GENERAL REGULATIONS ON ENSURING SAFETY OF NUCLEAR POWER PLANTS

OPB-88/97, NP-001-97 (PNAE G- 01 011-97)

Cover page

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Federal Nuclear and Radiation Safety Authority of Russia

(Gosatomnadzor of Russia)

FEDERAL REGULATIONS AND RULES

IN THE FIELD OF USE OF NUCLEAR ENERGY

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GENERAL REGULATIONS ON ENSURING SAFETY OF NUCLEAR POWER PLANTS

OPB -88/97

NP-001-97 (PNAE G- 01 011-97)

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The present revision of the OPB-88/97 was made by the group set up by Gosatomnadzor of Russia including: V.M. Berkovich (Atomenergoproekt), Bukrinsky A.M. (RSC Gosatomnadzor of Russia), M.I. Miroshnichenko (Gosatomnadzor of Russia), V.A. Sidorenko (Minatom of Russia) considering proposals and comments of the interested organisations and requirements of federal laws «About use of nuclear energy» and «About radiation safety of population».

CONTENTS

1. ACCIDENT [Footnote1] - infringement of normal NPP operation wherein release of radioactive substances and/or ionizing radiation occurred beyond the boundaries provided in the design Footnote2 for normal operation in quantities exceeding the predetermined limits of safe operation. The accident is characterized by the initiating event, sequence paths and consequences.

2. ADMINISTRATION (ADMINISTRATIVE MANAGEMENT) OF NPP - authorities and other officials assigned by the operator with rights, liabilities, responsibilities at stages of construction, commissioning, operation and decommissioning of the NPP.

3. ACTIVE SYSTEM (ELEMENT) - system (element), functioning of which depends on the normal operation of another system (element), e.g. control safety system (CSS), energy source, etc.

4. NUCLEAR POWER PLANT [Footnote3] - nuclear facility designed for generation of power in specified modes and applications sited within the territory stipulated in the design where for this purpose a nuclear reactor (reactors) and a package of necessary systems, devices, equipment, and structures and the required workers (personnel) are used

5. DISTRICT HEATING NUCLEAR POWER PLANT - nuclear power plant intended for generation of thermal power for heating and hot water supply applications.

6. NUCLEAR ELECTRIC POWER STATION - nuclear power station intended for generating electric power.

7. NUCLEAR HEAT AND POWER PLANT - nuclear power plant (NPP) intended for generation of electric power and power for process needs.

8. SAFETY OF NPP, NUCLEAR AND RADIATION SAFETY (further in text - NPP SAFETY) - characteristic of a NPP to limit radiological impact on personnel, population and environment within the specified limits during normal and abnormal operation including accidents.

9. SAFE FAILURE - failure of a system or element on occurrence of which the NPP is brought to the safe state without the necessity to initiate any actions by means of the control safety system.

10. NPP UNIT - part of the NPP performing the NPP function within the scope specified in the design.

11. UNIT CONTROL CONSOLE (UNIT CONTROL ROOM) - the part of the NPP unit accommodated in special rooms stipulated in the design and intended for centralised automatic control of processes implemented by operational control personnel and automatic devices.

12. COMMISSIONING - process wherein systems and equipment of the NPP unit or NPP as a whole start functioning, and their compliance with the design is being checked. The process includes precomissioning adjustment works, physical and power start-up, trial operation and is completed by putting the NPP into commercial operation.

13. INHERENT SAFETY FEATURES OF REACTOR PLANT - property ensuring safety on the basis of natural feedback, processes and characteristics.

14. DECOMMISSIONING - process of implementing a set of measures after removal of nuclear fuel excluding the use of the unit as a source of energy and ensuring safety of personnel, population and environment.

15. CONFINEMENT SYSTEM - a set of structural or other elements confining space around the reactor plant or some other object containing radioactive substances create the boundary provided in the design and prevent escape of radioactive substances into the environment in quantities exceeding the predetermined limits. The space enclosed by the confinement system creates one of several sealed compartments.

16. STATE OF THE ART - totality of scientific and technical knowledge, technical design and engineering developments in a certain field of science and technology which have been proven by scientific investigations and practical experience and reflected in scientific and technical materials.

17. DEPENDENT FAILURE (PARTICULAR CASE OF COMMON CAUSE FAILURE) - failure of a system (element) being a consequence of other failure or event.

18. BEYOND DESIGN BASIS ACCIDENT - accident caused by initiating events not considered for design basis accidents or accompanied by additional, as compared to design basis accidents, failures of safety systems beyond a single failure, implementation of erroneous decisions of personnel.

19. PROTECTION SAFETY SYSTEMS (ELEMENTS) - systems (elements) intended for preventing or minimising damage of nuclear fuel, fuel element cladding, equipment, and pipelines containing radioactive substances.

20. INITIATING EVENT - single failure in systems (elements) of the NPP, external event or personnel error which lead to abnormal operation and may result in impairing safe operating limits and/or conditions. An initiating event includes all dependent failures being its consequence.

21. SYSTEM TRAIN - a part of the system performing system function within the scope specified in the design.

22. QUALIFICATION - level of training of a person of NPP personnel, including basic special education, professional knowledge, skills, and expertise as well as working experience providing quality and safety of NPP operation in performing professional duties.

23. END STATE - steady-state controlled status of systems and elements following an accident.

24. CONSERVATIVE APPROACH - approach to design and engineering whereby values and limits are deliberately assumed in the analysis for parameters and characteristics which lead to more unfavourable results.

25. REACTOR COOLANT CIRCUIT (PRIMARY CIRCUIT) - circuit and the pressurizer system intended for circulation of coolant through the core in operating conditions specified in the design.

26. SAFETY CRITERIA - values of parameters and/or performance data of the NPP established by regulatory documents and /or safety regulation bodies, in compliance with which its safety is justified.

27. SAFETY CULTURE - qualification and psychological preparedness of all individuals wherein ensuring NPP safety is a priority goal and intrinsic need leading to conscious responsibility and self-control in executing all safety-related works.

28. LOCALISING SAFETY SYSTEMS (ELEMENTS) - systems (elements) intended for limiting or minimising radioactive substances released during accidents and ionising radiation beyond the boundaries established in the design and their escape to the environment.

29. OPERATIONAL OCCURRENCE - abnormalities in NPP operation wherein deviations from predetermined operational limits and conditions occur. In this case other limits and conditions including operational safety limits may be impaired.

30. INDEPENDENT SYSTEMS (ELEMENTS) - systems (elements) for which failure of one system (element) does not lead to failure of another system (element).

31. NON-DETECTED FAILURE - failure of the system (element) which is not revealed at the moment of its occurrence during normal operation and is not detected by instrumentation and control in accordance with maintenance and inspection regulations.

32. NORMAL OPERATION - operation of the NPP within limits and conditions predetermined in the design.

33. QUALITY ASSURANCE - activities planned and systematically carried out and aimed at following the established order in executing works on creating and operating the NPP and achieving results satisfying the requirements imposed on them.

34. SUPPORT SAFETY SYSTEMS (ELEMENTS) - systems (elements) intended for supplying power, working fluid to safety systems and providing conditions for their functioning.

35. TRIAL OPERATION - stage of NPP commissioning from power start-up to putting into operation the NPP.

36. COMMON CAUSE FAILURES - failures of systems (elements) resulting from one failure or personnel error or external or internal effect or some other internal cause.

Note.

1. Internal effects or causes - effects occurring during initiating events including impact waves, jets, missiles, variation of fluid parameters (pressure, temperature, chemical activity etc), fires, etc, design features, technological and other internal causes.

2. External effects - effects of natural phenomena peculiar to the NPP site and man-made activities, e.g. earthquakes, high and low level of ground and underground waters, hurricanes, accidents on air, water and ground transport, fires, explosions at objects adjacent to NPP, etc.

37. PERSONNEL ERROR - a single unintentional action on control members or a single omission of the correct action; or a single unintentional wrong action in maintenance of equipment and systems important to safety.

38. ERRONEOUS DECISION - wrong unintentional performance or non-performance of a number of successive actions because of inadequate assessment of evolving processes.

39. PASSIVE SYSTEM (ELEMENT) -system (element), whose functioning is associated only with an event causing its operation and does not depend on operation of other active system (element), e.g. control system, energy source etc.

Note.

By their design features passive systems (elements) are divided into passive systems (elements) with mechanical moving parts (e.g. check valves) and passive systems (elements) without mechanical moving parts (e.g. pipelines, vessels).

