeframes of operation of the major equipment shall be identified and its replacement criteria shall be determined.

3.6. At the stage of safety justification development for planned critical facility changes the operating organization shall:

- carry out an analysis aimed at revealing of initiating events, which are supplementary to those earlier considered in TJS KS (see para 3.3. of these Rules) as conditioned by the planned changes to the critical facility;
- carry out a safety analysis with determining the radiation consequences of accidents pertaining to the new list of initiating events of the critical facility being changed.

3.7. A categorization of the upcoming changes with attributing them to one of the below categories shall be done on the basis of the said analyses.

3.7.1. Changes which consequences can significantly affect the critical facility safety, the change of the composition and values of safe operation limits and conditions set forth in the design requiring updating of TJS KS (fundamental refurbishment of the critical facility – reconstruction).

3.7.2. Changes in the critical facility systems and elements which consequences affect safety and require updating the critical facility safe operation limits and conditions as well as additions to TJS KS (replacement of individual or installation of additional systems and (or) elements and experimental devices) - modernization.

3.7.3. Replacement of the critical assembly and refurbishment of its core (out of the CF composition as provided for by the design and CA certificate) – replacement of the critical assembly.

3.7.4. Changes to systems and elements affecting safety but not changing the established safe operation limits and conditions of the critical facility.

3.7.5. Changes which do not affect safety of the critical facility.

3.8. While refurbishing the critical facility (para 3.7.1 of these Rules) it is required to develop a new design (putting the mark "Refurbishment of Critical Facility" on the title page). The design documentation may include the documentation of the previously done design for systems and equipment, which are not subject to change in the course of refurbishment.

At this, the procedure for design and commissioning of the refurbished critical facility shall remain the same as that for the newly built critical facility.

3.9. The modernization of the critical facility (para 3.7.2. of these Rules) shall provide for the following main stages:

- development of changes to the critical facility design documentation;
- obtaining the permit to introduce changes;
- making changes to TJS KS;
- manufacturing, assembling and testing of equipment;
- introducing changes to the operating documentation;
- employee (personnel) training;
- obtaining the permit for further operation of the critical facility.

3.10. The replacement of the critical assembly (para 3.7.3 of these Rules) or refurbishment of its core (from composition of the critical assemblies provided for by the CF design and certificate) shall be justified in TJS KS and carried out at the operating organization management's decision in the scope of the operating license conditions.

3.11. The making changes associating with replacement of individual or installation of replacement elements of the structure, systems and (or) experimental devices (para 3.7.4 of these Rules) can be carried out in accordance with the Critical Facility Operating Procedure provided that (in accordance with para 3.7 of these Rules) it is demonstrated that this replacement will not change the safe operation limits and (or) conditions and results of analysis of accident consequences considered in TJS KS.

3.12. Changes which do not affect safety of the critical facility shall be done in accordance with the procedure determined by the operating organization.

At this, the technical documentation shall reflect the introduced changes and their category as safety irrelevant shall be justified.

3.13. Changes being done to the critical facility and its design documentation, changes to its technical characteristics shall be reflected in the technical and operating documentation and kept until the critical facility is decommissioned.

4. CRITICAL FACILITY COMMISSIONING

4.1. The following shall be in place by the critical facility commissioning:

- start-up and alignment operations performed;
- integrated inspection of the critical facility equipment without nuclear fuel done;

- technical and operating documentation formalized;
- employees (personnel) of the critical facility trained and have work permits;
- first criticality availability record are in place for:
  - critical assembly (without nuclear fuel);
  - CPS and instrumentation and controls (I&C);
  - neutron source and its moving device;
  - all actuators of loading and experimental devices;
  - nuclear fuel storage facilities and fuel bundle assembling sections (if necessary);
  - nuclear fuel transportation devices (if available);
  - critical facility power supply systems;
  - ventilation systems;
  - health physics and radiation monitoring systems;
  - alarm, communication and other systems and equipment necessary for safe operation of the critical facility.

