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Briefing

La Hague Particularly Exposed to Plane Crash Risk

Briefing NRA1

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Contents:

La Hague Particularly Exposed to Plane Crash Risk

1. Summary

The 11 September 2001 attacks against the World Trade Center and the Pentagon also hit the classical risk assessment procedures. In the case of nuclear facilities, it clearly appears that the international approach, summed up in France in two Fundamental Safety Regulations (Règles Fondamentales de Sûreté – RFS) applicable to reactors and other facilities, is now out-of-date: it is based on a probabilistic reasoning according to which a very serious risk but very improbable is admitted as «acceptable».

For the design of nuclear facilities, this vision resulted in considering only the risk of an accidental crash of small-sized aircraft, several hundred times less significant as far as impact is concerned, and containing only a fraction of the amount of kerosene (or jet fuel) the airliners «used» by the terrorists in the United States.

In spite of the reassuring tone adopted by the French authorities – contradicted by safety experts in France as well as by specialists of the International Atomic Energy Agency (IAEA) – the risk is that of a major accident: besides the fact that nuclear reactors are not conceived to resist a crash of such a scope, building experts agree to say that no construction made either of steel or concrete is guaranteed against the impact of a heavy airplane loaded with fuel. In the case of the containment wall of a nuclear reactor, this could lead to a scenario of releasing radioactivity comparable to that of the Chernobyl accident.

But the greatest danger comes undoubtedly from the La Hague reprocessing facilities, which concentrate a stock of radioactive substances that largely exceeds those of all the French nuclear reactors put together. WISE-Paris estimated that a serious accident scenario in only one of the irradiated fuel cooling pools at La Hague could lead to the release of radioactive cesium up to over 60 times the amount release during the Chernobyl accident.

A voluntary crash of an airliner on La Hague, a hypothesis still judged « improbable » by COGEMA, but which today has become « plausible », could result in such a scenario. Neither the reactors, nor the La Hague facilities are designed to resist such an impact. The crash of a big plane on La Hague could severely damage or destroy, besides the spent fuel pools, other parts of the plant such as the storage of high active wastes and the store of more than 55 tons of plutonium, the consequences of which would be impossible to price.

2. New Threats

In an article published in the beginning of September 2001, two EDF experts described the «*protection of reactors against airplane crashes*» [1]. The authors detailed the applicable safety regulations as far as this matter is concerned. Taking into account probability calculations, they explained how the only expected risk in the construction of power stations is the crash of a «civil» aviation aircraft: in other words, the probability of a military plane or airliner crashing on a nuclear reactor is judged too weak to take this risk into consideration. According to the experts, the probabilities are confirmed by experience: *«in any case, flying over the sites does not question their safety because, given the very small annual number of such flights and the probabilities of accident due to crashes per flight, it does not modify in a significant way the probabilities of undermining the safety functions and therefore does not lead to a significant increase of risk ».*

Before the 11 September 2001 terrorist attacks in New York and Washington, almost nobody had seriously imagined that a large plane could be used as a missile against a building. The only known

[1] Vitton, F. & Bai, J.-P., "*Protection des centrales contre les chutes d'avion*", *Contrôle*, September 2001. Francis Vitton is Director of the Nuclear Safety and Environment Division of SEPTEN, EDF's Engineering and services branches; Jean-Pierre Bai is Assistant Safety Mission Director at the technical direction of EDF's Nuclear Production Division.

precedent dates back to 12 November 1972, when three hijackers took control of a DC-9 of Southern Airlines and threatened to crash it on the Oak Ridge military nuclear research reactor in Tennessee. The hijackers flew on to Cuba after they obtained two million dollars.

The scenario of a real attack of this kind on one or several nuclear facilities by kamikaze commandos can no longer be ignored.

The large amount of data published on the attacks, attest of the credibility of the hypothesis of the use of nuclear terror by presumably involved organizations. Most of the information or hypotheses put forward concern the making and the potential use of nuclear explosives made of stolen fissile material[2]. Today, one has to take into consideration an attack similar to the one against the World Trade Center, against a nuclear site or a nuclear shipment. In 1993, the terrorists behind the car bombing against the World Trade Center, belonging to the terrorist networks that claimed to be part of the Islamic *jihad*, threatened to target nuclear sites in a letter received by the New York Times and authenticated by the authorities. In addition, the investigation is said to have revealed that the terrorist group trained in November 1992 in a camp near Harrisburg, in Pennsylvania 15 km away from the Three Mile Island nuclear power station[3].

Safety measures in France against this new risk are absolutely insufficient: according to an internal document drawn up by the French Defense Ministry, cited by *Libération*, on 12 September 2001, *«safety measures are not serious guarantees against kamikaze acts»*.

