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SAFETY GUIDE  
IN THE USE OF ATOMIC ENERGY   
"RECOMMENDATIONS TO THE REPORT ON IN-DEPTH SAFETY ANALYSIS   
OF NPP UNITS UNDER OPERATION"   
RB-001-19

I. General provisions

1. The Safety guide in the use of atomic energy "Recommendations to the Report on In-depth Safety Analysis of NPP Power Units under Operation" (RB-001-19) (hereinafter - the Safety Guide) has been developed in accordance with Article 6 of the Federal law dated November 21, 1995 No. 170-FZ "On atomic energy use" for the purpose of securing the compliance with the requirements of item 4.1.18 of the Federal Rules and Regulations in the field of atomic energy use "General provisions for NPP safety assurance" (NP-001-15), approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 522 dated December 17, 2015. (registered by the Ministry of Justice of the Russian Federation on February 2, 2016 under registration number No. 40939) (hereinafter - NP-001-15); item 15 of the Federal Rules and Regulations in the field of the atomic energy use" Main requirements for the extension of the NPP Unit operating lifetime" (NP-017-18), approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 162 dated April 5, 2018. (registered by the Ministry of Justice of the Russian Federation on May 4, 2018 under registration No. 50977) (hereinafter NP-017-18).

2. This Safety Guide contains the recommendations of the Federal Environmental, Industrial and Nuclear Supervision Service regarding the structure and contents of the report on the in-depth safety analysis of NPP Units under operation including the procedure for developing and updating the report on the in-depth safety analysis of the NPP Unit in compliance with the actual state.

3. This Safety Guide shall be applicable to the NPP Units under operation with the operating lifetime extended and (or) being extended beyond the design lifetime of their operation, except for NPP Units for which at the moment of approval of this Safety Guide the reports on safety justification have been or are being developed in accordance with the requirements of the Federal Rules and Regulations in the field of the atomic energy use "Requirements for the contents of the report on safety justification of the VVER NPP" (NP-006-16), approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 53 dated February 13, 2017. (registered by the Ministry of Justice of the Russian Federation on May 10, 2017 under registration number No. 46663) or the Federal Rules and Regulations in the field of atomic energy use" Requirements for the contents of the report on safety justification of fast- neutron reactor NPP" (NP-018-05), approved by the decree of the Federal Environmental, Industrial and Nuclear Supervision Service No. 9 dated December 2, 2005. (registered by the Ministry of Justice of the Russian Federation on January 26, 2006 under registration number No. 7413) (hereinafter NP-018-05).

4. This Safety Guide shall be intended for specialists of operating organizations and those involved in developing the report on the in-depth safety analysis of the NPP Unit as well as for the specialists of Rostechnadzor involved in safety regulation in atomic energy use and for specialists of the scientific and engineering support organizations.

5. By in-depth safety analysis of the nuclear power plant Unit in this Safety Guide is understood safety assessment of the operating NPP Unit made for the purpose of its life extension beyond the life stipulated in the NPP design in compliance with the requirements NP-017-18 following which it is justified that in the additional life period (repeat additional life) the NPP Unit shall meet the requirements of the current Federal Rules and Regulations in atomic energy use and/or if there are non-compliances justified and sufficient measures shall be taken allowing remedy or compensate perceived non-compliances.

6. The provisions of this Safety Guide shall be applied based on the design features of NPP Units and reactor plants used in their structure.

7. The list of abbreviations used in this Safety Guide is given in Appendix No. 1 to this Safety Guide.

II. General recommendations for the development and procedure for preparation   
of the in-depth safety analysis report of the NPP unit

8. ISAR of the NPP unit <1> is recommended to develop for confirming compliance of the NPP unit to the requirements of the FRR in force and/or availability and sufficiency (effectiveness) of the engineering and/or administrative measures taken at the NPP unit directed at rectification or compensation of the non-conformities, rendering or capable of rendering negative impact on the safety of the NPP unit operation during the supplementary or repeat additional life.

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<1> The term "NPP unit" is used in this Safety Guide in accordance with NP-001-15.

9. It is recommended that the NPP ISAR shall include the information relevant to the NPP current status at the completion of the design (assigned) lifetime and based on the NPP and RF designs; materials justifying the NPP unit safety during the design lifetime; modernization and reconstruction projects for individual systems and the NPP unit in general including all changes for the entire NPP operating lifetime as well as the outputs of the following works to be performed for the purpose of justification of the term for the extended operating lifetime (another additional extension of the operating lifetime) of the NPP unit:

- assessments of the residual life of irreplaceable components of the NPP unit, and the building constructions, buildings, structures and status of their foundations;

- results of the executed integrated survey of the NPP unit;

- residual lifetime values of replaceable safety-related components of the NPP unit, lifetime thereof was not stipulated during comprehensive examination;

- data about the changes of characteristics of the NPP location site for the entire period of observations and prediction of their development for the duration of the planned supplementary operation period;

- operation experience analysis;

- justifications of the observation of operational limits and conditions, conditions and limits of safe operation considering the executed upgrades and/or replacements of systems and components;

- estimates of the possibility for safe storage of spent nuclear fuel and handling of radioactive waste generated during the extended operating lifetime;

- estimates of the possibility of safety assurance of the NPP Unit during its decommissioning.

10. Data on implementation of the requirements of the Federal Rules and Regulations presented in the NPP ISAR shall be supported by the information about justification of their execution with a reference to the supporting documents. Brief information about their contents and the outputs of the executed justifications shall be presented together with the references to the supporting documents.

11. It is recommended to give the list of program for computers used for constructing the design models of the processes affecting the safety of the NPP unit and NPP overall (hereinafter the design analysis of safety) specifying information on qualification data sheets of software for computers execute following expert review of the specified software at the scientific-technical support organization of the authorized state safety regulatory agency.

It is recommended to give information about the performed safety design analysis confirming the sufficiency and completeness of the performed scope of design analyses, consideration of all the factors affecting the result, and confirming that the program for computer was used in the area of application specified in the qualification data sheet. In addition, the design safety analyses are recommended to be accompanied with error analyses and indeterminacies of the results obtained.

Data sufficient to perform another design analysis in case of necessity (input data, design diagrams, assumptions adopted for calculations) shall be submitted upon the request of the competent authority for state regulation of safety in atomic energy use.

12. These documents shall be submitted jointly with the ISAR of NPP unit (in addition it is recommended to include them in ISAR of the NPP unit as individual appendices) if references are given to the documents in the ISAR of the NPP unit where the insufficient information is given instead of submission of information recommended in conformance with this Safety Guide on in-depth safety analysis (the availability thereof in ISAR of the NPP unit is recommended in the sections of the appendices to this Safety Guide).

13. It is recommended to avoid any data duplication in various sections of the NPP unit ISAR. In case it is necessary to provide similar information in several chapters of the NPP ISAR (or sections within the same chapter) such information shall be presented in one of the NPP ISAR chapters (or chapter sections) and references to this information shall be given to other chapters (or chapter sections) in the NPP ISAR.

14. The developed ISAR of the NPP unit, which is submitted to the authorized body of state safety control when using nuclear energy being a part of the set of documents justifying NPP safety during operation in the period of supplementary operation period (repeat supplementary operation period) of the NPP unit shall be agreed with the developers of NPP and RP designs and approved from the part of the operating organization.

15. It is recommended to develop an independent ISAR of the NPP unit for each unit of the multi-unit NPP.

16. For justification of the possibility of repeat supplementary operation period of the NPP unit it is recommended to update the available ISAR of the NPP unit with reduction of the justification of the possibility of NPP unit safe operation during repeat supplementary operation period.

It is allowed to develop a new NPP ISAR which justifies a possibility of the NPP unit safe operation during the period of another extended operating lifetime.

The recommendations presented in the Safety Guide shall be applicable to the ISAR of NPP units both being developed for the extended operating lifetime and for another extended operating lifetime.

17. The available ISAR of the NPP unit with addition of new sections and/or chapters and appendices if required shall be corrected following the periodical safety assessment.

III. General recommendations for the development and procedure for preparation of the report   
on the in-depth safety analysis of the NPP unit

18. Information of the NPP Unit in ISAR shall be presented in accordance with the following structure:

- section "Introduction" (this section may be included in chapter 1 or be developed as a separate chapter);

- chapter 1 "General background of the NPP Unit";

- chapter 2 "Safety concept";

- chapter 3 "Characteristics of the NPP site";

- chapter 4 "Data on NPP safety-related systems, components, buildings and constructions, BDBA management engineering tools";

- chapter 5 "NPP unit safety analysis";

- chapter 6 "Operation";

- chapter 7 "Planning of further safety enhancement measures";

- chapter 8 "General NPP unit safety assessment";

- chapter 9 "Decommissioning";

- Appendix 1 Safety case materials of NPP Unit;

- Appendix 2 Materials for additional safety assurance of NPP Unit (it is allowed to divide this appendix into several individual appendices);

- Appendix 3 Probabilistic safety assessment;

- Appendix 4 Analysis of beyond design basis accidents.

If required it is allowed to include additional chapters and appendices in the NPP Unit ISAR.

It is allowed to include the information (a part of the information) from appendices 1, 2, 3 and 4 to the NPP unit ISAR without developing the said appendices but with saving the similar scope of the included data.

Detailed recommendations for the structure and contents of section "Introduction", chapters 1 - 9 and appendices 1 - 4 to the NPP unit ISAR are presented in Appendix No. 2 to this Safety Guide.

19. For each chapter and section of the NPP unit ISAR it is recommended to include references to the design, operational materials and documentation supporting the safety operation of systems, components, buildings and constructions during the extended operating lifetime on the basis of which the current version of the NPP unit ISAR have been developed (updated). It is recommended to include the data on the said documents (title and their details) in reference lists to be placed at the end of each chapter or section of the NPP unit ISAR.

IV. Recommendations for maintaining the in-depth   
safety analysis report of the nuclear power plant unit in accordance   
with the real state of the nuclear power plant unit

20. NPP Unit ISAR should be maintained in accordance with the real state of the NPP Unit by introducing changes.

21. When implementing the engineering and organizational solutions directed at NPP safety assurance, and changes of the design basis of the safety-related systems and components, a detailed description of the changes made should be given in the NPP Unit ISAR with assessment of their impact on safety of the NPP Unit. It is recommended to present detailed information which provides a possibility to get familiar with the contents of modifications planned for implementation at the NPP including the justification of their safety impacts without the need in addressing to additional information.

22. It is recommended to include any changes in the NPP unit ISAR by replacing the pages and (or) by adding new ones.

The serial number of the changes and date of replacement (month, year) should be indicated in the fields of each of the replaced (new) pages of the NPP Unit pages.

It is recommended to include a revision sheet at the end of each chapter, section or subsection of the NPP unit ISAR (it is allowed to include a unified revision sheet in the NPP unit ISAR).

23. The corrected (new) text in the replaced (new) pages of the NPP Unit ISAR should be highlighted, for example, by a vertical bar in the fields of the changed text and using italics for the newly introduced text.

24. The changes made to the NPP Unit ISAR should be agreed with the NPP and RP design developers and approved at the operator organization.

Appendix No. 1   
to the safety guide  
in the use of atomic energy   
"Recommendations for the contents of the report   
on in-depth safety assessment   
of active NPP power   
units", approved by the order of   
the Federal Environmental, Industrial and   
Nuclear Supervision Service   
dated \_\_\_\_ \_\_\_\_\_\_\_\_\_\_ 20\_\_ No. \_\_\_\_\_

ABBREVIATIONS

|  |  |  |
| --- | --- | --- |
| NPP | - | Nuclear Plant |
| EFWP | - | Emergency Feedwater Pump |
| ECWSS | - | Emergency Cooling Water Supply System |
| SFP | - | Spent Fuel Pool |
| MCR | - | Main Control Room |
| BRU-A | - | steam dump valve to atmosphere |
| BRU-K | - | steam dump valve into condenser |
| SD | - | Steam Drum |
| PSA | - | Probabilistic Safety Assessment |
| VVER | - | Water cooled, water moderated power reactor |
| ASW | - | Air Shock Wave |
| - | - | Containment |
| MSH | - | Main Steam Header |
| RCP | - | Reactor Coolant Pump |
| TCV | - | Throttle Control Valve |
| SZ | - | Surveillance Zone |
| - | - | Containment |
| BDBA | - | Beyond Design Basis Accident |
| IE | - | Initiating Event |
| MCL | - | Minimum Controllable Level (power); |
| SSE | - | Maximal Safe Shutdown Earthquake |
| DGP | - | Dangerous Geological Processes |
| CR | - | Control Rods |
| SFA | - | Spent Fuel Assembly |
| ISAR | - | In-depth Safety Analysis Report |
| SNF | - | Spent Nuclear Fuel |
| DBA | - | Design Basis Accident |
| OBE | - | Operating Basis Earthquake |
| SG | - | Steam Generator |
| PSA | - | periodical safety assessment |
| NPP QAP | - | nuclear power plant quality assurance program |
| EFP | - | Electrical Feed Pump |
| RW | - | Radioactive Waste |
| RBMK | - | High Power Channel Type Reactor |
| RS | - | Radioactive Substances |
| ECR | - | Emergency Control Room |
| RP | - | Reactor Plant |
| ECCS | - | Emergency Core Cooling System |
| ECCS | - | Emergency Core Cooling System |
| SS | - | Safety System |
| SPZ | - | Sanitary Protection Zone |
| PCS | - | Pressure Control System |
| CPS | - | Control and Protection System |
| PPS | - | Physical Protection System |
| FA | - | Fuel Assembly |
| FE | - | Fuel Element |
| - | - | fuel channel |
| SAR | - | Safety Analysis Report |
| MVTR | - | Maintenance, Verifications, Tests, Repair |
| TP | - | Transport Package |
| FRR | - | Federal Rules and Regulations in the Field of Atomic Energy Use |
| - | - | Personal Computer |
| EGP | - | Heterogeneous Loop Power Reactor |
| NM | - | Nuclear Materials |
| NF | - | Nuclear Fuel |
| ATWS | - | Anticipated Transient without Scram |

Appendix No. 2   
to the safety guide  
in the use of atomic energy   
"Recommendations for the contents of the report   
on in-depth safety assessment   
of active NPP power   
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RECOMMENDATION   
FOR THE CONTENTS OF CHAPTERS AND APPENDICES INCLUDED   
TO THE NPP UNIT ISAR

1. Introduction and NPP unit background

1.1. Section "Introduction"

It is recommended to introduce:

- brief information about official decisions of public authorities regarding NPP construction, design and construction periods, official decisions on acceptance for operation;

- information on decision taken about the possibility of continuing the operation of NPP unit after end of its additional life assigned by the design;

- general information about key NPP and RF design developers and the NPP operating organization;

- information on organization of safety justification works of the NPP Unit in the additional life period;

- information about the developer organizations, separate independent chapters or sections of the NPP Unit ISAR;

- information on performed PSA.

1.2. Chapter 1 "NPP unit general information"

1.2.1. Chapter 1 of the NPP unit ISAR shall include the following:

- general information about the NPP project and basic technical characteristics of the considered NPP unit;

- information on the technical standards base, based thereof the NPP Unit was designed, and about its fundamental differences from the requirements of the legislative and regulatory documents in force in the Russian Federation at the time of development of the NPP Unit ISAR;

- list of FRR and other regulatory legal acts for compliance with the requirements thereof safety analysis was made and the possibility of operation of the NPP Unit during the additional life was justified;

- data on compliance of the structure and contents of the information presented in the NPP unit ISAR with the recommendations of this Safety Guide.

1.2.2. When conducting the Periodical Safety Assessment (PSA) it is recommended to include section "the PSA outputs" to Chapter 1 of the NPP unit ISAR, where with references to the PSA implementation programme and the PSA output report it shall be recommended to present brief information on the outputs of the PSA completed and on the revisions to be made in the NPP unit ISAR based on the PSA outputs.

2. Chapter 2 "Safety concept"

2.1. Main criteria and principles of safety assurance

2.1.1. The following information shall be presented:

- basic criteria and safety principles accepted in the engineering project of the NPP (RP) with references to the regulatory documents in force during the NPP design development for NPP safety assurance during the design, construction and operation. In case there is information in the NPP technical safety justification (TSJ) or any other document justifying safety of the NPP unit a reference shall be made to the relevant section of Appendix 1 to the NPP unit ISAR;

- basic criteria and safety assurance principles in compliance thereof the NPP Unit shall be operated in the period of the additional life;

- information on NPP safety assurance by means of consistent implementation of the defence in depth principle, including the availability of independence assurance measures between the various levels of defense in depth;

- information on the use of the properties of internal self-protection of the RP specifying at the cost of what they are implemented, and the measures directed at excluding the threshold effects.

If during the period after commissioning of the NPP unit under review the safety-related systems (components) have been modernized and their operation modes have been changed including major revisions of maintenance and in-service inspection which has resulted in the change of the originally adopted RF and NPP design criteria and principles of safety assurance, then a consolidated list of the said activities shall be presented with references being made to the relevant sections (sub-section, items, sub-items) of the NPP unit ISAR where their description is presented.

2.1.2. Information on the application of the concept "leakage before damage" at the NPP Unit, and reference to the ISAR section of the NPP Unit where the description of the hardware and organizational measures are presented providing timely detection of through cracks in the reactor coolant circuit piping and switchover of the RP to a safe state before the crack attains critical dimensions.

2.2. Assurance of compliance with the requirements   
of nuclear and radiation safety

2.2.1. Nuclear safety assurance

2.2.1.1. Information on the concept of nuclear safety assurance shall be presented including the list of references to other chapters of the NPP unit ISAR which present information on engineering and organizational measures with the assistance of which the execution of the said concept is assured.

2.2.1.2. The following data shall be presented:

- on justification of nuclear safety assurance due to the use of properties of the internal reactor self-protection;

- on control and monitoring of the core reactor power;

- on the reactivity balance for all possible states of the normal NPP operation and any abnormal operation including design basis accidents (besides the possibility for any positive reactivity effects in case of accidents shall be analyzed and their potential consequences shall be assessed);

- on the structure of the provided technical reactivity control means, functions of individual systems and subsystems and their reliability;

- on efficiency, reliability and response time of the emergency protection system;

- on the measures directed at providing reliable core cooling, non-exceedance of the damage limits of FRs and providing integrity of the coolant circuit boundaries;

- on nuclear safety during reloading, transportation and storage of nuclear fuel, including information on prevention of local criticality during the specified types of works.

