

Plutonium *Investigation*

FRANCE

ON THE WEB
www.pu-investigation.org

WISE-Paris

31-33, rue de la Colonie

F-75013 Paris

Telephone +33 1 45 65 47 93

Fax +33 1 45 80 48 58

e-mail: WISE-Paris@globenet.org

<http://www.pu-investigation.org>

EDITORIAL

The end of a myth

Summer is the high season for politics in France. Nothing else is happening, and the stage is free. A surprising number of delicate political decisions are made in the seventh and eighth months of the year. It is not yet clear into which category the report from the Charpin-Dessus-Pellat mission, handed to Prime Minister Lionel Jospin at the end of July 2000, will fall: to be passed on, or to be buried. The diverse backgrounds of these "three musketeers", respectively Commissioner for Planning, Director of the Ecodev program at the CNRS, and High Commissioner for Atomic Energy, prompted the Minister for Environment to say, "this is probably the first equitable report in the history of nuclear energy in France". Perhaps. But it still has to be read.

The main 250-page volume is entitled "Étude économique prospective de la filière électrique nucléaire" (forecast economic study for nuclear energy) and the report is published with three annexes dedicated to the analysis of the current reactor generation and the prospective for nuclear and non-nuclear technologies. Those who do read it will find many data and a few truths which it is not always easy to express (in France). For example, the additional cost for the plutonium sector is around 164 billion Francs over the life of the current nuclear energy program.

Since the appearance of *Plutonium Investigation*, exactly three years ago, the amount of plutonium stored in France has risen by 13 tonnes to reach 78 tonnes, of which around 41 tonnes are of French origin. Plutonium is extracted at a very high price and no electricity company in the world would accept to take it on for free (see **Plut'Info**). The French stockpile corresponds more or less to the amount of plutonium separated in the UP2-800 plant in La Hague since it came into service. The value of plutonium has now reached negative levels. The obvious has to be faced. This is the end of a myth, but who will take the consequences?

FRANCE Plutonium Country... Yet.

On Christmas night, 1999, the second reactor of the Civaux nuclear power plant, in the Vienne Department, not far from Poitiers, southwest of Paris, was connected to EDF's national electricity grid. It was the last reactor remaining under construction in western Europe, 43 years after the first was put on line in the United Kingdom. Henceforth the order books are empty.

Civaux-2 brings the total number of nuclear power plants operating in France to 58 pressurized water reactors, of which 34 of 900 MW capacity, 20 of 1,300 MW, and 4 of 1,450 MW, plus the fast neutron reactor Phénix. Thus the nominal installed nuclear capacity is 61,700 MWe net. In 1999, nuclear reactors produced 374.7 TWh (billions of kWh), or 75.3% of the national production of 497.6 TWh. The company exported 68.1 TWh (the equivalent of the production of 11 reactors of 900 MWe, or 13.7% of the national production), but that did not prevent it importing 4.5 TWh at the same time. In fact, EDF has seen its net exports decline regularly for five years while progressively increasing its imports.

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The surplus capacity of the French nuclear park was illustrated again in 1999 with EDF's load factor of 72%, compared with 80% in Japan, 82% in Germany, and even 84% in the United States. The four N4 reactors, which account for almost 10% of the total installed capacity but have produced very little so far, are not even included in this load factor. Among the four reactors (Chooz-B1 and B2, ordered in 1984, Civaux-1 and -2 respectively ordered in 1991 and 1993), only the first one has fulfilled the conditions (like a minimum of continued operation) for "commercial operation" status (mise en service industrielle, MSI), in May 2000. Their average load factor was less than 40% in 1999, according to the *Élecnucl* database of CEA. However, the two last units have been used by EDF to bring two nice Christmas gifts to the General Council of the Vienne Department: in the whole 1997 year, Civaux-1 has been connected to the national grid for only a few hours, on the 24th of December, and the same happened with Civaux-2 in 1999. In each case, that was enough for EDF to pay the professional tax exactly as if the reactor had been fully operational all the year long. In each case, it was months before the reactor would be connected again.

Reprocessing: Managing the End of the Contracts

The reprocessing of irradiated fuels at La Hague makes France the world's largest producer of "civilian" plutonium, with 1,562 tons reprocessed in 1999 for a cumulative total on December 31, 1999 of 15,098 tons of light water reactor fuel, which represents around 130 tons of plutonium separated since the beginning of light water fuel processing in 1976.

The distribution of reprocessed fuels among COGEMA's customers continues its slow progress in favor of EDF, as the La Hague plants approach the completion of their foreign contracts. In 1999, the share of foreign fuels still amounted to 56% of the total light water fuel reprocessed in La Hague since the beginning of operation, and 46.5% of the total reprocessed that year (see the following table).

Status of contracts for reprocessing light water reactor fuels at La Hague

(in metric tons of heavy metal, as of 31 December 1999)

Client	Quantities under contract	Total reprocessed quantities as of the end of 1999	Quantities reprocessed during the year 1999
EDF	8,156	6,645	848.5
Germany	5,779*	4,127	305
Belgium	603	592	0
Japan	2,925	2,944	302
Netherlands	390*	226	0
Switzerland	649	562	106.5
TOTAL	18,399	15,098	1,562

* includes so-called post-2000 contracts, or 1,024 tons for Germany (according to GNS, less than the figure given by some German utilities), 165 t. for the Netherlands.

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Source: COGEMA, GNS

However, the La Hague plant may see the end of its foreign fuels reprocessing in 2002 if there is no new contract to support the French plutonium industry. In fact, the reprocessing of foreign fuels could end in 2001 if Germany, as a result of the agreement to halt reprocessing, signed June 15, 2000, between the Government and the electricity companies, canceled part of its so-called "post-2000" contracts. At present, by themselves, they constitute the major part of the foreign activity of COGEMA as of 2001. A recent Australian contract changes nothing. It is for 1,300 research reactor fuel assemblies (MTR, Material Testing Reactor), but it involves only 3.8 tons, a negligible quantity compared to the 1,600 tons per year processed on average each year for the last five years. Information about possible supplementary contracts with Japanese utilities is still to be confirmed, and in any case, they involve only a quantity of about 600 tons spread out over several years. Nor does EDF itself foresee any increase in the amounts reprocessed after 2001 when its present contract ends.

The request by COGEMA to increase the capacity of the UP2-800 and UP3 plants to 1,000 tons/year, without, however, increasing the authorized cumulative throughput of 1,700 tons/year, which was up for public inquiry earlier in 2000 (see hereunder), seems all the more strange in view of the limited existing and potential further contracts.

In reality, COGEMA is preparing for the closing of one of its plants at La Hague. It is banking on the hypothesis that EDF will be obligated by the Government to maintain reprocessing at the level of some 850 tons/year. The 150 tons of supplementary capacity per plant would allow it to meet the few foreign contracts remaining for a few more years.

Public Inquiries at La Hague: License Guaranteed

The public inquiries opened at La Hague on 2 February and closed on 17 May 2000, dealt with five separate requests, three of which were from COGEMA and two from ANDRA.

For COGEMA (according to the terms of the request for modification of its authorizing decrees) requested:

- "increase of annual reprocessing capacity for each of the UP3-A and UP2-800 plants to 1,000 tonnes. The industrial optimization of the installations will lead to a distribution of annual production of a maximum of 1,700 tonnes to one or other of the installations while respecting the maximum capacity of 1,000 tonnes per installation";

- increase the storage capacity of pools C, D and E by around 30% (3,590 tonnes to 4,800 tonnes for C, 3,490 tonnes to 4,600 tonnes for D, and 4,910 tonnes to 6,200 tonnes for E), increasing the total storage capacity from 13,990 tonnes to 17,600 tonnes;

- "increase in burnup rate and initial enrichment of spent fuels authorized at present".

Furthermore, the request stipulates that, regarding the adaptation of the types of fuels and material to be reprocessed in UP3-A and UP2-800, "each significantly different type will, at the appropriate moment, be the subject of a special safety file and of a request for authorization to be submitted to the relevant authorities and ministries, especially the ministers responsible for environment and for industry". This wording is aimed specifically at contracts for reprocessing of fuel from research reactors as of the Australian type.

For ANDRA:

- To go to an active phase of monitoring of the Centre de Stockage de la Manche (CSM - final surface repository for short lived radioactive waste in northern France), planned for 50 to 100 years. This means setting up surveillance of packages and making regular measurements (even if only every 5 or 10 years) of releases of radionuclides (in other words leaks) and the condition of the covering structure (already showing signs of early fatigue).

