

# Plutonium *Investigation*

CADARACHE SPECIAL

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## EDITORIAL

### **Safety authority: paper tiger or accessory to the fact?**

*The Durance fault is a zone of exceptional geological instability. As early as March 1994, the IPSN (Institut de Protection et de Sûreté Nucléaire - Institute for Nuclear Protection and Safety) concluded that the seismic activity, 60 km northeast of Marseilles, "has shown a significant increase since the end of December 1993". This is no surprise, since an important centennial earthquake is expected - "massive damage; the most vulnerable housing destroyed; almost all dwellings suffering considerable damage" - after the ones that took place in 1812 and in 1913...*

*Cadarache, the largest French nuclear centre outside the Parisian region - 450 buildings, 5000 employees - is situated only a few kilometres away from the main fault. In 1995, following the IPSN analysis, the safety authority asked COGEMA to prepare to shut down the plutonium fuel (MOX) production plant "shortly after 2000". It claimed the installation did not comply with the applicable anti-earthquake regulations and doubtless constituted the greatest potential risk for the site in the event of an earthquake. Since then the plant has not ceased to increase its production and now, six years later, it is still operating. The safety authority "threatens" to shut down the plant "by court order" at the end of 2002. COGEMA "proposes" to shut down the plant on one condition: that it be authorised to increase the capacity of its other MOX plant, MELOX, at Marcoule. "Blackmail", retorts the safety authority; "not with us" adds the ministry for the Environment. As a result: COGEMA makes an official application for authorisation to increase its production at Marcoule.*

*Is it understandable that the French technocratic élite should have decided to build a nuclear site of this scale in such a place? Is it believable that the legal existence of the second largest producer of commercial MOX in the world should be based on a simple declaration as a research laboratory in 1964? Is it acceptable that industry should impose its purely commercial logic and fly in the face of all safety considerations?*

*In other words, what does the controlling State weigh compared with the shareholder State?*

## CADARACHE SPECIAL

### The MOX plant condemned: sending tremors through the plutonium industry?

It could be a first in the world of nuclear power: if COGEMA does not submit a closure plan for the MOX fuel production plant at Cadarache, France, the director of safety of nuclear installations (DSIN - Direction de la sûreté des installations nucléaires) would be obliged to "close the plant by order at the end of 2002." These were the terms of a declaration, made on 30 January 2001, by Mr André Claude Lacoste, head of the DSIN, in response to a question by *Plutonium Investigation*.

On 18 April 2001, the Provence-Alpes-Côtes d'Azur region's regional directorate for industry, research and the environment (DRIRE - Direction Régionale de l'Industrie, de la Recherche et de l'Environnement) confirmed that the DSIN "would oversee [...] the closure

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of activities of the plutonium technology facility (ATPu - *Atelier de Technologie du Plutonium*) for which the capacity to withstand seismic disturbances has not been demonstrated."

This is only one in a series of serious mishaps for the European plutonium industry. On 11 June 2001, the Federal German Government and the country's major electricity companies signed an agreement of capital importance, laying the way for the phase out of nuclear power and for ending transport of irradiated fuels to reprocessing plants by 1 July 2005<sup>1</sup>. With the La Hague plant approaching the end of its contracts with its overseas clients, and Sellafield (UK) still not able to operate at full capacity, the scandal of falsified quality-control documents delivered a heavy blow to BNFL in September 1999. In July 2000, the Charpin-Dessus-Pellat report was published, passing a severe verdict on reprocessing in France. In August 2000, *Plutonium Investigation* published the story of the geological faults at Cadarache<sup>2</sup>, completed its investigation into the quality control of fuel cladding at CEZUS<sup>3</sup> in December 2000 and, in mid-February 2001, revealed the "secret" shipments between Hanau in Germany and La Hague<sup>4</sup>. On 26 February 2001, the Governor of the Japanese Prefecture of Fukushima forbade the first loading of MOX into a Japanese reactor in Units I-3 of the Fukushima power station.

The spectacular developments in Japan may well upset the long-laid plans of the plutonium industry. Thirty-two fuel assemblies were manufactured for the Tokyo Electric Power Company (TEPCO) electricity company, in 1999, at the Dessel plant in Belgium, and were recently sent – with 28 assemblies made in the French MELOX plant at Marcoule – by sea to Japan. The Governor of Niigata Prefecture then announced that he would not authorize use of MOX in the third unit at Kashiwazaki-Kariwa, also operated by TEPCO, before loading of the MOX into the reactor at Fukushima. On 27 May 2001, the citizens of Kariwa voted against MOX use in an unprecedented referendum. The situation now appears to have reached a total deadlock and could have dramatic consequences for the main interested party, COGEMA, who is at present – together with Belgonucléaire – the only manufacturer of commercial MOX in the world.

What can we make of the MOX industry, which is currently a "bottleneck" for the flow of separated plutonium? With a three-cornered operation – comprising two COGEMA plants, the MELOX plant at Marcoule and the ATPu at Cadarache, as well as the Belgonucléaire plant at Dessel (see table, page 7) – Europe's maximum "absorption" capacity for plutonium is 13 tons per year. However, La Hague is able to separate more than 16 tons per year, while the BNFL THORP reprocessing plant at Sellafield (nominal capacity of 1,200 tons of irradiated fuel per year), if it were to operate at planned capacity, could produce an additional 10 tons of plutonium. What is the solution for this foundation stone of the plutonium sector if the plutonium facility at Cadarache were to close at the end of 2002? What then would be

the fate of the plutonium belonging to Germany's electricity companies, presently the only clients of the ATPu at Cadarache?

The continual requests since 1995 for the "rapid closure of the installation"<sup>5</sup> illustrate the DSIN's concern over one of the most active seismic faults in France on which the French commission for atomic energy's Cadarache center (CEA Cadarache) is built, threatening the structural integrity of the ATPu in the case of an earth quake.

However, the ATPu is not the only installation affected by this problem. The Provence-Alpes-Côtes d'Azur DRIRE announced, on 18 April 2001, the schedule for closure of installations threatened by seismic disturbance: 2002 for the ATPu; 2006 for the Waste and Effluent Treatment Plant; 2010 for the Central Store of Fissile Materials; and 2015 for the Laboratory for the Inspection of Active Fuels. The waste store and Pégase storage installation are also due to be closed. However, no date had been announced by the end of April 2001.

### The Cadarache Nuclear Studies Center (CEN)

The Cadarache nuclear research center (CEN - Centre d'Etudes Nucléaires) was created in 1959 by the CEA (Commissariat à l'énergie atomique), at the confluence of the Verdon and Durance rivers, on a 1,625 hectare site in the Bouches-du-Rhône region. It is the largest CEA complex outside the Paris region, with 450 buildings and 5,000 employees.

