The La Hague Reprocessing Plant: Basic Facts

Infrastructure, Contracts, and Products*

By

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*Information in this report is drawn from a more detailed presentation of La Hague on the web site http://www.francenuc.org/en_sites/lnorm_hague_e.htm. The author can be contacted at ecoperspectives (at) gmail.com

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The La Hague Reprocessing Plant

IDENTITY CARD

Purpose/type: to reprocess irradiated fuel to produce military and civilian plutonium
Installations: AT1 shut down, UP2 and UP2/HAO shut down, UP2-800, UP3
Location: 290-ha area at Digulleville, Jobourg, Omonville la Petite (Manche), west of Cherbourg, France
Operator: in the beginning the CEA; since June 1976, Cogéma, which became in March 2006, Areva NC
Period of operation: since 1966
Raw material: irradiated fuel from France and abroad
Procedure: Purex
Nominal capacity: a total of 1700 t/yr of irradiated fuel (up to 1000 t each) for UP2-800 and UP3
Actual production: in 2008, reprocessed a total of 937 t of irradiated fuel
Wastes: solution of fission products and transuranic elements, substantial emissions, solid wastes in great quantity

REPROCESSING INSTALLATIONS

I.A. ***AT1--shut down***

A pilot workshop for the reprocessing of fuel from Rapsodie and for perfecting the process for treating fast neutron reactor fuel in general, AT1 operated from 1969 to 1979. Nominal capacity was 1 kg/d.

I.B. ***UP2—shut down***

Put into operation in 1996, UP2 was originally devoted to reprocessing metal fuel from gas graphite reactors. However, starting in 1976 the plant treated alternatively gas graphite fuel and, with the help of the new head end, HAO (see below), light-water reactor fuel. Between 1966 and 1987, UP2 reprocessed 4895 t of gas graphite fuel from the reactors of EDF and from Vandellos in Spain [Bourgeois 96].

I.C. ***UP2/HAO (often called UP2-400)—shut down***

Because of EDF's decision to abandon the gas graphite line, in favor of pressurized water reactors, the CEA constructed the HAO workshop (high activity oxide), attached to UP2, to carry out the reception, the cutting up, and the dissolving of fuel from light water reactors. HAO entered into service in 1976.

UP2/HAO reprocessed, from its entry into service in 1976 to the entry into service of UP2-800 in 1994, about 4100 t of light water reactor fuel. After the autumn of 1994, the high-activity workshops of UP2-400 were used only for special campaigns. Cogéma stopped all reprocessing in UP2-400 as of January 1, 2004.

I.D. *UP2-800 (INB 117)*

UP2-800, intended to reprocess essentially EDF fuel, had a nominal capacity of 800 t/yr of fuel until 2003 when it was authorized to reprocess up to 1000 t/yr. Cogema announced the entry into service of UP2-800 in 1994, when the new R1 and R2 workshops entered into service. UP2-800 uses some of the workshops in UP2-400.

I.E. *UP3 (INB 116)*

The UP3 plant, like UP2 had a nominal capacity of 800 t/yr of fuel until 2003, when it was authorized to reprocess up to 1000 t/yr. It was prefinanced by reprocessing contracts that foreign operators of nuclear reactors had made with Cogema. The plant went into industrial service in 1990.

I.F. *Storage pools*

As of 1994, fuel awaiting reprocessing was stored in pools with a total capacity of 14,390 t of uranium metal contained in fuel elements before irradiation. With the intention of reracking pools, Cogéma obtained authorization in 2003 to store 17,600 t of uranium and plutonium metal at UP2-800 and UP3 [JO 11.i.05]. However, as of October 2008, Areva had not installed the compact racks that would allow it to take advantage of the increase in the authorization [NucF 20.x.08]. These pools are under the control of the IAEA and Euratom.

As of December 31, 2008, 9179 t of plutonium and uranium metal calculated before irradiation were stored in pools awaiting reprocessing at La Hague. Of the 9179 t, 99.9% was of French origin [Areva TraitLH 08].

The heat produced by the disintegration of fissile materials in the pools has to be evacuated continuously by a complicated system of cooling circuits and exchangers to avoid boiling and escape of radionuclides [Hirsch 90].

