

Main Principles of the Perspective System of SNF Management in Russia – 13333

Mikhail Baryshnikov, Head of Project Office for SNF Management,
Russian State Atomic Energy Corporation “ROSATOM”,
Bolshaya Ordynka str., 24, Moscow, Russia, 119017, MiVBaryshnikov@rosatom.ru.

ABSTRACT

For the last several years the System of the Spent Nuclear Fuel management in Russia was seriously changed. The paper describes the main principles of the changes and the bases of the Perspective System of SNF Management in Russia. Among such the bases there are the theses with the interesting names like “total knowledge”, “pollutant pays” and “pay and forget”. There is also a brief description of the modern Russian SNF Management Infrastructure. And an outline of the whole System. The System which is – in case of Russia – is quite necessary to adjust SNF accumulation and to utilize the nuclear heritage.

INTRODUCTION

Spent Nuclear Fuel (SNF) - an unavoidable product of the nuclear industry. It is no matter what is the type of nuclear reactor, no matter what does it produce (electricity, thermal power or just neutrons for research), the invariable product of its work is the spent nuclear fuel. And it is necessary to manage it somehow. Just to isolate and store it or process - better to do it systematically.

At least because it reduces the cost per unit. For example, everybody knows that SNF contains valuable elements. Uranium, plutonium, rare earth elements – some of them we can already extract from SNF at affordable prices. And the larger the scale, the cheaper the product. But even if for some reason you do not want to recycle spent nuclear fuel, even to store it cheaper if you do it in a big scale, systemically.

Another inherent feature of SNF – is its danger. The high radioactivity, high residual heat - these properties require very careful handling of SNF. Provide this care, ensure safety, also easier with a systematic approach. Even when you have a lot of the SNF. And we really have it a lot: in Russia it has accumulated about 22 thousand tons of SNF, in the U.S. - about 70 tons.

Thus, to manage SNF the System is quite necessary.

THE MAIN PRINCIPLES

What should be the system to be efficient and effective? What should be its basic principles to make it undoubtedly reliable? Obviously, these principles have to be also reliable and indisputable. As to the Russian system for SNF management, we have three of them:

First is Safety. That is the main criterion of all - the decisions, selected targets, the certain tasks - should be the safety. Nuclear, radiation, environmental, physical, industrial, etc. Transcription of this principle is very simple: we have to protect against the risk ourselves and our children, and certainly not to create such the risk with our own hands.

Second principle of the SNF management system is the Clarity. That means its components, its mechanisms should be obvious to all parties involved: for SNF producers, for those who take the SNF and refabricate it or will store it, and for the population, which wants to know who can personally guarantee its safety, in which way etc.

Third main principle is Development. SNF management system must be capable of growth: firstly, the growth of efficiency: SNF handling has to be less expensive year by year, remaining safe at the same time. The system should encourage the development of new methods of SNF management, new processing technologies, new approaches to storage. Being safe. As a consequence of these changes, SNF Management System has to support the development of nuclear energy, so that it will become the most environmentally-friendly and the most cost-effective way to produce energy.

There were three main principles, which underlie the Perspective System of SNF Management in Russia. And further is the portrait of the System itself – the bases, the infrastructure and the management circuit.

THE LAW

Standards of SNF handling are distributed now in various Russian laws:

- Law on the Use of Atomic Energy (dated 21 November 1995 № 170-FZ),
- Law on Radiation Protection (dated 9 January 1996, № 3-FZ),
- Law on Sanitary and Epidemiological Welfare (dated 30 March 1999 № 52-FZ),
- Law on Special economic, social and environmental programs (dated 10 July 2001 № 92-FZ),
- Law on Environmental Protection (dated 10 January 2002, № 7-FZ),
- Law on the State Atomic Energy Corporation "Rosatom» (dated 1 December 2007 № 317-FZ).

In general, they contain all the necessary requirements that ensure the safe SNF handling. But so many of them, first, is not too convenient. And second, it does not reflect the whole picture. That's why the principle of clarity is not observed. Therefore the special SNF regulation is under construction today, Federal Law on Spent Nuclear Fuel Management. Nowadays the text of the Law is intently examined by the Federal Authorities. Thus it is not good to disclose all its details here and now. But the bases could be uncovered in general.

