The Unified State System for the Spent Nuclear Fuel and Radioactive Waste Management (conceptual approaches and formation principles)

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Over a period of decades in the USSR and then during nineties (90s) in the Russian Federation problems of radiation and nuclear safety assurance have been accumulated, mostly during spent nuclear fuel and radioactive wastes management along with problems concerning decommissioning of nuclear- and radiation-hazardous sites.

With the beginning of the new century, in the period of Russian contemporary history the attitude towards these problems has been changed significantly.

A complex of objectives connected with the considerable and qualitative increase of nuclear and radiation safety (NRS) level, change of the attitude towards spent nuclear fuel (SNF) and radioactive wastes (RW) management is stated in "Basics of the State policy in the Field of Nuclear and Radiation Safety of Russian Federation until 2010 and beyond". This very important and conceptual document was approved on December 4th, 2003 by the President of Russian Federation. Particularly, it settles that "key factors defining state policy in the field of nuclear and radiation safety assurance are:

- considerable increase of nuclear- and radiation- hazardous sites and materials on the territory of Russian Federation in the recent years, which are subjected to the decommissioning and utilization and are not used for the state defense and economics;
- necessity of sufficient volume of nuclear materials reprocessing along with spent fuel assemblies from nuclear reactors, radioactive wastes accumulated in the course of nuclear weapons creation and nuclear weapon-grade materials manufacturing, operation of atomic energy and industrial enterprises, exploitation of submarines, surface vessels and ships with nuclear power installations as well as result of other activities in the sphere of atomic energy use in the RF;…
- significant upgrowth of international collaboration in the field of nuclear and radiation safety and necessity of its efficiency enhancement;…"

The main steps for the improvement of forms, ways and mechanisms of international collaboration in the frames of today meeting are the following:

- development and realization of worldwide safety and utilization strategy for nuclear- and radiation- hazardous sites and materials;
- decommissioning of nuclear- and radiation- hazardous sites;

- enhancement of safety while working with nuclear- and radiation-hazardous sites and materials at all stages of life cycle;
- assurance of nuclear and radiation safety during the management of spent nuclear fuel and radioactive wastes, generated as the result of activities reduce in this field and during nuclear power facilities operation.

Realization of "Basics of the State policy in the Field of Nuclear and Radiation Safety of Russian Federation until 2010 and beyond" has already required the development of a set of legislative documents and Federal Target Programs, the process of normative legal groundwork for NRS is far from being completed at that.

Documents which are currently in force specify "development of unified state system for SNF and RW management, including building up separate research and manufacturing complex aimed to solve accumulated and postponed problems and problem of decommissioning of objects using atomic energy" as necessary provision for the development of the RF atomic branch (Fig.1).

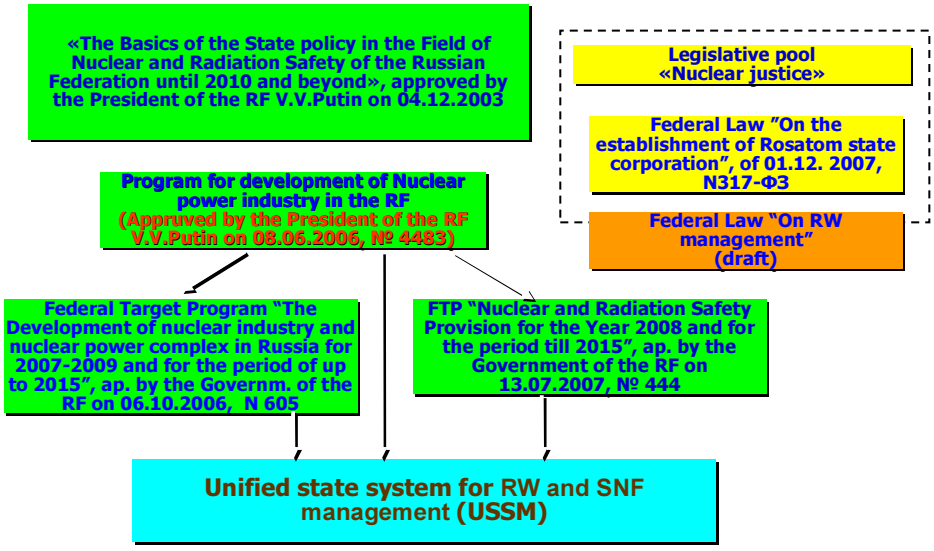

Fig. 1. Legal basis of the Unified State System for RW and SNF Management (USSM)