The main focus of the research carried out at the Center, using the on-site experimental reactors (Cabri, Scarabée, Phébus, etc.), is the industrial application of research and development work on uranium- and plutonium-based fuels. Several departments cover a wide range of activities: Reactor Studies (DER), Fuel Studies (DEC), Safety Research (DRS), Controlled Fusion Research (DRFC) and Temporary and Permanent Storage of Waste (DESD).

Other bodies add to the range of research: Center for Study of Solar Energy, Department of Plant Eco-Physiology and Microbiology, Industrial Recycling, etc. The DER and DEC departments represent around 50 per cent of the activity, the DRS and DRFC 20 per cent each, and waste treatment 9 per cent.

<sup>1</sup> <http://www.wise-paris.org/english/ournews/news3.html>

The text signed on 11 June 2001 is apparently identical with the agreement dated 14 June 2000.

<sup>2</sup> [http://www.wise-paris.org/english/ournewsarchives/ournews\\_trn3\\_2000.html#cogem](http://www.wise-paris.org/english/ournewsarchives/ournews_trn3_2000.html#cogem)

Then repeated, for example, by *Libération*, 1 August 2000.

<sup>3</sup> See Briefing, [http://www.wise-paris.org/english/ournewsarchives/ournews\\_trn4\\_2000.html#thec](http://www.wise-paris.org/english/ournewsarchives/ournews_trn4_2000.html#thec)

Then repeated, for example by the *Financial Times*, see <http://www.wise-paris.org/othersnewsframe/others2.html>

<sup>4</sup> <http://www.wise-paris.org/english/ournews/news3.html>

<sup>5</sup> DSIN letter of 28 March 1995: DSIN/GRE/SD1/N°134/95

The CEA's Cadarache center also houses some of its subsidiaries. For example, Technicatome makes prototype reactors for naval nuclear propulsion systems (submarines and aircraft carriers). COGEMA is engaged in activities relating to the nuclear fuel cycle in the Cadarache production complex (CFCa - Complexe de Fabrication de Combustible au Plutonium). The Société des Techniques en Milieu Ionisant (STMI), Intercontrôle and Compagnie Internationale de Services en Informatique (CISI) companies are also present.

### The Cadarache Production Complex (CFCa)

Created in 1961 as a laboratory and with the purpose of developing manufacturing processes for nuclear fuels containing plutonium, the CFCa soon became an industrial production center. It thus comprises the only "Basic Nuclear Installations" (installations nucléaires de base - INB) used in the fuel cycle on the Cadarache site. Made up of the ATPu (INB n°32) which produces the fuel, and the chemical purification laboratory (LPC - Laboratoire de Purification Chimique, INB n°54) carrying out quality control and processing of waste, the CFCa began to produce fuel in 1962. Although the CFCa is often presented as a COGEMA installation<sup>6</sup>, it has in fact belonged to the CEA since its creation. According to the DSIN's Annual Report of 2000, the CEA is at present the legal operator of the ATPu and LPC. However, from the industrial point of view, it is COGEMA that has operated both installations since 1991.

In the list of INBs established by the DSIN, no change has been indicated in the ATPu's or LPC's authorizations since the respective declarations of 27 May 1964 and 8 January 1968, made by the CEA. Decree N°63-1228 of 11 December 1963, which fixes all of the rules applying to INBs, and especially to the regime governing their authorization, nonetheless stipulates that a new authorization is necessary if an INB changes operator. The DSIN justifies this situation by a terminology that distinguishes between the "industrial operator", associated with production, and the "administrative operator" legally responsible for operation in terms of safety. Thus, to date, the CEA remains the "operator" from the point of view of safety, and COGEMA the "industrial operator". This, Mr André-Claude Lacoste agreed, in an interview with *Plutonium Investigation*, "is not the most desirable situation".

Furthermore, the change of status from laboratory to that of production unit in 1989 – two clearly distinct activities from the legal and safety points of view – does not appear to be covered by a decree.

### Production of MOX at the ATPu

The ATPu began producing plutonium fuel in 1962, for research reactors, then fuel for fast neutron reactors in France (Phénix and Superphénix), and in the U.K. (Dounreay, Scotland).

With the aim of moving to industrial production of

MOX, and after re-examination of the safety of the facility in 1987 by the safety authority – then known as the central safety department for nuclear installation (SCSIN - Service Central de Sûreté des Installations Nucléaires) – "the authorization to pursue fuel manufacturing activities" was granted.<sup>7</sup> In January 1989, within the framework of this procedure, the SCSIN authorized – and without a decree modifying the INB<sup>8</sup> – the use of the ATPu for manufacture of MOX fuel for water-cooled reactors, stating that "the characteristics of these fuels come [...] within the more general envelope established for fuels for fast neutron reactors."<sup>9</sup>

Production has diversified since:

□ Production of fuels for fast neutron reactors continued until 1999. The last delivery for Superphénix dates from the end of 1996<sup>10</sup>, but the ATPu subsequently produced fuel for the Phénix reactor. The last production runs were in the years 1998 and 1999 and involved 1.3 tons and 1.2 tons of fuel respectively. No further runs for Phénix are planned.<sup>11</sup>

□ Industrial production of MOX fuel for light-water reactors began in 1991, with a rapid growth in annual production. The plant doubled its output in two years, going from 15.3 tons of heavy metal (tHM) uranium and plutonium in 1993 to 31.6 tHM in 1995. Production has continued to increase since, reaching 41.4 tHM in 2000.

MOX for light-water reactors was produced mainly for Germany. According to Mr Philippe Pradel, then Production Manager at COGEMA's Fuels and Recycling Division,<sup>12</sup> EDF used MOX from Cadarache until 1996. Since then only a few fuel rods have been occasionally made for the French generating company. It is fair to say that for several years the ATPu's activity has been entirely devoted to contracts to supply German operators

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<sup>6</sup> See CEA Cadarache website (<http://www-cad.cea.fr/r33.htm>) pages on fuel production: "having become the COGEMA-Cadarache establishment in 1991, [the CFCa] has found its place naturally in the COGEMA Group's fuel cycle production installations." Also see DSIN's *Contrôle* review (April 1996): "CFCa (a COGEMA MOX fuel production installation)."

<sup>7</sup> According to *Bulletin Sûreté Nucléaire*, n°67, 1-2/1989.

<sup>8</sup> Under the terms of Decree N°63-1228 of 11 December 1963 relative to INB, a new authorization for a given INB is necessary if "modifications that could lead to failure to observe conditions previously imposed on the installation" are made to it.

<sup>9</sup> According to *Bulletin Sûreté Nucléaire*, n°67, 1-2/1989. It is stated that "bringing into service workstations assigned to the production of mixed plutonium and uranium oxide fuel assemblies for light-water reactors [...] is authorized", referring to a Telex, 13 January 1989.

