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Annex 2 for the Nuclear Illustrative Programme
Summary of nuclear fuel cycle activities carried out in individual EU Member States

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Figure 1 - MS Share in the EU-Nuclear Production

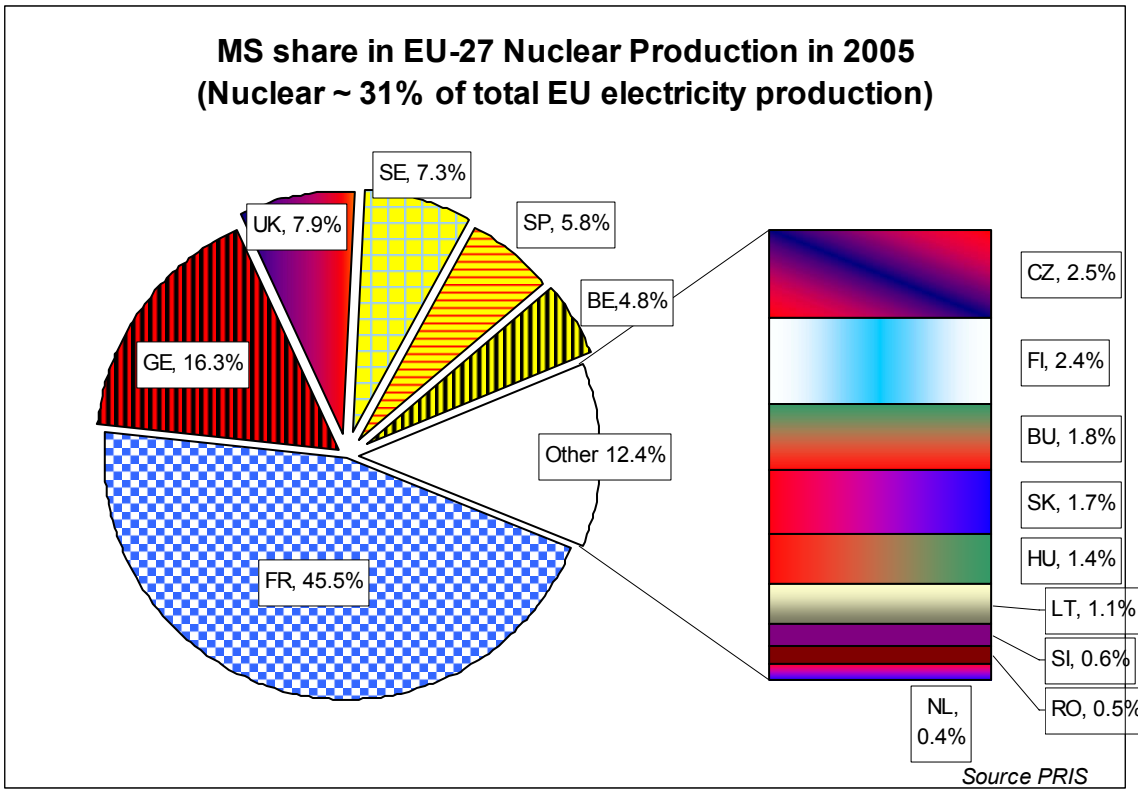
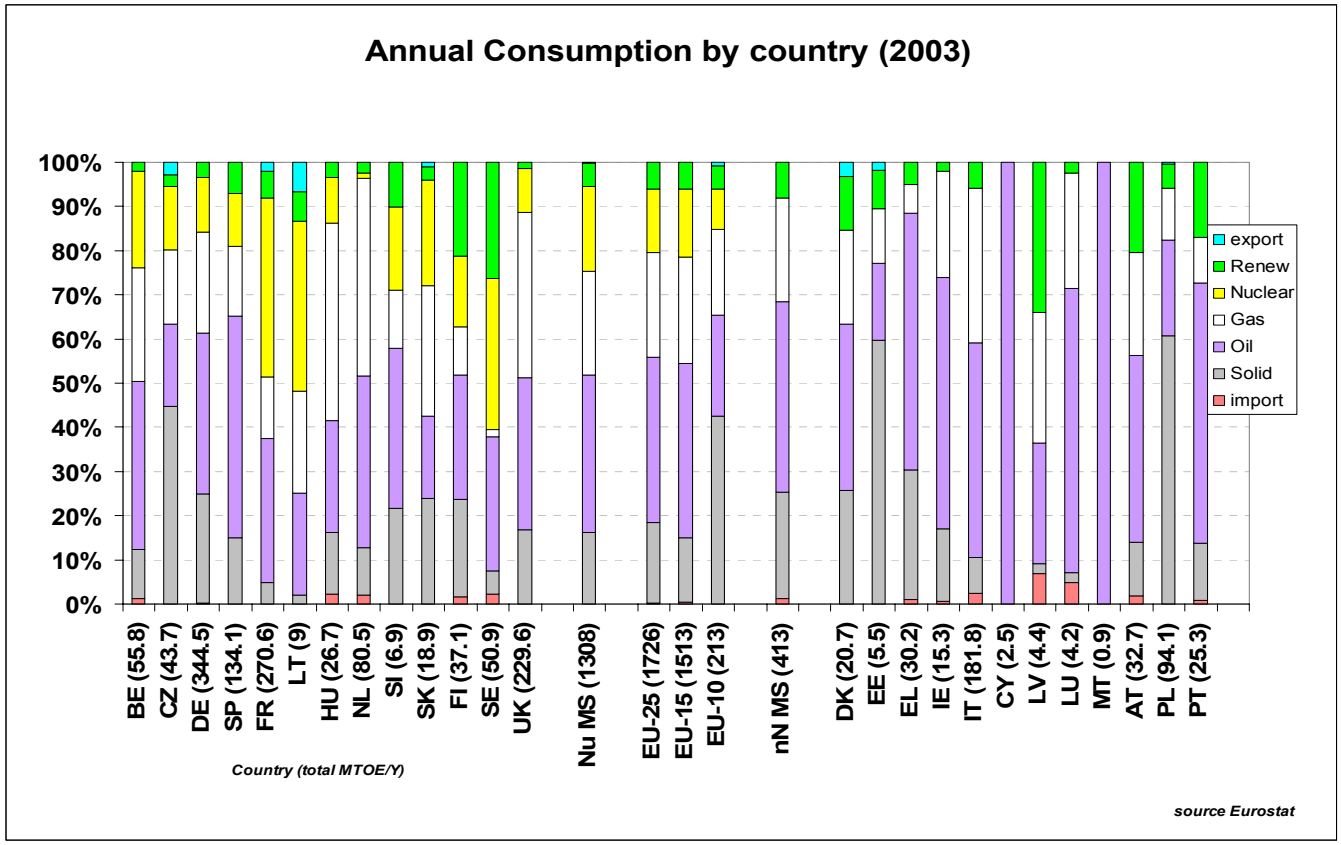


Figure- 2: Primary Energy used for Electricity Production in MS



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1. BELGIUM

1.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 45.35 TW·h (44.3 TW·h in 2006), about 55.6 % (55% in 2006) of total produced electricity.

– Average cumulated load factor for 2005 was 89.2% (86.9% in 2006).

– Seven Nuclear Power Plants (NPPs) are operated by Electrabel (now owned by Suez) on two different sites, Doel (4) and Tihange (3), with total installed capacity of ~5.8 GWe. All NPPs are of the pressurized water reactor type (PWR).

– Related annual U requirement is approximately 1045 t U.

– One NPP has been shutdown (BR3), since June 1987.

– Electrabel also has a share of 25% in both of the EDF NPPs in Chooz (France).

– A phasing-out law after 40 years operation is still applicable, except in case of "force majeure", which requires the closure of the first NPP in 2015 and the last NPP in 2025.

– A dedicated "Commission for Energy 2030" report was published in June 2007 on the short and long-term energy strategies, focusing the analysis on scientific, economic, environmental and social aspects of the different energy sources, including nuclear energy, and the related needs of investments in, energy transmission as well as production and storage capacity.

– Synatom is a private company, owned by Electrabel, responsible for the management of the nuclear fuel cycle upstream and downstream of nuclear power plants (procurement and enrichment of U, reprocessing of irradiated fuel, interim storage and conditioning of radioactive waste and spent fuel). The Belgian federal government has a right to veto.

1.2. Public Opinion (Eurobarometer 2005)

– 58.5% declares knowledge on radioactive waste (EU average is 48.5%).

– 50% of the interviewees were in favour of nuclear energy.

1.3. Research Reactors

– There are 4 operational research facilities: for teaching, activation and isotopes production purposes.

– Two shutdown facilities, including the experimental and power reactor BR3, are being decommissioned.

– No significant related U requirements.

1.4. Mining and milling of uranium

– None

1.5. Conversion

– None

1.6. Enrichment

– None

1.7. Fabrication

– AREVA NP operates a 400 t U/y PWR fuel fabrication plant at Dessel (ex-FBFC) as well as PWR and BWR MOX fuels assemblies from the Melox plant at Marcoule (France).

– BELGONUCLEAIRE NV operated a 35 t HM/y MOX plant at Dessel, closed in July 2006 for market reasons. The engineering division is maintained.

1.8. Spent fuel and Radioactive Waste Management

– Spent fuels

  - 2312 t of spent fuel are actually stored in BE.
  - Wet storage is in operation at the Tihange site and dry storage at the Doel site.

