Greenpeace International Briefing paper
November 18th 2005

Europe's radioactive secret

how EDF and European nuclear utilities are dumping nuclear waste in the Russian Federation

1 Executive Summary

It is well know that the nuclear industry produces nuclear waste in a variety of forms and a range of hazards. What is less well known is what they do with some of their wastes produced during uranium enrichment and plutonium reprocessing. This report summarises the secretive attempts of the European nuclear industry to 'solve'one of their largest waste problems, by exporting and dumping tens of thousands of tonnes of uranium wastes in Siberia, in the Russian Federation.

The nuclear wastes concerned are of two types:contaminated uranium (Repu) resulting from reprocessing at the Cogema/Areva facilities at la Hague, Normandy; and depleted uranium (DU) resulting from enrichment at facilities in France (Eurodif/Areva de Pierrelatte), and the Urenco facilities in Germany (Gronau), the Netherlands (Almelo) and the UK (Capenhurst). These are the facilities that support the day to day operation of Europe's 135 nuclear reactors.

Reprocessing and enrichment operations are conducted for Europe's large nuclear electricity generating companies operating in Sweden, Germany, Belgium, the Netherlands, the UK, France, Spain, and Switzerland, as well as non-European clients in Asia and the Americas.[1]

In total hundreds of thousands of tonnes of waste uranium have been generated at these facilities. In France alone over 16000 tonnes of Repu, and over 220 000 tonnes of enrichment waste depleted uranium (DU) have been produced. The volumes are continuing to increase each year.

Understandably the nuclear industry has not been transparent about their nuclear waste dumping operations. A great deal of information remains undisclosed. However, from information obtained from official sources, research conducted by Greenpeace and the important work of Wise-Amsterdam, an estimated total of uranium waste exported by the European nuclear industry to Russia during the last 30 years is in excess of 100 000 tonnes.

That the European nuclear industry is dumping large volumes of dangerous nuclear waste in Russia

[1] Main clients are: Vatenfall – Sweden/Europe, EoN and RWE - Germany, Electrabel - Belgium, EPZ - the Netherlands, British Energy - the UK, EDF - France, Iberdola - Spain, and NOK/Swissnuclear - Switzerland,

is shocking itself. But there are other factors that make this activity even more pernicious:

- Claims that the uranium is processed for manufacture into fuel are incorrect, with only a very small fraction of exported uranium returned to Europe;
- The waste is exported to some of Russia's most contaminated sites, with long-standing, major environmental and human health problems;
- Russian law does not permit the importation of nuclear waste for either storage or disposal, as such the exports are illegal under Russian Law;
- The nuclear waste is transported in most cases in the form of uranium hexafluoride a hazardous material that reacts violently with water;
- Nuclear industry tests have demonstrated that HEX containers fail fire tests leading to release of hazardous uranium gas;
- The International Atomic Energy Agency (IAEA) has failed to impose stricter standards on the industry;
- Shipments between west European ports are regular transiting through the North Sea, Skagarak, Baltic and Gulf of Finland before arriving at St Petersburg are made on non-purpose built general Russian-owned cargo vessels, despite the known hazards and risks posed by uranium HEX transports.
- The transportation route includes through major cities such as St Petersburg (5 million population) and Tomsk (0.5 million); a release in the vicinity of these cities could be devastating.

Nuclear waste is not just a problem after a nuclear reactor has been operating – even before the reactor delivers electricity it has created volumes of hazardous nuclear material that needs to be managed to the highest environmental standards. At minimum it needs to be treated responsibly, with the least environmental risk and to be monitored and retrievable. Dumping it in Siberia is not a responsible approach but an accurate reflection of the dirty reality of nuclear power.

2 Background

The uranium waste detailed in this paper originates from two stages in the nuclear fuel chain – from enrichment of natural uranium and the separation of nuclear spent fuel at reprocessing plants.

2.1 Uranium Enrichment

Enrichment of uranium increases the content of the fissile Uranium-235 component from the naturally occurring level 0.7% to 2 to 4% for commercial reactor fuels. The enrichment process incrementally diffuses or centrifuges a uranium hexafluoride (HEX) -bearing gas into an enriched stream, with the feedstock stream being depleted uranium (DU) below the 0.7% natural abundance which is referred to as DUF6. For the low levels of uranium enrichment required for civil nuclear reactor fuels, about 90% of the original feedstock mass remains in the DUF6 tails.

The general ratio is that for every one tonne of uranium enriched to 3.5% U-235 an additional 7 tonnes of DU at 0.3% U-235 remains. With an average sized nuclear reactor (1 gigawatt) requiring around 25 tonnes of fresh fuel each year of operation, seven times this much in the form of depleted uranium waste is produced in the enrichment process. That is one nuclear reactor - there are 135 reactors in operation in Western Europe.

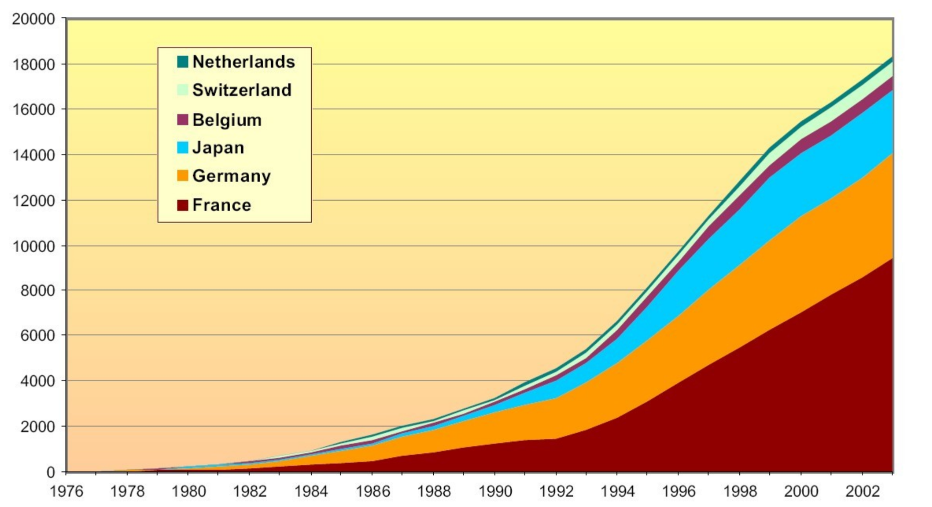
The principle enrichment plant in France, operated by Eurodif (a subsidiary company of Areva) is located at Pierrelatte, in the Rhone Valley. It is one of the largest such facilities in the world. Its principal customer is Electricite de France (EDF) but it has many other European customer countries. The other uranium enrichment company is the Dutch/German/UK consortium Urenco with facilities at Almelo (Netherlands), Gronau (Germany) and Capenhurst (the United Kingdom).

At the end of 2003, the inventory of the French nuclear waste agency Andra stated that there were 220,000 tonnes of DU stored in France, resulting from the contracts from EDF and other customers. According to forecasts, this gigantic stock will exceed 350,000 tonnes by 2020 only as a result of enrichment for EDF.

2.2 Reprocessed Uranium

The reprocessed uranium (Repu) referred to in this report arises from the reprocessing of spent fuel at the two plants operated by Cogema/Areva factory la Hague. Additional large amounts of reprocessed uranium have been produced from the British government operated site at Sellafield. It appears that a small amount of this has been exported to Russia. When irradiated spent fuel is reprocessed various nuclear materials are separated out: plutonium (around 1% of volume), high level waste fission products and minor actinides (3%) with the largest volume of solid waste being reprocessed uranium (96%). This does not include large volumes of gaseous and liquid wastes discharged directly to the environment.

