| **The training program****“Water-chemistry mode of the VVER-1000 NPP primary circuit”** |
| --- |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours )Kurchatov(** | **Number****of hours )Tavana(** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| **General information about nuclear energy and nuclear reactors** |
| 1 | General issues of holding the primary circuit water-chemistry mode (WCM). | 4 | 0 | National Research Center “Kurchatov Institute” | This item is general and so preliminary issue. It is not needed to present because TAVANA experts have got sufficient knowledge about this topic. |
| 2 | Primary circuit WCM norms. Selection of optimal quality parameters:* regulated quality parameters;
* diagnostic quality parameters
 | 2 | 2 | National Research Center “Kurchatov Institute” |  |
| 3 | Basic requirements for holding the primary circuit WCM:* suppression of the formation of oxidative corrosion products;
* minimization of corrosion processes of the primary circuit equipment materials and fuel assemblies of the reactor core;
* minimization of mass transfer and the formation of corrosion product deposits on the heat-exchange surfaces of the circulation circuit;
* minimization of the circuit equipment contamination with activated corrosion products
 | 8 | 2 | National Research Center “Kurchatov Institute | It would be helpful if calculation methodology for water chemistry parameters such as:* Calculating methodology related to the distribution of Boric Acid and the important impurities in the primary circuit
* Calculating and estimating methodology related to the sedimentation rate on the fuel rods and heat transfer surfaces in the primary circuit
* the calculating and estimating methodology of acidity value at operating temperature (pHT) and electrical conductivity related to the primary circuit fluid
* the calculating and estimating methodology of acidity value at operating temperature (pHT), cationic electrical conductivity (Xн), organic material content in SG blow down water, qualitative indexes of SG feeding water
* Calculating and estimating methodology of sedimentation rate on heat transfer surfaces and SG tubes in the secondary circuit of BNPP
* Methodology of identifying the amount of chemical material injection (hydrazine, ammonia, MEA and etc.)
* Methodology of identifying the operational norms in order to control the chemical parameters of the primary and secondary circuit in the contemporary and new water chemistry regime
* Calculation method for estimation of vacuum in condenser

Would be mentioned. |
| 4 | Basic principles for optimal coordinating dependence of WCM norms schedule development | 4 | 2 | National Research Center “Kurchatov Institute” |  |
| 5 | Primary-circuit WCM norms in normal operation modes of the power unit:* the reactor start-up and “hot” condition reaching;
* work at MCL power and at power levels up to 30%;
* work at power levels from 30 to 50%;
* work at power of more than 50%;
* power unit cooling down, cold condition.
 | 2 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 6 | Process diagram and operating efficiency of the primary circuit WCM holding systems equipment:* operation of filters for cleaning the KBE system (mixed-bed filters, H + and OH- filters);
* operation of the KBA system deaerator;
* operation of the KBD system reagents dosing unit
 | 4 | 2 | NationalResearch Center “Kurchatov Institute” | The training issues should be up to dated and based on new technologies; otherwise TAVANA experts have got sufficient knowledge about this topic. |
| 7 | The technology of dosing corrective reagents in normal operation modes of the power unit, including:* reactor start-up and “hot” condition reaching;
* work at MCL power and at power levels up to 30%;
* work at power levels from 30 to 50%;
* work at power more than 50%;
 | 2 | 2 | NationalResearch Center “Kurchatov Institute” | It is helpful if the topic would be aboutMethod of selecting the best secondary water chemistry regimes like:* Reagents selection and concentration
* Physicochemical model of mass transfer of corrosion products in secondary circuit by VNIIAES
* Determination of the main parameters required to be monitored:
* Calculation method of pHT based on pH 25oC
* Calculation method of reagent concentration and rate of for dosing
* Mono ethanol amine(MEA) and hydrazine decomposition mechanisms
* The effect of copper alloys in secondary circuit on water chemistry regime
 |
| 8 | Requirements for the scope and frequency of monitoring the primary circuit WCM quality parameters | 2 | 2 | NationalResearch Center “Kurchatov Institute” | It is suggested that this item would be modified with the following items:* Chemistry monitoring
* Radioactivity monitoring
