Focus 13 Plutonium stockpiling, a signal for proliferation

Like every other country that has developed this technology, France became involved in reprocessing irradiated nuclear fuel in order to produce the plutonium necessary to develop a military arsenal. These countries then continued the activity for civil purposes to supply their breeder reactor programmes. While the USA abandoned civil reprocessing in 1976-77 because of the technology's very high risk of proliferation, France embarked on a programme of reprocessing of the fuel from its pressurised water reactors at La Hague, confirmed and extended in the mid-1980s with the launching of a programme to reuse the plutonium separated in the same reactors in the form of MOX fuel.

Large-scale separation of military plutonium began in 1958 and finished between 1991 and 1993, by which time about six tonnes had been produced in total.[82] Allowing for the quantities used up in tests and processing losses, the present stock can be estimated at around five tonnes. The civil nuclear programme brings much bigger quantities into play. The total quantity of civil plutonium stored in France, including all forms, stood at 294.2 tonnes at the end of 2006, according to France's latest official declaration to the IAEA (Table 12). This constantly changing total has probably exceeded 300 tonnes since that date.

This stock includes in particular unprocessed plutonium in the stocks of unreprocessed irradiated fuel, stored to await future reprocessing, and also separated plutonium stored to await reuse. It includes a proportion of plutonium of foreign origin in each category – though this proportion is falling rapidly as the reprocessing contracts with foreign electricity companies gradually come to an end. The most worrying point is the growth in the stock of separated unirradiated plutonium, theoretically awaiting reuse but actually piling up on the shelves. Although the official doctrine, ever since MOX fuel was first introduced into EDF's reactors in 1987, has been to preserve a "balance of flows" between the amounts coming from reprocessing and the amounts being reused, the un-reused stock, which stood at zero at the time, has grown more or less continuously to a total of 52.4 tonnes at the end of 2006. To this must be added a total of 29.7 tonnes of separated plutonium belonging to foreign customers.

The nuclear industry has long allowed this plutonium to build up while rejecting any concerns about the potential military implications of this stockpile. Areva used regularly to state that this plutonium could not be used to make a nuclear weapon, but this relied on semantics: according to the classification introduced by the USA, this plutonium is considered to be of "reactor grade", as opposed to the plutonium known as "weapons grade" used for weapons. The difference lies in the isotopic composition and in particular the level of odd-numbered isotopes responsible for the fission reaction (plutonium 239 and plutonium 241).[83] While this difference means that it is preferable to use the latter, it does not at all imply that it is impossible to use the former.

The IAEA, responsible for non-proliferation inspection on behalf of the UN, has expressed its position on this point very clearly, stating that it considers "any plutonium derived from fuel irradiated at a high burn-up, and of whatever composition except for plutonium containing over 80% of plutonium 238, to be usable in a nuclear weapon".[84] Pressed on this point during the national public debate on nuclear waste management in 2005-06, the directors of Areva admitted for the very first time, in a reply to the experts of Global Chance, that it was technically possible to use the plutonium separated at La Hague for military purposes. Claiming to have "no specific competence in the design or production of nuclear weapons", Areva referred to an article by the former Assistant Director General of the IAEA, Bruno Pellaud, to recall that not one of the more than 2,000 nuclear explosions carried out worldwide since 1945 had used reactor-grade plutonium, while admitting that it "could in principle be

[82] This figure is an average of available estimates which run from 4.3 to 7.8 tonnes.

[83] Plutonium derived from the reprocessing of irradiated fuel from modern reactors is "degraded" by the high burn-up fraction. Weapons-grade plutonium, which contains over 90% of fissile isotopes, is made from fuel that has been only slightly irradiated.

[84] Hans Blix, then Director of the IAEA, in a letter of 1 November 1990 replying to Paul Leventhal, President of the Nuclear Control Institute.

used to produce a bomb but [that] the practical difficulties are considerable".[85] The criticisms advanced over many years have never said otherwise.

The IAEA estimates the "significant amount" of plutonium, in other words the rough amount from which, taking account of the conversion processes, it cannot be technically ruled out that a bomb could be produced, to be 8.5kg. The stock of plutonium stored at La Hague in oxide powder form, which would be the most readily usable for this purpose, is around 50 tonnes, equivalent to nearly 5,900 bombs.