Figure 1 - Cumulated quantities of reprocessed uranium arising from reprocessing of light water reactor spent fuel by COGEMA at the La Hague plants, in tHM, 1976-2003*



* Estimates based on the quantities of spent fuel reprocessed and the trend in their average burn-up.

© **WISE-*Paris*** *Source: WISE-Paris estimates based on NuclearFuel, COGEMA, CEA Annual Reports*

In the case of reprocessing operations at la Hague, around 1,200 tonnes of irradiated spent fuel is transported from EdF's 58 reactors. Approximately 850 tonnes are reprocessed each year of which around 805 tonnes is Repu. In addition to reprocessing of spent fuel from EdF, la Hague has reprocessed thousands of tonnes of spent fuel from utility customers in Europe and Japan.

The cumulated quantities of Repu produced through light water reactor spent fuel reprocessing at La Hague are over 18,000 tonnes, of which half is of French origin and half arising from foreign fuel, mainly from Germany and Japan.

If one adds the production of Repu at the older UP1 reprocessing plant at Marcoule, near Avignon, which was both for commercial and military operations, French reprocessing has generated a total estimated quantity of Repu at the end of 2003 of 30,000 tonnes.

3 The 'trade' that is dumping

Confronted by ever growing mountains of uranium nuclear waste the option to export part of the problem to Russia was taken up by the European nuclear industry led by Eurodif/ Cogema, Urenco and their leading utility customers.

Comprehensive information on all aspects of the nuclear waste trade with Russia are not in the public domain, so the figures available only tell part of the story.[2] However, contract details have become available through official sources (see annex 5) in Russia which reveal the dimension of the trade:

- In compliance with a contract between Minatom and the French company Cogema (#54-02/60006), reprocessed uranium was to be imported for enrichment at the Siberian Chemical Plant (Tomsk-7) in 1992-1993 in the form of uranium protoxide at the amount 150 tonnes per year, from 1994 and further on in the form of hexafluoride – up to 500 tonnes per year. The contract expired in 2000.[3]
- By 1995 the Siberian Chemical Plant (Tomsk-7) received 759 tonnes of uranium in the form of oxides and 100 tonnes in the form of hexafluoride from the French company Cogema.[4]
- The Eurodif company (France) was to send under various contracts: in 1996-1999 13,887 tonnes of depleted uranium, in 2000-2003 - 8386 tonnes of DU, in 200-2003 – 9,815 tonnes of DU. The company Urenco (Great Britain) in 1996-2003 was to send 59,328 tonnes of DU under the contract, in 2002-2003 – 13,676 tonnes of DU.[5]

Under these contracts some depleted uranium with enrichment 0.3% (with uranium-235) was to be re-enriched to the level of natural uranium (0.7%) or the level of enrichment sufficient to produce fresh uranium fuel –3.5-4.95%. During the enrichment most of the imported waste uranium hexafluoride is converted to even more depleted uranium in the form of hexafluoride with enrichment of about 0.2%.[6]

This process leaves the vast bulk of the uranium at Russian nuclear sites. For the contracts listed above, 106,725 tonnes of uranium (depleted and reprocessed) were shipped to Russia. Only 9,742 tonnes were returned to Europe, in the form of enriched or natural uranium. Thus 96,983 tonnes or more than 90% remain in Russia.

The four locations in the Russian Federation where European uranium waste located:

- Urals Electrochemical Plant (Sverdlovsk-44),
- Siberian Chemical Plant (Tomsk-7),
- Angarsk Electrolysis Chemical Plant (Angarsk),
- Electrochemical Plant (Krasnoyarsk-45).

All are under the control of the Federal Nuclear Energy Agency, Rosatom, formerly Minatom.

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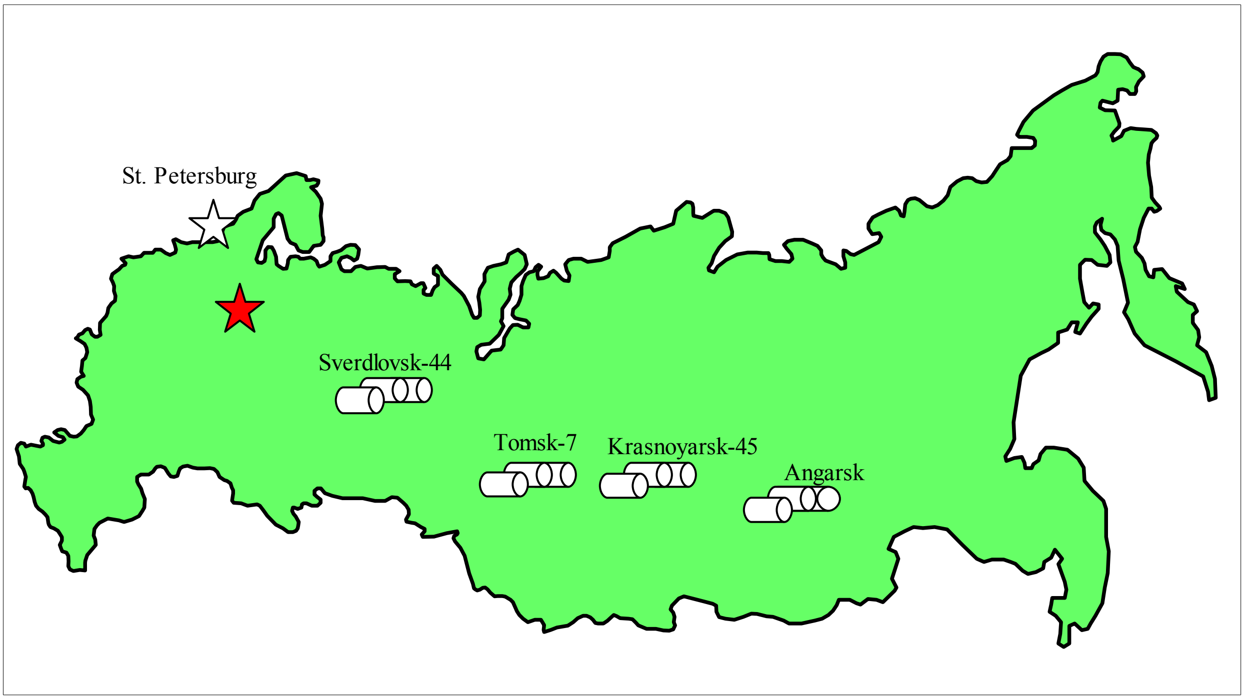
2 EDF recently confirmed the existence of contracts with Russian nuclear export company TENEX at a public meeting on October 8th 2005 in Villette, France. When questioned to give more details, such as quantities involved, EDF spokeperson Granger stated that it was "indecent to speak about such things".

3 Summary Conclusion of the Independent Panel on Expertise of the Contract on Reprocessing Nuclear Materials at the Siberian Chemical Plant from May 23, 1992, Tomsk.

4 Copy of letter of the Siberian Chemical Plant #02-17/808 from 30.11.1995.

5 Copy of the letter of the RF Nuclear Energy Minister #01-5328 from 29.09.2003.

6 ibid.



