Federal Environmental, Industrial and Nuclear Supervision Service

Federal Codes and Regulations
in the field of atomic energy use

Approved by
Resolution № 3 of
the Federal
Environmental
Industrial and
Nuclear,
Supervision
Service
dated May 14, 2008.

PROVISION ON THE PROCEDURE OF INVESTIGATION AND ACCOUNTING OF OPERATIONAL OCCURRENCES AT NUCLEAR POWER PLANTS

NP-004-08.

As amended

by Order No. 103 of March 5, 2011;

In force since

December 1, 2008.

Moscow, 2008

This regulatory document establishes categories of NPP operational occurrences, principles of setting up a Commission for investigation of an operational occurrence, order of submission of information on occurrences, procedure of accounting, investigation and reporting occurrences.

This regulatory document is issued in replacement of NP-004-97*, "The Provision for the procedure of Investigation and Accounting of Operational Occurrences at Nuclear Power Plants."

This regulatory document is developed based on the legal regulatory acts of the Russian Federation, the Federal codes and regulations in the field of atomic energy use and IAEA recommendations.

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* The document is developed by the Scientific and Engineering Centre for Nuclear and Radiation Safety (SEC NRS) with participation of the following persons: S.A.Adamchik, M.I.Miroshnichenko, V.A.Manakov, O.B.Lapshev (Rostechnadzor), R.B.Sharafutdinov, A.L.Khazanov, D.L.Protserov, V.A.Obruchkov, V.P.Slutsker (SEC NRS), V.M.Kuznetsov, A.S.Mefodyev (Concern Rosenergoatom).

Proposals by Rosatom, Federal Medical and Biological Agency (FMBA of Russia), JSC VNIIAES, Concern Rosenergoatom were taken into consideration when developing this document.

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LIST OF ABBREVIATIONS:

EP	–	emergency protection
FR	–	fast reactor
VVER	–	water-moderated water-cooled power reactor
LWGR	–	light water-cooled graphite- moderated reactor
RI	–	reactor installation
CPS	–	control and protection system
FA	–	fuel assembly
FE	–	fuel element
GSPR	–	graphite steam power reactor type

1. GENERAL

1.1. This Provision for the procedure of investigation and accounting of operational occurrences at nuclear power plants (hereinafter referred to as Provision) establishes:

- categories of NPP operational occurrences;
- principles of setting up a Commission for investigation of an operational occurrence;
- order of submission of information on occurrences;
- procedure of occurrence accounting;
- order of occurrence investigation;
- order of occurrence reporting.

1.2. Investigation and accounting of NPP operational occurrence are aimed at the following:

- identifying the causes of an occurrence;
- determining occurrence category in accordance with features and consequences provided in tables 1 and 2;
- developing corrective measures to prevent repetition of a similar occurrence.

1.3. Failures, defects, damages of equipment and pipelines of safety critical systems that are not subject to this Provision shall be investigated and accounted in the order established by the operating organization. The investigation result reports are submitted to the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostechnadzor) by request.

2. CATEGORIES AND ACCOUNTING OF OPERATIONAL OCCURRENCES

2.1. Categories of the operational occurrences that are subject to accounting are presented in tables 1 and 2.

Table 1

ACCIDENT CATEGORIZATION

ACCIDENT CATEGORY	FEATURES AND CONSEQUENCES OF ACCIDENTS

A01	Release of radioactive substances to the environment in the severe beyond design basis accident, as a result of which acute radiation damages of the NPP employees (personnel) and public, severe injury to health, contamination of large territories by radioactive substances are possible. Transboundary transport of radioactive substances is possible. Long-term radiation effect on the environment.
A02	Releases of radioactive substances to the environment as a result of which level B of the criteria for taking urgent decisions at the initial period of emergency in accordance with radiation safety regulations has been achieved or exceeded: the forecast radiation dose over the first 10 days is 500 mGy for the whole body or 5000 mGy and more for thyroid gland, lungs, skin.
A03	Releases of radioactive substances to the environment as a result of which level A of the criteria for taking urgent decisions at the initial period of emergency in accordance with radiation safety regulations has been achieved or exceeded: the forecast radiation dose over the first 10 days is more than 50 mGy for the whole body or 500 mGy for thyroid gland, lungs, skin.
A04	Releases (discharge) of radioactive substances into the environment, which can result in any of the following consequences: • exceeding of the main dose limit of public radiation of • 5 mSv/year; • single external and (or) internal exposure of some members of the personnel, the dose of which exceeds the potential dangerous doze (200 mSv). Damage of fuel elements, at which the limit of safe operation by number and significance of fuel element defects is exceeded, while the maximum design limit is not exceeded.

Notes:

Accidents of category A01-A03 are characterized by excess of the maximum design limit of fuel element damage.

Accident of category A04 is characterized by damage of fuel elements, at which the limit of safe operation by quantity and value of fuel element defects is exceeded, while the maximum design limit is not exceeded.

Table 2

INCIDENT CATEGORIZATION

INCIDENT CATEGORY	FEATURES AND CONSEQUENCES OF INCIDENTS
P01	Penetration of radioactive substances into the premise (premises) of the personnel permanent attendance, NPP site or environment due to failures of the systems (components), drawbacks of the operating procedures, erroneous actions of the personnel resulting in any of the following consequences: • contamination of the premise (premises) of personnel permanent attendance by beta-active nuclides in amount of 10,000 particle/(min'cm2) and (or) alpha-active nuclides 200 particle/(min'cm2); • contamination of the control area leading to the radiation dose of 1-5 mSv/year. • single external and (or) internal exposure of some members the staff by the dose of 50 - 200 mSv.

P02	Violation of the safe operation limits (except for the radiation ones).
P03	Violation of the safe operation conditions.
P04	Failure of one or several safety system channels revealed during NPP unit operation, including regular trial run or inspection (except the events provided in item 2.2.4).
P05	Safety system channel actuation associated with the need to perform the safety function during the NPP Unit operation and accompanied by failures of safety system components beyond the single failure, additional to those considered in the design-basis accidents, and/or personnel erroneous actions.
P06	Safety system channel actuation associated with the need to perform the safety function during the NPP Unit operation and not accompanied by failures of safety system components beyond the single failure, additional to those considered in the design-basis accidents, and/or personnel erroneous actions.
P07	Safety system channel actuation not associated with the performance of the safety function, including that part of the fire extinguishing system, which provides for conditions of operation of the safety system.
P08	Shutdown of the reactor or disconnection of the NPP Unit without actuation of the EP (or other system for quick reactor shutdown) during the NPP operation caused by failure of the systems (components) and (or) personnel erroneous actions.
P09	Decrease of NPP unit thermal power by 25% and more of the directly preceding power level caused by the failure of systems (components) and/or personnel erroneous actions (with the exception of events defined in item 2.2).
P10	Drop and/or damage of the FA, fuel elements in the treatment of

	fresh or spent nuclear fuels caused by the failure of systems, components (including the NPP hoisting equipment used in the treatment of the nuclear fuel) and/or erroneous personnel actions (except for those, which are accompanied by features and consequences of the incidents of categories P01-P03). Failure* (failures) of an element (elements) of safety classes 1 and 2 (with the exception of events accompanied by features and consequences of the occurrences belonging to categories A01–A04, P01–P03, P05, P06, P08, P09 and failures as per item 2.3).

* Component failure – an event resulting in the loss of its performance capability.

Amendment For the period when an NPP Unit is in the process of commissioning till its acceptance for the commercial operation, the NPP operational occurrences characterized by features and consequences specified in Table 2 are subject to accounting by the Operating organization and Rostechnadzor separately from the operational occurrences at power units of nuclear power plants in commercial operation. The investigation of operational occurrences at an NPP Unit in the Commissioning phase shall be performed subject to this Provision.

2.2 The following events are not considered to be NPP Unit operational occurrences (unless they are accompanied by features and consequences specified in Tables 1 and 2).

2.2.1. Decrease of RI thermal power, transfer of the reactor to the subcritical state to perform maintenance required by the process regulation and operating manuals of the systems (components).

2.2.2. Decrease of the RI thermal power, shutdown of the NPP Unit caused by putting the systems (components) out of operation to eliminate damages and defects according to the application agreed in the established order (except for the events of category P10 or events

resulted in the violation of the limits and/or conditions of safe operation).

2.2.3. Shutdown of the Unit or decrease of the RI thermal power according to the dispatcher schedule of loads due to the operation of the emergency system automatics or operational occurrences of the power system, and if it is provided by the Unit startup program.

2.2.4. Withdrawal of some channels (components) of the safety critical systems from the state of readiness for the period permitted by the process regulations.

2.3. The following failures of NPP components of the 1st and the 2nd classes of safety that have not led to an initiating event and are not accompanied by the features and consequences specified in Tables 1 and 2 are not considered to be NPP Unit operational occurrences but are subject to investigation and accounting in the order established by the operating organization in accordance with the Regulatory Documents requirements:

2.3.1. Revealed during maintenance and (or) repair:

- defects and damages in core components, internal reactor devices and components, reactor cavity equipment;
- failures (defects, damages) of CPS components;
- failures, errors (defects, damages) of reactivity member actuators;
- failures, errors (defects, damages) of refueling equipment for nuclear reactors and transport-process equipment used for nuclear fuel handling;
- failures of electrical and electronic equipment;
- failures of valves actuation or its control circuit;
- failures of the reactor coolant pump (RCP) components;
- failures of detachable joint seals in pipelines and tanks;
- failures of localizing safety systems equipment;
- damage of support and load carrying structures of the reactor.