– Reprocessing

  - After termination of the reprocessing contracts of 1975-1978 with Cogéma (France), no new reprocessing contract has been concluded for the reprocessing of the spent fuel from nuclear power plants. A reprocessing contract for the research reactor BR2 is still running.
  - The return of vitrified waste after reprocessing in La Hague (France) is about 87% completed.
  - The EUROCHEMIC Pilot reprocessing plant (Dessel) with a capacity of 350 kg U/y was shut down in 1975. The vitrification of produced HLW was carried out at the end-of the 80s. Dismantling of the plant is in progress.

– Waste treatment and storage facilities operated on the Eurochemic site by Belgoprocess, subsidiary of ONDRAF/NIRAS (Belgian national Agency for Radioactive Waste and Enriched fissile Materials - www.nirond.be):

  - HLW storage facility for the EUROCHEMIC vitrified waste and reprocessed vitrified product returned from La Hague (AREVA reprocessing plant).
  - LILW radioactive waste treatment, conditioning and storage facilities.

- The Belgian federal government decided in June 2006 on the location of the disposal site for low and medium active short-lived waste. It will be a surface disposal facility on the territory of Dessel. This decision makes it possible to develop the next phase of the programme, i.e. the construction of final a disposal facility.

– A new nuclear waste management plan will be published at the end of 2010 by ONDRAF-NIRAS, which will focus on mid and long-term solutions.

– ONDRAF/NIRAS is responsible for developing a realistic solution for the final disposal of high-level and long-lived radioactive wastes. Deep geological disposal in clay is the primary option studied and an experimental geological disposal laboratory is in operation on the territory of Mol, in collaboration with SCK-CEN. An extension is under construction.

1.9. Waste Management, Radiation Protection, and Safety Authorities

– ONDRAF/NIRAS is responsible for the safe transportation, treatment, conditioning, storage and disposal of all radioactive waste produced in the country and with decommissioning of old nuclear installations (www.nirond.be).

– Supervising body of ONDRAF/NIRAS is the federal ministry of economics (http://economie.fgov.be)

– Federal Agency for nuclear Control (FANC) is a public agency responsible of public health and environmental protection against ionising radiations (www.fanc.fgov.be).

– The Association Vinçotte Nucléaire (AVN) (www.avn.be) and Controlatom are private expert and advisory companies.

– SYNATOM is a mixed company (State-Private) owning nuclear fuels from fabrication to transfer to ONDRAF-NIRAS as waste.

1.10. Decommissioning & related Funds

– Before the law of 11 April 2003, the provisions for the management of spent fuel were accounted for by Synatom. The provisions for the decommissioning of the nuclear power plants were accounted for by the electricity producers (i.e. internal).

– After 11 April 2003: provisions are accounted for by the Nuclear Provision Company (in which the State has the right to veto). For long-term management the radioactive waste transferred to ONDRAF/NIRAS, the necessary provisions are accounted for by this agency.

2. BULGARIA

2.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 17.3 TW·h (19.5 TW·h in 2006), about 43 % (42.99% in 2006) of the total electricity production.

– Average cumulated load factor in 2005 was 60.5 %.

– There are 6 nuclear power reactors with total installed capacity 3760 MW constructed on the Kozloduy site.

– Two VVER-440/230 units (kozloduy 1 and 2) have been closed in December 2002, in fulfilment of an understanding between the Bulgarian Government and the European Commission of 29 November 1999, as a condition for the opening Bulgaria's negotiations for accession to the EU.

– Two further VVER-440/230 units (Kozloduy 3 and 4) were closed in December 2006 in application of Bulgaria's Accession Treaty.

– At present, Kozloduy NPP PLC operates two VVER-1000 units (Kozloduy 5 and 6) comprising total installed capacity 2000 MW.

– Two new units will now be constructed at the Belene site, which was earlier planned to host an NPP whose construction was suspended in 1990.

– Annual U requirements are approximately 363 t U (for VVER-1000 units only), For 2006, the estimated requirements for 4 units were 373 t U;

– Decommissioning of Kozloduy 1 to 4 is foreseen with the financial participation of European Funds.

2.2. Public Opinion

– Bulgaria was not included in the 2005 Eurobarometer survey.

– A vast majority of Bulgarian citizens (75-90%) support the development of nuclear energy and they are opposed to the early decommissioning of units 1 to 4 of Kozloduy NPP (According to a number of public opinion polls made by Bulgarian and international agencies for social and political research, such as Market Links, Alpha Research).

2.3. Research Reactors

– One IRT – 2000 research reactor was shutdown in 1999. In 2001, a decision was adopted by the Bulgarian Government for the reconstruction of the research reactor. The procedure for the reconstruction project approval is on-going.

2.4. Mining and milling of uranium

– All production ended in 1994 following the Government’s decision to close the uranium production industry.

– Reasonably assured uranium resources at €110 /kg U are estimated at 6300 tonnes.

2.5. Conversion

– None

2.6. Enrichment

– None

2.7. Fabrication

– There is no domestic fuel fabrication. VVER fuel is supplied by the Russian manufacturer TVEL JSC.

2.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels**:

- Spent fuel (wet) storage facilities are installed at the Kozloduy NPP site.
- An additional storage facility is under construction at the Kozloduy site for the interim dry storage of spent fuel after initial cooling.

– **Reprocessing:**

- Until 1989, spent fuel from all VVER nuclear power reactor units was regularly sent to Russia for reprocessing.
- The agreement between Russia and Bulgaria on reprocessing of Bulgarian spent fuel was re-negotiated in 1998 for VVER-440/230 fuel and in 2000 for VVER-1000/320 fuel, with return of the high level waste to Bulgaria.

– The actual strategy for spent fuel and radioactive waste management foresees two possible annual transfers of spent fuel to Russia, the construction of a dry storage facility together with financial provisions.

– State's Company Radioactive Waste (SE RW) established in January 2004 is responsible for the management of waste from NPP (storage at Kozloduy site) or other nuclear facilities (Novi Han storage), including treatment of LILW.

– A surface disposal facility is operated at Novi Han Site.

– No geological disposal project.

– Preferred option for spent fuel management is export (to Russia), as storage or reprocessing of spent fuel/high level waste is not foreseen until 2050.

2.9. Waste Management, Radiation Protection, and Safety Authorities

– The government body responsible for the implementation of the strategy of radioactive waste management is the Ministry of Economy and Energy (www.mee.government.bg).

– The Bulgarian Nuclear Regulatory Agency (NRA) (http://www.bnsa.bas.bg) was created in 2002, by the new Act on Safe Use of Nuclear Energy. According to the NRA Statutes, the State regulation for the safe use of nuclear energy and ionising radiation, the safety of radioactive waste management and the safety of spent fuel management are implemented by the Chairman of the Nuclear Regulatory Agency who is an independent specialised body of the executive authorities of Bulgaria.

– The NRA took over from the Committee on the Use of Atomic Energy for Peaceful purposes created back in 1957.

2.10. Decommissioning & related Funds

– Centralised (blocked) State Decommissioning Fund independent from plant operator;

– Centralised (blocked) State Fund for the safe management of radioactive waste and spent fuel, independent from plant operator;

– ınternational financial support, primarily from the European Community.

3. CZECH REPUBLIC

3.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 23.3 TW·h, about 31% of its total supply.

– Four VVER-440/213 power reactors are in operation at the Dukovany site and two VVER-1000/320 reactors are operated at the Temelin site, all by the czech power company (CEZ)), with a total installed capacity of ~3.5 GWe.

– Average cumulated load factor in 2005 was 84 % for Dukovany and 70% for Temelin.

– Related annual U requirement is approximately 540 t U.

– No shutdown NPPs.

– Discussions are on-going on the construction of two new nuclear reactors, which together would provide an additional 1900 MWe.

3.2. Public Opinion (Eurobarometer 2005)

– 55.5% declares knowledge about radioactive waste (EU average 48.5%).

– 61% of the interviewees were in favour of nuclear energy.

3.3. Research Reactors

– There are 3 experimental and isotope producing research facilities in operation, Russian fuel supplied.

– One other was decommissioned.

– No related significant uranium requirement.

3.4. Mining and milling

– Current production is about 400 t U/y for the country's last active uranium mine at Rozná, which could produce output until 2008.

– Re-opening of the old mine, Brzkov, is under discussion.

3.5. Conversion

– None

3.6. Enrichment

– None

3.7. Fabrication

– Fresh fuels are imported from the Russian Federation for Dukovany NPP and from Westinghouse (USA) for the Temelin NPP.

3.8. Spent fuel and Radioactive Waste Management

– **Reprocessing:**

  – Until 1989 spent fuel was contracted to be sent for reprocessing to the Mayak Facility (RT-1) in the former Soviet Union and did not return to the former Czechoslovakia, but the contract was never implemented.

– **Spent Fuels:**

  – Between 1989 and 1992 the spent fuel assemblies from the Dukovany plant were transported (after a 3-year cooling period) to the interim storage (wet) facility at Jaskovske Bohunice in Slovakia. The transports were stopped after Czechoslovakia split into two separate countries.

  – At the Dukovany site, a dry storage facility for spent fuel is operational since 1997 with a capacity of 60 Castor casks (or 600 t HM).A new facility with a capacity of 1340 t HM was put into trial operation in 2006. A dry store is designed for the Temelin plant.