- Renewal of authorization for emissions from the CSM, benefiting, in particular, from the opportunity to make official the practice of discharge of rain water (assumed not to have been in contact with the packages) into the Sainte Hélène river which receives the run-off water from La Hague. Infiltrating water is already drained to the COGEMA effluent treatment station before being discharged to the sea via the COGEMA-La Hague facility's sea discharge pipe.

After these public inquiries, the Inquiry Commission submitted the report containing its conclusions to the Prefect of the La Manche region, on 26 June 2000. The Prefect then communicated the report to the nuclear safety authority. Findings were favorable to all of the requests, sometimes accompanied by reservations and recommendations.

For ANDRA, moving to the monitoring phase requires that, "the very active monitoring phase be extended to 10 years" and, "study of the possibility of carrying out spot checks under the structures carried out by the operator in order to make measurements of radioactivity as close as possible to structures that could be cause for concern" and that, "means for inspection, cleaning and repair of drains be examined by the operator". The Commission also recommended that authorizations be limited to 10 years, that they should then be the subject of study and public inquiry, and that they be accompanied by a certain number of safety studies (discharges, seismic conditions, etc), and surveys.

For COGEMA, the modifications of the La Hague facilities are to be authorized under the condition that they do not cause "notable or long-term increase in actual impacts and emissions (radioactive and chemical) to the environment" and that reprocessing of new types of fuels and materials be limited "to elements that do not lead to exceeding of a "technological threshold" likely to affect either the safety of the installation or increase impact on the environment and health". It is also recommended that authorizations on emissions be revised

downwards periodically on the basis of actual emissions, that the major radionuclides be subject to individual limits and that the inventory of chemicals stored and used at the establishment be updated with regard to their toxicity and prevention of chemical risk.

The public inquiries at La Hague were neither very democratic and nor very public. Obtaining the public inquiry dossiers was subject to draconian conditions:

- a charge of 5,370 Francs (about \$US 750) in two checks, one made out to COGEMA for 3,222 Francs, the other to ANDRA for 2,148 Francs;

- a copy of the Official Journal indicating that the requesting party is an association registered with the Ministry of the Environment;

- and finally, a wait of two to three weeks which became more than a month even for the associations represented on the La Hague Commission spéciale et permanente d'information (CSPI - special permanent information commission) which had refused to pay.

No debate took place on three studies made for Greenpeace on this subject — the only technical elements added to the file by experts independent of industry or of the State, and handed to the French government and to the OSPAR Commission — did not, apparently, provoke any debate among the inquiry commissioners. Yet these studies address the question of the impacts of radioactive releases on health and on the environment, the risks of serious accident and alternatives to reprocessing in management of spent fuels. They concluded, in turn:

- "that each of the changes [requested by COGEMA] could significantly increase La Hague's hazard potential" whereas to date, "COGEMA has not presented any analysis of the hazard implications of the proposed changes";¹

- that the "US system for dry storage systems for PWR fuel is estimated to be 8 to 20 times less expensive per tonne than reprocessing", i.e. US\$ 35,000 to US\$ 68,000 per ton for dry storage against US\$ 540,000 to US\$ 720,000 per ton for reprocessed fuel;²

- and finally, that "estimates of collective doses show that there have been significant increases throughout the 1990s", e.g. for 14C going from 868 man sieverts (man Sv) in 1991 (for total emissions of 6.2 TBq) to 4,108 man Sv (for 28.93 TBq) in 1999. Emission authorizations for Sellafield (UK) correspond to 4,100 man Sv.³

¹ Dr Gordon Thompson, "Hazard potential of the La Hague site: an initial review", IRSS, May 2000

² Dr Ian Fairlie, "Dry storage of spent nuclear fuel: the safer alternative to reprocessing", May 2000

³ Dr David J. Sumner, "Radioactive discharges from La Hague", May 2000

The "Reprocessing-recycling" Option is a Clearly Uneconomic Choice

The current lobbying is fierce. It cannot be in the interest of EDF to continue the reprocessing and use of MOX, two very costly activities, at a time when this nationalized company must, for the first time, face the tough competition of other European utilities. It now seems difficult to lower the price of the kWh by 30%, as announced by EDF's CEO, and to prolong a particularly costly industrial activity for the sole purpose of maintaining employment at COGEMA. Clearly, the government is being called upon here in its role as arbiter. Much on this subject was expected of the mission that Lionel Jospin assigned to three personalities, to re-evaluate the cost of the nuclear kWh and of the end of the fuel chain in particular.

The conclusion of the Charpin-Dessus-Pellat mission report is clear: Reprocessing and use of the plutonium extracted is considerably more expensive and causes additional problems when compared with temporary then final storage of non-reprocessed irradiated uranium fuels:

"In conclusion, it can be estimated that pursuing the French strategy of reprocessing-recycling, if fully implemented in the existing nuclear power plants (28 units using MOX) and under optimum operating conditions at La Hague (regarding its workload) would provide, over the life of the currently operating nuclear reactors, considered in isolation, and in relation to stopping of reprocessing in 2010:

- a saving in natural uranium of around 15%;
- a reduction in the quantities of plutonium and americium to be stored of around 12 to 15%, depending on the life of the currently operating nuclear power plants.

These reductions would be possible at a total additional cost of 1% (28 to 39 billion Francs) and an extension of storage time for some waste: irradiated MOX, in particular, would have to be stored until 2150-2200 before going into final storage."

The verdict is clear and leaves no room for appeal: *"In other words, from the point of view of the electricity company, this strategy represents an increase in the cost of kWh, which is a barrier to competitiveness, something that is increasingly difficult to bear in a market opening up to competition."*

And the balance is even less favorable for a less optimistic life span than the 45 years used above, if La Hague does not operate as planned and if the additional costs of "reprocessing-recycling" from the start of the strategy until 2010 are included. The cost is then estimated at 164 billion Francs — 6% of the total.

In an internal note, EDF says, *"this is the first time we have seen such an advanced study on the economics of the fuel cycle in a public document"* and that the results are *"in line with current EDF thinking"*, especially that *"the reprocessing/recycling option reveals to be extremely expensive"*.

"The Storage in France of Imported Radioactive Wastes is Forbidden..." So What?

If the distribution of fuels reprocessed in the past tilts in favor of foreign customers, the same is true of the quantity of wastes from reprocessing, and stored or disposed of on the national territory. Indeed, the question of the return of foreign wastes remains current, since the status quo is continuing. The balance sheet may be quickly drawn up:

- five shipments of vitrified wastes to **Japan** —one in 1995, 1997, 1998, and two in 1999— or 272 canisters of vitrified wastes in 5 TN 28 VT type containers and 7 TN 20 VT type containers (manufactured by Transnucléaire, a subsidiary of COGEMA, containing 28 and 20 canisters of vitrified wastes respectively), corresponding to the reprocessing of around 360 tons of spent fuel (or one eighth of what has been processed);

- two shipments of vitrified wastes to **Germany**⁴, one TN 28 VT in 1996, and two Castor 220/28 (a German-designed transport container analogous to the French TN 28 VT) in 1997, corresponding to the reprocessing of around 110 tons of spent fuels (or less than 3% of what was processed);

- two shipments of vitrified wastes to the Belgoprocess site in Dessel, **Belgium**⁵, on 5 April and 17 November 2000, or two TN 28 VT corresponding to the reprocessing of 72 tons of spent fuel or 12% of what was reprocessed (see also the box on that issue: "Conflict over the return of vitrified waste to Belgium").

Compared to the 8,451 tons of foreign fuels reprocessed up to 31 December 1999, the returns of wastes are late and infrequent. Not only does COGEMA not respect article 3 of the law of 30 December 1991, which stipulates that *"the storage of imported radioactive wastes (...) is forbidden beyond technical delays necessitated by reprocessing"*, but it has also chosen the option of the "curie-swap", which consists of managing the return of foreign waste in terms of activity and not of volume, which is also against the law, insofar as wastes that are clearly identifiable as physically imported would remain on French soil. Therefore, COGEMA may be considered to have been in an illegal situation for years, since the first foreign contracts were signed at the beginning of the 70s, and only a small fraction of highly active waste has been returned, not to mention wastes of medium or low activity that compose the largest portion of the volume and of which not a single gram has been returned.