3. Safety Measures Applicable to French Nuclear Sites

3.1. A risk not taken into consideration

The conception of nuclear sites in France, as far as the risk of airplane crashes is concerned, is based on Fundamental Safety Regulations (Règles Fondamentales de Sûreté (RFS)), established by the Safety authority, to take into consideration «*risks linked to aircraft crashes*»:

- Regulation N° I.2.a of 5 August 1980, applicable to *«nuclear sites with pressurized water reactors»*;

- Regulation N° I.1.a of 7 October 1992, applicable to *«basic nuclear sites other than reactors, except the sites meant for long-term storage of radioactive waste»*.

Before the RFS were published, no specific regulation existed relative to air crash risk within the conceptualization of these nuclear facilities. This excludes *de facto* most of the existing nuclear facilities other than reactors – including most of the La Hague facilities – built prior to the coming into force of the RFS.

For nuclear reactors, the probabilities calculation that have been used, are based on the prescriptions of the RFS, and are presented in table 1 below. The risk of an airliner (i.e. over 5.7 tons) or a military plane crash is considered smaller than the threshold of risks that are sufficiently probable to be considered as *«plausible aircraft crashes»*, which is the only case dealt with in the regulations, according to the RFS N° I.1.a.

To design the facilities against the only risk taken into consideration, that of the crash of a small aircraft (i.e. below 5.7 tons), the RFS defines two types of planes «*judged as representative*»: (i) a 1.5-ton single-engine CESSNA 210 (propeller engine) and (ii) a 5.7-ton twin-engine LEAR JET 23 (twinjet), both of which are supposed to hit the facilities at a speed of 100m/s.

2 For a recent example, see David Leppard, "Warlord tried to buy uranium", *Sunday Times*, 16 September 2001 : *« Osama Bin Laden, the chief suspect behind the attack on the World Trade Center, has tried at least twice to buy enriched uranium to make a nuclear bomb, according to a former terrorist and Western intelligence »*.

3 For further information, see the Three Mile Island Alert's website, http://www.tmia.com/threat.html.

Table 1: Considered probabilities in the conception of nuclear sites taking into account plane crashes

Category	*Flights/yr in general*	*Probability of accident/flight*	*Probability of impact/year/ site/safety function*
Commercial aviation	700,000	$< 10^{-6}$	$< 10^{-8}$
Military aviation	500,000	10^{-6}	10^{-7}
General aviation	2,000,000	10^{-4}	Approximately 10^{-6}

Source: EDF, in Contrôle, *September 2001*

3.2. Appreciation of the capacity of nuclear installations to withstand a plane crash

The State Secretary for Industry, Christian Pierret, made statements that were surprising, to say the least: according to Agence France Presse (AFP)[4], he declared during a press conference, a spokes-person qualified as « informal », that «*nuclear reactors are conceived in their structures to resist to aircraft crashes. (…) Our energy system is closely controlled and designed in the first place to face such attacks* ». His nuclear adviser soon corrected the statement, explaining that «*it all depends on the size of the plane* » and that, in the case of an airliner, «*the measures to be put in place to prevent this kind of attack from happening are unachievable* »[5]. Numerous declarations from various experts suggest the impossibility to guarantee that any construction could withstand such a crash (see ***Annex 1***)

The Safety authority[6] confirmed in a press release, 13 September 2001 (see ***Annex 2***), that the case of a voluntary airliner crash has never been taken into consideration:

> *«Given the probabilities of aircraft crashes on nuclear facilities, the latter were built in the 1970s to resist without damages the impact of first category aircraft crashes, small general aviation planes. They were not built to resist without damage the crash of other planes, of which the probabilities to crash accidentally are extremely weak. As far as this matter is concerned, the French regulations are not different from those applied abroad.*
>
> *«The crashed planes in the USA were not accidental but were actually acts of war that are not taken into consideration in the construction of nuclear facilities.»*

The tone was meant to be reassuring on the potential impact of such an act:

> *«As to the crash of airliners, the impact on the safety of nuclear facilities would depend on several parameters and not only the weight of the plane. Although they were not built to resist without damage such a shock, nuclear power stations would offer a good ability of resistance with notably the concrete containment walls.»*

Very basic calculations on the kinetic energy of different types of aircraft in terms of flying characteristics show however that the shock would be of a totally different order: the scope of the shock caused by an airliner crash would be **several hundred times, even several thousand times, more important than the one considered in the regulations** (see table 2) and therefore in the design of nuclear facilities in France. Further, in addition to the effects of the crash, there are effects linked to the explosion and combustion of enormous amounts of fuel contained in the plane.