2.3.2. Defects and damages, variation of physical-mechanical properties and structure of the metal in equipment and pipelines belonging to groups "A" and "B" according to the rules for design and safe operation of the equipment and pipelines of nuclear power plants revealed in monitoring of metal condition and in technical examination.

2.3.3. Failures (defects, damages) of load lifting machines and mechanisms belonging to special group "A" cranes according to the rules for design and safe operation of the load lifting cranes for nuclear facilities revealed during maintenance and (or) repair and in technical examination.

2.4. The Operating organization upon completion of the scheduled preventive repair (within 1 month after the NPP Unit startup) shall submit to Rostechnadzor central office the documents with information according to item 2.3 on the nonconformities with the requirements established in the regulatory, design and operation documents (failures, malfunctioning, defects, exceed of discontinuity limits) detected during the scheduled preventive repair and measures taken for elimination of these nonconformities.

If components of the 1st and the 2nd classes of safety with the detected nonconformities are accepted for operation, the documented information according to item 2.3 and safe operation justification shall be submitted before the NPP Unit startup.

2.5. Concurrent operational occurrences of several Units of a multi-unit NPP caused by a common-cause failure is accounted as one occurrence if the occurrence's behavior at every unit was similar to that designed. The occurrences shall be accounted for every Unit separately and documented for every Unit in separate reports if they were accompanied by different failures of systems (components).

2.6. The NPP operational occurrences that have not led to an initiating event and are not accompanied by the features and consequences specified in Tables 1 and 2 but are accompanied by or caused by the fire and (or) the collapse of NPP buildings and structures shall be investigated considering the requirements of the regulatory documents on examination of fires and (or) the regulatory documents on investigation of buildings and structures collapse.

2.7. Investigation of accidents that occurred with the NPP personnel shall be conducted in compliance with the requirements of regulatory legal documents establishing the order of investigation and accounting of accidents in industries.

3. INFORMATION ABOUT NPP OPERATIONAL OCCURRENCES AND ACCOUNTING

3.1. Information about the NPP operational occurrences shall include the following:

- Operational informing about an occurrence;
- preliminary information about an occurrence;
- report on occurrence investigation;
- additional report on occurrence investigation (if necessary).

3.2. Order of transfer and content of information on NPP operational occurrences

3.2.1. OPERATIONAL INFORMATION ON NPP OPERATIONAL OCCURRENCES

3.2.1.1. operational information about NPP operational occurrences shall be submitted within 1 hour after the occurrence is revealed, it shall be drawn up using a special filled-in form and it shall contain the following:

- NPP name and unit number;
- occurrence date and time;
- unit state before the occurrence took place;
- brief characteristics of the occurrence, supposed reasons for the occurrence;
- unit state at the moment of information submission;
- state of radiation situation at the Unit, in NPP site territory, in the control area and the radiation control area, as per the data of regular automated radiation monitoring systems.

3.2.1.2. The NPP shift supervisor is responsible for delivering the operational information.

3.2.1.3. The NPP shift supervisor submits operational information about operational occurrences of A01–A04, P01 categories to the following organizations and individuals: *:

- Situational Crisis Center of State Nuclear Power Corporation "Rosatom" (State Corporation "Rosatom");
- Operating organization Crisis Center;
- on-site units of the federal fire service of the Ministry for Civil Defense, Emergencies and Disaster Relief (EMERCOM of Russia) of the Russian Federation for NPP protection;

- dispatcher of power system corresponding department (in cases foreseen by current provisions on relations between an NPP and a power system);**;
- man on duty of Rostechnadzor Headquarters;
- department of NPP nuclear and radiation safety inspection;
- man on duty of the Federal Medical and Biological Agency of Russia;
- head of a municipality (city next to an NPP) and of a region of the Russian Federation;
- head of the medical center of the Federal Medical and Biological Agency of Russia, in charge of the NPP;
- other organizations according to the order established by an operating organization.

After receiving operational information from the NPP, head of Operating organization Crisis Center shall submit the operational information to: *:

- corresponding Interregional Territorial Office for supervision over nuclear and radiation safety of the Federal Environmental, Industrial and Nuclear Supervision Service of Russia;
- man on duty of the National Emergency Management Center of Russia;
- head of the regional body of the Federal Medical and Biological Agency of Russia, at the territory of which the NPP is situated;
- man on duty of Emergency Medical Radiation Dosimetry Center of the Federal Medical and Biological Agency of Russia;
- other organizations according to the order established by the State Corporation "Rosatom".

3.2.1.4. The NPP shift supervisor submits operational information about operational occurrences of P02–P10 categories to the following organizations and individuals: *:

- Situational Crisis Center of the State Corporation "Rosatom";
- Operating organization Crisis Center;
- dispatcher of power system corresponding department (in cases foreseen by current provisions on relations between an NPP and a power system) **;

- man on duty of Rostechnadzor Headquarters;
- department of NPP nuclear and radiation safety inspection;
- other organizations according to the order established by an operating organization.

After receiving operational information from the NPP, head of Operating organization Crisis Center shall submit the operational information to: *:

- corresponding Interregional Territorial Office for supervision over nuclear and radiation safety of the Federal Environmental, Industrial and Nuclear Supervision Service of Russia;
- man on duty of the Federal Medical and Biological Agency of Russia;
- other organizations according to the order established by the State Corporation "Rosatom".

2.2.3. PRELIMINARY INFORMATION ON NPP OPERATIONAL OCCURRENCES

3.2.2.1. The preliminary information about an NPP operational occurrence, filled into a special form, shall be signed by the NPP Chief Engineer and the Head of department for inspections of nuclear and radiation safety of the affected NPP and shall be delivered within 24 hours after occurrence detection *.

3.2.2.2. Preliminary information on the NPP operational occurrences shall contain the following:

- NPP name and Unit number;
- occurrence date and time;
- Unit state before the occurrence took place;
- names of actuated safety systems;
- brief description of the way the occurrence emerged and progressed, supposed caused of the occurrence, measures taken to localize and eliminate occurrence consequences, information about the availability of safe operation limits and conditions;
- preliminary established occurrence category;
- names of damaged systems (elements), place, character and possible reason for the

damage and failure;

- state of the Unit and other NPP Units at the moment of information submission;
- radiation consequences of the occurrence (as per the data of regular automated radiation monitoring systems, portable instruments, and as per the data of laboratory monitoring);
- preliminary assessment of the occurrence as per the International Nuclear Event Scale (INES).

3.2.2.3. Preliminary information of the NPP operational occurrences shall be delivered regarding:

- events with the features and consequences of occurrences of categories A01–A04, P01 – in the order as specified in item 3.2.1.3;
- events with the features and consequences of occurrences of categories P02–P10 – in the order as specified in item 3.2.1.4.

3.2.3 REPORT ON NPP OPERATIONAL OCCURRENCE INVESTIGATION

3.2.3.1. The report on NPP operational occurrence investigation shall be drawn up by the Commission. The form and the content of the report on NPP operational occurrence investigation are given in Appendices 1 and 2.

3.2.3.2. The report on NPP operational occurrence investigation and all its appendices, including Operational and preliminary information, are submitted to the following organizations and individuals within not more than 5 working days after the completion of the work of the Commission, in accordance with the order established by the operating organization:***:

- operating organization;
- the State Corporation "Rosatom";
- Rostechnadzor;
- the EMERCOM of Russia (regarding the occurrences of A01-A04 categories);
- the Federal Medical and Biological Agency of Russia (regarding the occurrences of A01-A04, I01 categories);

- head of the regional body of the Federal Medical and Biological Agency of Russia in the city at the territory of which the NPP is situated (regarding the occurrences of A01-A04, I01 categories);
- corresponding Interregional Territorial Office for supervision over nuclear and radiation safety of the Federal Environmental, Industrial and Nuclear Supervision Service of Russia;
- department of NPP nuclear and radiation safety inspection;
- Scientific and Engineering Centre for Nuclear and Radiation Safety;
- other organizations according to the order established by an operating organization.

3.3. A report on NPP operational occurrence additional investigation is prepared by the Commission in charge of additional investigation of NPP operational occurrences in case the organization that set up the investigation Commission according to item 4.2 or Rostechnadzor makes a decision to conduct additional investigation of the NPP operational occurrences after detection of important additional information on the circumstances, causes and corrective measures. The additional report shall be consistent with the form and the content presented in appendices 1 and 2 shall have the same number as the basic report. The report title shall be on the title sheet as follows: ADDITIONAL REPORT ON NPP OPERATIONAL OCCURRENCE INVESTIGATION. The additional report is issued in replacement of the initial report on the NPP operational occurrences investigation, is sent to the same addresses and on the same dates as the initial report ***.

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* Transfer of information on the operational occurrences (Operational, preliminary information, report on the operational occurrences investigation) is done through communication channels in the established order.