The need in the USSM state status is stipulated by the following:

- Obligations accepted by the RF under the frames of "Joint Convention on the Safety of Spent Nuclear management and on the Safety of Radioactive Waste Management" according to which the final liability for safety assurance rests with the Government;
- Federal status for the program of atomic, power and industrial complex development;

- Liabilities acknowledged by the State for solving “historical” SNF and RW problem, as well as decommissioned nuclear- and radiation- hazardous sites – the legacy of the past defense industry, planning and economics activities (it is specified in FTP “Assurance of Nuclear and Radiation Safety for 2008 and for the period of up to 2015”).

Development of USSM for RW and SNF shall be considered as an infrastructure project for the program of atomic, power and industrial complex development. At the same time USSM shall provide the solution to the nuclear legacy problem regarding decommissioning of nuclear- and radiation- hazardous sites, safe management of accumulated SNF and RW (Fig.2)

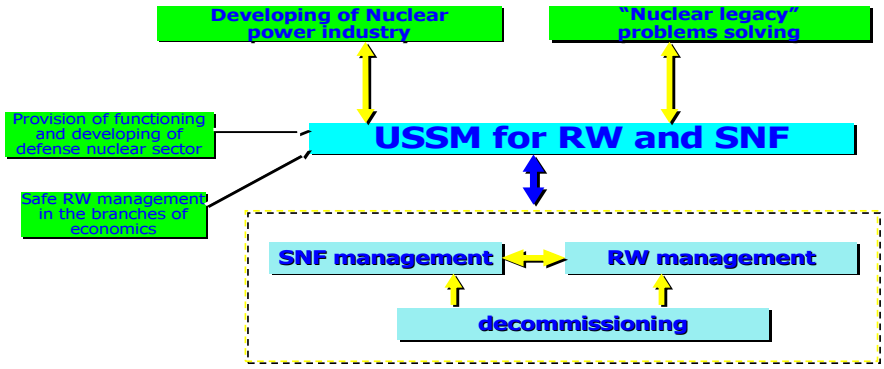

Fig. 2. Objectives of the USSM

The “trinity of USSM” from the point of solution for the problems of SNF and RW management and decommissioning of nuclear- and radiation- hazardous sites (NRHS) merits the acknowledgment. At this efficient decommissioning of NRHS is defined by the existence and effective operation of SNF and RW management subsystems.

USSM operation is supposed to be performed on the assumption of 4 key principles (the first two are economic-organizational, the rest two - technical-organizational) – Fig.3

“Contaminant pays” – companies generating wastes and producing SNF and RW bear financial responsibility for its management. Thus, all property rights from the moment of SNF and RW generation belong to those companies.

“Pay and forget” – responsibility for SNF and RW exhausts itself after wastes are brought into the full compliance with the USSM standards, after fixed fee is paid and SNF and RW are hanged over to the authorized USSM company (national operator). In this case national operator becomes the owner of the wastes.

The property rights for SNF and RW transferred to engineering (technological) companies are defined by the contract (agreement) and set by the

party, liable for transfer of products of reprocessing to the national USSM operator.

Principles of **"Rational (optimal) conditioning of RW"** and **"Taking into the consideration RW category and classification during its allocation at the storage facilities"** are necessary because existing system of RW classification (liquid and solid) and their management in the RF is far from being perfect looking from a scientific and economical stance. This system is also the USSR legacy and at present it does not allow to create effective USSM system which will be socially and economically proven, safe and efficient, and which meets current requirements. The creation of the new system of RW categorization/classification is a very independent objective. The outline of this system is given at Fig.3.