CONTRACTS

Disappearance of Reprocessing Contracts for Foreign Fuel

The UP3 reprocessing plant at La Hague was prefinanced with contracts between Cogéma and twenty-seven operators of foreign power plants for the reprocessing of about 7000 tons of irradiated fuel over a ten-year period. The fuel came from Belgium, Germany, Japan, the Netherlands, Sweden, and Switzerland. Until around 2004 about half of Cogéma's reprocessing was for foreign clients. Today Cogéma/Areva's most significant foreign clients have abandoned reprocessing [Schneider 08].

As of December 31, 2008, only the following irradiated fuel (in metric tons of heavy metal—thm) from foreign companies was in pools at La Hague, waiting to be reprocessed:

Australia	0.131 thm (MTR fuel)	work to be completed in 2010
Belgium	0.367 tHM (MTR fuel)	work to be completed in 2012 [NucF 4.vii.05]
Switzerland	0.148 tHM	work to be carried out in 2011
Italy	12.4 tHM*	to be reprocessed by 2014 [ArevaTraitLH 08]

*Areva has a contract with Italy for the reprocessing of a total of 235 thm of LWR fuel. As of the close of 2008, 94.1 thm, including the 12.4 thm listed above, had been received. The waste from reprocessing of the 235 thm is to be returned to Italy by the end of 2025 [ArevaTraitLH 08].

Dependence on EDF for continuation of reprocessing

Of the 9179 thm of irradiated fuel awaiting reprocessing at La Hague at the end of 2008, 99.9 percent came from EDF [ArevaTraitLH 08], on which Areva depends for the continued operation of the plant.

EDF unloads fuel containing approximately 1200 thm from its reactors each year. Approximately 100 thm are MOX fuel; 1100 thm are standard UOX fuel. EDF's policy since the year 2000 has been to reprocess about 850 thm of UOX fuel each year. The remaining 250 thm of UOX fuel are stored at reactor sites and at La Hague, as are the 100t of MOX fuel.

In December 2008 EDF signed an agreement with Areva by which EDF will increase, by 2010 from 850 thm to 1050 thm per year the amount of UOX fuel that it will reprocess. (It will at the same time increase production of MOX from 100 thm to 120thm per year by 2010.) It will not reprocess MOX at this time, but expects to reprocess it at some future date to obtain plutonium for so-called Generation IV nuclear reactors.

Areva hopes to increase the reprocessing at La Hague to 1500 tHM per year by 2015 [NucF 29.xii.08]. In 2008 it reprocessed only 937 tHM. To obtain the increase it will need to find new foreign contracts to carry out alongside its work for EDF. Where sufficient big contracts will come form is not apparent.

Only limited reprocessing of MOX and research and test reactor fuel

Cogéma/Areva seeks reprocessing contracts for irradiated MOX fuel and for irradiated research reactor and materials test reactor (MTR) fuel. However, they do not offer a lucrative source of contracts.

In comparison with U02 fuel, the reprocessing of MOX poses supplemental problems, including the degradation of solvents because of the increase in alpha emissions and difficulty in manipulating plutonium containers because of the heat emitted by the plutonium 238 [Baetslé 94]. Cogéma/Areva dilutes MOX in LWR fuel in order to reprocess it; and, as of the end of 1997, La Hague had reprocessed in this way only some 67.5 t of MOX, according to Jean-Guy Devezeaux de Lavergne of Areva [NucF 24.iii.08].

Devezeaux de Lavergne has stated that reprocessing of MOX even in diluted form multiplies by "fivefold" in comparison with irradiated UO2 fuel, the plutonium content of the pipelines and changes the "nature of the plutonium" being handled. Therefore, the La Hague plant will have to undergo "significant adaptations" in order to reprocess the amount of MOX that would be required to provide plutonium for fuel for Gen IV reactors [NucF 24.iii.08].

Research reactor and MTR fuel is likewise difficult to handle, in part because it contains highly enriched uranium. Reprocessing is made possible by dissolving the fuel in standard LWR fuel at a dilution ratio of "'a few tens of kg in tons of UOx,'" Philippe Knoche, director of Cogema/Areva's Reprocessing Business Unit, told *Nuclear Fuel* [NucF 4.vii.05].

Cogéma/Areva installed in UP3 a special line of mechanical equipment designed to handle highly enriched uranium without causing a criticality [NucF 4.vii.05]. However, Jean-Pierre Gros, the head of Areva's Recycling Business Unit, told *Nuclear Fuel* in December, 2008, that if Areva can increase its reprocessing contracts for UOX fuel to 1500 thm per year, it will stop seeking customers wanting to reprocess research reactor and MTR fuel, because the reprocessing operation is "complicated" and, for a given mass, absorbs much more of La Hague's reprocessing capacity than UOX fuel [NucF 29.xii.08].