2.2.2. Radiation safety assurance

2.2.2.1. Information on the radiation safety assurance concept shall be presented with the list of references to other chapters of the NPP unit ISAR which present engineering and organizational measures with the assistance of which the execution of the said concept is assured.

2.2.2.2. The following information shall be presented:

- on the routes and the level of the NPP radiation impact on personnel, public and environment;

- on engineering means and organizational measures on safety assurance of personnel, public and environment against ionizing radiation including the justification of their efficiency. It is recommended to demonstrate that the applied protection means and implemented protection measures are justified by the practice and they are not resulting in exceedance of the established dose limits and exclude unjustified exposure, and the existing radiation impact is retained at the level which is as low as it may be reasonably achieved considering both economic and social factors;

- on the efficiency of protection against potential radiation sources in order to ensure non-exceedance of individual risk under normal NPP operation conditions shall be provided; it shall be specified that the risk of potential radiation exposure does not exceed the overall risk limits for personnel and public within the period established in the regulations;

- on adherence to the requirements for releases and discharges into the environment (with due regard for all NPP Units) established by the regulations of the Russian Federation.

2.3. Principles for construction of safety systems

2.3.1. The SS list shall be presented with their safety functions being specified. Information shall be presented on which of the specified safety systems apply a passive principle of implementation of the safety function.

2.3.2. The list of special hardware for management of BDBA and information on the functions performed using this hardware should be given.

2.3.3. The following information shall be presented:

- on implementation of SS construction principles: single failure, redundancy, diversity, independence (information shall be supplemented with the principal structural diagrams characterizing SS construction);

- on existing SS protection measures and special engineering means to control BDBA against a common cause failure;

- on multiple use of SS and their components with justification of such use;

- on provision of Unit SS independency of multi-unit NPP agaisnt SS of another Unit of the same NPP. When using the same SS for different NPP units the information shall be presented on the measures compensating the absence of independence of such systems;

- on sufficiency of special-purpose engineering means for beyond design basis accident control in case of simultaneous accident occurrence at all Units of a multi-unit NPP.

2.3.4. The information shall be supported with the references to the sections of Chapter 4 and (or) Appendix 2 to the NPP unit ISAR which present the description of the relevant SS and engineering means on BDBA management.

2.4. Design Limits

The values of the set design limits shall be presented including DBA design limits as well as the the values of the set operation limits and the safe operation limits.

2.4.1. Operation limits

2.4.1.1. The following data on operation limits shall be presented in a tabular form:

- name of the operation limit;

- value of the system (component) NPP unit parameter or a characteristic (operation limits may be set both for one parameter and for a combination of parameters, for example, a combination of the primary coolant temperature and pressure);

- operational states (the NPP unit states characterized by operational limits and conditions established in the NPP design) or the NPP unit operation mode which the operation limit is referred to;

- the measurement unit of the parameter;

- condition, the performance thereof certifies about the observation of the operation limit;

- data on justification of the presented values with a reference to the relevant supporting documentation.

References shall be made to the sections of Chapter 4 and (or) Appendix 2 to the NPP unit ISAR which present information about the control of the parameter values of operation limits as well as the personnel activities in case of their breach.

2.4.1.2. The measurement unit of the parameter for which an operation limit has been set should be specified in the system of units used in the NPP design of the RP and NPP. The specified value should be given in the measurement units allowed for use by the Federal Law No. 102-FZ dated June 26, 2008 "On ensuring the uniformity of measurements" (hereinafter - the Federal law No. 102-FZ of June 26, 2008), in case if a different system of measurement units is used in the NPP design.

2.4.1.3. Measures on restoration of normal operation shall be presented in case of the breach of operation limits referred to the NPP unit in general. Measures on restoration of normal operation in case of the breach of operation limits for certain systems shall be presented when describing such systems.

2.4.1.4. Operation limits shall be presented for the following parameters:

- characterizing the discharges of radioactive substance into the atmosphere (based on the normatives of maximum permissible discharges of radioactive substances stipulated for a specific stationary source of discharges and the NPP overall);

- characterizing the discharges of radioactive substances to the atmosphere (based on the norms of permissible discharges of RS to the atmosphere, established for specific stationary source of discharges);

- specific activities of datum radionuclides in the primary circuit coolant (based on the conformance between the damage limits of NF and primary circuit coolant operation considering the efficiency of the coolant treatment system);

- other parameters set in the RF and NPP designs (reactor power, pressure, temperature, coolant level).

2.4.1.5. Operation limits not referred to the parameters characterizing effluents and discharges of radiation substance to the environment (radiation parameters) shall be presented on a system-by-system basis, that is, operation parameters referred to one and the same system shall be grouped. Operation limits may be presented for a combination of several systems (for example, for the RF or for a complex of NF storage and handling systems).

2.4.1.6. Both rated and diagnostic parameters the coolant quality and operating media of safety-related systems including the primary coolant, operating media of the secondary circuit, FP and SS borated solutions.

The control levels, non-compliance thereof specifies the malfunction of safety-related system designed for maintaining the admissible values of specified parameters should be given for the diagnostic indicators.

2.4.1.7. For each of the rated parameters the range of deviations from the admissible values (deviation levels) shall be presented.

2.4.1.8. For rated and diagnostic parameters the NPP unit operation states or operation modes shall be presented which these parameters are applied to. The rated and diagnostic parameters may be delimited within operation states and modes of the NPP unit (for example, to specify different rated and diagnostic parameters for reactor fuelling, re-fuelling and unloading, for NPP operation at various power levels, for the NPP repair states which also include circuit, equipment and pipeline decontamination, flushing, cleaning, passivation and preservation).

2.4.2. Safe operation limits

2.4.2.1. The following data on the safe operation limits shall be presented in a tabular form:

- name of the safe operation limit;

- parameter values of the process set as limits (safe operation limits may be set both for one parameter and for a combination of parameters, for example, a combination of the primary coolant temperature and pressure);

- NPP operation states or operation modes which the safe operation limit is referred to;

- parameter measurement unit;

- condition, the performance thereof certifies about the observation of the safe operation limit;

- periodicity of control of the parameter values;

- sequence of personnel actions on non-observation of (non-compliance with) the safe operating conditions including information on the deadlines for performing each of these actions;

- information on the safe state to which the NPP Unit is switched over on non-compliance with the safe operation conditions;

- data on justification of the presented limits of safe operation with a reference to the relevant supporting documentation;

- information on in which cases the values of the limits of safe operation coincide with the set-points of emergency protection and actuation of SS.

2.4.2.2. The measurement unit of the parameter for which a safe operation limit has been set shall be presented in the measurement unit system used in the NPP design. The specified value should be given in the measurement units allowed for use by the Federal Law No. 102-FZ dated June 26, 2008 No. 102-FZ, if a different system of measurement units is used in the NPP design.

2.4.2.3. Safe operation limits shall be presented for the following parameters:

- characterizing the discharges of radioactive substance into the atmosphere (based on the normatives of maximum permissible discharges of radioactive substances stipulated for a specific stationary source of discharges and the NPP overall);

- characterizing the discharges of radioactive substances to the atmosphere (based on the norms of permissible discharges of RS to the atmosphere, established for specific stationary source of discharges);

- specific activities of datum radionuclides in the primary circuit coolant (based on the conformance between the damage limits of NF and primary circuit coolant operation considering the efficiency of the coolant treatment system);

- other parameters set in the NPP design (including reactor power, pressure, temperature and coolant level).

2.4.2.4. Safe operation limits not referred to the parameters characterizing effluents and discharges of radiation substance to the environment (radiation parameters) shall be presented on a system-by-system basis, that is, safe operation limits referred to one and the same system shall be grouped. Safe operation limits may be presented for a combination of several systems (for example, for the RF or for a complex of NF storage and handling systems).

2.4.3. Design limits for design basis accidents

The values of design limits shall be presented by the FE damage degree and the level of radiation impact on personnel, public and environment established for the design basis accident.

Data on their justification shall be presented with a reference to the relevant supporting documentation.

2.5. Fire safety assurance

2.5.1. It is recommended to give information on the regulatory documents used as the basis to justify the NPP Unit fire safety.

2.5.2. It is recommended to give information on technical management for NPP fire safety assurance, including information on:

- assurance of the design fire safety level by compliance with the general safety criteria in all NPP normal operation modes as well as in case of any accidents at the NPP;

- results of regarding fire as a consequence of NPP operational occurrences under the analysis of effect of fires and their consequences on safe shutdown and cooldown of the RP, localization and monitoring of radioactive releases to the environment (hereinafter analysis of the effect of fires on NPP safety) for such scenarios of NPP operational occurrences and its update (review) in compliance with the requirements established by the fire safety regulations and considering the implementation of measures for life extension of a specific NPP Unit;

- on fire-attackable NPP safety-related systems (components) detected during the analysis of fire impacts on the NPP safety and fire protection measures for these systems (components), regulatory or scientific and technical justification of the adopted solutions;

- the NPP operation procedure in case of any fire in the rooms where safety-related equipment is located and in the rooms where a fire breakout results in the necessity of the RF shutdown;

- substantiation of impossibility of simultaneous loss of control from the MCR and the ECR in case of a fire.

2.5.3. Information on assurance of the NPP fire protection system shall be presented including the following:

- on determination of the design number of simultaneous fires at the NPP site;

- on the determinant provisions for analysis of fire loads on the rooms of the main NPP buildings and structures with characteristics of fire and explosion hazard of substances and materials;

- on classification of the main NPP buildings and structures in accordance with the degree of their fire-and-explosion, fire hazard and fire resistance;

- information on types of fires determinant for calculations of the fire protection system;

- basic principles of the fire protection system: multibarrier, safety system channel redundancy, their physical division;

- on observance of the zoning principle of buildings (division into fire zones and compartment) and on approach to fire localization in the scope of an individual segment, zone by using fire stops (barriers) and safe distances for physical division of different safety system chanels;

- on constructing principals of active fire extinguishing systems, including redundancy, independence, single-failure, diversity principles related to supporting safety systems;

- on the effect of external natural impacts, and impacts occurring during design-basis accidents at the NPP on the apparatus for detection, firefighting, as well as localization of fire related to the systems important to safety;

- on the fact that in case of any false alarms and disruption of fire extinguishing installation equipment the impact of fire extinguishing means on the components important to safety does not result in any dangerous consequences from the NPP safety viewpoint.

2.5.4. Information on the impact of any fires at the NPP site (outside the NPP buildings), on the personnel work as well as on the civil structures of the buildings located in the vicinity of the fire and safety-related systems and components in accordance with the regulatory documents on fire safety should be specified.

2.5.5. If any part of the specified information is given in the chapter 4 and/or in the Appendix 2 to the NPP Unit ISAR on description of the fire extinguishing systems, reference may be given to the respective section of the chapter and/or appendix where these data are given instead of providing information.

2.6. Protection against external   
natural and human-induced impacts

2.6.1. Information on the concept of NPP protection against external natural and human-induced impacts during the additional operation period and its compliance with the requirements of FRR.

2.6.2. The following information should be presented:

- on the potential sources of external impacts including the industrial, transport and military facilities located near the NPP;

- on the list of external natural and human-induced impacts and their combinations considered in the safety analysis of the NPP Unit with indication of the impact intensity characteristics and frequency of their occurrence. Information on justification of the accepted list and characteristics of external impacts included in it including the information on presented information update, on the procedures and used software for the computers, which are used for assessment of the external impacts, should be given.

- on regulatory framework of the calculation of NPP components protection against external impacts and on the approaches to performing tolerance analysis of the buildings, structures, systems and components to the external impacts included in the list;

- on accounting during performance of deterministic and probability safety analyses of natural and human-induced external impacts, including external impacts exceeding the intensity of impacts accepted in the NPP design and combination of various external impacts;

- on approaches to organizational and engineering measures on engineering protection of the NPP unit against external impacts;

- on approaches to the assessment of impacts on the NPP components important to safety: ASW (air shock wave), fall of aircraft, flying objects generated following these impacts;

- on the parameters, characterizing the levels of the earthquakes taken in the NPP design, and their accounting during calculation of the buildings and structures;

- on the composition and construction principles of the engineering protection systems during systematic impacts.

The references to the chapters of NPP Unit ISAR should be given, where the description of implementation of the specified principles and approaches to assurance of protection against external natural and human-induced impacts is presented.

2.7. Safe operating conditions   
and operating conditions

2.7.1. Operating conditions

2.7.1.1. The following should be given for each operating condition:

- formulation of operation condition;

- information on operation states or modes of the NPP Unit for which the safe operation condition is applicable;

- information on justification of operation conditions.

2.7.1.2. The operation conditions should be introduced system-related i.e. the operation conditions related to one and the same system should be grouped. Operation conditions may be presented for a combination of several systems (for example, for the RP or for a complex of NF storage and handling systems).

2.7.1.3. Operation limits and operation conditions may be presented in one section (without division into operation limits and operation conditions).

2.7.2. Safe operation conditions

2.7.2.1. The following should be given for each safe operation condition:

- formulation of the safe operation conditions;

- information on operation states or modes of the NPP Unit for which the safe operation condition is applicable;

- minimum requirements to the quantity of functional systems (components, channels of the systems) important to safety;

- requirements for the characteristics and functional state of the systems (components, system channels) important to safety;

- requirements to maintenance, control and tests of the systems (components, system channels) important to safety, with respect to the scope, periodicity and other conditions of maintenance, control and tests (it is allowed to give reference to the NPP Unit ISAR chapter (appendix) where the specified information is presented);

- description of potential non-compliances with the safe operation conditions;

- sequence of personnel actions on non-compliance with the safe operating conditions including information on the deadlines for performing each of these actions;

- information on the safe state to which the NPP Unit is switched over on non-compliance with the safe operation conditions;

- information on justification of the safe operation conditions.

2.7.2.2. The operation conditions should be introduced system-related i.e. the safe operation conditions related to one and the same system should be grouped. Safe operation limits may be presented for a combination of several systems (for example, for the RP or for a complex of NF storage and handling systems).

2.7.2.3. For the safety systems one (several) of them being supporting (are supporting) with respect to the other (to the others), the safe operation conditions with respect to the requirements for the minimum quantity of functional items (channels) specified in the safety system should be given in such manner so that the exclusion of simultaneous nonoperability of the safety systems was shown (functioning thereof depends on the considered supporting safety systems), whereby they are not capable to perform the safety functions provided for in the NPP design considering the FRR standardized number of failures in the safety system.

In particular, it si recommended to specify the safe operation condition for the safety system provided with energy and/or operating medium considering the failures of components (channels) both of this safety system as well as the the failures of components (channels) supporting its safety system.

2.7.2.4. The exact and identical formulations should be used for the safe operation conditions. The formulations of the type "system in operable state" (system is operable"), "system in readiness state" should be used.

2.8. Provision of physical protection

The basic principles of building the physical protection system should be given and the regulatory requirements applicable at the NPP for provision of physical protection should be specified.

2.9. Emergency preparedness

2.9.1. It is recommended to give information on the security concept of personnel and the public in the event of accident at a NPP, and the description of specific engineering and organizational measures should be given in the chapter 6 of NPP Unit ISAR.

2.9.2. It is recommended to give information on the concept used when making the action plans for protection of personnel and the public in the event of a radiation accident at the NPP including information on the sizes and boundaries of the established protective measures planning zone and planning zones of actions for compulsory evacuation of the public, as well as other emergency response planning zones specified in the plan of actions for protection of the public.

2.9.3. It is recommended to give the criteria for declaring the states "Emergency readiness" and "Emergency situation" and evacuation criteria of personnel and the public.

2.9.4. It is recommended to give information on the concept of using protected command post for emergency actions located at the NPP site and outside the NPP site, as well as about the concept of organizing extern help to the NPP in the event of accident with severe radiation consequences.

3. Chapter 3 Characteristics of the NPP site

3.1. General provisions

3.1.1. Information on geographical, topographic, hydrological, meteorological, aerological, meteorological, aerological, geological, hydrogeological, seismotectonic, geotectonic and engineering-geological conditions of the NPP location, potential human-induced external impacts, the existing and future population distribution is recommended to be presented in Chapter 3 of the NPP Unit ISAR.

3.1.2. Completeness and sufficiency of the performed engineering surveys and studies in the NPP location area and at the NPP site in order to reveal and obtain reliable characteristics of the NPP site that shall be taken into account during operation and in emergency planning for evacuation of the personnel and the public from the NPP location area shall be substantiated.

3.1.3. It is recommended to give information confirming the meeting of the requirements of the Federal Rules and Regulations in atomic energy use "Accounting for external natural and man-made impacts on nuclear facilities" (NP-064-17), approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 514 dated November 30, 2017 (registered by the Ministry of Justice of the Russian Federation on December 26, 2017 under registration number No. 49461) (hereinafter NP-064-17);

3.1.4. The following data shall be presented:

- List of parameters and characteristics of external natural and human-induced impacts on the NPP in accordance with the nomenclature of processes, phenomena and natural and human-induced origin factors established in NP-064-17;

- List of parameters and characteristics of the NPP impact on the environment within the NPP location area;

- Critical values of the controlled parameters of external impacts with hazard classes I and II established in accordance with the federal rules and regulations that require to make a decision on the necessity to implement administrative and technical safety assurance measures subsequent to the results of local monitoring and control in the course of the NPP Unit construction and operation;

- Quantitative values of the parameters adopted as reference intensity levels for external impacts of natural and human-induced origin with dynamic nature of manifestation (earthquakes, external explosions and fall of aircraft) that require automatic or manual shutdown of the NPP Unit in case of their exceedance (during occurrence of the above-mentioned external impact at the NPP site) shall be specified.

- List of organizational and technical measures for engineering protection of nuclear facilities from external impacts.

3.1.5. Data on the characteristics of the NPP deployment site obtained following surveys before start of NPP operation should be given.

3.1.6. Information on update of the presented characteristics of NPP site following monitoring of the parameters of processes, phenomena and factors of natural and human-induced origin during NPP Unit operation should be given.