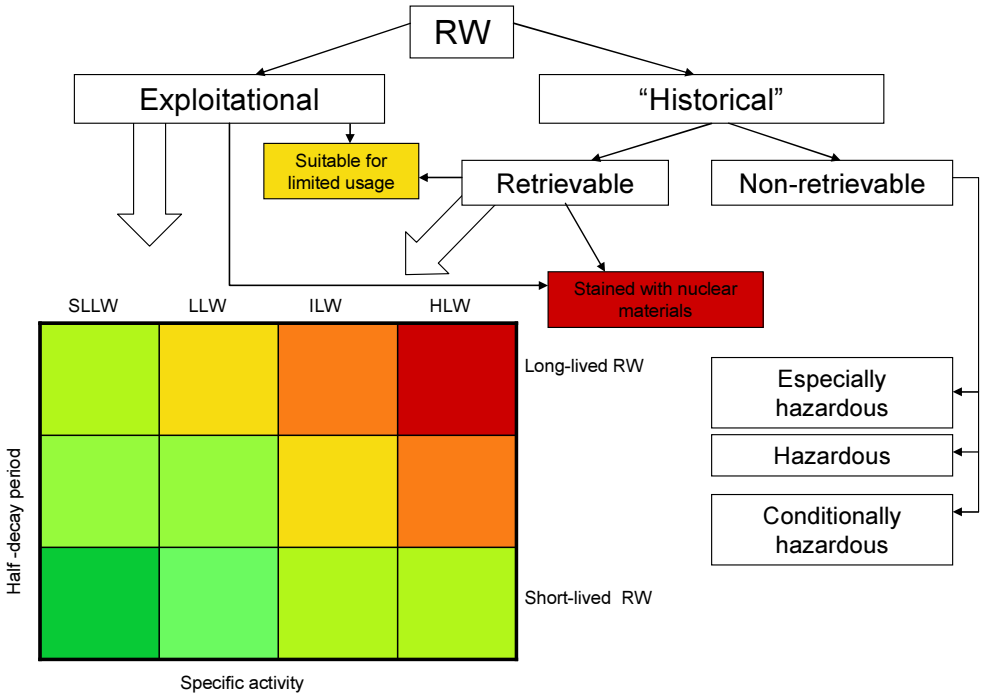

Fig. 3. Outline of New System of RW Classification/ Categorization

The important condition for the creation of effective USSM and launch of economic mechanisms of its operation is limitation for terms of SNF and RW storage at sites and on the territories of operating facilities, for the amount of SNF and RW (activity, mass, volume) and, possibly, for the volume of RW during the manufacturing of useful products.

It is natural that these limits should be differential, and all peculiarities of the creation and operation of separate NRHS must be taken into the consideration. For "historical" NRHS limits can be set by the special documents. As for the newly commissioned sites, their limits can be defined and established within the scope of project documentation.

With a glance to written above, the common strategy of RW management is specified at Fig.4

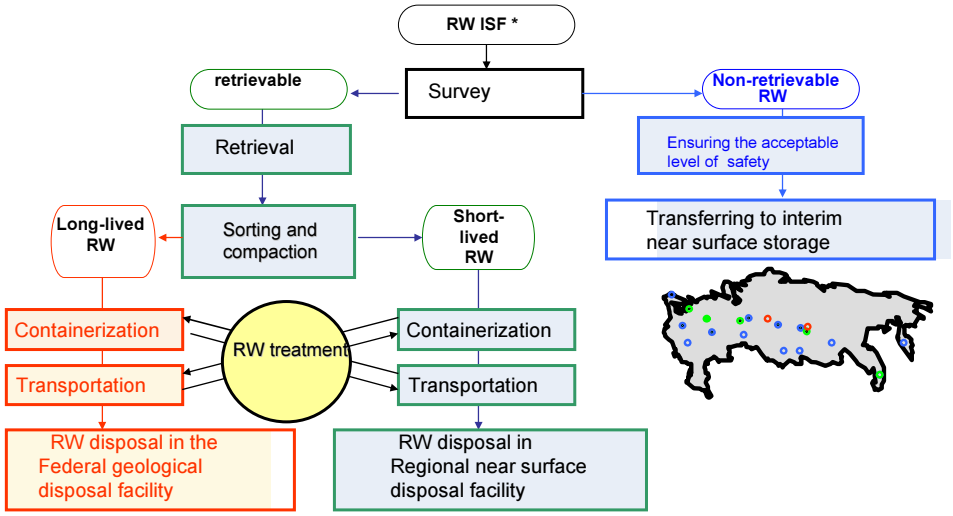

Fig. 4. Radioactive waste management strategy of the Russian Federation

The basic elements of USSM infrastructure concerning RW management shall be the federal geological disposal facility (or facilities) for long-lived RW, regional and local disposal facility for short-lived RW and low activity (conditionally radioactive) wastes. As for the SNF management, the basic element of USSM shall be federal repository (or repositories) for SNF reactors from VVER-1000, RBMK types and non-standard spent fuel.