Contracts to help to clean up other sites

Many of the contracts that Areva is obtaining at the present time are for what is essentially clean-up work for other plants.

La Hague receives for conditioning and treatment, material rejected from the production circuit at fuel fabrication plants in France and abroad and, on occasion, unirradiated materials that are removed from storage at other sites undergoing cleanup or decontamination/dismantling. The French material that La Hague has received includes various materials from the Melox installation, from the UP-1 reprocessing plant, which is undergoing shut down, and from Cadarache where most of the uranium and plutonium have been removed from the Complex for the manufacture of fuel elements with plutonium (CFCa) [ASN 08].

Work for foreign facilities includes repackaging in UP3-A powdered PuO2 from the English installation Sellafield [Contrôle, xi.08, p. 170]; reprocessing MOX assemblies made from production scrap,,from the former Siemens MOX fuel plant at Hanau in Germany [NucF, 15.vi.09]; and receiving, packaging, storing, and treating powdered plutonium oxide, unirradiated powdered MOX, and unirradiated tablets of MOX from the international research center Ispra in Italy [Contrôle, vii.09]. In 2014-2015, Areva will reprocess 16 unirradiated MOX fuel assemblies made by BNFL and rejected by Kansai Electric [NucF 15.vi.09

PRODUCTS AND BY-PRODUCTS OF REPROCESSING

PRODUCTS THAT THE ELECTRICITY INDUSTRY CONSIDERS TO BE REUSABLE

Approximately 95% by mass of the contents of irradiated fuel is uranium and approximately 1% is plutonium, with, up to 0.1%, other transuranic elements. Some 4% is fission products [ArevaTraitLH 08]. Reprocessing is designed to separate the uranium and the plutonium from each other and from the fission products and other transuranic elements. Advocates of reprocessing emphasize that uranium resulting from reprocessing (known as RepU) has a residual enrichment, which supports its use in fresh reactor fuel and that plutonium can be used in mixed oxide (plutonium and uranium) fuel or MOX. Nevertheless, stocks of unused RepU and separated plutonium are growing, and reuse creates additional waste.

Uranium

At the end of 2007 France had in storage 21,180 tons of RepU, at La Hague and at Areva's portion of Tricastin. Of the 21,180 tons, only 2,770 tons belonged to foreign countries. Most of the 18,410 tons of French RepU belonged to EDF part of the remainder to Areva and part to the CEA [AndraSyn 09].

EDF has used fuel made from RepU in only two reactors both at its Cruas plant, and the extent to which it is doing so at the present time is uncertain [Marignac 08]. As Andra notes, the quantity of RepU actually reused depends on the state of the market in natural uranium, with which RepU is in competition [AndraSyn 09].

In order to be reused, RepU must be re-enriched and then made into fuel. RepU is contaminated with a variety of radionuclides, which makes its reuse more difficult at each stage of the fuel chain than the use of natural uranium. The contaminants include

--uranium 232: an alpha emitter (half-life of 72 years) which rapidly produces descendents that are alpha, beta, and gamma emitters, in particular bismuth 212 and thallium 208;

--uranium 234: a gamma and alpha emitter with a specific activity that is greater than uranium 235 and uranium 238. It is a neutron absorber and modifies the reactivity of uranium;

--uranium 236: also an absorber of neutrons;

--products resulting from the decay of uranium: bismuth 212, thallium 208, emitters of hard and intense gamma radiation. If not eliminated, they reach an equilibrium and their maximum after ten years of storage of RepU;

--transuranic elements: neptunium 237, americium 241 and the various isotopes of plutonium;

--fission products: cesium 134 and 137, technetium 99, and others.

Because re-enriching RepU in a gaseous diffusion enrichment plant contaminates the entire plant and at present France's only fully operating enrichment plant is of this type, France ships RepU for enrichment to Russia, where it is enriched by centrifuges. Areva is authorized to enrich RepU in the northern portion of the Georges Besse II centrifuge plant that it is constructing at Tricastin.

At Areva's Romans fuel fabrication plant, RepU is processed in a special line with extra shielding, which has a capacity greater than 150 t/yr of uranium.

