

This document has been signed between May 15<sup>th</sup> and December 21st, most likely in autumn 1999. The document has been given out to local journalists based in Krasnoyarsk / Russia on the occasion of a press conference on the MOX issue by Vladimir Mikheev, Head of the Citizen Center on Nuclear Non-Proliferation / Krasnoyarsk on December 22<sup>nd</sup>, 1999. Nevertheless no information on this document has appeared in the media outside the Krasnoyarsk region yet. The document has been obtained and translated by Tobias Muenchmeyer / Greenpeace International, Feb. 25<sup>th</sup>, 2000.

Explanation: "GKhK" is the Russian abbreviation for "Mining and Chemical Combine" and means the nuclear complex at Zheleznogorsk in Central Siberia, known as "Krasnoyarsk-26".

-----  
For internal use  
Copy No. XXX

I approve  
First Deputy of the Ministry  
Of the Russian Federation  
For Atomic Energy

*Signature* V.B.Ivanov

<<\_>> \_\_\_\_\_ 1999

**MINISTRY OF THE RUSSIAN FEDERATION  
FOR ATOMIC ENERGY**

**TECHNICAL-ECONOMIC BASIS FOR THE LAW  
OF THE RUSSIAN FEDERATION**

**"On the proposed amendment to article 50 of the Law of the RSFSR  
"On environmental protection""**

(This Material has been prepared by specialists of the GI "VNIPIET", GNZ RF VNIINM A.A.Bochvar-Institute, Chlovik Institute, Minatom Russia and the RNZ Kurchatov Institute on the basis of the project documentation, worked out during the years 1997-1999.)

## 1. Potential of the world market for the SNF management services.

Up to now about 200,000 t Spent Nuclear Fuel (SNF) have been produced by reactors of all NPP in the world.

Every year this figure is increased by 11,000-12,000t, that means that after 10 years there is an enlargement of SNF amounts by 1.5 times, and after 25 years of 2.5-3 times (up to ~550,000t).

There are three main approaches for SNF management existing: reprocessing with the aim to reuse the useful components and to decrease the activity of the stored radioactive wastes, final disposition of SNF without reprocessing and a delay of a decision (long time storage). Today the global perspectives for the future of SNF management look as follows:

Kind of management	share of total amount
- Reprocessing	47%
- Final disposition	38%
- long time storage (delayed decision)	15%

Services for SNF management can include the following options:

1. Reprocessing with the return of Uranium, Plutonium and nuclear wastes;
2. Long-time storage (40 or more years) with the return of SNF;
3. Long-time storage and then reprocessing with the return of Uranium, Plutonium and nuclear wastes;
4. Long-time storage and then reprocessing without the return of Uranium, Plutonium and nuclear wastes.

A quantitative market analysis for these services gives table 1.

**Table 1**

**Potential market for SNF management services**

Kind of management	Amount of fuel in 2000 (in t)	Amount of fuel in 2010 (in t)
Long time storage	17150	31600
Reprocessing without return of nuclear wastes or final disposal	40200	72750

Up to now ~10% of the accumulated amounts of SNF have been reprocessed (most of all in France, Great Britain and Russia), every year up to 30% of the fresh SNF is getting reprocessed. According to prognoses by 2010 the share of reprocessing SNF will be increased to 50% of the annual produced SNF.

The capacity of the radiochemical plants in the world is more than 3,000 t / year. By 2010 there can be expected an increase of capacity up to 5,500 to 7,500 t / year.

Nevertheless the overall amount of reprocessed SNF by 2025 won't exceed 25% of the total amount of SNF from nuclear reactors.

The existing and planned capacities of out-of-reactor repositories for long time storage of SNF (a few decades) will be able to take ~25% SNF more. That means that the unbalanced amount of SNF will reach by 2010 an amount of ~120,000 t and by 2025 ~250,000 t.

The main customers on this market for unresolved services (table 2) can be countries of South-East Asia (Japan, Taiwan, Korea, China and others) as well as some countries in Europe, which are waiting for cheaper prices for SNF reprocessing, than offered by the European monopolist-companies Cogema and BNFL, or for services of a higher quality.