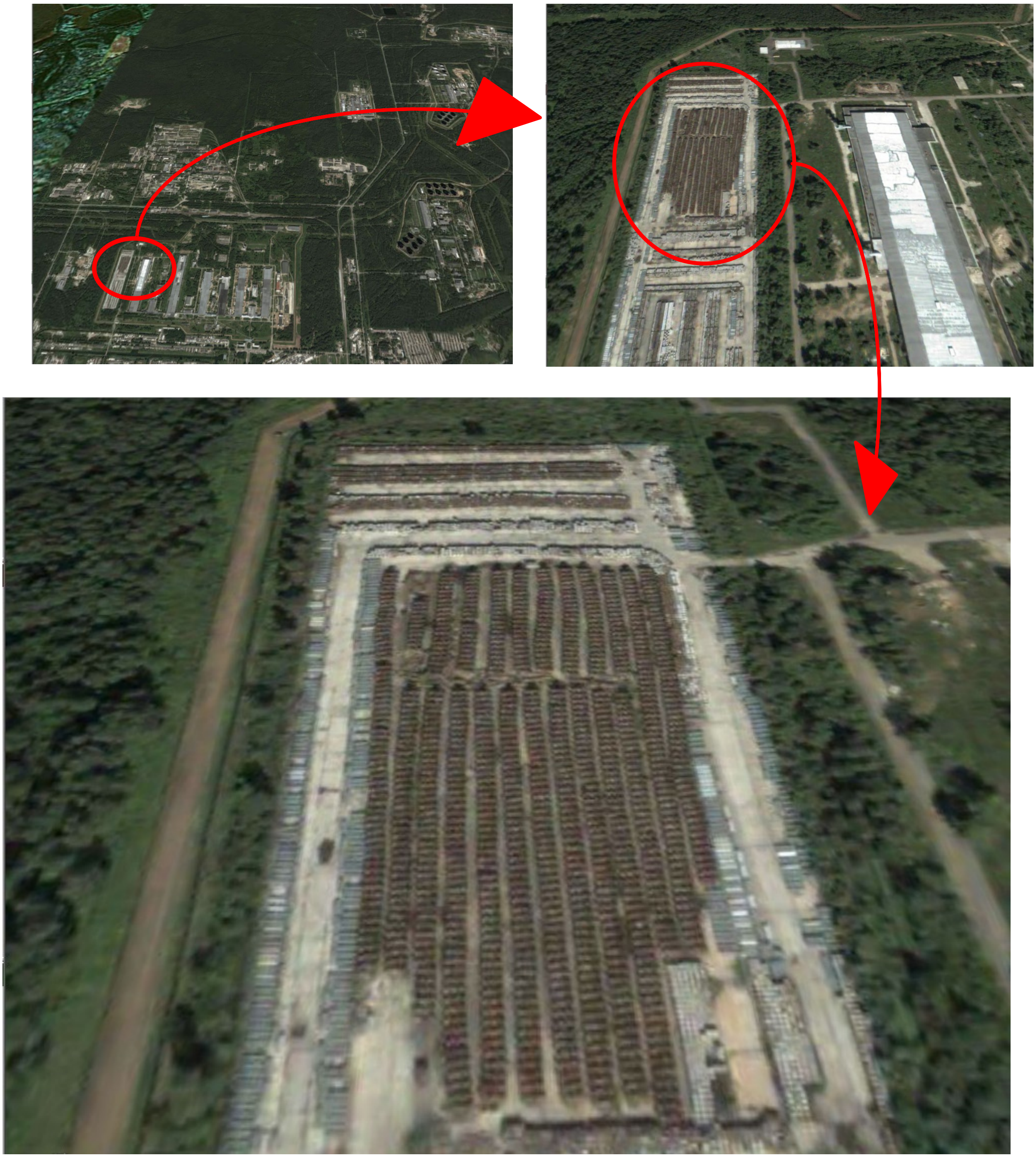
4 Violating Russian Safety Standards

The uranium is stored in cylindrical steel containers, each one holding over ten tonnes. At the four industrial sites [7]the steel containers are subject to external corrosion. Pin holes and fissures arising from corrosion are initially plugged by the reaction of the UF6 with moist air and iron leached from the container steel alloy, forming hydrates of the more stable uranium tetrafluoride (UF4) which partially seals up the breach. There is no technology (defluorination) currently operating in Russia for converting UF6 for long term stable storage.

According to the Russian Federal Service for Supervision over Nuclear and Radiation Safety, storing containers with waste uranium hexafluoride at industrial grounds at the sites listed above do not meet current safety requirements.[8]

[7] Copy of the letter of the Ministry of Health Care of the Russian Federation #2510/8197-03-20 from 24.07.2003.

[8] Report on activities by the Russian Federal service of Supervision over Nuclear and Radioactive Safety in 2003, Moscow, 2004.



Satellite pictures of UF6 storage site at Tomsk-7 (Russia). Source: google.com

5 The closed and secret city of Tomsk-7

The Russian sites were established during the Soviet era, and as such have major environmental problems. The example of the site of Tomsk-7 illustrates this. The ‘Siberian Chemical Combine’ whose activity started in 1954, is an immense nuclear complex located a few kilometers from the town of Tomsk, administrative capital of the south of Siberia, and approximately 3000 km east of Moscow. The site covers more than 190 km2 bordering the Tom river. Within the site is the closed city of Seversk with more than 100,000 inhabitants. For most of the last fifty years it was only known in code as Tomsk-7.

Nuclear facilities at Tomsk are extensive, the principal operation being plutonium production in five reactors (two still operating). It is the largest source of military plutonium for nuclear warheads still in operation worldwide. In addition to the two reactors, is an associated reprocessing plant, initially intended to extract plutonium from the production reactors irradiated fuels from other sites.

Environmental impacts at Tomsk have been significant over the years. Direct discharge to the environment of liquid, gaseous and solid wastes. The discharges from the reprocessing plant continue to this day into the channel tributary "Ramashka" of the Tom river, contaminating much of the river bed . Even more disturbing is the method for dealing with liquid high level waste, which in western Europe is solidified in glass blocks. The Tomsk approach is to inject the waste directly into underground rock fissures. Millions of cubic meters of radioactive liquids representing several million Tera-Becquerel have been injected. One of the largest radioactive sources on the planet.

On April 6, 1993 a serious explosion of a reserve of $25m^3$ of a solution containing several thousands of kilograms of uranium and several hundred kilograms of plutonium occurred.. The accident dispersed radio-nuclides with a long half-life contaminating all the north-eastern area of the site. Certain villages have being evacuated and today 12 years later, warning signs indicate it unsafe to pick wild fruit.

This is the environment into which the European nuclear power industry export their rejected uranium wastes.

6 The mythological justification

The nuclear industry justification for exporting a large amount of uranium waste to Russia is for further processing, including re-enrichment. This then either to be supplied back to Europe in the form of uranium oxide or manufactured fuel.

In Russia, in theory the imported DUF6 are fed into surplus enrichment cascades as feedstock and the enriched product is mostly natural-equivalent uranium plus some reactor-grade low-enriched uranium. The re-enriched uranium is sent back to Urenco and Eurodif. According to figures collected by Peter Diel[9] in an authoritative report:

- out of 14000 tonnes exported annually, European nuclear companies (Eurodif/Cogema and Urenco) receive back 2,330 tonnes.
- a further 3300 tonnes is re-enriched by Rosatom for either domestic use or further export. Thus the net increase in imported European uranium waste, year on year is in excess of 8000 tonnes. Further details at Appendix 1.

On Diehl's figures, the Russia recovery ratio of 3 to 4% enrichment for the return stream, seems to be too high for DUF6 imports that are likely to be depleted to around 0.3 to 0.4%, but even so if annual imports have been consistent since 1996, the DUF6 imported stockpile should now be about 90,000 tonnes of uranium in around 7,000 containers, in addition to nuclear waste imports prior to 1996.

As with all aspects of the nuclear industry, there are many issues that remain uncertain. While EDF claim that reprocessed uranium exports to Russia are reused, in 1989, vis-a-vis the problem arising

[9] See Peter Diel report Re-enrichment of West European Depleted Uranium Tails in Russia for Eco Defence, August 2005, extract at Appendix 1.

from Repu and the inability to re-enriching it at the Eurodif factory, representatives of the French Atomic Energy Commission (CEA) declared officially: *"the solution was until now to export the uranium of reprocessing, in exchange, of enriched natural uranium"*.[10] Thus the basis of contracts during the 1980's was a form of swapping rather than direct re-export of imported uranium.