<sup>10</sup> Probably assemblies meeting special product requirements under the CAPRA program: COGEMA's 1997 *Annual Report* indicated that three experimental assemblies for a fast neutron reactor were supplied in 1996 by COGEMA-Cadarache.

<sup>11</sup> Personal communication from Mr J. E. Saulnier, spokesperson for COGEMA, 1 February 2001

<sup>12</sup> Personal communication of 19 May 2000.

**"FLAWS IN SAFETY CULTURE"  
AND "FAILURE IN OPERATING PROCEDURES" AT THE ATPu**

These stinging conclusions from the DSIN followed an incident which occurred in March 1992, classed at level two on the International Nuclear Event Scale (INES)<sup>1</sup>. A spot inspection by the safety authority revealed the presence of an excessive number of "centering cages", devices making it possible to handle fissile materials and prevent the risk of criticality, in a storage area of the ATPu. "Criticality" means a situation in which a sufficient mass of fissile material is brought together in a configuration favorable to the triggering of an uncontrolled nuclear reaction. This serious anomaly in operation did not have any radiological consequences, but such "*flaws in safety culture*" and "*failures in installation operating procedures*" had "*severe potential consequences*" according to the DSIN, which suspended then the facility's activities. The improvements "*proposed*" by the operator covered operating procedures, monitoring, and raising of awareness among personnel; they led to the lifting of the DSIN's restriction one month after the accident. Nine years later, nothing had apparently changed as, on 18 April 2001, the Provence-Alpes-Côte d'Azur DRIRE – in a press conference on the status of safety at Cadarache in 2000 – recalled the "*lack of rigor of the operators of the installations.*"<sup>2</sup>

The more recent incident, on 17 December 1997, casts doubt on the measures adopted by the operator: "*a mass of fissile material 50 per cent greater than that authorized by safety requirements*" was placed in the centering cages. This failure to obey safety requirements may stem from a somewhat lax attitude on the part of operators and a lack of awareness of the "safety culture", but other factors directly incriminate the operating procedures themselves. Some operations, for which the degree of control varies, expose operators to potential risks. A look back over the history of operation of the ATPu and LPC highlights systematic loss of confinement causing contamination by plutonium of the premises and of personnel (reaching the Annual Limit of Intake (ALI) ). This was not the result of confinement failures but rather of contact with protruding metal objects in glove boxes, able to pierce the vinyl envelopes and operatives' gloves (even though these are lined). These recurring incidents led the safety authority to state, in its safety bulletin of January 1998, that "*in spite of all precautions taken, such piercing of gloves could not be totally avoided.*" Two years later, a technician from LPC was contaminated again<sup>3</sup>, with exposure at "*around the Annual Limit of Incorporation.*" The incident was classed at level two on the INES, given the "*significant contamination of areas accessible to personnel.*" It originated from the piercing of the double envelope of a package containing the residues of mixed uranium and plutonium oxide pellets and powdered plutonium oxide. On 25 April 1999, a level one incident at the ATPu involved piercing of an operator's protective glove by a metal shard.<sup>4</sup> Such loss of confinement caused by piercing of vinyl envelopes has given rise to a number of incidents at the CFCa, two of which were classed at level two on the INES and in which the Annual Limit of Incorporation was reached for operators.

Another event confirms the flaws in the procedures at the ATPu. This time it was removal of materials that was pinpointed by the safety authority:<sup>5</sup> "*failures in the procedures for removal of materials present in the installations*" were revealed in a level one incident that occurred on 18 October 1991. Inspection of a truck "*revealed that 40 Rapsodie type assemblies each containing 1.800 grams of depleted uranium were delivered in 1970 and never irradiated!*"

<sup>1</sup> The International Nuclear Event Scale (INES) is used to indicate the gravity of any event occurring in nuclear power stations or other facilities. Level two corresponds to:  
- significant on-site consequences: significant contamination, overexposure of a worker,  
- degradation of defense in depth: incident with significant failure in safety provisions.

<sup>2</sup> Provence-Alpes-Côtes d'Azur DRIRE, "Press Conference on Nuclear Safety at CEA Center at Cadarache in 2000", 18 April 2001.

<sup>3</sup> See *Contrôle* review, January 1990.

<sup>4</sup> See *Contrôle* review, June 1999.

<sup>5</sup> See *Contrôle* review, December 1991.

with MOX.

According to COGEMA (on the CEA-Cadarache website) the ATPu "has two production lines with an annual capacity that can reach 35 tons of MOX fuel." According to DSIN, the total capacity is actually of 45 tons<sup>13</sup>. In May 2000, Philippe Pradel confirmed the existence of the two lines and stated that only one of them is used to produce MOX for pressurized-water reactors. In the future, the plant may supply MOX for boiling water reactors, although this is not planned at present. The second was reserved for manufacture of fuels for fast neutron reactors and produced fuels for Phénix and Superphénix.

### The ATPu and Monitoring of MOX Production

#### The international context

The BNFL scandal and its international repercussions have dented the confidence of many electricity companies (especially Japanese and German) in the European MOX sector. Falsifying of MOX quality control data in the BNFL plant at Sellafield, resulting in reports from the Nuclear Installations Inspectorate (NII) that mentioned "systematic management failures", led nuclear reactor operators to carry out audits on all of the MOX producers. In the light of the "scandal", the Irish, Danish and Norwegian governments, signatories to the OSPAR Convention<sup>14</sup> and firmly opposed to reprocessing, denounced the polluting effects of the activity. The Danish proposal submitted to the OSPAR Commission, and demanding "suspending of reprocessing [...] with immediate effect", finally received the necessary support of three-quarters of the signatories to the Convention and came into force on 16 January 2001. France and Great Britain, however, did not vote, allowing them not to commit and thus reducing the effectiveness of the resolution as it does not include the two major reprocessing countries.

The reaction of Japanese operators was to require audits of the Sellafield production line, to forbid any further shipment of spent fuel to the U.K. reprocessing plant, and to demand that BNFL take back the MOX involved. Germany, then Switzerland and Sweden, also froze their MOX programs with BNFL. Even the British operator British Energy seems decided to abandon reprocessing rapidly.<sup>15</sup> The only good news for BNFL is that it appears that the company was able to secure an agreement with the German electricity company E.ON for manufacture of MOX. No details of this had been published at the end of May 2001.

The Japanese and then German audits did not spare other manufacturers. A delegation from Japan's Ministry of International Trade and Industry (MITI) and representatives of Japanese companies visited the Belgonucléaire plant in Belgium to check on the efficiency of quality control, and German operators checked the quality at Cadarache.