** If the NPP operational occurrences are due to change in Units power and/or failures of equipment under management (in the ownership) of a corresponding power system.

*** Transfer of information on the operational occurrences (Operational, preliminary information, report on the operational occurrences investigation) is done through

communication channels in the established order.

4. INVESTIGATION OF NPP OPERATIONAL OCCURRENCES

4.1 Every NPP operational occurrence subject to accounting in accordance with section 2 shall be investigated by the Commission within not more than 15 working days after the occurrence takes place, not including the day of its detection.

4.2 The Commission shall be formed:

- by Rostechnadzor: in case of events with the features and consequences of the occurrences of categories A01-A04. The Commission consists of the representatives of the State Corporation Rosatom, Federal Medical and Biological Agency, Ministry of Emergency, the Federal Service for Supervision of Rights of Customers, other ministries, federal services and agencies, operators and organizations performing works and rendering services to operators, the representatives of the regional authorities on whose territory the NPP is located.
- by the operating organization: in case of events with the features and consequences of the occurrences of categories P01-P04. The representatives of the Federal Medical and Biological Agency of Russia shall be members of the Commission if occurrences with personnel exposure are investigated.
- according to the procedure established by the operating organization: in case of events with the features and consequences of the occurrences of categories P05-P10.

4.3. The Chairman of the Commission and its members are assigned in compliance with the order of the organization that sets up the Commission.

The Commission includes a specialist for analysis of NPP operational occurrences and an NPP psychologist if the occurrence is associated with erroneous actions of the personnel (or a psychologist from a special organization).

The Commission also includes representatives of organizations participating in the design, development, construction of the NPP, manufacturing, assembling, adjustment and repair of failed, faulty systems (components).

The chairman of the Commission shall inform the department of NPP nuclear and radiation safety inspection about the establishment of the Commission, the place and time of its functioning in a written form.

4.4. The Commission has the right to ask the NPP personnel (including officials), other organization representatives for explanations, to involve experts to the work, to require necessary tests and checks to be performed.

The chairman of the Commission establishes the order of work of the Commission.

4.5. Before the Commission is been set up, it is necessary to take measures to preserve (register) the situation in the area of the occurrence in the form it was before the event; and to stop the work on all the systems (components) where the event occurred if it does not threat life of personnel and does not lead to progression of the event.

4.6. Opening (disassembling) of the damaged components (systems) and registration of their state before the Commission starts working can only be done by agreement with its chairman.

4.7. Operating organization (NPP administration) shall create all conditions necessary for Commission functioning and provide the following:

- design, operational and other materials;
- implementation of necessary calculations, laboratory investigations, tests and inspections, taking pictures of objects, systems (elements);
- premises, communication means, transport;
- printing, duplication of investigation materials.

4.8. Prior to the Commission operation, the NPP administration shall do the following:

- define the character and the magnitude of the occurrence;
- organize (if necessary) involvement of representatives of appropriate organizations;
- take measures for preservation of diagrams of registration devices, oscilloscope records, printouts, electronic (magnetic) records of operating meetings, logs;
- register values of the reactor neutron characteristics, position of switching devices, cut off and control valves, blinkers, trims at the time of occurrence;

- collect after the shift explanatory notes from the personnel participating in the occurrence elimination, witness thereof, shop managers;
- on the basis of the available information, prepare diagrams (in unified timescale) of parameters variation at the start and in progression of the occurrence necessary for the analysis of the system (components) operation with notes about switchings, actuations of process protections, interlocks;
- prepare necessary design documentation, test reports, inspection reports, checks information, diagrams, operating instructions;
- prepare documentation on repairs and on similar occurrences that took place at this NPP before.

4.9. Results of investigation of NPP operational occurrences are presented as a report in accordance with Appendices 1, 2 and 3. The final version of the report is discussed and approved by all members of the Commission. The members of the Commission who do not agree with an accepted decision shall formulate their special opinion in writing; their opinion shall be included into the appendices to the report. Special opinions of the Commission members are subject to mandatory consideration of the Commission and justification for them being rejected (accepted). The results of the discussion are formulated in writing and are also enclosed to the report. In case of disagreements, a final decision about the investigation results is made by the Commission Chairman.

4.10. The first copy of the report on the NPP operational occurrence signed by all the Commission members with all enclosed appendices shall be retained at the NPP for the whole period of its operation.

4.11. A decision about changing the preliminary established category of occurrence, verification of causes of events and corrective measures considering special opinions of the Commission members and other circumstances is made by an organization that set up the Commission. This organization also notifies all the organizations where the report was sent about the changes. The category of occurrence is considered finally established if Rostechnadzor does not require re-assessment of the category, verification of the cause of the occurrence and corrective measures after it receives the report.

4.12. A decision to extend the term of investigation of the NPP operational occurrence is made by the organization that set up the Commission. This decision shall be substantiated. The organizations participating in the investigation shall be notified about the term extension well in advance (not later than 24 hours)

4.13. If more severe consequences are revealed during the NPP operational occurrence investigation (besides category A01), according to which the status of the Commission does not correspond to the requirements of item 4.2, a decision about continuation of the Commission work or about formation of a new Commission is made by an appropriate organization according to item 4.2.

4.14. Control of quality of the NPP occurrence investigation and storage of reports on NPP occurrences investigation over the whole time of operation and in decommissioning are performed in the order established by the operating organization considering requirements of the regulatory documents.

5. CORRECTIVE MEASURES

The Commission formulates proposals for corrective measures for each NPP operational occurrence, while the operating organization develops and obtains approval of the corrective measures to prevent repetition of the event. The list of corrective measures compiled by the operating organization includes terms of their implementation and assigned responsible persons.

The operating organization submits a report on implementation of the corrective measures to Rostechnadzor.

Appendix 1

(sample)

FORM OF THE REPORT

ON INVESTIGATION OF NPP OPERATIONAL OCCURRENCE

TITLE PAGE

REPORT ON INVESTIGATION OF NPP OPERATIONAL OCCURRENCE

REPORT N.	Date of issue (day, month, year):
Date when the occurrence took place (day, month, year):	Time of occurrence:
Name of occurrence:	
NPP, NPP Unit:	Type of NPP Unit:
Assessment according to INES:	
Operating organization:	
Report distribution list:	
Organization:	
NPP Divisions:	
Contact person at the NPP	Full name. Address: Tel: Fax: Teletype: e-mail:

1. OCCURRENCE DESCRIPTION

1.1. Unit state before the occurrence took place.

1.2. Description of the sequence of failures, personnel errors made during the occurrence;

1.3. Measures taken to clarify the failures, personnel errors causes;

1.4. Proceeding similar occurrences at this and other NPPs.

2. OCCURRENCE CONSEQUENCES

2.1. Violation of safe operation conditions.

2.2. Exit of reactive substances beyond the established boundaries.

2.3. Personnel exposure, public exposure.

2.4. Radioactive contamination of the systems (components), premises and site of the NPP,

territory beyond the NPP site.

2.5. Release (discharge) of industrial harmful (non-radioactive) substances into the environment (level and kind of contamination).

2.6. Time of Unit outage.

2.7. Reduced production of electrical and Thermal energy.

2.8. Damaged, failed equipment (component).

2.9. Personnel injury.

2.10. Positive personnel practice.

3. OCCURRENCE CAUSES

3.1. List of failures, personnel errors made during the occurrence.

3.2. Immediate causes of the failures, personnel errors.

3.3. Root causes of the failures, personnel errors.

4. SAFETY EVALUATION

4.1. Importance to safety of events in the course of occurrence.

4.2. Assessment substantiation as per INES;

5. DRAWBACKS REVEALED DURING OCCURRENCE INVESTIGATION

5.1. In personnel actions.

5.2. In the functionality of normal operation systems (components).

5.3. In the functionality of safety systems (components).

5.4. In the functionality of the control and monitoring systems (components).

5.5. In the maintenance and repair.

5.6. In the operating documentation.

5.7. In the arrangement of operation.

6. CORRECTIVE MEASURES CONCERNING THE FOLLOWING:

6.1. Repair of systems (components).

6.2. Replacement of systems (components).

6.3. Operation of systems (components).

6.4. Engineering of systems (components).

6.5. Design of systems (components).

6.6. Manufacture of systems (components).

6.7. Construction of systems (components).

6.8. Installation of systems (components).

6.9. Adjustment of systems (components).

6.10. Regulatory and operational documentation.

6.11. Personnel.

6.12. Procedures of the detection and elimination of system (components) defects and damages, procedures drawbacks, personnel training drawbacks.