  – In UJV-Rez, an interim storage facility for spent fuel from research reactors is in operation since 1996, with sufficient capacity for their entire operating life.

– **Radioactive Wastes:**

  – A shallow repository of operational radioactive LILW from both the Dukovany and Temelin NPPs is operated at the Dukovany NPP site. In 2006, the repository was also additionally licensed for institutional RAW.

  – Institutional RAW is also disposed of in 2 other repositories located at the Richard and, Bratrství mines. All 3 repositories are operated by the Radioactive Waste Repository Authority (RAWRA). The Czech acronym is SURAO (www.rawra.cz).

  – CZ plans to store spent fuel in a deep repository, to be operational by 2065. The procedure for locating the site is currently stopped until 2009.

3.9. Waste Management, Radiation Protection, and Safety Authorities

– The Radioactive Waste Repository Authority (SURAO-RAWRA,) was established in June 1997 by decision of the Ministry of Industry and Trade. RAWRA is a state organisation responsible for disposal of radioactive wastes (www.rawra.cz).

– The State Office for Nuclear Safety (SÚJB) is the CZ's regulatory authority responsible for governmental administration, supervision and licensing in the domain of use of nuclear energy and radiation as well as radiation protection. Authority and responsibilities of the SÚJB are stipulated by Act. No.18/1997 Coll. On Peaceful Utilisation of Nuclear Energy and Ionising Radiation (Atomic Act) (www.sujb.cz).the SÚJB reports directly to the Government.

3.10. Decommissioning & related Funds

– A Dedicated Nuclear Account (NA), established for radioactive waste disposal is managed by the Ministry of Finance.

– Under conditions given by the Atomic Act, NPP operators are obliged to steadily create financial resources, deposited on a blocked account, for future decommissioning. Available funds on the blocked accounts may be utilised solely in line with the approved programme of decommissioning and any withdrawal of funds is monitored by RAWRA.

4. FINLAND

4.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 22.3 TW·h, equivalent to 26% of total electricity supply.

– Four nuclear power plants are operated with a total installed capacity of ~2.7 GWe:

– Fortum Power and Heat Oy (FORTUM) operates two 510 MWe, Russian designed, reactors at the Loviisa site.

– Teollisuuden Voima Oy (TVO) operates two 860 MWe BWR, Swedish designed, reactors at the Olkiluoto site.

– Average cumulated load factor in 2005 was 95.9%.

– Related annual U requirement is approximately 473 t U.

– No shutdown NPPs.

– Finland and France are the only two EU 15 MS having officially started the construction of a nuclear power plant. This fifth Plant, EPR 1600 MWe PWR reactor is under construction since 2005 (FRAMATOME-ANP design). Grid connection by Operator TVO is now expected by 2011.

– The use of nuclear power is considered as an option in the new energy and climate strategy adopted by the Parliament in 2006.

4.2. Public Opinion (Eurobarometer 2005)

– A majority (60 %) declares knowledge about radioactive waste (EU average 48.5%).

– A majority (58%) of interviewees are in favour of the use of nuclear energy.

4.3. Research Reactors

– There is one TRIGA design 250 kW reactor facility for medical and academic use.

– No related significant uranium requirement.

4.4. Mining and milling

– Finland produced 30 t U between 1958 and 1961. Currently no mines are in operation.

– Finnish reserves of U at an extraction cost of €110 /kg U are estimated at 1125 t U.

– Various uranium prospecting companies (including AREVA, FR) showed interest in new mine exploration in Finland.

4.5. Conversion

– None

4.6. Enrichment

– None

4.7. Fabrication

– None

4.8. Spent fuel and Radioactive Waste Management

– **Spent Fuel**

  - The last return shipment of spent fuel from Loviisa to the Russian Federation took place at the end of 1996.
  - Both operating nuclear power plants have interim storages for spent fuel: 490 t HM capacity wet storage at the Loviisa NPP and 1200 t HM capacity at the Olkiluoto TVO-KPA facility.

– Low and ILW temporary store facilities are also operated at both sites. The facility for final disposal of low and intermediate level radioactive wastes was put into operation at Olkiluoto in 1992 and the facility for disposal of low-level waste at Loviisa, in 1998.

– A project for final disposal of spent fuel was started in the early 80's:

  - In 2001 the Finnish parliament endorsed the Government's decision-in-principle on the construction of a final disposal facility for spent fuel and high-level waste at Olkiluoto.

- The preparation of the spent fuel disposal facility is highlighted by the construction of an underground rock characterization facility Onkalo, started in 2004.

- The application for the construction license is scheduled for the early part of the next decade and operation to start in 2020. Its foreseen capacity reaches 6500 tons, equalling the amount generated by the existing nuclear power plants during 60 years of operation.

- The private Finnish Radwaste Management Company POSIVA (www.posiva.fi) will be in charge of these operations.

– No decommissioning projects of nuclear facilities are underway.

4.9. Waste Management, Radiation Protection, and Safety Authorities

– Responsible governmental bodies are:

- The Finnish Council of State for licensing, and general safety regulations.

- The Ministry for Social Affairs and Health, as supreme authority related to radiation protection (www.stm.fi), with the Ministries of the Environment (www.vyh.fi) and Interior (www.intermin.fi) for the population protection in emergency cases.

- The Ministry of Trade and Industry, Energy Department (http://www.ktm.fi/E&S), supervising the Nuclear Energy Sector.

- The Radiation and Nuclear Safety Authority, STUK (www.stuk.fi) under the Ministry for Social Affairs and Health.

– Nuclear waste management is guided by the Nuclear Energy Act and Decree and detailed regulations and regulatory guides are issued by the STUK, assisted by the Advisory Committee on Nuclear Safety (YTN).

4.10. Decommissioning & related Funds

– Finnish report to the 3rd review Meeting of the Joint Convention mentions that the provisions for licensing and the waste management obligation included in the current nuclear energy legislation are adequate for regulating a decommissioning project.

– Generators of nuclear waste are responsible for estimating, on an annual basis, future costs of managing the existing waste, including spent fuel disposal and decommissioning of NPPs, supplying a State Nuclear Waste Management Fund, managed independently from operators.

5. FRANCE

5.1. Nuclear Power Outlook

– Total nuclear production in 2005 reached 430.9 TW·h, about 79% of total electricity production.

– France started nuclear electricity generation in 1959 with Gas Cooled Reactors (GCR), which are now shut down.

– The country currently has 59 PWR units, all owned by ELECTRICITÉ DE FRANCE (EDF), with a total installed capacity of ~63.5 GWe.

– EDF has licensed 20 reactors for use of MOX fuels.

– Average cumulated load factor in 2005 was 83.4%

– The NPPs are licensed for a period of 40 years. EDF recently declared in favour of lifetime extension.

– Related annual requirement for uranium is approximately 10150 t U.

– There are 11 shutdown NPPs (8 GCR, 1 HWGCR 1 PWR and 1 FBR).

– The construction of an additional PWR reactor has started at Flamanville for operation in 2012. The construction of a second EPR could be proposed soon. Those 1600 MWe EPR-type designed by the consortium AREVA-NP (ex-FRAMATOME-ANP) and the Finnish EPR at Olkiluoto are supposed to herald a standardised, new family of Generation-III reactors, designed for 60 years operation.

– An annual connection to grid of 2 EPRs from 2020 is announced by the French ministries.

– EDF was partially privatised in 2005.

– The consortium constituting SUEZ-GdF owns the Belgian nuclear producer ELECTRABEL.

– AREVA is the global leader in all the nuclear fuel cycle technologies (AREVA-NC) and plant engineering and fuel fabrication (AREVA-NP). It has a dominant position in Europe, particularly in France: mining and conversion with COGÉMA (AREVA-NC), enrichment with EURODIF (AREVA-NC), fabrication with (AREVA-NP) FRAMATOME-ANP (alliance with SIEMENS), AREVA-NP, COGÉMA (AREVA-NC) and MELOX (AREVA-NC), reprocessing with COGÉMA-LA HAGUE, plus also related engineering, metallurgical and logistics activities, etc.

– The French policy is based on a closed fuel cycle with reprocessing of PWR spent fuel as and when required to supply plutonium for MOX fuel at La Hague (AREVA-NC) and the recycling of plutonium in MOX for PWRs.

– France is member of the Generation IV Forum (GIF) and is re-launching programs both on Sodium-cooled reactors (Phenix and Super Phenix) and gas-cooled reactors (Very High Temperature Reactors-VHTR and Gas Fast Reactors-GFR). CEA has the mandate to develop a first Generation 4 pilot plant by 2020.

– The French site of Cadarache was chosen for the construction of the International Thermonuclear Experimental Reactor (ITER).

5.2. Public Opinion (Eurobarometer 2005)

– More than half (53.5%) declares knowledge about radioactive waste (EU average 48.5%).

– And 52% of interviewees were in favour of the use of nuclear energy.

5.3. Research Reactors

– The new 100 MWth CEA research reactor, JULES HOROWITZ, is planned to go critical in 2014, construction starting in 2007.

– The PHENIX 563 MWth Fast Breeder reactor is used for irradiation experiments, using CEA-COGEMA fuels.

– Twelve additional material or irradiation testing, academic, training and isotopes producing facilities are still operated.

– Twelve others are shutdown and 5 decommissioned.

– No related significant uranium requirements.