The practise of swapping was confirmed by CEA, but Greenpeace investigations in the last few years suggest that at least for some exports to Russia it continues to this day.. As reprocessed uranium is being exported in some (of not all cases) in the form stable of U308 as detailed by the transport manifest below, which is the form generally dedicated to storage.

At least as far as depleted uranium in the United States is concerned, Areva confirmed earlier this year that material arising from its new enrichment plant to be built in New Mexico would be disposed of at a nuclear waste facility.[11] On Sep. 8, 2004, U.S. NRC staff presented its view before the U.S. Nuclear Regulatory Commission that depleted uranium *is a low level waste* - and the DU therefore may be transferred to the Department of Energy (DOE) for disposition, as requested by the license applicant (Urenco's U.S. subsidiary Louisiana Energy Services – LES).[12]

Reprocessed uranium (Repu) use in French and other European reactors remains extremely limited. In addition to the poor economics, reprocessed uranium presents problems due to the presence of fission products which are not separated during reprocessing, such as U-232 and U-236. The use of repu in fresh fuel manufacture increases the radioactive burden for workers, as well as contaminating the plant. Another reason why repu is exported to Russia where radioprotection standards are below those of western Europe. In terms of long term plans to re-use reprocessed uranium, EDF has declared in its accounts that it will be monitoring the storage of reprocessed uranium over the next 250 years.[13] Further details on the nuclear industry approach to reprocessing uranium can be found at Appendix 2.

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[10] Rapport IPSN (aujourd'hui IRSN) du 28 nov 2001 pour le groupe permanent cycle du combustible. H. Guillaume, R. Pellat, Ph. Rouvillois, "Rapport sur le bilan et les perspectives du secteur nucléaire en France", CEA, May 1989 - p. 87 *"Uranium arising from reprocessing is significantly different from natural uranium. Slightly more enriched (1% instead of 0.7%), it also contains some highly irradiating isotopes (U234 and U236). The presence of these isotopes makes the operations of enrichment and fabrication of fuel more difficult, and moreover more costly, because of stricter rules for operators protection et because of the risk of contamination of the facilities and equipments used. In particular, reprocessed uranium can hardly be re-enriched in the EURODIF plant, where the gaseous diffusion technology used does not allow for the separation of 234 and 236 isotopes from the useful ones (235 and 238); a period of some months of "cleaning" would be necessary after a campaign of reprocessed uranium re-enrichment before the plant can be operated again for natural uranium. The solution has been up to now the export abroad of the reprocessed uranium and the delivery, in exchange, of natural uranium enriched. Reprocessed uranium quantities held by EDF did not amount to an important volume up to now anyway. With the end of the exchange contract planned in 1990, coïnciding with the start of large scale reprocessing of EDF spent fuel in La Hague UP2-800 plant, will highlight the problem. This can however be partly solved by incorporating reprocessed uranium to the strategic stocks, equivalent to three years of consumption, that EDF is bould by regulation to hold. Reprocessed uranium would therefore only be used in the case of a serious crisis of uranium supply, that would make the overcost due to the higher radioactivity of this resource negligible"*

[11] LES and AREVA Sign Memorandum of Understanding for Deconversion Facility near the National Enrichment Facility, ALBUQUERQUE, N.M., Feb. 3 /PRNewswire/ 03/02/05.

[12] See Re-enrichment of West European Depleted Uranium Tails in Russia prepared for Ecodefense Russia by Peter Diehl, August 2005.

[13] Rapport de la Cour des Comptes, January 2005

7 Transportation hazards

There are major issues of safety in relation to the transportation of uranium waste to Russia, including extreme risk from fire hazards and non-compliance with IAEA standards. The risks are even higher given the fact that the transport trains pass through large populations centres – such as the Paris suburbs and St Petersburg, as well as within close proximity to cities along the sea route (Malmo for example). This is important as Hex is particularly dangerous because as well as being radioactive it reacts with air to produce hydrofluoric acid, a gas which destroys the lungs.

The bulk of uranium exported to Russia is in the form of UF6. While stable and unreactive with oxygen, nitrogen and carbon dioxide it reacts violently with water, including water vapour in the air, forming corrosive hydrogen fluoride (HF) and a uranium-fluoride compound called uranyl fluoride (UO2F2). Because of this instability, DUF6 is stored and transported in containers requiring compliance with IAEA TS-R-1 for conveyance between states.

In addition to leaks through corrosion (in particular at sites in Russia) DUF6 containers are at most risk from external fire, and as with other nuclear transport's there are major issues of safety involved. Analysis of the time to failure under the IAEA TS-R-1 thermal test conditions (800C for 30 minutes) of the most common type of DUF6 container (48G) predicts rupture to occur 12 minutes 20 seconds from the onset of fire.[14] At the point of rupture, the UF6 liquid and vapour temperatures have reached 127C and 356C respectively, giving an airborne release of about 1,750kg of the 12,700 kg total DUF6 contents. So in the case of DUF6 containers, the shipments do not meet even IAEA standards. To make matters worse average ship fires burn in excess of 21 hours and in excess of 1000 degrees.

The fire hazard could be even greater, as disclosed by French government agency Institut de Protection et de Sreté Nucléaire (IPSN) in Paris, which advises the French government on nuclear safety. In a 2000 study[15] flasks were baked in an oven and running computer simulations if the hex container most widely used, a type 48Y, would survive the kind of fire that could erupt after an accident. Their conclusion was,

"Rupture of the 48Y container in a fire seems likely and its resistance to fire should be improved to guarantee safety," they said. IPSN's experiments suggest current flasks would explode after 175 seconds *"in the most favourable case"*.

Defects found ISPN by x-raying welds on the flasks, mean that the explosion could come even sooner.

"Large quantities of uranium hexafluoride might be released in a transport accident involving a fire," the scientists said.

The IPSN study was launched in the wake of the sinking of the French cargo ship, Mont Louis, on August 25 1984 after a collision with a ferry in the English Channel. It went down off Ostend, Belgium, loaded 350 tonnes of uranium waste hexafluoride destined for Russia.

Compliance and protection against prolonged fire engulfment is less obvious and seems to be under

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[14] Uranium Hexafluoride Tailings, Large&Associates, for Greenpeace International November 3rd 2005.

[15] A study conducted in 2000 by French nuclear safety agency, IPSN, based upon computer simulations found that UF6 containers were breached within in 175 Citation: Int. J. Radioact. Mat. Transp. 11(4), pp 279-294 (2000) "Simulation of the Thermal Behaviour of UF6 Containment Packages in Fires, J.C. Ferreri, A. Clausse and F. Basombrio.