7. FORM OF THE ENCODED INFORMATION CARD

<table>
<tr><td colspan="5">7. ENCODED INFORMATION CARD</td></tr>
<tr><td colspan="3">REPORT NUMBER: ___ - ___ - __-__-__</td><td colspan="2">DATE OF OCCURRENCE___.___.___</td></tr>
<tr><td colspan="3">1. OCCURRENCE CATEGORY: _____</td><td colspan="2">TIME OF OCCURRENCE___.___.___</td></tr>
<tr><td colspan="5">2. UNIT STATE BEFORE THE OCCURRENCE TOOK PLACE: __.___.___</td></tr>
<tr><td colspan="5">3-5. FAILED SYSTEMS, COMPONENTS; PERSONAL WHO MADE AN ERROR CASUES OF OCCURRENCES, PERSONNEL ERRORS</td></tr>
<tr><td>Main failed systems</td><td>Failed component; personnel who made an error</td><td>Auxiliary failed systems</td><td>Failed component; personnel who made an error</td><td>Root causes of the failures, personnel</td></tr>
</table>

	independent	dependent		independent	dependent	errors: 5.1 – immediate 5.2 – root	
3.A-3.L	4		3.M	4		5.1	5.2
3._____ 3._____ 3._____ 3._____ 3._____ 3._____	4.____ 4.____ 4.____ 4.____ 4.____ 4.____	4.____ 4.____ 4.____ 4.____ 4.____ 4.____	3._____ 3._____ 3._____ 3._____ 3._____ 3._____	4.____ 4.____ 4.____ 4.____ 4.____ 4.____	4.___ 4.___ 4.___ 4.___ 4.___ 4.___	5.1.___ 5.1.___ 5.1.___ 5.1.___ 5.1.___ 5.1.___	5.2. ___ 5.2. ___ 5.2. ___ 5.2. ___ 5.2. ___
6. EFFECT ON THE UNIT OPERATION MODE:							
7. NATURE OF OCCURRENCE:							
8. TYPE OF OCCURRENCE, PERSONNEL ERROR:							

8. LIST OF APPENDICES TO THE REPORT ON INVESTIGATION OF THE NPP OPERATIONAL OCCURRENCE

9. MEMBERS OF THE COMMISSION FOR INVESTIGATION OF NPP OPERATIONAL

OCCURRENCE

Signature full name

Chairman of the Commission: (position,
Official Name of Organization)

Members of the Committee: (position,
Official Name of Organization)

Appendix 2

(Sample)

CONTENT OF THE

REPORT ON INVESTIGATION OF THE NPP OPERATIONAL OCCURRENCE

TITLE PAGE

Report number

The number is assigned by the NPP occurrence investigation Commission and includes the following information:

- number of NPP Unit;
- an abbreviated name of NPP (first three letters of the full NPP name, for example BEL - The Beloyarsk NPP) except for the Kalinin NPP, the Novovoronezh NPP and the Volgodonsk NPP that are designated as KLN, NVO and VDN;
- a category of occurrence designated by letters and numbers from the appropriate item of Tables 1 and 2 of section 2. If the occurrence shows features of several categories, it is assigned the highest category;
- a cross-cutting number of the NPP operational occurrence in the current year written in two digits (01, 02, etc.);
- month, year when the occurrence took place. For example, 1KLN-P02-04-05-06 – this is an occurrence at Unit 1 of the Kalinin NPP. It has led to violation of the safe operation conditions. It is the fourth occurrence at this NPP that took place during this year. The occurrence took place in May 2006.

Date of report issue

Is specified at the NPP when the report is being signed.

Date of occurrence

The date when the occurrence was detected (for example 28.05.06, that is the 28th of May, 2006) is specified.

Time of occurrence

The time when the occurrence was detected (for example, 02:46:12, that is 2 hours, 46 minutes, 12 seconds a.m.).

Name of occurrence

The name of the occurrence shall begin with the main consequence of the occurrence according to which it is classified (according to the definition of categories, for example, "Personnel exposure...", "Damage of fuel elements...", "Reactor unit shutdown...", "Unit load reduction...") followed by the immediate cause of this occurrence.

NPP, Unit

A name of the NPP and a digit designating the unit number (for example The Smolensk NPP -3) is specified.

Type of Unit

A type of the unit is specified and the design number in parentheses, for example, VVER-1000
(V-320), LWGR-1000, BN-600, GSPR-6].

Assessment according to INES

Level of occurrence as per INES is specified.

Operating organization

Official name of the Operating organization (for example, concern Rosenergoatom) is specified.

Report distribution list

Abbreviated names of the companies and the NPP divisions where the report is sent (for example, concern Rosenergoatom, Rostechnadzor) are specified.

1. OCCURENCE DESCRIPTION

1.1. State of the (NPP) Unit before the occurrence took place

Information is presented regarding the unit operation conditions (of the NPP - if required), state of the main and auxiliary systems (components) (in operation, in reserve, in repair); performance; monitoring, testing, checks and maintenance of the equipment; currently detected damages or defects of the systems and equipment; deviations from the process regulations requirements and operating instructions and main nonconformities.

All abbreviated names of the systems and equipment shall be decoded next to the first mentioning. Designation of parameters and dimensions of their values shall be consistent with the state standards.

1.2. Description of the sequence of failures, personnel errors made during the occurrence

Description of the sequence of events that took place during the occurrence, equipment failures, personnel incorrect actions is given (in chronological order with indication of time) including the following:

- variation of parameters and modes;
- actuation of interlocks and protections;
- information on operation of the safety critical systems (automatic or manual actuation), other important to safety systems (components), personnel actions taken during the occurrence (both correct and incorrect); failures of systems (components), consequences of these failures.

Date and time is given in the following sequence:

day, month, year, h: min: s (for example 28.05.1995, 01:26:45)..

The occurrence description shall be accompanied by schedules and diagrams illustrating

dynamics of variation of the main and other parameters important for this particular occurrence analysis. The schedules and diagrams shall indicate moments when failures, personnel errors, actuations (actuation failures) of protections and interlocks took place.

A sequence of unit operational occurrence development shall be described including the stage when the unit parameters get stabilized or the unit is shut down, withdrawn for repair.

1.3. Measures taken to clarify the failures, personnel errors

Information is presented regarding the equipment features and performance, the procedures and systems (components) operation analysis that was made, personnel actions taken at the beginning and during the occurrence, measures on arrangement of investigation (setting up the Commission, involving third party organizations) and on clarification of occurrence causes (test, verification, examination of damaged equipment, analysis of technical documentation, analysis of procedures and erroneous personnel actions). Conclusions on results of the performed analysis with references to reports, information notes, justifications, etc. attached to the reports confirming these conclusions of the Commission are presented.

1.4. Predecessor similar events

Information on operational occurrences that took place at this NPP due to failures of similar systems (components), similar personnel errors are given (according to sections 4 and 5 of Appendix 3) with indication of unit number, date of the occurrence, report on the NPP operational occurrence investigation. Information on implementation of measures for correction of these occurrences is presented. A conclusion is made why the previously taken measures have not prevented the repetition of the occurrence. Information is presented regarding similar occurrences in operation of other NPPs.

2. FAILURE CONSEQUENCES

Information on consequences of the occurrence for the NPP safe operation including radiological consequences (if these took place) for the NPP personnel, the population, the environment, etc. is presented with regard to the following issues:

2.1. Violation of limits, conditions of safe operation (indicate where specifically this is manifested, describe the essential of the occurrence, give a reference to an appropriate

paragraph of the process regulation or the operating instruction).

2.2. Exit of reactive substances beyond the established boundaries.

2.3. Exposure of personnel, population (mSv).

2.4. Radioactive contamination of the systems (components), premises and site of the NPP, territory beyond the NPP site (indicate area, level and type of contamination).

2.5. Release (discharge) of industrial harmful (non-radioactive) substances into the environment (level and kind of contamination).

2.6. Time of Unit outage (h)

2.7. Reduced production of electrical (mil kWh) and Thermal (Gcal) energy:

2.8. Damaged, failed component [indicate a particular component (equipment), system, nature of damage]

2.9. Injury of personnel (nature of injury).

2.10. Positive practice in personnel actions.

3. OCCURRENCE CAUSES

Abnormal occurrences in the chronological order with their immediate and root causes; factors contributing to every abnormal occurrence during the NPP operational occurrence are presented.

3.1. List of failures, personnel errors made during the occurrence

A list of all system (component) failures, personnel errors (misoperations) made during the occurrence including the initiating event is presented in the chronological order in the form of the following table.

No. of item	Date, time of equipment failure, personnel	Even (action)	CAUSE: failure of system, component, error of personnel, drawback of operation procedures

	misoperation.		

3.2. Immediate causes of the failures, personnel errors

An immediate cause is a phenomena, process, or state that cause a violation of a normal process (for example, pipeline vibration, erroneous action of the operating personnel on the protection components, change of insulation resistance, etc.).

The immediate cause (including the contributing factors) is specified for every abnormal occurrence. If the immediate cause is a human factor, then reference is made to items 4.11 and 5.1.8 of Appendix 3.

A detailed list of immediate causes of failures, personnel errors is given in item 5.1 of Appendix 3.

3.3. Root causes of the failures, personnel errors

A root cause is a circumstance that created conditions for availability or occurrence of direct cause (for example, constructional defect, workmanship defect, personnel skills shortage).

The root cause (including the contributing factors) is specified for every abnormal occurrence. A detailed list of root causes of failures, personnel errors is given in item. 5.2 of Appendix 3.

Names of organizations or categories of NPP personnel whose substandard work contributed to the failure (personnel error) are specified when giving root causes. Categories of personnel are given in item 4.11 of Appendix 3.