4 AFP, 12 September 2001
5 Cited by *Les Échos*, 13 September 2001.
6 Direction de la sûreté des installations nucléaires (DSIN)

Table 2: Evaluation of the energy released by the crash of different types of aircraft

Aircraft type	*Mass (tons)*	*Speed (m/s)*	*Kinetic energy (MJ)*	*Energy/ CESSNA*	*Energy/ LEAR JET*	*Fuel (liters)*
General aviation						
CESSNA 210	1.5	100	7.5	x 1.0	x 0.3	~ 350
LEAR JET 23	5.7	100	28.5	x 3.8	x 1.0	~ 1,500
Commercial aviation						
BOEING 747	397	252.8	12,680	**x 1,690.7**	**x 444.9**	216,840
BOEING 767	179	236.1	4,994	**x 665.9**	**x 175.2**	90,770
AIRBUS 320	77	243.9	2,289	**x 305.3**	**x 80.3**	29,660
AIRBUS 380	560	261.7	19,177	**x 2,556.9**	**x 672.9**	310,000

WISE-Paris Estimates

Notes : - Characteristics of general aviation aircraft : parameters taken into account in Fundamental Safety Regulations (RFS N° I.1.a and N° I.2.a).
- Characteristics of airliners (weight, speed, contained fuel): sources Boeing and Airbus, 2001. For commercial airliners, the weight, speed (cruising speed) and fuel are maximum values.

4. The Case of the La Hague Nuclear Reprocessing Facilities

Among the nuclear facilities located on the French territory, the scenario of a targeted plane crash on COGEMA's La Hague facilities would be the most extreme in terms of impact on the environment and public health: the spent fuel reprocessing facilities in the Nord-Contentin represent in fact an inventory of radioactive substances several orders of magnitude larger than that of a nuclear power station. The site is in particular used to store thousands of tons of irradiated fuel, tens of tons of separated plutonium and thousands of cubic meters of radioactive wastes.

On 30 June 2001, COGEMA presented the situation of its storage pools: 7,484.2 t of varied nuclear fuels (of which 7,077.7 from France) for a total storage capacity of 13,990 tons, spread in five pools. In addition, there are more than 55 tons of separated plutonium[7], which is conditioned in the form of oxide powder, more than 1,400 m^3 of highly radioactive glass, more than 10,000 m^3 of hulls and nozzles (of which 75% contained in temporary containers) and more than 11,650 m^3 of radioactive sludge (of which only 20% are stabilized)[8], as well as thousands of cubic meters of other less radioactive wastes and unknown quantities of chemical products, of which some are highly flammable, such as solvents.

4.1. The potential impact of a typical accident

WISE-Paris calculated the potential impact of a major accident in La Hague's pools. The analysis was completed in August 2001. The calculation of the impact is based on the hypotheses of an accident with internal causes. The scenario of a commercial aviation aircraft crash, which originally was not specifically taken into consideration in the calculation, is however likely to produce a similar result on a larger scale.

The calculation was made for the case of an explosion and/or fire in the spent fuel storage pool D (the smallest one), assuming that it is filled up to half of its nominal capacity of 3490 t, (corresponding to the present average saturation level of La Hague's spent fuel storage facilities), and supposing a release of up to 100% of the contained cesium. The limitation on cesium is justified by the fact that it is estimated that about three quarters of the long term radiological impact of the Chernobyl accident is due to Cesium-137.

[7] There was in France 81.2 t of « unirradiated » plutonium as of 31 December 1999, of which 37.7 t belonging to foreign companies, according to a statement made by the French Permanent Mission to the International Atomic Energy Agency (IAEA), INFCIRC/549/Add.5/3 of 19 March 2001. The same declaration indicated that 55 t of « separated » plutonium (i.e. in the form of oxide powder) are stored in the reprocessing plants, in La Hague.

[8] Calculations made by WISE-Paris and based on ANDRA's national inventory of wastes, edition 2000.

The impact analysis is a rather simple evaluation of the order of magnitude, because we assumed identical dispersion conditions as in the case of the Chernobyl accident. However, considering the exposure scenarios of the Chernobyl accident, the result then obtained, based solely on the stock of cesium in pool D, shows that a major accident in this pool could have an impact up to 67 times that of the Chernobyl accident.

In other words, a release limited to only 1.5% of the stock of cesium in a half full pool D would be consequently comparable to the release of cesium during the Chernobyl accident.

The WISE-Paris cesium release hypothesis is based on a study[9] published in October 2000 by the US Nuclear Regulatory Commission (NRC). In the study, the NRC calculated the risk of a «zirconium fire» following a loss of water in the storage pool of irradiated fuels. The NRC study shows that, should the temperature at the level of irradiated fuel for light water reactors reach 900°C approximately, the «zirconium fire», self sustained by various chemical reactions, would lead to the release of 50 to 100% of the volatile stored substances on site. The release periods vary according to the type of fuel and the configuration of the pool but the authors estimated that 4 to 8 hours are necessary in the case of light water fuels before a «substantial release» of fission products takes place. Besides, they underlined that criticality calculations should be specifically undertaken in the case of particular fuels such as MOX.

COGEMA successively stated in press release that *«the hypothesis put forward by WISE, i.e. the release of the cesium contained in the fuel, is unrealistic»*[10] and that there is *«not any basis»* for it (see the press release of 19 September 2001 in ***Annex 3***). In its study, WISE-Paris bases its calculations on the above-mentioned NRC report. Further, the example was meant to fix the orders of magnitude. The accidental release limited to a fraction of the cesium, let's say 10%, of the quantity contained in the considered spent fuel pool, would still correspond to 6 times the amount of cesium released during the Chernobyl disaster. Let alone the impact of a full larger pool or of the simultaneous destruction of several pools – which clearly has to be considered (see ***Annex 4***) – or stored plutonium and wastes.