40. CLADDING DAMAGE - infringement of even one of cladding damage limits established for fuel elements.

41. ACCIDENT SEQUENCES - radiation situation resulting from an accident and causing losses and harm as a result of exceeding the established limits of radiological impact on personnel, population, and environment.

42. PREACCIDENT SITUATION - state of the NPP characterised by breach of safe operating conditions and limits which has not developed into an accident.

43. NPP SAFE OPERATIONAL LIMITS - values of process parameters established by the design whose deviations can lead to an accident.

44. PRECOMMISSIONING ADJUSTMENT WORKS - stage of putting into operation the NPP wherein systems and elements of the NPP construction and erection of which has been completed are brought to the condition of operating availability with checking their compliance with criteria and characteristics established in the design and which is completed by NPP readiness for physical start-up.

45. SINGLE FAILURE PRINCIPLE - principle in accordance with which the system shall perform the predetermined functions during any initiating event requiring its operation and failure of anyone of active or passive elements moving mechanical parts independent of the initiating event.

46. INSPECTION - in-service control of the system (element) for the purpose of determining either their operable or inoperable status and detecting malfunctions.

47. DESIGN BASIS ACCIDENT - accident for which initiating events and end states are specified in the design and provision is made for safety systems mitigating its consequences within limits established in the design for such accidents with account of the single failure principle of safety systems or one personnel error independent on an initiating event.

48. DESIGN LIMITS - values of parameters and characteristics of status of systems (elements) and NPP as a whole established in the design for normal operation and operational incidents including pre-accident period and accidents.

49. COMMERCIAL OPERATION - operation of the NPP commissioned in the established order, compliance with the design and safety of which have been demonstrated by tests at stages of putting it into operation.

50. ACCIDENT SEQUENCE PATH - sequence of states of NPP systems and elements in a process of accident development.

51. DEVELOPERS OF NPP (RP) DESIGN - organisations developing the design of the NPP (RP) and providing its scientific support at all stages of NPP (RP) service life.

52. REACTOR PLANT - set of NPP systems and elements intended for conversion of nuclear power to thermal power, incorporating reactor and systems directly related to it and necessary for its normal operation, emergency cooling, emergency protection and maintaining it in safe condition provided that

required auxiliary and support functions are performed by other plant systems. RP boundaries shall be established for each NPP in the design.

53. EMERGENCY CONTROL CONSOLE (EMERGENCY CONTROL ROOM) - part of NPP unit, located in the room specified in the design and intended in case of UCR (unit control room) failure for bringing the NPP unit safely to subcritical cooled state and maintaining it for an unlimited period of time, activating safety systems and obtaining information about reactor state.

54. REPAIR - totality of procedures for recovering serviceable or operable state of the object (systems and elements) and/or recovery of its service life.

55. NETWORK COOLANT -medium whereby heat is transferred from the NPP to external or internal loads.

56. SYSTEM - a set of elements intended for performance of predetermined functions.

57. SAFETY SYSTEMS (ELEMENTS) - systems (elements) designed for fulfilling safety functions.

Note: Depending on functions to be performed safety systems (elements) are divided into protective, localising, support, and control systems (elements).

58. SYSTEMS (ELEMENTS) IMPORTANT TO SAFETY - safety systems (elements) as well as normal operating systems (elements) whose failures impair normal operation of the NPP or impede elimination of deviations from normal operation and can lead to design and beyond design basis accidents.

59. NORMAL OPERATING SYSTEMS (ELEMENTS) - systems (elements) designed to assure normal operation.

60. NPP CONSTRUCTION - process of constructing buildings and structures of the NPP including a complex of civil works, works on equipment erection, auxiliary, transport and other works.

61. MAINTENANCE - entirety of procedures for maintaining serviceability and operability of an object (systems and elements) when used for its designated purpose, in stand-by mode, on storage and transportation.

62. SEVERE BEYOND DESIGN BASIS ACCIDENT - beyond design basis accident with damage of fuel elements beyond the maximum design limit wherein maximum permissible emergency release of radioactive substances into the environment may occur.

63. ACCIDENT MANAGEMENT - actions aimed to prevent design basis accidents from developing into beyond design basis accidents and mitigate consequences of beyond design basis accidents.

64. CONTROL SAFETY SYSTEMS (ELEMENTS) - systems (elements) intended for initiating operation of safety systems, performing their control and monitoring in a process of fulfilling the predetermined functions.

65. CONTROL NORMAL OPERATING SYSTEMS (ELEMENTS) - systems (elements) forming and implementing in conformity with goals to be sought , criteria and restrictions control of process equipment relating to normal operating systems at the NPP unit.

66. LEVEL OF EMERGENCY PREPAREDNESS- the established extent of readiness by personnel, authorities dealing with civil defence and emergency situations, other involved bodies as well as technical provisions to be used for undertaking actions on protection of personnel and population in the event of an accident at the NPP.

67. LEVEL FOR ACTION - parameters and performance data determining radiation situation and its evolution and requiring measures to be taken on protection of personnel and population.

68. SAFE OPERATING CONDITIONS - minimum conditions specified in the design with respect to number, characteristics, serviceability state and maintenance conditions of systems (elements) important to safety wherein safe operating limits and/or safety criteria are met.

69. PHYSICAL PROTECTION OF NPP - technical and administrative measures for ensuring preservation of nuclear materials and radioactive substances contained at the NPP, prevention of unauthorised entry to the NPP territory, prevention of unauthorised access to nuclear materials and radioactive substances and timely detection and suppression of sabotage and terrorist acts threatening NPP safety.

70. PHYSICAL START-UP - stage of NPP commissioning including reactor loading with nuclear fuel, reaching the critical state by the reactor and performance of the necessary physical experiments at power level wherein removal of heat from the reactor shall be accomplished due to natural heat losses (dispersion).

71. SAFETY FUNCTION - specific goal and actions contributing to its achieving and directed towards prevention of accidents and mitigation of their consequences.

72. ELEMENTS - equipment, instruments, pipelines, cables, structural members and other articles making possible performance of predetermined functions independently or being incorporated into systems and treated in the design as structural units in carrying out reliability and safety analyses.

73. OPERATION - all activities directed towards attaining the objective for which the NPP was constructed including operation at power, start-up, shutdown, tests, maintenance, repairs, nuclear fuel refuelling, inspection during operation and other related activities.

74. OPERATIONAL LIMITS - values of parameters and characteristics of systems (elements) and NPP state as a whole established in the design for normal operation.

75. OPERATIONAL PERSONNEL OF NPP - workers operating the NPP.

76. OPERATING CONDITIONS - conditions established in the design with respect to number, characteristics, serviceability state and maintenance of systems (elements) required for operation without infringement of operational limits.

77. ABNORMAL OPERATION - NPP operation with deviations from operational limits or conditions but without violation of safe operational limits or conditions.

78. OPERATING ORGANISATION OF NPP - organisation set up in accordance with legislation of the Russian Federation and recognised by the relevant body on use of nuclear energy, suitable for operating the NPP and carrying out independently or involving other organisations activities relating to NPP siting, design , construction, operation and decommissioning as well as activities associated with handling of nuclear materials and radioactive substances.

For performing activities of this type the NPP operating organisation shall have licenses from Gosatomnadzor of Russia.

79. NPP POWER START-UP - stage of NPP unit commissioning from completion of physical start-up to beginning of electric power generation.

80. NUCLEAR ACCIDENT - accident involving damage of fuel elements exceeding established safe operational limits and/or personnel exposure exceeding permissible limits caused by:

abnormal control and monitoring of the chain nuclear fission reaction in the reactor core;

occurrence of criticality on refuelling , transfer and storage of fuel elements;

disruption in heat removal from fuel elements;

other factors leading to damage of fuel elements.

1. MAIN REGULATIONS

1.1. PURPOSE OF DOCUMENT

1.1.1. General regulations on ensuring safety of nuclear power plants (further in text - General regulations) are assigned to federal regulations and rules in the field of use of nuclear energy. They concern safety issues, specific for NPP as a source of postulated radiological impact on personnel, population and environment.

1.1.2. The present General regulations establish goals, targets, and basic safety criteria as well as main principles and types of technical and administrative measures aimed at ensuring safety. The scope, volume and degree of implementing these principles and measures shall meet federal regulations and rules in the field of use of nuclear power as well as other regulatory documents and state standards (further in text - regulatory documents), validity of which shall be confirmed by the Federal supervisory body of Russia on nuclear and radiation safety (Gosatomnadzor of Russia) in licensing.

In the absence of the necessary regulatory documents, proposed specific technical concepts shall be validated and established in the design according to the current state of the art. Acceptability of such concepts shall be determined by Gosatomnadzor of Russia in licensing.