#### Questions of quality at Cadarache

It was in this context that COGEMA indicated to two

German companies, Siemens and the electricity company Bayernwerk, "a malfunction which occurred in a software" at the ATPu. The two companies carried out a joint "contradictory" audit at the Cadarache plant. The malfunction concerned a batch of fuel sent to the ISAR-2 power plant, operated by Bayernwerk, in December 1999. The software in question recorded the second check on statistical samples of fuel pellets. A COGEMA communiqué of 30 March 2000, describing the function of the software as recording "secondary tests", states that "the computer system error [...] did not affect the quality of MOX produced at Cadarache." This is the same formula as that used by BNFL regarding its incriminated fuel. The deficient stage – the second quality control point for diameter of pellets – is also identical to the U.K. case. The incident was not classified on the INES scale.

### Closure of the ATPu, a Reprieve?

An IPSN report<sup>16</sup> dating from March 1994 established that seismic activity in the Cadarache region "shows significant recurrence since the end of December 1993." The document also states that a segment of the Durance fault, a few kilometers from the center, "experienced an event with an intensity of VII-VIII on 20 March 1812." The environs of Cadarache are the seat of destructive seismic disturbances (maximum intensities reach VIII on the qualitative MSK scale<sup>17</sup>) with a return period of around a century. The most recent event of this type occurred in 1913.

On 27 January 1995, a meeting on this subject brought together Mr. Lacoste (head of DSIN), and managers from CEA, IPSN and COGEMA. The DSIN expressed the view<sup>18</sup> that the analysis presented by the IPSN "indicates the necessity of rapid closure of the installation." The DSIN "requested that COGEMA should propose a scheme for the future of the ATPu, including a definitive and irreversible closure date for the installa-

<sup>13</sup> DSIN communication, 23 May 2000. One line produces MOX fuel for pressurized water reactors, and has a capacity of 35 t, the other line can produce an additional 10 t, or alternatively around 1.5 t of fuel for fast breeder reactors.

<sup>14</sup> The Convention for the Protection of the Marine Environment of the North-East Atlantic, ratified by the contracting parties (including France) on 25 March 1998, at Sintra, Portugal.

<sup>15</sup> Mr Michael Kirwan, Financial Director of British Energy, declared, in *The Independent* national newspaper, 11 May 2000: "From our point of view, reprocessing is an economic absurdity and should be stopped immediately." On 19 May, *The Guardian* confirmed that British Energy had started negotiations with BNFL to end its reprocessing contracts and convert to storage of spent fuel.

<sup>16</sup> IPSN Report, 1994, Technical Note SERGD 94/13.

<sup>17</sup> In a press file of January 1997, the IPSN described the degree of intensity of level VIII of the MSK scale – which goes from I to XII – as seismic effects including: "massive damage; the most vulnerable houses are destroyed; almost all experience severe damage."

<sup>18</sup> DSIN letter of 28 March 1995: DSIN/GRE/SD1/N°134/95.

tion shortly after 2000."

On 22 October 1997, in spite of "several reminders on his part" (June 1995 and June 1996) Mr Lacoste renewed his request<sup>19</sup> in a letter addressed not to COGEMA but to the Director of CEA/Cadarache, in which he concluded that "the situation is unacceptable."

In December 1997, a joint letter<sup>20</sup> from COGEMA and CEA provided a reply from the "operator", in December 1997. Both organizations recognized that "since 1991, in-depth consideration has been given to the examination of [its] behavior in the event of an earthquake", indicating that "reinforcement of existing structures would be extremely complex to implement." The solution they proposed was "the creation of an entirely new superstructure which would fully encompass the 'powder handling' part of the existing installation [...] and would guarantee confinement of [nuclear] materials" in the event of a safe shutdown earthquake (SSE), the most serious earthquake to be considered for safety.<sup>21</sup> Giving assurances that studies "had concluded that such a project was feasible", they envisaged "being able to make the decision as to the actual creation of this superstructure in the autumn of 1999."

In February 1998<sup>22</sup>, Mr Lacoste turned to the General Administrator of the CEA. In his letter he referred to the superstructure project as "having attendant uncertainties" and stating that its "innovative nature [...] meant that it ran counter to [his] wishes", expressed in January 1995. He therefore confirmed that the project "does not correspond to [his] demand." In the event of the corresponding scheme not being presented to him shortly, he threatened, though without giving details, "to take the necessary steps to remedy this situation."

It was only on 30 January 2001 that the Director of the DSIN, still (according to him) without response from COGEMA, declared that the "DSIN would take the necessary steps vby order to close the plant by the end of 2002." Asked about this by *Plutonium Investigation* two days later, Mr Jacques-Emmanuel Saulnier, COGEMA's spokesman, declared that COGEMA had provided proposals to the Minister of Environment, Ms Dominique Voynet, and to the Secretary of State for Industry, Mr Christian Pierret, in September 2000. The spokesman was unwilling to make a statement as to the terms of the COGEMA's proposals but underlined that "the primary constraint is clear: it is the seismic situation." According to *Plutonium Investigation's* information, COGEMA, in a letter to the two supervising ministers, repeated its proposal to close Cadarache on condition that it obtained an authorization to increase annual production for the MELOX plant at Marcoule. It is also in these terms that COGEMA presented its "closure plan" to the Director of the DSIN in its letter of 1 March 2001.<sup>23</sup> This proposal remains unacceptable, at least to one of the two ministers in charge.

Finally, on 18 April 2001, the Provence-Alpes-Côtes d'Azur DRIRE, in a press conference on safety at the CEA's center at Cadarache in the year 2000, recalled that the "ASN [i.e. DSIN] would see that [ ] the *Atelier de Technologie du Plutonium (ATPu)* – for which the ability to withstand an earthquake has not been demonstrated – would cease activity soon." Echoing this, the CGT Mines-Energie trade union, in a communiqué of 20 April 2001, called on COGEMA to "examine a re-deployment plan for the 350 employees of the CFCa as soon as possible."

### The Industrial Implications

In the strategy put in place by COGEMA, the distribution of production between Marcoule and Cadarache is clear: MELOX produces MOX for pressurized water reactors (PWR) on its first line (intended for EDF), and MOX for boiling water reactors for Japanese clients and potentially for German clients on its second line. The ATPu produces MOX for PWRs for German clients.

In this way, the Cadarache site, which has ISO 9002 and ISO 14001 certification, also obtained the KTA (Kerntechnischer Ausschuss) label specific to the quality standards of the German nuclear industry. The ATPu has been managed for several years by the former director (of German nationality) of the MOX plant at Hanau, in Germany, which has been out of production since 1991.

According to the German operator Preussen-Elektra (on 1 January 2000), 262.6 tons of MOX fuel remain under contract for delivery to German clients.<sup>24</sup> The plants available in Europe for this are (theoretically): BNFL's MDF plant at Sellafield (UK); the Belgonucléaire plant at Dessel (Belgium); and the COGEMA plants at Marcoule (MELOX) and Cadarache (ATPu).