4.2. The preparedness of the critical facility for commissioning shall be checked; the critical facility commissioning procedure shall be followed; and the preparedness of the critical facility for safe operation shall be checked.

4.3. The said check shall be carried out by commissions:

- the commissioning acceptance commission for the critical facility with supporting systems and premises; the commission shall be appointed in accordance with the procedure determined by the legislation and the body responsible for control over use of atomic energy;
- the nuclear safety commission to appointed by the order of the operating organization management.

4.4. The critical facility commissioning acceptance commission shall check:

- whether the work done complies with the design;
- whether the construction standards and rules' requirements are met as well as environmental requirements, requirements of regulations approved by the federal safety regulatory authorities and occupational safety;
- whether the radiation safety requirements are met;
- whether the equipment test record, systems, equipment and premises operating availability records are in place;
- whether the staffing plan is completed with employees (personnel) and whether they have independent work permits;
- whether the necessary design, technical, operating and administrative documentation is in place.

The commission shall produce a record on preparedness of the critical facility for operation, its supporting systems and premises; the record shall be approved by the management of the operating organization.

4.5. The nuclear safety commission shall inspect into:

- whether the nuclear safety measures have been implemented as provided for by the critical facility design over all sections of these Rules;
- whether the record as per para 4.4 of these Rules is in place;
- whether the documentation as per section 6 of these Rules (except for para 6.2.7) is in place;
- the degree of skills and availability of work permits for employees (personnel) for the critical facility operations.

The inspection results shall be formalized in a record to be approved by the management of the operating organization.

4.6. The beginning of the critical facility operation shall be formalized by the order issued by the operating organization after it has obtained the CF operating license.

4.7. If in the course of the critical facility operation, including first criticality and changes to the physical characteristics of the critical assembly, its actual characteristics will differ from the design and (or) certificate ones, the design and (or) certificate shall be corrected in the scope of safety justification contained in TJS KS.

The TJS KS shall be updated basing on the results of the first criticality as well as changes done during construction, assembling and start-up and alignment operations (if necessary).

5. CRITICAL FACILITY WORK CONDUCT REQUIREMENTS

5.1. ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES. CRITICAL FACILITY EMPLOYEES (PERSONNEL)

5.1.1. The management of the operating organization shall develop the organizational structure of divisions and employees (personnel) of the critical facility with the clear-cut functional duties, authorities and interactions.

The critical facility operating personnel shall be a separate division.

5.1.2. Functions, responsibilities, authorities and duties of the critical facility employees (personnel) shall be described in the corresponding provisions and job descriptions.

5.1.3. Organizations which have several critical facilities may set up the critical facility maintenance divisions (CPS and I&C divisions, electrical engineers and mechanical engineers divisions and the like).

5.1.4. The employees (personnel) seconded from other divisions and (or) organization can be involved in conducting experiments at the critical facility, work to change, repair and maintain it along with the critical facility employees (personnel). The management of the operating organization shall issue administrative directives as to allocate staff and seconded employees.

The responsibilities of seconded employees shall be determined by the provisions and instructions applicable in the operating organization.

5.1.5. The organization of work, structure, documenting system and allocation of responsibilities shall be reflected in the critical facility quality assurance program for the corresponding stage of the critical facility service life.

5.1.6. All nuclear hazardous operations and any experiments at the critical facility shall be carried conducted only by the critical facility employees (personnel) as per the critical facility operating procedure.

5.1.7. The operating organization shall develop a procedure for training employees (personnel), which is to include a program of training and retraining, frequency of exams and briefings. The employees (personnel) training program and members of the examination commission shall be approved by the management of the operating organization.

5.1.8. Only the individuals acknowledged fit in terms of health shall be involved in the work at the critical facility.

5.2. REQUIREMENT FOR SHIFT WORK ORGANIZATION

5.2.1. The shift work organization and experiment conduct procedures shall be described in detail in the Critical Facility Operating Procedure.

5.2.2. For each critical facility the operating organization shall develop methodologies and procedures corresponding to the requirements of section 5 of these Rules as regards both stages of experiment conduct, which are nuclear hazardous: preparation of the experiment and experiment conduct.