1.1.3.The present General regulations are mandatory for all juridical and physical entities performing activity relating to siting, design, construction, commissioning, operation and decommissioning of NPP units and valid on the whole territory of the Russian Federation.

1.1.4. Enforcing the present General provisions does not involve termination or change of validity of licenses and permits by Gosatomnadzor on the right to execute works in the field of use of nuclear energy. Terms and scope of bringing the NPP into correspondence with the present General regulations shall be identified in each specific case in the order established for licensing activities relating to construction and operation of NPPs.

1.1.5. Amendments and alterations in the present General regulations shall be introduced in the order established by the Government of the Russian Federation for elaborating and approval of federal regulations and rules in the field of use of nuclear energy.

1.2. BASIC CRITERIA AND PRINCIPLES OF ENSURING SAFETY

1.2.1. The NPP meets safety requirements if its radiation influence on personnel, population and environment during normal operation, operational incidents, including design basis accidents does not lead to exceeding exposure doses established for personnel and population, permissible rates on releases and discharges, content of radioactive substances in the environment and is minimised during beyond design basis accidents.

This is achieved also due to observance of federal regulations and rules in the field of use of nuclear energy and other regulatory documents.

1.2.2. Permissible exposure dose rates for personnel and allowable limits of exposure doses for population and , in necessary cases permissible releases and discharges and content of radioactive substances in the environment shall be specified in compliance with federal laws and regulations and rules on radiation safety for normal operation and accidents. Personnel exposure doses at the NPP and population as a consequence of releases and discharges of any radioactive substances from the NPP shall be below the predetermined levels and as low as reasonably achievable.

1.2.3. NPP safety shall be ensured due to consistent implementation of the defence in depth concept based on the application of the system of physical barriers on the path of release of ionising radiation and radioactive substances into the environment and a system of technical and administrative arrangements on protection of barriers and maintaining their effectiveness as well as on protection of personnel, population and environment.

The system of physical barriers of the NPP unit includes fuel matrix, fuel element cladding, reactor coolant circuit pressure boundary, confining structures of the reactor plant and biological shield.

The system of technical and administrative measures shall provide five levels of defence in-depth and include the following levels.

Level 1 (NPP siting conditions and prevention of abnormal operation):

- assessment and selection of a site suitable for NPP construction;
- establishing safe area as well as surveyed area around the NPP, where protective emergency measures shall be planned;
- developing the design on the basis of a conservative approach with inherent safety features of the RP;
- ensuring the required quality of systems (elements) of the NPP and works to be executed;
- operation of the NPP in accordance with requirements of regulatory documents, technological regulations and
- operational manuals;
- maintaining in operable state of systems (elements) important to safety by means of timely detection of deficiencies, undertaking preventive measures, replacement of equipment which reached the end of its service life and creating an efficient system of accounting and recording results of works and control;
- selection of personnel and ensuring the necessary level of its qualification for actions during normal operation and operational incidents including situations preceding accidents and accidents, inculcation of safety culture.

Level 2 (Prevention of design basis accidents by systems of normal operation):

- preventing initiating events from developing into design basis accidents and design basis accidents into beyond design basis accidents by use of safety systems;
- mitigation of accident consequences which could not be prevented by confining radioactive substances released.

Level 4 (Management of beyond design basis accidents):

- prevention of aggravation of beyond design basis accidents and mitigation of their consequences;

- protection of the confinement system from destruction under design basis accidents and maintaining its serviceability;

- return of the NPP to the controlled state wherein chain fission reaction is interrupted, continuous nuclear fuel cooling is ensured and radioactive substances are confined within the established limits.

Level 5 (Emergency planning):

- preparation and, if necessary, implementation of emergency procedures on the NPP site and outside its boundaries.

The concept of defence in-depth shall be implemented at all stages of activities relating to ensuring NPP safety in the area which is covered by this type of activities. Priority shall be given to the strategy of preventing unfavourable events, particularly, for levels 1 and 2.

1.2.4. During normal operation all physical barriers shall be operable, and measures to be undertaken for their protection shall be ready available. On detection of loss of functions by anyone of physical barriers envisaged in the design or unavailability of measures for its protection the RP shall be shutdown and measures shall be taken to bring the NPP to safe condition.

1.2.5. Technical and administrative decisions made for ensuring NPP safety shall be well proven by the previous experience or tests, investigations, operating experience of prototypes and shall meet requirements of regulatory documents. Such approach shall be applied not only in development of equipment and design of the NPP but also in manufacture of equipment, construction and operation of the NPP, its backfitting and reconditioning of its systems (elements).

1.2.6. Design and reliability of systems (elements) important to safety, documentation and various types of works affecting provision of NPP safety shall be the subject of activities relating to quality assurance.

1.2.7. The operating organisation of the NPP provides development and execution of quality assurance programs at all stages of NPP service life and to this end elaborates the general quality assurance program and performs supervision of the activities by organisations executing works or rendering services to the NPP (survey, design, engineering, research, construction, erection organisations, suppliers of systems and elements, NPP equipment manufacturing plants etc).

Organisations performing works and rendering services for the operating organisation of the NPP develop particular quality assurance programs concerning relevant types of activities within the frame of the general quality assurance program.

1.2.9. In all individuals and organisations engaged in siting, construction, operation and decommissioning of NPPs, design, engineering and manufacture of their systems (elements) safety culture shall be inculcated through the proper selection, training of personnel in each sphere of safety-related activities, establishing and strict observance of discipline with accurate distribution of personal responsibilities among authorities and executives, elaboration and strict observance of requirements of instructions in force on works execution and their periodic updating with account of experience gained. All the above mentioned ….individuals shall be aware of the degree of influence of their activity on safety. They shall realise those consequences to which non-observance, non-fulfilment of requirements indicated in current instructions and regulatory documents may lead.

1.2.9. The operating organisation of the NPP ensures NPP safety including measures on preventing accidents and minimising their consequences, accounting and control, physical protection of nuclear materials, radioactive substances and waste, radiation control over the environmental conditions in the safe area and surveyed area as well as provides the use of the NPP for those purposes for which it was designed and constructed.

The operating organisation of the NPP is fully responsible for NPP safety.

The operating organisation shall not be relieved of responsibilities of the NPP in connection with the independent activity and commitments of organisations performing works or rendering services to the NPP and by state safety regulation bodies.

1.2.10. The operating organisation of the NPP sets up structural subdivisions for carrying out directly on the NPP site activities relating to construction and safe operation of the NPP, endowing them with necessary rights, financial means, material resources and manpower and imposes on them responsibility for this activity as well as performs supervision of this activity.

1.2.11. Construction of major buildings and structures of the NPP may start with the design available after obtaining the license by Gosatomnadzor of Russia on NPP construction.

1.2.12. In the NPP design technical provisions and administrative measures shall be envisaged which are aimed at preventing design basis accident and minimising their consequences and ensuring safety during anyone of initiating events [Footnote4] considered in the design with simultaneous occurrence - according to the principle of single failure - of a failure independent on an initiating event of anyone of the following safety systems elements [Footnote5] of safety systems: active or passive element having moving mechanical parts or one personnel error independent on the initiating event.

In addition to one failure of one of the above mentioned elements independent on an initiating event account must be taken of elements failures leading to deviations from safe operational limits affecting progress of an accident and not detected during NPP operation.

1.2.13. Technical provisions and administrative measures shall be envisaged to prevent impairment to safe operational limits and conditions.

1.2.14. On the basis of the list specified as per i. 1.2.16 for beyond design basis accidents provision shall be made in the design of the RP and NPP for management of these accidents unless they are excluded due to inherent safety features of the reactor and its design principles.

1.2.15. Emergency planning arrangements minimising hazard of radiation influence on personnel, population and environment and their protection in the event of a beyond design basis accident shall be set up.

The procedure for development and approval of such plans shall be established by federal regulations and rules in the field of use of nuclear energy.

1.2.16.Tentative lists of initiating events preceding design basis accidents and list of beyond design basis accidents (BDBA) including initiating events, sequence paths and consequences shall be specified in regulatory documents for each type of reactor. They shall include representative scenarios with severe consequences for defining the plan of possible response.

The final lists of BDBA, their realistic (not conservative) analysis containing assessment of probabilities of BDBA accident sequence paths including accidents involving core meltdown,

consequences of BDBA, functioning of safety systems shall be established in the NPP design and presented in the NPP Safety Analysis Report.