4. SAFETY EVALUATION

4.1. Importance to safety of events in the course of occurrence

Consequences that have taken place or could take place in the case of other possible flow of the occurrence for the Unit (NPP) safe operation are specified.

Failures and personnel errors important to safety are selected out of the list of all failures and personnel errors and are presented in the chronological order in the form of the following table.

No. of item	Time of failure personnel errors	Failure, personnel error	Deviation from the regulations, requirements of the operating instructions.

Assessment of importance of every selected failure and personnel error and their consequences with regards to safety is given after the table for the purpose of identification whether it could have been more severe in real and other possible conditions.

The safety assessment of the NPP operational occurrence shall be performed using the information specified in the safety case, NPP safety analysis report, as well as results of the probabilistic safety analysis (PSA) considering safety importance of every abnormal event during the occurrence.

4.2. Assessment substantiation as per INES

Assessment substantiation as per INES is performed based on the INES Operation Manual Vienna.: IAEA-INES-2001.

Detailed assessment substantiation as per INES is presented.

5. DRAWBACKS REVEALED DURING OCCURRENCE INVESTIGATION

Only those drawbacks revealed during the occurrence investigation are specified that did not have direct influence on the occurrence flow but that are potential indication of other occurrences:

5.1. In personnel actions.

5.2. In the functionality of normal operation systems (components).

5.3. In the functionality of safety systems (components).

5.4. In the functionality of the control and monitoring systems (components).

5.5. In the maintenance and repair.

5.6. In the operation of relay protection and automatics, monitoring equipment and automation, process protections and interlocks, emergency regulating valves.

5.7. In the operating documentation.

5.8. In the arrangement of operation.

6. CORRECTIVE MEASURES

Preventive and corrective measures shall be foreseen for each immediate and root cause of element failure, erroneous action of personnel in the course of an occurrence, as well as of each drawback revealed during the investigation. The Commission shall suggest corrective measures in such a way that ultimate goals and dates of implementation are clear.

Corrective measures shall concern the following:

6.1. Repair of systems (components).

6.2. Replacement of systems (components).

6.3. Operation of systems (components).

6.4. Engineering of systems (components).

6.5. Design of systems (components).

6.6. Manufacture of systems (components).

6.7. Construction of systems (components).

6.8. Installation of systems (components).

6.9. Adjustment of systems (components).

6.10. Regulatory and operational documentation.

6.11. Personnel.

6.12. Procedures of detection and elimination of systems (components) defects and damages, procedures drawbacks, personnel training drawbacks.

Dates of implementation and a responsible person are necessarily specified for every corrective measure.

Control of the implementation and effectiveness of corrective measures are provided by the operating organization according to the established order.

7. ENCODED INFORMATION CARD

To be filled out at the NPP using codes in appendix 3. Corresponding digits and designations are put down in every item from Appendix 3. When encoding, it is necessary to specify all codes pertaining to this occurrence.

The main objective of the NPP occurrence encoding is provision of the possibility for the Operational search for the occurrences data stored in the computer base and the retrieval of required data from the base.

Codes are grouped according to the following eight areas (fields):

7.1. Category of occurrence (Appendix 3, section 1).

This field defines a category to which this occurrence belongs.

7.2. Unit state before the occurrence (Appendix 3, section 2).

This field defines the unit state before the occurrence took place.

7.3. Failed systems (Appendix 3, section 3).

Fields 3.A-3.L define basic process systems, safety critical systems and unit construction systems, which failed:

- during performance of their functions as a result of which the NPP operational occurrence was initiated;
- during performance of their functions in the occurrence flow;
- during the system actuation.

Field 3.M defines auxiliary systems supporting serviceability of the main systems equipment or a human factor (3.MMZ) that failed:

- during performance of their functions as a result of which the equipment or the main systems failure was initiated;
- during performance of their functions in the occurrence flow;
- during the system actuation.

7.4. Failed components, personnel who made the error (Appendix 3, section 4).

This field defines:

- system components failures of which are not conditioned by other failures (independent failures);
- personnel who made the error;
- system components failures of which are conditioned by other failures (dependent failures);

7.5. Causes of occurrence (Appendix 3, section 5).

This field defines immediate and root causes of failures, personnel errors.

7.6. Effect on the unit operation mode (Appendix 3, section 6).

This field defines a result of the occurrence effect on the unit operation mode.

7.7. Nature of occurrence (Appendix 3, section 7).

This field defines the nature (feature) of the occurrence. Specific information on occurrence consequences is presented there.

7.8. Type of occurrence, personnel error (Appendix 3, section 8).

This field defines a type of occurrence consisted of one or several failures, personnel error, common-cause failure. The term "single failure" in Appendix 3 means that one failure of a component took place or one misoperation of the personnel was performed, the term "multiple" means that there were two or more failures or personnel misoperations.

If the occurrence is characterized by features specific to several types of occurrences specified in section 8 of Appendix 3, then all types of occurrences are written down.

8. LIST OF APPENDICES TO THE REPORT ON INVESTIGATION OF NPP OPERATIONAL OCCURRENCE

The list of appendices to the report on the NPP operational occurrence investigation is presented as defined by the Commission. The appendices shall contain sufficient detailed justification of decisions and conclusions made by the Commission.

The recommended list of appendices to the report on the NPP operational occurrence investigation is as follows:

- diagrams of variation of the main systems (components) parameters, printouts of registered variations of the main systems (components) state during the occurrence;
- data of the radiation environment inspection, data on the personnel exposure;
- explanatory notes of the personnel;
- personnel survey protocol;
- required process diagrams, electrical circuits or their parts, drawings, rough drawings, photos of damaged components and places of damage;
- protocols and reports of post-accident checks, results of metallographic analysis, reports of opening (disassembling) of damaged components at the NPP;
- information by weather stations and extracts from the design or the calculation (in the case of occurrences initiated by external effects);
- special opinions of the Commission members;
- other information confirming the Commission conclusions about the occurrence causes.

The following data about every unit of the failed, damaged or faulty component shall be presented:

- brief description of failure, damage or defect;
- station designation;
- type (mark);
- plant number;
- manufacturing organization;
- date of manufacturing and putting into operation;
- date of conduct and type of the latest (before the occurrence) repair;
- results of the latest (before the occurrence) inspection, test (compliance with the requirements of the regulatory and operation documentation);
- time for restoration of the operable condition of the system (component);
- life length of the system (component) since the beginning of operation and since its last failure, damage or defect;
- specify whether similar failures, damages or defects of this or similar component

have ever occurred (specify when).

The NPP operational occurrence investigation report shall be accompanied by a decision about extension of the investigation term if this term exceeds the one established by this Provision.

9. COMMISSION MEMBERS

The following form is used for specification of position, name of the chairman and the members of the Commission:

	Signature	full name
Chairman of the Commission: (position, name of the organization)		
Members of the Commission: (position, official name of organization)		

Appendix 3

ENCODING OF THE NPP OPERATIONAL OCCURRENCE INFORMATION

1. CATEGORY OF OCCURRENCE

A category of the occurrence shall be described according to tables 1 (accident category) and 2 (category of events).

2. UNIT STATE BEFORE THE OCCURRENCE TOOK PLACE

2.0. Other state.

2.1. Reactor is at the steady-state power level:

2.1.1. rated power;

2.1.2. reduced power;

2.1.3. minimum controllable level;

2.1.4. refueling (at NPP with LWGR reactor type).

2.2. Reactor is in the mode of power change:

2.2.1. increase of power;

2.2.2. decrease of power;

2.3. "Hot" shutdown (the reactor is subcritical):

2.3.1. "hot" shutdown (coolant temperature corresponds to the coolant temperature in normal operation);

2.3.2. "hot" shutdown (coolant temperature is lower than the coolant temperature in normal operation);

2.4. "Cold" shutdown (coolant temperature meets the requirements of the process regulations, the reactor is subcritical):

2.4.1 "cold" shutdown (coolant boundary is hermetically sealed).

2.4.2. refueling (at AC with reactors of VVER, BN, GSPR types) or the reactor pressure vessel is open (for maintenance).

2.5. Commissioning.

2.5.1. pre-Commissioning activities;

2.5.2. physical start-up;

2.5.3. power start-up;

2.5.4. trial commercial operation.

2.6. Testing.

2.7. scheduled preventive repair, maintenance;

2.8. Decommissioning

3. FAILED SYSTEMS

3.A REACTOR SYSTEMS

3.AA Reactor core.

3.AB Vessel, metal structures.

3.AC Graphite stack.

3.AX Other.

3.B PROCESS SYSTEMS OF THE PRIMARY CIRCUIT, REACTOR ISLAND

3.BA Coolant circulation system.

3.BB Pressurizer system.

3.BC Component cooling circuit systems (at the NPP with an FR reactor type and at nuclear heat plants).

3.BD Make-up, blowdown and boron control system.

3.BE Active water treatment system.

3.BF Controlled leakage, floor drain water system.

3.BG Gas removal system.

3.BH Fresh nuclear fuel storage system.

3.BI Spent nuclear fuel storage system.

3.BK Spent fuel pool cooling and cooling water cleaning system.

3.BL Refueling system [including the refueling (fuel handling) machine].

3.BM Cooldown system.