There is still no solution to the situation of the shipments to Germany, since the scandal of the contaminated shipments, revealed by **WISE-Paris** in April, 1998. Although the German government, in January 2000, gave a green light on principal to the resumption of cer-

⁴ It appears that a shipment of conditioned hulls and nozzles, that is so-called intermediate level waste, was planned for Germany and a shipment of cemented technological wastes for Belgium, both in 1994 or 1995, according to the list of authorized shipments established by the "Second Commission on the application in the Member States of Directive 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community", Council of European Union, 11.01.1999

⁵ Idem

CONFLICT OVER THE RETURN OF VITRIFIED WASTE TO BELGIUM

The first return of vitrified waste to Belgium was carried out on 4 April 2000. However, the question of quality control of the waste packages is causing a stir between the nuclear establishment and the Belgian government. It is the State Secretary of Energy, Olivier Deleuze, who asked to review the acceptance procedures for wastes by the Belgian State and therefore the rules applied to quality control. The Belgian government followed its minister and declared on 3 March 2000, even before the arrival of the first package, that *"this reception does not commit the government to the reception of the following packages."* The decision of the Council of Ministers defines the ensuing reception criteria for wastes:

"The government will organize the control of these wastes in two ways:

- *Verification of the conformity of the package to be received with the acceptance criteria established by ONDRAF [the national radioactive waste management agency] (non-destructive analysis);*
- *A physical check to determine the life expectancy of the various components used (quality of the vitrification, cooling period, neutron dose during the evacuation phase)—(destructive analysis on a sample);*

Only at the outcome of these inspections will the reception of the subsequent packages be anticipated."

Applying the governmental decision, Olivier Deleuze, on 6 July 2000, wrote to ONDRAF, the national organism for the management of radioactive wastes, asking it not to approve a second shipment for the time being. At first, this led ONDRAF to correctly inform Synatom of this by a letter of 7 September 2000 (Synatom has been given responsibility by the Belgian electric companies for the execution of reprocessing contracts with COGEMA). Meanwhile, research bodies were asked to work on the development of a new quality control procedure. But on 12 October 2000, in a spectacular turn of events, the State Secretary of Energy announces in a press release (<http://www.wise-paris.org/introournews.html>) that *"it now seems that ONDRAF wishes in spite of everything to authorize this shipment, thus opposing the controls decided by the government and thus reinforcing Belgian society's distrust of the nuclear lobby and its lack of openness"*. And in stunning terms, Olivier Deleuze *"notes that the development of the radioactive waste control program is systematically sabotaged by the nuclear lobby that perceives it as unacceptable interference in its private hunting grounds"*. The Belgian Council of Ministers has finally decided on 10 November 2000 to accept the reception of *"two additional shipments of vitrified waste until April 2001"* under the condition that *"active samples corresponding to the conditioning mode of Belgian waste (vitrified waste) will be delivered before the end of 2000 in order to proceed to additional destructive controls in application of its decision of 3 March 2000"*. Indeed, the second shipment has arrived at Belgoproces on 17 November 2000. The officials of other governments responsible for surveillance of repatriated waste from COGEMA are attentively following the conflict in Belgium...

tain shipments within six months, it was clear that in fact no shipment could occur before the end of Expo 2000, the world fair that took place between June and October 2000 in the city of Hanover. Given the security needs for the two events—the latest shipment of waste to the site of Gorleben in Lower Saxony necessitated the deployment of around 30,000 police personnel in all of Germany—it is obvious that the earliest possible date was November 2000. In fact, another problem has been added, which is the reconstruction of a rail bridge over the Jeetzel River, indispensable for the passage of casks weighing over 100 tons each. An alternative route by highway has been rejected for reasons of security. It goes through forests considered to be the favorite action terrain for opponents. An early return of German waste is not foreseeable before spring 2001.

An analysis carried out in October 2000 by the GNS company, which manages reprocessing contracts for German nuclear operators, reveals the current schedule for the return of wastes:

- 124 casks with highly radioactive waste to be sent from La Hague to Gorleben in Germany at the rate of 12 (or 2 shipments of 6 casks each) per year between 2001 and 2010 and 4 in 2011;

- 305 casks containing compacted wastes of medium activity to the intermediate disposal site of Ahaus at the rate of 24 casks per year (raised progressively from 6 to 24 between 2008 and 2012) until 2022.

The GNS accounting contains nothing about the other types of wastes generated to the present time, that is the cemented and bituminous wastes of medium activity as well as cemented so-called low activity wastes visibly destined for permanent—and illegal—disposal in France. In fact, until 1989, all of the so-called low activity wastes from reprocessing at La Hague were buried in the final repository Centre de Stockage de la Manche (CSM).

The French government finds itself in a delicate situation: on the one hand, it must enforce the law; on the other, it supports the commercial interests of COGEMA. The legally private company with a majority of public capital is accused of *"putting the lives of others in danger"*, in particular by the storage of foreign waste, in the framework of a complaint made by the Green regional counselor Didier Anger and the local association CRILAN in 1997. Although the first suit was brought in 1994, it was the second appeal to the legal system that led to an examination of COGEMA and a much tougher investigation, including the seizure of documents at COGEMA headquarters in September 1999. The present position of Lionel Jospin's government is that it is desirable for Germany first to resume accepting shipments of waste from La Hague before resuming shipments of irradiated fuels in the other direction. This position reflects the mounting pressure in the legal case in process. It does not really put the German utilities in trouble in the short term. Their capacities for disposing of irradiated fuel are still sufficient. And supplementary capacities are under construction or in the advanced

Superphenix's Setbacks Continue...

Despite the disastrous trajectory of Superphenix, the fast reactors option continues to fascinate certain nostalgic characters who do not hesitate to talk about "the path of fast neutrons and its promises", or of "Superphenix: a symbol". Let us recall that Superphenix, according to the "Cour des Comptes" [Government Accounting Office] will have cost 60 billion francs when EDF (which replaced the European consortium NERSA, dissolved 6 October 2000, in its long term obligations) finishes paying interest at the end of 2000. The plant continues to cost 800 million francs per year, including the expense of heating sodium in order to keep it in a liquid form. It will also be necessary to spend at least 17 billion francs to pump some 5,500 tons of highly flammable sodium, to unload the 650 core assemblies (which will no doubt take longer than the 18 months initially forecasted), and finally to tear down the installation. Begun on 1 December 1999, the unloading in mid-October 2000 concerned the 67th assembly. Unloading had been suspended for two months, pending a permit to continue, required because the amounts of residual sodium on the assemblies were greater than foreseen.

In these conditions, how can one justify the investment of 600 million francs for "re-conditioning" of the predecessor Phenix whereas, since 29 May 1998, the plant has been subject to three requests introduced by the Forum Plutonium for cancellation of its restart permit? These requests are based principally on insufficient safety criteria; on 13 November 1998, Phenix was prematurely stopped following a sodium leak that passed the second confinement barrier...The affair awaits judgment by the Administrative Court of Appeal in Paris to which it was referred more than two years ago.

planning stage on the reactor sites. But the German government position is not transferable to other countries insofar as the near totality of fuel under contract has already been delivered to La Hague, or even is already processed.

Plutonium Stocks Still growing

The quantities of separated plutonium stored on French territory continue to increase, although more slowly, reaching 75.9 tons on 31 December 1998 (up 5% compared to 1997), the last figure published by the government, of which 40.3 tons (up by 1.6 tons) is French plutonium and 35.6 tons (up by 2 tons) belong to foreign clients. France has not made any new declaration to date. According to the estimate by **WISE-Paris**, the stocks have continued to increase during 1999 to

reach some 41.1 tons for French plutonium and some 37 tons for foreign plutonium. With 20 nuclear reactors authorized to load MOX fuel, and already loaded (some of which alternate with UOX fuel), the principle of "equality of flow" vaunted by nuclear organisms is far from being realized.

The Production of MOX

With the addition of a production line of about 50 tons/year at MELOX, intended to produce MOX for boiling water reactors—necessarily for foreign, primary Japanese clients, since EDF uses only pressurized water reactors—the plant theoretically now possesses a total annual capacity of 165 tons of oxides (COGEMA even indicates a technical capacity of 250 tons/year), but remains limited to an authorized annual production of 115 tons of oxides (around 100 tons of heavy metal), which was reached in 1998. This limitation of annual production has allowed the new Marcoule line, the construction of which was complete even before publication of its permit on 30 July 1999, to avoid having to get around problems and opposition that a new public inquiry (certainly necessary in the case of a production rate increase) could have aroused. It is to be noted that this "true-false" capacity increase was approved by the Minister of the Environment, Dominique Voynet, in July 1999, even though two years earlier she had declared⁶: "I would sign no decree for the extension of the plant in order to produce and export more", which, moreover, corresponded to one of the main points of the common Greens-Socialist political text of March 1997. If it is true that the plant does not produce more, it does indeed manufacture fuel for export.