Should the analysis of BDBA consequences not confirm that i. 1.2.17 is met, it would be necessary to provide in the design additional technical approaches to accident management for the purpose of mitigating their consequences.

The analysis of BDBA consequences presented in the NPP design is a basis for drawing up emergency planning procedures on personnel and population protection in the event of an accident and elaborating the manual on accident management.

1.2.17. To avoid the necessity of evacuating population beyond the area covered by planning protective measures established according to regulatory requirements to NPP siting efforts should be made to ensure that. the estimated probability rate of limiting emergency release did not exceed 10E-7 per reactor year.

1.2.18. The system of technical and administrative measures on ensuring NPP safety shall be presented in the NPP Safety report which shall be elaborated by the operating organisation of the NPP or organisation which announced its intention to build and operate a NPP (applicant) with participation of NPP and RP designers. Any differences between information contained in the NPP Safety Analysis Report and information in the NPP design as well as differences between NPP design and its implementation are not allowable. The compliance of the NPP Safety Analysis Report to the real conditions shall be maintained by the operating organisation of the NPP during the whole NPP service life.

1.2.19. Design materials on the analysis and technical basis of NPP safety shall contain probabilistic safety analyses.

1.2.20.The appropriate organisational management structure and requirements to the level of NPP personnel qualification shall be developed in the NPP design.

1.2.21.Provision shall be made in the design for a training point (centre) with a laboratory of psychological and physiological studies having the necessary material base for providing adequate training of NPP personnel, technical accessories for training and staff of experts.

The design shall provide for one type NPP units a full-scale simulator with putting it into operation prior to physical start-up of the NPP unit

1.2.22. Technical and administrative measures on ensuring physical protection and fire safety of the NPP shall be envisaged in the design.

1.2.23. Communication lines shall be provided in the design including redundant lines for planning NPP control and annunciation systems in normal operating conditions, under design basis and beyond design basis accidents.

1.2.24. Accounting and control of all nuclear materials, radioactive substances and waste shall be provided at the NPP.

2. CLASSIFICATION OF SYSTEMS AND ELEMENTS

2.1. Systems and elements vary in:

- designation;
- relation to safety;
- type of safety functions to be performed

2.2. Systems and elements are divided by their functions into:

- systems and elements of normal operation;
- safety systems and elements.

2.3. NPP systems and elements with respect to their safety are divided into:

- systems and elements important to safety;

- other systems and elements not related to safety.

2.4. By the type of their functions safety systems and elements are divided into :

- protection systems;

- localising systems;

- support systems;

- control systems.

2.5. Four safety classes are identified depending on their relation to safety of NPP elements.

Safety Class 1. Safety Class 1 includes fuel elements and elements of the NPP whose failures represent initiating events preceding beyond design basis accidents leading to damage of fuel elements with exceeding limits established for design basis accidents on normal functioning of safety systems .

Safety Class 2. To Safety Class 2 the following elements of NPP are assigned:

- elements whose failures are initiating events leading to damage of fuel elements within limits established for design basis accidents on proper functioning of safety systems with allowance for specified number of failures in them for design basis accidents;

- safety systems elements , single failures of which lead to non-performance of functions by the relevant systems.

Safety Class 3. Safety Class 3 includes the following NPP elements:

- systems important to safety, not included into safety classes 1 and 2;

- containing radioactive substances release of which to the environment (including NPP rooms) on failures exceeds values specified in radiation safety standards;

- performing control functions of radiation protection of personnel and population.

Safety Class 4. To Safety Class 4 are assigned NPP normal operating elements not affecting safety and not included into Safety Classes 1,2,3.

Elements used for accident management not included into Safety Classes 1,2 or 3 are also assigned to Class 4.

2.6. Any element which possesses attributes of different safety classes at one time it shall be assigned to a higher class.

2.7. Areas separating elements of various safety classes shall be assigned to a higher class.

2.8. The safety class is a mandatory characteristic in forming other classifications of NPP elements to be established in regulatory documents. Other characteristics of these classifications shall be defined in accordance with a set of NPP elements parameters specified in regulatory documents.

2.9. Safety classes of NPP elements shall be designated by NPP and RP design developers in compliance with requirements of the present General regulations.

2.10. Quality assurance requirements to NPP elements assigned to Safety Classes 1,2,3 and to their design and operation shall be specified in current regulatory documents. In this case more stringent requirements to quality assurance presented in these documents shall be applicable to a higher safety class.

Requirements of general industrial regulatory documents shall be imposed on elements relating to Safety Class 4.

2.11. It should be indicated In the documentation on design, manufacture and supply of NPP systems and elements that elements belong to Safety Classes 1,2,3 and this shall be designated as such in requirement s of regulatory documents.

2.12. The classification designation implies that elements are pertaining to Safety Classes 1,2,3.

2.13. The classification designation shall be supplemented by the following symbol reflecting the purpose of an element:

Н - normal operating element ;

З - protective element;

Л - localising element;

О -support element;

У - control safety system element.

If an element serves several purposes , they shall be reflected in its designation.

Examples of classification designation are as follows:

2Н, 23, 2Н3.

3. STATE SUPERVISION OF USE OF NUCLEAR ENERGY FOR THE PURPOSE OF ENSURING NPP SAFETY AND STATE CONTROL OF NPP SAFETY

3.1. State control of use of nuclear energy shall be the responsibility of specially authorised federal bodies in compliance with their competence.

State supervision of use of nuclear energy relating to NPPs has been imposed on the Ministry of the Russian Federation of atomic power (Minatom of Russia) which performs functions according to the relevant ordinance guided by the Constitution of the Russian Federation, federal laws, decrees and directives by the President of the Russian Federation, regulations and directives by the Government of the Russian Federation, federal regulations and rules in the field of use of nuclear energy and other regulatory documents.

Minatom of Russia is responsible for developing and implementing measures on ensuring safety in use of nuclear energy in subordinate organisations.

3.2. Minatom of Russia recognises the operating organisation suitable for operating the NPP and carrying out by itself or involving other organisations activities relating to NPP siting , design, construction, operation and decommissioning.

3.3. Minatom of Russia within the frame of its powers establishes a procedure for appointing organisations - NPP (RP) designers, establishes the order for interrelations of NPP (RP) designers and NPP (RP) designers with the operating organisation of the NPP, and regulates relations of all organisations involved in developing NPP (RP) design and its operation at all stages of NPP service life (design, siting, construction, operation and decommissioning).

3.4. In case the operating organisation is incapable of ensuring NPP safety Minatom of Russia bears responsibility for NPP safety and appropriate handling of nuclear materials, radioactive substances and waste. Minatom of Russia is liable to ensure NPP safety and proper handling of nuclear materials, radioactive substance and waste prior to establishment of a new operating organisation of a NPP.

3.5. State control of safety in using nuclear energy shall be achieved by specially authorised federal bodies - safety regulation bodies performing supervision of radiation, technical and fire safety. Gosatomnadzor of Russia is responsible for state control of nuclear safety as well as technical issues of NPP radiation safety. Other NPP safety issues shall be handled by other state safety regulation bodies in accordance with legislation of the Russian Federation.

3.6. Gosatomnadzor of Russia fulfils its functions in conformity with the relevant ordinance, guided by the Constitution of the Russian Federation, federal laws, decrees. and directives by the President of the Russian Federation, regulations and directives by the Government of the Russian Federation, federal laws and rules in the field of use of nuclear energy and other regulatory documents.

3.7. Gosatomnadzor reviews materials providing the technical basis for nuclear and radiation safety of the NPP and grants in the established order : licenses to operating organisations of NPPs and organisations executing works and rendering services for the operating organisation of NPPs, as well as permissions to NPP workers on the right of works performance according to the list of works specified by the Government of the Russian Federation.

4. BASIC PRINCIPLES OF ENSURING SAFETY IMPLEMENTED IN DESIGN OF NPP AND THEIR SYSTEMS

4.1. GENERAL REQUIREMENTS

4.1.1. Systems (elements) important to safety shall be designed in accordance with principles of the present General regulations and other federal regulations and rules in the filed of use of nuclear energy as well as documents application of which shall be approved by Gosatomnadzor of Russia in licensing.

4.1.2. According to the defence in-depth concept the NPP shall have safety systems intended for fulfilling the following main safety functions:

- reactor scram and maintaining it in subcritical state;
- emergency removal of heat from the reactor;
- confining radioactive substances within the predetermined limits.

The necessary scope and methods of safety functions implementation are detailed in federal regulations and rules in the field of use of nuclear energy and with application to each NPP are established and justified in the design and reflected in the NPP Safety Analysis Report.