The impact of a Boeing 767 on a building containing a storage pool, can imperil the integrity of fundamental safety equipment *«such as energy supplies, heat exchangers, and auxiliary water sources and could also affect rescue actions»* within the impact area, according to the NRC study (see Annexes 1 and 2). In other words, not only the directly hit –and certainly destroyed– cooling pool but also other neighboring pools and buildings containing large amounts of radioactive substances could be seriously damaged. The release of radioactivity could consequently largely exceed the content of a single cooling pool.

Considering the dominant wind map around La Hague, as mentioned in public inquiry documents , the main directions, 40, 60 and 200°, correspond respectively to the English Channel, London and Nantes.

COGEMA and the public authorities must urgently analyze these scenarios in order to take clear priority measures to protect the facilities.

It can also be noted that the NRC report cited above considered the scenario of plane crash as a plausible hypothesis causing the loss of water in spent fuel storage pools. As of 18 September 2001, COGEMA continues to pretend on its website[11] that *«the crash of an airliner on the La Hague site is a highly improbable scenario»*, adding *«that low altitude flying over the area are forbidden»*.

4.2. The protection of the La Hague facilities against aircraft crashes

As far as the design basis is concerned, the La Hague facilities are no more protected against an airliner crash than any nuclear power station: «*in such an extreme scenario, in addition to safety measures taken at the design phase, the safest protection resides in the capability of the National Defense to act*», declared a COGEMA-La Hague spokesman[12]

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9 US NRC, « Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants », October 2000.

10 Excerpt from the first press release put on its website www.cogemalahague.fr by COGEMA, 18 September 2001, replaced by a new press release on 19 September 2001.

11 Idem.

12 *Les Échos*, 13 September 2001.

The COGEMA application for increasing storage capacity (from 13,990 to 17,600 t) and reprocessing capacity (up to 1,000 t/year in each of the two facilities, instead of 800 t/year presently, although still remaining within the annual 1,700 t/year site limit) submitted to a public inquiry in December 1998, might aggravate the situation. COGEMA stated in the chapter on risk assessment of the public inquiry document that *«the probability [of a plane crash was] judged as sufficiently low not to take into consideration this risk in the design»* of the UP2-800 (INB 117) facility, one of the two largest facilities of La Hague.

Beyond this indication, the document COGEMA submitted for public inquiry does not provide any information on the design of the various facilities regarding this risk. Questioned by WISE-Paris on 18 September 2001 on this particular matter, a COGEMA spokes-person was unable to comment.

Finally, concerning the *«risk of fire and external explosion»* COGEMA in its risk assessment study estimates that the fact that *«potential sources constituted by the storage of flammable substances»* are kept isolated and at distance, permits *«to guarantee the absence of dispersion of radioactive matters»*, The document, however, does not specify the underlying scenarios. What would happen should a large jet fuel fire start on (or even in) the store containing tens of tons of plutonium or in one of the spent fuel storage buildings? *«Neither concrete nor steel would resist to such a quantity of fuel and temperature of more than the likely reached 2,000 degrees»*, said Charles Baloche, Head of Safety, Structures and Fire Division at the French construction industry's Scientific and Technical Center.[13]

As reference, COGEMA mentions the study of one single case of a crash of a Cessna 210. The Cessna is 120 times less heavy, and contains 260 less jet fuel in its tanks than a Boeing 767. The study published by the NRC in October 2000, in the chapter dealing with potential plane crashes, presents the possible resistance of a site to the penetration of an aircraft (see table 3).

Table 3: Penetration probability in terms of location and thickness of reinforced concrete

		Penetration probability (%) relative to the thickness of concrete (cm)			
Location of the site	**Aircraft category**	***30.48 cm***	***45.72 cm***	***60.96 cm***	***182.88 cm***
≤ 8 km away from airport	Small ≤ 5,4 t	0.3 %	0 %	0 %	0 %
	Big > 5,4 t	96 %	52 %	28 %	0 %
> 8 km away from airport	Small ≤ 5,4 t	28 %	6 %	10 %	0 %
	Big > 5,4 t	100 %	100 %	83 %	32 %

Source: NRC, October 2000

The authors broadly assumed a 45% penetration probability in the irradiated fuel storage facility, then a 50% probability reaching safety functions and leading to a «zirconium fire». They finally came to the conclusion that «*as long as the zirconium fire is possible, the long-term consequences of a fire in an irradiated fuel pool are significant. The long-term consequences (and the risks) decrease extremely slowly in time due to caesium-137, which has approximately a 30-year half-life* ». Cesium-137 is estimated to be responsible for more than 75% of the dose received worldwide following the Chernobyl accident. As of 30 June 2001, La Hague's irradiated fuel storage facilities contained more than 7,500 kg of cesium, representing more than 85 times as much as the Chernobyl reactor core, when the accident happened, or 280 times as much as the amount released after the accident.