**Table 1**

**SNF of potential customer countries  
for SNF management services**

Country	Annual SNF production	
	in 2000	in 2010-2015
<b>1. ASIA</b>		
1.1. Japan	1267	1200
1.2. Taiwan	130	165
1.3. South Korea	200	400
1.4. China	60	150
1.5. Vietnam	-	20
1.6. Iran	-	50
1.7. Thailand	-	50
<b>TOTAL ASIA</b>	<b>~1700</b>	<b>~2000</b>
<b>2. EUROPE</b>		
2.1. Eastern Europe (Bulgaria, Hungary, Czech Republic, Yugoslavia - without VVER-440)	50	150
2.2. Switzerland	87	130
2.3. Germany	614	600
2.4. Spain	-	50
<b>TOTAL EUROPE</b>	<b>~750</b>	<b>~930</b>
<b>TOTAL ASIA and EUROPE</b>	<b>~2400</b>	<b>~3000</b>

**2. Possibilities for the enlargement of the management services for foreign SNF in Russia**

**2.1. Storage of SNF**

Currently there are two large “pools” for the reliable and safe storage of SNF of domestic NPPs, industrial reactors and transport nuclear-energetic devices existing in Russia (GKhK in Zheleznogorsk, PO “Mayak” in Ozersk) (table 3).

As one can see from the given figures, after small reconstruction measures, already the existing SNF repositories at PO “Mayak” and GkhK will be able to take additionally more than 8,000 t SNF.

Moreover currently two more large SNF repositories of an universal type are under planning, which are designed for a wide range of fuel (including foreign) and for the “dry” technology of storage (in containers or in a iron-concrete mixture):

- At GKhK the total capacity is more than 30,000 t;
- new repository of a capacity of up to 10,000 t at one of the combines of Minatom.

In consequence of the construction of these repositories Russia is able to take more than 20,000 t SNF from abroad for long time storage, without causing a problem for the storage of fuel from the Russian NPPs and from NPPs of other countries, which are equipped with Russian reactors (graphic 1).

**Table 3**

**Existing SNF repositories in Russia\***

Place	Type of stored fuel	Storage capacity (in t)	Comment
PO “Mayak”. Operating plant RT-1 (buildings 101 “A” and 801 “A”)	SNF from transport reactors, from NPPs with VVER-440 reactors	~2,500	Reconstruction required for the reception of SNF from VVER-1000 and PWR
GKhK. Plant RT-2 under construction (building No.1)	SNF from NPPs from VVER-1000 reactors	6,000 (by 2001 3000t will be occupied)	Required are reconstruction for the reception of SNF from PWR and enlargement of the capacity up to 9,000t

\* excluding on-site storage capacities at NPPs

**2.2. Transport of SNF**

In Russia has been accumulated great experience in transporting SNF of NPP in special transport-packing sets (TUK) for various means of transports.

For the transport of VVER-440 fuel, TUK-6 is used. Since 1979 SNF from VVER-440 reactors is transported. Until 1999 860 container transports have been carried out.

For the transport of SNF from Russian and foreign NPPs to the PO “Mayak” routes have been worked out using three different kinds of transports: cars/trucks, river barges, trains.

Most of the transports of SNF from VVER-1000 reactors are carried out by using TUK-13V. Transports of SNF from VVER-1000 reactors to the RT-2 plant are fully

developed. Since 1985 694 container transports with more than 5,000 fuel elements from Russian and Ukrainian NPPs have been carried out.

For the organization of SNF transports from foreign PWR (BWR) reactors the following transport schemes are recommended:

East: Port “Vostochnyi” – train to the repository site, for example: GKKhK

North: Port Dudinka – barge on the river Yenisey – train to GKKhK

Europe: Station Mukachevo – train to GKKhK or PO “Mayak”

Ports of Germany – ports of Russia at the Baltic Sea – train to GKKhK or PO “Mayak”.

For the SNF transport from NPPs of European countries it is preferred to use routes which don't require the construction of large objects: the operating, tried and tested route for SNF transport by train from station Mukachevo or the newly developed route via the ports of Bulgaria, - ports of Russia at the Black Sea – river Volga to Volgodonsk – train to PO “Mayak” or GKKhK.