The possibility to organize regional disposal facilities of near-surface type for RW in the European, the South Ural and the Eastern Siberia regions is under consideration. Local disposal facilities for wastes can be established at 35 cites of Rosatom and Rosstroy (these are special facilities of the Radon system).

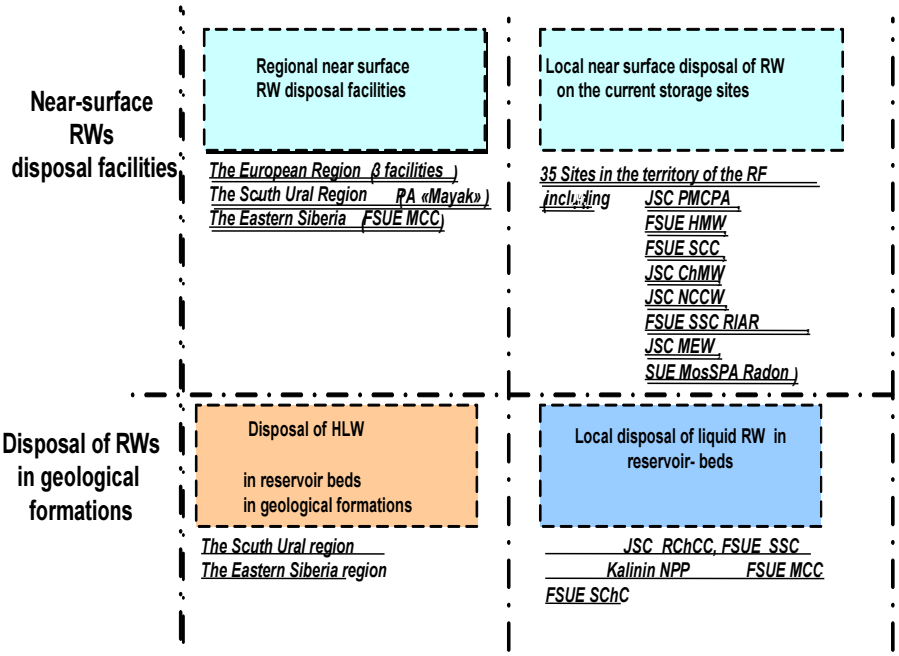

Fig. 5. Location of Radwaste disposal facilities in Russian Federation

When the new principles of RW categorization/ classification are implemented in the near future, it is planned to elaborate technical requirements for RW packages designed for geological and near-surface disposal. A pilot standard regional facility is also planned to be created for the long-term waste disposal. It can be further used as a site for the near-surface disposal.

In the midterm it will be necessary to shortcut the number of interim storage facilities (ISF, today there is 1170 of them) till the number of facilities, generating RW (69). Such sites should be liquidated or transformed to the near-surface disposal facilities. At the same time, wastes should be transferred to the "mobile" status in order to provide correspondence of RW packages with the acceptance criteria for its further near-surface or geological disposal. Also, wastes should be placed to the certified container suitable for the transportation. The USSM creation strategy provides the transit to such type of end product during RW management at all facilities.

The liquidated facilities can be replaced by new IFSs designed under the standard project, if necessary.

Midterm RW management objectives (to the considerable degree presented in the FTP "Assurance of Nuclear and Radiation Safety for 2008 and for the period of up to 2015") are specified at Fig.6.