Until now, Cadarache and Dessel represented two-

<sup>19</sup> DSIN letter of 22 October 1997: DSIN/FAR/SD1/N°11708/97.

<sup>20</sup> CEA-COGEMA letter of 11 December 1997, signed by Mr Marcel de la Gravières and Mr Philippe Pradel, then Director of CEA/Cadarache and Deputy Director of the COGEMA reprocessing division: DIR/CSN 97/982 - BR/SX 97/18.

<sup>21</sup> The safe shutdown earthquake (SSE) is the historically most likely maximum earthquake of which the intensity on the MSK scale is increased by one point. For the ATPu this is level IX which the IPSN, in its 1997 press file (see above), indicates as resulting in "destruction of many buildings".

<sup>22</sup> DSIN letter of 23 February 1998: DSIN/GRE/SD1/N°35/98.

<sup>23</sup> Letter of 21 March 2001, from Mr Yves Coupin to Mr André Claude Lacoste, available on COGEMA website.

<sup>24</sup> PreussenElektra table presented to the "Plutonium-Workshop", 13-14 January 2000, in Jülich, Germany.



## MOX plants in the world capacities and output at end of 2000

Site	Country	Operator	Capacity in tHM	Type of fuel	Commissioning	Output in 2000 in tHM	Total at end 2000 in tHM	Clients
CFCa (Cadarache)	France	CEA - COGEMA	1,5	FBR	1961	0.0	~105.0	FR, DE
			and 35	PWR/BWR	1989	41.4	244.9	
MELOX <sup>1</sup> (Marcoule)	France	COGEMA	101,3	PWR	1996	101.0	434.6	FR, JP
			and 44,2	BWR	1999			
MDF (Sellafield)	United Kingdom	BNFL	8	PWR/BWR	1993	0.0	<sup>2</sup> ~18	DE, CH, JP
P0 (Dessel)	Belgium	Belgonucleaire	10	FBR	1973	0.0	451.9	FR, B, DE, CH, JP
			or 35	PWR/BWR	1986	37.0		
PFPF <sup>3</sup> (Tokai Mura)	Japan	JNC	40	ATR	1988	0.0	0.0	JP
			or 5	FBR		0.0	~16	
PFFF <sup>3</sup> (Tokai Mura)	Japan	JNC	10	ATR	1971	~6.0	~150	JP
			or 1	FBR		0.0	0.0	
AFFF (Tarapur)	India	BARC	20	PHWR BWR ?	1990 ?	?	?	India

PFPF : Plutonium Fuel Production Facility  
PFFF : Plutonium Fuel Fabrication Facility  
AFFF : Advanced Fuel Fabrication Facility  
BARC : Bhabha Atomic Research Center

<sup>1</sup> The technical capacity of MELOX is more like 145.5 tHM but its output is limited by decree (n°99-664 du 30/07/1999), to 101.3 tHM

<sup>2</sup> BNFL, written response to Sellafield Local Liaison Committee, dated 2 December 1999, from CORE (Cumbrians Opposed to a Radioactive Environment)

<sup>3</sup> According to CNIC (Citizens' Nuclear Information Center), Tokyo

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thirds of the German fuel imports. To fulfill its contracts with the German electricity companies, COGEMA at Cadarache would have to run its fabrication facility until at least 2006 (with output of 40 tons per year).

As imports of MOX from BNFL are now suspended (after the problems described above), only the Dessel and Marcoule plants can, theoretically, propose an alternative in the event of closure of the ATPu. In practice, moving the activity to the Belgian company does not appear possible, given the specifications of the Dessel plant and its full order books.

### "Blackmail" by COGEMA.

COGEMA's current intention is to continue production at Cadarache. Given the risk of an inadequate abi-

lity to withstand earthquakes, the DSIN has repeatedly requested<sup>25</sup>, since January 1995, that – while awaiting the requested closure – "compensatory measures be introduced immediately, for example, on the source term." This request has not prevented production from surpassing the 1995 level (31.2 tHM) since 1998, even going beyond the announced production capacity for the MOX-PWR production line (35 tHM per year).

In parallel, the DSIN recorded six occasions between 1991 and 1997 on which the 1 per cent limit on americium in the plutonium stored at the ATPu was exceeded (of which three were in the years 1996 and 1997 alone).

<sup>25</sup> This request, reported in the meeting report of 27 January 1995, was, for example, repeated in the letter of 22 October 1997.

Highly radiotoxic, americium results from the decay of plutonium, and constitutes a problem for radiological protection and safety. However, the operator states in a letter that *"large-scale investment, decided in 1991, and introduced progressively between 1993 and 1996 [...] has allowed a reduction in the quantities of material present within the equipment at any given moment."*<sup>26</sup> COGEMA clearly wishes to gain maximum profit from the ATPu: *"from the industrial point of view, it would be highly desirable to obtain a return on the major investments [...] made since 1991."*

Would it be possible for COGEMA to transfer the production of MOX for Germany to MELOX? The company's response is negative, as affirmed in the letter already mentioned<sup>23</sup>: *"for technical, industrial and administrative reasons, no other installations would be able to fulfill this mission at present."* The "technical" reasons do not, in reality, appear of prime importance: production of MOX for German PWRs is possible at MELOX, even though it would require some technical adjustments. It is the administrative and commercial constraints that are the determining factor. With a load factor of 100 per cent and authorized annual production of 101.3 tHM, the MELOX plant cannot take on additional MOX production without reducing the quantities manufactured for EDF. Now, under the present contracts for reprocessing between EDF and COGEMA, all of the MELOX output would not be sufficient to ensure the equality of flows established as a principle by the national electricity company.<sup>27</sup> And, it is now known that MELOX's work load includes the production of MOX for Japanese BWRs and possibly German reactors.

This saturation was predictable, and was foreseen by COGEMA and by the safety authority. As of January 1995, the DSIN associated its request for closure of the installation with a proposal for *"two intermediary stages, one around 1995 relative to the decision as to whether or not to include authorization for a MOX plant in the new decrees authorizing La Hague, the other, around 1997, relative to the actual decision to build the plant."*<sup>28</sup> For COGEMA, the solution is not at La Hague but at Marcoule: its project for MELOX is to reach a production level of 250 tons of oxide per year, far greater than the 115 tons authorized when the first production line was commissioned and maintained at the commissioning of the second one.