4.1.3. Technical provisions assuring mitigation of beyond design basis accidents consequences as per i. 1.2.16 shall be envisaged at the NPP.

4.1.4. The NPP design shall provide for working documentation on systems (elements) important to safety and safety systems and elements assigned to Safety Classes 1 and 2; prior to physical start-up, checking devices and accessories and making them available for service as well as programs and methodologies for:

- checking serviceability of systems and elements (including devices located inside the reactor), replacement of equipment the service life of which has reached its end;
- systems testing to assure their compliance with design parameters;
- checking sequence in transmission of signals and actuation of equipment (including transfer to emergency power sources);
- control of metal status and welded joints of equipment and pipelines;
- checking whether or not metrological characteristics of measuring channels meet design requirements.

4.1.5. Systems (elements) important to safety shall be capable of performing their functions within the scope specified in the design with allowance for natural phenomena possible in the NPP site region) external man-induced events peculiar to the site selected for NPP construction and /or on postulated mechanical, thermal, chemical and other effects of design basis accidents.

4.1.6. In the NPP design measures on prevention or protection of systems (elements) from common cause failures shall be reviewed and justified.

4.1.7. In the design of NPP and RP systems (elements) priority shall be given to systems (elements) design of which has been based on the passive principle of action and inherent safety features (self-control, thermal inertia and other natural processes).

4.1.8. The design shall provide for the possibility to exclude personnel single errors and mitigate their consequences in maintenance as well.

4.1.9. Multipurpose use of safety systems and their elements at the NPP shall be justified. Combination of safety functions and functions of normal operation shall not lead to violations of requirements to ensuring NPP safety and reduction in reliability of systems (elements) performing safety functions.

4.1.10. NPP systems (elements) important to safety shall be subjected usually to direct and full checks to assure their compliance with the design parameters in commissioning, after repair and periodically during the whole lifetime of the NPP.

Should performance of direct and/or full checks not be possible which shall be proved in the design, indirect and/or partial checks shall be carried out. Adequacy of indirect and/or partial checks shall be validated in the NPP design.

The possibility shall be provided for diagnostics (examination) of state of safety systems normal operating elements important to safety and referred to Safety Classes 1 and 2 , and their representative tests. During operation maintenance and checks shall be conducted on the basis of regulations for operation and maintenance meeting safe operational conditions and limits established in the NPP design and presented in the NPP Safety Analysis Report. Regularity and allowable period of time for maintenance and checks shall be adopted in accordance with regulatory documents in force or justified in the design.

4.1.11. Safety systems shall function in such a way that once their action begun it could be brought to the full completion of their function. Return of safety systems to the initial state shall require successive actions by the operator.

4.1.12. The NPP Safety Analysis Report shall contain data on reliability indices of systems of normal operation important to safety and their elements assigned to Safety Classes 1 and 2 as well as safety systems and elements. The reliability analysis shall be conducted with account of common cause failures and personnel errors.

4.2. CORE DESIGN AND CHARACTERISTICS

4.2.1. The NPP design shall establish limits of fuel elements damage (amount and degree of damage) and associated levels of reactor coolant radioactivity by reference isotopes in accordance with federal regulations and rules in the field of use of nuclear energy.

The core and other systems determining its operating conditions shall be designed such that established limits of fuel elements damage for safe operation could not be exceeded for their whole service life in the reactor.

4.2.2. The core shall be designed in such a way as to ensure during normal operation and design basis accidents mechanical stability and absence of deformations impairing normal functioning of means acting on reactivity and reactor scram or impeding cooling of fuel elements.

Efforts should be made to ensure that the total probability rate of severe beyond design basis accidents estimated on the basis of the probabilistic safety analysis shall not exceed 10 E -5 per reactor/ year.

4.2.3. The core with its elements affecting reactivity shall be designed so that any reactivity changes with the help of control rods and reactivity effects in operational states and under design basis and beyond design basis accidents do not cause uncontrolled increase in heat release in the core leading to damage of fuel elements beyond the specified design limits.

4.2.4. Characteristics of nuclear fuel, design of the reactor and other primary circuit components (including the coolant clean-up system) considering operation of other systems shall not permit of formation of secondary critical masses under severe beyond design basis accidents and those involving fuel melt.

Should such a probability exist technical features shall not allow the permissible limiting emergency release to be exceeded as per i. 1.2.17.

4.3. REACTOR COOLANT CIRCUIT

All equipment and pipelines of the reactor coolant circuit shall withstand without destruction static and dynamic loads and temperature effects arising in their any assemblies and components (with allowance for actions of protection safety systems and their probable failures as per i. 1.2.12), during all initiating events considered, including inadvertent energy releases to coolant caused by:

- sudden insertion of positive reactivity on ejection of a control member at the maximum rate acting on the maximum effective reactivity if such release could not be prevented by the design;

- injection of «cold» coolant into the core (with negative temperature reactivity coefficient in relation to coolant) or any other probable positive reactivity effect associated with coolant.

4.4. CONTROL OF PROCESSES

4.4.1.1. For control of process equipment relating to normal operating systems and safety systems at each NPP unit provision shall be made for :

1) unit control console;

2) emergency control console;

3) control normal operating system;

4) control safety system;

5) autonomous means for data recording and storage.

4.4.1.2. The NPP design and NPP Safety Analysis Report shall contain:

1) analysis of response of control systems to postulated failures in control systems;

2) reliability analysis of control systems functioning;

3) stability analysis of control circuits.

4.4.2. Unit control console

4.4.2.1. The unit control console (UCC) shall be provided at the NPP unit, operational personnel of which performs control of process equipment relating to normal operating systems and safety systems in normal and abnormal operating conditions including accidents.

4.4.2.2. Adequacy of measures provided shall be proved in the design to ensure survivability, habitability and normal functioning of the unit control console in all regimes including design basis and beyond design basis accidents.

4.4.2.3. In the design of the UCC problems of «man-machine interface» shall be solved. Parameters to be controlled at the UCC shall be so selected and displayed as to provide personnel with unambiguous information indicating that NPP safe operating limits and conditions are met, and identification and diagnostics of automatic response and functioning of safety systems are possible.

4.4.2.4. For the unit control console the following shall be provided in the design:

1) instrumentation for control and monitoring nuclear fuel fission processes in all regimes and under all conditions in the core during normal operation (including subcritical regime in a process of refuelling);

2) position indicators of control members acting on reactivity, automatic control of soluble absorber concentration and indicators of a status of other means acting on reactivity;

3) Information support systems for the operator , including the system for representation of summarised data to personnel indicating the current safety level of the RP and NPP as a whole.

4.4.2.5. Instructions on remote control of mechanisms generated by the automatic control system or remote control keys from UCC panels shall be automatically recorded.

4.4.3. Emergency control console

4.4.3.1. The emergency control console.. shall be provided at the NPP unit.

4.4.3.2. From the emergency control console the following actions shall be performed:

1) control of safety systems;

2) bringing the reactor to subcritical state;

3) maintaining the reactor in subcritical state;

4) removal of heat from the reactor;

5) control of the RP status.

4.4.3.3. Independence of the emergency control console from the unit control console and adequate survivability and viability and habitability of the emergency control console shall be provided.

Measures aimed at avoiding common cause failure of the unit control console and emergency control console shall be undertaken.

4.4.4. Control normal operating systems

4.4.4.1. The control normal operating system at NPP unit shall perform control of processes under all operating conditions of the NPP unit with quality, reliability and metrological characteristics meeting the design values.

4.4.4.2. The control normal operating system shall include:

1) means of reliable group and individual communications between unit control console, emergency control console and operational personnel of the NPP performing works locally;

2) means for collection, processing, recording and storage of information sufficient to ensure the possibility of timely and unambiguous identification of initiating events preceding abnormal operation and accidents, their evolution, establishing the actual algorithm of operation of safety systems and elements important to safety and referred to Safety Classes 1 and 2, including control and monitoring systems, deviations from stationary algorithms, personnel actions.

4.4.4.3. The control normal operating systems of the NPP unit shall provide automatic and/or automatic diagnostics of status and operating conditions including hardware and software control and monitoring facilities.

4.4.4.4. The control normal operating systems shall be designed so as to assure the most favourable conditions for operational personnel to make correct decisions on NPP control and minimise the possibility of making wrong decisions.

4.4.4.5. The design of control normal operating systems shall include:

1) analysis of response of control and monitoring systems of the RP and NPP unit to probable failures in the system;

2) reliability analysis of functioning of hardware and software and system as a whole;

3) stability analysis of control and monitoring circuits.