While EDF is obliged to alternate between MOX and UOX—and to pile up tons of supplementary plutonium—for lack of plutonium fuel, COGEMA chooses to turn to foreign customers. In this context, how can the famous "equality of flow" targeted by the MOX program be realized? In fact, each ton produced at MELOX for Japan or at Cadarache for Germany (whose closing DSIN had demanded, moreover, "soon after 2000") is a ton less produced for EDF—and everyone is satisfied. For EDF is not at all favorable to MOX on principle. Each ton of MOX avoided is a net financial saving for the company obliged to seek savings where it can. Furthermore, Germany and Japan have little, or even no more, capacity for disposal of plutonium or for MOX production.

Scraps From the Manufacture of MOX

In 1999, about 8% of MELOX' production consisted of scraps, at least a part of which is sent to La Hague. However, the MOX production plant has a recovery workshop for scraps allowing "recycling" by re-dissolving the defective pellets (MIMAS process, Micronized Master-blend). It is interesting to note that the other MOX production plant in France, Cadarache, with a declared capacity of 35 tHM/year (completely surpassed in 1999 with a production of 45.6 tons of oxides, or

⁶ Dominique Voynet, *Politix*, 18 September 1997.

40.2 tHM), also has a rejection rate of about 8%. A plant of the CEA, operated since 1991 by COGEMA, the ATPu has been almost entirely devoted since that year to contracts made with German utilities. In fact, as of 31 December 1999, according to the utility PreussenElektra, 262.6 tons of heavy metal were still to be delivered to German companies⁷, or 300 tons of oxide, which corresponds to about seven years of production at a rate of 40 tons of heavy metal (or 45 tons of oxide) per year.

Since the beginning, production of plutonium fuel in France has had its share of incidents. Particularly notable is the one classified level 2 on the INES scale, which occurred 28 July 1997, and which concerned the exceeding of the authorized mass of fissile material in a storage cell of the Laboratory for the experimental study and manufacture of advanced nuclear fuels (LEFCA), following a failure of the system for managing fissile materials. In fact, 170 grams of plutonium were found after analysis, in a batch supposed to contain only natural uranium. One should note that the mission of LEFCA is to manipulate plutonium in order to find applications for it in nuclear reactors, and that since 1996, the laboratory has undertaken the recovery and the reconditioning of nuclear materials from manufacturing residues. If it is possible to lose track of tens of grams of plutonium in a laboratory handling only small quantities of fuel, what about the MELOX manufacturing lines, which in 1999 handled 115 tons of MOX (0.6 tons more than in 1998), or close to 8.2 tons (up by 1.6 tons) of plutonium? The average content of plutonium in MOX is increasing, for, since February 1999, EDF is authorized to load MOX with 7.08% of plutonium compared to 5.3% before.

Conclusion

France has entered a process of isolation on the question of plutonium, choosing a path, MOX, that is increasingly discredited. Direct disposal of spent fuels is the method favored by most nuclear operators in the world, including the present customers of COGEMA. It is unlikely, indeed impossible, that significant foreign contracts will be signed after the fulfillment of those in process:

- Belgium has officially excluded reprocessing in the future.
- The Netherlands will have no reactor in operation as of 2004.
- The German government has announced the end of shipments to reprocessing plants for 2005 at the latest.
- The Swiss government anticipates the prohibition of reprocessing.
- The Japanese utilities are the only ones to have let it be known that they would sign a new contract in the spring of 2001. But even if the contract is concluded, the quantity would be limited to 600 tons total, or the equivalent of four and one-half months of work for La Hague.

In these conditions, the pressure on EDF and on the government is increasing. Contrary to some nuclear construction companies such as Framatome only half of whose business is now in nuclear, COGEMA has not (yet) developed a diversification strategy, even at least within the nuclear sector. Today, EDF and the French state are called to save COGEMA. But at what price?

Economically unfavorable compared with uranium oxide fuel, problematical in terms of safety and proliferation, plutonium has seen its value revised downward for some years, reaching zero or negative levels even in EDF's accounting. In an internal document at the end of August 2000, EDF's assessment is quite clear: "The reprocessing/recycling option reveals to be extremely costly". What a revelation.

UP1 Begins its Costly Deconstruction

With a total estimate by the Cour des Comptes (Accounting Court) of 37 to 40 billion francs (20 billion for the reconditioning of wastes and 17 to 20 billion for the actual dismantling), the Marcoule plant will, over the next 30 years, and after 40 years of operation, be the object of the first dismantling in France of a reprocessing plant. Let us recall that the plant, put on line in 1958, has been used in succession (and in parallel) for military applications and then for the reprocessing of civilian UNGG fuels (Natural Uranium Graphite Gas), and that its final shut-down was announced at the beginning of 1998, after the reprocessing of over 18,200 tons of nuclear fuel from the CEA (for the Ministry of Defense), from EDF, and from other customers of COGEMA. The Codem GIE (Groupement d'Intérêt Économique), created in July 1996 under the triangular aegis of the CEA (45%), of EDF (45%) and of COGEMA (10%) is responsible for controlling and financing the three phases: Mise à l'Arrêt Définitif (MAD) [Permanent Shut-down], Reprise et Conditionnement des Déchets (RCD) [Reconditioning of Wastes], and Démantèlement des installations jusqu'au niveau 2 (DEM) [Dismantling to Level 2]. Provisions made by EDF and COGEMA for the dismantling operations of UP1 went up from 4.6 billion francs in 1992 to 16.7 billion francs in 1997.

⁷ Plutonium Workshop, 13-14 January 2000, Jülich, Germany



Who's Who ? In France

STATE and INDUSTRY

Ministry of the Environment and of Spatial Planning - MATE (Ministère de l'Aménagement du territoire et de l'Environnement)

The Environment Minister, along with the Secretary of State for Industry, is responsible for verifying the safety of nuclear installations and the transportation of radioactive materials.

Roland Lagarde, Energy adviser to Dominique Voynet
20, av. de Ségur, F-75302 Paris 07 SP
TEL: +33 (0)1 42 19 10 28 - FAX: +33 (0)1 42 19 11 97
e-mail: roland.lagarde@environnement.gouv.fr
<http://www.environnement.gouv.fr>

State Secretariat for Industry - Secrétariat d'État à l'Industrie - DGEMP (Direction générale de l'énergie et des matières premières) - Service des Affaires Nucléaires

The mission of the nuclear department is to elaborate and implement government decisions concerning the nuclear industry. It also supervises the Commissariat à l'Énergie Atomique (CEA), COGEMA and ANDRA.

Philippe Kahn, Director
Secrétariat d'État à l'Industrie, 61, bd. Vincent Auriol, F-75703 Paris 13
TEL: +33 (0)1 44 97 02 43 - FAX: +33 (0)1 44 97 09 30
e-mail: philippe.kahn@industrie.gouv.fr
<http://www.industrie.gouv.fr/energie>

DSIN (Direction de la sûreté des installations nucléaires)

The DSIN is the French nuclear installations safety authority. It defines general safety objectives in the nuclear domain. It is also responsible for verifying that the operator implements the necessary measures in order to attain these objectives. In particular, it delivers operating licenses to the various different nuclear facilities. It is responsible both to the Ministry of Industry and the Ministry of the Environment. The DINs (Divisions des Installations Nucléaires) are in charge of verifying safety on the French territory on a day-to-day basis.

Cathia Mascarau, PR Department
99, rue de Grenelle, F-75353 Paris Cedex 07
TEL: +33 (0)1 43 19 39 61 - FAX: +33 (0)1 43 19 39 24
e-mail: cathia.mascarau@industrie.gouv.fr
<http://www.asn.gouv.fr>

DRIRE (Directions Régionales de l'Industrie, de la Recherche et de l'Environnement)

The DINs (Divisions des Installations Nucléaires) at the DRIRE are in charge of verifying safety on French territory on a day-to-day basis. They report to the DSIN and also play a role in monitoring the transportation of radioactive materials by conducting inspections and organize technical meetings.