5.2.3. All critical facility experiments shall be carried out by the employees (personnel) of the critical facility who are on the shift list. The shift personnel shall be composed of the performers as determined by the work program proceeding from the requirements of a specific experiment and recorded in the Operations Log. The employees who are not provided for by the work program can be added to the shift list only by written directive of the head of division operating the critical facility. The shift list shall be agreed upon with the Shift Supervisor.

5.2.4. While carrying out the experiment the shift shall include at minimum the Shift Supervisor, critical facility control board operator, supervising physicist and CPS duty engineer.

5.2.5. It is not mandatory to put on the shift list the supervising physicist if when carrying out experiments at the critical facility with the anticipated reactivity margin of not more than 0.7 β_{eff} (considering reactivity introduced by experimental devices) the reactivity change is done only by remote moving of CPS rods and remotely moved experimental devices where the reactivity values have been determined by experiment.

5.2.6. If during the maintenance of the critical facility the critical assembly is in safe state and the possibility is excluded of affecting its reactivity, it is not required to set the shift. The work is done upon the written directive of the critical facility manager or head of division which operates the critical facility as entered in the Operations Log and under supervision of the Shift Supervisor or a specially designated employee out of the critical facility staff.

5.2.7. Persons who are not on the shift list are allowed to the critical facility control board room during the experiment only with consent of the Shift Supervisor and only by the written directive of the head of division operating the critical facility as entered into the Operations Log.

5.3. REQUIREMENT FOR PREPARING CRITICAL FACILITY FOR EXPERIMENT

5.3.1. Before the commencement of work to prepare the critical facility for the experiment the shift personnel shall sign in the Operations Log as to the shift turn-over in accordance with the procedure established by the operating organization.

5.3.2. The shift personnel may switch on the CPS instrumentation and other systems and equipment of the critical facility as necessary for conducting the work in accordance with the shift work program only after the Shift Supervisor's directive.

5.3.3. The control board operator and CPS and I&C duty engineer shall check on operability of the control and protection channels, check on EP actuation (except for EP rods actuation) and other necessary equipment, and switching on the dosimetry instrumentation. The operability of the control and protection channels indicated in paras. 2.3.3 and 2.3.6 of these Rules shall be checked with the use of the neutron source.

5.3.4. After all necessary critical facility systems have been checked, an entry shall be made in the Operations Log as to the preparedness of the critical facility for operation, EP set pont values, results of EP actuation checks, and radiation situation survey.

5.3.5. The activities to implement the shift work program is allowed to commence only after the Shift Supervisor signs the relevant directive in the Operations Log.

5.4. REQUIREMENTS FOR EXPERIMENT CONDUCT

5.4.1. The experiment shall begin with introduction of the neutron source in the critical assembly (except for the critical assemblies outlined in para 2.3.2 of these Rules), EP rod actuation check and their subsequent withdrawal into the working position.

5.4.2. In the course of experiments presupposing alternating introduction positive and negative reactivity, as a rule, negative reactivity should be introduced first and only then negative.

5.4.3. The instruments of control channels shall be adjusted to the most sensitive measurement sub-ranges or sub-ranges at which the requirement of para 2.3.3 of these Rules is met (operating sub-ranges).

5.4.4. The EP actuation set points shall be put:

- regarding power – not higher than 100 % of the working sub-range;
- regarding power doubling period – not less than 5 s;
- regarding process parameters – as per the experiment program but without violation of safe operation limits.

5.4.5. Should the critical assembly monitoring instrumentation produce contradictory readings, the experiment shall be immediately terminated, the critical assembly brought into safe state, and the cause of readings contradiction revealed.

5.4.6. Should the circumstances not foreseen by the shift working program emerge, the experiment shall be immediately terminated and the program corrected.

5.4.7. The critical assembly units and parts not used in the given experiment shall be in the storage locations ruling out their misuse.