5.4. Mining and milling

– COGÉMA (now AREVA-NC) exhausted its mines in France. The French reserves of uranium at an extraction cost of €110 /kg U are estimated at 11700 t of U, approximately one year of actual requirements.

– AREVA-NC also operates or has a share in mines in Niger, Canada Kazakhstan, Australia and the USA.

5.5. Conversion

– AREVA-NC operates two conversion COMURHEX facilities in Malvesi (UOC to UF4) and Pierrelatte (UF_4 to UF_6), with a total capacity of 14.000 t U/y, and two other AREVA plants for de-fluorination of depleted uranium (to U_3O_8) and conversion of reprocessed uranium (REPU) to UF_6.

5.6. Enrichment

– AREVA and URENCO have a 50% partnership venture for the development of Centrifuge Enrichment Technology (CET).

– EURODIF (AREVA) performs enrichment at its GEORGES BESSE-I gaseous diffusion (GF) plant, located at Pierrelatte (capacity 10 800 t SWU/y[1]). It is a very energy intensive facility; it will be progressively replaced, at the same Pierrelatte site, by a new installation, GEORGES BESSE –II, using centrifuge enrichment technology.

[1] Separative work unit

5.7. Fuel fabrication

– FRAMATOME-ANP (AREVA NP-SIEMENS) fabricates UO_2 fuel from enriched natural uranium at Romans (capacity 1400 t HM/y). It also operates the FRAMAROME ANP plant in Belgium and the (ex) ANF-Lingen installation in Germany. Intermediate products (UO_2 powder) are exported.

– MTR fuel for research reactors is manufactured at CERCA (Romans) from HEU metal.

– MOX fuels are fabricated by MELOX (AREVA) at Marcoule, with a license to upgrade its production from 145 to 195 t/y. The AREVA-NC MOX fabrication plant at Cadarache stopped its activities in 2004.

– AREVA-NC is also associated in the construction of a MOX fabrication plant in the USA.

– France has component manufacturing facilities operated by Cesus and Zircotube.

5.8. Spent fuel and Radioactive Waste Management

– **Reprocessing of Spent Fuels**:

- All GCR fuel (18000 t) was reprocessed at the AREVA-NC, UP1 plant, located at Marcoule. This plant is now undergoing decommissioning.

- At La Hague, two reprocessing facilities operated by AREVA-NC, with total capacity of 1600 t/y. UP2 (AREVA-NC) used to treat French EDF PWR fuels and AREVA-NC, UP3 by contract for fuel supplies to other countries. Domestic spent fuel is also treated in UP3 since expiry of several international contracts.

- Total LWR spent fuel reprocessed is approximately 18.000 t Fuels.

– France will develop the Partitioning & Transmutation (P&T) option for the reduction and management of spent fuel and LLHAW.

– Recovered depleted uranium and plutonium are sent to other AREVA installations for storage or/and re-use in the fuel fabrication plants. HLW from reprocessing is vitrified and stored before return transfer to foreign customers, from where the fuel originated, or to the *AGENCE NATIONALE POUR LA GESTION DES DÉCHETS RADIOACTIFS* (ANDRA, www.andra.fr).

– LILW, LLW and Very-LLW are managed by ANDRA.

– A debate launched in 1991 on waste management (*Loi Bataille*) focused on P&T, disposal and long-term surface storage. The related 2006 law launches a research program on the same three axes with a calendar for their implementation. It also sets up the structure for the provision of financing of waste management by industry. The French strategy will include:

- Reprocessing of Spent Fuel and recycling of U and Pu.

- Final treatment of non-recoverable spent fuel for intermediate surface storage

- Reversible disposal in deep geological for after surface storage.

5.9. Waste Management, Radiation Protection, and Safety Authorities

– The national authorities are:

  - The '*Autorité de Sûreté Nucléaire'* (ASN, www.asn.gov.fr) is responsible for all safety and health and safety aspects of nuclear fuel cycle, emergency situations and for related controls. ASN gathers the *Direction Générale de la Sûreté nucléaire et de la Radioprotection* (DGSNR) and decentralised services from the Ministries of Environment, Industry and Health.

  - A new '*Haute Autorité de Sûreté Nucléaire'* created in June 2006 is responsible for the Safety and Transparency legislations.

  - The '*Institut pour la protection radiologique et la sûreté nucléaire'*, IRSN (www.irsn.org) provides expert analysis in radiological and safety matters under the joint authority of different ministries. IRSN replaces two previous organisations (IPSN & OPRI).

  - Licences are issued by the *'Service des Affaires Nucléaires du ministère des Finances et de l'Industrie'* (www.industrie.gouv.fr)

– All categories of waste levels, when transferred by producers, are managed and treated by the independent Agency ANDRA (www.andra.fr) on several sites in the country. Conditioned intermediate and high-level waste is stored at production sites, pending creation of a disposal site by ANDRA.

– One site for disposal of spent fuel and HAW is under evaluation (research and feasibility) at Bure, in the north of France.

5.10. Decommissioning & related Funds

– Internal non-segregated fund. Recent change in the law requires funds to be segregated by 2010.

– EDF is fully responsible for fund management.

6. GERMANY

6.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 154.6 TW·h, about 31 % of total produced electricity.

– 17 plants are still operational, 11 PWRs and 6 BWRs, operated by 4 different private companies: E.ON (7), RWE (5), EnBW (3) and Vattenfall (2), totalling an installed capacity of ~20.3 GWe. Some of these installations are operated by more than one company together with another.

– Average cumulated load factor for 2005 was 80.6 %.

– Related annual requirements for uranium are about 3450 t U.

– Nineteen shutdown NPPs (9PWR, 5 BWR, 2 HGTR, 1 HWGCR, 1 PHWR, 1 FBR), five commercial NPPs (Gundremmingen A, Würgassen, Mülheim-Kärlich, Stade, Obrigheim).

– A Phasing-Out-Law, based on an Agreement (2001) between the Federal Government and the nuclear power producers on the total electronuclear power to be produced over a period of about 32 years is in place. This allows life extensions by kW-h transfers from older to more recent nuclear plants. Opposite transfers need the consensus (agreement) of three authorities[2].

– With the exception of disposal sites and some interim storage facilities (Morsleben, Konrad and the disposal project Gorleben) all other nuclear fuel cycle facilities are owned by private companies.

6.2. Public Opinion (Eurobarometer 2005)

– 54 % declares knowledge about radioactive waste (EU average ~48.5 %)

– 38 % of interviewees were in favour of the use of nuclear energy.

6.3. Research Reactors

– There are 13 operational facilities dedicated to research, academic purposes and isotopes production, 11 shutdown and 22 decommissioned.

6.4. Mining and milling

– No mining or milling has been undertaken in Germany since the closure in 1991 of the former German (DDR)-Soviet Company WISMUT, which was the third largest producer in the world. Remediation is ongoing.

6.5. Conversion

– - None.

6.6. Enrichment

– In URENCO's Gronau uranium enrichment plant, natural uranium, or uranium recovered from reprocessing in the form of UF6, is enriched by centrifuge separation. The plant started operation with a capacity of 400 t SWU/y in 1985. This capacity has been expanded to 1800 t SWU/y in 2005. A second plant is under construction. The whole site is licensed for up to 4500 t SWU/y.

6.7. Fabrication

– FRAMEATOME ANP (ex-ANF Lingen) operates a fabrication plant (capacity 650 t U/y) for LWR fuel at Lingen.

– A MOX fabrication plant in Hanau (ALKEM) was in operation; a new plant was constructed but never started, and is actually now dismantled.

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2 A consensus is needed between the Ministry of Environment, Nature Conservation and Nuclear Safety (BMU), Ministry of Economics and Technology (BMWi) and the Federal Chancellery.

6.8. Spent fuel and Radioactive Waste Management

– **Reprocessing**:

- All domestic reprocessing activities have ceased. After WAK reprocessing plant achieved its mandate, a new reprocessing plant with improved separation technology was planned in Wackersdorf but never went active due to a commercial decision by the company.

- Contracts were signed for reprocessing of spent fuels in La Hague (Fr) and Sellafield (UK).

- A law forbidding the shipment of spent fuel for reprocessing from 1 July 2005 was adopted in 2002 and the last shipment of spent fuel to France took place in spring 2005.

- Casks with vitrified radioactive materials returned from La Hague and Sellafield are temporary stored at the interim storage facility Gorleben.

– **Spent Fuel:**

- Cooling ponds at reactor buildings, dry interim storage at reactor sites, interim storages facilities at Greifswald.

- As at 31/12/2004, a total of about 3.360 t HM for a total capacity of about 6120 t HM was stored at the nuclear power plants.

- There are 12 licensed interim spent fuel storages facilities.

- All spent fuels are currently being stored at nuclear power plant sites, in order to avoid transportation to the existing central interim storage facilities near Ahaus and Gorleben.

- Three interim storage facilities are operated at ZLN, Lubmin/Greifswald (560 t HM), BZD-Ahaus (3960 t HM) and BLG-Gorleben (3800 t HM).

– LILW: Interim storage is organised at both local and federal levels (conditioning facilities, interim facilities by nuclear industry, research institutions, central interim storages facilities, state collecting and finally 3 federal repositories (licensed or projected)).

– Uranium and plutonium recovered in foreign reprocessing plants are recycled as uranium- and MOX fuels.