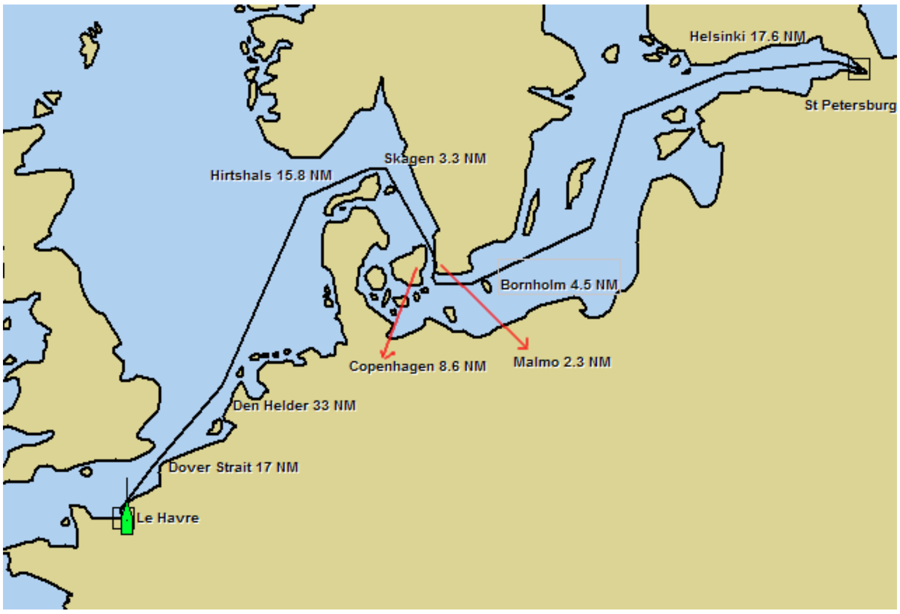
continuing review by the IAEA HEXT Working Group. The claim is that the existing container designs have survival times of 25 to 35 minutes for an unprotected container so that, to meet the TS-R-1 30 minute compliance ‘only a small adjustment’ to the container’s fire resistance is required, although this is contrary to the previously cited US analysis.

The IAEA Co-ordinated Research Programme (CRP) has evaluated the performance of UF6 containers subject to fire conditions and, although actual testing with a UF6 filled container is not mandatory being considered not to be ‘a realistic option’ (and has never been undertaken), the CRP cannot agree (2003-4) on a general computer/calculation model to predict container performance under fire engulfment. Present ‘solutions’ to the doubts over thermal performance include thermal over-packs, and fire shields for the transport vehicles. Once the container has finished with its transportation role there is not, apparently, any internationally binding requirements relating to the adequacy of inspection and upkeep for the storage role. Only when the container is reused for transportation of UF6 will compliance with IAEA TS-R-1 be required.

The conclusion is that there are major issues of compliance with existing IAEA standards (which themselves are not robust in terms of real ship fire conditions).

UF6 transport in France

UF6 transport in Le Havre (France)



transport route of uranium waste from France (Le Havre) to Russia (St. Petersburg)

8 Illegal storage of uranium waste in Russia

Despite changes made in the Russian Atomic Law, the importation of nuclear waste for storage and or disposal is not permitted under Russian law. To this end, Greenpeace Russia has filed a complaint against JSC “Tekhsnabexport” for concluding contracts with Eurodif, Urenco, Internexco and GKN which are breaching the Russian Federal law of 2001 'On Environmental Protection'.

Under these contracts, a total of 106,725 tonnes of uranium waste was shipped to Russia, while only 9,742 tonnes were sent back. For example, under the contract #60111 with Eurodif (France), 13887 tonnes of depleted uranium (DU) enriched 0.3% with uranium-235 were exported to Russia. After re-enrichment, 228.8 tonnes of uranium with natural enrichment of 0.711% with uranium-235 were returned to the client company. The remaining 13658.2 tonnes with an enrichment of 0.29% uranium-235 was made the property of the Russian Federation and was put in storage. Thus, some 98% of the initially exported depleted uranium is stored as UF6 in Russia.

The Russian legislation prohibits the import of foreign nuclear materials for storage. According to paragraph 3 of article 48 of the federal law of 2001 “On Environmental Protection”, import of nuclear waste and foreign nuclear materials to the Russian Federation for the purpose of its storage or disposal is prohibited. These contracts are thus a clear breach of the Russian law and under Russian legislation, all uranium tails should be sent back to the clients. The Greenpeace lawsuit is on-going.

9 The global threat from nuclear waste and the IAEA Multilateral Approach

The international trade in nuclear waste between Europe and Russia has a wider global context. Specifically the efforts by the nuclear industry, national governments and the International Atomic Energy Agency (IAEA) to establish regional high-level waste disposal sites. The furthest advanced is a site in the Russian Federation. This effort is driven by the growing crisis in nuclear waste volumes, in particular reactor spent fuel (figure). The Russian government after years of effort amended the Atomic Law in 2000 to permit the importation of spent fuel for the purpose of storage, reprocessing and disposal. In March 2000, Greenpeace disclosed the details of Russian Ministry of Atomic Energy Agency (Minatom), to import of 20,500 tonnes of spent nuclear fuel. Half of the expected revenue estimated at US$21bn would be used for a high level waste disposal site the remainder, according to Minatom, will be profit. Russia despite seeking to import thousands of tonnes of high level waste has no repositary.

Countries that have been identified by Russia as potential clients, include Germany, Switzerland, and Spain – all enrichment and reprocessing client nations with commercial contracts to Eurodif, or Urenco, or Areva or a combination. While the high level waste disposal plan remains a future threat, the utilities in these countries (and others) are already responsible for the dumping of nuclear waste uranium in Russia. The existing established waste trade with Russia is a step along the road to high level waste disposal.

Aiding and abetting the nuclear utilities, the European Commission and IAEA are seeking to ease the pain of the pain of the 'Western' nuclear industry by promoting the dumping of nuclear waste spent fuel in regional sites, in the first instance in the Russian Federation’s nuclear facilities in Siberia. The Commission has opened negotiations for greater nuclear trade between the EU and

Russia, including the export of high level nuclear waste[16]. The IAEA has established a proposal for Multilateral Nuclear Fuel Cycle centers, including regional high-level waste disposal sites, with the lead candidate cited as Russia.

As this briefing has sought to highlight, foreign nuclear waste dumping has already been established in Russia and the trade is regular and on a large scale. Greenpeace along with environmental organizations in Russia and a large majority of the Russian population strongly oppose the establishment of any nuclear waste dump in Russia.

End

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[16] EU Commission Proposal for a Directive (Euratom) on the management of spent nuclear fuel and radioactive waste, January 30th 2003. http://europa.eu.int/comm/energy/nuclear/safety/doc/com2003_0032en01.pdf

Appendix 1

Extract from **Re-enrichment of West European Depleted Uranium Tails in Russia** prepared for Ecodefense Russia by Peter Diehl, (consultant to Wise-Amsterdam) August 2005

The re-enrichment deals between Urenco / Eurodif and Rosatom:

- Urenco and Eurodif each send 7,000 t U in tails per year to Russia for enrichment, see Nuclear Fuel, May 12, 2003
- Urenco's tails have an assay of 0.3%, Eurodif's an assay of 0.35%, see Nuclear Fuel, May 12, 2003.
- Urenco and Eurodif each get back 1,100 t U of re-enriched natural-equivalent uranium (Uneq) contained in UF_6, see Nuclear Fuel, May 12, 2003.
- Approximately half of the total of 2,200 t U of re-enriched Uneq received by Urenco and Eurodif is used by EU utilities the rest is being exported, see Euratom Supply Agency: Annual Reports 1996 – 2003.
- Eurodif, in addition, gets back 130 t U in UF_6 of uranium re-enriched to 3.5%, see Nuclear Fuel, May 12, 2003.
- Rosatom spends a total of 2.58 million SWU on this re-enrichment deal for Urenco and Eurodif, see Bukharin, Oleg: Russia's Gaseous Centrifuge Technology and Uranium Enrichment Complex, Program on Science and Global Security, Woodrow Wilson School of Public and International Affairs, Princeton University, January 2004.
- Rosatom does not charge the market price for the SWU it spends, but presumably a cost price of $20 per SWU, see Bukharin 2004.
- The secondary tails generated by the re-enrichment process remain in Russia, see BT-Drs.13/8810, and Bukharin 2004.

