Attachment to the report prepared for the State Council (Gossovet) meeting on environmental issues chaired by Russian President Dmitry Medvedev on June 9, 2011.

Attachment 3

Plan of measures to enhance safety levels at nuclear power plants

No.	Problem	Solution Approach	Timeframe	Executor organisation
		1. Seismic performance and seismic strength		
1.1	Seismicity levels of a number of sites with NPP[1]s are underrated compared to the "General Seismic Zoning Maps of Russia" (OSR-97), approved by the Russian Academy of Sciences. There are no regulations determining the procedure for assessing seismicity of sites of nuclear power plants; no body with authority to issue such assessments is established, either.	1. Conduct a re-evaluation of seismicity of NPPs; introduce amendments to supporting documentation if needed. 2. Provide regulatory framework for establishing the procedure of determining seismicity levels of sites of nuclear power plants and establish a body with authority to determine such levels.	2012	State Corporation Rosatom, OAO Concern Rosenergoatom, Schmidt Institute of Physics of the Earth (Russian Academy of Sciences)
1.2	Not all of the nuclear power plants have the option of automatic emergency reactor shutdown provided for earthquakes of a given intensity level.	Introduce a system of seismometric control, warning system and that of reactor emergency protection.	2012	OAO Concern Rosenergoatom
1.4	Seismic strength category is underestimated[2] or not determined at all for a number of NPP systems and equipment as per NP-031-01[3].	Assign seismic strength categories, as per NP-031-01, too all NPP components, including construction elements.	2012	OAO Concern Rosenergoatom
1.5	Compliance with seismic strength requirements is not substantiated for some of the safety-significant NPP equipment (for instance, mounting fixtures of the separator drum at Bilibino NPP). In a number of cases, existing calculations serving as a basis for seismic strength assessments are not supported by experimental studies.	Substantiate compliance with seismic strength requirements for safety-significant NPP equipment.	2012	OAO Concern Rosenergoatom
		2. Management of spent nuclear fuel (SNF)		

[1] Nuclear power plants. – Translator.

[2] "Overestimated" is possibly what is meant, as seismic strength of particular systems is presumed to be less reliable than the seismic resistance class they are currently assigned. – Translator.

[3] For "Norms of Designing Earthquake-Resistant Nuclear Power Plants," introduced by the former State Agency for Nuclear Supervision (now, Federal Service for Environmental, Technological and Nuclear Oversight of Russia) in 2002. – Translator.

2.1	No concrete engineering solutions or SNF management project are provided for Beloyarsk NPP. No storage facility is available for long-term storage of SNF generated at Reactor Units 1, 2 of Beloyarsk NPP. On-site SNF storage facilities (both cooling ponds and stand-alone SNF storage facilities) are in a critical condition.	1. Build SNF storage facilities. 2. Remove the fuel from Reactor Units 1, 2 of Beloyarsk NPP for long-term storage or further reprocessing (regeneration).	Early 2012	OAO Concern Rosenergoatom, State Corporation Rosatom
2.2	The final stage of SNF management has not been determined for SNF generated at Bilibino NPP.	Develop an SNF management programme for SNF generated by Bilibino NPP.	2014	OAO Concern Rosenergoatom, State Corporation Rosatom
2.3	SNF is not being removed from NPP reactor units running RBMK-1000 reactors; no capacities are available for its storage or reprocessing, as a result of which SNF is being accumulated to amounts far in excess of design-basis values. The accumulation of the amounts of SNF in the on-site cooling ponds is only taking place at the expense of reducing the grid spacing that serves to separate spent fuel assemblies in the cooling ponds, which leads to impaired subcriticality of the SNF.	1. Complete the commissioning of SFA[4] dismantlement shops at Kursk and Leningrad NPPs in the shortest time possible. 2. Improve the schedule of construction of a spent fuel assembly dismantlement shop at Smolensk NPP.	2011 2011	OAO Concern Rosenergoatom, State Corporation Rosatom
3. Management of radioactive waste				
3.1	Classification of radioactive waste as per the sanitary rules in force – OSPORB-99/2010 and SP AS-03, SPORO-2002[5] – is done according to criteria that are at extreme variance with one another. Thus, the introduction of the criteria stipulated in OSPORB-99/2010 reduces significantly radiation safety for the personnel and the population when managing radioactive waste at an NPP.	Bring the classification of LRW and GRW[6] as per OSPORB-99/2010 into conformity with the requirements set forth in NRB-99/2009[7] with respect to intervention levels (10IL)[8] and the maximum allowable level of airborne activity concentration for the population (AACpop[9]).	2011	Chief State Sanitary Inspector of the Russian Federation.
3.2	Storage facilities for liquid and solid radioactive waste (LWSFs and SWSFs[10]) are filled to 60 percent. The LWSFs of Smolensk and Leningrad NPPs, as well as the SWSFs of Kursk and	Expedite the commissioning of liquid and solid radioactive waste storage and reprocessing complexes at Leningrad, Smolensk, and Kursk	2012	OAO Concern Rosenergoatom, State Corporation Rosatom