* Fuel failure estimation from coolant activity and its possibility to implement in diagnostic systems
* Corrosion monitoring
* Electrochemical corrosion potential (ECP) monitoring
* Further development of on-line HT sensors for ECP measurements
 |
| 9 | Practical training and answers to the questions. | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 10 | Approach to water chemistry and corrosion control **)it is suggested that this item will be included for the training program)** |  |  |  | It is recommended that some courses for Major purposes of water chemistry control would be considered such as:* Off-line (grab) sampling
* On-line monitoring
* Data storage
* Data processing, trending and analysis
* Quality assurance of data
* Updating chemistry specifications
 |
| 11 | Development of models and methods **)it is suggested that this item will be included for the training program)** |  |  |  | * Development of method for defining optimum pH-ECP for
* corrosion control
* Modeling of electrochemical potential (ECP)
* Corrosion control
* Life time prediction
 |
| **TOTAL:** | **32** | **20** |  |
| **Information and Advisory Services Program** **“Management of beyond design basis accidents for the power unit”** |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours )Kurchatov(** | **Number****of hours )Tavana)** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| 1 | General principles of accident management | 2 | 2 | NationalResearch Center “Kurchatov Institute” | should be replaced by: guidance on review and validation of accident control guidelines” |
| 2 | Review of power unit accident-prevention documentation | 2 | 2 | NationalResearch Center “Kurchatov Institute” | should be replaced by: guidance on review and validation of accident control guidelines” |
| 3 | Phenomenology of accidents occurrence at nuclear power plants with VVER units:processes at the power unit in case of accidents before their transition to the severe stage;Phenomenology of severe accidents. | 6 | 6 | National Research Center“Kurchatov Institute” | should be replaced by: guidance on review and validation of accident control guidelines” |
| 4 | Beyond design basis accidents management strategies:management of beyond design basis accidents at the stage of core damage prevention;management of beyond design basis accidents at the stage of severe accidents consequences mitigation. | 6 | 6 | National Research Center“Kurchatov Institute” |  |
| 5 | Accident mitigation procedures (together with the developersof the AMP) | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 6 | Design-basis justification for the “Accident mitigation procedures” (examples of accident design analysis with accident management) | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 7 | Procedures of the “Beyond design basis accident managementguideline” (together with the developers of the BDBAMG) | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 8 | Design-basis justification for the “Beyond design basis accident management guideline” (examples of accident design analysis with accident management) | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 9 | Severe accident management guideline instructions | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| 10 | Design-basis justification for the “Severe accident managementguideline” (examples of accident design analysis with accident management) | 4 | 4 | NationalResearch Center “Kurchatov Institute” |  |
| **Total:** | **40** |  **40** |  |

|  |
| --- |
|  **The training program “Supervising physicist” (IR)** |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours )Kurchatov(** | **Number****of hours )Tavana(** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| 1 |  Neutron-physical characteristics of the first and subsequent reactor fuel loads | 2 | 2 | National Research Center “Kurchatov Institute” |  |
| 2 |  Reactor control under normal operating conditions:* the reactor is in the subcritical state and at MCL power;
* restrictions on the energy release of the core;
* mutual influence of power and axial offset;
* Xenon transition processes;
* control actions;
* management of the reactor integrated power;
* management of the energy release distribution;
* basic and maneuverable operating modes.
 | 12 | 12 | National Research Center “Kurchatov Institute” |  |
| 3 |  Reactor physical launch:* stage program of physical launch;
* physical launch hardware, PLH;
* methods and means of experimental data processing;
* the first fuel loading into the reactor core;
* the first exit to a critical state, achievement of MCL;
* determining the effectiveness of regulating units;
* determining reactivity effects and coefficients;
* determining the emergency protection effectiveness.