<http://www.drire.gouv.fr/>

IPSN (Institut de Protection et de Sûreté Nucléaire)

The IPSN is the technical arm of the DSIN. It conducts research in all disciplines necessary for risk control in nuclear installations. Its domain of activity also includes assessing the safety of the methods used to transport radioactive materials and real-time monitoring of sensitive transports.

Emmanuelle Gailliez, PR Department
BP 6, F-92285 Fontenay-Aux-Roses Cedex
TEL: +33 (0)1 46 54 91 27 - FAX: +33 (0)1 46 54 84 51
e-mail: emmanuelle.gailliez@ipsn.fr
<http://www.ipsn.fr>

ANDRA (Agence nationale pour la gestion des déchets radioactifs)

Created in 1979, ANDRA is a state authority that is responsible for managing the radioactive waste produced in France. Its job is to verify the quality of the waste, design, locate, build and manage storage centres. It manages the Centre de Stockage de la Manche (CSM), saturated since 1994, and the Centre de Stockage de l'Aube (CSA), which has taken over from the CSM. A decree issued on 3 August, 1999 authorized ANDRA to set up and operate an underground laboratory at Bure (in the Meuse Department) for the purpose of studying the possibilities of storing radioactive waste in deep geological formations. Each year an inventory is published listing and locating "all" radioactive waste present on French territory. ANDRA's annual budget of about one billion francs is financed by the waste producers in proportion to the quantity of waste produced, and not by the State. Thus, in 1998, 56% of the turnover of the Agence (614 MF in 1998) came from EDF, 20% from COGEMA, 16% from the CEA and the rest from small-to-average sized producers of radioactive waste (hospitals, research centres, etc.).

Thomas Busuttil, Director PR Department
Parc de la Croix Blanche, 1-7, rue Jean Monnet, F-92298 Châtenay-Malabry Cedex
TEL: +33 (0)1 46 11 82 94 - FAX: +33 (0)1 46 11 81 00
e-mail: thomas.busuttil@andra.fr
<http://www.andra.fr>

CSM (Centre de Stockage de la Manche)

With a capacity of 530 000 m³, the CSM was the first final repository for low-to-medium level nuclear waste. Opened in 1969 and operated by ANDRA since it came into existence in 1979, it received its last delivery of radioactive waste on 30 June, 1994. Following the public inquiry at La Hague this year, the CSM is due to enter a phase of "active surveillance".

Place de la Préfecture, F-50009 Saint Lo Cedex
Mr Degenne, Director PR Department
BP 807, F-50448 Beaumont Cedex
TEL: +33 (0)2 33 01 69 00 - FAX: +33 (0)2 33 52 74 34

CSA (Centre de Stockage de l'Aube)

Taking over from the CSM, the CSA repository went into operation on 13 January, 1992. With a capacity of 1 000 000 m³ it will receive short-life radioactive waste produced in France over a period up to sixty years. The CSA is operated by ANDRA and represents a total investment of 1,400 million francs, including studies. 100 000 m³ of waste are already stored there.

Christophe Neugnot, Director PR Department (CSA/ ANDRA)

BP 7, F-10200 Soulaines-Dhuys

TEL: +33 (0)3 25 92 33 04 - FAX: +33 (0)3 25 92 33 83

e-mail: christophe.neugnot@andra.fr

CEA (Commissariat à l'Énergie Atomique)

Created in 1945, the CEA is a State research and development organisation in the domain of nuclear weapons and energy. It operates under the authority of the Ministry for Research, the Ministry for Defense and the Ministry for the Economy, Finance and Industry. In 1999 it had a budget of 18.6 billion francs, 40% of which was devoted to defense programmes. The CEA operates research centres, including those at Cadarache and Marcoule in the south of France.

Jean-Louis Chambon, Director PR Department

31/33, rue de la Fédération, F-75752 Paris Cedex 15

TEL +33 (0)1 40 56 24 97 - FAX: +33 (0)1 40 56 29 70

e-mail: dcom@aramis.cea.fr

<http://www.cea.fr>

OPRI (Office de protection contre les rayonnements ionisants)

Created in 1994, the OPRI (formerly the SCPRI) is a State authority that operates within the Ministry for Employment and Solidarity under the authority of the DRT (Direction des Relations du Travail) and the DGS (Direction Générale de la Santé). Its role is to protect the population, occupationally exposed people and the environment from dangers arising from ionizing radiation. To do so, OPRI maintains a permanent monitoring system, intervenes in the event of incidents and verifies that rules and regulations are respected in the domain of radiation protection. This surveillance also covers radioactive effluents.

Marianne Durand, Director PR Department

31, rue de l'Ecluse, F-78110 Le Vésinet

TEL: +33 (0)1 30 15 52 67 - FAX: +33 (0)1 39 76 08 96

e-mail: marianne.durand@opri.fr

<http://www.opri.fr/>

OPECST (Office parlementaire d'évaluation des choix scientifiques et technologiques)

Consisting of 8 deputies and 8 senators, as well as their substitutes, the OPECST was created on 8 July 1983 to "inform the Parliament of the consequences of scientific and technological choices in order, particularly, to enable them to make enlightened decisions". To this end, the Office organizes study programmes and conducts assessments.

Marie-Bénédicte De Maigret, Director PR Department Assemblée Nationale, 233, boulevard Saint-Germain, F-75355 Paris Cedex 07 SP

TEL: +33 (0)1 40 63 88 06 - FAX: +33 (0)1 40 63 88 08

e-mail: mbdemaigret@assemblee-nationale.fr

<http://www.senat.fr/opecest/>

CSSIN (Conseil supérieur de la sûreté et de l'information nucléaires)

Created on 2 March 1987, the CSSIN is a consultative council that makes recommendations to the ministers for the environment and industry concerning all questions relating to nuclear safety and informing the public and the media. It consists of personalities from different backgrounds: members of parliament, scientists, journalists, representatives from trade unions, associations and operators, as well as those actively involved in the administration of nuclear industries. In 1999 a work group was constituted around the application of the INES (International Nuclear Event Scale) scale to the transportation of radioactive materials. The DSIN keeps it informed of the actions conducted by the safety authority and also acts as a secretariat.

Jacques Ibert, General Secretary

DSIN, 98, rue de Grenelle, F-75353 Paris 07

TEL: +33 (0)1 43 19 39 40 - FAX: +33 (0)1 43 19 23 32

e-mail: jacques.ibert@industrie.gouv.fr

<http://www.asn.gouv.fr/cssin>

CLI (Commission locale d'information)

Created in 1981, the CLIs have a twofold mission: to inform the public and to monitor the impact of major energy installations. They are set up by the Department's General Council and consist of elected representatives (mayors, departmental councillors, members of parliament), trade union organisations, associations and academics. The Presidents of the CLIs meet once a year on the national level.

(For site by site contact addresses, visit:

<http://www.asn.gouv.fr/cli>)

(CSPI) The Commission spéciale et permanente d'information for La Hague

The CSPI is the CLI for La Hague. This independent and pluralistic commission was created in 1981 by decision of the Minister for Industry. Bernard Cazeneuve, MP for la Manche and mayor of Octeville, presides over it. It consists of 18 elected representatives, 6 association representatives, 6 trade union representatives and 6 scientists. Its mission is to collect information relative to the operation of the COGEMA reprocessing plant at La Hague as well as data concerning any possible effects the plant may have on the environment and the health of the public and to inform the local population and all interested parties of its work. It publishes a newsletter that is distributed to the inhabitants of the Nord-Cotentin region.

Bernard Cazeneuve, President

27, rue François La Vielle, F-50100 Cherbourg

TEL: +33 (0)2 33 87 22 00 - FAX: +33 (0)2 33 87 22 01

Albert Collignon, Scientific advisor

Secrétariat, Centre d'Affaires atlantiques,

27, rue Dom Pedro, F-50100 Cherbourg

TEL: +33 (0)2 33 23 46 00 - FAX: +33 (0)2 33 23 46 09

e-mail: cspi@wanadoo.fr

<http://www.asn.gouv.fr/cli/regions/Caen/lahague.asp>

CLI (Commission locale d'information) de Cadarache

The Cadarache CLI consists of about 80 people: prefects, elected representatives, personnel from the Cadarache plant, associations, etc. A semestrial bulletin financed by the Nuclear Safety Authority provides general information

on nuclear questions and deals more specifically with events relating to the Cadarache site.