5.4.8. It shall be prohibited to simultaneously change two or more parameters of the critical assembly related to its reactivity change, except for heat-up (cooldown) cases.

5.4.9. It shall be prohibited to change reactivity manually using two or more ways simultaneously, except for heat-up (cooldown) cases as well as by two or more individuals.

5.4.10. During all experiments the critical assembly power doubling period shall be not less than 10 s.

5.4.11. In case where the critical charge (number of bundles, assemblies, fuel rods, solution, moderator, CPR rods' position, etc.) were not determined beforehand by experiment, the critical mass build-up shall be conducted with meeting the following additional requirements:

- the first loaded batch shall not exceed 10% of the minimum design value of the critical parameter;
- the second loaded batch shall be loaded after countdown in the control channel and shall not exceed the first one;
- each subsequent batch shall not exceed 1/4 of the value remaining to the extrapolated critical parameter value obtained through the curve producing the minimum critical value of this parameter;
- construction of the countdown curves shall be done at least over two neutron flux density control channels. At this, two and more curves shall have the "safe run";
- when $K_{eff,}$ equal to 0.98 is reached (multiplication equals 50) an assessment shall be done of the CPS rods worth in the units of measure of the measured parameter.

5.4.12. The further loading is permitted by two ways.

5.4.12.1. In case of non-remote critical mass build-up the core loading shall be done as follows:

- the critical assembly reactivity shall be reduced by insertion of CPS rods so as to exceed at least twice the future reactivity increment as regards the absolute value;
- carry out planned additional loading; after that the employees (personnel) shall leave the critical facility compartment. At this, the engineered means shall exclude a possibility of reactivity increase by any controlled device when the critical facility compartment door is open;
- remotely with the increment of not more than 0.3 β_{eff} increase reactivity using CPS rods until criticality is reached.

5.4.12.2. In case the loading devices are used, the loading shall be done by increments (batches, pitches) not more than 0.3 β_{eff}. The rate of introduction of positive reactivity by the loading devices shall be at this not more than 0.03 β_{eff}/s.

5.4.13. The re-gaining criticality at the critical assembly which load was previously determined by experiment is allowed before K_{eff} becomes equal 0.98; it shall be done in batches (steps) determined in the shift work program. The necessity to assess CPS rods worth at $K_{eff,}$ equal 0.98 is determined by the work program. The subsequent loading shall be done similarly to the procedure of para 5.4.12 of these Rules.

5.4.14. At the critical facilities where the critical assembly safe state is achieved through removal of nuclear fuel, etc. (see para 2.2.5 of these Rules) the rendering its critical when the work is being resumed shall be conducted as re-gaining criticality (see para 5.4.13 of these Rules).

5.4.15. The experiment shall be considered completed after the critical assembly has been brought into the safe state and power supply switched off the actuators of loading and experimental devices. Operation requiring presence of people in the critical assembly compartment to render the CA safe shall be done after operations conducted remotely.

When the work at the critical facility is over the EP rods shall be the last to be inserted into the critical assembly; that is followed by de-powering CPS instrumentation. The entry shall be made in the Operations Log as to the state of the critical assembly and equipment. The critical assembly (or the critical assembly compartment) shall be closed and sealed; the Shift Supervisor, control board operator and supervising physicist shall sign in the Operations Log (except for cases outlined in para 5.2.5 of these Rules).

6. DOCUMENTATION

6.1. The operating organization shall generate a full list of documents for the critical facility to include internal, directive, operating and other documents as well as the documents of other organizations relevant and mandatory for the critical facilities. It shall ensure that the requirements of the said documents are met at all stages of the critical facility service life.

6.2. The complete set of the critical facility documents shall be determined by the management of the operating organization basing on the existing requirements. The following documents are mandatory.

6.2.1. The license for the corresponding stage of the critical facility service life and its conditions.

6.2.2. The CF Certificate (the format of CF Certificate is given in Attachment).

6.2.3. Sanitary certificated for the critical facility premises and for the operations with ionizing radiation sources.

6.2.4. A list of all regulatory documents relevant for the critical facility and the regulatory document which requirements, as the operating organization considers, the critical facility meets.