- Rosatom's additional exploitation of the secondary tails from the Urenco / Eurodif deals:
- The secondary tails are re-enriched further by Rosatom on its own account.
- Rosatom strips them down to a tails assay of 0.1%, see Bukharin 2004.
- Rosatom this way obtains a further 3300 t U [?] of re-enriched natural-equivalent uranium per year, which it can use or sell on its own account; Rosatom uses at least part of this material for the production of blendstock (assay 1.5%) for the downblending of HEU, see Nuclear Fuel, May 12, 2003 and Bukharin 2004.

Appendix 2
The myth of recycling

Claims that reprocessing allows full utilization of the valuable nuclear material contained in the spent fuel have long been known to be mythology. In addition to the global plutonium stockpile in excess of 200 metric tonnes, thousands of tonnes of reprocessed uranium have been generated. A fraction of this has according to official sources been re-used in nuclear reactor fuel. The section below details official documentation/statements on the use of reprocessed uranium, as compiled by Wise-Paris for Greenpeace International.

1 - "Under a contract signed last year with Framatome ANP's German subsidiary when it was still part of Siemens, the 140 metric tonnes of reprocessed uranium (Repu) from the Oskarshamn spent fuel have been combined with downblended Russian high-enriched uranium and are being incorporated in fuel elements manufactured at the Elektrostal factory near Moscow. Elektrostal has made fuel for other western European reactors, notably in Germany, under a Siemens license. Nordloef said four lead assemblies are being tested at Oskarshamn-2 and that performance so far has been good. In all, 100 of the Russian assemblies will be delivered through 2003.[17]

2 - "The first four reactors to use the fuel, based on feedstocks of blended-down Russian-origin HEU and German-origin REPU, were Obrigheim, Brokdorf, Unterweser, and Neckarwestheim-2.Thre years ago, Siemens, now ANP, and Elektrostal signed contracts to supply about 30 metric tonnes (MT)/yr of power reactor fuel through the beginning of 2005. […] For each metric ton of fuel produced, between 30 and 40 kilograms of HEU are used up. The HEU is provided from Minatom inventories and is purchased directly by the utility customers of ANP/Elektrostal. […] The first fuel—four test assemblies—was loaded at the Obrigheim PWR in 1995. As of 2000, Obrigheim had loaded 32 more assemblies and has since ordered 48 more. According to Elektrostal officials, the firm fabricated 28 assemblies for Obrigheim in 1997 and another 28 for the same reactor in 1999. […] Fuel for two PWRs owned by E.On-Energie, Brokdorf and Unterweser, has been supplied on the basis of a 1998 contract that called on Elektrostal to fabricate a total of 120 assemblies. The first four assemblies at Unterweser were loaded in 2000. According to data from E.On-Energie, 32 more assemblies will be loaded in 2003, followed by another 32 assemblies in 2004. […] Neckarwestheim-2 began loading the fuel in 2001, after it had contracted for delivery of 54 assemblies of Russian-made fuel. It now has about a third of a core of Russian-made fuel—48 of 178 assemblies. More will be loaded there in 2003. As of last year, RWE and E.On took delivery of 32 assemblies for the Gundremmingen-B BWR, shipped to the reactor last in Nov. 2001. The fuel was loaded this March. By 2005, Gundremmingen will have been supplied about 45 MTU from Russia. Gundremmingen has a REPU inventory at Cogema's La Hague reprocessing plant of about 300 MT, and the annual storage cost it pays Cogema is said to be equivalent to the cost of shipping the REPU to Russia for fabrication."[18]

*3 - "Industry sources observed that it isn't known publicly exactly what material Electrostal uses in the fuel, nor in particular how much of western European REPU is actually re-used".*21

[17] A. Sains, "OKG and Framatome ANP agree on MOX manufacture at Sellafield", in *NuclearFuel*, n°10, 14, May 2001.

[18] M. Hibbs, "Framatome, Elektrostal looking to double business in down-blended HEU fuel", in *NuclearFuel*, n°17 vol. 27, 19 August 2002.

In the case of principal nuclear states:

1. France

•"Esteve[19] said EDF is still assigning a slight positive value to reprocessed uranium (REPU) because the extra cost of fabricating REPU fuel, as compared to fresh U fuel, is not well known "But we could very well decide to put REPU at zero value in one or two years," he told a meeting of the French Nuclear Energy Society on MOX fuel October 28.[20]

•"The same approach [as for plutonium] has now been taken, as of EDF's 1997 accounts, Jacques Chauvin, the utility's chief financial officer, said March 3rd. He told NuclearFuel that a decision by EDF to discontinue the REPU credit had caused an increase of 2.8 billion French francs (about $550 million) in its back-end liability provisions. As has been recent practice for plutonium, the Repu is given a book value only when it enters the cycle of fabrication into fuel assemblies or use in reactors."[21]

•"Debes[22] was less comfortable with recycling reprocessed uranium (REPU, or URT in French). Reprocessing at La Hague produces about 800 MTHM of REPU per year, which can theoretically be re-enriched but given economic conditions, is now transformed into stable U3O8 for long term storage. REPU is *"potentially usable"* in reactors, he noted, and *"if there's a uranium supply crisis in 15 years, we could run our reactors on it for five years."* But Debes acknowledged that higher burnups don't favor the use of REPU, since they lead to a higher content in spent fuel of the unwieldy U-236 isotope."[23]

2. Germany

•"Perschmann[24] said that official German policy requiring demonstration that reprocessing products are used during reactors' lifetime doesn't allow time for wait-and-see approach" as this is the case for the EDF's 'strategic uranium reserve' which is tapped only when it's economically justified.[25]

•"According to data provided by the Federal Ministry of Environment & Nuclear Safety (BMU) to the German parliament last month, about 3,900 metric tonnes (MT) of REPU has been generated by reprocessing of spent German power reactor fuel. BMU elaborated that REPU separated by the pilot plant (WAK) in Karlsruhe, now decommissioned, was shipped to several locations for storage and processing: 82 MT went to a uranium processing plant in Ellweiler, Germany; 112 MT to Comurhex's conversion plant at Pierrelatte; 2.6 MT to another Comurhex facility in Malvesi; 3.7 MT to Cogema at Pierrelatte; 3.1 MT to the former RBU (now Siemen) LWR fuel fabrication plant in Hanau, also decommissioned, and 3.2 Mtwere said to be at the Karlsruhe Nuclear Research Center, where the WAK is located. According to utility data obtained by BMU, a total of 1,104 MT REPU separated by Cogema and British Nuclear Fuels plc (BNFL) are being stored at Pierrelatte and at Sellafield. *"The rest of the REPU separated*

[19] Bernard Esteve, former EDF's fuel chief.

[20] A. MacLachlan, "EDF to erase positive Pu value in 1995 accounts", in *Nucleonics Week*, n°44 vol. 36, 2 November 1995.

[21] A. MacLachlan, "EDF REPU change does not reflect shift in policy, just an accounting change", in Nuclear Fuel, n°5 vol. 23, 9 March 1998.

[22] Michel Debes is Director of EDF's nuclear fuel division.

[23] A. MacLachlan, "EDF: high burnups plus limited MOX equal cheaper power and less waste", in Nuclear Fuel, n°1 vol. 26, 8 January 2001.