4.4.4.6. Provisions and methods shall be envisaged in the design for detecting leakage of primary coolant exceeding the value established in the design and, if possible its location.

The automatic control of coolant radioactivity and control of discharges and releases of radioactive substances and control of radiation situation in NPP rooms, in the safe area and surveyed area during NPP operation including accidents and in a period of NPP decommissioning shall be incorporated in the design.

4.4.4.7. The automatic control of safe conditions of nuclear fuel and radioactive waste storage shall be provided and alarm system pointing to deviations from these conditions shall be provided.

4.4.5. Control safety systems (CSS)

4.4.5.1. CSS shall be envisaged at the NPP unit.

4.4.5.2. CSS shall automatically perform their functions under conditions stipulated in the design.

4.4.5.3. CSS shall be designed so as to eliminate on their automatic actuation the possibility of their disconnection by operational personnel during 10-30 min.

4.4.5.4. The possibility of putting into service safety systems remotely and manually -for valves at their location shall be provided. Failure in the automatic initiating circuit shall not prevent remote activation and performance of safety functions. For remote and manual actuation the action on the minimum number of control elements shall be sufficient.

4.4.5.5. The CSS structure shall be designed so as to reduce the possibility of spurious response to the minimum. The circuits for remote control of safety systems mechanisms shall allow for their initiating not less than two or more logically interrelated actions (two keys, .patch panel and key etc)

4.4.5.6. The CSS shall be separated from the control normal operating system to such a degree that malfunction or putting out of operation of any element or train of the system mentioned above could not affect the CSS capability of performing its functions.

4.4.5.7. The CSS shall satisfy the following safety principles:

1) redundancy;

2) independence;

3) diversity.

Redundancy, independence and diversity shall be such as to provide the possibility of their protection against common cause failures as per i. 4.1.6 and not permit single failures in the CSS to disrupt their operability.

4.4.5.8. The CSS shall allow for:

1) continuous automatic diagnostics of control systems serviceability;

2) periodic diagnostics of status of CSS trains and process equipment as per i. 4.1.10 from unit and emergency control consoles.

Failures of hardware and software and malfunctions in the CSS shall lead to triggering signals in control rooms (unit and emergency control rooms etc) and bring about actions aimed at ensuring NPP safety.

In those cases when it is not feasible in technical respect methodology and means of periodic CSS checks shall reveal malfunctions available without reducing functional availability of other safety systems and elements and systems (elements) important to safety assigned to Safety Classes 1 and 2.

4.4.5.9. Design materials on the CSS shall contain analyses within the scope similar to requirements of i. 4.4.4.5.

4.4.6. Autonomous data recording and storage devices

Autonomous devices for recording and storage of data necessary for investigation of accidents shall be provided. These devices shall be protected from unauthorised access and maintain their functional features under design and beyond design basis accidents. The volume of data to be recorded and stored shall be proved in the NPP design.

4.5. PROTECTION SAFETY SYSTEMS

4.5.1. Protection safety systems shall be incorporated in the NPP design which ensure reliable reactor scram and maintaining it in subcritical state in any normal and abnormal operating conditions including design basis accidents.

4.5.2. Effectiveness and fast response of reactor scram systems shall be sufficient to minimise energy .release to the level not leading to damage of fuel elements beyond the limits established for normal operation or design basis accidents and suppress positive reactivity arising from occurrence of any reactivity effect or possible combination of reactivity effects during normal operation and design basis accidents.

4.5.3. The reactor scram shall be ensured irrespective whether energy source is available or lost.

4.5.4. The protection systems shall comprise systems for emergency removal of heat from the reactor having several independent trains and yielding effectiveness with account of requirements of i.1.2.12.

The use of cooling systems (trains) intended for normal operation as systems (trains) for emergency heat removal from the reactor is allowed.. In this case they shall meet requirements imposed on safety systems

4.5.5. Measures shall be taken to ensure that the reactor is not brought. to critical state and the permissible pressure in reactor coolant circuit is not exceeded. on actuation and operation of the emergency heat removal system.

4.5.6. Operation of protection safety systems shall not lead to failures of equipment in normal operating systems. The number of responses of protection safety systems (including spurious responses) allowable for the whole lifetime of the NPP unit considering their effect on equipment service life shall be justified in the design.

4.6 LOCALISING SAFETY SYSTEMS

4.6.1. Provision shall be made for localising safety systems confining radioactive substances and ionising radiation under an accident within the limits specified in the design.

4.6.2. The reactor and NPP systems and elements containing radioactive substances shall be accommodated entirely in leak proof compartments for localising radioactive substances released within their limits during design basis accidents. In this or any other case of arrangement it is necessary that during normal operation and design basis accidents the corresponding reference exposure doses are not exceeded. as well as allowable release rate and content of radioactive substances in the environment. The necessity and acceptability. of the .directed release of radioactive substances under beyond design basis accidents shall be substantiated in the design.

4.6.3. Localising safety systems shall be envisaged for each NPP unit and fulfil the preset functions for design and beyond design basis accidents as per i.1.2.16.

Separate elements and localising safety systems as a whole can be shared by several units if it has been proved that the accident cannot extend. from one NPP unit to others

4.6.4. In those cases when for preventing pressure rise in leak tight rooms systems for heat rejection with active elements are to be provided, several independent heat rejection trains having the required effectiveness considering requirements of i. 1.2.12. shall be used.

4.6.5. All lines intersecting boundaries of the confinement system through which escape of radioactive substances outside sealed compartments is possible shall be equipped with isolating elements.

4.6.6. The degree of allowable loss of integrity .by the confinement system shall be proved in the design and methods for achieving it shall be indicated. Compliance of actual leak tightness with the

design value shall be confirmed prior to reactor loading with nuclear fuel and verified in a process of operation with periodicity established in the design.

Tests of the confinement system in commissioning shall be conducted at design pressure, subsequent tests shall be carried out at pressure specified in the design. Equipment located inside sealed compartments shall withstand tests without loss of its functions. The methodology and equipment for testing the confinement system to make sure it complies with the design parameters shall be incorporated in the design.

4.6.7. Measures on detecting and preventing formation of explosive concentrations of gases in rooms accommodating localising safety systems shall be envisaged.

4.7. SUPPORT SAFETY SYSTEMS

4.7.1. The necessary support safety systems performing functions of supplying safety systems with working fluid, energy and creating the required conditions for their functioning, including heat transfer to the ultimate heat sink shall be provided in the NPP design.

4.7.2. Support safety systems shall have reliability indices of functions performance sufficient for achieving along with the corresponding indices of safety systems which they support the necessary reliability of the latter, specified in the design.

4.7.3. Performance of functions presented in i. 4.7.1 by the support safety systems shall have priority over actions of internal safety features of support safety systems elements if it does not lead to more severe consequences for safety; the list of internal safety features of support safety systems not disconnected shall be justified in the NPP design.

4.7.4. The necessary and adequate provisions for NPP fire protection including detectors and equipment for suppression of moderator and coolant combustion shall be envisaged in the design as well as automatic regime of fire extinguishing systems from the moment of voltage supply to equipment of the NPP unit during precommissioning adjustment works.

4.8. NUCLEAR FUEL AND RADIOACTIVE WASTE STORAGE SYSTEM

4.8.1. At each NPP new and spent nuclear fuel and radioactive waste storage facilities shall be available. The capacity of nuclear fuel storage facilities shall be designed such as to provide the possibility of full discharge from the core at any time.

In the NPP Safety Analysis Report information shall be presented on ensuring safety in handling of new and spent nuclear fuel, radioactive waste. The safety analysis of storage facilities during normal and abnormal operation including accidents shall be conducted.

Handling of nuclear fuel shall be ensured in conformity with requirements of regulatory documents.

4.8.2 The possibility of reaching criticality in storage facilities by new and spent fuel on its location and transfer shall be excluded due to providing the appropriate characteristics of storage facilities.

4.8.3 Provision shall be made for reliable residual heat removal systems to prevent damage of nuclear fuel and escape of radioactive substances to NPP rooms or environment beyond limits established in the design.

Fuel transfer operations and special devices for transfer of new and spent nuclear fuel including disposal of spent nuclear fuel from the NPP shall be envisaged in the design.

4.8.4. The NPP design shall include the analysis of content and amount of solid and liquid radioactive waste and gaseous radioactive substances during normal operation and their estimation for design basis accident.

The design shall provide for facilities for reprocessing radioactive waste and gases, areas and methods for temporary and long-term storage, systems for cleaning air and water before venting into the atmosphere and discharge to natural reservoirs, facilities for transport of radioactive waste within the NPP territory and to storage location.