Alexandre Medvedowsky, President
Conseil Général des Bouches-du-Rhône, Hôtel du département, 52, avenue Saint-Just,
F-13256 Marseille Cedex
TEL: +33 (0)4 91 21 12 27 - FAX: +33 (0)4 91 21 16 65
Jean-Pierre Cocagne, Secretary
Maison de la Nature et de l'Environnement
Place Jeanne d'Arc, la Rotonde,
F-13 100 Aix-en-Provence
TEL: +33 (0)4 42 93 15 80 - FAX: +33 (0)4 42 93 15 89

EDF (Electricité de France) - Fuel Division

EDF is the national electricity utility. EDF now operates 58 light-water reactors in France. In 1999 the group had a turnover of 210 billion francs (32 billion euros), more than 18% of which came from outside France.

Fuel Division, Secretariat
1, place Pleyel, F-93282 Saint Denis Cedex
TEL: +33 (0)1 43 69 29 58 - FAX: +33 (0)1 43 69 21 31
Christine Collaert, Director PR Department
EDF, 2, rue Louis-Murat, F-75384 Paris Cedex 08
TEL: +33 (0)1 40 42 46 37 - FAX: +33 (0)1 40 42 12 74
e-mail: christine.collaert@edf.fr
http://www.edf.fr

COGEMA - Etablissement de La Hague

The COGEMA plant at La Hague, situated 25 kilometers west of Cherbourg, went into operation in 1966. It reprocesses irradiated nuclear fuel coming from EDF reactors and foreign electricity companies (Belgium, Germany, Japan, Netherlands and Switzerland). The plant at La Hague is the largest reprocessing facility in the world. About 6.000 people work there permanently, including 3.000 from COGEMA subcontractors.

Hervé Hacard, Director PR Department
F-50444 Beaumont-Hague Cedex
TEL: +33 (0)2 33 02 64 00 - FAX: +33 (0)2 33 02 66 11
e-mail: bd083-1@dial.oleane.com
http://www.cogemalahague.fr

MELOX S.A.

MELOX S.A., a subsidiary of COGEMA (50%) and Framatome (50%), operates the plant at Marcoule, also called MELOX, that produces MOX fuel. On 30 July 1999, a decree was signed authorizing the extension of the plant to add a production line for boiling water reactor fuel.
Valérie Réale, PR Department
BP 124, F-30203 Bagnols-sur-Cèze Cedex
TEL: +33 (0)4 66 90 69 80 - FAX: +33 (0)4 66 90 64 97
e-mail: vreal@melox.fr

NERSA

NERSA, a French company with its capital coming from EDF (51%), the Italian company ENEL (33%) and the German company SBK (Schnell-Brüter Kernkraftwerksgesellschaft, 16%, itself a consortium including Belgian, Dutch and UK capital), was created on 8 July 1974 to build and operate the Superphénix fast neutron reactor. As a result of the government decision on 19 June 1997 to close down Superphénix, NERSA was dissolved on 6 October 2000.

SFEN (Société Française d'Énergie Nucléaire)

The SFEN, the French nuclear industry lobby organization, consisting of 5,300 members, is an association with officially has a scientific and informative vocation. The SFEN organizes symposia, national and regional meetings on themes related to the nuclear industry and founded the RGN (Revue Générale Nucléaire), its bimonthly magazine. It is a member of the European Nuclear Society (ENS).

67, rue Blomet, F-75015 Paris
TEL: +33 (0)1 53 58 32 10 - FAX: +33 (0)1 53 58 32 11
e-mail: contact@sfen.org
http://www.sfen.org

INDEPENDENT and OPPOSITION

Forum Plutonium

The Plutonium Forum is a network of organisations and individuals which was created in 1994 in order to promote the dissemination of information concerning the plutonium industry, and to initiate a counter-expertise of the consequences of this activity, particularly in France. The Plutonium Forum is currently engaged in a court case against the operation of the Phenix reactor. The general secretary of the Forum Plutonium is a member of the Conseil Supérieur de la Sûreté et de l'Information Nucléaires (CSSIN).

Jean-Pierre Morichaud, General Secretary
Hameau des Oliviers, F-26110 Venterol
TEL: +33 (0)4 75 27 97 67 - FAX: +33 (0)4 75 27 98 46
e-mail: forumpu.jpm@wanadoo.fr

CRILAN (Comité de Réflexion, d'Information et de Lutte antinucléaire)

The CRILAN is a local anti-nuclear group that is a member of the CSPI and the Flamanville CLI. For many years the CRILAN has opposed the reprocessing activities at La Hague. A complaint lodged against COGEMA in 1997 for not respecting the Bataille law of 30 December 1991 concerning the illegal storage of foreign nuclear waste led to an investigation of COGEMA in January 1999 for "endangering life".

Didier Anger
10, route d'Etang-Val, F-50340 Les Pieux
TEL: +33 (0)2 33 52 45 59 - FAX: +33 (0)2 33 52 53 26
e-mail: Paulette.Anger@wanadoo.fr

Greenpeace France

The environmental organisation Greenpeace continues its campaign against reprocessing and the use of MOX fuel. Greenpeace France recently commissioned WISE-Paris to conduct a study on the "recycling" of plutonium and uranium. (<http://www.wise-paris.org/reports/000505RecyclagePu-U.pdf>)

Jean-Luc Thierry, Nuclear Campaigner
22, rue des Rasselins, F-75020 Paris
TEL: +33 (0)1 44 64 02 06 - FAX: +33 (0)1 44 64 02 00
e-mail: jean-luc.thierry@diala.greenpeace.org
http://www.greenpeace.fr

Greenpeace Cherbourg

The local Greenpeace group at Cherbourg keeps a close eye on COGEMA reprocessing activities at La Hague. Campaigns have been conducted over several years (http://www.greenpeace.fr/campagnes/energie/activite_gp_a_la_hague.htm), particularly with a view to highlighting pollution around La Hague. Greenpeace demands a halt to reprocessing and the implementation of a systematic epidemiological study of the populations.

Yannick Rousselet, Nuclear Campaigner

3, rue Louis Aragon, F-50120 Octeville

TEL & FAX: +33 (0)2 33 93 28 00

e-mail: yannick.rousselet@diala.greenpeace.org

Réseau "Sortir du nucléaire"

The "Sortir du nucléaire" network is a federation of 612 groups. Born as a result of the success of the struggle against Superphénix and initiated by a core of 15 groups that have met regularly since 1996, the network conducts regular campaigns against the nuclear industry and publishes its own newsletter.

Philippe Brousse

9 rue Dumenge F-69004 Lyon

TEL: +33 (0)4 78 28 29 22 - FAX: +33 (0)4 72 07 70 04

e-mail: rezo@sortirdunucleaire.org

<http://www.sortirdunucleaire.org>

Info Nucléaire

Created in 1998, Info Nucléaire is a personal Internet site that belongs to no association or organization. Its main sources are *La Gazette Nucléaire* (published by the GSIEN) and the work of Bella and Roger Belbéoch, members of GSIEN.

Mathias Goldstein

18, rue de la Pierre Levée, F-75011 Paris

TEL: +33 (0)1 47 00 22 91

e-mail: infonucleaire@altern.org

<http://www.multimania.com/mat66/>

Coordination nationale des collectifs contre l'enfouissement des déchets radioactifs

The national coordination brings together local groups that oppose the burial of radioactive waste. Its goal is the abandonment of all projects to bury radioactive waste, particularly the immediate stop to the activities of the Bure (Meuse Department) underground laboratory. It publishes *Bien Profond* (www.multimania.com/bienprofond), a liaison bulletin between the sites concerned by the burial of radioactive waste.

33 rue du Port, F-55000 Bar-Le-Duc

TEL & FAX: +33 (0)3 29 45 45 55

e-mail: burestop@multimania.com

<http://www.multimania.com/burestop/>

ACRO (Association pour le Contrôle de la Radioactivité dans l'Ouest)

The ACRO, created after the Tchernobyl catastrophe to enable citizens to conduct their own supervision of the environment, is an independent sampling laboratory and an information and documentation centre. Local

branches exist in the Cotentin, in Haute-Normandie and in Touraine. The ACRO sits on some official commissions and publishes *L'Acronique du nucléaire*, a trimonthly bulletin.