 | 12 | 12 | National Research Center “Kurchatov Institute” |  |
| 4 | Power start-up and pilot operation:* stage programs for power start-up and pilot operation;
* determining the effectiveness of regulating units;
* determining reactivity effects and coefficients;
* determining the integrated xenon processes characteristics;
* determining the spatial xenon processes characteristics;
* testing of energy release control algorithms;
* testing of daily load schedule mode.
 | 8 | 8 | National Research Center “Kurchatov Institute” |  |
| 5 | IR program in on-line and off-line modes | 8 | 8 | National Research Center “Kurchatov Institute” |  |
| 6 | Practical training on the reactor operation design simulation using the IR program | 12 | 12 | National Research Center “Kurchatov Institute” |  |
| **TOTAL:** | **54** | **54** |  |

|  |
| --- |
| **The training program on the****basic principles of VVER-1000 reactor fuel cycle design** |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours (Kurchatov)** | **Number****of hours****(Tavana)** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| 1 | Nuclear and physical design part | 12 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 2 | Analysis of the VVER-1000 reactor core neutron-physical characteristics. | 30 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 3 | Development of the VVER-1000 reactor fuel cycle alternate designsunder the PROROK-A program | 12 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 4 | Preparation of documents on fuel management for fuel loads generated during the operation of nuclear power plants | 30 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 5 | Answers to the questions of Iranian specialists upon all internship program | 6 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 6 | Test problems solution by TAVANA specialists | 12 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 7 | **KASKAD issues:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
| KASKAD settings for neutron-physics parameters calculations in transient cycles (from UTVS to TVS-2M fuel type). |  | 10 |
| Structure of PAR files in KASKAD such as: BIPPAR, PERMPAR, TEPLOPAR… for 30 and 60 and arbitrary axial layer nodes.  |  | 20 |
| Answer to Iranian specialists’ questions. |  | 2 |
| 8 | **Ql Calculation:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
| Extracting maximum Ql for all axial layers for TVELs and TVEGs from KASKAD. |  | 5 |
| Producing Ql diagram by ALBUM module. |  | 2 |
| Answer to Iranian specialists’ questions. |  | 1 |
| 9 |  **Cell Calculation by TVS-M code:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
|  Modeling of fuel pins and fuel assembly by TVS-M code. |  | 8 |
| All settings for describing desired states. |  | 8 |
| Application of some parameters such as PC3, PK8. |  | 2 |
|  Calculation of neutronic constant and sensitivity coefficients for ICIS by TVS-M code. |  | 10 |
| Procedure of preparing BIPR and PERMAK libraries for UTVS and TVS-2M types of fuel assemblies by TVS-M code. |  | 10 |
| Calculation of BETA and decay constants of precursors. |  | 2 |
| Answer to Iranian specialists’ questions. |  | 2 |
| 10 | **Core map design by PROROK-A:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
|  | Procedure of core map design for transient cycles. (cycles 7 and further) |  | 10 |
|  | Some useful notes for best core map design. |  | 5 |
|  | Discussion about some possible scenarios for replacements of fuels such as UTVS instead of TVS-2M fuel type in transient cycles. |  | 10 |
|  | Answer to Iranian specialists’ questions. |  | 2 |
| 11 |  **Comparison of calculation and measurement results:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
| Discussion about relevant methods for comparison |  | 8 |
| Discussion about PIR-A results |  | 8 |
| Answer to Iranian specialists’ questions. |  | 2 |
| 12 | **MCU-PD Monte Carlo code:** | National Research Center “Kurchatov Institute” | (it is suggested that these items will be included for the training program) |
| Modeling of the whole core of VVER-1000 by MCU-PD. |  | 8 |
| Calculation of neutron flux on the barrel. |  | 8 |
| Dose calculation by MCU-PD. |  | 8 |
| Variance reduction methods |  | 4 |
| Compiling of MCU-PD source code for Parallel Processing. |  | 3 |