3.2. Structure and content of information,   
 presented in chapter 3 of NPP power ISAR

3.2.1. Site location and description

The following territory pick-up radii shall be applied (the main building (the reactor building) shall be assumed as the NPP site center):

- region - at least 300 km;

- the neighboring region (location) - at least 30 km;

- the NPP site - at least 3 km.

The NPP location shall be recorded with indication of the latitude, longitude and altitude in the unified coordinate and elevation system. The study scope of territory on pickup radii is determined by the regulatory documents in force.

3.2.1.1. Geographic location

The following data shall be presented:

- administrative location of the NPP site (republic, territory, region);

- name of the administrative center;

- distance from the centere of the NPP site to the nearest boundary of the administrative center;

- distance from the NPP site center to the nearest administrative boundaries;

- distance from the NPP site center to the state boundary, and names of the bordering states;

- geographic deployment coordinates of NPP site center in the system of coordinates taken for the site;

- position of the NPP site in relation to natural and artificial benchmarks (populated localities, water bodies, airports, railway stations, sea and river ports);

- hazardous industrial facilities (plants, factories, chemical works, food industry facilities, power engineering facilities), hydraulic structures that can affect the NPP safety;

- position with respect to the transportation facilities (gas and oil pipelines, railroads, motor roads, aerodromes, sea and river ports) and main airways;

- position with respect to the military facilities;

- territories where location of any NPPs is prohibited by the environmental legislation of the Russian Federation;

- engineering protection facilities of the NPP site (dams, dikes, canals and drainage systems) and any soil modifications at the NPP site (soil replacement or levelling changes).

3.2.1.2. Topographic conditions

The list of documentation containing the results of topographical surveys and studies as well as analysis of these results shall be given.

The characteristics of the relief of the region including the following information should be given:

- topographic map of the region (pickup radii up to 300 km from the site center) made according to the topographic maps of scale 1:500 000, 1:200 000;

- topographic maps for the near region (location) of scale 1:200000, 1:100000, 1:50000, 1:25000;

- maximum and minimum absolute elevations of the NPP location area;

- surface slope and its direction;

- availability of special topographic features (including ravines, precipices, degradations, occurrences, karst, quarries);

- presence of wetlands;

- availability of water resources;

- presence of forests and farming lands.

The following information should be given for the NPP location site:

- topographic maps of scale 1:25000 and 1:10000;

- topographic plan of scale 1:5000;

- a topographic and bathymetric plan and map on the scale of 1:10000 for the shelf area with the bottom contour section by isohypses with the interval of 5-2.5 m combined with topographic plans of the onshore area of the location;

- information on observations over present-day crustal movements including diagrams and information on the observation materials.

Information given in the NPP Unit ISAR should be based on topographic material: topographic maps obtained no later than for five years before the moment of their presentation and topographic plans obtained no later than two years before their presentation. Apart from the specified topographic materials it is recommended to give the topographic maps made before the start of NPP construction.

3.2.2. Population distribution

Information on the distribution of population in the NPP location area considering the prospects of population growth should be given.

The provided data shall be based on the results of the latest census of population with due regard for the population migration and growth, the need for efficient evacuation of the public in the NPP construction area as well as any population travelling along transportation lines.

The following data shall be presented:

- population density in the zone with the radius of 30 km from the NPP site boundary: prior to construction commencement, during the construction period and during the NPP operation period;

- distance to the cities with the population size exceeding 100,000 people for the zone with the radius of 100 km from the NPP site;

borders of SPZ and SZ;

- population distribution (by size and density) on the map by sectors (rings) around the NPP bounded with the radii of 10, 10÷15, 15÷20, and 20÷30 km and divided into 16 rhumbs;

- information on specific population groups: permanent and temporary residents, age groups (children, the elderly), hard-to-evacuate groups (patients, prisoners);

- public food ration, share of imported and local food products;

- domestic water demand, sources of water supply;

- information on daily and seasonal migration of the public;

- duration of the public stay in open spaces.

3.2.3. Human-induced conditions of the NPP location

Information on human-induced conditions of NPP location should be given. The influence of external impacts, occurrence thereof is possible at the NPP site, on the NPP Unit safety should be assessed.

3.2.3.1. Frequency of implementation and parameters of external   
human-induced impacts

Data sufficient for justification of the probabilistic assessment of the occurrence of external impacts and prediction of their intensity, parameters and characteristics of the impacts both for the purposes of accounting in the NPP design basis and for the purposes of compliance assessment of NPP to the probability targets of large emergency blowout.

A summary list of the processes and factors of external impacts of human-induced origin should be given based on the inspection of region of construction and NPP site taking account of the list presented in NP-064-17.

The data should be given in the form of text information, maps, diagrams and tables.

The list of organizations, legally confirming information about the sources of man-induced hazard, specifying the details of the documents confirming the given information should be given.

3.2.3.2. Methods for prediction of parameters and characteristics of   
human-induced external impacts.

It is recommended to give an extensive description of the methods and procedures for calculation of the basic parameters and characteristics of the external impacts of human-induced origin on use of the mathematical apparatus; assumptions and limitations; results of experimental justifications. Information on the qualification data sheets of software used for PC should be given.

3.2.3.3. Parameters and characteristics of   
human-induced external impacts.

The parameters and characteristics of external impacts in the scope stipulated by NP-064-17 should be given.

It is recommended to give the dependency of the intensity of impact on its probability for the external impacts of human-induced origin, the parameters thereof are not regulated in NP-064-17.

3.2.4. Meteorology and aerology

3.2.4.1. The following analysis results for meteorological and aerological conditions in the NPP location area shall be presented:

- the list of meteorological and aerological processes and phenomena characteristic for the NPP location area;

- substantiated opinion on presence or absence of certain meteorological and aerological processes and phenomena at the NPP site;

- analysis of the conditions impacting the normal and emergency discharges of radioactive substances.

Information shall be provided separately for each type of meteorological and aerological processes and phenomena. Conclusions on intensity and frequency of occurrence for processes and phenomena shall be accompanied with evidence in the form of description of the results of special-purpose observations, calculations, analysis of statistical data.

3.2.4.2. Meteorological characteristics

The following data shall be presented:

- average monthly and average annual wind speeds, rated peak velocities of wind up to reliability 1.0; 0.1 and 0.01% (repeatability once in 100, 1000 and 1000 years, including as a 10-minute average, and gusts τ = 3.0 sec respectively); repeatability of the wind directions (wind rose) for the observation period; joint repeatability of wind directions, atmospheric stability criteria and gradations of wind speeds;

- average and extreme values of air saturation with water vapors (absolute and relative humidity, dew point temperature), daily variations of humidity;

- average, extreme for the entire observation period and design maximum amount of precipitation (liquid, solid, mixed type) up to the reliability of 1.0, 0.1 and 0.01% (repeatability of once per 100, 1000 and 10000 years respectively), their daily maximum; duration of precipitation; their intensity distribution: monthly and annual wind roses bringing precipitation;

- average and maximum repeatability and duration of fogs, thunderstorms, blizzards, hail, glaze, dust and sand storms;

- average, extreme observed monthly and annual and design maximum air temperature values up to the exceedence probability of 1, 0.1 and 0.01% (repeatability of once per 100, 1000 and 10000 years);

- average and extreme temperature of soil on the surface and at standard depths;

- average and extreme atmospheric pressure;

- pollution, dust content and corrosive activity of the atmosphere;

- annual probabilistic assessment of the dangerous meteorological phenomena (cyclones, whirlwinds, hurricanes, gusts including information on potential flying objects on their passing, snow avalanches, snowdrifts, ice-covered ground, dust storms, lightning strikes, extreme air temperatures, precipitations, blizzards;

- data on temperature conditions at the NPP location area;

- average monthly and average annual values of the solar radiation parameters and duration of sunshine.

3.2.4.3. Aerological characteristics

The following data shall be presented:

-on repeatability of windless conditions, wind directions and average wind speeds in 16 rhumbs at the height of 10, 100, 200 and 300 m;

- on repeatability and average power values of near-ground and raised inversions in the near-ground boundary layers of the atmosphere up to a height of 1000 meters;

- on repeatability of the atmospheric stability categories;

- on the height of the mixing layer in various atmospheric stability categories;

- on average values of the vertical temperature gradient in the layers 0÷300, 0÷600 and 0÷900 m;

- joint repeatability of wind speed and direction in 16 rhumbs for various atmospheric stability categories;

- on long term and short term atmospheric dispersion of contaminants;

- on probability of the distribution parameters of atmospheric dispersion for least favorable of impurities with high reliability of the meteorological conditions for the impurity dispersal in the atmosphere typical for the NPP location area under normal NPP operation conditions (long-term atmospheric dispersion) and under the worst conditions in case of any accident at the NPP (short-term atmospheric dispersion).

The values of aerological characteristics should be given in the following form:

- on wind direction and speed in table form and in the form of wind rose;

- on near-ground and raised inversions in table form in the form of vertical profiles of temperature change with height.

3.2.4.4. Assessment of scattering properties of atmosphere

3.2.4.4.1. Information on scattering properties of atmosphere for assessment of radiation situation at the location during long-term normal operation of NPP should be given.

3.2.4.4.2. Information on scattering properties of atmosphere for assessment of the radiation situation at the boundary of SPZ and beyond its limit on accident occurrence should be given.

3.2.4.5. Calculation methods for characteristics and parameters of   
meteorological and aerological processes and phenomena.

Those of all analyzed events that are considered in the NPP safety assurance shall be listed, and characteristics of their impact on the NPP structures and systems shall be given.

Source data sufficient to calculate the loads on the NPP structures caused by these impacts shall be provided.

Information on the calculation methods for the main parameters and characteristics required to calculate the loads on the structures, assemblies and systems, the list thereof is determined by NP-064-17 should be given.

3.2.5. Hydrology and hydraulic works

3.2.5.1. It is recommended to give information on hydrological surveys made, including the assessment of scope, quality and sufficiency of surveys made; assessment of the state of exploration of the territory including information on stream flow measuring stations (observation posts, sections) specifying their locations on the diagrams, maps; information on used historical materials, data on state and departmental survey grids.

3.2.5.2. The description of the site location in hydrological and hydrotechnical aspect including description should be given:

- surface water bodies specifying their dimensions, forms and other hydrological characteristics;

- existing and prospective waterworks located at the water bodies and at the NPP site;

- safety criteria of hydraulic works accepted in the safety declarations;

- all elevations of the building and construction sites (it is recommended to combine information on elevations with the topographical map).

3.2.5.3. Information on performed assessment of hydrological characteristics of water bodies (water level regime, flow regime, temperature regime of water bodies, wave regime, ice regime, tsunami, seiches), including the following information:

- maximum, minimum, mean values of the levels, flows and temperature of water and water bodies by months, seasons, for a year, during summer and winter runoff low;

- results of calculations of the values of parameters up to reliability 1.0; 0.1 and 0.01%; 99.0; 99.9 and 99.99% (repeatability once in 100, 1000 and 10000 years respectively);

- dependence between the water levels and flows up to the flow value with the exceedence probability of 0.01% (curve Q = f(H)) for rivers in the NPP location cross-sections;

- flooding boundaries at design levels (on topographic map considering deployment of NPP facilities). It is allowed to show the boundaries of flooding zones on the figures obtained using software;

- annual distribution of river stream flows by seasons and months for indicative years (exceedence probability of 50, 95 and 97%), water balance;

- extreme, mean and minimum values of water flow velocities, their direction;

- characteristics of tidal phenomena, waves, surges and seiches for seas;

- assessment of the territory flooding boundary by the design tsunami wave;

- data on deformations, processing, displacement of shores, waterways, flood lands, near shore zone of water bodies, including forecast results of their changes to end of NPP operating life near the NPP siting;

- flow patterns of suspended and bottom sediments with analysis of the annual distribution of flow, turbidity of water, lithodynamic characteristics along the shoreline of the NPP facilities siting.

- probabilities of hazardous hydrological phenomena.

3.2.5.4. Information on the chemical composition of surface water bodies (source), description of the capabilities of surface layers to dissipate, dilute or concentrate the wastes (hydrological dispersion) should be given, including the dynamics of quantitative indices of the chemical composition of water by seasons at different years by water content should be shown.

3.2.5.5. The following analysis results for hydrological conditions in the NPP location area shall be presented:

- the list of hydrological processes and phenomena characteristic for the NPP location area;

- substantiated opinion on presence or absence of certain hydrological and hydrological processes and phenomena at the NPP site;

- the conditions impacting the normal and emergency discharges of radioactive substances.

Conclusions on intensity and frequency of occurrence for processes and phenomena shall be accompanied with evidence in the form of description of the results of special-purpose observations, calculations, analysis of statistical data.

3.2.5.4. Migration of radioactive substances   
in the surface waters

Information on the capability of surface waters to disperse, dissolve or concentrate radioactive leakages in normal and emergency conditions, and about the possibility of radioactive substances monitoring in these waters shall be presented.

It is recommended to give information on how the specified site specific features impacting the migration of radioactive substances formed during the leakage and transition of radioactive substance by surface waters are shown in the NPP project.

3.2.5.5. Calculation methods for characteristics and parameters of   
hydrological processes and phenomena.

Those of all analyzed hydrological processes and phenomena that are considered in the NPP design shall be listed, and characteristics of their impact on the NPP structures and systems shall be given.

Input data used for calculation of loads against impact of the specified processes and phenomenon for NPP construction shall be given.

Information on the calculation methods for the main parameters and characteristics required to calculate the loads on the structures, assemblies and systems, the list thereof is determined by NP-064-17 should be given.

Information on the observation, measurement methods, hydrological characteristics, technologies of performing hydrological works, the results thereof are used for performing calculations shall be given considering item 3.2.9 of this appendix to the Safety Guide.

3.2.6. Geological, hydrogeological,   
seismotectonic and geoengineering conditions.

3.2.6.1. Information on geological, hydrogeological, seismotectonic and engineering and geological conditions of the NPP siting area and site should be given.

3.2.6.2. The following data shall be presented:

- list of materials developed following studies and surveys at the NPP siting area and site for assessment of geological, hydrogeological, seismotectonic and engineering geological conditions at the NPP site (basic materials). It is recommended to give the results of analysis of basic materials sufficient for NPP safety assurance with substantiated reports on the presence or absence of geological processes at the NPP location site, their quantitative and probabilistic characteristics and parameters which should be taken into account during NPP design;

- results of the engineering surveys (geological with topographic basis) used to study seismotectonic conditions in the NPP construction area, other dangerous geological processes (landslides, rockfalls, karst, depressions, mud streams, avalanches, erosion of banks, slopes and stream beds, underground scouring, cryogenic processes, crevasses, subsidence, territory flooding, mud volcanoes and volcanic eruptions, aeolian processes) and their combinations . Predictions of any unfavorable changes in geological, hydrogeological and seismotectonic conditions that can activate any geological process in the course of the NPP construction, operation and decommissioning or preservation shall be provided.

- information on the properties and stabilty of sois including calculation procedures of the main parameters of soils;

- list of dangerous geological processes and phenomena and also the calculation methods for the main parameters of geological and seismic processes and phenomena;

- information on the chemical composition of underground water sources, capability of surface layers to disperse, dilute or concentrate radioactive wastes.

For each type of processes and phenomena information should be given according to the requirements of NP-064-17.

Conclusions on classification of processes and phenomena according to their hazard degree, their intensity and frequency of occurrence shall be provided together with substantiations in the form of descriptions, graphical materials (profiles, plans, sections, borehole logs, maps, photographs), results of analysis thereof as well as information on any special-purpose field or laboratory investigations and laboratory investigations.

3.2.6.3. The following data for the NPP siting area shall be presented:

- analysis of archive and library materials;

- cartographic diagrams and profiles on the scale of 1:100000 - 1:500000 for geological, tectonic, recent and present-day crustal motions with the use of aero-, photo- and space images;

- a seismotectonic map or a map of geological seismicity criteria, a detailed seismic zoning map, a schematic map of any potential earthquake source zones with indication of expected maximum magnitude, its repeatability, effective depth of the source in each zone; historical data on earthquakes and other geological and geoengineering events and processes;

- description of lithology and stratigraphy in the region, composition and thickness of quaternary deposits, structure and occurrence depth of the crystalline basement;

- schematic maps of zoning in accordance with the hazard of exogenous geological processes;

- data on freezing depth and thickness of the active layer, landslides, rockfalls, subsidence and crevasses, karst and creek formation; erosion of banks; potential soil movements due to extraction of gas, liquid and solid mineral resources and human-induced loads on the Earth surface (water reservoirs, high-density multi-storey urban development, seismic loads from explosions in quarries); observed settlement and tilt of foundations for the buildings and structures; results of geodetic observations over modern crustal motions;

- data on hydrogeological conditions: on the depth and fluctuations of ground water levels; on communications of aquifers with one another and with the surface waters; on the feed and discharge areas of aquifers; on assessment of hydrogeological dispersions in ground waters. Data on the depth of ground water level with probability 10% and seasonal level fluctuations, on the flow directions and velocities and soil permeability in different layers of the section;

- results of macro-seismic and instrumental seismological studies in the region;

- description of soil types, their location at the NPP site;

- geological and geophysical profiles and block schemes of the main key strata up to the depth of the first hundreds of meters on the scale of: horizontal 1:100000 - 1:500000, vertical 1:5000 - 1:20000 (at the constructed facility the horizontal scale is 1:20000 - 1:50000, vertical - 1:1000 - 1:5000);

- interpreted aero-, photo- and space images;

- results of high-accuracy repeated geodetic measurements of modern crustal motions.

In addition, information on the capability of ground waters to disperse, dissolve or concentrate radioactive leakages in normal and emergency conditions, and about the possibility of radioactive substances monitoring in these waters shall be presented. Similarly information on how the specified site specific features impacting the migration of radioactive substances formed during the leakages and transition of radioactive substance by ground waters ashall be presented.

3.2.6.4. Maps of geoengineering site zoning and seismic site micro-zoning with indication of geological profiles, test holes and the main structures from the general layout (horizontal scale 1:2000 - 1:10000, vertical - 1:200 - 1:1000), as well as geotechnical cross-sections, logs of exploratory holes drilled at the site and in the points of essential structure locations and additional sections along the axes of essential structures (horizontal scale - 1:500 - 1:2000, vertical - 1:50 - 1:200) shall be provided for the NPP location site. All layers (geoengineering elements) shall be distinguished and represented on the profiles, the standard, physical and mechanical and dynamic properties of soils in their natural and water-saturated state and in natural and unfrozen state for permafrost soils under dynamic impacts and static impact from the weight of structures shall be specified. Information on any unstable soils with non-steady coherency and properties present in the profile shall be specified.