– Amendments to the Atomic Act in Germany, which became law in 1994, opens the way for direct disposal of spent fuel. As mentioned above, shipment to reprocessing is forbidden from 1 July 2005.

– The plan approval procedure was passed for Schacht Konrad as disposal for LILW (waste with negligible heat production) in 2002. Court decision is still outstanding.

– The German Federal Government is aiming to establish a repository in deep geological formations for the disposal of all kinds of radioactive waste, including spent fuel

assemblies, by the year 2030. All activities at the Gorleben site remain actually suspended. Since November 2005 the present government aims to find solutions and progress by 2009.

– The Federal Office for Radiation Protection (Bundesamt für Strahlenschutz) is responsible for construction, operation and closure of final repositories.

6.9. Waste Management, Radiation Protection and Safety Authorities

– The federal authority for several safety and radiation protection authorisations is the *Bundesamt für Strahlenschutz*, subordinated to the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU) in responsible for nuclear safety, with the expert support of the Reactor Safety Commission (Reaktor-Sicherheitskommission) and the Commission on Radiation Protection (*Strahlenschutzkommission*).

– Each Land has its own authority in charge of the implementation of nuclear safety, licensing and supervision.

– The ministries involved in the phasing-out policy are the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU), the Federal Ministry of Economics and Technology (BMWi) and the Federal Chancellery (Bundeskanzleramt).

6.10. Decommissioning & related Funds

– Provision for decommissioning, spent fuel and waste management (disposal) must be separately accounted for during the operating life of the nuclear plant.

7. HUNGARY

7.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 13 TW·h, accounted for 37% of the country's total electricity production.

– The four VVER-440/213 reactors with a total capacity 1866 MWe are operated by the Company PAKS NPP LDT (www.npp.hu), providing a total installed capacity of ~1.8 GWe.

– Average cumulated load factor in 2005 was 85.5 %

– Related annual U requirement is approximately 250 t U.

– No shutdown NPPs

– A public hearing on NPP's lifetime extension from 30 to 50 years is actually on-going in Hungary, extended to the Austrian authorities and other countries (Romania and Croatia).

7.2. Research Reactors

– There are 2 operational facilities (training, research, total 10.1MWth), another is decommissioned.

– No significant related uranium requirements.

7.3. Mining and milling

– Prior to its closure, the MECSEKURAN LIC/CSERKUT mining and ore facility produced up to 500 t U/y, or half the requirements of the PAKS nuclear power plant.

– Production ceased in 1997 and production at the milling facility was phased out in 1999.

– Remediation programs of old mines is ongoing

7.4. Public Opinion (Eurobarometer 2005)

– 55% declares knowledge about radioactive waste (EU average 48.5%).

– 65% of the interviewees were in favour of the use of nuclear energy.

7.5. Conversion

– None

7.6. Enrichment

– None

7.7. Fabrication

– There is no domestic fuel fabrication. At present, nuclear fuel is supplied from the Russian Federation.

7.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels**:

- Between 1989 and 1998 around 2300 spent fuel assemblies were sent to the MAYAK facility (RT-1) in the Russian Federation without any obligation of recovering Uranium, Plutonium and high-level waste from its reprocessing.
- The total amount of spent fuel stored at the end of 2004 was 2488 t in the Plant's ponds and 3767 t at the interim spent fuel dry storage facility at the PAKS nuclear power plant.
- A spent fuel storage facility is operated at research plants sites.
- Although no final decision has been made for the back-end of the fuel cycle a repository is foreseen for around 2040.

– A repository for LILW is under construction at Bátaapáti.

7.9. Waste Management, Radiation Protection, and Safety Authorities

– The Hungarian Atomic Energy Authority is the HAEA (www.haea.gov.hu) is responsible for nuclear safety related matters. In general, for radiation protection issues, the Ministry of Health is the responsible authority.

– The Public Agency for Radioactive Waste Management (PURAM) (www.rhk.hu) was established to deal with all activities related to the treatment of radioactive waste and the decommissioning of nuclear facilities.

– The information and analysis centres responsible for managing the emergency cases are (www.haea.gov.hu) (www.bik.hu).

7.10. Decommissioning & related Funds

– Central nuclear financial fund in a dedicated treasury account, managed by the Hungarian Atomic Energy Authority independently from operators.

– PURAM is responsible for the decommissioning and waste management activities.

8. LITHUANIA

8.1. Nuclear Power Outlook

– In application of the Accession Treaty the first power reactor IGNALINA-1 was definitively shutdown in December 2004, and the second IGNALINA-2 will close in 2009. Both are 1300 MWe Russian designed LWGR powered by atominé elektriné (Ignalina Nuclear Power Plant) (www.iae.lt).

– The remaining plant has an installed capacity of ~1.3 GWe.

– Average cumulated load factor in 2005 was 59.74 %.

– Related annual uranium requirement is approximately 134 t U.

– One shutdown NPP (LWGR Ignalina1).

– Decommissioning of (both reactors) is foreseen with financial participation of European Funds.

– Total nuclear production in 2005 was 9.5 TW·h accounting for 70 % of all generated electricity.

– Prime Ministers of the three Baltic States and Poland have agreed, in principle, on the construction of a new NPP in Lithuania. Poland will join the project subject to agreement between Baltic energy companies (Lietuvos Energija, Latvenergo and Eesti Energia) and Polish designated company (Polskie Sieci Elektroenergetyezne).

8.2. Public Opinion (Eurobarometer 2005)

– 45% declares knowledge about radioactive waste (EU average 48.5%).

– 60% of the interviewees were in favour of the use of nuclear energy.

8.3. Research Reactors

– There is no research reactor in Lithuania.

8.4. Mining and milling

– None

8.5. Conversion

– None

8.6. Enrichment

– None

8.7. Fabrication

– There is no domestic fuel fabrication. Fuel is flown in from the Russian Federation.

8.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels:**

- A Spent fuel dry storage was commissioned in 1999 after delivery of the required 20 castor flasks and 40 CONSTOR casks manufactured by GNB (GE).
- Previously, all spent nuclear fuel had been stored in the pools situated next to the reactors.
- There are plans to build a new interim spent fuel storage facility at the Ignalina nuclear plant site, which will start operation in 2009.

– A process for selection of a site is underway for a Near Surface LILW Radioactive Waste Repository. Decision permitting design works for Lanfill (VLLW) made in 2006.

8.9. Waste Management, Radiation Protection, and Safety Authorities

– The Radioactive Waste Management Agency (www.rata.lt) was established by the Ministry of Economy (www.ukmin.lt) for management and final disposal of all radioactive waste that is transferred to the Agency, as well as to collect, process and finally dispose of the radioactive waste. The law on Radioactive Waste Management provides for all radioactive waste generated by the Ignalina plant during its operation and decommissioning shall be transferred to the Agency.

– Radiation Protection matters are coordinated by the Radiation Protection Centre (www.rsc.lt), established in 1997, and Safety Regulation matters by the State Nuclear Safety Incorporate (www.vatesi.lt).

8.10. Decommissioning & related Funds

– Centralised (blocked) State Fund independent from plant operator.

– Significant international financial support primarily from the European Community.

9. THE NETHERLANDS

9.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 3.8 TW·h, about 3.9% of the generated electricity.

– ELEKTRICITEITS PRODUKTIE MAATSCHAPPIJ ZUID NL N.V (EPZ) is operating the only remaining 449 MWe PWR at Borssele.

– Average cumulated load factor of its only reactor in 2005 was 83%.

– Related annual uranium requirement is approximately 112 t U.

– One shutdown NPP (Dodewaard, BWR), safe enclosure as of July 2005.

– After two successive governmental shutdown decisions on the Borssele Plant, the Government agreed to postpone the latter's closure due to the Kyoto obligations in 2002. Operation extension was given until 2033.

– The Dutch government (Ministry of Environment) recently set out conditions for new nuclear build, and initiated a decision process for HLW disposal strategy by 2016.

– For the short term a modification of the Nuclear Energy Act is envisaged which aims to:

  – limit the validity period of a license of a NPP to 40 years;

  – introduce the possibility of denial to issue a license for reprocessing on grounds of general interest;

  – strengthen the financial security for the establishment and management of decommissioning funds;

  – simplify the competent authority for nuclear, radiation and radioactive waste safety.

9.2. Public Opinion (Eurobarometer 2005)

– 55% declares knowledge about radioactive waste (EU average 48.5 %).

– 52% of interviewees were in favour of the use of nuclear energy.

9.3. Research Reactors

– There are 3 research reactors operating in the Netherlands, of which one, the HFR, 45 MW(th) is owned by the EC-JRC-IE. The other 2 operating research reactors are located in Petten (LFR) and Delft (HOR).

– Two decommissioned facilities.

– No related significant uranium requirements.

9.4. Mining and milling

– None

9.5. Conversion

– None

9.6. Enrichment

– URENCO has developed the advanced gas ultracentrifuge technology for the enrichment of uranium. This Company is 50% partner in ETC (see FR) with AREVA, for the development of enrichment technologies.

– Uranium enrichment is carried out by URENCO Nederland B.V., which is located in Almelo. URENCO Nederland is owned by the multinational company URENCO Ltd, which is located in Marlow (UK), which has three equal shareholders: ULTRA CENTRIFUGE NEDERLAND (UCN) in the Netherlands, URANIT (Germany) and BNFL (UK). The Government of the Netherlands owns 99% of UCN.