6.2.5. The principal flow diagrams of experiments to describe the goal and tasks of experiments, stages of studies and term of effect.

6.2.6. Work programs. Each work program shall be compiled for one work stage or class (type) of experiments foreseen in the overall program. The program shall contain a procedure and methodology for the experiment conduct with indication of experimental devices placed in the critical assembly; evaluation of the anticipated reactivity effects; nuclear safety measures.

Note. The work program generated for one class (type) of experiments may be used at different stages of research as determined by the overall program.

6.2.7. One shift program. The program shall be an expanded part of the overall program and shall contain the experiment sequence during the shift, anticipated critical parameter values, reactivity effects, critical assembly power levels and additional nuclear safety measures.

6.2.8. The critical facility operating procedure. The procedure shall contain a brief description of the critical facility, its technical operation procedures, safe operation limits and conditions, description of technical and organizational measures to ensure nuclear safety, and work conduct.

6.2.9. Operations Log.

6.2.10. A compilation of the core load mapping, countdown curves, calibrating plots and CPS rod worth diagrams. All maps and calibrating plots for CPS rods shall be dated and signed by performers.

6.2.11. Nuclear safety procedure for storage, transportation and handling of nuclear fuel off-critical assembly.

6.2.12. Job descriptions of employees (personnel) of the critical facility.

6.2.13. Emergency plan of actions for the employees (personnel).

6.2.14. Radiation safety and occupational safety procedures for all types of operations conducted at the critical facility.

6.2.15. Orders regarding designation of the scientific supervisor, head of critical facility and shift supervisors.

6.2.16. The critical facility employees (personnel) training program and members of the examination commission.

6.2.17. Examination records and records of briefing of the critical facility employees (personnel) and the supporting personnel.

6.2.18. The critical facility technical documentation. It shall include:

- critical facility design, TJS KS;
- records of tests and periodic inspections of equipment;
- operating procedures for equipment and instruments;
- technical solutions regarding changes made to the critical facility equipment and their implementation records;
- permits resulted from relevant inspections, etc.

6.2.19. The critical facility quality assurance program for the corresponding life stage.

6.2.20. Radian accident decision-making criteria.

6.2.21. Provisions for accounting of and investigation of violations at the critical facility.

6.2.22. List of documentation effective for the whole critical facility and each working place approved by the head of division (critical facility manager).

6.3. The fact of familiarization with all documentation existing at the critical facility shall be formalized by the signature of the familiarized individual.

The supporting personnel shall get familiarized with documents and changes within the scope of their duties.

6.4. All documents shall have archiving and registered numbers.

7. OFF-CA NUCLEAR FUEL STORAGE AND RADIOACTIVE WASTE MANAGEMENT

7.1. Nuclear fuel shall be stored at the critical facilities in permanent and (or) temporary storage facilities as determined by the critical facility design.

7.2. The permanent nuclear fuel storage facilities shall meet the requirements of the Rules of Safety for Storage and Transportation of Nuclear Fuel at Nuclear Power Facilities.

7.3. While storing nuclear fuel in temporary storage facilities the mutual arrangement of fuel rods, FAs, nuclear fuel containers, etc. shall be such as to ensure the value of K_{eff} not more than 0.95 during normal operation and initiating events determined in the critical facility design (including flooding of the storage facility).

7.4. Arrangement of fuel rods, FAs, containers in the temporary storage facility shall be fixed and exclude their inadvertent movements.

7.5. At the critical facilities where under the experimental conditions it is required to assembly and (or) re-assembly FAs there shall be working places for such operations. These working places shall be located in the prmanent nuclear fuel storage rooms, in the critical assembly compartment or in special premises incorporated in the critical facility premises. If necessary, they shall be equipped with an emergency alarm system which meets the requirements of the Rules of Design and Operation of Emergency Alarms Systems of Self-Sustained Chain Reaction and Organization of Measures to Limit Its Consequences.