Information about the proposals for improving soil properties shall be presented.

The following information shall be presented for seismotectonic conditions of the NPP site:

- intensity on the MSK-64 scale for the medium grade of soils;

- SSE and OBE for particular points of the site with due regard for human-induced changes and soil conditions at the site;

- rated accelerograms and consolidated soil response spectra in graphical and digital format with the specified probability;

- geodynamic characteristics of the site.

3.2.6.5. Methods, procedures, hardware and testing equipment used for the following purposes shall be described:

- seismic survey, electric prospecting and other geological and geophysical studies at the NPP site prescribed by the regulations in order to detect geoengineering and geological processes, phenomena and factors;

- determination of the physical and mechanical properties of soils, specific properties of subsiding, swelling, soft and high-plasticity, loose and permafrost soils in each layer of the investigated stratum in the top section of the geological profile up to the depth of at least 120 m, chemical composition of underground water.

Accuracy characteristics for the equipment, units and methods applied in the course of geological, geophysical and laboratory investigations of the region, location and site in order to supplement, adjust and specify the data on geoengineering and seismological micro-zoning of the site shall be provided for confirming the reliability of the obtained information.

3.2.6.6. Information on the methods used to predict parameters and characteristics of factors and processes shall be presented, and reliability of the applied methods shall be substantiated.

3.2.7. Factors causing external biological phenomena.

Information on availability of biological phenomena impacting NPP Unit safety shall be presented. The potential impacts on the NPP site, including directly the NPP Unit shall be indicated.

3.2.8. Fulfilling the requirements of regulatory   
documents in force for NPP location, which are not considered   
in th NPP unit design

The characteristics of meeting the requirements of regulatory documents in force in the Russian Federation for NPP location effective after the considered NPP unit project development shall be presented. If required references for the analysis made of the non-conformities of NPP unit to the requirements of the regulatory documents in force shall be given.

3.2.9. Monitoring programs

3.2.9.1. A list of the integrated monitoring programs over natural and industrial factors during the NPP lifecycle including the following types of monitoring shall be presented:

- radiation;

- meteorological

- aerological;

- hydrological;

- hydrogeological;

- geotechnical monitoring of foundation grounds including observations of tilting and subsidence of nuclear facility project and structures;

- seismological;

- geodynamic monitoring of current-day earth surface motions;

- periodic control of parameters of external human-induced impacts.

An integrated assessment of the interconnections and interactions of various processes, safety state of NPP against impact of external natural ad human-induced factors, processes and phenomena shall be made based on the results for each monitoring type.

3.2.9.2. The following information shall be provided for each of the integrated monitoring programs:

- lists of observed processes, phenomena and factors as well as types of monitoring;

- safety criteria (adopted on the basis of the design requirements as well as established in the NPP design);

- locations and elevations of the observation and measurement points;

- performed observations and measurements;

- brief description of the observation and measurement methods and characteristics of the equipment and test facilities;

- recording systems and their location;

- the procedure for collection, storage, analysis and transmission of information;

- forms of reporting.

Following each type of monitoring and integrated assessment of interrelation and interaction of different processes, the NPP safety states against impact of external natural and human-induced factors, processes and phenomena it is recommended to prepare the annual reports, information from them is included in NPP Unit ISAR.

3.2.9.3. Information on geodetic monitoring of settlements and deformations of the NPP buildings and structures shall be given.

The following information shall be specified in the description of the geodetic observation (geodetic monitoring) database:

- description of the foundation arrangements;

- calculated values of design settlement and tilt of buildings and structures;

- values of the physical and mechanical properties of soils at the foundations of buildings and structures to be controlled in the course of monitoring;

- arrangement schemes for settlement points;

- elevation records for the settlement points starting from the foundation arrangement completion (the first cycle of geodetic observations).

- level line diagrams and layout diagrams of vertical control network settlement probe;

- information on stability of the vertical survey network (bulletin of benchmark elevation);

- results of observations of settlements and tilts of buildings and structures in the construction period up to completion of construction (up to 100% of design load on the foundation).

3.2.9.4. Results of the monitoring (control) of any processes, phenomena and factors of natural and human-induced origin performed by various methods shall be provided for the entire observation period starting from the NPP site selection with the frequency prescribed by the monitoring programs.

In addition the following information shall be presented:

- breaks in the observations and/or loss of data specifying the reasons of what happened. Information on recovery and (or) compensation of the lost data with indication of the relevant procedure shall be indicated;

- the results of analysis of monitorings with recommendations on possible further NPP operation considering the conformance analysis of the results of monitoring and values of parameters controlled by monitoring;

- accounting of the results of monitoring when performing periodic safety assessment;

- recommendations on further improvement of the monitoring system considering the observation results.

3.2.9.5. Information on the monitoring programs and results in the scope of specified items 3.2.9.1 - 3.2.9.4 of this appendix to the Safety Guide may be given as part of the relevant thematic sections (subsections, items, sub-items) of the chapter 3 of NPP Unit ISAR. In this case the relevant reference to the indicated section (sub-section, item, sub-item) of chapter 3 of NPP Unit ISAR, where the description of the monitoring programs is given, shall be presented in this setion.

3.2.10. Interdependent processes, phenomena and factors of   
natural and human-induced origin

Information on interdependent processes, phenomena and factors of natural and human-induced origin detected in the course of engineering surveys and studies shall be presented. Presence or absence of such processes, phenomena and factors shall be substantiated. In case of any interacting or interdependent processes and phenomena of natural and human-induced origin information on special programs for monitoring and (or) integrated application of the results of the performed monitoring types as well as analysis of their impact on the NPP safety shall be provided. If there is more detailed information about the specified processes, phenomena and factors in other sections (sub-sections, items, sub-items) of the chapter 3 of NPP Unit ISAR, it is allowed to present only the list of interdependent processes, phenomena and factors with reference to other sections (sub-sections, items, sub-items) in this section, where a more detailed information is specified.

3.2.11. Life support for the personnel and public   
in the NPP location area and their evacuation in case of   
emergencies caused by external impacts.

The following information shall be presented:

- results of analysis of any accidents at the NPP and in the NPP location area caused by intensive earthquakes and other extreme external impacts and their combinations, as well as emergency planning in emergencies. Administrative and technical measures aimed to protect the evacuation routes shall be described.

- any cases with damage of transportation lines, airfields, bridges, tunnels caused by fissures, crevasses, overthrust faults and other surface deformations (gravitational phenomena), screes, rockfalls, landslides shall be analyzed.

- information on the possibility to use the existing access roads in case of emergency, the necessity for relocation or refurbishment of roads, bridges, ports, construction of new transportation routes shall be provided.

- characteristics of vehicles and transportation lines to be used in case of emergency.

A reference may be given to the information specified in chapters 2 and 6 of NPP Unit ISAR instead of presenting the specified information, provided that the personnel and public protection issues during accidents caused by external impacts are considered individually in the specified chapters.

3.2.12. List of documents used   
 for determining the quantitative-probabilistic characteristics   
and parameters of the external natural and human-induced processes   
and phenomena

The list of of documents used in compliance thereof the quantitative-probabilistic characteristics and parameters of external natural and human induced origin on the NPP obtained following the surveys, studies and observations for identifying and gathering statistical data on the processes and phenomena taken into consideration for establishing the complete list of expected external impacts in the NPP construction area were determined. The sources of information used for detection and identification of the external processes, phenomena and natural and human induced factors according to the list NP-064-17 shall be specified in the list, as well as the references to the documents containing source data, processing and analysis procedures of source data and obtained results shall be given. The indicate list is allowed to be given as part of the relevant sections (subsections, items, sub-items) of chapter 3 of NPP Unit ISAR.

4. Chapter 4 "Data on NPP safety-related systems, elements, buildings   
and constructions, BDBA management engineering  
 tools";

4.1. Classification of systems and elements,   
NPP buildings and structures

4.1.1. The classification of the systems and elements, buildings and structures of the NPP Unit, control hardware of BDBA in compliance with FRR shall be given provided that the following information on the systems and elements, buildings and structures shall be given.

- name

- in-plant designation (code);

- information on safety classification (safety classes and classification notations);

- seismic resistance category of NPP elements;

- group for buildings and piping operating under excess, hydrostatic or vacuumetric pressure;

- for buildings and structure classification by liability for radiation and nuclear safety and assurance of functioning of the equipment and system located there;

other classifications (these data shall be specified in cases when a system or a element is subject to classification in accordance with federal rules and regulations establishing the requirements for safety-related control systems or the requirements for arrangement and safe operation of hoisting cranes for nuclear facilities or the requirements to pipeline valves for NPP).

4.1.2. Information on justification of presented classification including information on justification of referring NPP elements to the element not safety-related.

4.2. Systems, elements, NPP buildings and constructions,  
 important to safety

4.2.1. Information on the systems, elements, buildings and structures of the NPP important to safety, hardware for BDBA management. The description of the systems, elements , buildings and structures of NPP, as well as the hardware for BDBA management shall be given in accordance with the Standard Structure of system description in the NPP Unit ISAR presented in Appendix No. 3 to this Safety Guide (hereinafter the Standard Structure). A similar approach is use on implementation of a new system and/or during the construction of a new building or structure at the NPP Unit.

Information on the technical means of control used in the emergency conditions including severe BDBA and post-accident monitoring means used in the emergency conditions including severe BDBA and post-accident monitoring means shall be given when describing the safety-critical systems.

Information on the systems, elements, buildings and structures of NPP shall be given considering the changes of the original design and upgrades made.

The mentioned descriptions of the safety-critical systems, elements, buildings and structures of the NPP, technical means for management of BDBA shall be included in the Appendix No. 2 to NPP Unit ISAR. The list of safety-critical systems, elements, buildings and structures of the NPP, technical means for management of BDBA shall be given in this case in the chapter 4 of the NPP Unit ISAR with reference to specific sections of the Appendix No. 2 to NPP Unit ISAR where their detailed description is given and executed in accordance with the above mentioned Standard Structure.

4.2.2. A detailed description of the planned upgrade with assessment of its impact on safety shall be given on upgrade (retrofitting) of the existing systems, elements, buildings and structures. Changes shall be made to all the relevant part of the NPP Unit ISAR where information on the system, which due to the performed upgrade shall no more reflect the real state (including the system diagram, reliability analysis, system characteristics and its elements, description of the functioning of system elements shall be corrected).

Information on the design, engineering and other documents based thereof the system (buildings and structures) upgrade (retrofitting) is made shall be given.

Information on the works for commissioning of the safety-critical system, element, buildings and structure and tests performed therein, with references to the program in accordance thereof the new system (building and structure) is commissioning shall be given.

4.2.3. Information on the results of justification of strength and operability of the fuel elements and fuel assemblies shall be given when describing the elements included in the reactor scope. Subject to changes in the design of fuel elements and fuel assemblies, use of new structural materials, changes in the chemical composition of the fuel, changes in the manufacturing technology of fuel elements, fuel assemblies or fuel element cladding (if these changes may affect their strength characteristics), changes in the standards of water chemistry regime of the primary coolant, changes in the design conditions of operation impacting the strength and operability of fuel elements and fuel assemblies information shall be given on performance of the relevant justifications of strength and operability of the fuel elements and fuel assemblies. The meeting of the requirements of the Federal Rules and Regulations in the field of nuclear energy use "Basic requirements for justification of the strength and thermo-mechanical behavior of the fuel assemblies and fuel elements in the core of pressurized water reactors" (NP-094-15) approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 13 dated January 18, 2016 shall be confirmed for the NPP Units with VVER (registered by the Ministry of Justice of the Russian Federation on April 21, 2016, registration No. 41891).

4.2.4. The possibility of safe operation assurance shall be justified when describing the complex of nuclear fuel storage and handling systems:

- on fresh nuclear fuel handling and storage;

- on reactor core refueling, evacuation of SNF to the storage facility and storage of SNF (considering safety assurance of temporary storage of SNF generated during the additional period of operation):

- on transportation of fresh NF over the NPP site;

- on preparation (loading to TP) of SNF for shipment outside the NPP;

- on transportation of SNF to TP over the NPP site for shipment to the centralized storage facility or for processing.

4.2.4.1. The following information shall be presented for the set of NF storage and handling systems (outside the reactor):

- list of all fresh NF and SNF storages

- characteristics of fresh NF used at the NPP as well as the fuel removed from the core with indication of the methods for burn-up determination;

- allowable storage period of NF at NPP specified in the design;

- maximum design capacity (volume) of each of the storages and package quantity stipulated for assuring core evacuation at any time of operation, for offload of SNF from one of the storage compartment, for repair of the compartment or in case of accident for storage of the rejected NF both fresh and spent;

- brief characteristic of the NF storage methods both at the fresh NF storage and at the SNF storage (or in a standalone SNF storage); presence of absorber additives in the storage materials or in the coolant;

- the method of NF delivery to the NPP and SNF removal from the NPP, information on the proposed transportation frequency and the TP types used;

- information on in-plant transportation (types of transport and types of transport packages, transportation conditions);

- information on the rejected NF handling (for both fresh and spent NF) beginning with the rejection method.

- NF storage and transportation norms and information on their confirmation by independent nuclear safety report;

- lists of procedures and software used for safety justification of NF storage and transportation specifying the field of their application and information on software certification according to the established procedures;

- information on the hardware stipulated for storage and transportation of damaged NF.

4.2.5. The possibility of safety assurance when handling RW generated in the period of additional operation period shall be justified when describing the RW handling systems (if required considering the additional safety justifications presented in the Appendix 2 to the NPP Unit ISAR).

4.2.6. Information on the level of their reliability, on capability of these systems withstand impact of single equipment failures shall be given for the active firefighting systems classified as assuring SS. If the firefighting systems in the rooms, where the safety-critical system elements are located, are classified as systems not affecting NPP safety, the justification of such classification shall be given instead of the specified information.

4.2.7. Information on the analysis results of strength endurance of the safety-critical buildings and structures and their structures to external an internal impacts.

4.2.8. Information on organizational and engineering measures for engineering protection of the NPP Unit against external impacts with references to the relevant justifications confirming the sufficiency and efficiency of the measures taken including information on the systems of engineering anti-seismic protection.

4.2.9. Information on the special hoisting cranes classified as important to safety shall be given. For the special hoisting cranes classified as not impacting safety but used in the rooms (zones) where the safety-critical systems and elements are located, the justification of absence of their impact on the safety during failures confirming the classification for these element shall be justified.

The relevant justification if the special cranes are classified in the category of rarely used shall be included in the NPP Unit ISAR.

5. Chapter 5 NPP Unit safety analysis

The key results of the analysis of operational occurrences including analysis of DBA and BDBA as well as the basic conclusions on PSA results shall be given in the chapter 5 of the NPP Unit ISAR. A limited scope of information on the safety analysis results shall be given in the chapter 5 of the NPP Unit ISAR.

The justified list of IE, classification of IE, design limits and safety criteria, description of program for PC and initial data used for the analysis shall be given for the operational occurrences including DBA.

The representative list of BDBA scenarios, justification of the representativeness of the scenarios included in the list, safety criteria adopted when performing analysis of BDBA (representativeness of the scenarios is provided by considering the NPP state severity, moreover potential operability or non-operability states of the safety systems and special hardware for BDBA management) shall be given for BDBA including severe accidents. The detailed results of safety analysis for each IE included in the final list of operational occurrences including DBA shall be allowed to be given in Appendix 2 to NPP Unit ISAR in accordance with the recommendations given in the section 5.1 of this Appendix to the Safety Guide.

The detailed results of the analysis for each BDBA scenario, including severe accidents shall be given in the Appendix 4 to the NPP Unit ISAR in accordance with the recommendations given in the section 5.3 of this Appendix to the Safety Guide.

5.1. Operational occurrences   
including design basis accidents.

For all the NPP operation states on occurrence of IE the observation of the safety criteria stipulated in NRR and in the design limits stipulated in the NPP design shall be assured based on the results of analysis of the operational occurrences including DBDA.

The analysis of operational occurrences shall be performed for all IE included in the final list of operational occurrences, including DBA.

5.1.1. List of IE of the operational   
occurrences, including DBA

It is recommended to confirm that the final list of operational occurrences including DBA has been generated considering:

- recommended list of IE of the operational occurrences, including DBA given in Appendix No. 4 to this Safety Guide (the exclusion of the final list of any of the recommended IE shall be justified);

- results of the analysis of failure consequences for the NPP elements selected for subsequent detailed analysis;

- operation experience for this NPP Unit and operation experience for similar Units or prototype Units;

- PSA result.

The following shall be considered in the final list of operational occurrences including DBA:

- all types of design-basis events which may lead to accident (equipment failures, human errors, internal events (fires, flooding, explosions), external impacts of natural and human-induced nature);

- all possible locations of NF, RS and RW defined in the NPP design (including RP, spent fuel pool, NF storage, NF location during transportation, containers and piping of RW handling system);

- all possible operation states of the NPP Unit, defined in the NPP design.

The analysis results of operational occurrences including DBA are the basis for development of instruction for liquidation of the operational occurrences and DBA for the NPP Unit.

5.1.2. Classification of IE of the   
operational occurrences, including DBA

IE included in the final list of operational occurrences shall be classified by the type of their impact on the RP. The classification of IE by the probability of their occurrence shall also be given.

5.1.3. Design limits and safety criteria.

Design limits and safety criteria accepted in performing analysis of operational occurrences, including DBA shall be given.

Information on the approaches accepted in assigning safety criteria shall be given.

The limits and criteria established for the operational occurrences, including DBA are observed for all IE included in the final list, considering the single failure principle according to the requirement of item 1.2.12 of NP-001-15, and considering the failures dependent on IE and equipment failures which cannot be detected during normal operation shall be confirmed.

5.1.4. Provision of conservative approach in the analysis of   
operational occurrences including DBA

The safety shall be performed for all IE included in the final list based on conservative approach, which is provided by conservative selection of the initial and boundary conditions, assumptions and simplifications used during accident simulation.