| 13 | Answer to Iranian specialists’ questions. |  | 2 |  |  |
| **TOTAL:** | **102** | **160** |  |  |

| **The training program on the in-core monitoring system (ICMS)** |
| --- |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours****(Kurchatov)** | **Number****of hours****(Tavana)** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| 1 | ICMS name, basic controlled parameters | 0.5 | 0.5 | National Research Center “Kurchatov Institute” |  |
| 2 | The structure of the ICMS SHC, connection with external systems. The composition of technical means used in the system, the basic parameters, design, placement of equipment | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| **SHC-LL (lower level)** |
| 3 | SHC-LL racks, SHC-LL terminal-block cabinets. Purpose, composition, structure, maintenance. Power on, health check, power off | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 4 | BUP-\*\*R control block | 0.5 | 0.5 | National Research Center “Kurchatov Institute” |  |
| 5 | Discrete signals I/O units | 0.5 | 0.5 | National Research Center “Kurchatov Institute” |  |
| 6 | Analog signals input units.Metrological support of analog signals input units | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 7 | Units failure. Faults diagnosis | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 8 | Program software for calibration of the SHC-LL measuring channels | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 9 | SHC-LL functioning program (FP) | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 10 | Lower level control station (CS-LL). Structure and maintenance | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 11 | Operation Support Program (OSP) | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 12 | Answers to the questions | 1 | 2 | National Research Center “Kurchatov Institute” |  |
| **ICND (in-core noise diagnostics) SHC** |
| 13 | Purpose, composition, basic parameters, configuration of equipment implementing the function of the ICND | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 14 | ICND SHC racks. Composition, principle of action, specifications. Power on, health check, power off. Maintenance | 0.5 | 0.5 | National Research Center “Kurchatov Institute” |  |
| 15 | Calibration of in-reactor direct-charge detector noise component channels in the ICND SHC | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 16 | Computer complex (CC) of the ICND. Presentation of information. Communication with external systems. Power on, health check, power off | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 17 | ICND SHC functioning program (FP) | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 18 | Application program software of the ICND CC | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 19 | Answers to the questions | 1 | 2 | National Research Center “Kurchatov Institute” |  |
| **ICMS computing facilities (upper level)** |
| 20 | ICMS CC computing devices, communications gateway.Purpose, composition, basic parameters, design. Functional interaction of computer complexes. Power on, health check (testing) and power off. Maintenance | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 21 | Purpose and structure of system program software (SPS) | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 22 | Structure of ICMS application program software (APS) | 0.5 | 1 | National Research Center “Kurchatov Institute” |  |
| 23 | Application program software of the ICMS computer complex (CC):“SKIF” APS. Purpose. Structure. Executable modules. Adjustment. Faults diagnosis.“HORTITSA” APS. Purpose. Structure. Executable modules.Adjustment. Faults diagnosis“MF” PS. Purpose. Adjustment. Faults diagnosis | 111 | 222 | National Research Center “Kurchatov Institute” |  |
| 24 | Application program software of the shift engineer service station(SESS):Work with the Control PanelWork with the Data Submission Program | 11 | 11 | National Research Center “Kurchatov Institute” |  |
| 25 | Protection functions | 1 | 1 | National Research Center “Kurchatov Institute” |  |
| 26 | Preparation for launch. Sensors checking before launch. | 2 | 2 | National Research Center “Kurchatov Institute” |  |
| **TOTAL:** | **24** | **33** |  |