For the transport of SNF from Asia it is needed to carry out a little preparation of equipment at the port “Vostochnyj” with the construction of a transfer facility for loading to the railway station “Nakhodka”.

The use of the Northern Sea way is possible after the organization of a transfer basis in the port of “Dudinka” and of a pier at the river Yenisey.

### **2.3. Reprocessing of SNF**

Radiochemical reprocessing of SNF from a range of Russian and foreign reactors is carried out since 1977 at the plant RT of the production unit “Mayak”, determined for the reprocessing of fuel from industrial, transport, scientific-research and energetic nuclear facilities.

The designed capacity of the plant is 400t/year.

Result of the radiochemical reprocessing of SNF of all types of the production of the RT plant is Uranium Nitrate with enrichment of the Uranium 235 isotope of 2.4% which is used for the production of fuel for reactors of the RBMK type.

Beginning from the middle of the Eighties the load of the capacities of the reprocessing plant is in a steady decline and today 35-40% of the designed capacity is in use. The further perspectives for reprocessing of SNF from VVER-440 reactors at the RT-1 plant are depending on two factors:

- 1) position of Finland and countries of Eastern Europe, which have NPPs with VVER-440 reactors in relation to the commercial viability of contracts for sending SNF to Russia compared to on-site storage at NPP sites and to reprocessing at other radiochemical plants in Europe;
- 2) Decisions on plant life extension for reactors of the given type (e.g. for 10 years, up to 40 years).

It has to be noted, that the service period of the RT-1 plant (according to the experience from operation of industrial military radiochemical plants) can be quite long (more than 50 years under the condition of a modernization of equipment), reconstruction work at the RT-1 plant is ongoing.

The reconstruction of the plant allows, beginning with 2006, to reprocess at the same time fuel from VVER-440 reactors, from VVER-1000 reactors and from PWR reactors.

The plant RT-2, which is planned and under construction, is determined for the reception, temporary storage and following reprocessing of SNF from NPPs, equipped with reactors of the VVER-1000 type.

The designed productivity of the RT-2 plant is 1500t / year.

The construction of the plant has begun in 1977 and in 1985 part I of it was put into operation – the SNF storage complex (building 1) with a range of auxiliary buildings, facilities and engineering nets.

The construction of the reprocessing complex of the plant was started in 1984. Due to specific economic problems of the former USSR and later of Russia construction was halted in 1989, in 1992 construction was formally continued (decree of the Government RF No. EG-VI – 05305 from 13.02.92), but de facto the construction hasn't been continued so far because of the lack of finances. The total amount of money already spent for the construction is about \$ 350 million.

During the years 1994-1995 the “Technical-Economic Basis” for the construction of the RT-2 plant has been revised in connection to the changes in the legislative and normative documentation.

The corrected Technical-Economic Basis was in 1996 went through the state ecological expertise, and got approval by an order from the Environmental Ministry on 14.08.96 No. 364. The Technical-Economic Basis was further approved by the Administration for state ecological expertise for projects (protocol No. 66/43 DSP from 15.10.96). Now there exists the permission by the expertise to continue with the next stage of the planning.

The analysis of the dynamic of the emerging of SNF from Russian VVER reactors shows, that the perspective capacities of the two radiochemical plants (total ~2,000t / year) allow to reprocess by 2025:

- at the RT-1 plant all SNF from VVER-440 reactors from Russian and Ukrainian NPPs and about 6,000 t SNF from NPPs of other countries and in addition to that it is possible to carry out reprocessing of about 3,000t SNF from VVER-1000 or PWR reactors.
- At RT-2 (if it is put into operation in 2020) about 6,000-8,000t SNF of VVER-1000 and PWR reactors.