– The current capacity of URENCO Nederland is 3500 t SWU/y. However, with a 2006 license to expand its capacity to 3700 t SWU/y, for which a fifth enrichment plant has been built at the Almelo site. The first three enrichment plants have already been decommissioned.

9.7. Fabrication

– None

9.8. Spent fuel and Radioactive Waste Management

– **Reprocessing:**

- In 2004 EPZ has renewed its contract for reprocessing of spent fuel by COGÉMA (AREVA-NC). This covers the spent fuel from reactor operation until 2015.

– **Spent Fuel:**

- There are ponds for temporary spent fuel storage in Borssele, Petten, and Delft.
- The Central Organisation for Radioactive Waste (COVRA) (www.covra.nl) manages spent fuel from the research reactors in Delft and Petten and high-level waste from reprocessing of the spent fuel of the NPPs Dodewaard and Borssele.
- The repacking and transfer of all spent fuel to COVRA facility in Borssele is scheduled over a period of 10 years.
- HLW returned from reprocessing, spent fuel from research reactor HOR and from the HFR as well as from production plants will be stored at the centralised storage facility for HLW, called HABOG (Vlissingen) managed by COVRA, with a storage time of around 100 years.

– **Other Waste management :**

- All radioactive wastes with a half-life less than 100 days are stored on site.
- The radioactive waste storage facilities at Borssele are managed by COVRA.
- Since 2002, the Dutch State is the only shareholder of COVRA.

9.9. Waste Management, Radiation Protection, and Safety Authorities

– COVRA is entrusted with the treatment and storage of all categories of radioactive waste.

– The regulatory responsibility is distributed between:

- The Ministry for Housing, Spatial Planning and Environment (www.vrom.nl) for environmental and nuclear safety matters, including inspections.
- The Ministry of Social Affairs and Employment for health-and-safety and radiation protection aspects.
- The Ministry of Economic Affairs (www.minez.nl) for energy production.

– The HABOG (storage facility for HLW) was commissioned at the end of 2003.

9.10. Decommissioning & related Funds

– Dodewaard (50 MWe BWR) currently in 'safe store' for 40 years prior to final decommissioning.

– Funds for waste management transferred under a 2002 agreement to the State together with ownership of responsible company COVRA.

– Operators have to make financial provisions for decommissioning requirements.

10. ROMANIA

10.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 5.5 TW·h, about 9.3 % of Romania's total electricity production.

– The 700 MW(e) CANDU-PHWR CERNAVODA-1plant is operated by the State National Company *"NUCLEARELECTRICA"* (www.nuclearelectrica.ro)

– Average cumulated load factor of the only operating plant in 2005 was 90.1%.

– Related annual uranium requirement is approximately 100 t U.

– No shutdown NPPs.

– The CERNAVODA-2 plant is under construction. It should be connected to the grid in 2007. The production of nuclear electricity should double by 2008 and triple by 2015[3], based upon the completion of another two reactor units.

– CNCAN issued licensing requirements for CERAVODA NPP units 3 and 4, with constructions foreseen to restart in 2008.

– Front end nuclear fuel cycle industrial facilities have been developed to supply nuclear fuel and heavy water for civil reactors.

10.2. Public Opinion (Eurobarometer 2005)

– Romania was not included in the 2005 Eurobarometer survey.

10.3. Research Reactors

– There are two TRIGA reactors in the same pool: - one Steady State Reactor (SSR) of 14 $MW_{(th)}$ with low enriched fuel and one Annular Core Pulse Reactor (ACPR) capable of a pulse of 20000 $MW_{(th)}$ that can also operate as a steady state reactor of 0.5 $MW_{(th)}$. The reactors are operated at Pitesti by the Nuclear Research subsidiary of the Romanian Authority for Nuclear Activities (RAAN), SCN Pitesti (www.scn.ro).

– No related U requirements till 2010.

– There are also: 1 nuclear research reactor, Russian type VVR-S-2MW_{th} permanently shutdown for decommissioning, 1 zero power nuclear research reactor RP-01 in conservation phase, 1 sub-critical assembly HELEN type in conservation phase; all of them are located at the National Institute of Physics and Nuclear Engineering- Horia Hulubei (IFIN-HH) Bucharest-Magurele-(www.nipne.ro).

10.4. Mining

– Uranium mining activities are lead by the (now autonomous) NATIONAL URANIUM COMPANY (CNU, www.cnu.ro) which operated 3 uranium mining branches at Bihor, Banat and lastly Suceava, which is the last remaining operational mine with a production capacity of 70 t U/y.

– The uranium production capacity is tailored to meet the requirements of the national nuclear power programme.

– Reasonably inferred resources are actually estimated at 3150 t U at an extraction price of €110 /kg U.

10.5. Conversion

– At Feldioara, CNU is processing milling-concentration and refining-conversion in 2 distinct plants. The annual capacity is 300 tons of uranium as UO_2.

– Feldioara is the only uranium production plant in Europe for CANDU fuels.

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[3] INS – National Institute of Statistics

10.6. Enrichment

– None

10.7. Fabrication

– The State *national company "NUCLEARELECTRICA" – NUCLEAR FUEL PLANT Subsidiary* (FCN PITESTI) operates in Pitesti. The present production capacity of FCN Pitesti is 200 t U/y in accordance with the requirements of the CERNAVODA nuclear plant. FCN Pitesti has been qualified by AECL as a CANDU fuel supplier.

10.8. Heavy water production

– The Romanian Nuclear Activities Authority operates the ROMAG heavy water plant (design capacity 360 t/y). Using the Girdler–sulphide process ROMAG is the largest producer of heavy water in Europe.

10.9. Spent fuel and Radioactive Waste Management

– **Spent Fuels**:

- The wet storage for spent fuel near the NPP CERNAVODA unit 1 has a limited capacity of 950 t, corresponding to at least six years of cooling time.
- Research reactors have their own spent fuel (wet) storage (at SCN Pitesti and IFIN-HM Magurele).
- The 2003 interim dry spent fuel storage facility at the Cernavoda NPP is being extended and will accommodate the spent fuel for 2 reactors for at least 50 years of interim storage.
- Wet and dry storages are also operated at Pitesi for the research reactors.

– Other L&ILW management facilities are located at the same sites Cernavoda (CNE), Pitesi (SCN), Magurele (IFIN) and at the CNU Mining Company.

– A new repository for LILW/SL, resulting both from operation and decommissioning of Cernavoda NPPs, is expected to be commissioned by 2014.

10.10. Waste Management, Radiation Protection, and Safety Authorities

– The National Commission for the Control of nuclear activities is a state-secretary Commission with competences in all nuclear related matters (www.cncan.ro): safety, safeguards, transport and public health, including emergency measures.

– The national Nuclear Authority falls under the Ministry of Education and Science (www.mct.ro) while the national energetic strategy falls under the Ministry of Economics and Commerce (www.minind.ro).

– The National Agency for Radioactive Wastes (www.andrad.ro) is the competent authority for the coordination on national level, of the safe administration process of spent nuclear fuel and of radioactive wastes, including their disposal.

– There is a Romanian Energy Regulatory Authority for energy matters (www.anre.ro).

– Two professional organisations provide information and support to the nuclear sector: the Romanian Nuclear Energy Association (www.aren.ro) and the Romanian Society for Radiological Protection (www.ispb.ro).

10.11. Decommissioning & related Funds

– Currently no decommissioning, radioactive waste and spent fuel final disposal funds. The Governmental Ordinance no. 31/2006 requires the establishing of two segregated funds (one for radioactive waste and spent fuel management including disposal and the second one for decommissioning).

11. SLOVAKIA

11.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 16.3 TW·h, about 56 % of produced electricity.

– Six 440 MWe power units are operated in Slovakia, four VVER (PWR) at Bohunice and 2 at the Mochovce, with total installed capacity of ~2.5 GWe, both are operated by Slovenské elektrárne, a.s. From May 2006 onwards, two units at Bohunice are operated by JAVYS, a.s.

– Average cumulated load factor in 2005 was 75%.

– Related annual uranium requirement is approximately 356 t U.

– One shutdown NPP (HWGCR Bohunice). A-1

– *SLOVENSKÉ ELEKTRÁRNE* (www.seas.ssk) was taken over in 2006 at 66% by ENEL (www.enel.it). Radioactive waste and spent fuel management and the NPPs of Bohunice A-1 and V-1 were transferred to company JAVYS a.s.

– A plan to complete the construction of two VVER type reactors at the Mochovce nuclear power plant is currently under evaluation.

11.2. Public Opinion (Eurobarometer 2005)

– 48.5% declares knowledge about radioactive waste (the EU average).

– 56% of them were in favour of the use of nuclear energy.

11.3. Research Reactors

– None

11.4. Mining and milling

– In the 1960s and 1970s small quantities of uranium were mined in eastern Slovakia for geological survey purposes.

11.5. Conversion

– None

11.6. Enrichment

– None

11.7. Fabrication

– None

11.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels and LILW at/in Plants:**

- Some spent fuel was returned to the Soviet Union up until 1987.
- A temporary, wet spent fuel storage facility of ~ 1700 t HM capacity at the Bohunice site is operational since 1987.
- Radioactive operational waste from Bohunice and Mochovce units is stored temporarily at the sites.

– An NSR Disposal for LILW-SL is operational at Mohovce with a possible expansion and/or construction of VLLW.