This is why the operator of the ATPu does not envisage closure of the installation in the present administrative situation: in its response of 1998 to the DSIN, it states when referring to production at the ATPu, that: *"in the future, only MELOX, with technical and administrative capacity extended to 250 tons per year of MOX production, will be able to provide such manufacture."*

And it concludes that *"in these conditions, shutting down the ATPu cannot be envisaged, from the industrial point of view, before the MELOX plant has been develo-*

*ped as described above."* For the safety authority, this constitutes *"blackmail"*, as attested by a comment in the margin of the letter in question<sup>29</sup>.

### No way out for German plutonium

Closure of the ATPu at the end of 2002 would have serious consequences not only for COGEMA but would also trigger a complete overhaul of the German strategy for plutonium management. The 40 tons of MOX produced annually at Cadarache for German electricity companies absorb more than 2 tons of plutonium. The remaining 262.2 tons under contract at the start of 2000 represent more than 15 tons of plutonium, or the equivalent plutonium content of the 1,652 tons of irradiated fuel still under contract (including the 1,127 tons termed "post-2000") for reprocessing at La Hague. In case of closure of Cadarache, there would be no alternative outlet route for the German plutonium separated in the La Hague plants by 2005, and the question can be posed as to the decisions Germany might take concerning its reprocessing contracts. On this subject, Mr Wolfram König, the head of Bundesamt für Strahlenschutz (BfS) – a state agency and sort of mixture of the DSIN, ANDRA and OPRI – has declared that:<sup>30</sup>

*"Reprocessing is limited under the consensus agreement until 2005.<sup>31</sup> The companies have the possibility of fulfilling former contracts. In the future, we will see if, finally, the companies will use this. There are already at present – amongst other things – economic arguments in favor of not fulfilling them. The key model envisaged at present as the solution by the Federal Government – avoiding transport by direct storage [of irradiated fuel] and storage of waste on nuclear power station sites – will certainly be a success."*

<sup>26</sup> CEA-COGEMA letter of 11 December 1997: DIR/CSN 97/982 - BR/SX 97/18.

<sup>27</sup> EDF has around 850 tons of plutonium reprocessed each year at the La Hague plant, producing between 8 and 8.5 tons of plutonium. With, at present, an average plutonium content for MOX of around 6 per cent, it would be necessary to produce around 135 to 150 tons of MOX to use up the plutonium separated each year. At the maximum level of 7.08 per cent of plutonium in the MOX, authorized since the end of 1998, MELOX nominal capacity of 101.3 tons is not sufficient to use up more than 7.2 tons of plutonium in a year. The present situation therefore, inevitably, leads to an increasing stock of plutonium "on the shelf".

<sup>28</sup> DSIN letter of 28 March 1995: DSIN/GRE/SD1/N°134/95.

<sup>29</sup> CEA-COGEMA letter of 11 December 1997: DIR/CSN 97/982 - BR/SX 97/18.

<sup>30</sup> Phoenix-TV, 27 March 2001

<sup>31</sup> In fact, the agreement between the German Government and the major nuclear operators stipulates that *transport* to reprocessing plants would no longer be allowed after July 2005. The fuel stored in the reprocessing plants can be processed later.



# Who's Who ? In France

## STATE BODIES and INDUSTRY

### Direction de Sûreté des Installations Nucléaires (DSIN)

The DSIN is the French nuclear safety authority (it also uses the acronym ASN). It defines general safety targets in the nuclear sector. It ensures that the exploiting companies take the necessary measures to achieve the targets and it notably grants exploitation authorizations to the different nuclear facilities. It is jointly supervised by the Ministry of the Environment and the State Secretariat for Industry  
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<http://www.asn.gouv.fr>

### DSIN - Sous-Direction Cycle du combustible, Transport (1<sup>er</sup> sub-division)

This sub-division deals with questions in relation with the fuel cycle and transport of nuclear materials. In particular, it examines applications introduced by COGEMA, Transnucléaire and the French-Belgian Fuel Manufacturing Company, FBFC.  
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### Institut de Protection et de Sûreté Nucléaire (IPSN) - Département de Recherches en Sécurité (DRS)

The Nuclear Protection and Safety Institute (IPSN) is the DSIN's technical back up. It undertakes research in all of the disciplines necessary to the control of risks within the nuclear facilities. The Cadarache-based Security Research Department (DRS) deals with the nuclear reactors security, carrying out studies by simulating situations of accidents.

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### Ministry of Land Planning and the Environment

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### COGEMA-Vélizy (Headquarters)

COGEMA, Compagnie générale des matières nucléaires, is an industrial company, exercising its activity in a context of competition. Its capital is held by the French State, through the CEA (74.7%), and by private groups: TOTAL-FINA-ELF with 14.5%, ERAP with 7.6% and Technip 3.2% (the latter has recently withdrawn from the capital). COGEMA is specializing mainly in products and services linked to the nuclear fuel cycle, from uranium extraction to the production of new fuels using plutonium resulting from spent fuel reprocessing.

**Philippe Pradel, Reprocessing Director at the Fuel Reprocessing Engineering Pole**  
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<http://www.cogema.fr>

### COGEMA-Cadarache

The Cadarache site is part of the fuel cycle production facilities held by COGEMA. The Cadarache production complex produces several types of fuel adapted to different existing reactors. The Plutonium Technology Facility (Atelier de Technologie du Plutonium (ATPu)), run by COGEMA, is located on the Cadarache site.

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<http://www-cad.cea.fr/ca3.htm#cogema>

### Cadarache CEN

The Cadarache Nuclear Research Center (Centre d'Etudes Nucléaires de Cadarache (CEN)) belongs to the CEA, R&D state body. Legally, the CEA owns but also exploits the Cadarache site. In fact, COGEMA exploits the CFCa for industrial purposes only, taking on production management, while the CEA is responsible for safety.

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and <http://www.cea.fr>

### CLI de Cadarache (Commission Locale d'Information)

The Local Information Commission (CLI) gathers approximately 80 persons: prefects, local representatives, personnel of the Cadarache site, NGOs... The CLI publishes a quarterly review, financed by the nuclear safety authority, providing general information on the nuclear sector and dealing more specifically with events taking place on the Cadarache site.  
<http://www.asn.gouv.fr/cli>

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## INDEPENDENT and OPPOSITION

### Greenpeace France

Greenpeace continues its campaign against spent fuel reprocessing and the use of MOX. In 2000, it entrusted WISE-Paris with a survey on the recycling of nuclear materials ([http://www.wise-paris.org/english/listingpublications/u\\_purecyclingconcl.html](http://www.wise-paris.org/english/listingpublications/u_purecyclingconcl.html)).

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<http://www.greenpeace.org>

### Forum Plutonium

Forum Plutonium is a network of organizations and individuals, created in 1994, to promote the distribution of information concerning the plutonium industry, and initiate a counter-expertise of the consequences of this activity, particularly in France. Jean-Pierre Morichaud, Secretary of Forum Plutonium, is a member of the High Council for Nuclear Safety and Information (Conseil Supérieur de la Sûreté et de l'Information Nucléaires (CSSIN)).