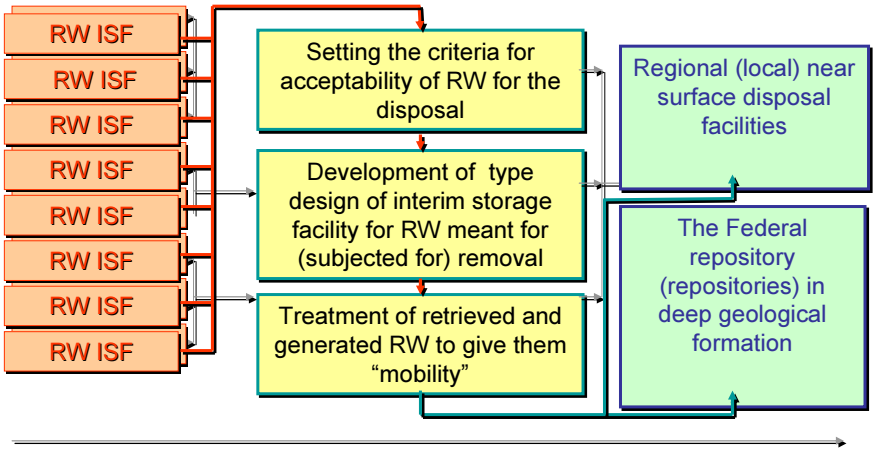

Fig. 6. Objectives of RW management in the Russian Federation

In the imminent future the main infrastructure object that provides management of SNF from NPPs will be "dry" storage facility which is under construction at the Mining Chemical Complex site (MCC), it is one of the key Rosatom's facilities located in the Krasnoyarsk region (Fig.7). At this, it is possible to create container storages for some kinds of SNF for NPPs of new generation.

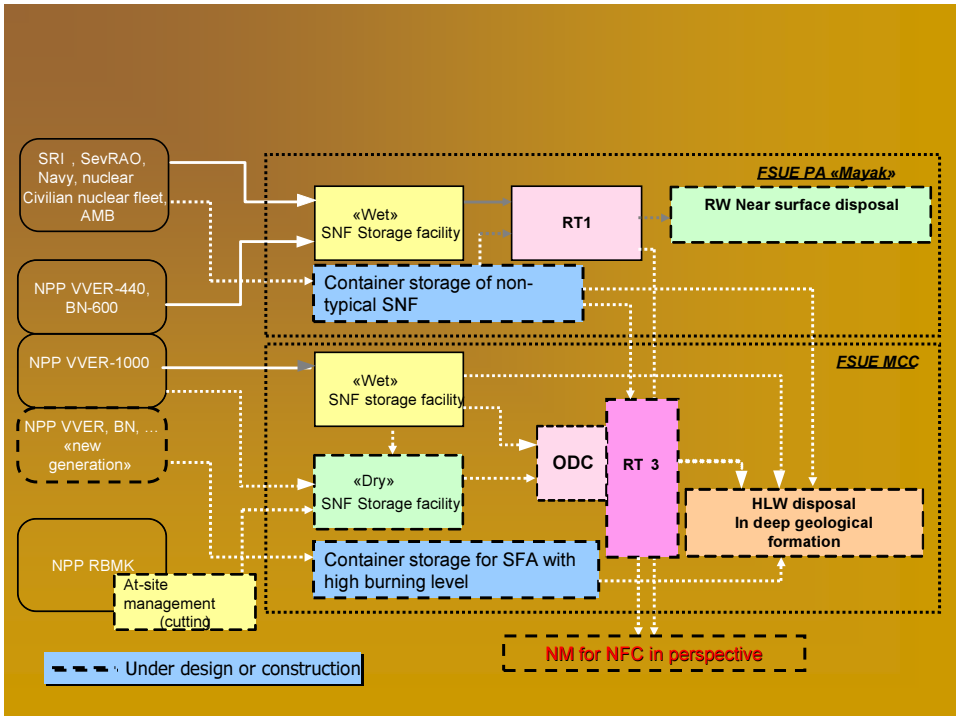

Fig. 7. Strategy of the SNF management infrastructure creation

Maintenance and development of SNF reprocessing technologies will be implemented on the basis of "PO "Mayak" facility's PT-1 Plant and the Experimental Demonstration Center (EDC) which is currently under the construction at MCC site.

The decision to construct a large-scale reprocessing plant for SNF of the next generation will be taken in accordance with the results of the activity based on the knowledge/technologies obtained during EDC operation.

The USSM will be the part of Rosatom's State Corporation for Atomic Energy which is being created in Russia now. Its creation was defined by the FL №317-FL on December 1st, 2007. This law specifies goals, objectives, functions, authorities and the general structure of the Corporation including NRS block designed to solve SNF and RW management problems and those of the decommissioning of nuclear- and radiation-hazard sites.

The USSM structure is based on the principles of liability distribution for SNF and RW management among the Corporation, the USSM national operator, operating facilities, and engineering companies engaged in the process of SNF and RW management (Fig. 8).