– Interim spent fuel storage is in operation at Bohunice site.

– Spent fuel /HLW disposal is planned for around 2075.

11.9. Waste Management, Radiation Protection, and Safety Authorities

– UJD is the national Nuclear Regulatory Authority, *Urad Jadrového Dozoru Slovenskej Republiky* (www.ujd.gov.sk), responsible inter- alia for the legal framework in the fields of its responsibility for the supervision of nuclear safety (including –licensing, review and assessment, inspections and enforcement), emergency preparedness as well as supervision of waste management aspects. UJD is reporting directly to the government. Radiation protection is the responsibility of the Public Health Authority, Úrad verejného zdravotníctva (ÚVZ), under the Ministry of Health.

11.10. Decommissioning & related Funds

– Centralised (blocked) State Fund independent from operator.

– International financial support primarily from the EU.

12. SLOVENIA

12.1. Nuclear Power Outlook

– The total nuclear production in 2005 was 5.6 TW·h, 42 % of the country's total electricity production.

– The only NPP is a 700 MWe, 1981, PWR located in Krsko, operated by *NUKLEARNA ELEKTRARNA KRSKO* (www.nek.si), 50 % owned by Croatia.

– Average cumulated load factor in 2005 was 80.4%.

– Related annual uranium requirement is approximately 144 t U.

– No shutdown NPPs.

12.2. Public Opinion (Eurobarometer 2005)

– 64.5% declares knowledge about radioactive waste (EU average 48.5 %).

– 44% of the interviewees were in favour of the use of nuclear energy.

12.3. Research Reactors

– There is one TRIGA teaching and experimental facility at Lubljana, 250 kW(th), US enriched U.

12.4. Mining and milling

– Between 1982 and 1990, 362 t of uranium were produced at the ZIROVSKI VRH mine and processing plant. This plant is now being decommissioned.

– Reasonably inferred resources with an extraction price of €110 /kg U are estimated at 1200 t U.

12.5. Conversion

– None

12.6. Enrichment

– None

12.7. Fabrication

– None

12.8. Spent fuel and Radioactive Waste Management

– **Spent Fuel:**

- A spent fuel wet storage pool (capacity 690 t HM) is in operation at the Krsko plant site, which has recently been re-racked to provide sufficient capacity for the operating lifetime of the plant and even for possible lifetime extension.

- There are no spent fuel off-site management facilities.

– **Other Waste management:**

- A Central Interim Storage for Radioactive Waste in Brinje.

- Interim Storage facilities at the Borst mill tailings site; the Jazbec mine and Zirovski Uranium Mine are the only radioactive waste management facilities.

- The Slovenian Parliament adopted in 2006 the National Programme for radioactive Waste and Spent Fuel management, while regarding the site for the LILW repository project, the site evaluation programme is in the final stage and it is envisaged to be finalized by the end of the spring 2007.

12.9. Waste Management, Radiation Protection, and Safety Authorities

– In 2004 all energy matters passed under the departmental competence of the Ministry of Economy (www.mg.gov.si).

– The Ministry of Environment and Spatial Planning (www.gov.si/mop/en) heads the Slovenian Nuclear Safety Administration, URSJV-SNSA.

– SNSA is the Slovenian Nuclear Safety Administration, URPAVA REPUBLIKE SLOVENIJE ZA JEDRSKO VARNOST (www.ursjv.gov.si), the regulatory, control and information national body, under the Ministry of Environment. URSJV powers in all national and international nuclear related competences, as nuclear - and radiological safety, trade, transport, accountancy, physical protection, as well as liability, early notification and emergency actions, environmental monitoring.

– ARAO is the governmental Agency established in 1991 for radioactive waste management (www.gov.si/arao/eindex.html) and is responsible for all types of waste including provision of safe conditions for final disposal.

– There is a Nuclear Training (and information) Centre in Ljubljana (www.icjt.org).

12.10. Decommissioning & related Funds

– External.

– Managed by a specific agency.

13. SPAIN

13.1. Nuclear Power Outlook

– The total nuclear production in 2005 was 57.5 TW·h, equivalent to 19.5% of the country's total electricity production.

– After the shutdown of the JOSE CABRERA Plant, eight nuclear power plants remain operational in Spain on six sites, totalling a capacity of 7.7 GWe.

– Average cumulated load factor for 2005 was 83.4%.

– Related annual uranium requirements are about 1500 t U.

– Two shutdown NPPs (Vandellos1, José Cabrera).

– ENDESA and IBERDROLA have shares in 7 plants, UNIÓN FENOSA GENERACIÓN in 3 plants and HIDROELÉCTRICA DEL CANTÁBRICO is involved with 1 plant.

13.2. Public Opinion (Eurobarometer 2005)

– 40.5% declares knowledge about radioactive waste (EU average 48.5 %).

– 16% of the interviewees were in favour of the use of nuclear energy.

13.3. Research Reactors

– One shutdown, 3 decommissioned.

– No related uranium requirements.

13.4. Mining and milling

– ENUSA INDUSTRIAS AVANZADAS, S.A. (www.enusa.es) operated an open-cast uranium mine and concentrates facility at Saelices el Chico (Salamanca), closed in 2000 for economic reasons. ENUSA is shared by 40% CIEMAT (see below) and 60% SEPI (a holding of state-owned companies).

– The inferred uranium resources at an extraction price of €110 /kg U were recently estimated at 6400 t U.

13.5. Conversion

– There is no more domestic conversion (up until 2002, 1325 t U managed by ENUSA).

13.6. Enrichment

– There is no domestic enrichment. (Up until 2002, 799 t SWU managed and supplied in enrichment services by ENUSA).

– ENUSA holds an 11% share of the French company, EURODIF.

13.7. Fabrication

– ENUSA is operating a fuel fabrication facility for BWR, PWR and VVER assemblies at Juzbado (Salamanca). The design capacity of this facility is 400 t U/y.

13.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels:**

- Wet storage of spent fuel in ponds in each NPP totalling 3,026 t U as of 31 December 2005.

- A temporary spent fuel wet storage facility is operational at the Trillo nuclear power plant since 2002 with a capacity of 1080 t U. It contained 344 t U as of 31 December 2005.

– An old uranium prospecting site at El Cabril is operated for LILW-SL storage in vaults.

– The construction of a VLLW repository is under construction at El Cabril. This centralized temporary storage facility should start in 2007.

– The main strategy established in the 6th General Plan for Radioactive Wastes, approved by the Government on 23 June 2006, is based on the availability of a centralised temporary storage facility by the year 2010.

13.9. Professional Nuclear organisations

– Two professional nuclear groups (lobby) are the FORO DE LA INDUSTRI NUCLEAR ESPAGNOLA (www.foronuclear.org) and the SOCIEDAD NUCLEAR ESPAGNOLA (www.sne.es).

13.10. Waste Management, Radiation Protection, and Safety Authorities

– The Ministry of Industry, Tourism and Trade is the organisation responsible for granting the corresponding authorisations, after receiving a binding report issued by the CSN.

– CSN is the National Council of Nuclear Safety, CONSEJO DE SEGURIDAD NUCLEAR (www.csn.es), responsible for nuclear safety, radioprotection, early notification and emergency actions, and related controls.

– CSIC is the National Institute for Science & Technology, CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS (www.csic.es) is the national multidisciplinary advisory body.

– CIEMAT (www.ciemat.es) is a national centre on energy, environment and technological research attached to the Ministry of Education and Science.

– The EMPRESA NACIONAL DE RESIDUOS RADIACTIVOS (ENRESA) is the state-owned company (80% CIEMAT, 20% SEPI) responsible for producing a draft proposal of the General Radioactive Waste Plan and for executing the definitive Plan approved by the Government. ENRESA is in charge of El Cabril radioactive waste disposal facility (www.enresa.es).

13.11. Decommissioning & related Funds

– The state company ENRESA holds and manages funds independently from operators under the supervision of a Committee made up of representatives from the ministries with relevant competences.

14. SWEDEN

14.1. Nuclear Power Outlook

– After the closure of BARSEBACK 2 in 2005, the 10 operational nuclear reactors have a total installed capacity of ~9.0 GWe.

– Total nuclear production in 2005 was 69.5 TW·h, equivalent to approximately 45% of the country's total production of electricity.

– There is one operator for each site with respect to two international utilities: The VATTENFALL Group (www.vattenfall.se) is running 4 plants at the Ringhals site operated by RINGHALS AB (http://www.ringhals.se/) and 3 at the Forsmark site operated by FORSMARKS KRAFTGRUPP AB (www.forsmark.com), and the E.ON Sverige AB (www.eon.se) owning OKG AKTIEBOLAG (www.okg.se/en), operating 3 plants at the Oskarshamn site.

– Average cumulated load factor in 2005 was 75%.

– Related annual uranium requirement is approximately 1435 t U.

– Three shutdown NPPs (Agesta, Barsaback1+2).

14.2. Public Opinion (Eurobarometer 2005)

– 61.5% declares knowledge about radioactive waste (EU average 48.5%).

– 60% of the interviewees were in favour of the use of nuclear energy.

14.3. Research Reactors

– There are 3 shutdown research reactors at Studsvik (www.studsvik.se) and one critical assembly which is now decommissioned.

– No related uranium requirements.

14.4. Mining and milling

– Inferred resources with an extraction price of €110 /kg U are actually estimated at a few thousands t U.