138 rue de l'Eglise, F-14200 Hérouville Saint-Clair

TEL: +33 (0)2 31 94 35 34 - FAX: +33 (0)2 31 94 85 31

<http://acronique.citeweb.net/>

CRII-RAD (Commission de Recherche et d'Information Indépendante sur la Radioactivité)

Created in 1986 in the aftermath of the Tchernobyl disaster, the CRII-RAD is the oldest independent laboratory in France. Its role is to inform the population about radioactivity and its dangers, to expose offenses and make sure that regulations are respected. To do so it organized a system of surveillance, carries out regular checks and carries out sample analysis on request. The CRII-RAD publishes a quarterly review, the *Trait d'union*.

471, avenue Victor Hugo, F-26000 Valence

TEL: +33 (0)4 75 41 82 50 - FAX: +33 (0)4 75 81 26 48

e-mail: contact@criirad.com

<http://www.criirad.com>

GSIEN (Groupement des Scientifiques pour l'Information sur l'Énergie Nucléaire)

The GSIEN is a loose group of –now mostly retired– scientists, established 25 years ago, commenting on nuclear issues and publishing a newsletter called *La Gazette nucléaire*.

Monique Sené, Director of the publication

2, rue François Villon, F-91400 Orsay

FAX: +33 (0)1 60 14 34 96

e-mail: monique.sene@cdf.in2p3.fr

<http://www.multimania.com/yvesrenaud/Gazette/gazette.html>

STOP MELOX

STOP MELOX is a local group that opposes the MELOX MOX fuel fabrication plant at Marcoule.

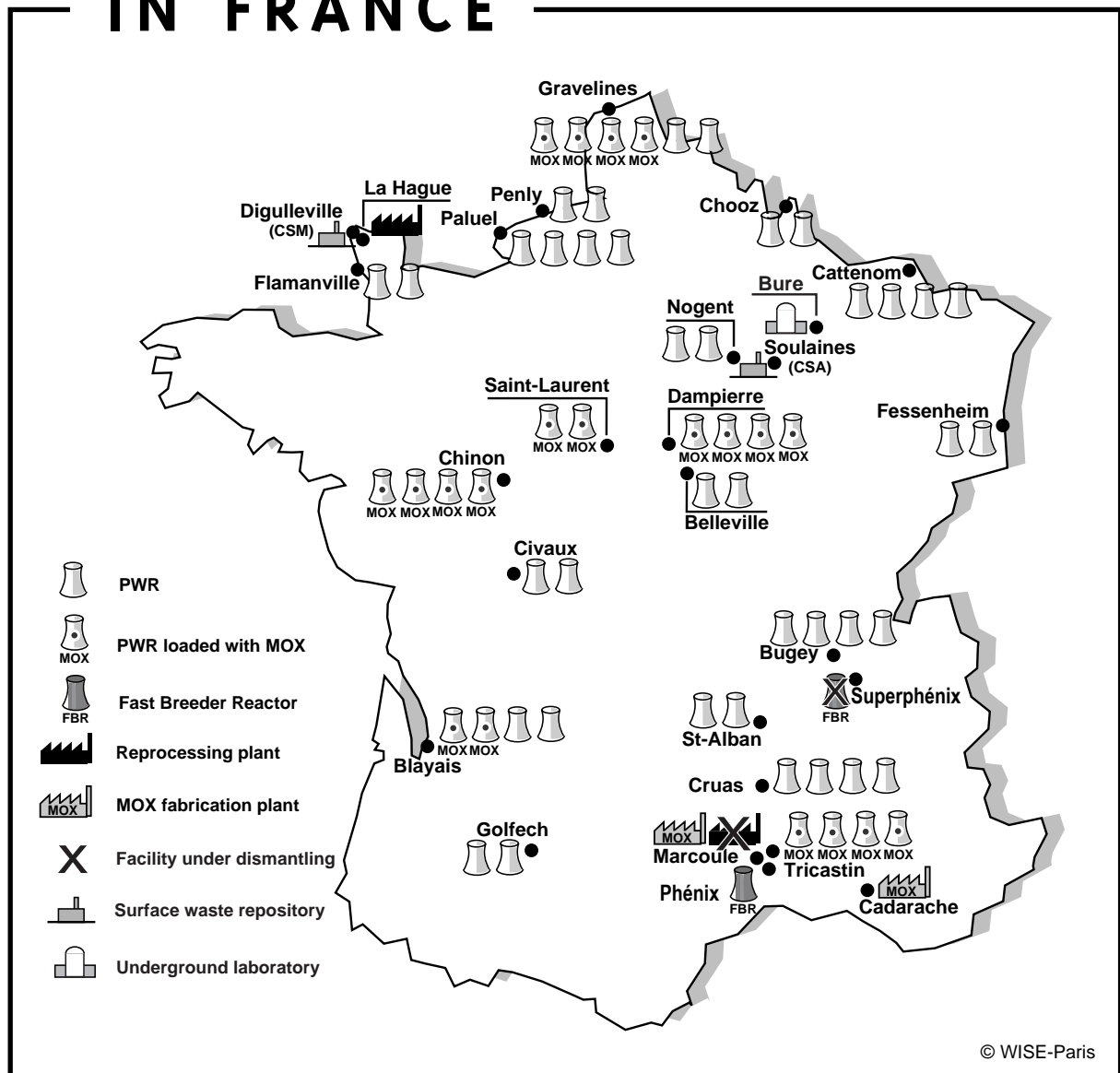
Quartier St Hilaire, F-84560 Ménerbes

TEL: +33 (0)4 90 75 85 44 - FAX: +33 (0)4 90 75 99 13

e-mail: stop.melox.marc.faiwet@wanadoo.fr

<http://www.multimania.com/stopmox>

Plutonium IN FRANCE



Situation as of 20/10/2000

59 NUCLEAR POWER PLANTS

- 58 pressurized water reactors (PWR) of which:
 - 4 units of 1450 MW
 - 20 units of 1300 MW
 - 34 units of 900 MW (of which 20 loaded with MOX fuel)
- 1 Fast Breeder Reactor (FBR): Phénix

2 REPROCESSING PLANTS

- UP2-800 and UP3 at La Hague with a nominal capacity of 800 t/an each.

2 MOX FUEL FABRICATION PLANTS

- MELOX at Marcoule with an authorized capacity of 100 t of heavy metal (tHM) per year (115 t of oxide) and a real capacity of 145 tHM/year (165 t of oxide)
- CFCa at Cadarache with a nominal capacity of 35 tHM/year (40 t of oxide)

2 FACILITIES UNDER DISMANTLING

- 1 Fast Breeder Reactor (FBR): Superphénix
- 1 reprocessing plant: UP1 at Marcoule

FIGURES OF THE MONTH

A still rising trend

A survey of the countries with large stocks of plutonium is easily done. Regarding the stocks of "civilian" plutonium, France takes the lead with around 78 tons (all figures in metric tons of heavy metal) at the end of 1999 (76 t in 1998) of which 37 t from foreign sources, ahead of the United Kingdom (72.5 t at the end of 1999). Bravo! They come neatly before the two record "military" plutonium holders: their stocks, as in their last declarations, end of 1997 for the United States, and end of 1999 for Russia (obviously more prompt in supplying data to the Vienna Agency) were of respectively around 45 t and 32 t of "civilian" plutonium. Only Japan has pulled off the exploit of storing almost 85% of its plutonium abroad. That is worth the jury's special award!

ANNUAL DATA ON "CIVILIAN" PLUTONIUM PER COUNTRY (in tons rounded for 100 kg)

Country Stock as of	Germany 31.12.97	Belgium 31.12.99	China 31.12.98	United States 31.12.97	Russian Federation 31.12.99	France 31.12.98	Japan 31.12.99	United Kingdom 31.12.99	Switzerland 31.12.99
1. Unirradiated separated plutonium in product stores at reprocessing plants	0.0	0.0	0.0	0.0	30.9	52.0	0.5	69.5	0.0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	0.3	2.5	0.0	< 0.05	0.0	11.8	3.1	0.8	0.0
3. Plutonium in unirradiated fuel or other fabricated products at reactor sites or elsewhere	3.9	1.4	0.0	4.6	0.2	6.8	1.2	2.2	0.6
4. Unirradiated separated plutonium held elsewhere *	1.8	0.0	0.0	40.4	0.9	5.3	0.4	0.0	< 0.05
TOTAL DISPOSED IN EACH COUNTRY (This line does not exist in the official document)	6.0	3.9	0.0	45.0	32.0	75.9	5.2	72.5	0.6
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.		**	0.0	0.0		35.6	0.0	11.8	< 0.05
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries and therefore not included above.		0.9	0.0	0.0		< 0.05	27.6	0.9	0.0
TOTAL BELONGING TO EACH COUNTRY (This line does not exist in the official document)	?	≤ 4.8	0.0	45.0	?	40.3	32.8	61.6	0.6

* : of which plutonium separated for research purposes

** : " Not to be communicated due to secrecy reasons "

Sources : Declarations of the Permanent Missions to the IAEA, published under the reference n°549 of the IAEA "Information Circular".