The first base is the postulate «total knowledge», according to which even before the nuclear fuel, fresh fuel, is loaded into the reactor, everyone should know what it will be after it is unloaded from the reactor: where it will be followed, where will be sent: immediately to reprocessing or first to storage, and how much it will be stored, how it will be processed and where it will happen, what will happen to the radwaste, etc. Moreover, the usage of nuclear fuel, for which it is not established the technological scheme for the spent nuclear fuel, will

be prohibited. Thus, the country will avoid appearance of so called "unexpected SNF", like the fuel of the northern NPP in Bilibino, Chukotka region, for which we are today (just today! although the station has been operating for 30 years) decide what we should do with it. Other necessity of the postulate "total knowledge" is that knowing the technological scheme of the future SNF handling, SNF producer could calculate the cost of SNF handling even before the fresh fuel is charged into reactor. So he can schedule his expenses, investments, etc. And the third reason is that the people, the residents will be assured: at any time, they can look at this technological scheme and say: "yes, our kids do not get nothing unknown: now have an understanding of how and what will happen to SNF in 30, 50, 100 and more years".

The second postulate is «pollutant pays», establishing legal and financial responsibility of the SNF producer for SNF handling. That is, in short: the one who produce SNF should bear full responsibility for its disposal. That is the cost of the SNF technological scheme should be completely covered by SNF producer. By the so-called full-fare. How it should be done: in one-off payment when SNF leaves its producer or by the lapsed payment, or maybe in one-off at the moment of fresh fuel purchase – these conditions are still debatable. But it is important that all the payments should be done by the SNF producer. And it is always clear to whom and what to request.

The third postulate - «pay and forget», or in other words, the division of responsibility: SNF producer after payment for the SNF handling, can not worry about the fact that over the years somebody will come to him and will ask to pay more, for instance, for disposal of waste or some transport. Now it happens sometime: for example, a part of so called AMB SNF was transported to the reprocessing plant twenty years ago, but the producer have to pay now for the activities concerned to its reprocessing, which, in general, he could make long time ago. But he did not make and now have to spend money for this heritage, while it is not make any profit for him. So, after the payment for SNF handling, the responsibility for it is taken off from the SNF producer and together with the titles and ownership transferred to the organization responsible for the future SNF handling: either it storage or reprocessing.

INFRASTRUCTURE

To make the SNF Law operational, to make the SNF handling really effective, it is necessary also to develop the infrastructure of SNF handling. It means the technologies of SNF handling and the certain plants where these technologies are implemented should be developed.

Russia moves in this direction also. What is the SNF infrastructure now and what we expect in 2025 can be seen from the following table:

Table 1. SNF management infrastructure in Russia in present and future.

2013, February	2025
<ul style="list-style-type: none"> • PA “Mayak” – reprocessing of SNF VVER-440, defective SNF RBMK (in limited quantity), SNF BN-600, RR SNF, SNF of the transport apparatus. 	<ul style="list-style-type: none"> • PA “Mayak” - reprocessing of SNF VVER-440, defective SNF RBMK, Fast Breeder Reactor SNF, RR SNF, SNF of the transport apparatus and other «non-widescale» SNF.
<ul style="list-style-type: none"> • MCC Centralized Storage – wet storage of SNF VVER-1000, dry storage of SNF RBMK-1000. 	<ul style="list-style-type: none"> • RT-2 at MCC (including Pilot Demonstration Centre as it first branch) – reprocessing of SNF VVER-1000, SNF BN-800, SNF RBMK.
<ul style="list-style-type: none"> • On-site storage: AMB SNF, Bilibino SNF, different types of RR SNF, SNF of the transport apparatus. 	<ul style="list-style-type: none"> • MCC Centralized Storage – dry storage of SNF VVER-1000, SNF RBMK-1000. • SNF of RR and transport apparatus is taken out and reprocessed «from wheels», right after the necessary coolant.
<ul style="list-style-type: none"> • RBMK Spent Fuel Assemblies bisection complex works in pilot-industrial mode at the Leningradskaya NPP. 	<ul style="list-style-type: none"> • SNF of RR and transport apparatus is taken out and reprocessed «from wheels», right after the necessary coolant. • RBMK Spent Fuel Assemblies bisection complex completes the dispatch to the reprocessing the SNF of the Leningradskaya NPP. The same complexes at Kurskaya NPP and Smolenskaya NPP are crossed their «equator».
	<ul style="list-style-type: none"> • MOX Manufacturing at MCC produces the Fuel Assemblies for Fast Reactor BN-800 from the reprocessed uranium and plutonium. • Developing the REMIX Technology. • Developing of on-site nuclear fuel cycle.