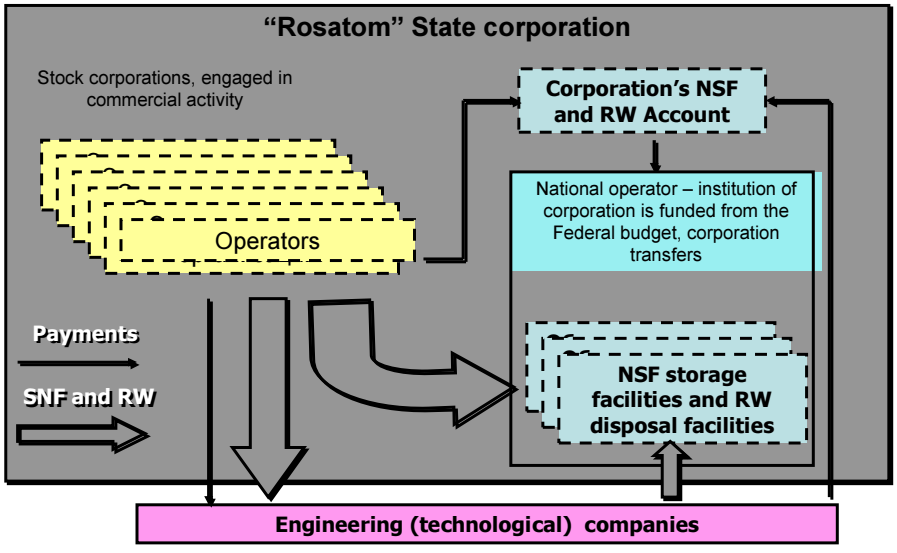

Fig. 8. Unified state system for RW and SNF management in the Rosatom State corporation system

The Corporation creates and manages the decommissioning fund, sets the fee to be paid by operating facilities for SNF and RW, makes up an estimate of

revenues and expenses; sponsors the creation of sites for SNF storage/ processing and RW disposal, as well as the operation of these sites and pays at the budget expense to the engineering companies for their services of managing “historical” SNF and RW and decommissioning “historical” nuclear- and radiation-hazardous sites.

It is important that the existence of special funds in Rosatom’s Corporation (Fig. 9) is legally provided and defined (Federal Law No.317-FL).

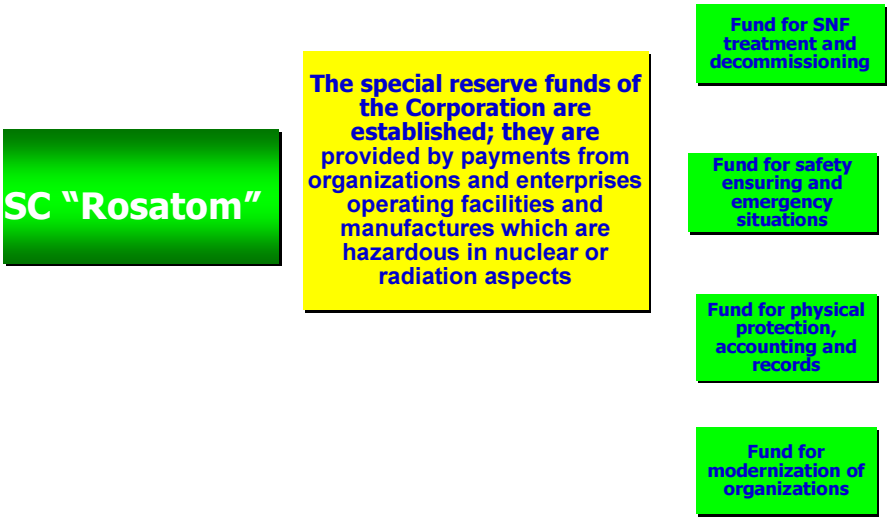

Fig. 9. Special funds of SC “Rosatom”

The USSM national operator perform the operation of SNF and RW storage facilities, creates the sites for RW disposal, and/or transfers storage facilities into this category, as well as monitors the RW disposal sites.

The operating facilities by their own or by involving the engineering companies bring the RW and SNF in the accordance with the USSM standards for further storage, transfer the SNF and RW to the USSM national operator per the fixed rates and to remit funds to the State Corporation’s budget for the purpose of decommissioning of nuclear- and radiation-hazardous sites, also pay for the engineering companies services if it is considered economically efficient.