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### APRII-RAD

A non-governmental organization providing independent research and information on radioactivity. It notably follows up the activities carried out in Cadarache, and is a member of the Cadarache CLI.

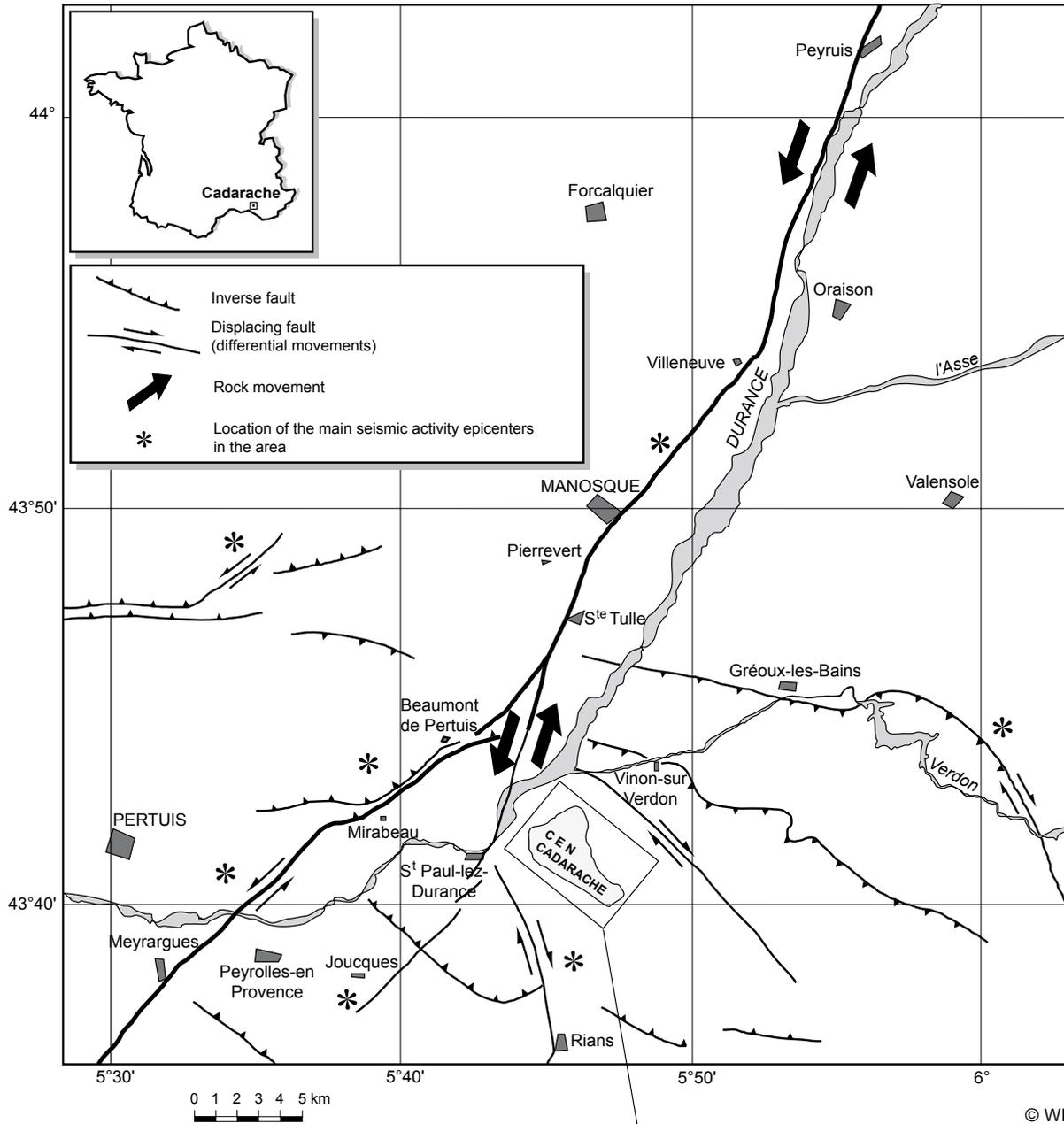
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### Stop MÉLOX

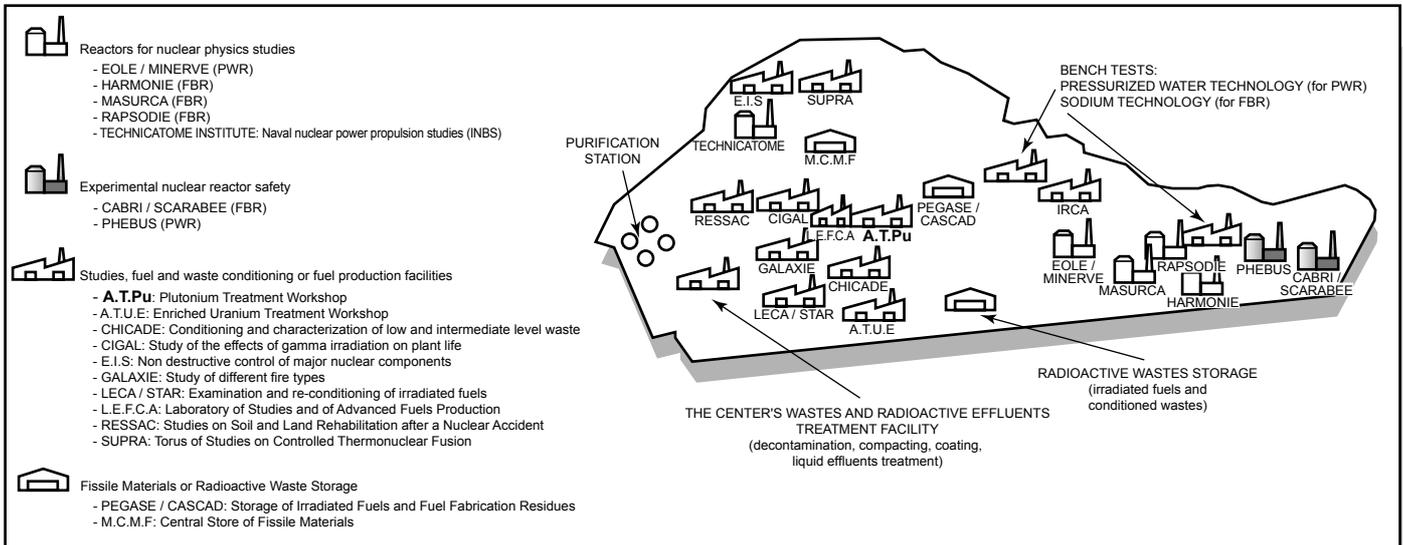
Stop MELOX is a local information group against the MELOX factory. It has launched information campaigns on the risks and dangers of MOX, and has been campaigning in favor of stopping the production and use of this fuel. It has been calling for the repeal of the Decree authorizing the construction of the Marcoule MOX production factory, MELOX.