It should be noted that at the present time in Russia the main concept of the SNF handling is its reprocessing. It is considered that only the reprocessing could provide the long-term safe storage of SNF, to be exact - its products. Additionally, SNF reprocessing can return to the Nuclear Cycle the useful elements: fissile uranium and plutonium, and in the future - rare earth metals and radioactive sources. Therefore the development of SNF infrastructure in Russia is aimed primarily at medium-term storage and subsequent processing SNF, which is easily seen from the table.

The tabled list is not just the plan – it is a list of the facilities under construction now. A striking example of SNF infrastructure development in Russia is the facilities combination being constructed at the Mining & Chemical Combine (MCC) in Krasnoyarsk region, Siberia:

- SNF Centralized Storage – a vigorous dry storage, which could contain all the SNF produced by Russian RBMK-1000 and VVER-1000 reactors (including foreign ones); launch complex storage is already running, the final commitment is expected in 2015;
- two lines of the reprocessing facility: Pilot Demonstration Centre (PDC) with the capacity of 250 ton SNF per year and the full-scale reprocessing plant RT-2 with the capacity of 700 ton of SNF per year; PDC launch is expected in 2018, launch of RT-2 – in 2025;
- MOX manufacturing plant with the productivity of 400 MOX Fuel Assemblies per year; the customer of these FAs will be the brand new fast neutron reactor BN-800, which is expected to be put into operation in 2014.

The principal difference between the perspective image and today's picture – is in significant increase in capacity of the SNF handling: the reconstruction of reprocessing plant at PA "Mayak" and the addition of RT-2 MCC plant the total capacity of Russian reprocessing enterprises will be about 1,200 tons of SNF per year. Thus, the processing volume will exceed the volume of accumulation (now SNF accumulation rate is about 650 tons per year, and in 2025 it will be about 1,000 tons taking into account the VVER reactors expansion).

Another important feature of the development of SNF handling infrastructure is in the endeavor to the closure of the nuclear fuel cycle. Both for thermal reactors and for fast neutron reactors. And for the both the specific programs have already taken and being realized in Russia. Here, in this report, they just announced, a more detailed description can be found by the keywords: REMIX Technology and On-site Nuclear Fuel Cycle “Breakthrough”.

MANAGEMENT SYSTEM

It is important to list the actors and performers. SNF handling should be made by the specialized, so called, authorized companies. Authorized in accordance with the Federal Law for the implementation of long-term storage and (or) reprocessing of spent nuclear fuel, as well as other activities, for example, SNF transportation or packaging. And it will be a Governmental Body, whose responsibilities will include the development of the conceptual statements about SNF handling, approval of the SNF technological schemes, monitoring the adequacy of funds and other management functions in general. Over the Governmental Body should be only the Russian Government, which approves the concept, makes the decision on SNF import and export, and controls and all the international activities in the field of SNF management. In addition, the government takes a decision on the financing of the activities concerned to the spent nuclear fuel in the federal property.

Illustration of the outline could be made on the example. If SNF law is adopted right now, the casting could be the following. The government would remain the Government.

Governmental Body probably would be Rosatom. And authorized companies are PA "Mayak" (reprocessing plant), MCC (centralized storage, reprocessing and MOX manufacturing plants) and, perhaps, Atomspetstrans (SNF transportation). But since we have some time till the law is issued, other companies also should think about working on the SNF handling market. The requirements for such organizations by the Russian regulatory authorities are likely to be as usual very strict and uncompromising in terms of licensing. But the conditions in the market to be more transparent. So all those who have not thought about SNF reprocessing and MOX fabrication in Russia, as a responsible but profitable business, are invited to do so.

CONCLUSIONS

1. SNF is unavoidable, valuable and dangerous product. We have plenty of it. SNF handling requires the systematic approach.
2. It should be made in the way assuring safety, clarity and development. On these principles the System of SNF Management in Russia is being built.
3. The System uses the well-developed infrastructure: Centralized Storage, SNF Reprocessing Plant on nearby, MOX Manufacturing for Fast Neutron Reactors, prosperous new technologies for the Nuclear Cycle Closing.
4. The System is based on a coherent legal framework: SNF Law with the main postulates "total knowledge", "pollutant pays", "pay and forget".
5. The System considers three levels of SNF Management: Government, Governmental Body and Authorized Companies. Become an authorized organization is difficult, but possible - the system will be transparent.

Thus, Russian System of SNF management will provide a safe handling of the spent nuclear fuel at all the stages: from the NPP gate up to the radwaste storage. In addition, clear and transparent system will create a favorable investment climate around the SNF facilities. All together it should give a new impetus to the development of nuclear energy.