5.1.5. Representation of the analysis results of   
operational occurrences, including DBA

The following information shall be given for each IE included in the final list following analysis:

- characteristic of IE (cause of occurrence, level of disturbance in case of any parameter deviations, leakage size and location in case loss of piping or equipment, flow rate in case of unauthorized switch-on of a pump and any other characteristics and (or) parameters depending on the IE nature);

- initial state (RP initial parameters, state of the NPP Unit systems and components);

- failures accepted during simulation (single failure of SS element or human error independent of IE, failures not detected during normal operation, dependent failures, common cause failures);

-assumptions and simplifications applied in the analysis;

- information of PC software used for analysis (name, version, reference to the qualification data sheet);

- chronology of transition process development in table form specfying the following: points of time corresponding to commissioning and disconnection of systems and elements; points of time corresponding to the attaining of minimum reserves up to the stipulated design levels and safety criteria; points of time corresponding to the significant events, determining further development of the transition process (including core uncovery, dehumidification of SG, stall of natural circulation occurring of recriticality/restoration of subcriticality);

- text description of the transition process development with references to the representative parameter change schedules;

- change schedules of representative parameters which confirm the design limits and safety criteria; characterize the state of basic safety functions, demonstrate survival of physical barriers; confirm sufficient length of the design period (it is recommended to confirm that at the end time of the design analysis the NPP Unit is in a controlled safe state, safe state of the NPP Unit may not significantly change due to minor change of one of the parameters);

- a description of the process flow inside the containment or in the accident localization systems and change schedules of the representative parameters in the containment rooms or accident localization area shall be given for IE leading to primary and secondary circuit blowdown within the containment limits or accident localization area.

If the accident development conditions result in any thermo-mechanical deformation of fuel element claddings affecting the core cooling conditions information on the ways to consider these phenomena in the analysis shall be provided.

The number of leaky fuel elements shall be assessed on the basis of the analysis results. Fuel element leakage criteria adopted in the analysis shall be specified with reference to the relevant justification of the adopted criteria.

Results of the conservative analysis of radiological consequences of the accident and description of the processes determining RS releases into the containment as well as from the containment to the NPP Unit room as well as from the NPP Unit rooms to the environment shall be provided for design basis accidents leading to damage of fuel elements exceeding the established safe operation limits or to RS releases into the environment. The effective exposure doses of personnel and the public shall be given.

Conclusion of the observance of design safety limits and criteria shall be formulated based on the results of analysis.

Reference to the documents confirming the justification of presented results, if required reference to the documents containing more detailed information on safety analysis shall be given.

5.1.6. PC software used   
for performing accident analysis

The list of programs for PC used for analysis of accidents with specification of information on qualification data sheets of the PC software (data sheet number, date of issue and validity), documented following review of the specified programs in the organization for scientific and technical support of the authorized state safety regulatory agency shall be given.

The following shall be specified for all the PC programs used in the safety analysis:

- name and scope of application, application restrictions;

- brief description of the procedures and software (reference to the sources, where a more complete description of the software for PC is given);

- design nodalization schemes used for analysis (their applicability for the performed analysis shall be substantiated).

5.2. PSA results

5.2.1. The results of PSA of the given NPP Unit made, which is given in the Appendix 3 to NPP Unit ISAR shall be given with indication of the used source data, data base. Information on used software for PC in the scope of recommendations specified in item 11 of this Safety Guide shall be given.

5.2.2. The results of analysis of reliability data of equipment, systems, stipulated barriers, systems, stipulated barriers on the propagation path of radioactive media and exposure.

5.2.3. The following information shall be given in the conclusions about PSA results:

- probabilistic safety indices of the NPP Unit obtained following PSA;

- verification of probabilistic safety indices of the NPP Unit with targets for aggregate probability of a severe accident and aggregate probability of a large-scale emergency discharge;

-information on the initiating events, emergency sequences of the NPP Unit probabilistic model, the NPP Unit systems (elements), the personnel's actions that are the most significant for the NPP Unit safety;

- information on the priorities during development and implementation of planned measures directed at safety assurance of the NPP Unit during the additional operation lifetime;

- assessment of impact produced by measures on modernization of the NPP systems (elements) on the probabilistic safety indices of the NPP Unit.

5.3. Beyond design basis accidents

5.3.1. Final list of beyond design basis accidents

The final list of BDBA (including the representative scenarios of severe BDBA), including information on the approach taken in formation of the list of BDBA shall be given.

It is recommended to justify that the representativeness of the scenarios included in the accepted list of BDBA is provided by taking account of the severities of NPP state and potential operability or non-operability states of SS and special hardware for BDBA management.

The information that the final list of BDBA presented in NPP Unit ISAR has been formed considering the following shall be given:

- recommended list of BDBA given in Appendix No.5 to this Safety Guide;

- analysis of failure consequences for the NPP components selected for subsequent detailed analysis;

- operation experience for this NPP Unit and operation experience for similar Units or prototype Units;

- PSA result.

The final list of BDBA shall consider:

- all types of events capable of causing an accident namely: equipment failures, human errors, internal impacts, external impacts of natural and human-induced origin (from the source located both at the NPP site and outside);

- all possible NPP operation states stipulated by the design;

- all possible locations of NM, RS and RW stipulated by the NPP design where accident may occur, including: RP, fuel pool, NF storage, NF locations during transportation;

- representative scenarios of severe accidents (representativeness of several accident scenarios is provided by considering the potential threats of containment integrity, current for the considered NPP Unit, including detonation of hydrogen containing environment, melt-concrete interaction, direct heating of containment, overpressurization of containment and degree of damage severity of the physical barriers).

5.3.2. Analysis of BDBA, management of BDBA

The results of realistic (non-conservative) analysis of BDBA included in the final list of BDBA shall be given. The assessment of the probabilities of the propagation paths and radiological consequences of BDBA for the personnel and public shall be given as part of the analysis results. The dose exposures on the public related to the consequences of BDBA including severe accidents shall be performed for the critical group under least favorable meteorological conditions characteristic for the NPP location region.

The BDBA analysis results given in the NPP Unit ISAR are the basis for development of BDBA management guidelines as well as for planning actions for protection of personnel and public in case of accidents.

The effectiveness of the measures for BDBA management stipulated by the NPP design and limitation of the radiological consequences of BDBA (impacts on personnel and public within the planning area of the protective measures, planning areas of obligatory evacuation measures of the public, and territory on which radiation impact may be possible during BDBA and on which in accordance with the criteria of decision making on compulsory evacuation and restriction of the consumption of contaminated food products stipulated by the current radiation safety standards shall be confirmed based on the BDBA analysis results presented in the NPP Unit ISAR, and measures for protection of the public must be planned.

In case the NPP personnel intervention is needed to bring the NPP into controlled and safe state under the conditions of the considered beyond design basis accident and the analysis results shall be presented both for the scenario disregarding the NPP personnel's actions (in order to determine the main BDBA development stages and available time reserves for the NPP personnel prior to any accident management actions) and results of the analysis with due regard for the NPP personnel's actions in order to confirm efficiency of the accident management measures stipulated by the BDBA management guidelines.

Information on any special-purpose hardware for BDBA management as well as any other engineering features existing at the NPP for BDBA management that have been taken into account in the accident analysis shall be provided. The priorities for use of various systems and equipment for accident management shall be established, and the time required for activation of the above-mentioned engineering features shall be assessed.

The requirements for the actions on BDBA applicable to any physically possible scenario of BDBA shall be formulated following analysis of BDBA.

The scope of information on the NPP state required to control the NPP state and to manage beyond design basis accidents shall be determined, engineering features and methods enabling to obtain this information shall be specified. If direct measurement of the required parameters is impossible the possibility for indirect assessment of the required parameters shall be taken into account, and the methods for such assessment shall be described.

Based on the results of BDBA analysis it is recommended to justify that the measures for management of BDBA presented in the NPP Unit ISAR and provided for in the BDBA management manual provide for attaining objectives of BDBA management: return of NPP to safe controlled state, taking attainable steps for protection of containment, mitigation of radiation consequences of accident (it is allowed to include the specified justified in the NPP Unit ISAR in the form of an individual appendix).

Recommendations for the scope of presentation of the results of BDBA analysis not leading to severe damage of NF, similar to the scope of recommendations presented to analysis of DBA and given in the subsection 5.1.5 of this appendix to the Safety Guide.

5.3.3. PC software used for BDBA analysis

The recommendations for presentation to the NPP Unit ISAR of the description of PC software used for analysis of BDBA are similar to the recommendations given in the sub-section 5.1.6 of this Appendix to the Safety Guide.

6. Chapter 6 "Operation"

The following information shall be given in the chapter 6 of the NPP Unit ISAR, which is confirmed by the possibility of safe operation of the NPP Unit during the addition operation period:

- on operation of NPP Unit including the indicators characterizing the current state of operational safety during operation of the NPP Unit.

- on the possibility of safe operation of NPP Unit during extended service life;

- on the program of confirmation of the safety-critical systems and elements performing their functions;

- on quality assurance activity;

- on accounting of operation experience;

- on environmental impact.

6.1. Arrangement of operation

6.1.1. Organizational pattern and area of responsibility

6.1.1.1. Information on organizational set-up of the operating organization shall be given, including:

- organizational plan of the operating organization showing organization units of the operator intended to perform activities for safe operation of the NPP directly at the NPP site;

- description of the procedure for interaction between organization units of the operating organization performing the activities for assurance of safe NPP operation;

- information on distribution of tasks, functions, authorities and responsibilities among organization units of the operator and also on professional skills of the operator's employees.

6.1.1.2. Information on organizational set-up of the operator shall be given, including:

- NPP organizational plan;

- information on the liability of the relevant organization units of the operator for the NPP safe operation activity and information on supervision of this activity;

- information on distribution of tasks, functions, authorities and duties between the organization units;

- description of the procedure for interaction of the NPP organization units performing the activities aimed to ensure safe operation of the NPP including the units and (or) persons carrying out in-process control of the NPP and the NPP Unit;

- information on distribution of authorities and personal responsibilities of the managers and executives, information on succession of authorities, on transfer of the right for issuance of directives and orders, on responsibility of the NPP management for the safe NPP operation activities.

6.1.2. Personnel

6.1.2.1. Information on the number and list of NPP personnel allowed for non-supervised operation, information on the correspondence of the number and list of personnel to staff schedule shall be presented. Information on the personnel participating only in the operation of the considered NPP unit shall be presented.

6.1.2.2. The following information on the recruitment and training of NPP personnel shall be presented.

- on confirmation of the fact that the NPP (NPP Unit) has been staffed with operational personnel having the required qualification and allowed for non-supervised work in the procedure established by the operating organization. Requirements for the NPP personnel qualification level shall be specified.

- on availability of permits with the NPP personnel for specific types of activity in the field of atomic energy use issued by he authorized state safety regulation agency for using nuclear energy, and on qualification requirements for NPP personnel who does not require specified permits, with provision of information about the supervision over compliance with these requirements from the part of the operating organization;

- on the system of recuritment and training of personnel including the organization of monitoring assurance and improving the level of its qualification, and information about the training department, on the simulator provided for the NPP design other training hardware of the operation personnel, on availability of the relevant schedules and programs and required document. Analysis shall be made to confirm compliance of the training facility with the requirements of FRR as well as with state of the art in science, technology and production.

- on holding periodic class sessions and drill for operations drill during accidents;

- on accounting of any modifications in the documentation of the RP and NPP designers and operation documentation related to the NPP unit as well as consideration of the analysis results for previous errors and erroneous decisions of the operating personnel in the system of recruiting and training of the NPP operating personnel.

6.1.2.3. Information on the established procedure for the NPP personnel health monitoring shall be provided.

6.1.2.4. Information on the formation and support of the safety culture for the operator's and NPP personnel as well as the employees of the organization participating in the works for justification of the possibility of prolonging the NPP life.

6.1.3. Operation documentation

6.1.3.1. Information on the accepted procedure for development and correction of the operation documentation shall be presented. The operation documentation list developed for the NPP shall be given.

6.1.3.2. The following data shall be presented:

- the requirements taken into account in development of the process regulations for the NPP Unit operation, adopted approaches to define their structure and content;

- the requirements taken into account in development of the review and test programs, accepted procedures for determining their structure and content, information on the organizations participating in their development;

- the requirements taken into account in development of the operation instructions of the systems and equipment, adopted approaches to define their structure and content;

- the requirements taken into account in development of the maintenance and repair reviews, adopted procedures for determining their structure and content, information on the organizations participating in their development;

- approaches for development of nuclear hazardous works;

- list of nuclear hazardous works adopted at the NPP Unit with references to the details of the relevant programs under which they are executed;

- information on the procedure for maintaining and storing operation documentation;

6.1.3.3. The requirements taken into account in development of accident-prevention manuals and guidelines including the design basis accident mitigation guidelines and the beyond design basis accident management guidelines (particularly for severe accidents) and approaches to development of their structure and content. Accident management strategies (sequences of actions) provided in the design basis accident mitigation guidelines of DBA and the beyond design basis accident management guidelines (particularly for severe accidents) shall be substantiated.

6.1.4. Organization of technical support,   
 maintenance and repair

6.1.4.1. The following data shall be presented:

- on the organizational units of the operation technical support services, including common-plant (station-wide) engineering and technical division and procurement department, as well as on the interaction procedure of the NPP organization units and organizations carrying out MVTR;

- that the specified organizational units are endowed with all required authorities and provided with funds, materials, equipment and human resources, regulatory documents and scientific and technical support and are responsible for these activities and also carry out supervision over these activities;

- on efficiency of existing organization setup, accounting and analysis system of the causes of failures in equipment operation, operation best practices, improvements of the job and operation instructions on their basis, NPP retrofitting and upgrade plans;

- on system of repair personnel training and advanced training.

6.1.4.2. Information on MVTR system of the NPP systems and components, as well as information on planning and holding of MVTR, performing post-repair tests and verifications, quality assurance in performing MVTR, safety assurance, documentation of MVTR results shall be given.

How the operation experience of the NPP Units has been accounted and recommendations of the manufacturers shall be specified in making the plans of periodic MVTR of the NPP systems and elements.

Information on the conditions of verifications of safety-critical elements and systems after MVTR shall be presented.

Information on performing systematic assessment an use of work experience in functioning of the MVTR system.

6.1.4.3. Brief information on procurement, operation and maintenance of the NPP Unit, and on the availability of relevant control facilities, repair tooling, interchangeable equipment and materials, spare parts shall be given.

6.1.5. Organization of radiation protection

6.1.5.1. Information on compliance with the requirements of the Russian Federation law, FRR and other regulatory legal acts (including Sanitary Rules and Regulations) for organizing radiological safety assurance during normal operation and during accidents shall be given.

6.1.5.2. Information about the organization set-up and tasks of the NPP divisions assuring radiation safety shall be given. Information on qualification and experience of the personnel, its authorities and responsibility for radiological safety assurance, and control procedure for handling NM, RS (including in the form of closed and open radionuclide sources) and RW shall be presented.

Information on the service on which the liability for performing radiological control, its strength, structure stipulated in the procedure of interaction of the NPP Unit divisions forming part of it with each other, and with other divisions of the NPP Unit and NPP overall shall be given. Information on any provided mobile units equipped with the hardware enabling to obtain information on radioactive contamination both under normal operation conditions and in case of any abnormal operation including accidents shall be presented.

6.1.5.3. Information (or reference to other chapters and appendices of NPP Unit ISAR, where such information is presented) about the organization of radiological control of the radiation situation in the rooms, at NPP production site, in SPZ and supervised area of the NPP, and on individual monitoring including the system of gathering, analysis, presentation, documenting and storage of data on radiation situation and results of individual monitoring shall be given.

The following information shall be presented:

- on any technical and administrative measures aimed to control the personnel stay in the controlled access area and compliance with the guidelines for performance of radiation-hazardous works;

- on classification of the rooms by degree of potential radiation impact on the personnel specifying and justifying the categories of rooms, their data sheet, organization of personnel access;

- on the quality, nomenclature and basic technical characteristics (ranges of measurements, reliability indices, accuracy, maximum permissible error) of permanent, transferable and portable radiometric and dosimetric devices, including individual monitoring hardware both for the normal operation modes and for accidents;

- on the scope of radiological control (type and periodicity) in the rooms and at the NPP Unit site, radiological control over the environment state in SPZ and supervised area, monitoring the discharges and releases of RS to the environment, monitoring radiation characteristics of RW. Including information on the locations of permanent gauges of radiological control facilities shall be given. The stipulated scope, methods and radiological control facilities provide measurement of the values of controlled parameters characterizing the radiation situation considering the range of parameter changes, as well as the basic technical characteristics of radiation situation monitoring facilities including the justification of the arrangement of permanent radiological monitoring posts at SPZ and the supervised area shall be justified;

- on methodological support used for radiological control assurance, operation documentation where the volume, methods and means of radiological control are defined;

- on the storage conditions for radiological monitoring instruments, their calibration and metrological certification;

- on the procedure and retention periods of the radiological control results

- on how the authorities for state regulation of safety in atomic energy use are informed about the results of any works for radiation safety assurance.

6.1.5.4. Information shall be provided to confirm that the requirements aimed to reduce occupational exposure doses to the minimum achievable level with due regard for economic and social factors are taken into account in arrangement of operation.

Information about the assessment shall be given:

- duration (within a year) of the personnel stay (specifying the number of people and their stay duration) in the controlled access area rooms under normal NPP operation conditions, in transient modes of the NPP and in the course of repair works. Duration of the personnel stay (in man-hours) and the value of RS ingress into the human organism due to inhalation shall be given for the controlled access area rooms where gas and aerosol activity is expected.

- annual individual human exposure dose (total and separately external and internal exposure) and dose consumptions of personnel (collective dose) during normal operation, maintenance, operation control and investigation of welded joints, RW handling, reactor core refueling, repair works and information on assessment of the human exposure doses during DBA with reference to the chapter 5 of NPP Unit ISAR;

- public exposure doses at all normal operation modes of NPP, DBA and BDBA including information on source data, procedures and PC software used for assessment of the public exposure dose.

6.1.6. Organization of fire protection

6.1.6.1. Information on the organizational set-up of the operating organization and its efficiency, ensuring safe operation of NPP with respect to the issues of due management of fire protection and functioning of organization units for fire safety assurance at NPP.