[4] For “spent fuel assembly.” – Translator.
[5] For Main Sanitary Rules of Assuring Radiation Safety-99/2010, of 2010; Sanitary Rules for Designing and Operating Nuclear Power Plants-03, of 2003; and Sanitary Rules of Management of Radioactive Waste-2002, of 2002, respectively. – Translator.
[6] For Liquid Radioactive Waste and Gaseous Radioactive Waste, respectively. – Translator.
[7] For Norms of Radiation Safety-99/2009, of 2009. – Translator.
[8] Levels of avertable dose at which a specific protective action or remedial action is taken in an emergency exposure situation or a chronic exposure situation (from the IAEA Nuclear Safety and Security Glossary). – Translator.
[9] For Allowable Activity Concentration for the population. – Translator.
[10] For Liquid Waste Storage Facilities and Solid Waste Storage Facilities, respectively. – Translator.

	Leningrad NPPs are filled to more than 85 percent. No NPP is at present equipped with a full-cycle LRW reprocessing complex.[11]	NPPs.		
3.3	No unified scientific and technological approach exists for radioactive waste management at new NPP reactor units.	Develop a long-term radioactive waste management strategy for new NPP reactor units.	2012	OAO Concern Rosenergoatom, State Corporation Rosatom
4. Structural integrity of building components and equipment				
4.1	Reactor buildings of a number of reactor units (for instance, at Balakovo NPP and Kalinin NPP) show progressing subsidence and differential settlements, as well as progressing tilt, which may lead to their structural failure.	Run an analysis and develop a plan of measures to stabilise the settlements and building tilt.	2012	OAO Concern Rosenergoatom
4.2	A bend in the foundation plate of the SFSF[12] building at Kursk NPP, revealed in the course of geodetic observations, can lead to the building's failure.	Substantiate safety of further operation of the SFSF building's foundation plate.	2014	OAO Concern Rosenergoatom
4.3	Intragranular stress corrosion cracking in welding seams of DN 300 (Du 300) austenitic pipelines and joint seams at the bottoms of distributing group headers of the multiple forced circulation circuit of RBMK-1000 reactor plants: The mechanism of development of longitudinal and transverse cracks in the deposited weld metal in the welding seams has not been established; the ultrasound control methods that serve to detect such cracks are not sufficiently developed.	1. Complete the implementation of "Programme of works No. NPP RBMK PRG-19 (04-03)2010 to complete the task of solving the issue of welding seams of Du 300 austenitic pipelines of RBMK-1000 reactor plants." 2. Complete the introduction of the comprehensive coolant leak control system (ACLDS[13]).	2012 2011	OAO Concern Rosenergoatom
4.4	Structural strength (impact resistance) of construction elements of most NPPs does not meet the requirements of the regulations in force with respect to loads occurring as a result of extreme environmental impacts.	1.Carry out substantiation of necessary measures to ensure structural strength (impact resistance) of NPP construction elements against loads occurring as a result of extreme environmental impacts. 2. Upon analysis completion, implement the measures necessitated by the results of said analysis.	2013 2015	OAO Concern Rosenergoatom
5. Hydrogen explosion safety.				
5.1	Hydrogen concentration control systems and systems and components ensuring hydrogen explosion safety do not meet the requirements of the Rules of Hydrogen Explosion Safety Assurance at Nuclear Power Plants (NP-040-02).	Bring hydrogen explosion safety systems into conformity with NP-040-02.	2012	OAO Concern Rosenergoatom

[11] The original Russian text is unclear as to whether "none of the mentioned NPPs" is meant here or none of Russia's ten NPPs in operation. – Translator.
[12] Spent Fuel Storage Facility. – Translator.
[13] For Automated Coolant Leak Detection System. – Translator.