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

# CADARACHE NUCLEAR RESEARCH CENTER: SEISMICITY AND INSTALLATIONS



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## FIGURES OF THE MONTH

### USE AND MANAGEMENT OF MOX FUEL IN GERMANY (AS OF 31 DECEMBER 1999)

Réacteur <sup>3</sup>	Site Name	Weight of FE	In reactor core	In Storage Facilities	Already Stored <sup>2</sup>					% max. of MOX
					COGEMA	BNFL	CLAB	Other <sup>1</sup>	Total	
		tHM	tHM	tHM	tHM	tHM	tHM	tHM	tHM	%
KBR	Brokdorf	0.530	33.9	11.1	10.1	0	0	0	55.1	33
KKU	Unterweser	0.530	25.4	15.4	2.1	14.3	0	0	57.2	33
KWG	Grohnde	0.530	8.5	2.7	14.3	0	0	0	25.5	33
KWO	Obrigheim	0.286	4.6	6.9	1.1	0	9.4	0.3	22.3	23
KKP2	Philippsburg 2	0.532	27.1	25.0	5.3	0	0	0	57.4	37
GKN1	Neckarwestheim 1	0.357	0	0	5.7	0	0	5.7	11.4	9
GKN2	Neckarwestheim 2	0.535	8.6	0	0	0	0	0	8.6	37
KRBB	Gundremmingen B	0.174	21.6	0	0	0	0	0	21.6	38
KRBC	Gundremmingen C	0.174	2.1	0.7	0	0	0	0	2.8	38
KKI2	Isar 2	0.535	8.6	0	0	0	0	0	8.6	50
KKG	Grafenrheinfeld	0.533	2.1	12.8	17.1	0	0	0	32.0	33
<b>Shut down installations</b>										
KRBA	Gundremmingen A	0.117	0	0	0	0	7.5	0	7.5	
KNK2	Karlsruhe	0.021	0	0	0.3	0	0	0.1	0.4	
MZFR	Karlsruhe	0.055	0	0	0	0	0.4	0	0.4	
VAK	Kahl	0.058	0	0	0	0.1	6.5	0	6.6	
<b>Total</b>			<b>142.5</b>	<b>74.6</b>	<b>56</b>	<b>14.4</b>	<b>23.8</b>	<b>6.1</b>	<b>317.4</b>	

<sup>1</sup> at KWO: WAK; at GKN1: Block 2 cooling pond; at KNK2: FZK Karlsruhe/hot cells

<sup>2</sup> Gorleben's Storage Facility / Ahaus Center: 0 tML

<sup>3</sup> Authorized reactors for MOX loading but not loaded: KKE-Emsland (25%), KWBA-Biblis A (41%), KWBB-Biblis B (41%), KKB-Brunbüttel (26%), KKK-Krümmel (25%), KKI1-Isar 1 (54%)

tHM: tons of heavy metal  
FE: Fuel Elements

Source: GRS, 'Entsorgung abgebrannter Brennelemente aus den Kernkraftwerken in der Bundesrepublik Deutschland', June 2000  
Translation and presentation by WISE-Paris

## WORDS OF THE MONTH

"Just between us, if La Hague is closed due to a lack of waste to reprocess, we won't shed any tears."

André Lajoinie, (PCF, Communist Party) Chairman of the National Assembly's Commission for Production and Trade (France), [*Enferme*, 7 February 2001]

"We need to find a clean way out of nuclear energy. That is why we have asked Anne Lauvergeon, CEO of COGEMA, to set up a fuel-cell research unit. The La Manche region is ready to welcome this type of research establishment."

Jean-François Le Grand, (RPR, Conservative Party), President of La Manche Regional Council [*La Presse de la Manche*, 28 April 2001]

**WORTH READING**



**Fred Barker, Mike Sadnicki, "The Disposition of Civil Plutonium in the UK", April 2001, 241 p.**

Immobilization of plutonium in storage MOX (or "bad MOX") could be up to 30 per cent cheaper and twice as quick to implement as the reprocessing-recycling option for disposal of plutonium. A study of disposal of stocks of "civil" plutonium in the UK by two independent British experts, F. Barker and M. Sadnicki, confirms that the plutonium route is not a competitive solution and indicates possible solutions for getting out of the dilemma of the continually increasing stocks of plutonium.

This study is the UK counterpoint to the French Charpin-Dessus-Pellat report submitted to France's Prime Minister in July 2000, which demonstrated that the reprocessing option is economically unfavorable. The British study was not based on calculation of the costs of the nuclear option with and without reprocessing, but rather on a comparison of the management costs of the enormous and ever growing stocks of separated plutonium from the nuclear power sector (61.7 tons at 31 March 2001). In particular, the experts compare the costs and time for disposal of plutonium using the MOX plant at Sellafield (with a capacity of 120 tons per year, the plant – officially – cost £460 million but has never been put into service) to produce either reactor quality MOX (it would then be necessary to build new reactors to use the MOX) or "storage MOX" (making low-quality or "bad MOX", according to the concept developed by the German Öko-Institut), or in ceramic pucks with a matrix that immobilizes the plutonium.

The results indicate that manufacture of storage MOX performs best in terms of cost and time and that immobilization in ceramic matrix (including the building of plant) is equivalent in terms of cost to the reprocessing-recycling option, but twice as efficient in terms of time. The analysis of these scenarios from the point of view of resistance to proliferation, waste management or even political acceptability confirms that "there is no economic justification for operation of the Sellafield MOX Plant (SMP) for MOX fuel production".

Four scientists from the University of Princeton and the Massachusetts Institute of Technology (MIT), who analyzed the basis of the storage MOX concept (see *Bulletin of the Atomic Scientist*, May/June 2001), also came to the following conclusion: "converting plutonium to storage mox and placing it in a massive container mixed with highly radioactive waste or spent fuel is clearly preferable to storing it indefinitely in a separated form."

Barker and Sadnicki's conclusions leave no room for appeal: "The poor commercial prospects for use of plutonium fuels mean that separated plutonium is unlikely to re-emerge as having commercial energy value in the foreseeable future. Civil separated plutonium should therefore be categorised as a liability and a waste. The costs of plutonium disposition should be included in forward projections of cash flows, and in balance-sheets. (...) It follows that a 'recycling' rationale for continued reprocessing does not exist."

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- N°17-18 USA    N°19 France
- "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).
- Payment to WISE-Paris by check in FRF or bank transfer.

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