| **The training program****“Analysis and control of fission products activity in the primary coolant”** |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours****(Kurchatov)** | **Number****of hours****(Tavana)** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| 1 | Radiation safety. General provisions | 1 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 2 | Regulations. The principle of defense in depth. Therequirements for controlling the activity of the primary coolant. | 1 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 3 | Interrelation of coolant activity with fulfillment of radiationacceptance criteria. | 1 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 4 | Tightness control of fuel element claddings at power and during refueling. )it is suggested that this item will be included for the training program) | 1 | 1 | National Research Center “Kurchatov Institute” | all aspects of “control” of fuel element claddings including the common and recent technologies and instruments regarding the measurement of coolant activity, the designprotocols of a coolant activity control system, and the specific considerations at VVER units should be presented; |
| 5 | Existing operational experience of nuclear power plants withVVER units. | 1 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| 6 | The principle of zero fuel failure. | 1 | 0 | National Research Center “Kurchatov Institute” | It is suggested to be deleted |
| **Introduction:** |
| 7 |  Mechanisms of fuel damage during plant operation. |  | 3 | National Research Center “Kurchatov Institute” | )it is suggested that these items will be included for the training program) |
|  Type of defects and their root cause and preventive actions |  | 4 |
| Type of radionuclides and their release type that is important to fuel integrity monitoring and analyzing. |  | 2 |
| Recent experiences in fuel integrity monitoring and defected fuel. |  | 2 |
| Online and offline fuel integrity monitoring systems. |  | 1 |
| Instrumentations, equipment and computer codes and their applications, capabilities and accuracy in fuel integrity monitoring systems.  |  | 2 |
| Acceptance criteria for fuel integrity. |  | 1 |
| **Determining of failed fuel assembly in the core:** |
| 8 | Introducing norms and standards and technical documents applied in  this field. |  | 2 | National Research Center “Kurchatov Institute” | )it is suggested that these items will be included for the training program) |
| Explanation of methods and algorithms used in the latest version of РД ЭО 1.1.2.10.0521-2009 document for determining of failed fuel assembly.  |  | 20 |
| Determining number of leaky Fuel assemblies and their burnup, defects  size during reactor operation by :* Manual analyzing method.
* Computer code analyzing method (analysis with codes such as RTOP and RELWWER and …).
 |  | 30 |
| Answer to Iranian specialists’ questions. |  | 3 |  |  |
| **Introduction to computer used for determining of failed fuel assembly (including history, inputs, outputs, analysis method, reliability of the obtained results, graphical** **user interface and an example):** |
| 9 |  Introduction to RTOP computer code |  | 4 | National Research Center “Kurchatov Institute” | )it is suggested that these items will be included for the training program) |
|  Introduction to RELWWER computer code |  | 3 |
| Answer to Iranian specialists’ questions. |  | 1 |
| **TOTAL:** | **6** | **79** |  |

* Related standards and acceptance criteria should be reviewed more comprehensively;
* The origin of set–points and acceptance criteria should be demonstrated (codes and analysis methods used, etc.);
* As the title says “Analysis”, the computer codes such as RELWWER or RTOP which are used in these cases should be trained. The interrelation between the data measured by the radiation monitoring instruments and the input for the abovementioned codes should be explained;
* All situations resulting in a fuel clad failure, their signs and appropriate measures to be taken in each situation should be reviewed;
* The operator and technical support roles and protocols to deal with the data generated from the analysis of fission products activity in the primary coolant should be presented based on the norms, codes and standards.