6. Organisational structure, management, and safety culture.				
6.1	No criteria are developed for the assessment of the necessary financial and human resources that the Operator Organisation (OO) must have at its disposal both as part of its head office staff and in branch organisations in order to ensure NPP safety.	Establish the criteria needed to determine the baseline staffing requirements with respect to the necessary number of production and engineering personnel and their qualitative composition in order to fulfil the Operator Organisation's functions both at the head office and in branch organisations.	2011	State Corporation Rosatom, OAO Concern Rosenergoatom
6.2	The OO maintains no efficient cumulative records on NPP operational experience, which results in: - low quality of investigations into operational disturbances at NPPs by the OO's commissions (in seven instances throughout 2010, Rostekhnadzor[14] was forced to return investigation reports for additional investigation), - low quality of remedial measures developed by the OO, - operational violations occurring repeatedly for the same reason, - underreporting the number of defects, system or equipment failures, violations or operational disturbances.	1. Develop measures to improve the quality of investigations. 2. Carry out an analysis and develop steps to improve the quality of remedial measures.	2011	OAO Concern Rosenergoatom
6.3	Reorganisation and casualisation of NPP maintenance staff leads to outflow of highly skilled personnel.	Develop and implement staffing policy measures at the OO where it concerns retaining highly qualified personnel.	2011	OAO Concern Rosenergoatom
6.4	Shortage of inspectorial staff at Rostekhnadzor results in a reduced level of efficiency of maintaining supervision over nuclear and radiation safety at NPPs.	For the Government of the Russian Federation, establish and implement a financing mechanism needed to ensure efficient control over nuclear and radiation safety.	To be determined by the Government of the Russian Federation	Federal Service for Environmental, Technological and Nuclear Oversight of Russia
6.5	At a number of NPPs, full cover is not provided in protective shelters to accommodate the largest number of workers on shift in case of an emergency.	Ensure that full cover is provided in protective shelters at all NPPs for the largest team on shift in case of an emergency.	2013	OAO Concern Rosenergoatom
6.6	The more than 20-year-long operation of four reactor units (Units 1, 2 of Novovoronezh NPP and Units 1, 2 of Beloyarsk NPP) in full shutdown mode results in an absence of solutions to the issues of their decommissioning. No applications for licenses to be issued	Ensure that applications for decommissioning licenses are filed with Rostekhnadzor for Reactor Units 1, 2 of Novovoronezh NPP and Reactor Units 1, 2 of Beloyarsk NPP.	2011	OAO Concern Rosenergoatom

[14] Or Federal Service for Environmental, Technological and Nuclear Oversight of Russia. – Translator.

	for the decommissioning of these reactor units have as yet been filed with Rostekhnadzor.			
7. Performance ability of safety-significant components.				
7.1	No systemic analysis is done with respect to the safety of equipment that serves to perform safety functions. Its reliability is not ascertained for conditions arising due to external impacts or during design-basis accidents.	1. Develop a branch-wide programme and branch-wide methods and procedures for analysing the protectedness of equipment that serves to perform safety functions against general failures and for ascertaining its qualification. 2. Perform equipment analysis in accordance with the methods developed. 3. Implement a complex of necessary measures as required by the results of said analysis.	2012 2013 2014	OAO Concern Rosenergoatom
7.2	Flaws and defects in the design of the actuators of control rod clusters (CRC) of RBMK-1000 reactor plants could lead to accidents.	Upon running an analysis of the design of CRC actuators, present a plan of action to enhance operational reliability of CRCs (based on proposals detailing ways to improve the CRC design), complete with specific implementation time frames.	2011	State Corporation Rosatom, OAO Concern Rosenergoatom
7.3	NPP project documentation lists an unfoundedly lower safety class for a number of systems and equipment items, as per NP-001-97[15]. For instance, assigning current/voltage transformers to Safety Class 4 results in an unsatisfactory quality of the equipment used to monitor the functioning of NPP electrical power output systems (failures experienced by components of these systems cause reactor units to switch off the grid and trigger safety system response).	Conduct an analysis based on principles of conservative approach with the purpose of verifying that the adopted classification of systems and equipment is in conformity with the requirements set forth by relevant norms and rules. Conduct re-classification if needed.	2012	State Corporation Rosatom, OAO AEP (Atomenergoproyekt, Moscow), OAO NIAEP (Nizhny Novgorod Engineering Company Atomenergoproyekt), OAO SPbAEP (Atomenergoproyekt, St. Petersburg)
7.4	No framework of regulatory and engineering provisions exists for the creation, verification, validation, qualification, and certification of automated process control systems (APCS). Deliveries of APCS equipment to NPP reactor units under construction or renovation are done absent of full-scale and comprehensive tests conducted on bench or test models.	Develop regulatory norms to enable creation, verification, validation, qualification, and certification of APCSs.	2013	State Corporation Rosatom, OAO Concern Rosenergoatom
8. Safety analyses. Accident prevention measures.				

[15] For General Standards and Rules of Assuring Safety at Nuclear Power Plants-001-97, of 1997. – Translator.