4.3. A major airport at 30 km from La Hague

COGEMA stated on a potential air crash on La Hague: *«The defense against such a hypothesis is the responsibility of the National Defense. The Air Force, on alert, is ready to take off within two minutes and intervene immediately »*[14] adding a day later that *«given its geographical location, the National Defense*

[13] Centre scientifique et technique du bâtiment, CSTB, *www.lesechos.fr*, 13 September 2001.
[14] www.cogemalahague.fr, 18 September 2001, replaced on 19 September 2001

would have time to act should it suspect an infringement to this rule». The delay envisaged does not seem to include the time necessary for fighter planes to reach the area.

The December 1998 public inquiry COGEMA documents contain some information on air traffic near La Hague:

«The Cherbourg-Maupertus airport (30 km to the east) gives access to large carriers except those of a Boeing-747 size.

In 1996, 14,761 plane movements were registered (take off and landing) for a total of 48,496 passengers.

These movements are mainly due to general aircraft, training flights of neighboring air-clubs, business aviation, military planes and commercial aviation airliners linking the Anglo-Norman Islands to Paris. […]

One may note that the La Hague Site is located 25 km away from the air lines.

Controlled airspace corresponds to the areas where traffic is the most intense. This airspace is far from the La Hague site. In fact, the La Hague site is outside the Anglo-Norman Islands' and Cherbourg-Maupertus's «Terminal Movement Areas», as well as the air lines:

- *the Cherbourg T.M.A. limit; is 7 km to the east; those of Jersey, Guernsey and Aurigny, 8 km to the west,*
- *the W 8 London – Jersey airline is 30 km to the south of the site».*

A general plane flying at 100 m/s covers a distance of 8 km in 1 min 20 s. It would take half this time for a commercial aviation aircraft, flying at 200 m/s, to cover this distance, that is 40 seconds. The average time the planes take to cover this distance is, in both cases, within the two minutes necessary for the Air force planes to intervene. It is however correct that an airliner (flying generally at 200 m/s) and taking the air corridor 30 km south of the facilities, would be within the intervention time put forward by COGEMA. It would take the airliner 2 min 30s to reach the reprocessing facilities. However, the safety margin would be virtually zero and it seems highly questionable whether the identification and interception of a kamikaze plane by fighter planes is a practical defense strategy.

Finally, COGEMA states that «*flying over the factory is forbidden at any time*» but omits to add that the prohibition, according to its own public inquiry documents, is limited to «*low altitude flying: 300 m for single-engine aircraft and 1,000 m for jet-engine aircraft* ».

4.4. The need to revise the evaluation of probabilities

The RFS N° I.2.a and N° I.1.a, which concern reactors and other facilities respectively, define in their final paragraph (§3.3) the applicable prescriptions in the case of the *« evolution of the environment »* :

> *« When, on a particular site, the airspace is to change, resulting in the changing of the order of scope and previous probabilities, it shall be taken into account in the examination of the compatibility of the planned site with its environment. »*
>
> *« When on the contrary developments take place after the building of the site has been approved, a new evaluation of the probabilities shall be presented by the operator to the Safety authorities with, when necessary, the description of additional measures planned as well as the corresponding justifications. »*

Since 11 September 2001, more than an *evolution*, there has been a *revolution* in the airspace. COGEMA is required to present a new evaluation of probabilities to the Safety authorities… and to the population.

Annex 1

Statements on the non-resistance of facilities to aircraft crashes

Since 11 September 2001, several statements were made by key figures in the nuclear safety sector in France or abroad, as well as by specialists of the building sector, which confirm that nuclear facilities, as any other buildings, are not made to resist to a large airliner crash:

- *«No regulation in the world can guarantee that a nuclear power station will not be damaged by a crash of a big airliner».*

  Jérôme Goellner, Assistant Director, DSIN. Cited by *Les Échos*, 13 September 2001.

- *«No classified facility, either nuclear or industrial, is built to resist the impact of a big carrier».*

  A high official of the MATE Pollution and Risk Prevention Division (Direction de la Prévention des Pollutions et des Risques (DPPR)). Cited by *Les Échos*, 13 September 2001.

- *«No building in the world could resist an impact as violent as that of the two planes»* that crashed on the World Trade Center.

  Bertrand Lemoine, Group Usinor Building Development Director. Cited by *lesechos.fr*, 13 September 2001.

- *«We can't guarantee that containment building of a reactor would resist to a crash of an airliner».*

  Philippe Jamet, IPSN. Cited by *Le Monde*, 14 September 2001.

- *«The nuclear reactor building would probably not resist to the impact of the accidental or terrorist-induced crash of a big airliner because this risk is statistically too weak to be taken into consideration in their conception, declared Wednesday an IPSN expert to AFP».*

  AFP, 12 September 2001.