Table 12 Development of stocks of plutonium stored in France (1996-2006)

State of stock (at 31 December of the year)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Separated plutonium in the reprocessing plants	43.6	48.4	52.0	55.0	53.7	51.1	48.7	48.6	50.7	49.8	48.6
2. Separated plutonium being manuf./in half-finished products[a]	11.3	12.2	11.8	13.0	14.8	14.1	15.0	13.3	12.7	14.4	12.7
3. Plutonium contained in unirradiated fuel/manuf. products[a]	5.0	6.3	6.8	8.2	9.2	9.9	12.7	13.2	12.8	15.9	19.6
4. Separated plutonium stored in other installations[a]	5.5	5.4	5.3	5.0	5.0	5.4	3.5	3.5	2.3	1.1	1.2
Total unirradiated plutonium stored in France[c]	**65.4**	**72.3**	**75.9**	**81.2**	**82.7**	**80.5**	**79.9**	**78.6**	**78.5**	**81.2**	**82.1**
(i) Of which plutonium belonging to foreign organisations	30.0	33.6	35.6	37.7	38.5	33.5	32.0	30.5	29.7	30.3	29.7
(ii) Plutonium in one of the above forms (1 to 4) abroad	0.2	0.2	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total unirradiated plutonium belonging to France[c]	**35.6**	**38.7**	**40.3**	**43.5**	**44.2**	**47.0**	**46.4**	**48.1**	**48.8**	**50.9**	**52.4**
1. Plutonium in spent fuel/ reactor sites[b]	65.0	66.7	74.9	80.0	82.6	89.4	91.6	94.1	96.4	99.1	94.6
2. Plutonium in spent fuel/ reprocessing plants[b]	88.0	88.8	83.4	79.2	81.3	83.3	89.8	96.5	101.8	105.9	110.9
3. Plutonium in spent fuel/ other sites[b]	0.0	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	6.6
Total plutonium stored in spent fuel in France[c]	**153.0**	**156.0**	**158.8**	**159.8**	**164.4**	**173.2**	**181.9**	**191.1**	**198.7**	**205.5**	**212.1**
Total stored plutonium (irradiated and unirradiated)[c]	**218.4**	**231.1**	**234.7**	**241.0**	**247.1**	**253.7**	**261.8**	**269.7**	**277.2**	**286.7**	**294.2**

a. Rows 2 and 3 essentially correspond respectively to the plutonium held in the manufacturing plants and the power stations (other than in the reactors); row 4 includes plutonium separated for research purposes.

b. Rows 1, 2 and 3 essentially correspond respectively to the plutonium in discharged fuel still at power station sites, transferred to a reprocessing plant, and stored in research facilities.

c. Totals calculated by WISE-Paris, not given in the official declarations.

Sources: 1994–95 – French Secretary of Industry, 1997 ; 1996–2006 – declarations to the IAEA (InfCirc), 1997–2008

[85] Response to the questions of independent experts in the context of the Groupe de Travail sur l'Accès à l'Information (working group on access to information), reproduced in the report on the work of this group, *op.cit*.

In the first instance, the size of the stocks and of the plutonium flows resulting from the adoption of reprocessing and MOX presents a direct risk of proliferation associated with the danger of diversion. The misappropriation of only a thousandth of the quantities handled in a year by the reprocessing plant at La Hague and the MOX fuel manufacturing plant at Marcoule would give the perpetrators more than this 'significant amount'. The authorities have provided no details as to the accuracy of the flow measurements in these plants, that would enable us to know whether such a misappropriation would be detected, or after how long. Various precedents worldwide, and even in France (namely the inventory of the former ATPu MOX plant at Cadarache), have shown that "materials unaccounted for" (the discrepancies noted in the account of material coming in and going out) can reach this order of magnitude. On each occasion, the explanation given blames an accounting error or an undetected technical accumulation during some stage of the process. Nevertheless, when questioned as part of the 2005–06 public debate, the director of the department responsible for this monitoring within the IRSN stated that if a genuine loss was ever detected, this information would not be made public.

Beyond this direct risk, the stockpiling of 'civil' separated plutonium sets a very bad example internationally. The national electricity provider EDF, which legitimises a nonetheless technically and economically questionable reprocessing policy, bears a large share of the responsibility for this. The operator is undoubtedly the foremost producer of separated plutonium in the world today, and holds a stock of 26 tonnes, or over 3,000 times the 'significant quantity', stored in oxide powder form at the La Hague site. By completely covering up this aspect of proliferation in France, while promoting the extension of reprocessing internationally, the French authorities and nuclear industry are sending out an extremely dangerous signal on the international stage.