Plutonium

EDF's stated policy on irradiated fuel has since 1987 been based on maintaining an "equilibrium" of flow in regard to plutonium, i.e. it has claimed that it reprocesses just enough irradiated UOX fuel to provide plutonium for the MOX that it is able to use in its power plants in the short term. Nevertheless, plutonium belonging to EDF is accumulating. In 1987 the French stockpile of separated plutonium was almost zero [Marignac 08]. At the end of 2007 it was 60 tons, of which about 29 tons stored at La Hague had been separated from fuel irradiated by EDF. The 29 tons would be sufficient for three years' supply of MOX [AndraSyn 09].

Prolonged storage of separated plutonium reduces its energy value by decreasing its content in fissile isotopes and increases the problems of radioprotection during its manipulation. The plutonium 241 decays with a half-life of 14 years, giving americium 241, which decays with a period of 458 years by alpha disintegration into neptunium 237. Americium 241 is a very powerful gamma emitter; neptunium 237 is an alpha emitter with a period of 2 million years. A separation of americium 241 from plutonium is possible, but creates new wastes.

EDF does not reprocess MOX and has no plans to do so in the short term. The fuel is stored under water, as is the UOX fuel that EDF does not reprocess. Eventually it plans to reprocess MOX in order to obtain sufficient plutonium for Generation IV reactors [NucF 29.xii.08].

ATMOSPHERIC EFFLUENTS

Radioactive atmospheric effluents come from the dissolution of irradiated fuel, from the calcination of high level liquids during vitrification, from the air released by aeration installations, and possibly also from evaporation units. They are released into the environment after partial decontamination in the workshops where they are produced.

As of 2007, La Hague is authorized to release each year the following radioactive gaseous effluents or aerosols: 150 TBq of tritium, 0.018 TBq of radioactive iodine, 470,000 TBq of radioactive rare gases including krypton, 28 TBq of carbon 14, 0.001 TBq of other artificial beta and gamma emitters, and 0.000,01 TBq of artificial alpha emitters [JO 10.i.07]. A major revision to the regulations, including introduction of a limit on carbon 14, was made in 2003 and small changes in 2007. In 2003 for the first time limits were set on releases into the air of chemical substances.

Releases of radioactive gaseous effluents in 2008 as reported by Areva were 46.4 TBq of tritium; 0.00714 TBq of radioactive iodine; 155,000 TBq of rare gases, in particular krypton 85; 13.5 TBq of carbon 14; 0.0001 TBq of other beta and gamma emitters, and 0.0000018 TBq of alpha emitters [ArevaSnrLH 08].

LIQUID EFFLUENTS

--THE ORGANIC SOLVENTS. In the late 1990s the treatment generated a decontaminated dilutant and a decontaminated solvent of concentrated TBP, which were reused, and a solution (about 1%

of the original solvent) that contained almost all the radioactivity. Areva states the process has been changed and in 2008 little organic solvent was produced. Nevertheless, solvent is still treated in the Atelier MDS (Solvent mineralization plant) on site. Alternatively solvents regarded as "very weakly" or "weakly" contaminated may be sent directly to Socodei's Centraco plant at Marcoule for incineration [Socodei 07; ArevaSnrLH 08].

--THE VERY HIGHLY RADIOACTIVE ACID SOLUTION containing fission products and transuranic elements. It is concentrated by evaporation, stored for a year in order to reduce the radioactivity, and then vitrified with other substances.

Vitrified wastes are poured into stainless steel containers, each holding 150 l. At the end of 2008, a total of 9541 containers were stored at La Hague [ArevaSnrLH 08]. Corrosive liquid waste from the uranium-molybdenum fuel used in early gas-graphite reactors has yet to be vitrified [NucF 3.xi.08].

The vitrified wastes include, according to Cogéma, 99% of the radioactivity of the irradiated fuel but represent about 3.5% of their mass [Cogéma 92b]. Because of the concentration of the radioactivity, a lethal dose would be received at one meter in less than one minute. The strong thermal emission of these wastes necessitates intermediate storage of at least thirty years before definitive storage [Wise 97]. France plans to eventually dispose of them in a deep underground repository.

--ACID EFFLUENTS OF MEDIUM AND LOW RADIOACTIVITY. The majority are treated and then reused or vitrified according to their level of radioactivity.

--BASIC SOLUTIONS. They are evaporated and the concentrates vitrified with the other very high activity wastes.