5. ENSURING SAFETY OF NPP IN OPERATION

5.1 ORGANISATION OF OPERATION AND OPERATIONAL DOCUMENTATION

5.1.1. The operating organisation of the NPP shall create organisational structures for safe operation of the NPP endowing the NPP administration with the necessary powers, provide the NPP with the required financial, material and technical resources, regulatory documents and scientific and technical support, physical and fire protection of the NPP, selection and training of personnel, , create atmosphere in which safety is regarded as a vitally important matter and a subject of personal responsibility of each one of personnel and carry out continuous control of NPP safety.

The operating organisation of the NPP ensures permanent control of all the activities important to NPP safety. The operating organisation of the NPP submits results of inspections relating to activities at the NPP on safety control and periodic reports on NPP safety level to Gosatomnadzor of Russia and Minatom of Russia.

5.1.2. The basic document determining safe operation of the NPP unit is the technological regulation containing rules and main procedures of safe operation, general order of performance of safety-related operations as well as safe operational limits and conditions.

The operating organisation of the NPP ensures development of technological regulations involving developers of the NPP and RP in compliance with the NPP design and NPP Safety Analysis Report and includes it into the documentation to be submitted to Gosatomnadzor of Russia for obtaining the operating license.

Changes introduced in technological regulations shall be agreed upon with organisations involved in their development and approved by Gosatomnadzor of Russia in duly order.

5.1.3 The NPP administration elaborates operational manuals on the basis of technological regulations approved and documentation by developers of equipment and NPP design before precommissioning adjustment works.

Manuals on operation of equipment and systems shall contain specific instructions to personnel on methods of works execution at normal and abnormal operation, including situations preceding an accident.

Operational manuals shall be adjusted based on data obtained from NPP commissioning.

5.1.4. Based on the technological regulations the NPP administration makes arrangements for elaborating and issue of guidelines and manuals determining personnel actions on ensuring safety under design and beyond design basis accidents.

Personnel actions prescribed by guidelines and manuals shall be based on characteristics of events happening and reactor plant states and prediction of conditions anticipated in a process of accident evolution. Actions based on prediction shall be directed towards recovering dominating safety functions and limiting radiological consequences of accidents.

5.1.5. To maintain safety systems in operable state and prevent hazardous failures in systems important to safety their maintenance, repair, tests and checks shall be conducted.

The aforesaid works shall be carried out according to relevant instructions, programs and schedules to be developed by administrative management of the NPP on the basis of design requirements and technological regulations and shall be recorded.

Conditions specified in technological regulations shall be observed and safety assured when removing safety systems from service for maintenance, repair as well as in testing and checking.

Provision shall made for arrangements excluding the possibility of unauthorised changes in schemes, instrumentation and algorithms of the CSS.

After maintenance safety systems elements and systems themselves shall be checked to assure their operability and compliance with the design characteristics and results of checks recorded.

5.1.6. The order of accounting, storage and revision of operational documentation shall be established by the operating organisation of the NPP considering requirements of regulatory documents.

The NPP design, executive documentation on NPP construction, test certificates and executive documentation on maintenance and repair of safety systems (elements) and elements important to safety belonging to Safety Classes 1 and 2 shall be kept for the whole lifetime of the NPP.

5.1.7. Records on control of safe operational limits and conditions shall be kept at the NPP during two campaigns between refuelling or two years. Before elimination of records results shall be included into interim reports on the status of NPP safety to be issued by the operating organisation of the NPP.

Materials on investigation into failures and accidents at the NPP shall be kept during the whole NPP service life.

5.1.8. The NPP unit shall be shut down if safe operational limits and conditions established for it cannot be observed at reactor operation.

5.1.9. Tests at the NPP not stipulated in technological regulations and operational manuals shall be conducted according to programs and methods containing description of arrangements on ensuring safety of these tests.

Programs and methodologies of tests shall be agreed upon with developers of NPP design and endorsed by the operating organisation of the NPP. Tests shall be allowed by Gosatomnadzor of Russia in compliance with conditions of transition from one stage of works to another established in the license and conducted by permission of the operating organisation of the NPP.

5.1.10. Infringement of safe operational limits and conditions including accidents which took place at the NPP shall be thoroughly investigated by commissions according to ordinances in force. The responsibility for development and implementation of measures preventing repeated disruption of safe operational limits and conditions for the same reasons shall be borne by the operating organisation of the NPP.

5.1.11. The operating organisation of the NPP is liable to forward in the established order information about disturbances in NPP operation.

There should be no obstacles to access to operational documentation containing data on the said infringements by representatives of state safety regulation bodies.

5.1.12. Prior to NPP commissioning and periodically in accordance with design requirements and regulatory documents checks of safety systems operability, systems (elements) important to safety, control systems, control of base metal and welded joints of NPP systems and elements important to safety shall be conducted.

Regularity and scope of checks shall be established in schedules developed by the NPP administration.

The aforementioned schedules shall meet requirements of regulatory documents and be related to the role the system (element) to be checked performs in ensuring NPP safety with allowance for the quantitative reliability analysis of systems (elements).

At the request of Gosatomnadzor of Russia extra checks of safety systems serviceability shall be conducted.

5.1.13. During NPP operation the operating organisation of the NPP shall provide acquisition, processing, analysis, systematising and storage of information about failures of elements relating to systems important to safety, and wrong personnel actions as well a its transfer to all interested organisations in duly order including developers of the NPP and RP.

5.1.14. Based on estimation of the residual service life of equipment and other safety validation studies the operating organisation may raise a question about extension of the NPP unit service life. In this case a new license on NPP unit operation shall be obtained from Gosatomnadzor of Russia.

5.2. COMMISSIONING

5.2.1. Requirements to sequence and volume of precommissioning adjustment works, physical and power start-up as
well as acceptance criteria for putting into operation NPP equipment and systems shall be identified in the NPP design.

The operating organisation of the NPP shall provide development and implementation of the program for NPP commissioning. The program shall be approved by Gosatomnadzor of Russia in a process of licensing.

5.2.2. Precommissioning adjustment works, physical and power start-up and power increase to the rated value shall confirm that the NPP as a whole, its systems (elements) important to safety are designed and functioning according to the design, and deficiencies detected have been eliminated. The NPP administration elaborates and coordinates with developers of the NPP and RP programs of precommissioning adjustment works, physical and power start-up and trial operation. The programs

shall be approved by the operating organisation and forwarded to Gosatomnadzor of Russia in the established order.

Documents regulating execution of precommissioning adjustment works, physical and power start-up and trial operation shall contain the list of nuclear hazardous works and measures designed to prevent accidents.

5.2.3. In implementing the commissioning program characteristics of systems (elements) important to safety, performance data on equipment and systems, safe operational limits and conditions and operational procedures shall be specified in more detail so that they reflect actual performance indicators of equipment and systems.

The list of parameters subject to recording shall be determined in the relevant test programs.

5.2.4. After trial operation of the NPP unit the procedure of its acceptance for commissioning is to be implemented. This procedure shall be carried out in the established order considering requirements of the present General regulations and other regulatory documents.

5.2.5. The NPP unit completed and being commissioned shall be separated from other operating units and areas where constructions works are being continued to ensure that works being carried out and possible infringement.. in the area of construction do not affect its safety and in case of postulated accidents at the operating unit safety of the unit under construction is guaranteed.

5.2.6. The license on NPP unit operation shall be granted by Gosatomnadzor of Russia to the operating organisation of the NPP upon completion of all precommissioning adjustment works in the established order with the final NPP Safety Analysis Report (preliminary revision of the final NPP Safety Analysis Report - prior to the first delivery of nuclear fuel to the site, the final revision -upon completion of trial operation), adjusted with account of results of physical and power start-up and trial operation of the NPP unit and approved by other state safety regulation bodies.

5.2.7. The first delivery of nuclear fuel to the site, physical and power start-up of the NPP unit, trial operation shall be allowed by Gosatomnadzor to the operating organisation of the NPP in accordance with conditions of transition from one stage of works to another established in the operating license after checking readiness of the NPP to these commissioning stages and obtaining approval by other state safety regulation bodies provided that emergency plans of personnel and population protection in the event of an accident at the NPP are available.

5.3. SELECTION AND TRAINING OF OPERATIONAL PERSONNEL

5.3.1. The NPP shall be staffed with personnel having the necessary qualification and admitted to independent work in the established order prior to delivery of nuclear fuel to the plant.

5.3.2. Admission of operational personnel to performance of certain types of activities shall be effected in case permits granted by Gosatomnadzor of Russia are available.