6.1.6.2. Information on organizational and engineering measures for fire protection assurance including the following information shall be given:

- about the development of operation instructions for the fire protection systems and elements;

- on operability support of the fire protection systems and elements (maintenance, repair, tests, verifications):

- on development of instructions about fire safety measures, fire suppression plans and evacuation of personnel during fire;

- on training and duties of operational personnel for fire safety assurance;

- on justification of the sufficiency of available personal protection equipment;

- on functioning of NPP fire department, its organization and interaction structure in the event of fire, including the procedure for engaging additional forces and means in radiation accident conditions;

- on the events related to fire during NPP Unit operation, on analysis of erroneous personnel actions during fire, on the resultls of fire drill and trainings for suppressing fires including in conditions of radiation accidents, changes in the drill and training programs.

6.1.7. Measures for protection of personnel and public during accidents

6.1.7.1. Information shall be presented on any planned and implemented administrative and technical measures for protection of the NPP personnel and the public in case of any accident at the NPP (NPP unit, several NPP units, any other nuclear facilities located at the NPP site). A description of the plans of actions for protection of personnel and measures for protection of personnel in case of accident at the NPP shall be given; in addition the dimensions and boundaries shall be specified:

- protection arrangements planning areas;

- compulsory population evacuation measures planning zone;

- distances at which radiation impact are possible during BDBA and within the limits thereof the public protection measures in accordance with the criteria of taking decisions on compulsory evacuation and restriction of the consumption of contaminated food products established by the current radiation safety standards

Information shall be presented on the accident scenarios based thereof action plans have been developed for protection of personnel and public shall be presented; specify the types and quantity of RS which enter the NPP room and environment during the considered accident scenarios, time of access and stay of people in the NPP rooms and at the NPP site, radiation impact paths on the personnel and public, characteristics of radiation releases and exposure of people.

Information shall be given considering the concept presented in the chapter 2 of the NPP unit ISAR.

6.1.7.2. The following data shall be presented:

- on the scope of protective measures in the event of accident, including measures for preventing and reducing RS output to the environment and organization of intense dosimetry control, on the methods and means used for notification of personnel and public for implementing the protective measures of personnel and population;

- on the organizational plan designed for emergency response, on distribution of duties and on the procedure of interaction of the employees (officials) of this structure;

- information on the persons responsible for coordination of activities with the external organizations, notification about the accidents and enforcement of the plan of actions for protection of personnel and public in the event of accident. Information shall be given on the quantity, qualification, psycho-physiological preparation and health of these persons;

- on the procedure of public notification and organizational measures in the event of accidents, including coordination of the actions of NPP and external organizations, law enforcement agencies, state fire service, control bodies in protection of population and territories against emergencies, medical institutions, local government bodies within the site and planning area of protective measures and plant and territorial forces of the emergency bodies of the constituent entities of the Russian Federation and local government bodies, ministries and departments participating in the implementation of measures for protection of the public and in emergency recovery;

- on protected emergency response control post located at the NPP site, and outside the NPP site including information on the functions performed by them, on their instrumentation and furnishing with communication means and their information support including the results of radiation monitoring and intelligence;

- furnishing MCR, ECR, shelters for NPP personnel and protected emergency response control posts at the NPP territory with air regeneration equipment and iodine sorbents;

- on the evacuation paths, places of gathering and rendering first-aid, shelters for operation personnel, military and fire brigade personnel, deputed personnel and other personnel carrying out vital activity at the NPP, on special transport with leak-tight cabins equipped with removable filtering and ventilation units and designed for transportation of people and delivery of food products, fallout shelter for the personnel and members of their families in the on-site population centers;

- on the arrangements aimed to ensure preparedness of the main and back-up evacuation routes and places (provision of the required amount of medicines, personal protection equipment, the required quantity and quality of the transportation routes (roads), control of the exposure dose levels for people and radiation contamination of the environment and food products);

- on availability of the reserve of devices, equipment, personal protection equipment (including medicaments) and other materials required for relief;

- on the system of formation of special emergency divisions, their training and periodic readiness inspection for actions during emergencies.

6.1.8. NPP physical protection

6.1.8.1. Information on the scope and architecture of NPP physical protection system in general and NPP Unit, on the implemented organizational and technical measures of physical protection in accordance with the requirements to the scope and functioning, including about the security measures of the nuclear facility and operation of PP engineering and technical means shall be presented. Information on confirmation of PP system compliance to the requirements FRR for efficiency of preventing implementation of the design threat of the impact of potential trespassers at the NPP.

6.1.8.2. The information about the physical protection system presented in the NPP Unit ISAR shall be given only in general form without disclosure of information about locations of PP objects, PP system forces and means, protected areas, security gatehouses, PP system control units, on the characteristics and functioning modes of PP engineering and technical means, on training and actions of PP personnel, on protection of information in the PP system, on the scope, deployment and organizing actions of the security forces.

A detailed description of the scope, arrangement of constitutive parts and elements and functioning of the physical protection system of the NPP unit in accordance with its design may be presented in an individual document with restricted access.

6.1.9. NM record and control

Information on the system providing NM record and control and justifications of its compliance with the requirements of the FRR in force.

6.1.10. Record and monitoring of radioactive substances and radioactive wastes

Information on the system ensuring record and control of RS and RW, and justification of its compliance with the requirements of FRR in force shall be presented.

6.2. Quality assurance

Information on quality assurance of all the works and services impacting NPP unit safety (information is presented applicable to the NPP Unit considered) shall be presented.

6.2.1. General provisions

The following information shall be presented:

- on the quality policy adopted by the operator;

- on the quality management system in force including its structure, list of basic documents on quality management system including information on the QAP content and execution specifying the description and details of the current quality assurance programs;

- on main functional obligations, authorities, liability and organization of interaction of the official (divisions) of the operator, managing the development and implementation of QAP and monitoring the performance and assessing the effectiveness of executing the quality assurance program, and on distribution of the liability of the persons (divisions) performing works and performing their quality control.

6.2.1.1. Documentation management

The following data shall be presented:

- on the list of regulatory and technical documents effective in the operating organization and applied to carry out any activities related to quality assurance;

- on any procedures effective in the operating organization for development, coordination, approval, entry into force, identification, modification, revision, distribution, storage and destruction of expired documents.

6.2.1.2. Design (engineering) control

The following data shall be presented:

- description of the measures (procedures) planned and implemented by the operating organization for control of designing (engineering) of the NPP buildings, structures and safety-critical systems (elements) which stipulates the validity check of the justification of decisions taken, and their conformance to the design requirements (when constructing new NPP buildings, structures and safety-critical systems (elements) at the operating NPP Unit;

- availability and performance of the procedure for control of any amendments to the design and engineering documentation as well as modifications of the NPP buildings, structures and safety-related systems (components) (in the course of their design, manufacturing, installation, repair, refurbishment, retrofitting and replacement including due to reduction in compliance with the requirements of FRR.

6.2.2. Procurement management with regard to equipment,   
components, materials, semi-finished products, documents and  
 software, as well as services rendered.

Information on the following effective procedures shall be provided:

- procurement arrangement with regard to equipment, components, materials, semi-finished products and software as well as provision of services, selection of organizations performing works and rendering services to the operator;

- identification, assurance of control and testing completeness, traceability of the control and testing results for the purchased equipment, components, materials, semi-finished products, documents and PC software;

- storage, transportation, preservation, packaging of equipment, components, materials and semi-finished products;

- organization of control over compliance with the requirements for the rendered services and their acceptance.

6.2.3. Production activities

The description of the planning procedures, monitoring the main production processes, performed during activity on which the current QAP are applicable, including the description of the procedures in force at the operating organization, providing the conduct (in accordance with the stipulated schedules and criteria) of tests, technical control,, operational control of metal and checks of the safety-critical NPP systems (elements).

6.2.4. Metrological support

Information shall be presented on the metrological support of the NPP Unit including information on organization of accounting, verification (calibration), certification and identification of the measuring instruments and testing equipment, and record and certification of the procedures (methods) of performing measurements.

6.2.5. Quality assurance software   
for PC and calculation procedures

Information on quality assurance programs for PC and calculation procedures shall be given.

6.2.6. Reliability assurance

The following information on reliability assurance shall be given:

- on the procedures effective in the operating organization which shall ensure reliability and control of compliance of the reliability indicators with the requirements set for safety-related systems (components) of the NPP Unit within their operating lifetime (with due regard for the extended operating lifetime);

- on the system for collection, registration, processing, accumulation, storage, analysis and distribution of information on reliability of safety-related systems (components) to the concerned organizations performing works and (or) rendering services to the operating organization.

6.2.7. Nonconformity management

Information on the current procedures providing the following shall be given:

- detection and registration of any deviations from the requirements for quality of works (services) and (or) equipment (design or manufacturing errors, defects and failures of equipment, abnormal operation modes, human errors);

- determination and analysis of causes of the detected non-conformities (with due regard for impact of non-conformities on the NPP safety);

- prevention of usage of any products that do not comply with the established requirements (procedure for identification, exemption, disposal, documenting of such products) or acceptance of any works and (or) services that do not comply with the established requirements;

- arrangement of the system for collection and processing of data on any detected non-conformities, violations, defects, their causes and adopted remedies;

- development, performance and control of implementation of the corrective measures aimed to prevent recurrent non-conformities and preventive actions and also analysis of their efficiency;

- notification of the management at the relevant level and management of the concerned organizations on any detected nonconformities and implemented corrective and preventive actions.

Information shall be provided on any cases of decisions on detected non-conformities registered as in the design operation life period with analysis of their causes, implemented corrective and preventive measures with account of their efficiency analysis as well as analysis results for any tendencies in changes of the causes and nature of non-conformities.

6.2.8. Verifications

Information shall be presented on any procedures effective in the operating organization in order to carry out and record the results of independent inspections (audits) for the general and individual NPP QAPs containing criteria for their efficiency assessment.

Information on the results of inspections and implementation efficiency assessment for the general and individual NPP QAPs in design operation life period shall be provided with indication of the developed corrective and preventive actions.

6.3. Analysis and implementation of operating experience

Information on carrying out activity at NPP for analysis of the operation experience for record of the lessons learned from the events (including failures, defects, damages of equipment and piping of the safety-related system, non-conformities including accidents) which took place at the considered NPP unit and events which took place at other similar type NPP units, as well as in the nuclear industry and other industries in the Russian Federation, and use of the results of this activity for improving the operation conditions of equipment (elements) and safety assurance of technological and production process in the additional operation life period.

Information on use of the results of analysis for enhancement of NPP unit safety shall be given.

6.3.1.   
Operation data gathering, processing and accounting system

6.3.1.1. Information on the gathering, processing, analysis, systematization and storage of operation data (including malfunctions in the NPP unit) with assessment of its completeness and efficiency shall be given.

6.3.1.2. The following information shall be presented:

- about the requirements, principles and approaches to collection, processing and accounting of operation data and about the divisions and positions of operator persons liable for performing the specified activity;

- on the procedures, in accordance thereof the deviations from the safe operation limits and conditions are recorded, and the erroneous actions of the NPP personnel and failures of safety-critical system elements, and assuring transfer of this information to all the concerned organizations;

- on documenting and storage of collected data and results of their analysis including storage periods;

- on investigation into NPP operational occurrences and deviations;

- on the procedure of providing information about the NPP safety assessment considering information on NPP malfunctioning to the state safety control body for nuclear energy use;

- on analysis of operational data and accounting of operation experience at the NPP (own, other NPP);

- on development and performing corrective actions directed at accounting of the operation experience and prevention of repeated disturbances in NPP operation.

6.3.1.3. Information on the methods detection, analysis and record of events being indications of severe accidents.

6.3.1.4. Information on the availability of an accounting program of operation experience at the NPP specifying information on the content and periodic assessment of the program for its improvement (record of new information on operation experience, and on performing R&D and development works, the necessity thereof is determined by the modernization and new requirements of FRR).

6.3.2. Operability test and state monitoring of the systems   
and elements, safety-critical buildings and structures

6.3.2.1. The approaches and requirements for operability test and systems and elements, safety-critical buildings and structures, status assurance at the NPP unit, the methods and techniques of control shall be given. If required to make references to other sections of the chapter 6 of NPP unit ISAR with respect to MVTR).

Information on the control of systems and elements, NPP buildings and structures performed for assuring their operability during the additional operational life (repeated additional operational life) of the NPP shall be given.

6.3.2.2. The results of analysis of the periodic operability testing and state control of the systems and elements, safety-critical buildings and structures including the assessment of their life exhaustion

Detailed information on analysis of test results shall be given:

- elements, the service life thereof has not reached the end, but replacement thereof is required in the designated or additional operating life of the NPP Unit;

- components, the residual service life thereof has not been determined and for which the determination of the residual life or replacement shall be required;

- non-interchangeabel elements;

- load bearing structures of the buildings and constructions where the NPP Unit systems and elements are located, as well as the bases of buildings and structures.

6.3.2.3. Data on operability testing and verification of the operability of the systems and elements, buildings and constructions including safety parameters in the scope.

- generalized estimator of the results of tests and control of the values of parameters provided, which confirm the operability of the systems;

- basic deviations from the available test programs specifying the reasons and actions for compensation of these deviations.

6.3.2.4. The following data shall be presented:

- condition in which the following are present viz. the systems, elements, buildings and structures which impact on the operation (including the environmental conditions, access possibility and performance of maintenance, impact of chemical media on deactivation.

- comparison of these conditions with the design requirements;

- influence of deviations from the design for equipment and system operation;

- basic data on the state of equipment and systems obtained from the inspections of NPP by then committee, both at the plant stage and at the external organizations;

- data on equipment and system wear;

- summarized results of maintenance and repair;

- information on maintenance of operation documentation on the equipment and system;

- information on control of materials by non-destructive testing (test concept);

- information on status monitoring of the buildings and building structures, including about organization of monitoring of safety-critical NPP buildings and structures with information for the monitoring systems used for this purpose.

The references to other sections of NPP unit ISAR, where detailed information for the specified issues are given, shall be allowed instead of giving the specifying information.

6.3.2.5. The analysis of impact on safety of the detected shortcomings and deviations following monitoring shall be given specifying if required compensatory measures.

6.3.3. State analysis of the life of safety critical systems, elements, buildings   
 and constructions

6.3.3.1. Information on life management of the safety-critical systems, elements, buildings and constructions during the additional operation life (repeated operation life) shall be given. Information on the approaches and methods for organizing life management activity shall be given, description of the information on used regulatory base adopted at the NPP unit reliability monitoring and life characteristics management systems.

6.3.3.2. Information on the life management programs of the civil structures, buildings, structures, systems and elements of the NPP unit in the additional operation life period (repeated additional life period), its update following the works performed for prolongation of the NPP unit operation period and considering the planned actions for replacement and/or modernization of the NPP unit systems and elements.

Information on the measures for state monitoring of the building constructions, buildings, structures and their foundations as well as the NPP unit systems and components in the period of additional operating life shall be given.

6.3.3.3. Information on integrated survey of the NPP unit, its performance procedure including information on the integrated survey program and results obtained.

6.3.3.4. The list of non-interchangeable elements of NPP unit with justification of the classification these elements as interchangeable shall be given.

6.3.3.5. Information on the results of justification of the life of systems and elements, safety-critical buildings and structures, and about the documented solutions on prolongation of the life of these elements (references may be given to the relevant documented information presented in the chapter 4 of Appendix 1 and 2 to NPP unit ISAR). The specified information shall be updated following periodic assessments of the residual life of the NPP elements at the prolonged life stage.

6.3.4. Analysis of disturbances during NPP unit operation

6.3.4.1. Information on analysis of violations that took place at the NPP unit including accidents and occurrences. Procedure and approaches for accounting of the analysis of violations are given in the subsection 6.3.1 of NPP Unit ISAR.

6.3.4.2. The following information shall be given on the NPP operational occurrences that took place:

- description of the occurrence and its category;

- analysis of the reasons and consequences of non-conformity, assessment of their impact on safety;

- operational state wherein the disturbance occurred;

- information on documentation of the violation and sending of information to the state safety regulation authority for nuclear energy use and authorized control authority for nuclear energy use;

- results of occurrences investigations;

- corrective and compensatory measures for preventing repeat of the occurence, their implementation periods and information on their implementation (references to the chapter 7 of NPP Unit ISAR may be presented).

The following shall be highlighted when describing:

- occurrences, the reasons thereof are damages or failures of equipment elements, systems and civil structures following shortcomings of the project, design, quality of maintenance and repair;

- occurrences which take place due to personnel errors (violations of operational instructions, shortcomings and errors in the operational instructions).

6.3.4.3. Information on analysis and record of the failures, defects, damages of the safety-critical equipment and piping not being violations.

6.3.4.4. Data on the number of identified non-conformities, defects, failures shall be specified. Comparative analysis of the identified non-conformities, defects, failures at the considered NPP Unit and NPP Units with similar type RP shall be presented. Information on the dynamics of the number of disturbances shall be provided, give analysis of the reasons of growth (decrease) of the total number of disturbances.

6.3.5. Efficiency assessment of the protective barrier   
and reliability of safety systems

Information on efficiency assessment of the physical barriers and reliability of SS, on readiness of SS to performing its functions shall be given. Assessment of the impact of failures on the safety of NPP unit shall be presented.

6.3.6. Operational experience consideration

Information on the technical and organizational measures, implemented and planned a the NPP unit for accounting operation experience of the considered NPP unit or other units especially similar type NPP units and at the foreign NPP units.

6.4. Assessment of impact on the environment and the public

6.4.1. Information on assessment of the NPP impact on the environment and the public (chemical impact, radiation exposure, thermal pollution, electromagnetic and acoustic impacts) during operation shall be presented.