--OTHER AQUEOUS EFFLUENTS. These effluents come from the treatment of gaseous effluents, fuel storage pools, various cleaning operations, and laboratories.

Before STE3 entered into service, STE1 and STE2 treated effluents from UP2, mainly by co-precipitation. The sludge produced in STE2 was stored in bulk in six tanks located in STE2. According to Andra these tanks still contained 9077 m3 of sludge, representing 0.12EBq at the end of 2007 [AndraInv 09].

Starting in about 1989, STE3 treated the majority of the effluents coming from UP2 and UP3, likewise by coprecipitation. The sludge from this treatment was stored in containers. As of the end of 2007, STE3 contained 10,572 drums, representing 10.55PBq, largely of beta radiation [AndraInv 09].

Cogéma planned to shut down the units for coprecipitation and bitumen packaging at the end of 1995 [Bonnet 95]. These units continue to operate, but by 2008, under normal conditions of operation, almost no asphalted wastes were produced [ArevaSNR LH 08]. To decrease reliance on asphalting, Cogma/Areva sorts effluents more selectively and has added new evaporation units. The company treats much of the effluent by evaporation, producing concentrates containing the majority of the radioactivity and then incorporating these concentrates in glass.

After treatment, liquid effluents produced by the different workshops at La Hague, are filtered and monitored and released into the English Channel by means of a pipe, the end of which is located in the Raz Blanchard current. [ArevaSnrLH].

As of 2007, La Hague is authorized to release each year in liquid effluents18,500 TBq of tritium, 2.6 TBq of iodine, 42 TBq of carbon 14, 11 TBq of strontium 90, 8 TBq of cesium 137, 0.5 TBq of cesium 134, 15 TBq of ruthenium 106, 1.4 TBq of cobalt 60, 60 TBq of other beta and gamma emitters, and 0.14 TBq of alpha emitters [JO 10.i.07]. As with the gaseous effluents, the 1984 authorization was substantially revised in 2003 and slightly modified in 2007.

In 2003 releases of liquid chemical effluents were made subject to limitations for the first time. These effluents contain chemical compounds and elements in solution (acids or bases, salts, metals, organic products). More than twenty of them must now be reported to the nuclear safety authority (Autorité de sûreté nucléaire, ASN). Those released in the greatest quantity, accordiéng to figures from Areva, are nitrates (2390 t in 2008) and nitrites (less than or equal to 34 t in 2008).

Liquid effluents are classified as "V" if beta activity apart from tritium is less than 1.85 MBq per liter and if alpha is less than 3.7 kBq per liter. Other radioactive effluent is classified as "A." In 2008 La Hague released into the sea 1607 m3 of "A" effluent and 98,928 m3 of "V" effluent. It also released through the pipe 574,850 m3 of water from various rain water networks and underground drainage networks.

Releases of radioactive liquids into the sea in 2008, as reported by Areva, contained 8,190 TBq of tritium; 1.06 TBq of iodine; 6.24 TBq of carbon 14; 0.17 TBq of strontium 90; 1.0 TBq of cesium 137; 0.075 TBq of cesium 134; 3.37 TBq of ruthenium 106; 0.12 TBq of cobalt 60; 4.18 TBq of other beta and gamma emitters; and 0.020 TBq of alpha emitters [Areva SnrLH 08].

SOLID WASTE

Andra, the national radioactive waste agency, reports that from La Hague's creation through the end of 2007 the La Hague site produced the following total volumes of waste in equivalent cubic meters when packaged:

High activity: 1650 m3
Intermediate activity--long lived: 19,171 m3
Low activity-long lived: 4,952 m3
Low and intermediate activity- short lived: 156, 213 m3
Very low activity: 17,113 m3.

These wastes include the solid products resulting from treating gaseous and liquid effluents, as described above and other categories of solid waste described below [AndraSyn 09].

--HULLS AND END PIECES. The cladding and cartridges (magnesium and graphite) from fuel for UNGG (natural uranium, graphite gas) reactors are stored in bulk under water in silos in the north-west zone of the site. At present silos 115 and 130 contain a total of 1055 t of magnesium, graphite and metal [ArevaSnrLH 08], which Andra described in 2000 as representing 24 TBq of alpha and 2.2 PBq of beta/gamma activity [Andra 00].

The hulls and end pieces from PWR fuel reprocessed in UP2/HAO were stored in bulk under water in a silo near the HAO installation and, since 1988, in closed containers arranged in old storage pools for irradiated fuel [Andra 96]. In 1999 HAO, S1, S2, and S3 stored 2245.4 t of wastes [Andra 00].