3.BN Ventilation systems of normal operation.

3.BP Boron concentrate solution preparation and reserve system.

3.BQ Gas circuit (at NPP with a LWGR reactor type).

3.BX Other.

3.C PROCESS SYSTEMS OF THE SECONDARY CIRCUIT, TURBINE HOUSE

3.CA Turbine with support systems.

3.CB steam pipeline system.

3.CC Feed water system.

3.CD The system of level regulation in steam generators, drums, separators.

3.CE Condensate system.

3.CF Auxiliary steam extraction system [fast acting turbine deaerator steam dump devices, auxiliary bypass valves (BRU-D, BRU-SN) and associated components].

3.CX Other.

3.D PROCESS SYSTEMS OF GENERAL UNIT PURPOSES

3.DA Service water non-essential loads system.

3.DB Circulation water system.

3.DC System of water preparation, receipt and filling of the main circuits.

3.DD Radioactive waste collection and storage system.

3.DE Gas media preparation system (compressed air, nitrogen, etc.).

3.DX Other.

3.E POWER SUPPLY SYSTEMS

3.EB Auxiliary power supply system of alternate current of 6 kV, 10 kV (reliability group 3).

3.EC Auxiliary power supply of alternate current of 0,4/0,2kV (reliability group 3).

3.ED Auxiliary power supply system of direct current.

3.EE External power supply system of 35 kV and above.

3.EX Other.

3.F MONITORING SYSTEMS

3.FA In-core monitoring system.

3.FB Radiation and dosimetry monitoring system (radiation protection).

3.FC Fuel element failure detection system.

3.FD The secondary circuit coolant activity monitoring system.

3.FE System of monitoring the state of metal and welded joints of the reactor vessel, primary circuit pipelines, forced circulation coolant circuit pipelines.

3.FF Reactor graphite stack and structures temperature monitoring system.

3.FG Fuel channel failure detection system.

3.FH Radioactive process medial sampling system.

3.FI Integrated automated control system.

3.FX Other.

3.G PROTECTION SAFETY SYSTEMS

3.GA Reactor control and protection equipment.

3.GB Emergency (reactor) core cooling system, passive part (tanks, accumulator tanks).

3.GC Emergency (reactor) core cooling system, active part (pumping systems).

3.GD System of emergency absorber supply to the reactor (emergency borating system, emergency boron injection system).

3.GE Feed water emergency supply system.

3.GF Reactor (reactor cavity), primary circuit, forced circulation coolant circuit excess pressure protection system.

3.GG (Secondary circuit) steam pipelines excess pressure protection system.

3.GH Steam pipeline fast acting cut-off valves system.

3.GI Main coolant pipe hydroseal drainage system, primary circuit coolant loss protection system (at NPPs with FR type reactors.

3.GK Emergency gas removal system (from the primary circuit, hermetically sealed rooms).

3.GL Spent fuel pool emergency cooling system.

3.GM Seismic automated protection system.

3.GX Other.

3.H LOCALIZING SAFETY SYSTEMS

3.HA System of sealed enclosures (containment, containment preloading system, liner and walls of hermetically sealed rooms, penetrations, locks, hatches, doors, valves, diaphragms, blowout panel, reinforced concrete enclosure structures, etc..).

3.HB Localizing valves system.

3.HC Sprinkler cooling system.

3.HD Passive steam condensate, bubbling-condensing system.

3.HE Hydrogen concentration monitoring and emergency removal system.

3.HX Other.

3.I CONTROL SAFETY SYSTEMS

3.IA Reactor control and protection system automatics.

3.IB Safety systems controls (including the stepwise startup automatics).

3.ID Fire extinguishing system control system.

3.IX Other.

3.K SUPPORT SAFETY SYSTEMS

3.KA Essential loads service water system.

3.KB Standby diesel-generator station.

3.KC System of auxiliary reliable (emergency) power supply of alternate current of 6 kV, 10 kV (reliability group 2).

3.KD System of auxiliary reliable (emergency) power supply of alternate current of 0.4 kV (reliability group 2).

3.KE System of auxiliary reliable (emergency) power supply of alternate current (reliability group 1).

3.KF System of auxiliary reliable (emergency) power supply of direct current (reliability group 1).

3.KG Fire extinguishing system (part of fire safety system ensuring performance of safety system functions in fire).

3.KH Safety system compartments ventilation system, air condition system.

3.KI Nitrogen and compressed air systems used as power sources for safety systems.

3.KK CPS ducts cooling system.

3.KX Other.

3.L STRUCTURES

3.LA Nuclear Island building.

3.LB reactor island support systems building.

3.LC Turbine building.

3.LD Standby diesel-generator station building.

3.LE Outdoor switch-gear.

3.LF Indoor switch-gear.

3.LG Main, reserve control room.

3.LH Automatics panels room.

3.LI Fresh nuclear fuel repository.

3.LJ Spent nuclear fuel repository.

3.LK Radioactive waste reprocessing building.

3.LL Pump station building.

3.LM Cooling tower, cooling pond.

3.LN Vent stack.

3.LX Other.

3.M AUXILIARY SYSTEMS OF THE MAIN SYSTEMS EQUIPMENT AVAILABILITY SUPPORT

3.MAA Power supply system of control panels, control and protection units.

3.MAB Control, protection and warning circuits.

3.MAC Circuits of the electric networks relay protection and controls.

3.MBA Power supply system of the monitoring and measurement circuits.

3.MBB Monitoring and measurement of process variables.

3.MBC Monitoring and measurement of electrical parameters.

3.MBD Monitoring of equipment state (position).

3.MMA Blowdown water system.

3.MMB Drain and air vent system.

3.MMC Component cooling circuit system

3.MMD Autonomous circuit system (for RCP, diesel generator stator inclusive).

3.MME Steam extraction system (for the turbine driven feed water pump inclusive).

3.MMF Condensate system.

3.MMG Oil system.

3.MMH Compressed air system.

3.MMI Excitation.

3.MMK Seal system.

3.MML Turbine regulation and protection system.

3.MMM Heating, warm-up system.

3.MMN Actuator.

3.MMP Generator rotor cooling system.

3.MMQ Diesel fuel system.

3.MMR Communication system.

3.MMS Sodium purification system.

3.MMX Other.

3.MMZ Human factor.

4. FAILED COMPONENTS, PERSONNEL WHO MADE THE ERROR

4.0. Other

4.1. REACTOR EQUIPMENT (COMPONENTS)

4.1.00. Other.

4.1.10. Upper unit head

4.1.20. Reactor pressure vessel:

4.1.21. reactor head;

4.1.22. reactor pressure vessel seal.

4.1.30. Reactor internals:

4.1.31. spacer grid;

4.1.32. protective tube unit.

4.1.40. Process channel:

4.1.41. CPS ducts, power density monitoring sensor, reflector cooler, fission chamber;

4.1.42. channel sealing.

4.1.50. Guard tank.

4.1.60. Reflector.

4.1.70. Fuel assembly:

4.1.71. spacer grid;

4.1.72. fuel element.

4.1.80. CPS control rod (without drive), burnable poison rods.

4.1.90. Refueling (fuel handling) machine equipment.

4.2. EQUIPMENT (COMPONENTS) OF PROCESS SYSTEMS

4.2.00. Other.

4.2.10. Heat exchange equipment:

4.2.11. steam generator, drum separator;

4.2.12 Heat exchangers between circuits (at the NPP with an FR reactor type and at nuclear heat plants).

4.2.13. deaerator, separator;

4.2.14. process condenser;

4.2.15. high-pressure heater;

4.2.16. low pressure heater;

4.2.17. other heat exchangers.

4.2.20. Pumps:

4.2.21. RCP;

4.2.22. electric pump (except RCP);

4.2.23. turbine-driven pump;

4.2.24. water injection pump;

4.2.25. compressor.

4.2.30. Valves:

4.2.31. shut-off valves;

4.2.32. control valves;

4.2.33. safety valve, membrane;

4.2.34. check valve;

4.2.35. atmospheric steam dump station;

4.2.36. condenser steam dump device, bubbler;

4.2.37. pressure reducing valve;

4.2.38. other.

4.2.40. Pipeline:

4.2.41. distribution header;

4.2.42 distribution group header;

4.2.43. steam generator header;

4.2.44. large diameter pipeline (internal diameter above 100 mm);

4.2.44. small diameter pipeline (internal diameter below 100 mm);

4.2.50. Reservoir:

4.2.51. tank;

4.2.52. pressure vessel;

4.2.53. pool.

4.2.60. Filter:

4.2.61. mechanical;

4.2.62. ion exchanging.

4.2.70. sealing element.

4.3. EQUIPMENT (COMPONENTS) OF VENTILATION, AIR CONDITIONING, HEATING SYSTEMS

4.3.00. Other.

4.3.10. Fan.

4.3.20. Air conditioner.

4.3.30. Air cooler.

4.3.40. Filter:

4.3.41. mechanical (aerosol);

4.3.42. ion exchanging (iodine).

4.3.50. Check valve, butterfly valve, sealing valve.

4.3.60. Air duct.

4.3.70. Heater:

4.3.71. electric heating unit;

4.3.72. heater;

4.3.73. calorifer.