5.3.3. The list of positions of NPP workers which shall obtain permits from Gosatomnadzor of Russia on the right of executing works in the field of use of nuclear energy shall be drawn up by the Government of the Russian Federation.

According to the directive of the Government of the Russian Federation qualification requirements to workers obtaining permits according to the list of positions shall be specified in qualification manuals

concerning positions of managers. and experts (officials) agreed upon with safety regulation bodies in using nuclear energy and the Ministry of Labour and social welfare of the Russian Federation.

Qualification requirements to other NPP personnel shall be established by the operating organisation of the NPP.

5.3.4. The operating organisation of the NPP provides selection, training, admission to independent work and maintaining the operational personnel qualification level.. The system for selection and training of NPP operational personnel shall be aimed at achieving, control and maintaining its level of qualification required for ensuring safe operation of the NPP in all regimes as well as performance of actions directed towards mitigating consequences of accidents occurred.

Training shall imply inculcation of safety culture in operational personnel.

5.3.5. The system for training operational personnel and exercising. practical actions in operating the NPP operation shall involve technical provisions for training including simulators of various types permitted in the established order for application in training NPP personnel. Particular attention shall be paid to exercising actions on probable abnormalities (including accidents) in NPP operation and taking into account experience gained from previous errors and accidents.

5.3.6. Prior to admission to independent work and periodically operational personnel shall go through medical check-up. The state of health of workers from operational personnel shall ensure performance by them of professional duties relating to NPP operation safely and reliably.

5.4. RADIATION SAFETY IN OPERATION

5.4.1. Radiation safety of personnel and population during NPP operation shall be ensured by observance of legislation in force in the filed of radiation safety as well as requirements of federal regulations and rules in the field of use of nuclear energy.

5.4.2. The system for control of integrity of physical barriers on the pathway of ionising radiation and radioactive substances into the environment shall be envisaged, and intended for control of deviations from preset limits of NPP safe operation.

5.4.3. Provision shall be made for the radiation control system which shall provide measurements of controlled parameters characterising radiation conditions at the NPP and in the environment within the predetermined scope under any operating conditions of the NPP, including design basis and beyond design basis accidents.

5.4.4. The design shall contemplate continuous measurements in the safe area and in surveyed area of ionising radiation dose rates, wind speed and other meteorological parameters as well as periodic measurements of density of radioactive precipitation for assessment and prediction of radiation situation in the surrounding area during normal NPP operation and deviations from normal operation including design basis and beyond design basis accidents. Technical provisions for implementing these assessments and predictions shall be envisaged.

5.4.5. The NPP administration provides keeping account of exposure doses received by NPP personnel and personnel from other organisations involved in maintenance of NPP systems (elements), development and implementation of other arrangements to reduce personnel exposure to as low as reasonably achievable level.

5.4.6. The NPP administration keeps accounting and control of nuclear materials, radioactive substances and waste including new and spent nuclear fuel, radioactive equipment dismantled, contaminated tools, clothing industrial waste, other sources of ionising radiation.

5.5. EMERGENCY PLANNING ON PROTECTION OF PERSONNEL AND POPULATION IN CASE OF ACCIDENTS AND ACCIDENT MANAGEMENT

5.5.1. Prior to delivery of nuclear fuel to the NPP emergency planning procedures on protection of personnel and population in the event of an accident at the NPP considering radiological consequences of accidents shall be developed and made available. Plans shall be elaborated on the basis of NPP design characteristics and parameters, criteria for decision making relating to arrangements on protection of population in case of an accident at the NPP taking into account economic, natural and other site-specific features and extent of actual hazard of occurrence of the emergency situation.

Prior to delivery of nuclear fuel to the NPP main and .back-up means for communication with higher authorities, state safety regulation bodies and management bodies permanently working and specially authorised to make decisions as to protection of population and territories in case of emergency situations and executive power bodies of the Russian Federation and local regulatory bodies.

Emergency planning procedures developed for the purpose of personnel and population protection shall be agreed, approved and made available.

5.5.2. The plan of arrangements on protection of personnel in the event of an accident at the NPP shall be elaborated by the operating organisation. It shall provide for co-ordination of actions by the NPP and external organisations such as interior bodies, state fire service, civil defence and emergency control bodies within the site and area covered by emergency planning procedures. Maintaining permanent readiness and implementation of the plan is the responsibility of the NPP administrative management.

5.5.3. The emergency plan on protection of population to be elaborated in the established order by competent bodies in case of an accident shall suggests co-ordination of actions to be undertaken within the site and in the whole territory by civil defence and emergency control bodies, local self control bodies as well as ministries and departments involved in implementation of measures on protection of population and mitigation of accident consequences.

5.5.4. The level of emergency preparedness in emergency planning procedures in and level for action shall be clearly established the event of an accident; it shall be made clear who under what conditions using what communication means informs whom, which organisations about an accident, and declares beginning of implementation of plans. Plans shall provide for equipment and technical means, and indicate where these resources should be obtained and by whom.

5.5.5. Prior to delivery of nuclear fuel to the plant external and internal emergency centres shall be set up; they shall be provided with the necessary equipment, instrumentation and communication facilities through which management by implementation of plans indicated in i.i. 5.5.2 and 5.5.3 should be achieved.

5.5.6. The goal of beyond design basis accident management is to return the NPP unit to the controlled state to assure termination of the chain fission reaction, continuous fuel cooling and confining radioactive substances within predermined limits.

5.5.7. NPP personnel shall be ready for taking actions under design basis and beyond design basis accidents. Operational personnel undertaking actions under beyond design basis accidents shall be

guided by special manuals which shall be elaborated pursuant to i.5.1.4 on the basis of design basis and beyond design basis accident analyses conducted. Any technical provisions available and in working order shall be used for these actions.

5.5.8. Emergency training shall be periodically conducted to prepare personnel for actions required in case of emergency.

5.5.9. The operating organisation of the NPP shall develop methodology and programs for preparation and exercising emergency training for rehearsal of actions under accidents and make arrangements for this training.

5.6. NPP DECOMMISSIONING

5.6.1. NPP decommissioning shall be taken into account in the design, operation, maintenance, and repair.

5.6.2. Five years before the end of the NPP unit service life the operating organisation shall provide development of a program of NPP decommissioning and submit to Gosatomnadzor for approval in duly order resulting changes in terms of validity of licenses on NPP unit operation by Gosatomnadzor of Russia.

5.6.3. Before decommissioning overall survey of the NPP unit by the commission nominated by the operating organisation shall be performed Based on results of the overall review the operating organisation shall provide development of a draft plan for NPP decommissioning and make up a report on safety validation for NPP removal from service for obtaining a license on decommissioning from Gosatomnadzor of Russia.

5.6.4. The NPP unit shutdown for decommissioning is assumed to be in operation until disposal of spent nuclear fuel from the NPP unit. For this period all requirements to personnel, documentation etc remain valid as for the operating unit.

Reduction of a scope of maintenance, putting out of operation separate systems and elements, dismissal of personnel shall be performed in compliance with changes introduced in the established order to terms of validity of the operating license.

5.6.5 Off-schedule decommissioning of the NPP unit shall be accomplished with account of requirements of i.i. 5.6.3 and

5.6.4 of the present section.

Footnotes

Footnote1 (back to Definition 1)

Term «accident» hereinafter is understood as an event associated with radiological consequences.

Footnote2 (back to Definition 1)

Definition of the term «design» is established by the regulatory documentation in force.

Footnote3 (back to Definition 4)

Term “nuclear power plant”, if not specified otherwise, is understood as any project, mentioned in i. 4, 5, 6, 7 of main terms and definitions

Footnote4 (back to 1.2.12)

Further in the text instead of “initiating events considered in the design” a combination of words “initiating event” is used. Ruptures of equipment casings and vessels, whose manufacture and operation shall be carried out in accordance with the most stringent requirements of federal regulations and rules in the field of use of nuclear energy are not included into the list of initiating events. In this case it should be demonstrated that the probability rate of reactor vessel destruction does not exceed 10E-7 per reactor /year.

Footnote5 (back to 1.2.12)

In separate cases when the high reliability level of elements described above or systems to which they are included has been demonstrated or in a period of removal of an element from service for a certain time for maintenance or repair their failure may be not considered. The reliability level is presumed to be high if relevant indices of such elements are not less than those of passive elements, safety systems no having movable parts, whose failure are not considered (on the account of their low probability). The allowable time for removal of an element from service for maintenance and repair shall be derived from the reliability analysis of the system to which it is included to and established in the design.