The hulls and end pieces from PWR fuel reprocessed in UP3 and UP2-800 were for a time cemented and then stored. At the end of 2007, 1518 casks of cemented hulls and end pieces were stored at La Hague. Their radioactivity totaled 0.35 EBq, largely from activation products [Andra Inv. 09, p. 54]. The Atelier de compactage des coques (Hulls Compaction Workshop, ACC) which started operation at the end of 2001, now compacts hulls, end pieces, and technological waste that necessitate deep underground disposal. The compacted waste is in the form of disks and is stored in CSD-C canisters (universal canisters) identical in shape and size to canisters for vitrified waste. As of the end of 2007, 6089 containers of compacted hulls and end pieces were stored at La Hague. They have 818 PBq of beta activity [AndraInv 09].

--FINES from shearing and dissolution fines. Today they are vitrified with the solution of fission products. In the past they were stored with the cladding and the hulls.

--WASTES IN BITUMEN. See “other aqueous effluents” above. These wastes present an alpha activity of 3.7GBq/t and cannot be sent to Andra [Pradel 95].

--TECHNOLOGICAL WASTES. The wastes are decontaminated when necessary, preconditioned in standard 120-liter barrels, then conditioned by cementing or compacting [ArevaSnrLH 09]. Most of the cemented technological wastes can go to a site belonging to Andra [Pradel 95]. Wastes that are irradiating or are too contaminated with alpha emitters to be sent to Andra are stored at La Hague [Ledermann 96].

--RESINS. Resins are used to clean the water in storage pools. As of the end of 2007, 332 m3 of two categories of resins and 51 t of two other categories were stored at La Hague awaiting conditioning [AndraInv 09].. The radioactivity of the resins is chiefly due to cobalt 60. ACR (Atelier de Conditionnement des Résines) packages bead and crushed resins. The resins are concentrated and pretreated with calcium; mixed with cement; and poured into metal drums, which are stored in shielded casks ready for “near-surface disposal.” [Guerrand 98; ArevaSnrLH 08].

--OTHER WASTES. Among the other wastes at La Hague reported in 2009 are concretions from cleaning the discharge pipe (45 m3) [AndraInv 09] and 6538 drums of alpha-contaminated technological waste shipped to the installation from MOX fabrication plants and stored in Building 119 [ArevaSnrLH 08]

Pressing problems involving waste

The majority of the waste from UP2-400 was stored without packaging. Cogéma/Areva has been dragging its feet in regard to retrieving it, conditioning it, and storing it safely.

DSIN, the agency then charged with the safety of nuclear installations, wrote a letter to Cogéma in January 1999, stating that recovery and packing of bulk waste in tanks at STE2, in silo 130, and in the HAO silo required priority action. There were few concrete results. In November 2005, ASN confirmed the necessity of undertaking as rapidly as possible the retrieval of wastes in STE 2, silo 130, and the HAO silo. In addition, Areva was asked to assign priority to alpha waste stored in Building 119.

In 2002 Cogéma promised to begin incorporating the sludge at STE 2 in bitumen. However, on the basis of two experimental campaigns, ASN in September 2008 forbad further use of this process. Areva is studying, as alternative methods, cementing the waste or drying it through the DRY-PAC process. ASN has specified that retrieval of the waste must be complete by the end of 2010 at the latest [ASN 08].

Silo 130 is a buried blockhouse, containing two trenches, only one of which contains waste. The waste, which consists of cladding and end pieces from UNGG fuel, technological waste, and rubble, is stored under water. Areva plans to transfer the UNGG waste to a modern storage facility; remove the water from the silo and treat it in STE 3; then remove the waste and rubble from the bottom of the silo. However, it is talking about the need to shore up the building first [ASN 08].

The HAO Silo is a buried basin [AndraSyn 09] containing cladding and end pieces form light water fuel cut up in HAO, plus fines, resins, and technological waste resulting from the operation of HAO. In 2008 Areva told ASN that it was beginning new studies of how to proceed [ASN 08]. The decree authorizing the definitive shutdown and dismantlement of HAO states that all waste must be removed from the silo by the end of 2022 [JO 4.viii.09].

Areva has been gradually decontaminating and cementing the alpha-contaminated technological waste from MOX production, housed in Building 119. The work will apparently be speeded up by devoting a workshop in STE 3 entirely to this waste [ASN 08].