[24] Wolf-Dieter Perschmann, is nuclear fuel manager of Gemeinschaftskernkraftwerk Neckar GmbH (GKN)

[25] A. MacLachlan, "GKN says Elektrostal option only solution for REPU use", in Nuclear Fuel, n°20 vol. 27, 30th September 2002.

abroad from German spent fuel, about 2,600 MT, was sold to the reprocessors or to their subsidiaries", BMU said."[26]

3. United Kingdom

- *"The price and ready availability of uranium no longer seem to justify the expense of reprocessing spent fuel and converting the reprocessed uranium (RepU) arising into a form in which it can then be enriched and re-enter the fuel cycle. Virtually none of the RepU recovered at THORP has been re-used, although BNFL told us of prospects for a sale of a small quantity to Russia. BNFL holds a stockpile for its customers of 2,500 tonnes of RepU."*[27]

Reprocessed uranium use by nuclear reactor operators

The following figures gives only a partial view of RepU reuse as no comprehensive data could be found on the matter:

Table 9 - Fabrication of RepU based fuel assemblies at FBFC Romans, 1998-2003, in tHM

	Enriched RepU feed (as UF6)	Enriched Reprocessed Uranium fuel elaborated
<1994		120 assemblies
1995		110 assemblies
1996		160 assemblies
1997		
1998	102.0	78.0
1999	46.4	47.9
2000	9.8	22.9
2001	33.0	18.0
2002	27.0	24.0
2003	60.8	51.4

Source: DSIN, Annual Reports 1998-2003; RGN 1995-1996[33]

Footnote[28]

[26] M. Hibbs, "Japanese utilities in no hurry to blend up their REPU inventories", in *NuclearFuel*, n°18 vol. 24, 6 September 1999.
[27] UK, Trade and Industry - Ninth Report, 18 May 2000.

[28] K. Hummelsheim, W. Mester, "Entsorgung abgebrannter Brennelemente aus den Kernkraftwerken in der Bundesrepublik Deutschland – Ergebnisse in der Länderumfrage vom 31.12.2001", GRS, July 2002. Personal phone and email communications with Michel Debes, Director of EDF's nuclear fuel division, as of 4 May 2001 and 4 August 2004. Kernkraftwerk Gösgen-Däniken AG, 25-31. Geshäftsbericht über das Geschäftjahr 1997-2003.

Table 8 - Use of RepU by different reprocessing clients

	Since	REPU in core Ass.	REPU in core tHM	REPU unloaded Ass.	REPU unloaded tHM	Total Ass.	Total tHM
Germany[a]	1983						
Brokdorf		4	2.2	0	0.0	4	2.2
Unterweser		4	2.1	0	0.0	4	2.1
Obrigheim		48	14.0	1 (transported to COGEMA)	0.3	49	14.3
Neckarwestheim-1		0	0.0	8 (1.4 t to COGEMA / 1.4 t to storage)	2.8	8	2.8
Neckarwestheim-2		16	8.6	0	0.0	16	8.6
KNK2, Karlsruhe		0	0.0	5 (transported to CEA)	0.3	5	0.3
Total		***72***	***26.9***	***14***	***3.4***	***86***	***30.3***
France[a]	1987						
Cruas 3 & 4		314	145	234 (90 t to COGEMA / 18 t at reactor site)	108.0	548	253.0
Belgium[a]	1990						
Doel-1		?	?	?	?	?	?
Switzerland[a]	2000						
Gösgen		52	22.4	0	0	52	22.4

a. Data as of 31 December 2003, except for Germany, as of 31 December 2001.

Source: GRS, EDF, KKW Gösgen[32]

Footnote [29]

In all of the data so far analyzed the amount of reprocessed uranium resused in reactor fuel would appear to be far less than 1000 tonnes.

[29] B. Esteve (EDF), "Retraitement et recyclage des combustibles irradiés", in *Revue Générale Nucléaire*, n°1, January-February 1995; D. Magnin (Framatome), "Les combustibles MOX et URE à matières nucléaires recyclées", in *Revue Générale Nucléaire*, n°2, March-April 1996; B. Blanpain & al. (Framatome), "Le combustible Framatome pour réacteurs REP", in *Revue Générale Nucléaire*, n°3, May-June 1997.

Appendix 3
TRANSPORT OF DUF6 UNDER IAEA TS-R-1

Extract from *"Briefing note uranium hexafluoride (uf$_6$) tailings"* by Large & Associates, for Greenpeace International November 3rd 2005

DUF6 (and feedstock and enriched streams of UF6) is transported in sealed containers. Prior to transport containers are filled and cooled with the DUF6 assuming it crystalline state, and the container is evacuated to a slight negative pressure and then sealed with a non-venting valve. The maximum mass contents of certain containers held for long term storage of high purity DUF6 is set by defining a 5% ullage at a working temperature of 113oC (based on a UF6 mass of 3.33g/cm^3).

These International Atomic Energy Agency (IAEA) recommendations are generally accepted by all signatory states, being introduced in 1996. Since January 2002 specific requirements in TS-R-1 determine the transport of non-fissile and fissile excepted uranium hexafluoride which includes the transportation, although not on-site storage of DUF6.

The TS-R-1 requirements stipulate a unilateral approval H(U) requirement by 31 December 2003 being, essentially, satisfactory performance when subject to a structural internal pressure test of 2.76 MPa, 0.6m high drop test, survival of the 30 minute 800ºC thermal (fire) engulfment. Low levels of enrichment (hence non-fissile) DUF6 containers when in transport have to bear the label '*UN 2978*' with the proper shipping name *'RADIOACTIVE MATERIAL, URANIUM HEXAFLUORIDE'*. Other than the distinction between non-fissile and fissile consignments of UF_6, all uranium hexafluoride (DUF6 or otherwise) has to be transported in IAEA TS-R-1 compliant containers (other than a transit mass of less than 0.1kg)


transport with shroud

Containers with H(U) approval can be recognised by the valve protector shroud located at one end although newer designs (post 2002 48Y model) may have overcome the design weakness (where upon impact the shroud rim deforming inwards and damaged the valve stem).

Compliance and protection against prolonged fire engulfment is less obvious and seems to be under continuing review by the IAEA HEXT Working Group. The claim is that the existing container designs have survival times of 25 to 35 minutes for an unprotected container so that, to meet the TS-R-1 30 minute compliance 'only a small adjustment' to the container's fire resistance is required, although this is contrary to the previously cited US analysis.

The IAEA Co-ordinated Research Programme (CRP) has evaluated the performance of UF_6 containers subject to fire conditions and, although actual testing with a UF_6 filled container is not mandatory being considered not to be 'a realistic option' (and has never been undertaken), the CRP cannot agree (2003-4) on a general computer/calculation model to predict container performance under fire engulfment. Present 'solutions' to the doubts over thermal performance include thermal over-packs, and fire shields for the transport vehicles.

With thermal blanket

Once that the container has finished with its transportation role there is not, apparently, any internationally binding requirements relating to the adequacy of inspection and upkeep for the storage role. Only when the container is reused for transportation of UF6 will compliance with IAEA TS-R-1 be required.

JOHN H LARGE LARGE & ASSOCIATES CONSULTING ENGINEERS, LONDON

Annex 5:
Letter from Minatom to S.S. Mitrokhin, Member of the State Duma 2003

МИНИСТР
РОССИЙСКОЙ ФЕДЕРАЦИИ
ПО АТОМНОЙ ЭНЕРГИИ
(Минатом России)

119017, Москва, ул. Б.Ордынка, 24/26

29 СЕН 2003 № 01-5328ден

На № СМ-1349 от 22.08.2003

Информация по переработке иностранного уранового сырья

Депутату Государственной Думы
Федерального Собрания
Российской Федерации

С.С.Митрохину

Уважаемый Сергей Сергеевич!

В соответствии с Вашим запросом от 22.08.2003 № СМ-1349 Минатомом России подготовлены материалы, которые, по нашему мнению, отвечают на поставленные Вами вопросы, хотя затронутая Вами проблема носит сложный и комплексный характер, а информация по ряду поставленных вопросов содержится только в архивах и ее обработка потребовала дополнительного времени.