**3. List of objects needed for the finalization of the closed fuel cycle of nuclear energy**

**Table 4**

<b>Objects</b>	<b>Planned capacity</b>	<b>Costs in \$ mln</b>	<b>Start of operation year</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>1. TRANSPORT</b>			
1.1. Transfer basis (port “Vostochnyj”)	2000t / year	20	2001
Additional transport means (containers, wagons)	1,100 – 3,000 t / year	28	From 2001 according to the need
<b>TOTAL TRANSPORT</b>		48	
<b>2. STORAGE (40 years)</b>			
2.1. Completion of “wet” storage (building 1) at GKhK	up to 9,000t	12	2001
2.2. Completion of “dry” storage at GKhK (building 8)	9,000t	129	2004
2.3. Construction of a container repository on a new site	10,000t	125	Beginning 2004 step by step
2.4. Reconstruction of “wet” repositories of the RT-1 plant, buildings 101 “A” and 801 “A” at PO “Mayak”	1,600t	44	2006
<b>TOTAL STORAGE</b>	~35,000t	310	
<b>3. REPROCESSING</b>			
3.1. Reconstruction of the RT-1 plant at PO “Mayak”	400t / year	58	2006
3.2. Construction of the RT-2 plant	1,500t / year	1960	2020
3.3. Construction of a facility for the disposition of high-level radioactive wastes from the RT-1 plant		27	by 2020
3.4. Construction of a facility for the disposition of high-level radioactive wastes from the RT-2 plant		38	after 2025
<b>TOTAL REPROCESSING</b>		2083	
<b>TOTAL</b>		~2,590	
<b>Out of this:</b>			
1999-2001		50	
2001-2005		500	
2005-2010		550	
2010-2020		1490	
after 2020		60	

#### **4. Revenues from the sale of SNF management services**

According to marketing evaluations and planned technological possibilities it is possible to import in the period 2000-2010 about 20,000 t SNF from foreign countries for long-time storage with or without later reprocessing.

The world market prices for SNF management services can be calculated as follows:

- Reprocessing with the return of radioactive wastes – from \$ 600 to \$ 1,000 per kg (in average \$ 800);
- Long-time storage - \$ 300 to \$ 600 per kg (there's no market yet, figures are estimated);
- Reprocessing without return of radioactive wastes and Plutonium – \$ 1,200 to \$ 2,000 per kg (in average \$ 1,600).

On the basis of this figures the total of revenues from selling services for the management of foreign SNF have been calculated, table 5 (more detailed calculations of the revenue from the import of foreign fuel and the expenditures for the SNF management are given in table 7).

#### **5. Composition of expenditures for SNF management**

Into the list of expenditures the following expenditures have been included:

- Fulfillment of the NIOKR for the perfection of the dry storage technology and construction of equipment for storage, for the perfection of the SNF reprocessing technology at the operating RT-1 plant and the construction of perspective SNF reprocessing technology at the RT-2 plant under construction, for the development of transport means and containers for the transport and storage of SNF, for the development of technology for the disposition of nuclear wastes emerging during the SNF reprocessing;
- Construction of buildings and facilities for the proposed objects for SNF and nuclear wastes reprocessing, the acquisition of equipment and transport means, installation of the equipment and other works of large construction;
- Putting into operation objects for long-time storage and reprocessing of SNF and radioactive wastes, that means the acquisition of materials and chemical reagents, payment for electricity supply, for the working staff, completion of the current reconstruction and maintaining of buildings, facilities and equipment, pay-back payments for the reconstruction, payments to the social fund, payment to the Transport Ministry for using the railways by SNF transports trains and other expenditures, which have to be included into the production costs.

Table 5

**Dynamics of growth of revenues, gained from selling services of importing SNF from foreign countries**

Years	Amount of imported SNF, t / year		Total revenues accumulated in \$ mln.
	For Reprocessing	For storage	
2001	800	300	1080
2002	800	300	2160
2003	1200	400	3760
2004	1200	400	3760
2005	1600	400	7440
2006	1600	400	9520
2007	2000	500	12120
2008	2000	600	14760
2009	2400	600	17880
2010	2400	600	21000
<b>TOTAL</b>	<b>16000</b>	<b>4500</b>	<b>21000</b>

Table 6

**Dynamics of expenditures for management of foreign SNF**

Years	Total expenditures accumulated in \$ mln.			
	NIOKR	Investments	Ongoing costs	TOTAL
2001	15	35	19	69
2005	60	490	141	691
2010	90	960	449	1499
2015	150	2390	602	3142
2020	150	2450	1182	3782
2025	150	2450	3443	6043
2030	150	2450	5667	8267
2035	150	2450	7853	10453
<b>2040</b>	<b>150</b>	<b>2450</b>	<b>7900</b>	<b>10500</b>

## 6. Possible distribution of earned revenues

1. The total expenses for SNF management (storage up to 40 years, reprocessing, reuse and disposition of wastes) amount to \$ 10.5 billion, including investments for the

production needed for the SNF management – up to \$ 2.6 billion. From these finances it is possible to transfer up to \$ 7.2 billion to the State budget for the period of SNF storage (10-20 years).