- Lothar Hahn, Director of the German Reactors Safety Commission (RSK), declared that an aircraft attack on a nuclear power station was the *« worst case scenario».*

  Frankfurter Rundschau of 13 September 2001.

- *«If we consider the risk of a* jumbo jet *loaded with fuel, it is clear that [nuclear power stations] were not conceived to resist to such an impact».*

  David Kyd, IAEA spokesman, Associated Press, 17 September 2001.

Annex 2

DSIN press release, 13 September 2001

Paris, le 13 septembre 2001

Note d'information

sur la protection des installations nucléaires contre les chutes d'avions

La protection des installations nucléaires contre les risques externes (séismes, inondations, incendies d'origine externe, …) est un aspect de la sûreté pris en compte par l'Autorité de sûreté nucléaire (ASN).

Concernant les chutes d'avions, les règles fondamentales de sûreté (RFS) applicables distinguent, pour la construction des installations nucléaires, 3 familles d'avions :

1) les petits avions civils (aviation générale, de masse inférieure à 5,7 tonnes) ;

2) l'aviation militaire ;

3) l'aviation commerciale (avions de masse supérieure à 5,7 tonnes).

Compte tenu des probabilités de chute de ces avions sur les installations nucléaires, celles-ci sont construites depuis les années 70 pour résister sans dommages à l'impact de la chute d'avions de la 1ère famille, les petits avions civils. Elles ne sont pas construites pour résister sans dommages à l'impact d'autres avions, dont les probabilités de chute accidentelle sont extrêmement faibles. En la matière, les règles françaises ne diffèrent pas de la pratique internationale.

Ce qui s'est passé aux USA ne relève pas de chutes accidentelles mais de véritables actes de guerre, qui ne sont pas pris en compte dans la construction des installations nucléaires.

S'agissant de la chute d'un avion de grande taille, l'impact sur la sûreté d'une installation nucléaire dépendrait de multiples paramètres et pas seulement de la masse de l'avion. Même si elles ne sont pas construites pour résister sans dommages à un tel choc, les centrales nucléaires offriraient une bonne capacité de résistance grâce notamment à leurs enceintes de confinement en béton armé.

Par ailleurs, les installations nucléaires sont classées points sensibles et à ce titre font l'objet de mesures de protection contre le terrorisme, qui ont été renforcées dans le cadre du plan VIGIPIRATE. Ces mesures, de même que les études menées sur la résistance d'une installation nucléaire face à un acte de terrorisme ne peuvent pas, par nature, faire l'objet d'une communication publique.

Le numéro 142 de *Contrôle*, le magazine de l'ASN, paru début septembre 2001, traite de l'ensemble des risques externes (séismes, inondations, incendies d'origine externe, …) et compte un article consacré à la protection des centrales nucléaires contre les chutes d'avions.

www.asn.gouv.fr

Annex 3

COGEMA press release, 19 September 2001

19 septembre 2001

Le point sur la sûreté de l'usine de La Hague face au risque de chute d'avion

Le rapport évoqué dans deux récents articles de presse émane de Wise-Paris, une organisation anti-nucléaire notoire, comme il est facile de le constater sur son site Internet (www.pu-investigation.org).

COGEMA regrette donc que son avis n'ait pas été sollicité avant la publication d'articles qui ne reflètent qu'une position émanant d'une source unique délibérément partisane.

Un rapport non avalisé par les experts européens

Le rapport dont il est question ne porte en aucun cas sur les risques liés à une chute d'avion commercial sur l'usine de La Hague. Il a pour seul objet l'analyse de l'impact sur l'environnement des usines de traitement des combustibles usés de La Hague en France et de Sellafield en Angleterre.

Dès l'origine, les conditions dans lesquelles le STOA - Office du Parlement Européen en charge des questions Scientifiques et Technologiques - avait attribué la réalisation de cette étude à Wise-Paris, avaient fait l'objet de contestations. En particulier de la part de parlementaires européens conscients de la partialité de cette organisation.

A la connaissance de COGEMA, le rapport remis au STOA se trouve à l'état de projet, ses conclusions restant provisoires dans l'attente de leur examen par des experts et les parlementaires européens. Cet examen permettra d'établir la vérité scientifique.

Un scénario dénué de tout fondement

L'absence de rigueur scientifique de l'étude de Wise-Paris est d'abord illustrée par la comparaison faite avec Tchernobyl. Non seulement, l'usine de La Hague est une installation industrielle chimique ne s'apparentant en aucune façon à un réacteur nucléaire, mais son activité même réduit les risques d'accidents dus à une chute d'avion. Le combustible usé présent sur le site y est en effet moins vulnérable que dans une centrale nucléaire ou à proximité. Quant aux résidus vitrifiés issus du traitement, ils sont totalement inertes et exempts de tout risque.

Par ailleurs, WISE-Paris prend comme hypothèse le relâchement dans la nature de l'intégralité du césium contenu dans les combustibles en piscine. Cette hypothèse est dénuée de fondement scientifique pour plusieurs raisons :

• En premier lieu, les combustibles sont très bien protégés car contenus dans des gaines elles-mêmes assemblées et tenues dans des alvéoles métalliques, le tout placé sous quatre mètres d'eau.