В приложении 1 приводим данные по количеству и характеристикам иностранного уранового сырья (т.н. «давальческого сырья»), поступившего на переработку в Российскую Федерацию в рамках внешнеторговых контрактов начиная с 1995 года. В том же приложении содержится информация по отгруженной после переработки урановой продукции и урану, остающемуся в Российской Федерации в качестве продукта переработки («хвостов»).

Услуги по обогащению урана и поставки низкообогащенного урана (НОУ) осуществляют федеральные государственные унитарные предприятия Минатома России: ФГУП «Уральский электрохимический комбинат» (ФГУП «УЭХК»), ФГУП «Производственное объединение «Электрохимический завод» (ФГУП «ПО «ЭХЗ»), ФГУП «Сибирский химический комбинат» (ФГУП СХК), ФГУП «Ангарский электролизный химический комбинат» (ФГУП «АЭХК»).

Цены на оказание услуг по обогащению давальческого уранового сырья определяются на договорной основе с учетом текущих мировых цен на подобные работы. В связи с этим калькуляция себестоимости производимых работ в рамках международных контрактов не составлялась.

В соответствии с действующим законодательством Российской Федерации налоговые платежи и отчисления формируются не по каждому отдельно взятому контракту, а исходя из общей прибыли, полученной предприятием. С учетом этого, мы даем информацию об общем объеме прибыли и налоговых платежей по предприятиям, осуществляющим услуги по обогащению иностранного давальческого сырья (приложения 2 и 3).

MINISTER
OF ATOMIC ENERGY
OF THE RUSSIAN FEDERATION
(MINATOM)

To: S.S. Mitrokhin
Member of the State Duma
of the Federal Assembly
of the Russian Federation

Re: Reprocessing of imported uranium materials.

Dear Mr. Mitrokhin!

To follow up on your request of 22 August 2003 #CM-1349, the RF Ministry of Atomic Energy prepared materials that, we believe, can answer your questions, although the issue you touched upon is very complicated and information on certain question may be found only in the archives and its search and preparation would have taken some time.

Annex 1 contains data on the amount and the characteristics of the uranium materials (the so-called goods made on commission) imported into Russia for reprocessing under international trade agreements signed after 1995. Here as well, you can find information about uranium shipments after reprocessing and uranium left in Russia as the product of reprocessing (rejects).

Uranium enrichment services and shipments of low enriched uranium (LEU) are the responsibility of federal-level state-owned unitary companies of the RF Atomic Energy Ministry: “Uralsky Electrochemical Plant”, “Production Association “Electrochemical Factory””, “Siberian Chemical Plant” and “Angask Electrolysis Chemical Plant”.

The price of the services related to enrichment of the uranium goods made on commission are set up based on agreement that takes into consideration current world prices of similar services. Which is why no calculation of the prime cost of the services under the international agreements has been made.

Under the existing Russian Federation laws, taxes and deductions are defined not for each agreement, but based on the total income acquired by a company. With this in mind, we are giving you information on the total income acquired and taxes paid by each company providing services related to enrichment of imported goods made on commission (Annexes 2 and 3).

Rejects produced in the process of enrichment of the imported goods made on commission are left with the Russian companies as the property of the state (federal property). Storage and disposal of the above mentioned rejects are not provided for because the rejects are a valuable raw material used at Minatom plants in production of raw uranium of the natural quality with application of up-to-date technologies of isotope separation. Later on the reprocessing rejects may be used in production of fluorine for the needs of the national industry.

Very truly yours,

A. Rumyantsev
Minister of Atomic Energy

Enclosed: Annexes, 3 pages.

«Хвосты», образующиеся в процессе обогащения иностранного давальческого сырья, остаются на российских разделительных предприятиях в качестве федеральной собственности. Утилизация или захоронение указанных «хвостов» не предусматривается, т.к. они являются ценным материалом, из которого по существующей на предприятиях Минатома России современной технологии разделения изотопов можно производить наработку сырьевого урана природного качества. В дальнейшем из дополнительно переработанного материала будет извлечен фтор для использования в народном хозяйстве.

Приложения на 3 л. в 1 экз.

А.Ю.Румянцев

Информация об объеме уплаченных налогов в бюджеты за период 1995- 2002 г.г. предприятиями ДЯТЦ, являющимися поставщиками НОУ и услуг по обогащению урана

(млн. руб.)

Наименование федерального государственного унитарного предприятия	Период							
	1995	1996	1997	1998	1999	2000	2001	2002
УЭХК	242	437	482	792	1641	2954	2060	3652
СХК	217	189	398	448	1108	1687	829	1974
АЭХК	76	130	208	302	477	907	834	931
ЭХЗ	155	346	450	476	937	1672	1158	1662
ИТОГО:	690	1102	1538	2018	4163	7220	4881	8219

Информация об объеме прибыли до налогообложения за период 1995- 2002 годы, полученной предприятиями Минатома России, являющимися поставщиками НОУ и услуг по обогащению урана

(млн. руб.)

Наименование федерального государственного унитарного предприятия	Период							
	1995	1996	1997	1998	1999	2000	2001	2002
УЭХК	1159	765	1016	2747	4908	5627	2067	4791
СХК	336	714	543	725	2809	1759	331	1636
АЭХК	242	241	357	770	1410	1229	519	493
ЭХЗ	573	899	1222	2228	3529	2799	1889	2063
ИТОГО:	2310	2619	3138	6470	12656	11414	4806	8983

Сведения о контрактах по обогащению иностранного уранового сырья

СВЕДЕНИЯ О КОНТРАКТАХ				ПЕРИОД	СЫРЬЕ (иностранное давальческое)					ВОЗВРАЩАЕМЫЙ УРАН			ОСТАВШИЙСЯ УРАН	
№ контракта	Срок действия контракта	Наименование фирмы	Страна контракта	ПОСТАВКИ	Страна происхождения сырья	Фирма – владелец сырья	Обогащение %	Форма поставки	Количество (тонны урана)	Обогащение %	Форм а постав ки	Количество (тонны урана)	Форма	Количество (тонны урана)
60111	1996-1999	EURODIF.	Франция	1996-1999	Франция	EURODIF	0,3	ГФУ	13887	0,711	ГФУ	228,8	ГФУ	13658,20
50132	1995-2009	URENCO	Великобритания	1996-2003	Великобритания	URENCO	0,3	ГФУ	59328	4,28 – 4,95	ГФУ	450,18	ГФУ	
25040	2002-2009	URENCO	Великобритания	2002-2003	Великобритания	URENCO	0,3	ГФУ	13676	0,711	ГФУ	7947,18	ГФУ	64 606,64
90124 25020 25024	1999-2014 2002-2014 2002-2004	EURODIF EURODIF INTERNEXCO	Франция Франция Германия Германия Германия Грмания	2000-2003 2002-2003 2002-2003	Франция Франция Франция Узбекистан Намибия Казахстан	EURODIF EURODIF INTERNEXCO INTERNEXCO INTERNEXCO INTERNEXCO	0,3 0,3 0,711 0,711 0,711 0,711	ГФУ ГФУ закись-окись закись-окись закись-окись закись-окись	8386 9815 200 818 245 70	3,5	ГФУ	1 062,00	ГФУ	18472,00
80004	1975-2002	GKN	Германия	1997; 1998;2000	Китай	CNEIC	0,711	закись-окись	300	3,75;3,55;4,34	ГФУ	53,7	ГФУ	246,3
								Всего:	106725			9741,86		96 983,14

Примечание: обогащение по U-235 оставшегося в Российской Федерации материала в форме гексафторида урана в соответствии с условиями указанных контрактов составляет 0,2-0,38%.