2. Direct taxes and payments to the Federal and regional budgets will amount up to \$ 3.3 billion.
  3. Finances, which can be used for the solution of Federal and regional social-economic and ecological problems – up to \$ 7.2 billion.
-

**Table 7**

**Calculation of assumed revenues and expenditures related to  
SNF management of foreign countries**

Years	Import for reprocessing in t	Import for storage in t	Total import accumulated in t	Income in US\$ mln.	Expenditures for storage in US\$ mln.	Expenditures for Reprocessing in US\$ mln.	Expenditures for transport in US\$ mln.	Ongoing costs in US\$ mln.	Investments in NIOKR in US\$ mln.	Total expenditures in US\$ mln.	Total income
2001	800	300	1100	1080	2.2		16.5	18.7	50	68.7	1080
2002	800	300	2200	2160	5.5		33	38.5			
2003	1200	400	3800	3760	11.2		57	68.3			
2004	1200	400	5400	5360	59.3		81	100.3			
2005	1600	400	7400	7440	30.4		111	141.4	550	691.4	7440
2006	1600	400	7800	9520	44.5		117	161.5			
2007	2000	500	11900	12120	62.35		178.5	240.85			
2008	2000	600	14500	14740	84.1		217.5	301.6			
2009	2400	600	17500	17880	110.35		263.5	372.85			
2010	2400	600	20500	21000	141.1		307.5	448.6	1050	1498.6	21000
2011	16000	4500			171.85		307.5	479.35			
2012					202.6		307.5	510.1			
2013					233.35		307.5	540.85			
2014					264.3		307.5	571.6			
2015					294.85		307.5	602.35	2540	3142.35	21000
2016					325.6		307.5	633.1			
2017					356.35		307.5	663.85			
2018					387.1		307.5	698.6			
2019					417.85		307.5	725.35			
2020					447.1	425	310	1182.1	2600	6043.35	21000
2021					474.85	850	312.5	1637.35			
2022					501.1	1275	315	2091.1			
2023					525.85	1700	317.5	2543.35			
2024					549.1	2125	320	2994.1			
2025					570.85	2550	322.5	3443.35	2600	6043.35	21000
2026					591.1	2975	325	3891.1			
2027					609.85	3400	327.5	4317.35			
2028					627.1	3825	330	4782.1			
2029					642.85	4250	332.5	5225.35			
2030					657.1	4675	335	5667.1	2600	8267.1	21000
2031					669.85	5100	337.5	6107.35			
2032					681.1	5525	340	6546.1			
2033					690.85	5950	342.5	6984.35			
2034					699.1	6375	345	7419.1			
2035					705.85	6800	347.5	7853.35	2600	10453.4	21000
2036					712.6	6800	350	7862.6			
2037					719.35	6800	352.5	7871.85			
2038					726.1	6800	355	7881.1			
2039					732.85	6800	357.5	7890.35			
2040					739.6	6800	360	7899.6	2600	10499.6	21000

# Russian Academy of Sciences

317901 GSP I Moskau B-7g Leninsky Prosp. 14  
Tel. 973 03 09. Fax 954 33 20. Telex 111540 Nauk

14.05.99 No. 1-11 400-2210/143  
Ni No. YuM-P7-11735 from 09.04.99  
On the enlargement of the amount of electricity  
Exports from nuclear power plants

To the Acting  
First Deputy Head  
of the Governement of the  
Russian Federation  
Maslyukov, Yu.D.

Dear Mr. Maslyukov!