| **The program training** **“Specific Issues of VVER-1000 Reactors Radiation Materials Science”** |
| --- |
| **Seq****No.** | **Name of sections and disciplines** | **Number****of hours****(Kurchatov)** | **Number****of hours****(Tavana)** | **Kurchatov’s Place of****Training** | **TAVANA COMMENT** |
| **General information about nuclear energy and nuclear reactors** |
| 1 | The place of nuclear power in the fuel and energy balance. The structureof nuclear energy today, in the foreseeable and more distant future. The problem of extending nuclear reactors service life.Water-cooled vessel reactors (VVER, PWR, BWR): basic parameters, design features and materials. The main stages of VVER program development: first generation reactors, VVER-1000, VVER-1200 reactors; long-range VVER-TOI reactors. | 2 | 0 | National Research Center “Kurchatov Institute” | This item is general and so preliminary issue It is not needed to present because TAVANA experts have got sufficient knowledge about this topic. |
| **Materials for water-cooled reactors vessels** |
| 2 | Steels for reactor vessels (RV), RV safety criteria, critical brittle temperature, critical fracture toughness. Features of Russian steels for RV. Patterns of RV materials embrittlement. The kinetics of embrittlement, dependence on the composition and temperature, the influence of the neutron spectrum and the intensity of radiation (flux effect) and gamma radiation. Steels for the first generation RV. Accelerated embrittlement and restoration of properties by annealing. | 2 | 2 | National Research Center “Kurchatov Institute” | It would be helpful if these two items are merged together and present in 2 hours. It should be mentioned that TAVANA experts attended in this training course are mainly material engineers that have academic knowledge about these matters. Therefore it would be useful that training issues in this course be presented based on Russian standards, requirements and procedures for performing surveillance specimen tests and analyzing the result. |
| 3 | Steel for the VVER-1000 RV, the effect of nickel content on embrittlement, the problem of accelerated embrittlement of Russian RV with a high nickel content. The possibility of extending the service life of the VVER-1000 RV to 60 years and more. Areas for the development of RV new steels with a service life of up to 80-100 years. Mechanisms of the RV radiation embrittlement. Contemporary views on the mechanisms of radiation embrittlement. The formation of precipitates in cascade processes and due to radiation-stimulated diffusion, the structure and composition of precipitates, the role of radiation defects – dislocation loops. | 2 | National Research Center “Kurchatov Institute” |
| 4 | Methods for monitoring the state of RV materials. Witness samples (WS) program. The composition of the VVER-1000 WS. Testing methods included in the WS program. Method for the determination of fast neutron fluences on the WS. | 4 | 8 | NationalResearch Center “Kurchatov Institute” | It is suggested that this item is omitted and instead of that following items are presented (Its preferable to extend the duration from 4 hours to 8):* Requirements and procedures for analyzing surveillance specimens testing result based on PNAE G-7-008-89 and NP-089-15;
* Regulation for the control of mechanical properties of operating WWER-1000 reactor pressure vessels by the surveillance specimens testing result based on 1.3.2.01.00.61-2009;
* Determining fracture toughness from the results of surveillance specimens to calculate the strength and service life of WWER-1000 reactors based on RDEO 1.1.2.09.0789;

Determining the critical temperature of brittleness of the rector pressure vessel material according to the test result of small samples based on MT 1.2.1.15.002.0983;Method for the determination of fast neutron fluences on the surveillance specimens. |
| 5 | Diagnostic methods of structural phase state: mechanical testing, transmission electron microscopy (TEM), scanning electron microscopy (SEM). Auger electron spectroscopy (AES), atom probe tomography (APT). | 2 | 2 | NationalResearch Center “Kurchatov Institute” | It is helpful, if fractography studies of fracture surface of impact specimen and CT specimen are added. |
| 6 | Accelerated irradiation technology for advanced prediction of materials radiation embrittlement. Microstructural studies of materials irradiated with a different flax to identify the structural prerequisites of the flux effect. | 2 | 2 | NationalResearch Center “Kurchatov Institute” | It is suggested that this item is omitted and instead of that following items are presented:* Application of surveillance specimen test results to RPV Integrity and life assessment

Embrittlement correlation methods to identify trends in embrittlement in reactor pressure vessels (RPVs) |
| 7 | Influence of irradiation temperature on the tendency to radiation embrittlement on the example of VVER-1000 steels. The peculiarity of the structural state of steels after irradiation in the temperature range from ~50-400 °C. Mechanical characteristics of steels after irradiation at various temperatures | 2 | 2 | NationalResearch Center “Kurchatov Institute” | It is suggested that this item would be alternated with the following items: * Pressurized thermal shock (PTS) evaluation with applying the surveillance specimens results

How to know to apply the results of surveillance specimens in Pressure–temperature operating limits curve. |
| **TOTAL:** | **16** | **16** |  |