• Leur refroidissement à une température moyenne de 40° est assuré en permanence et, dans l'hypothèse déjà improbable où ils se retrouveraient hors d'eau, plusieurs jours seraient nécessaires pour qu'ils parviennent à une température équivalente à celle atteinte dans les réacteurs.

• Enfin, la température des combustibles pourrait être maintenue, grâce aux moyens d'intervention dont dispose l'usine, à un niveau tel que les risques de fusion ultérieurs peuvent être écartés.

COGEMA a étudié, bien avant les attentats commis aux Etats-Unis, l'éventualité d'un accident provoquant la vidange totale des piscines. Il est apparu que cette vidange ne serait pas immédiate et que le réchauffement des matières radioactives s'étalerait sur plusieurs jours, laissant le temps au dispositif anti-incendie de l'usine d'intervenir avec efficacité. En effet, l'usine COGEMA de La Hague dispose d'un centre de secours et d'un effectif d'une cinquantaine de pompiers hautement spécialisés et familiers des installations. Les capacités d'intervention anti-incendie propres au site sont équivalentes à celles d'une ville de 35 000 habitants.

Un site hautement protégé

L'usine de La Hague bénéficie de ce que l'on appelle une défense en profondeur. La quasi-totalité de ses bâtiments sont ainsi protégés par une épaisse couche de béton d'une extrême robustesse. Comme l'a rappelé le Directeur de l'Autorité de sûreté nucléaire dans des déclarations ces derniers jours, aucune installation nucléaire n'a été conçue pour résister à la chute d'un avion de ligne. COGEMA et l'Autorité de sûreté nucléaire avaient retenu l'hypothèse de la chute d'un bimoteur, mais, jugé trop improbable le risque accidentel de chute d'un avion gros-porteur (moins de 1 sur 100 millions). Cependant, la conception du site a fait l'objet d'études dites "hors dimensionnement" prenant en compte les conséquences extrêmes d'une vidange totale des piscines à l'occasion d'un accident d'origine non identifié. Ces études ont démontré que les moyens d'intervention et de secours mis en place permettraient de faire face à une telle situation.

Reste que le risque d'un écrasement volontaire d'un avion commercial sur l'usine et a fortiori sur les piscines demeure lui aussi extrêmement faible : même en dehors des périodes d'alerte renforcée, le site de l'usine est considéré comme un point sensible national placé sous surveillance et bénéficiant des moyens appropriés de protection.

Dans ce cadre, l'usine fait l'objet d'une interdiction permanente de survol. Compte tenu de sa position géographique, la Défense Nationale aurait le temps d'intervenir si une infraction à cette règle était suspectée.

La configuration même de l'usine rend le scénario imaginé par WISE irréaliste :

• Les structures sont en partie construites en sous-sol et les piscines occupent une faible superficie par rapport à l'ensemble des autres installations dans lesquelles elles se trouvent insérées. Il serait donc impossible à un avion de percuter verticalement une piscine.

• Les piscines de La Hague sont entourées d'autres bâtiments qui constitueraient un premier obstacle à la percussion d'un avion de ligne.

• Les piscines sont indépendantes les unes des autres et leur configuration rend impossible une percussion simultanée. De plus, leurs parois de béton armé ont en moyenne 80 centimètres à 1,60 mètre d'épaisseur et sont conçues pour résister à des séismes de magnitude 8.

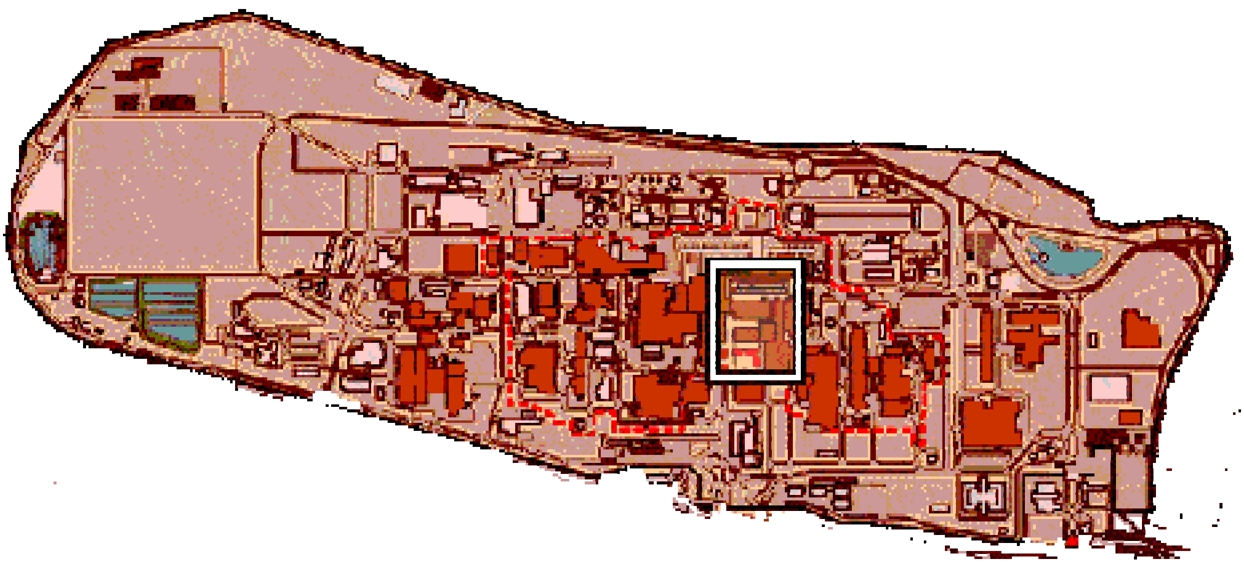
Au sol, la sécurité des installations de la Hague est assurée en permanence par des forces de sécurité spécialisées propres à COGEMA. L'ensemble du site est entouré d'une double clôture périphérique et muni de systèmes de détection et de télésurveillance très sophistiqués. L'accès aux zones les plus sensibles n'est possible que pour les personnels dûment autorisés.