4.4. TURBINE EQUIPMENT (COMPONENTS)

4.4.00. Other.

4.4.10. Turbo-generator set:

4.4.11. blade system;

4.4.12. stator;

4.4.13. rotor;

4.4.14. bearing;

4.4.15. diaphragm.

4.4.20. Stop, regulating valve.

4.4.30. Condenser.

4.4.40. Intermediate steam heater.

4.4.50. Manual control mechanism.

4.5. EQUIPMENT (COMPONENTS) OF AUTOMATIC AND REMOTE CONTROL, PROTECTION AND ALARM SYSTEM

4.5.00. Other.

4.5.10. Control cable, control plate (monitoring, alarm), connecting wire.

4.5.20. Terminal box. electric terminal, connector, plug-in.

4.5.30. Electronic component, logic unit, relay.

4.5.40. Switch gears:

4.5.41. button, limit switch;

4.5.42. packet-type switch;

4.5.43. manual control key.

4.5.50. signal panel, light indication of equipment state, position, parameters indicating device.

4.5.60. Panels, cabinets and elements of their structure.

4.6. EQUIPMENT (COMPONENTS) OF CONTROL AND INSTRUMENTATION SYSTEM FOR MEASURING THERMOPHYSICAL AND PROCESS PARAMETERS

4.6.00. Other.

4.6.10. Sensors, converters of measurement and control of thermophysical and process parameters:

4.6.11. flow, pressure;

4.6.12. temperature;

4.6.13. level;

4.6.14. substances concentration;;

4.6.15. humidity;

4.6.16. neutron flux;

4.6.17. seismic characteristics;

4.6.18. vibration.

4.6.20. Pulse tube, sleeve.

4.6.30. Bleeder, check valve.

4.6.40. End switch, position indication probe.

4.6.50. Control cable.

4.6.60. Relay terminal contacts.

4.6.70. Detector of the automatic fire extinguishing system.

4.7. EQUIPMENT (COMPONENTS) OF CONTROL AND INSTRUMENTATION SYSTEM FOR MEASURING ELECTRICAL PARAMETERS

4.7.00. Other

4.7.10. Measuring transformer:

4.7.11. voltage transformer;

4.7.12. current transformer.

4.7.20. Parameter measuring sensors (devices):

4.7.21. power measuring sensor (device);

4.7.22 current measuring sensor (device);

4.7.23. voltage measuring sensor (device);

4.7.24. frequency measuring sensor (device).

4.8. EQUIPMENT (ELEMENTS) OF THE POWER SUPPLY SYSTEM

4.8.00. Other

4.8.10. Supply transformer:

4.8.11. main transformer, autotransformer;

4.8.12. unit auxiliary transformer (work, reserve);

4.8.13. auxiliary transformer of 6/0,4 kV (10/0,4 kV).

4.8.20. Generator:

4.8.21. Other generator equipment;

4.8.22. rotor winding, rotor;

4.8.23. stator winding, stator;

4.8.24. brushes, collectors;

4.8.25. bearing;

4.8.26. generator hydrogen cooling system components.

4.8.30. Reactor, surge protection device.

4.8.40. Surge arrester.

4.8.50. Switch gear:

4.8.51. circuit breaker;

4.8.52. breaker, isolator, fault-thrower;

4.8.53. Transfer circuit breaker, packet-type switch, thyristor key.

4.8.60. Current-carrying elements:

4.8.61. power cable;

4.8.62. bus wire, wireway;

4.8.63. terminal block, terminal box, connecting unit;

4.8.64. panel.

4.8.70. Energy accumulators, generators:

4.8.71. accumulator battery;

4.8.72. reversible generator motor, inverter;

4.8.73. rectifying device;

4.8.74. non-sinusoidal current transducer;

4.8.75. sinusoidal current transducer;

4.8.76. condenser.

4.8.80. Isolating elements:

4.8.81. oil-filled insulator;

4.8.82. base insulator;

4.8.83. wall entrance insulator;

4.8.84. suspended insulator.

4.9. ACTUATING DEVICES OF PROCESS EQUIPMENT (ELEMENTS)

4.9.00. Other

4.9.10. Control rod drive

4.9.20. Electric motor.

4.9.30. Pipeline

4.9.40. Pneumatic actuator.

4.9.50. Diesel.

4.10. COMPONENTS OF BUILDINGS AND STRUCTURES

4.10.00. Other

4.10.10. Roof, floor.

4.10.20. Partition.

4.10.30. Wall.

4.10.40. Door.

4.10.50. Containment and its elements (liner and walls of hermetically sealed rooms, penetrations, locks, hatches, doors (of embedded penetrations, locks, latches, doors), pressure-relief valves, closures, blowout panels, reinforced concrete enclosure structures, etc.).

4.10.60. Palette.

4.10.70. Waterproofing

4.11. PERSONNEL, MAKING THE ERROR (ACTIVE MISOPERATION OR LOSS OF ACTION)

4.11.0. Other groups of personnel.

4.1.11 Administrative-engineering (management).

4.11.2. Operational.

4.11.3. Repair.

4.11.4. Personnel of services and laboratories.

5. OCCURRENCE CAUSES

5.1. IMMEDIATE CAUSES OF FAILURES, PERSONNEL ERRORS

5.1.0. Undefined

5.1.1. MECHANICAL PHENOMENA, PROCESSES, CONDITIONS

5.1.1.0. Other mechanical causes not included into this group of causes.

5.1.1.1. Corrosion, erosion.

5.1.1.2. Wear, unsatisfactory lubrication.

5.1.1.3. Destruction, fatigue, welded joint defect, internal defect of the material.

5.1.1.4. Exceeding of limit load (overloading).

5.1.1.5. Vibration.

5.1.1.6. End of life.

5.1.1.7. Leakage.

5.1.1.8. Blocking, restriction in movement, seizure, jamming.

5.1.1.9. Deformation, lack of alignment, shift, false movement, disconnection, loosening.

5.1.1.10. Loosening of attachment to foundation, civil engineering structures, destruction of foundation, civil engineering structures.

5.1.1.11. External mechanical effect.

5.1.1.12. Contamination, intrusion of foreign matters

5.1.2. ELECTRICAL PHENOMENA, PROCESSES, CONDITIONS

5.1.2.0. Other electrical causes not included into this group of causes.

5.1.2.1. Short circuit, sparking.

5.1.2.2. Current overload.

5.1.2.3. Voltage, frequency deviation.

5.1.2.4. Bad contact, interruption, opening of circuit.

5.1.2.5. Ground fault.

5.1.2.6. Decrease of resistance, isolation damage.

5.1.2.8. Internal damage.

5.1.2.9. Unforeseen electrical connection (shorting).

5.1.2.10. Disturbances, crosstalk due to instability (fluctuation) of electrical parameters.

5.1.2.11. Decrease (loss) of capacity.

5.1.3. CHEMICAL PHENOMENA, PROCESSES, REACTOR PHYSICS

5.1.3.0. Other chemical causes not included into this group of causes.

5.1.3.1. Chemical pollution (sediments, residual, scale).

5.1.3.2. Fire, ignition, explosion.

5.1.3.3. Uncontrolled chemical reaction.

5.1.3.4. Reactor physics problems.

5.1.3.5. Unsatisfactory chemical technology or nonconforming chemical monitoring.

5.1.3.6. Radioactive contamination.

5.1.4. HYDRAULIC PHENOMENA, PROCESSES

5.1.4.0. Other hydraulic causes not included into this group of causes.

5.1.4.1. Water hammer, overpressure.

5.1.4.2. Pressure decrease

5.1.4.3. Pressure pulsation.

5.1.4.4. Cavitation.

5.1.4.5. Gaslock.

5.1.4.6. Presence of moisture in the air system.

5.1.4.7. Surge.

5.1.5. PHENOMENA, PROCESSES IN THE MONITORING EQUIPMENT

5.1.5.0. Other environmental conditions not included into this group of causes.

5.1.5.1. False signal.

5.1.5.2. Parameter fluctuation.

5.1.5.3. Setting shift, "zero" shift.

5.1.5.4. Faulty reading of parameter.

5.1.5.5. Loss of signal, lack of signal.

5.1.5.6. Deficiency or defects of the computer hardware.

5.1.5.7. Defect of the PC software

5.1.6. ENVIRONMENTAL CONDITIONS FOR EQUIPMENT (ABNORMAL CONDITIONS INSIDE NPP COMPARTMENTS)

5.1.6.0. Other environmental conditions not included into this group of causes.

5.1.6.1. Temperature

5.1.6.2. Pressure

5.1.6.3. Moisture content

5.1.6.4. Flooding

5.1.6.5. Freezing

5.1.6.6. Radiation of units (components).

5.1.6.8. Smoke spread.

5.1.6.9. Explosion.

5.1.7. ENVIRONMENTAL CONDITIONS

(ABNORMAL CONDITIONS OUTSIDE NPP COMPARTMENTS)

5.1.7.0. Other environmental conditions not included into this group of causes.

5.1.7.1. Lighting stroke.

5.1.7.2. Heavy rain or snowfall, flooding.

5.1.7.3. Storm (hurricane), tornado, wind loads.

5.1.7.4. Earthquake.

5.1.7.5. Low temperature, freezing.

5.1.7.6. High temperature.

5.1.7.7. Air blast.

5.1.7.8. Falling, flying objects.

5.1.7.9. Icing.

5.1.7.10. Differential foundation settlement.

5.1.8. HUMAN FACTOR, CAUSES OF PERSONNEL ERRORS

5.1.8.1. Type of personnel erroneous actions.

5.1.8.1.0. Other personnel erroneous actions.

5.1.8.1.1. Incorrect implementation of process operations (including those performed during switching, connecting), impacts on elements of protection, automatics.