7.6. The procedures for all nuclear fuel handling operations and nuclear safety measures as in the nuclear fuel storage facilities as in assembling locations shall be determined in the nuclear safety procedure as required by para 6.2.11 of these Rules. The nuclear fuel location maps and standards for working places and storage locations shall be placed in the locations clearly visible to all employees (personnel).

7.7. Nuclear fuel handling off-CA operations shall be conducted at least by two employees. If such operations (excluding the operations listed in para 5.4.12.1 of these Rules) are conducted in the critical assembly compartment, the latter shall be in subcritical state.

7.8. Radioactive waste management operations shall be conducted in accordance with the requirements of the relevant regulations and procedures of the operating organization.

7.9. Nuclear fuel handling safety in temporary storage facilities, as well as radioactive waste management safety shall be described and justified in TJS KS.

8. ACTIONS OF EMPLOYEES (PERSONNEL) IN THE EVENT OF ACCIDENT

8.1. In the event of a pre-accident situation the Shift Supervisor shall terminate the experiment, render the critical assembly subcritical, and inform the critical facility manager and experiment scientific supervisor on the pre-accident situation. After the pre-accident situation cause has been found out and eliminated the experiment may be resumed by the written permission (directive) of the operating organization manager.

8.2. In the event of an accident the critical facility employees (personnel) shall implement the following priority actions:

- render the critical assembly subcritical by any of possible remote ways (if it has not been done automatically);
- actuate the emergency notification (if it has not actuated automatically);
- immediately evacuate people from the critical assembly compartment and nuclear fuel storage facility;
- implement measures for immediate evacuation of people from the hazardous zone (if necessary);
- assess the radiation situation in the critical facility premises;
- take measures to confine the radioactive product release;
- call for the officer of the radiation safety division;
- if necessary, call for the ambulance, fire brigade, technical support services of the operating organization;
- report to the operating organization management.

8.3. In the event of an accident at the critical facility led to a release of radioactive substances into the environment in excess of the established limits, the operating organization shall provide for the prompt informing on the radiation situation of the relevant state authorities, local administrations and population of the most jeopardized sections of territory, the authority controlling the use of atomic energy, safety regulatory authority, divisions of the state monitoring of the radiation situation and systems of warning and action in emergencies.

8.4. Each accident shall be investigated and accounted of in accordance with the applicable provisions.

8.5. In the event of an accident and until a special directive it is prohibited to change the EP channels' actuation set points and open CPS and I&C cabinets.

8.6. The operating organization shall determine the procedure and frequency of emergency drills of employees (personnel) of the critical facility (critical assembly) and implement them.

9. NUCLEAR SAFETY INSPECTION AT CRITICAL FACILITY

9.1. The operating organization manager shall periodically (at least once a year) issue an order to appoint the commission to inspect nuclear safety at the critical facility (critical assemblies) and of nuclear fuel storage as per sections of these Rules. The record generated by the commission shall be incorporated into the annual safety ensurance report which is submitted to the federal safety regulatory authority and to the federal authority for control over the use of atomic energy along the line of reporting.

9.2. When the critical facility certificate is renewed the operating organization commission shall inspect into the technical conditions of the critical facility; document availability, conditions and keeping; organization work conduct; procedures for training issuing work permits for the employees (personnel); procedures for storage and handling of nuclear fuel off-CA. The inspection results shall be reflected in a record which shall be submitted to the federal safety regulatory authority and to the federal authority for control over the use of atomic energy along the line of reporting.

10. CRITICAL FACILITY DECOMMISSIONING

10.1. The main technical safety objective at the critical facility decommissioning stage is that the radiation standards are not exceeded during dismantling and removal to special storages of radioactive waste, as well as the exclusion of any element of the critical facility or a part (section) of its building with induced or surface radioactivity from unlimited re-use.

10.2. Technical and organizational measures necessary to decommission the critical facility shall be provided for during its designing as well as they shall be considered during its operation, repair and refurbishment.

10.3. The critical facility decommissioning decision shall be made by the federal authority for control over the use of atomic energy on the basis of the critical facility decommissioning program.