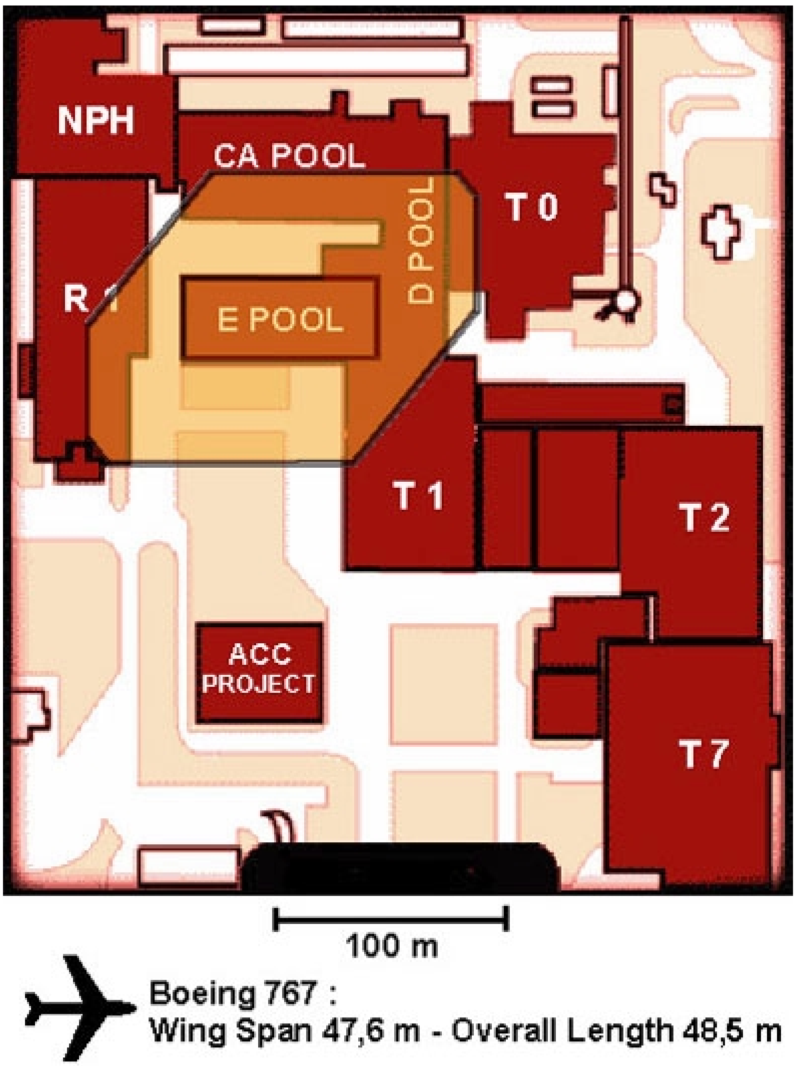
Ces mesures ont encore été renforcées depuis le 11 septembre avec la mise en place du plan Vigipirate. Les visites du public sont notamment suspendues depuis cette date.

www.cogema.fr

Annex 4

Area of potential damage in the case of an impact on one of the La Hague storage pools





Above: the La Hague nuclear reprocessing installation and its irradiated fuel storage pools (framed).

Opposite: Main area (in orange) of potential damage on buildings and equipment, in the case of a Boeing 767 crash on pool E (assessment method used by the US NRC).

Installations:

NPH, T0: Spent fuel storage reception / pools.

R1-T1: Shearing/dissolution facilities (head ends).

T2: Fission product separation/concentration plants.

T7: Vitrification plant.

Pools D, E, CA: Spent fuel storage pools.

Source : WISE-Paris, according to www.cogemalahague.fr, NRC, 20