14.5. Conversion

– None

14.6. Enrichment

– None

14.7. Fabrication

– The Westinghouse Atom fuel fabrication plant at Västerås produces PWR and BWR fuels and has a capacity of 600 t U/y.

14.8. Spent fuel and Radioactive Waste Management

– **Spent Fuels**:

- Prior to the decision to phase out nuclear power in Sweden, approximately 140 t HM were shipped to BNFL in the late 1970s.
- Since then, Sweden has opted for the direct disposal of spent nuclear fuel. Currently, all spent fuel is transported to the CLAB facility (wet storage) by dedicated shipment to be temporarily stored pending final disposal.
- Total pool capacity covering 11 plants is available for 30000 spent fuel assemblies: about 3400 spent fuel assemblies are stored as of 31 December 2004.
- Spent fuel from research reactors is stored in pools before export to the USA.
- Spent fuel will be stored in CLAB, Central Interim Storage Facility near Oskarshamn site for at least 30 years before encapsulation and disposal. The CLAB is operational since 1985 and more than 20000 spent fuel assemblies, equivalent to 4185 t HM are stored (31-12-04). Its capacity was increased from 5000 to 8000 t HM. It is operated by the SKB, the Swedish Nuclear Fuels and Waste Management Company SKB, *SVENSK KÄRNBRÄNSLEHANTERING AB* (www.skb.se).

– There are surface VLLW disposal sites in shallow land burials on 4 sites: Forsmark, Ringhals, Oskarshamn and Studsvik.

– All produced waste at the plants is managed on site before transport to the dedicated repository SFR.

– SFR is a cavern rock underground for the final repository for LILW and LILW-SL close to Forsmark site, also operated since 1988 by SKB. Its storage capacity is sufficient for all low and medium-level wastes. SFR will store most of the waste from decommissioning.

– SVAFO AB is an incineration facility of some LILW near the Studsvik research site shared by Studsvik (www.studsvik.se/en) and Vattenfall (www.vattenfall.se).

– Final Disposal: The Äspö Hard Rock Laboratory is acting on behalf of the nuclear utilities in conducting the extensive research with regard to the facility for final disposal of long-lived spent nuclear fuel and waste.

14.9. Professional nuclear organisations

– ICRP, the International Commission for Radiological Protection (www.icrp.org) is located at Stockholm.

– A knowledge preservation initiative of the Swedish Young Generation (www.younggeneration.nu) connected with the European Nuclear Society (ENS) is acting to ensure the production of economic, environment-friendly, and safe nuclear power, with the transfer of expertise to the next generation. It brings together members from 22 countries and organises periodic events.

– NSFS is the Nordic Society for Radiation Protection created by R. Sievert (www.nsfs.org/en).

14.10. Waste Management, Radiation Protection, and Safety Authorities

– SKI, the Swedish Nuclear Power Inspectorate *STATENS KÄRNKRAFTINSPEKTION* (www.ski.se) is supervising all nuclear activities, and is co-operating with SSI (below) for radiation protection matters. SKI reports to the Ministry of Environment (www.regeringen.se).

– SSI is the Swedish radiation Protection Authority, *STATENS STRÅLSKYDDSINSTITUT* (www.ssi.se). SSI is also responsible for the co-ordination of emergencies.

– KASAM is the National Council for Nuclear Wastes *STATENS RÅT FÖR KÄRNAVFALLSFRÅGOR* (www.sou.gov.se/kasam), an independent and governmental committee attached to the Ministry of Environment.

14.11. Decommissioning & related Funds

– Studsvik is the industrial group involved in decommissioning activities (www.studsvik.se/en).

– Nuclear Waste Fund (managed by the State) independent from operator.

15. UNITED KINGDOM

15.1. Nuclear Power Outlook

– Total nuclear production in 2005 was 75.2 TW·h, to approximately 20 % of the country's total production of electricity.

– Nineteen NPPs: Four Magnox (GCR), fourteen AGR (GCR) plants and one PWR are in operation at 9 nuclear sites with a installed capacity of ~11.0 GWe.

– BRITISH ENERGY (www.british-energy.co.uk) is operating 10 GCR and the only PWR as well as 4 GCR in association with SCOTTISH NUCLEAR LIMITED; British Nuclear Fuels (BNFL, www.bnfl.com) is operating the 8 remaining GCR plants.

– Average cumulated load factor in 2005 was 71.4%.

– Related annual uranium requirement is approximately 2160 t U.

– Twenty two NPPs shutdown (18 GCR, 2 FBR, 1 AGR, 1 SGHWR).

– A complete fuel cycle exists in the UK, both for the domestic market as well as for export.

– The British government shows a renewed interest for a significant share of nuclear in the future energy mix.

15.2. Public Opinion (Eurobarometer 2005)

– 43% declares knowledge about radioactive waste (EU average 48.5%).

– 44% of the interviewees were in favour of the use of nuclear energy.

15.3. Research Reactors

– There is a large variety of research reactors and critical assemblies: 27 are actually decommissioned, 6 are shutdown and 3 (small) remain operational, with a total thermal power of 100kW.

– No related uranium requirements.

15.4. Mining and milling

– No mining or milling of uranium ore takes place in the UK.

15.5. Conversion

– WESTINGHOUSE (TOSHIBA) operates a conversion facility at its Springfields plant near Preston, where uranium ore concentrate is converted to UF_6 for customers, capacity of 6000 t U/y.

– The conversion facility should have closed in 2007, but CAMECO bought 5000 t/y capacity over 10 years.

– Uranium metal for Magnox fuel is produced from UF_4, an intermediate product for UF_6 production. Magnox fuel production will cease in 2007.

15.6. Enrichment

– URENCO operates a commercial centrifuge enrichment plant at Capenhurst, with a capacity of 2300 t SWU/y. (www.urenco.com).

– URENCO is planning to build a new enrichment plant (NEF) in the USA.

– URENCO has a partnership venture with AREVA (FR) for the development of Centrifuge Enrichment Technology (CET).

15.7. Fabrication

– WESTINGHOUSE Springfields fabricates a number of different types of fuel. Present production capacities are: Magnox (1300 t U/y), AGR (260 t U/y).

– The UKAEA fabrication plant for material test reactor fuel closed down in 2002, pending decommissioning.

– BNFL operates a small scale MOX fuel demonstration facility at Sellafield that has a capacity of 8 t HM/y. This facility will only be used for development purposes in the future. The commercial scale MOX plant started at the end of 2001. Its theoretical production capacity of 120 t HM/y is not expected to exceed 30-40 t/y.

– Quantities of UO_2 powder are exported to foreign fabricators.

15.8. Spent fuel and Radioactive Waste Management

– BNFL operates a Magnox fuel reprocessing plant at Sellafield, which has an operational capacity of 1500 t HM/y (this will close in 2012).

– The BNFL reprocessing plant is also operated at Sellafield with an operational capacity of 1200 t HM/y.

– BNFL operates spent fuel storage ponds at Sellafield for both AGR and LWR fuels. The ponds have a total capacity of 8000 t HM.

– A spent fuel dry storage facility (capacity 700 t HM) is in operation at the WYLFA nuclear power plant, replacing wet stores in older reactors.

– A LLW surface disposal facility used by BNFL at Drigg, near Sellafield.

– Several disposal facilities at the Dounreay site in Scotland for mainly its own LLW.

– ILW (intermediate level waste) is stored, mainly at the centres of production, and will be disposed of in the NIREX proposed facility, when issued proposals.

– HLW is currently stored; either untreated or in vitrified form, mainly by BNFL at its Sellafield site. No decisions on final disposal have yet been taken by the Government.

15.9. Waste Management, Radiation Protection, and Safety Authorities

– Waste management and decommissioning are provided to the UK and international markets by BNG a subsidiary of BNFL.

– RWMAC is an independent Radioactive Waste Management Advisory Committee advising the Ministry of Environment and the Scottish and Wales Assemblies (www.defra.gov.uk/rwmac).

– The Committee on Radioactive Wastes Management (CoRWM) is in charge of recommendations for ILW and HLW (www.corwm.org.uk).

– NIREX is a government-owned non-profit making company, reporting to the same authorities, working to develop safe and environmentally responsible solutions for the management of nuclear waste (www.nirex.co.uk).

– Final disposal: CoRWM, presented its recommendations on LILW and HLW disposal and the UK Government will consult on proposals for geological disposal in the summer of 2007.

– The NRPB is the national radiological protection Board part of the health Protection Agency, in charge of research, advisory and technical services on radioprotection (www.hpa.org.uk/radiation).

– UKAEA is the British Research institute **United Kingdom Atomic Energy Authority,** owning 5 research sites.

15.10. Decommissioning & related Funds

– There is not a single common regime for funding.

– There are three main nuclear operators: BE (private) and BNFL and UKAEA (public sector).

– BNFL: Internal not segregated fund but a Nuclear Liabilities Investment Portfolio earmarked for that purpose.

– BE: Internal independent Nuclear Generation Decommissioning Fund (NGDF).

– Under a recently implemented scheme the Nuclear Decommissioning Authority (NDA) is responsible for securing the discharge of all public sector liabilities on civil public sector sites (i.e. owned by BNFL and UKAEA).

– Under a BE's restructuring plan, the NGDF would be worked in under the new Nuclear Liabilities Fund (NLF).