8.1	Terms and conditions of safe operation are not substantiated in full where they pertain to: - requirements set to the minimum amount of operational equipment in use, - the allowable time limit set for taking equipment out of operational condition, - periodicity of audits to verify operational condition of given equipment.	As per PSA[16] results, carry out substantiation of terms and conditions of safe operation.	2013	OAO Concern Rosenergoatom
8.2	The list of accident scenarios provided for by ILA and RUZA[17] is incomplete: Unprovided for are accidents occurring during fuel management, accidents occurring on reactor units in shutdown, fires, floods, external impacts occurring as a result of environmental or technogenic causes. Full analysis is not provided for fires and floods resulting from internal causes as well as external impacts of environmental or technogenic nature. No guidelines exist for management of severe accidents.	1. Conduct, for all NPPs, an analysis to examine the scope of coverage provided by ILA and RUZA for accidents occurring on reactor units in shutdown, accidents occurring during nuclear fuel management and storage, fires, floods, and external impacts. 2. Improve ILA, RUZA as per analysis results.	2012 2013	OAO Concern Rosenergoatom
8.3	No analyses have been performed for multi-unit NPPs (excluding Kola NPP) with a view to examine the impact of technogenic events (violations of normal operation) occurring at one unit on the safety of adjacent units. Neither have analyses been performed to examine the impact on NPP safety of violations involving non-unit-specific equipment (chemical facilities and equipment, vessels under pressure, hydroengineering structures).	1. Conduct an analysis of possible impact of violations of normal operation (accidents) on adjacent units of multi-unit NPPs (fires, floods, objects in flight, accidental explosions, release of hazardous substances, radiation accidents). 2. Conduct an analysis of possible impact on NPP safety of violations in the operation of non-unit-specific equipment.	2014 2014	OAO Concern Rosenergoatom
8.4	No substantiation is provided for the capability of reactor units of nuclear power plants to maintain safe condition during prolonged periods of time (up to several days) during accidents caused by: - loss of CP[18] cooling systems, - loss of power at the reactor unit compounded by failure of diesel generators, - failure of service water supply system on the side of the essential power consumer.[19]	1. Conduct BDBA[20] analysis for accidents involving: a) prolonged (up to several days) outage of CP cooling systems, b) loss of power for internal needs compounded by DG[21] failure, c) failure of service water supply system on the side of the essential power consumer. 2. As per analysis results, implement necessary	2015 2017	OAO Concern Rosenergoatom

[16] For Probabilistic Safety Assessment. – Translator.
[17] For Accident Liquidation Guidelines and Beyond-Design-Basis Accident Management Manual, respectively. – Translator.
[18] For "cooling ponds." – Translator.

		measures to provide for management of the above BDBAs.		
8.5	No analysis has been done of the impact on the safety of Novovoronezh NPP of shockwaves following a burst accident at hydropower installations, including Voronezh and Matyra Waterworks. The analysis done of the impact on the safety of Balakovo NPP of an accident at Kuibyshev Hydropower Plant is in need of being checked for currency.	1. Conduct an impact analysis with regard to safety of Novovoronezh NPP of shockwaves occurring as a result of an accident at hydropower installations, including Voronezh and Matyra Waterworks. 2. Conduct an update analysis of possible impact on the safety of Balakovo NPP of an accident at Kuibyshev Hydropower Plant.	2015	OAO Concern Rosenergoatom
8.6	For NPP units operating first-generation VVER-440 reactors (Units 3, 4 of Novovoronezh NPP, Units 1, 2 of Kola NPP): - the working efficiency of the jet-vortex condenser (JVC) in the conditions of a beyond-design-basis accident involving a rupture of the DN 500 (DU 500) primary circuit pipeline lacks proper substantiation. The operational efficiency of the JVC is not substantiated for conditions of external impacts; - no substantiation is provided for the sufficient cooling of the standby boric acid solution tank for accident conditions involving the largest-scale leak of the primary circuit provided for in the design, which could lead to an associated failure of the pumps of the emergency core cooling system; - the substantiation of application of the Leak Before Failure[22] concept is insufficient.	1. Conduct an analysis of a beyond-design-basis accident involving a rupture of the DN 500 (DU 500) MCP[23] that would take into account the possibility of pressure in the sealed enclosures exceeding maximum allowable values; as per analysis results, assess the sufficiency of technological and organisational measures available for accident management, provide substantiation for operational reliability of the JVC in conditions of external impacts. 2. Replace emergency feedwater pumps (ECPS[24] pumps) with pumps capable of operating on water with a temperature of up to 100° Celsius. 3. Improve the Leak Before Failure concept.	2015	OAO Concern Rosenergoatom

[19] Or sites of priority uninterrupted power supply "where outage in power delivery may entail a threat to human lives, threat to national security, considerable material damage, disruption of complex technological processes, and disruption in the operation of especially important elements of public services, communication links, or television," as per the Russian Ministry of Energy's Regulations for the Design and Construction of Electrical Installations of 2002. – Translator.
[20] For "beyond-design-basis accident." – Translator.
[21] For "diesel generator." – Translator.
[22] Leak Before Failure implies that the design and selection of construction materials rule out the complete destruction of a component that has suffered a through crack without the initial development of a stable leak that can be detected well before the crack reaches critical values with respect to structural stability. – Translator.
[23] For Main Circulation Pipeline. – Translator.
[24] For Emergency Core Protection System. – Translator.