5.1.8.1.2. Inactivity, act of omission.

5.1.8.1.3. Violation of maintenance technology.

5.1.8.2. Incorrect, random effect on elements of protection and automatics.

5.1.8.3. Unauthorized work performance, switchings, etc.

5.1.8.4. Inconsistent actions.

5.1.8.5. Installation, putting to operation of untested faulty hardware, components (with faulty devices, assemblies); installation of not designed assemblies, parts.

5.1.8.6. Lack of control, poor quality control of the system (components) condition and the process operations.

5.1.8.7. Intentional intervention to the automatics operation.

5.1.8.8. Working without a program, a switching form, a job order-authorization, deviation

from the work program, instructions and other documents.

5.1.8.9. Low-quality repair, violation of repair processes.

5.1.8.10. Low-quality welding.

5.1.8.11. Low-quality assembling (unreliable torqueing, clamping of detachable joints, seals, etc.).

5.1.8.12. Low-quality post repair testing, breaking-in.

5.1.8.13. Inspection errors, maintenance errors, test or adjustment errors.

5.2. ROOT CAUSES

5.2.0. Not defined

5.2.1. Designing drawbacks (including changes).

2.2.5. Engineering drawbacks (including changes).

5.2.3. Manufacturing defect.

5.2.4. Construction drawbacks.

5.2.5. Assembling drawbacks.

5.2.6. Adjustment drawbacks.

5.2.7. Drawbacks of repair performed by third party (with regards to the NPP) organizations.

5.2.8. Drawbacks of design engineering documentation and other documentation of the manufacturer

5.2.9. Weakness of NPP management and NPP operation arrangement.

5.2.9.1. Drawbacks of operating documentation such as the following:

5.2.9.1.1. missing documentation;

5.2.9.1.2. incorrect or ambiguous definition of documentation requirements;

5.2.9.1.3. Untimely introduction of changes in the documentation.

5.2.9.2. Failure to take necessary measures or their untimely implementation for the following:

5.2.9.2.1. provision of the systems with working media, materials, spare parts, assembles, units;

5.2.9.2.2. changes in circuit designs of the systems, component structures, engineering solutions and design documentation; as well as making decisions without agreement by the design, engineering organizations, manufacturer of the equipment (elements);

5.2.9.2.3. elimination of drawbacks revealed;

5.2.9.2.4. corresponding analysis of the engineering solutions, changes of design layouts before their implementation.

5.2.9.3. Defect in the procedure of authorization for elimination of deficiencies, maintenance and monitoring of these activities.

5.2.9.4. Defects in the procedures of maintenance and repair performed by the NPP personnel including the monitoring.

5.2.9.5. Problems of communication or errors in information transfer.

5.2.9.6. The NPP personnel drawbacks.

5.2.9.6.1. Psychological causes of the personnel erroneous actions are as follows:

5.2.9.6.1.1. inadequate motivation;

5.2.9.6.1.2. inadequate personal psychological qualities important for the profession;

5.2.9.6.1.3. inadequate psychophysiological qualities (speed and accuracy of reaction);

5.2.9.6.1.4. inadequate mental features, memory, attention;

5.2.9.6.1.5. subnormal functionality;

5.2.9.6.1.6. poor professional qualifications.

5.2.9.6.2. External factors and means of activity such as the following:

5.2.9.6.2.1. ergonomic features of the operational documentation;

5.2.9.6.2.2. ergonomic features of the labor conditions:

5.2.9.6.2.2.1. schedule of work and rest;

5.2.9.6.2.2.2. work place arrangement;

5.2.9.6.2.2.3. ergonomic deficiencies of the technology.

5.2.9.6.2.3. Hidden (unrevealed) ergonomic errors of the design and the assembling at the previous phases of the NPP life cycle.

5.2.9.6.2.4. Conflicts or any other social-psychological situation that influenced the functional ability during misoperations:

5.2.9.6.2.4.1. in the group (team);

5.2.9.6.2.4.2. in everyday life.

5.2.9.6.2.5. Social conditions.

5.2.9.6.2.6. Political and social situation.

5.2.9.6.2.7. Organizational factors:

5.2.9.6.2.7.1. organizational structure;

5.2.9.6.2.7.2. control;

5.2.9.6.2.7.3. communication.

5.2.9.7. Deficiencies in the station program for monitoring:

5.2.9.7.1. the reveal and elimination of the systems (components) unavailability;

5.2.9.7.2. the reveal and elimination of the procedures deficiencies;

5.2.9.7.3. the reveal and elimination of the personnel training drawbacks.

6. IMPACT ON THE UNIT OPERATION MODE

6/0. Other (without change of the Unit power).

6.1. Disconnection of the Unit from the network with EP actuation:

6.1.1. automatic;

6.1.2. manual (using EP CK).

6.2. Disconnection of the Unit from the network without EP actuation:

6.2.1. with reactor shutdown;

6.2.2. with reactor unloading.

6.3. Unit load reduction without disconnection from the network.

6.1.3 Automatic:

6.3.1.1. with turbine disconnection;

6.3.1.2. without turbine disconnection.

2.3.6. Manual:

6.3.2.1. with turbine disconnection;

6.3.2.2. without turbine disconnection.

6.4. Actuation of safety critical systems due to the need for safety function performance.

6.1.4 Actuation of process safety critical system channels.

6.2.4 Actuation of the primary circuit safety devices [safety valve of the pressurizer (PR SV) for NPP with WWER type reactors; main safety valve (MSV) for NPP with LWGR and Graphite steam power reactor types].

6.4.3. Actuation of the secondary circuit safety devices [safety valve of the steam generator (SG SV), steam dump device into atmosphere (BRU-A)].

6.4.4. Diesel generator startup.

6.5. Actuation of safety critical systems not associated with the need for safety function performance (spurious actuation).

6.6. Violation of safe operation conditions, limits.

6.7. Shutdown of the reactor not included into the Unit network:

6.1.7 Shutdown of the reactor in the critical state with EP actuation:

6.7.1.1. automatic;

6.7.1.2. manual (using EP CK).

6.2.7 Shutdown of the reactor in the critical state without EP actuation.

6.7.3. Actuation of EP on the shutdown reactor (lower than the minimum Controllable

Level):

6.7.3.1. automatic;

6.7.3.2. manual (using EP CK).

7. NATURE OF OCCURRENCE

7.0. Other.

7.1. Radioactive materials releases and radiation exposure.

7.1.1 Radioactive materials releases exceeding the established limits no matter whether they are within the site boundaries or went out of the site.

7.2.1 Population radiation exposure.

7.1.3 Radiation exposure exceeding the established dose limits for the personnel on the NPP site.

7.1.4 Local radioactive contamination of the NPP territory, compartments.

7.2. Cladding damage.

7.3. Main process loops loss of integrity:

7.3.1. The primary circuit loss of integrity, opening and nonclosure of EP CK (at NPP with WWER type reactors); loss of integrity of the forced circulation coolant circuit (at NPP with LWGR type reactors), opening and nonclosure of the main steam header (at NPP with LWGR and Graphite steam power reactor types);

7.3.2. loss of integrity of the secondary circuit of NPP with WWER type reactors (steam pipelines, opening and nonclosure of BRU-A, SG EP); main steam pipeline (at NPP with LWGR type reactors);

7.3.3. loss of integrity of other elements.

7.4. Loss of function of the containment or loss of its integrity.

7.5. Loss of function of the safety critical systems.

7.6. Failure or occurrence in the safety critical system.

7.7. Failure or occurrence in the control of reactivity of:

7.7.1. CPS control rods;

7.7.2. CPS control rod control system;

7.7.3. boron control system.

7.9. Failure or occurrence in the heat removal system.

7.10. Loss of power sources:

7.10.1. internal;

7.10.2. external.

7.12. Transient modes:

7.12.1. according to the design algorithm;

7.12.2. according to the algorithm other than design.

7.13. Physical harmful effects (at the NPP or off the NPP site).

7.14. Occurrence during Nuclear fuel management.

7.15. Occurrence during treatment of radioactive waste.

7.16. Violation of NPP physical protection, sabotage or malicious intent.

7.17. Equipment damage.

7.18. Detection of important conditions which have not been considered and analyzed before;

7.19. Water chemistry anomalies.

8. TYPE OF VIOLATION

8.0. Other

8.1. Single failure (misoperation).

8.2. Multiple failure (misoperations).

8.3. Common cause failure (misoperations).

8.4. Unexpected systems interaction (beyond design basis parameter change in transients).

8.5. Existence of similar violations before.

8.6. Dependent failure.

8.7. Independent failure.