The engineering companies involved in the SNF and RW management process at their own expense develop the RW management technologies (i.e. perform research and experimental activities, R&D activities), implement work and provide services at the different stages of RW and SNF management, perform SNF and RW transportation from the territories of the operating facilities to the

USSM sites. Such companies of all types of property are allowed to perform activities, if they have all necessary licenses.

In the near future, the operation of storage facilities can be transferred to the operating organizations along with the funding of current expenses.

The first stage of the USSM creation called scientific and methodical, will cover the formalization (standardization) of the requirements for the RW acceptance for disposal, the development of standard programs for the management of "historical" SNF and RW, and the justification of locations and the decision-making on the sites of SNF storage and RW disposal.

During the preliminary and organizational stages, it is necessary to justify fees paid to the SNF and RW funds in the State Corporation, also, centralize the calculations, develop a subsidy procedures for the maintenance of the "historical" SNF and RW, together with paying for their conditioning and transfer to the USSM. The USSM national operator will start up its activity during this stage.

The first practical activities will begin with the implementation of a pilot project designed for a regional RW disposal facility. A demand for the activities (services) on RW management and the decommissioning of nuclear- and radiation-hazardous sites will be defined on the basis of the approved rates and standards, as well as on the state order for the activities with "historical" wastes. The appropriate infrastructure will be gradually consolidated at the national operator's balance.

A very important issue is the distribution of authority between state bodies of nuclear power use and those of safety regulation, when using atomic energy with the reference to of the creation of Rosatom Corporation and the establishment a specialized NRS complex within its structure which will be responsible, among other tasks, for solving the objectives within SNF and RW safe management. Basically, the situation is not changed (Fig.10).

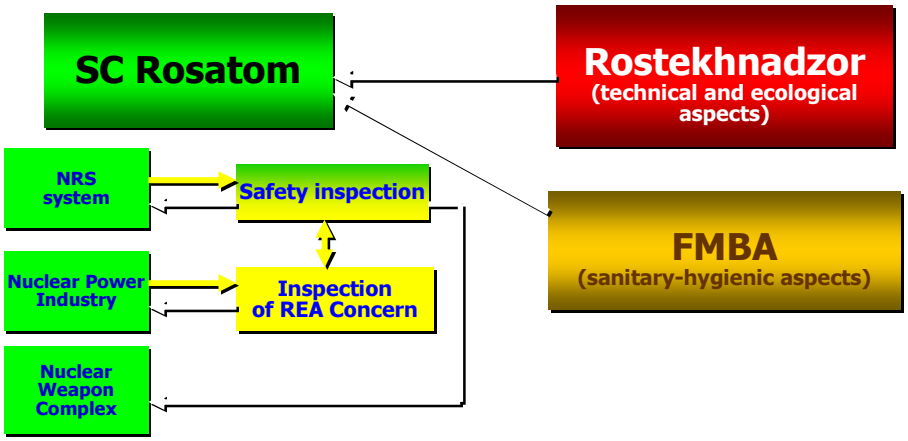

Fig. 10. Management and surveillance

However, important innovations emerge. Thus, in accordance with Article 10 of Law 317 "The Corporation's Authority and Functions for Safety Assurance, when Using Atomic Energy", the Corporation performs, in particular, the following authorities and functions for safety assurance during the use of nuclear power:

- participate in the development of obligatory federal norms and regulations which set the requirements for safe use of nuclear energy and agrees them in the prescribed order;

- develop and submit to the RF Government the proposals concerning the procedure for the organization of collection, storage and disposal of RW; and

- perform state control over the radiation environment in the areas of nuclear facilities location, radiation sources and storage facilities belonging to the Corporation's enterprises, joint stock companies and their affiliates, together with the facilities within the jurisdiction of the Corporation.

In order to increase the level of safety within the organizations of the Rosatom Corporation, the agency-level inspection is planned to be created within the structure of the NRS complex. It should be acknowledged that such inspection has been successfully running within the Rosenergoatom since the moment of its establishment.

To conclude, we should embrace that the suggested conceptual approaches and the principles of the USSM formation and operation are based on the accumulated domestic and international experience in the field of SNF and RW management, and correspond with the organizational and structural changes transpired within in Russian nuclear industry.