6.4.2. The following information shall be presented:

- background state of the environmental components in the NPP location area and at the NPP site: natural radioactivity, contamination with man-made radionuclides and (chemical) pollutants;

- the main migration paths of (chemical) pollutants and radionuclides in natural media;

- the main migration paths of (chemical) pollutants and radionuclides via agricultural products;

critical paths of ingress of radioactive and chemical substances into the human organism;

- radiological load on the site before the start of NPP operation;

- on releases of RS with air through organized and unorganized sources;

- on discharges of RS with effluents;

- on calculation methods of the RS releases to the atmospheric air including information on approval of these procedures by the state safety regulatory authority for nuclear energy use;

- on target emissions and releases of RS to the environment for individual sources and radionuclides;

- on maximum permissible emission limits, and details of documents establishing permits for RS discharges and releases to the atmosphere;

- on RW accumulated at the NPP site with segregation by classes established in accordance with the Russian Federation Government Decree No. 1069 dated October 19, 2012 "On criteria for attribution of solid, liquid and gaseous wastes to radioactive wastes, criteria for attribution of radioactive wastes to special radioactive wastes and to disposable radioactive wastes and criteria for classification of disposable radioactive wastes" (Collected Acts of the Russian Federation, 2012, N 44, art, 6017; 2015, N 6, art. 974) specifying the following for each RW class:

a) sources of generation of RW included in a given class;

b) morphological composition of RW;

c) categories of RW established in accordance with the sanitary rules and standards SP 2.6.1.2612-10 "Basic sanitary rules of radiation safety assurance (OSPORB-99/2010)" approved by the Resolution of the Chief Health Inspector of the Russian Federation No. 40 dated April 26, 2010 (registered by Ministry of Justice of the Russian Federation on August 11, 2010, registration number No. 18115).

d) RW volumes and weight;

e) volumetric and specific activities of radionuclides included in RW;

- on immediate (direct) exposure;

- on heat transfer to air and effluents (information on impact of cooling towers if available);

- on noise impact;

- on chemical discharges and wastes;

- on mpact on ground water;

- on other impacts.

6.4.3. The assessment of the actual loads from impact on the environment shall be given based on data of measurements made in preparation of the NPP unit for prolonging the operating life. The analysis of changes of the values with time, their comparison with the design data and forecast of their change for the additional operation life period shall be presented.

Results of the NPP environmental impact assessment at the operation stage with regard to radiation (potential consequences for the public and ecosystems in case of any RS releases into the atmosphere, discharges of RS into surface and ground water) and non-radiation factors (releases and discharges of chemical substances, acoustic and thermal impacts);

When assessing the dose loads on the public caused by NPP activity, it shall be shown how the following public exposure paths were considered:

- from radioactive cloud;

- from contaminated fallouts of radionuclides on earth surface;

- due to inhalation of radionuclides;

- due to consumption of radionuclide contaminated products of local agriculture production.

6.4.4. Information on the measures aimed to prevent and (or) reduce any potential adverse impact of the NPP on the environment shall be specified

7. Chapter 7 "Planning of further   
safety enhancement measures";

7.1. The description of the concept of further safety enhancement of the NPP unit shall be given in the chapter 7 of NPP unit ISAR.

7.2. Information on technical and organizational measures planned by the operating organization for further enhancement of the safety of NPP Unit, and for rectification of the non-conformities to the requirements of the applicable normative documents specified in the conformity analysis of NPP Unit to the requirements of the effective normative documents.

It is recommended to provide the following data for each event:

- serial number of the arrangement;

- brief account of the arrangement;

- reasons causing the expediency of implementing the actions (for actions implemented for rectification or compensation of the non-conformities to the requirements of applicable regulations shall be presented in the link to the specific non-conformity analysis items);

- safety function, which shall be improved when implementing this measure;

- assessment of the fact that this action shall not have negative impact on other safety functions and on the safety of NPP in general;

- timing of arrangements;

7.3. Information on executed activities shall not be excluded from the chapter 7. The reference to the NPP Unit ISAR section where detailed information on the action performed has been presented shall be given when implementing the actions at the NPP Unit as confirmation in the chapter 7 (in the table, where the time frames of the action were specified).

7.4. On postponement of the action implementation deadlines related to rectification of the non-conformities to the requirements of applicable regulatory documents and/or identified shortcomings in the part of safety justification of the NPP Unit, safety justification of the NPP Unit shall be given considering the postponement of the deadlines.

8. Chapter 8 Integrated NPP Unit safety assessment

8.1. Considering the justifications presented in the chapters and appendices of NPP Unit ISAR the conclusion on safety assurance of the NPP Unit during the additional operation life (repeat additional operation life) shall be formulated in the chapter 9 of the NPP Unit ISAR.

8.2. Information on the results of integrated survey of the NPP systems and elements shall be presented in general form.

8.3. The conclusions on performance of NPP Unit operation possibility criteria in the additional operation life shall be given and which are presented in the item 15 of NP-017-18.

8.4. The conclusion made earlier during the development of NPP Unit ISAR on NPP Unit safety assurance shall be confirmed following periodical safety assessment considering the corrected and updated justification presented in the chapters and appendices of the NPP Unit ISAR. Information on improvement or impairment of te safety level as compared to the earlier achieved level shall be given.

9. Chapter 9 Decommissioning

9.1. The concept of decommissioning the NPP Unit developed in accordance with the requirements of the Federal Rules and Regulations in the field of atomic energy use "Rules for safety assurance during decommissioning of the nuclear power plant Unit" (NP-012-16) approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 5 dated January 10, 2017 (registered by the Ministry of Justice on February 22, 2017, registration No 45740).

9.2. The following information shall be presented:

- description and comparison of the potential NPP Unit decommissioning options with indication of the radiation situation forecast at the NPP Unit, expected end states after the NPP Unit decommissioning;

- NPP Unit decommissioning option selected by the operator, criteria and substantiation of its selection.

9.3. The following shall be specified for the selected decommissioning option of the NPP Unit:

- operating configuration of NPP Unit shutdown for decommissioning;

- assessment of the total quantity (volume and activity), type, category and classes of radioactive wastes generated during NPP Unit decommissioning;

- prediction of the discharges and releases of RS to the environment on decommissioning as well as assessment of the public exposure doses caused by the discharges and releases of RS during decommissioning;

- the list, description and approximate schedule of implementation of the activities on pre-decommissioning and decommissioning of the NPP Unit;

- conditions, whereby a review (elaboration) of the decommissioning concept of the NPP Unit must be made in order to maintain relevance of the Concept.

9.4. Information on the planned technical and organizational measures directed at safety assurance of NPP Unit decommissioning including information on radiation safety assurance of NPP personnel, publoc and protection of environment (after removal of NF) at all the decommisioning stages of the NPP Unit.

9.5. Information on organizing collection and storage of information important for safety assurance during decommissioning of the NPP Unit in the scope required to develop the decommissioning program of the NPP Unit and decommissioning design of the NPP Unit. Information on the database monitoring procedure for decommissioning of the NPP Unit including periodicity of its update, scope of information stored in it, including information on the list of stored design, operation and process documentation of the NPP unit defined by the operating organization.

9.6. Justification shall be presented that the residual life of non-interchangeable elements of the NPP unit used during NPP decommissioning is sufficient for providing NPP decommissioning.

10. Appendix 1   
Safety case materials of NPP unit

10.1. NPP safety case

10.1.1. The existing safety case materials of the considered NPP Unit (including NPP safety case and/or RP safety case)shall be presented as materials safety case materials based thereof the NPP Unit is (was) operated in the operation life period assigned by the design. The safety case materials approved by the operator shall be included.

For the NPP Units having received license for operation in the period of additional operation life (repeat additional operation life), NPP safety case (included in the Appendix 1 to NPP Unit ISAR) shall not be subject to obligatory correction. In addition, if the NPP Units, the operation licenses thereof during the additional operation life period (repeat additional operation life period) were issued before the effective date of this Safety Guide, and above mentioned safety cases are not present, it is allowed to include the relevant information in the current NPP Unit ISAR.

10.1.3. Information on the NPP Unit ISAR in force at the first additional operation life shall be given in this section if a new NPP Unit ISAR is developed for getting the license for the repeat additional operation life.

10.2. Analysis of non-compliances of the NPP Unit with the requirements of   
the regulatory documents in force.

A list of the non-compliances with the requirements of regulatory documents available at the NPP Unit (or NPP in general, if these non-compliances are plantwide), content of these non-compliances, assessment of their influence on NPP safety and compensatory measures shall be presented.

A reference shall be given to the sections (sub-sections, items, sub-items), chapters and appendices of the NPP Unit ISAR, where their detailed description is given.

Information on the planned technical and organizational measures directed at remedial actions shall be given in the chapter 7 of NPP Unit ISAR.

10.3. Reactor plant equipment life justification materials

10.3.1. The results of justification of the RP equipment residual life, including RP equipment fastening elements shall be presented. Moreover, information on accounting of the degradation mechanisms of materials in justification of life shall be presented.

10.3.2. The following information shall be presented:

- list of operation modes and accepted rated number of loading cycles for these regimes for the entire operation life and for the additional operation life, data on accounting of neutron fluene and exposure temperature, on equipment power operation time;

- on input data taken for justification of the life, including information on the materials out of which the equipment is manufactured, and their properties specifying the documented sources based thereof these data have been taken;

- on the design justifications made and PC software used for their execution.

- residual life value specifying its exhaustion time.

10.3.3. Information on probabilistic analysis of reactor vessel structural failure shall be presented.

10.3.4. Information on the periodicity of studies of the actual physical and mechanical characteristics of graphite and measurements of graphite columns and about the results of these studies shall be presented for the RBMK and EGP-6 type reactors.

10.4. Materials for justification of residual life of the safety-critical buildings   
and structures of the NPP Unit, including   
building structures

10.4.1. Information on justification of the residual life of buildings and structures shall presented.

10.4.2. The following data shall be presented:

- assessment of the technical condition categories of the constructions, buildings, structures and their foundations;

- information on the results of surveys of the buildings and structures including information on revealed defects of the civil structures;

- information on the checking calculation made of the buildings and structures;

- information on the measurement procedures, testing and control facilities, measuring instruments used in condition surveys of the buildings and structures.

The justification of additional (repeat additional) operating life of the building constructions, buildings and structures of the NPP Unit and their foundations shall be presented considering the most unfavorable combination of all types of loads corresponding to the functional purpose and design solution of the buildings or constructions for which their mechanical safety must be provided.

11. Appendix 2 Materials for additional safety   
 justification of the NPP Unit

11.1. Materials for additional safety   
 justification of the NPP Unit

11.1.1. Information on the additional justifications of safety of the NPP Unit (reference thereof is presented in the chapters of NPP Unit ISAR) made both under the preparation for prolonging the operation life and in the process of NPP Unit operation during the additional life.

11.1.2. Information on additional safety justifications of the NPP Unit shall be given considering the recommendations of items 10 and 11 of this Safety Guide.

11.2. Analysis of design basis accidents

The detailed results of analysis for all the operational occurrences, including DBA, which were included in the final list of IE given in the section 5.1 of chapter 5 of the NPP Unit shall be presented. Besides the approach to perform safety analysis of the operational occurrences including DBA and scope of presentation of the results of analysis conforming to the recommendations given in the section 5.1 of this Appendix to the Safety Guide is used.

The results of analysis of the operational occurrences including design-basis accidents shall be presented in the Appendix 2 to the NPP Unit ISAR considering all the changes and modifications made to the design of the NPP Unit and considering the current status of the NPP Unit.

12. Appendix 3 Probabilistic safety assessment

The probabilistic safety assessment developed in compliance with the requirements of the Federal Rules and Regulations in the field of atomic energy use "Basic requirements to the probabilistic safety analysis of a nuclear power plant" (NP-095-15) approved by the order of the Federal Environmental, Industrial and Nuclear Supervision Service No. 311 dated August 12, 2015 (registered by the Ministry of Justice of the Russian Federation on September 4, 2015, registration No. 38807) and considering the safety guide in the use of atomic energy, which contain the recommendations for PSA.

13. Appendix 4 Analysis of beyond design basis accidents.

The detailed results of analysis for all the BDBA scenarios including severe accidents which was included in the final list of BDBA presented in the chapter 5 of the NPP Unit ISAR shall be presented in the Appendix 4 to the NPP Unit ISAR.

Approach to performing analysis of BDBA and scope of presentation of results of the analysis shall be taken in accordance with the recommendations given in the section 5.3 of this Appendix to the Safety Guide.

Appendix No. 3   
to the safety guide  
in the use of atomic energy   
"Recommendations for the contents of the report   
on in-depth safety assessment   
of active NPP power   
units", approved by the order of   
the Federal Environmental, Industrial and   
Nuclear Supervision Service   
dated \_\_\_\_ \_\_\_\_\_\_\_\_\_\_ 20\_\_ No. \_\_\_\_\_

STANDARD STRUCTURE FOR DESCRIPTION OF SYSTEMS IN THE NPP ISAR

Particular content structure of description of the system may change depending on the system peculiarities. Individual sections may be omitted or supplemented with other ones if it is determined by the system peculiarities. This standard structure shall be use in describing individual buildings and structures in the NPP Unit ISAR and large elements (equipment) of the NPP Unit for example, the turbine unit.

1. Purpose and design basis

The following data shall be presented:

- system designation and description of functions and reference to the classification given in the section 4.01 of NPP Unit ISAR.

- list of regulatory documents based thereof the in-depth safety assessment of the system was made;

- principles and criteria used as the basis for the system design including the requirements from the RP;

- modes of normal operation, abnormal operation including accidents (lists of initiating events for accidents, failures, external impacts, human errors and combinations of the above-mentioned events) when operation of the system is required; in case of special-purpose hardware for BDBA management the list of beyond design basis accidents requiring operation of this hardware shall be provided;

- maximum values of loads on system elements on normal operation and its disturbances including accidents, and during external impacts (characteristic for the NPP site) whereby the operation of this system is required;

- information on coupled systems;

- requirements for the system reliability indicators (if any);

Information on execution of the following principles embedded in the system design:

- compliance with the single failure principle for safety functions performed by the system under consideration (for safety systems);

- redundancy assurance (information on redundancy of individual system components (performing the same function irrespective of the requirements related to compliance with the single failure criterion) adopted in the design in order to enhance reliability of the system shall be specified);

- diversity assurance (it shall be specified how the diversity principle is implemented in the design of systems and components in order to prevent common cause failures);

- independence assurance (it shall be specified how functional and (or) physical separation of the system channels (components) is arranged so that a failure of any channel (components) would not result in a failure of any other channel (components));

- exception (accounting) of the common-cause failure (for SS and special technical devices for accident accidents);

- principle of actuation for safety systems (if actuation is not performed automatically the relevant substantiation shall be provided); algorithm for resetting of safety systems;

- in case safety-related systems combine safety functions with normal operation functions it shall be substantiated that it does not result in any violation of the requirements for the NPP safety assurance and reduction of required reliability for systems (components) performing safety functions.

2. Description of the design of system, construction   
 and arrangement of its elements

The following data shall be presented:

- description of the design and layout of the system generally including its process (electric) diagrams and channels, elements, constructions, supports catch arrangements, foundations included in its scope (for the buildings and structures their descriptioon is given);

- list of elements in included in the system scope specifying their design notation. Descriptions of individual elements performing independent functions as part of the system shall be given (if required) on such a structure as the description of the system in general;

- basic technical characteristics of the systems and elements;

- detailed drawings and schemes illustrating the design and operation of the system and its elements, its spatial layout and interfaces with other NPP Unit systems. The adopted coding of the system and its elements (drawing and diagrams shall be given in the scale allowing without difficulty read the station labels (coding) of the elements);

- justification of the classification assigned to the element Justification shall also be made that the failure of elements shall not lead to failure of elements of a higher safety class and/or seismic category;

- information on system layout and its elements;

- measures for accounting own weight loads, seismic impacts, temperature expansion in all the regimes considered by the design, and against the external and internal impacts considered in the design;

- information on the ambient conditions in the rooms where these elements are located in different NPP Unit operation modes;

- measures provided in the design for the system protection against external impacts as well as against internal impacts in case of any accidents;

- information on chemical (water chemistry) regime of the system;

- information on anti-corrosion protection and heat insulation of the system elements;

- information on possibility of system decontamination and its elements.

Information on the design of systems and its elements shall be given considering the changes of the original design and upgrades made.

3. System monitoring and control Power supply

Information on system monitoring and control shall be given, including:

- name an values of controlled parameters;

- information on location of control points, control procedures (for example), redundancy of detectors:

- description of protections and interlocks and alarm system during all normal operation modes, and during operational occurrences (including accidents) specifying the values of parameters (set points) in which the system elements are turned-on and turned-off;

- information and characteristics of the places from where the monitoring and control is made by the system and its elements, justification of the sufficiency of measures taken for fail safe and habitability assurance of the control units, including information on the scope of monitoring and control by the system and its elements made from MCR and ECR and on the availability of position alarm of the stop and safety devices (valves) at MCR and ECR;

- information on means stipulated by design for excluding human errors during system control and attenuation of their consequence;

- information on the sources of power supply of the system elements including the permitted break time in power supply of the systems and their elements, information on classification of the systems (elements) of the systems to the relevant group of consumers of the emergency power supply system.

Information on the used software, on measures for security assurance against computer threats and software integrity. Sufficiency of these measures for the NPP safety assurance shall be substantiated.

4. Materials

A list of materials out of which the system elements are made shall be given with indication of their grade and document in accordance with which the properties of materials are determined. It shall be substantiated that the materials are selected with due regard for normal operation conditions and any abnormal operation including accidents that require operation of the system.

5. Quality assurance in the course of manufacturing,   
installation and construction

This section shall be developed on implementation or a new and/or upgrade of the available system (buildings or structures) at the NPP Unit.

The requirements related to quality assurance for the system and its elements during its manufacture, erection (construction) and installation shall be provided.

Information on quality assurance requirements during NPP operation shall be given in the chapter 6 of NPP Unit ISAR.

6. Commissioning

This section shall be developed on implementation of a new and/or upgrade (retrofitting) of available systems (construction of new or upgrade of existing buildings and structures) in the period of additional operation life (repeat additional operation life). Moreover the specified subsection shall be developed for the systems, elements, implementation and/or upgrade thereof were made in the design operation life period for preparation of NPP unit for additional operation period, if such information is not available in the SAR materials presented in the Appendix 1 to the NPP Unit ISAR.

Information about the scope of commissioning works for the system including its tests (scope of tests, sequence and their procedure, acceptance criteria, safety assurance methods during their performance) shall be presented.