RETURN OF FOREIGN WASTE

In its *Traitement des combustibles usés provenant de l'étranger, Rapport 2008* (Reprocessing of used foreign-origin fuel, 2008 Report), Areva states that by the end of 2008 it had returned to the countries that signed reprocessing contracts before June 2006, 83% of the containers of vitrified fission products arising from the reprocessing of the fuel. The company also states that it is returning containers of compacted structural waste (hulls and end pieces), though it does not give a percentage of existing hulls and end pieces already returned. Seven thousand containers of compacted waste remain to be sent, Areva says. The lack of a percentage may reflect the fact that, as indicated in the section on products, some of the structural waste produced at La Hague is still stored in bulk under water and other structural waste produced prior to 1995 was conditioned in cement rather than compacted.

Intergovernmental agreements specifying when waste is to be returned are required in conjunction with reprocessing contracts signed since the passage of the June 2006 nuclear waste program management act, known as the Birraux Act. The French disagree among themselves as to what constitutes waste, however.

Areva asserts in its 2008 report that wastes from the operation and dismantling of the reprocessing plant do not fall under the obligation to return foreign waste. In this the company is stating French government policy. Article 3 of the December 1991 law on the management of nuclear waste contains a prohibition on foreign nuclear waste's remaining in France. This stipulation was superseded by Article 8 of the June 2006 nuclear waste program manage act, which forbids the disposal of foreign-origin waste in France but does not spell out the details. A decree of March 3, 2008, implements the prohibition in the June 2006 act in a way that has created controversy.

France must send back waste equivalent in mass and radioactivity to the waste produced by reprocessing, but need not consider in its calculations so-called usable materials (the plutonium and the uranium separated by reprocessing), authorized radioactive releases from the plant, wastes produced by operating and maintaining the reprocessing facility such as contaminated gloves and tools, and decommissioning waste.

Greenpeace France filed a request for annulment of the March 3 decree with the Conseil d'Etat, France's highest administrative court. In the challenge, filed in 2008, Greenpeace states that the 2006 act requires that all foreign "waste" be returned and, that the national radioactive waste management agency, Andra, lists materials produced by the operation of the reprocessing plants as "waste."

In support of its request Greenpeace states that the process and decommissioning waste from the reprocessing of foreign spent fuel, though not categorized as highly radioactive, are not trivial. According to a calculation by WISE-Paris, these wastes already amount to nearly 20,000 metric tons of material in almost 50,000 packages stored at La Hague and at the shut-down UP-1 reprocessing plant at Marcoule.

The Conseil d'Etat may not rule on the challenge for years. Greenpeace did not file for an injunction so its action had no immediate effect [NucF, 19.v.08].

Returning waste other than vitrified high-activity waste and compacted structural waste, which is of intermediate activity and long life, would raise a variety of problems. Among them is the fact that between the creation of La Hague and 1990, wastes described as being of "weak" activity were packaged in STE2 without prior sorting and sent to CSM--about 6000 m3 per year. At CSM a part was compacted and all were buried, actions that made the return of these wastes to the countries that produced them almost impossible [WISE 94b].

DISMANTLING

Decontamination and dismantling of UP2-800 and UP3 and associated facilities, when it eventually takes place, will be time-consuming and costly. No large reprocessing facility has yet been completely cleaned and dismantled.

The pilot reprocessing plant AT1at La Hague was decontaminated between 1982 and 2001. Complete dismantling has been postponed until the dismantlement of UP2-400 [ASN 2008, p. 436]. The only authorization to date for the dismantling of UP2-400 is limited to the INB that centers in HAO and does not include AT1 [JO 4.viii.09].

The decontamination and dismantling of HAO at La Hague was authorized in July 2009 and is scheduled to be completed by the end of 2033. Thus it will take twenty-four years.

The reprocessing plant UP1 at Marcoule, which operated from 1958-1997, is currently undergoing decontamination and dismantling. The work is expected to continue until 2040. The cost,was estimated in 2003 to be $6 billion euros. The facility is classified as a military installation. Thus only a limited amount of information about the operation is available [Schneider 08.; Marignac 08].

NOTES

[Andra . . .] Agence nationale pour la gestion des déchets radioactifs. Inventaire national des déchets radioactifs. Rapport de l'Observatoire nationale de l'Andra . . .

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