**ESTIMATED QUANTITIES OF PLUTONIUM CONTAINED IN SPENT FUEL
FROM REACTORS FOR CIVILIAN USE**

(in tons)

Country Stock as of	Germany	Belgium 31.12.99	China	United States 31.12.97	Russian Federation 31.12.99	France 31.12.98	Japan 31.12.99	United Kingdom 31.12.99	Switzerland 31.12.99
1. Plutonium contained in spent fuel at civil reactor sites		17		287	47	74.9	72	7	7
2. Plutonium contained in spent fuel at reprocessing plants		0		0	4	83.4	1	39	0
3. Plutonium contained in spent fuel held elsewhere		0		15	20	<0.5	<0.5	<0.5	0
TOTAL (This line does not exist in the official document)		17		302	71	158.8	73	46	7

Sources : Declarations of the Permanent Missions to the IAEA, published under the reference n°549 of the IAEA "Information Circular".

NEWS

Electricity companies refuse to use Russian plutonium

Electricity companies do not want Russian military plutonium, made available under the Russia-US agreement. This was the view that emerged from the Plutonium 2000 Conference, held in Brussels on 9-11 October 2000. In reply to an informal question on importation of Russian MOX for French reactors, EDF replied that *"we can't take foreign plutonium, we have problems recycling our own."* There were similar reactions from other European and Japanese nuclear utilities: *"If it was less expensive."* (Bayernwerk, Germany). *"If it made economic sense..."* (NOK, Switzerland) and, more explicitly, *"We have no such project."* (TEPCO, Japan). Where the manufacturers/builders are concerned, old projects are being brought out of mothballs: from the high-temperature reactor

(HTR) from Framatome to feedback on Russian fast reactors (FBR), via fuels with inert matrix, there is general agreement that, in the future, plutonium will be burned more efficiently. With efficiency in mind, the German and Swiss electricity companies are only envisaging better use of MOX by increasing burn-up. On the one hand, the electricity companies are increasingly pre-occupied by questions of competitiveness, as indicated by Bernard Estève, former Director of EDF's Fuels Department, who declared, in April 2000, that there was no market for plutonium and that, even if there was, the plutonium value would be negative. On the other hand, there is the reprocessing industry which, seeing the end of its contracts coming on apace, is attempting to mesmerize the electricity companies, as witnessed by COGEMA's Communications Director endlessly repeating that, *"plutonium is a sheep in wolf's clothing"*.

WORDS OF THE MONTH

"As far as I am concerned, reprocessing is certainly doomed in the mid-term, and maybe even in the short-term."

Dominique Voynet, France's Minister for Spatial Planning and Environment, *Les Echos*, 31 October 2000.

"One may regret the fact the report does not examine the hypothesis of a stop to reprocessing in 2002; sooner or later, it will be necessary to talk about that. (...) Unquestioned recourse to nuclear energy is now part of past illusions."

Roland Lagarde, Technical adviser to the French Minister of Spatial Planning and Environment, *Vert-Contact*, n°579, 14-20 October 2000.

"In terms of cumulative cost, the "stopping of reprocessing in 2010" scenarios compared to the "28 units using MOX" scenarios represent a saving of between 28 and 39 billion French Francs depending on the hypothesis adopted for the operating life of the installed nuclear power plants."

J.M. Charpin, B. Dessus, R. Pellat, *Étude économique prospective de la filière électrique nucléaire*, Report for the French Prime Minister, September 2000.

"The results of this report are in line with current thinking at EDF - the reprocessing/recycling option reveals to be extremely costly."

Internal EDF memo on the Charpin/Dessus/Pellat Report, August 2000.

"Recycling of plutonium in light-water reactors is an economic aberration. Furthermore, temporary then final storage of irradiated fuels from light-water reactors is not only safer, it is less expensive than reprocessing."

Jean-Louis Fensch, CEA Engineer, Report to the French Nuclear Safety Council, October 1982.

Étude économique prospective de la filière électrique nucléaire

(Economic forecast for nuclear power, an English version will be available within a few weeks)

by Jean-Michel Charpin, Benjamin Dessus, René Pellat. Report for France's Prime Minister, September 2000, Paris, 252 pages.

The plutonium industry is costing France a great deal: around 164 billion Francs as compared to the uranium option. This is one of the shattering conclusions from a report ordered by the French Prime Minister into the economics of nuclear energy, handed to him on 28 July 2000. The study, carried out by three authors with very different views, provides numerous elements for analysis without, however, making recommendations. The report is based on an original method describing the physical material flows associated with the electricity sector to establish a chronology for expenditure in different forecasting scenarios for the 2000-2050 period and calculating, at the end of the process, the discounted costs of production of electricity.

In this way, the report distinguishes between different scenarios for renewal of the present nuclear generating capacity (not before 2025 thanks to a hypothetical extension of power plant life to over 40 years) using "evolutionary" nuclear technologies (e.g. the European Pressurized Reactor) or revolutionary technologies (high-temperature reactors) or gas technology with combined cycle. It compares these alternatives in high-electricity-demand and low-electricity-demand scenarios, demonstrating the economic advantages of the latter.

The comparison of future solutions is based on a very detailed evaluation of France's present nuclear power plants (limited to pressurized water reactors), since its inception in 1977 to the end of its life. This analysis, to which **WISE-Paris** contributed, shows that the strategies for reprocessing and re-use of plutonium in MOX, are systematically more expensive than storage, with very limited savings in terms of uranium and reductions in the quantities of plutonium in waste. Over the life of the nuclear power plants, the report assesses the additional cost of the reprocessing-MOX route at 164 billion Francs, with an accumulation of 4,800 tons of irradiated MOX (needing to be stored for up to 150 years more than UOX),

a saving of 38,000 tons (i.e. 8%) of natural uranium, and a reduction in the stock of unseparated plutonium from 667 to 514 tons. The report thus calculates an additional cost of over 1 billion Francs per "tonne of plutonium avoided" in the final waste stockpile.

Leaving the responsibility of choice to the politicians, the three authors propose a global analysis that was lacking so far. The result is, according to French Minister of the Environment Dominique Voynet, "maybe the first equitable report in French nuclear history".

The report, published by la Documentation française, is available on the Internet at:
http://www.ladocfrancaise.gouv.fr/fic_pdf/charpinnucleaire.pdf

The study is based on three additional reports, published by the Commissariat général du Plan, available on the Internet at:

Le parc nucléaire actuel (the present nuclear power plant equipment),

by *Philippe Girard and Yves Marignac (Deputy Director of WISE-Paris)*, 434 pages

<http://www.plan.gouv.fr/organisation/seeat/nucleaire/annexe1.html>

La prospective technologique de la filière nucléaire (technological forecasting for the nuclear energy sector),

by *Jean Bergeron, Jean-Paul Schapira, Alain Simon, Jean-Baptiste Thomas*, 129 pages

<http://www.plan.gouv.fr/organisation/seeat/nucleaire/annexe2.html>

La prospective technologique des filières non nucléaires (technological forecasting for non-nuclear energy sectors),

by *Maurice Claverie, Daniel Clément, Claude Girard, Fouzy Benkhalifa, Michel Labrousse*, 166 pages

<http://www.plan.gouv.fr/organisation/seeat/nucleaire/annexe3.html>

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"La France Nucléaire 1997", Mary Byrd Davis, WISE-Paris, 256 pages; 120 FRF + 25 FRF for postage

"Comprehensive Impact Assessment of the Use of MOX Fuel in Light Water Reactors", Jinzaburo Takagi, et al., CNIC, Tokyo, 335 pages; 400 FRF (NGOs 160 FRF) + 60 FRF postage + VAT for Europe (contact CNIC for US and Asia, fax: 81-3-53 30 95 30).

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