In reply to your letter from April 9<sup>th</sup>, 1999 No. YuM-P7-11735 on the possible enlargement of the amount of electricity exports from nuclear power plants and on the question related to this on the reprocessing of radioactive materials and spent nuclear fuel in the Russian Federation, the Russian Academy of Sciences states the following:

The entry onto the market for spent nuclear fuel management services is important for the additional use of the already existing potential and technologies of the nuclear sector. Moreover, the offer of services on a commercial basis will be a real support for the governmental programs to solve the problems of territories which are radioactive contaminated as a result of the activities of the military complex (conversion of nuclear submarines, radioactive wastes, clean-up of territories of the nuclear fuel cycle plants, test sites).

We regard it as reasonable to support the proposal of Minatom of Russia under the condition of further joint economic and ecological preparation under participation of institutes of the Russian Academy of Sciences.

Vice-President  
Of the Russian Academy of Sciences

Professor

*Signature*

V.E. Fortov

---

BV-07-16725

---

## **EXPERTISE**

### **ON THE DRAFT OF THE FEDERAL LAW ON AMENDMENTS TO ARTICLE 50 OF THE LAW “ON ENVIRONMENTAL PROTECTION”,**

**Which has been proposed to the Government of the Russian Federation for revision  
by the Ministry of the Russian Federation for Atomic Energy**

The analyzed draft of the law is design for the solution of problems of the elimination of impacts of the “Cold War” and for the establishment of the radiological cleanness of Russia in return for the use of our own intellectual and technological potential.

It is proposed to solve these problems in return for services of ecological safe and economical efficient management of foreign spent nuclear fuel (SNF), which gives the opportunity to receive non-budget finances, which are needed to solve the mentioned above problems.

This draft law differs positively from other draft laws in this field by the fact, that it is oriented towards a change of minimal extend in one Federal Law: The Law on Environmental Protection.

Altogether we assess the analyzed proposal of the Law positively and think, that it has good chances to be approved. Moreover we have a number of comments and recommendations, consideration of which would allow to solve the mentioned above problems in greatest completion and during shorter periods.

Given the indefinite character of these comments, we are sending them with a single letter.

President  
RNZ “Kurchatov Institute”  
Professor

***Signature***

E.P. Velikhov

---

**LIST OF APPROVAL**

**For the proposal of the Federal Law "On the proposed amendment to RSFSR Law  
"On environmental protection"”**

Ministry, authority		
Ministry of Economy of Russia	Deputy Minister V.F. Mozgalev	Approved
Ministry of Finances of Russia	Deputy Minister A.A. Astakhov	Approved
Ministry of Foreign Affairs of Russia	Minister I.S. Ivanov	Approved
Ministry of Trade of Russia	First Deputy Minister G.B. Gabunia	Approved
Ministry for Health Protection	First Deputy Minister I.A. Leshkevich	Approved
Ministry for CIS Affairs	Deputy Minister M.Ch. Khusnutdinov	Approved
State Committee for Nuclear Control of Russia	Acting Head, Deputy Head A.M. Dmitriev	Approved
State Committee for Ecology of Russia	Head V.I. Danilov-Danilyan	Approved

*Muenchmeyer: On the last of the 16 pages there is a text of which the beginning is missing. It looks like a summary and has Ivanov's signature below. Given the summarizing character of these 4 paragraphs it is most unlikely, that the missing text indicates incompleteness of the document.*

---

... it is possible to transfer up to \$ 7 billion to the State budget for the period of SNF storage (10-20 years).

Direct taxes and payments to the Federal and regional budgets will amount up to \$ 3.3 billion.

Finances, which can be used for the solution of Federal and regional social-economic and ecological problems – up to \$ 7.2 billion.

The implementation of this new kind of services, which are proposed by the amendment of Point 3, article 50 of the RSFSR Law ‘On environmental protection’, does not require the allocation of additional funds, but in contrary allows not only to broaden the spectrum of external economic activities of the Russian Federation in the field of trade with high technology products and services, but also to change the given export-import structure into the direction characteristic for countries with a developed economy. Most important – it gives the opportunity to solve the difficult internal task to finance environmental protection measures in the framework of the ongoing Federal programs for management of radioactive wastes, cleaning-up of territories, contaminated as a result of the military use of companies and the perfection of the system of SNF management and reuse of radioactive wastes in the Russian Federation.

First Deputy of the Minister  
Of the Russian Federation for  
Atomic Energy

*Signature*      V.B.Ivanov

---