The works that are classified as nuclear hazardous works if available shall be specified. Information on the software in correspondence thereof these works are performed, and justification of the safety measures when performing the works shall be presented.

Justification of the absence of impact of the commissioning works performed on the available systems and their elements as well as the NPP overall.

The references to information on commissioning works presented in the engineering safety assurance materials (Appendix 1 to NPP Unit ISAR) shall be given for the systems, the commissioning thereof has been made during the design operation life.

8. In-service control and testing

Information on the regulations for maintenance and periodic testing of the system and (or) its individual elements shall be presented.

The following information shall be given with relevant justification:

- methods, scope and frequency of tests and inspections within the operation period and their metrological support;

- values of verified parameters of the system and/or elements;

- scope and type of instrumentation used in the course of testing.

- information on technical certification including the hydraulic test parameters (pneumatic tests) of the systems and elements and data on their registration (in cases required by FRR);

- information on the works which are related to nuclear hazardous works (if available) Information on the software in correspondence thereof these works are performed, and justification of the safety measures when performing the works shall be presented;

- information on presence of access to the system elements during NPP operation for performing maintenance and repair works and in addition complying with the human radiation safety requirements;

- information on diagnostics of the system elements, control methods and means for metal of pipelines and equipment, condition of assemblies, vibration, noise, loss of tightness, electrical resistivity.

8. System operation

8.1. Information on functioning of the system under normal operation conditions and in case of any abnormal operation including accidents (when operation of the system is required), interfaces with other systems, information on the operator's actions to control the system shall be given.

An analysis of system functioning considering the loads related to failures of other systems shall be given, as well as indicate the measures for protection of system against impacts of these failures.

Basic characteristics of the system for all operation modes prescribed in the design; it shall be demonstrated on the basis of justifying calculations and experimental substantiations that these characteristics do not exceed their limits established in the design and (or) regulatory documents;

8.2. Information on the methods and means of justification of the design functions performed by the system shall be give in implementing at the NPP a new and/or upgrade of the available system. Information on the feasibility studies shall be given.

If any experiments have been performed in order to substantiate operability of the system it is recommended to describe the conditions of these experiments, give an analysis of correspondence of these conditions to actual operating conditions of the system, describe the experimental base and metrological support of the experiments, and present the main results of the experiments.

9. System operation during failures

9.1. Failures of the system components with due regard for human errors and impacts of failure consequences on operability of the system under consideration, any interfaced systems and the NPP safety in general shall be analyzed. The failures that may be IE of the accidents (reference to the corresponding appendix to NPP Unit ISAR where such accidents are considered shall be given).

9.2. Common cause failures of the system (particularly due to fires) shall be analyzed, and impact of these failure consequences on operability of the system under consideration, any interfaced systems and the NPP safety in general shall be assessed. The failures of the passive and active elements, instrumentation of both the system and the associated CS and SS shall be considered.

10. System reliability analysis

The results of qualitative and quantitative analysis of the system reliability including the reliability indices of the safety-critical elements and reliability analysis of system elements in the cases required by FRR

11. Justification of system operability   
 during additional operation life

11.1. Justification of the prolongation of operation life of the safety-critical systems, elements, buildings and structures based on the results of works performed when prolonging the operation life of NPP Unit shall be given.

11.2. The following information shall be presented with reference to the relevant documented confirmations:

- results of integrated surveys;

- results of strength justification of system components for the entire additional (repeat additional) operating lifetime of NPP Unit;

- residual lifetime justification results during the additional operating lifetime;

- justification results confirming that the system and its components are capable to accommodate any loads on the equipment and building structures under normal operation conditions and in case of any abnormal operation (including accidents) requiring operation of this system and also under any natural and human-induced external impacts considered in the NPP design in the period of additional operating lifetime;

- analysis results of the resistance of buildings, constructions, systems and components to external effects characteristic for the NPP Unit location site, including the assessment of the impacts of earthquakes, air shock waves, fall of aircraft, flying objects generated following these actions;

- measures provided for with the objetive of residual lifetime management;

- results of performed tests, verifications, technical examination.

Information of calculations made and used software for PC shall be given.

11.3. The assessment of compliance with the requirements, principles and criteria specified in the regulatory documents as well as the design requirements shall be presented. If there are departures from the indicated requirements, principles and criteria in the system project, the following information shall be presented with reference to the performed analysis:

- justified assessment of the influence of specified non-conformities on performance of this system and on NPP safety overall (specific reference to the NPP Unit ISAR section is given where the non-conformity assessment is made);

- measures aimed at eliminating or compensating any deviations and time limits for implementation of these measures.

The conclusion on compliance of the systems to the requirements of FRR, other regulatory documents containing the mandatory requirements as well as on the conformance of the system to the design principles and criteria on the system's performance of its functions during the addition operating lifetime shall be formulated following assessment of the system.

Appendix No. 4   
to the safety guide  
in the use of atomic energy   
"Recommendations for the contents of the report   
on in-depth safety assessment   
of active NPP power   
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RECOMMENDED <2> LIST   
 OF INITIATING EVENTS FOR ANALYSIS OF DESIGN BASIS ACCIDENTS

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<2> In compliance with the requirements of item 1.2.15 of NP-001-15 the suggested list of IE DBA must be stipulated in the FRR. This Appendix contains the recommendations for making the specified list applicable for operating NPP units with VVER and RBMK RP. The list of IE given in NP-018-05 shall be used for the NPP Units with fast neutron reactors.

2. Recommended list of IE   
for analysis of DBA at NPP with RBMK

1.1. Loss of coolant accident

- guillotine rupture of pipeline or header of main coolant pump (note: - the specified IE are beyond design basis for the NPP Units of first generations of NPP with RBMK-1000 RP);

- guillotine rupture of distribution group header;

- guillotine rupture of downflow pipe of drum separator;

- rupture of FC feed pipe;

- rupture of FC discharge pipe;

- rupture of channel inside the reactor cavity;

- rupture of feedwater pipeline (note: - the specified IE are beyond design basis for the NPP Units of first generations of NPP with RBMK-1000 RP);

- rupture of main steam line (note: - the specified IE are beyond design basis for the NPP Units of first generations of NPP with RBMK-1000 RP);

- unfitting of MSH

- rupture of small bore pipelines outside the leaktight boxes (impulse lines, filling lines).

1.2. IE leading to change of reactivity an distribution of energy release:

- continuous CPS rod removal during reactor operation at rated power and at low power;

- continuous removal of a group of rods during reactor operation at rated power and at low power;

- control rod drop into the core;

- control rod fallout from the core;

- error during refueling including wrong fuelling;

- gas dumping or entry into the cooling circuits of CPS channels.

1.3. Breach of cooling and operational transients":

- shutdown of several MCP (including shutdown of all MCP) during operation of reactor at rated power at low power;

- spurious false closure of RCP TCV during reactor operation at energy power state;

- RCP jamming;

- termination of flow through one FC;

- separation of check valve closing disk of the distribution group header;

- loss of alternating current power supply (NPP Unit auxiliary de-energization);

- start of non-operating RCP;

- load rise of turbine generators (turbine generators 1 and 2);-

- outage of turbines (turbines 1 and 2);

- loss of major heat flow (disconnection of turbines with condenser failure);

- loss of feedwater;

- excess flow of feedwater;

- temperature fall of feedwater (failure of feedwater heaters);

- excess steam flow due to failure of steam pressure regulator or accidental opening of BRU-K;

- false actuation of ECCS;

- loss of residual heat removal (loss of service water).

1.5. Other IE:

- accidents during operations with fuel;

- internal events (flooding, fire, explosion);

- external effects (flooding, earthquake, whirlwind, explosion) with design intensity.

1.6 Initiating events for operational states "shutdown for repair", "shutdown for decommissioning":

- water leakage from the circulation circuit;

- channel leakage inside the reactor cavity;

- loss of fuel assembly leaktightness in the channel;

- loss of auxiliary power supply of the unit;

- loss of service water supply;

- accidents during operations with nuclear fuel;

- fires;

- flooding.

2. Recommended list of design   
 initiating events for NPP with VVER

2.1. For the operational states "power operation", "operation at the minimum controllable power level", "hot":

2.1.1. Initiating events with changes of reactivity and energy emission distribution:

- ejection of CPS CR;

- uncontrolled withdrawal of the working CPS CR group from the reactor core with the operating rate;

- connection of a non-operating loop of the reactor coolant pipeline without prior power reduction;

- inadvertent dilution of boric acid in the primary circuit coolant;

- human error in the course of xenon oscillations suppression (movement of CPS CR resulting in the maximum possible deformation of the power density field).

2.1.2. Initiating events resulting in reduction of heat removal from the primary circuit:

- reduction of steam flow rate to the turbine (due to improper operation or failure of the steam pressure controller);

- closing of the turbine stop valves or loss of external electrical load;

- loss of flow from feedwater pumps;

- feedwater pipeline rupture;

- unauthorized closure of the main steam isolation valve;

- loss of vacuum in the turbine condenser or any other failures resulting in the turbine trip;

- loss of auxiliary power supply of the NPP.

2.1.3. Initiating events resulting in reduction of heat removal from the primary circuit:

- deviations in operation of the feedwater system causing decrease of feedwater temperature;

- deviations in operation of the feedwater system causing increase of feedwater flow rate;

- unintended opening of the secondary circuit steam relief valve with subsequent failure to seat (safety valve of SG or BRU-A or BRU-K);

- increase of steam consumption per turbine (due to improper operation or failure of the steam pressure controller);

- a range of steam pipeline ruptures inside and outside the containment.

2.1.4. Initiating events resulting in decrease of coolant flow rate in the primary circuit:

- disconnection of various number of RCPs for different initial states of the RF;

- instant seizure of an RCP;

- RCP shaft breakage;

- emergency frequency deviation in the NPP auxiliary power supply network.

2.1.5. Initiating events leading to reduction of coolant mass in the primary circuit.

2.1.5.1. Leakages inside the containment:

- unauthorized opening of the pressurizer safety valve with subsequent failure to seat;

- a range of primary circuit coolant leaks including gross-section rupture of the reactor coolant pipeline;

2.1.5.2. Ruptures of pipelines connected to the primary circuit and crossing the containment resulting in leakages outside the containment.

2.1.5.3. Leakages of coolant from the primary to the secondary circuit:

- breakage of a steam generator heat exchange tube;

- breakaway of the steam generator header cover;

- rupture of SG header (size of nominal diameter of leakage is justified in the in-depth safety assessment report).

2.1.6. IE caused by unauthorized actuation of safety systems:

- unauthorized injection to the pressurizer;

- unauthorized actuation of the ECCS.

2.1.7. IE, caused by violations during handling of SNF:

- falling of separate fuel assemblies, leak-tight bottles, casings with fuel assemblies in the course of transportation and handling operations;

- falling of any objects (into the reactor or spent fuel pool) that can change the position and damage the integrity of fuel assemblies (in the reactor and spent fuel pool);

- breakage of packaging fasteners in the course of FA transportation;

- fall of transport container from SFA.

2.1.8. Violations on storage of SFA.

- leakage from the fuel pool or rupture of a pipeline resulting in water level decrease in the SFP;

- failures in the SFP cooling system;

- failures in the ventilation system leading to formation of explosive mixtures in SNF storage;

- reduction of homogeneous poison concentration in the SFP water.

2.1.9. Initiating events caused by releases of radioactive media from auxiliary systems and equipment:

- medium leaks through the equipment seals;

- pipeline leakages in the RW transportation, storage and processing systems containing radioactive gas;

- leakage or damage of systems containing liquid radioactive media;

- medium leakage from any vessel containing radioactive substances.

2.1.10. Fires

2.1.11. Flooding.

2.1.12. External impacts of natural and human-induced nature

2.2. For the operational states "cold", "shutdown for repair", "shutdown for refuelling":

- loss of primary circuit cooling on the shut-down reactor and during refuelling;

- coolant leakages from the primary circuit during NPP Unit shutdown with unsealed reactor and in the course of refuelling;

- hang-up of a spent fuel assembly in the course of refuelling operations.

3. Recommended list of IE for analysis of DBA at NPP with EGP-6

3.1. Loss of coolant accident

- rupture of FA;

- rupture of individual FA supply lines;

- rupture of individual discharge branch of FA;

- rupture of distribution group header;

- rupture of group header;

- rupture of hoisting main pipeline;

- rupture of downtake main pipeline;

- steam-line break;

- feedwater pipeline rupture;

- pipeline rupture at input to ECWSS;

- pipeline rupture of deep cooldown line;

- rupture of CPS distributing header;

- rupture of CPS collecting manifold;

- rupture of individual line of CPS channels;

- rupture of common suction header of FWP, CPS, EFWP;

- rupture of by-pass manifold;

- rupture of blowdown connection near the separator or blowdown line.

3.2. Operational occurrences:

- disconnection of CPS circuit pump;

- switch-off of the feed pump;

- termination (inadmissible decrease) of feedwater supply to the main coolant circuit;

- actuation and non-closure of MRV or pressure vessel;

- false activation of ECWSS;

- pressure reduction in RP circuit;

- level reduction in the drum steam separator;

- loss of regular auxiliary power supply;

- disconnection of the turbine generator from the grid;

- seating of stop vale due to disconnection of turbine generator from the grid or other failures in the turbine generator;

3.3. Reactivity related accidents:

- shunt running of the CPS rod;

- fall of fully extracted CPS rod (group of rods) into the core;

- fall of automatic control rod or manual control from the core in the lower reflector;

- dewatering of CPS circuit;

- excess of reactor power by 20% of the given;

- reduction of the reactor acceleration below 20 sec;

- reduction of coolant temperature in the reactor coolant circuit.

3.4. Other accidents:

- accidents during operations with nuclear fuel;

- internal events (flooding, fire, explosion);

external effects (flooding, earthquake, whirlwinds, extreme air temperature, snowfall).

Appendix No. 5   
to the safety guide  
in the use of atomic energy   
"Recommendations for the contents of the report   
on in-depth safety assessment   
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RECOMMENDED <3> LIST be OF BEYOND DESIGN BASIS ACCIDENTS

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<3> In compliance with the requirements of item 1.2.16 of NP-001-15 the suggested list of BDBA must be stipulated in the FRR. This Appendix contains the recommendations for making the specified list applicable for operating NPP units with VVER and RBMK RP. It is recommended to use the approaches for forming the list of BDBA lists given in NP-018-05 for the NPP Units with fast neutron reactors.

1. Recommended list of BDBA for NPP with RBMK

1.1. Expected transition modes without actuation of first time-initiated shutdown system and on full failure of both the shutdown systems of the reactor (ATWS):

- loss of major heat flow;

- partial loss of coolant flow rate through reactor;

- termination of power supply by alternating current (auxiliary de-energization);

- loss of feedwater;

- maximum reactivity insertion during sustained CPS rod withdrawal during reactor operation:

a) minimum controllable power (5% of nominal);

b) rated power.

1.2. Other accidents:

- fall of refueling machine;

- blackout of NPP Unit for a protracted time;

- termination of coolant supply to one distribution group header.

- hydrogen explosion in theaccident localization system rooms;

- external impacts of natural and human-induced nature with the intensity exceeding the intensity of impacts considered in the NPP unit design and also combinations of these impacts.

1.3. BDBA for operational states "shutdown for repair", "shutdown for decommissining":

- blackout of NPP Unit for a protracted time;

- external effects (flooding, earthquake, blizzard, explosion);

- airplane crash.

2. Recommended list of BDBA for NPP with VVER

2.1. For the operational states "power operation", "operation at the minimum controllable power level", "hot":

2.1.1. The range of expected NPP operational occurrences with coincident failure of emergency protection.

- unauthorized removal of group of CPS CR during operation at MCL and/or at nominal power level;

- loss of feedwater flow in SG;

- loss of auxiliary power loss (outage);

- closing of turbine stop valves;

- closing of cutoff valves on the SG steam line;

- unintended opening of the secondary circuit steam relief valve (safety valve of SG or BRU-A or BRU-K);

2.1.2. Beyond design basis accidents with desing functioning of reactor emergency protection:

- long-term complete outage (failure of normal operation power supply system and emergency power supply systems);

- spectrum of leakages from primary circuit within the containment with failure ECCS active elements (with complete outage of NPP unit);

- large-scale primary circuit leakages with additional failures resulting in the containment bypass;

- leakages from the primary circuit to the secondary circuit, complicated by additional failures (not considered as part of the analysis of design-basis accidents);

- spectrum of secondary circuit pipe ruptures with insulation failure of emergency SG (not considered as part of design-basis accidents);

- failure of normal operation systems and active safety systems removing heat from to the ultimate heat sink.

- external impacts of natural and human-induced nature with the intensity exceeding the intensity of impacts considered in the NPP unit design and also combinations of these impacts.

- spectrum of severe accidents (high and low pressure scenarios, including in-vessel and ex-vessel stage).

2.2. For the operational states "cold", "shutdown for repair", "shutdown for refueling":

- primary circuit cooling loss on the shutdown reactor (scenarios not considered as part of design-basis accidents);

- coolant leakage from primary circuit on shutdown reactor (scenarios not considered as part of design-basis accidents);

- accidents during fuel handling;

- spectrum of severe accidents (in-vessel and ex-vessel stages).

3. Recommended list of BDBA for NPP with EGP-6

3.1. Anticipated Transient Without Trip (ATWS):

- loss of major heat flow;

- alternating current power outage;

- loss of feedwater;

- fall of feedwater temperature (false triggering of ECWSS);

- inadvertent opening and unfitting of MRV or PCS;

- maximum reactivity insertion during sustained rod withdrawal during reactor operation: a) at CMM; b) at rated output.

3.2. Other accidents:

- rupture of more than one fuel element;

- termination of coolant supply to one distribution group header.

- complete loss of power supply for BOP needs for a protracted period of time;

- rupture of common suction header of FWP, CPS, EFWP with simultaneous complete blackout of the NPP;

- rupture of distribution group header with simultaneous complete blackout of the NPP;

- rupture of separator drum;

- fall of (rotating and adjustable fixtures) solid equipment or civil structures on the reactor domed roof;

- hydrogen explosion in the reactor space or in the accident confinement system;

- beyond design-basis accidents during NF handling;

- external impacts of natural and human-induced nature with the intensity exceeding the intensity of impacts considered in the NPP unit design and also combinations of these impacts.