10.4. The critical facility decommissioning program shall contain the following information:

- a complete list of premises, systems, equipment of the critical facility subject to decommissioning;
- main preliminary results of the radiation survey of the decommissioned premises, systems and equipment of the critical facility;
- end state to be achieved as a result of the critical facility decommissioning and a reference to the acceptability criteria of the results of the work done;
- main stages of the critical facility decommissioning;
- solutions of principle, which ensure safety at the critical facility decommissioning, radioactive waste management, cutting the radioactive equipment and its transportation inside the critical facility building and beyond it;
- a list of organizations performing work and rendering services relevant to the critical facility decommissioning.

10.5. Before the critical facility decommissioning commences, a report shall be developed to contain detail information on the initial state of the critical facility and include a description, drawings, schemes, photographs, etc.

10.6. At the initial stage of the critical facility decommissioning a thorough radiation survey of equipment, systems and rooms of the critical facility shall be done to meet the requirements of para10.1 of these Rules.

10.7. Before the critical facility decommissioning commences a quality assurance program for all operations to be performed shall be developed.

10.8. Results obtained at all intermediate stages of the work shall be documented in the corresponding reports. The continuity and sufficiency of information handed over by the employees (personnel) having performed a part of works to another employees (personnel) who continue the work at subsequent stages shall be ensured.

10.9. When the critical facility decommissioning ends up a detailed final report shall be generated to contain information on compliance of the work done to the critical facility decommissioning program, on the possibility to use the critical facility premises for other purposes or on the possibility of exempting them from the registries of the federal safety regulatory authorities as posing no radiation hazard.

10.10. Results of the critical assembly decommissioning work done shall be formalized by a record to be approved with participation of the federal safety regulatory authorities.

Attachment

CRITICAL FACILITY CERTIFICATE

1. Name of critical facility.....
2. Operating organization.....
   Critical facility location.....
3. Critical facility designers:
.....
.....
.....
4. Critical facility commissioning date.....
5. Type of critical assembly (core and reflector).....
.....
(type of nuclear fuel, manufacturing plant code,
.....
enrichment, moderator, reflector material, etc.)
6. Reactivity margin, β_{eff}.....
7. Maximum possible reactivity, β_{eff}.....
8. Limiting values of power and process parameters.....
.....
9. CPS characteristics:
   - 9.1. Power and period control channels:
     - a) power.....
       (type and number)
     - b) power doubling period.....
       (type and number)
   - 9.2. Emergency protection channels:
     - a) power.....
       (type and number)
     - b) power doubling period.....
       (type and number)
   - 9.3. Control and compensatory rods.....
     (number, worth, etc.)
   - 9.4. Emergency protection rods.....
     (number, worth, etc.)
   - 9.5. Additional emergency protection system (AEPS):
     .....
     (pump-out, drain of liquid, CPS actuators, etc.)
     .....
     (total worth, actuation technique)
10. Experimental, loading devices (type, purpose,
    maximum introduced reactivity, etc).....
11. Additional information.....

"....."....19

Operating organization
manager

Name signature

"....."....19

Head of division
(critical facility manager)

Name signature

Certificate is issued on the basis of (titles of documents and registered numbers)

.....
.....

Certificate valid until “.....”.....

Position of Gosatomnadzor of Russia
Official issued Certificate Name signature

Notes.

1. While filling in the Certificate:
   - paras. 9.1 and 9.2, indicate whether the functions of monitoring and protection are combined;
   - paras. 9.3 and 9.4, indicate the range of possible changes in quantity and worth;
   - para 9.5, indicate how AEPS id actuated (automatically or by the operator);
   - para пункту 10, indicate a possibility of combining the functions by one device.
2. The certificate information supplement shall list all current deviations from the requirements of these Rules and other regulations (at the moment of issuing the certificate).
3. The certificates shall be arranged in the file containing the previously issued certificates and the whole file shall be submitted to Gosatomnadzor of Russia for review in case of the certificate renewal.