WORKING PACKAGE NO 2

REVIEW OF INFRASTRUCTURES IN FRANCE

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1. THE FRENCH REGULATORY FRAMEWORK

The French regulatory framework for the radiological protection has evolved recently (it has been updated to implement the European Directives 96/29 and 97/43). The Law is now based on five decrees, two of them concerning the protection of public against ionising radiations (the three others are concerning the protection of workers and patients) : one deals with the protection of the population against dangers from ionizing radiations mainly in « normal situations »[1], and the other with the interventions in radiological ermergency situations[2].

Several other regulatory texts complete the regulatory framework as far as emergency situations are concerned, but they are all focussing on the crisis phase after the accident. They establish the regulatory requirements for :
- the preventive distribution of iodine tablets in the vicinity of nuclear power plants[3]
- the implementation of the alert procedures in case of an accident[4],
- the implementation of national and local emergency plans[5],
- and the organisation of the emergency aid (health care) in case of nuclear or radiological accident, including terrorist attacks using radioactive substances (for example, there is a list of the regional reference hospitals to host the victims from an accident)[6] .

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1 Décret n°2002-460 du 4 avril 2002 relatif à la protection générale des personnes contre les dangers des rayonnements ionisants

2 Décret n°2003-295 du 31 mars 2003 relatif aux interventions en situation d'urgence radiologique et en cas d'exposition durable et modifiant le code de la santé publique.

3 In 1997, the French government decided to distribute stable iodine tablets to those living in the vicinity of NPPs (within a 10 km radius of a nuclear power plant). The next campaign of iodine tablets distribution is scheduled in 2005. (cf. Circulaire interministérielle n°4.483/SG of 30th April 1997). For further information on iodine tablets distribution, also see : - Circular of April 11th 2000 concerning the renewing of iodine tablets distribution for the population living in the vicinity of nuclear installation, - Circular DGS/2000/262 of May 17th 2000 concerning missions connected to tablet iodines distribution for local Public Health services, - Circular DGS/SD7D/SGCISN/DDSC no 2001-549 of November 14th 2001, and circular DGSNR od December 23rd 2002 concerning the management of preventive distribution and proximity stocks of iodine tablets.

4 Décret 90-394 du 11 mai 1990 relatif au code national d'alerte, modifié par le décret n°2001-368 du 25 avril 2001 relatif à l'information sur les risques et sur les comportements à adopter en situation d'urgence

5 Décret n°88-622 du 6 mai 1988 modifié relatif aux plans d'urgence pris en application de la loi n°87-565 du 22 juillet 1987 relative à l'organisation de la sécurité civile, à la protection de la forêt en cas d'incendie et à la prévention des risques majeurs.

Concerning the contamination limits for food, cattle feed and products meant to export market, France is using the values defined by the European Community (Euratom).[7]

The above mentioned French decree on interventions after an accident defines also the responsabilities of the utility where the accident occurred and those of the French authorities towards the evaluation of the circumstances and consequences of the accident (eg. dose assessment), the information of public and if necessary, the implementation of protective measures; it also defines the training requirements and establishes the needs in terms of protective equipments of the interveners; it states the limitations in relation with the intervention (eg. dose limits[8], interdiction of intervention for young people and pregnant women) and reinforces the health surveillance of interveners according to the roles they would have - technical staff, medical staff, or other professionnals - during the emergency or long-term post accidental phases.

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6 Circulaire DHOS/HFD/DGSNR n°277 du 2 mai 2002 relative à l'organisation des soins médicaux en cas d'accident nucléaire ou radiologique.

Circulaire n°2002-800/SGDN/PSE/PPS relative à la doctrine nationale d'emploi des moyens de secours et de soins face à une action terroriste mettant en œuvre des matières radioactives.

Circulaire DHOS/HFD n°2002-284 du 3 mai 2002 relative à l'organisation du système hospitalier en cas d'afflux de victimes.

Circulaire DHOS/HFD/DGSNR no 277 du 2 mai 2002 relative à l'organisation des soins médicaux en cas d'accident nucléaire ou radiologique.

Circulaire DGS/DAGPB/HFB n°2002-191 du 3 avril 2002 relative au renforcement des moyens en personnels des services déconcentrés dans le cadre du plan gouvernemental de lutte contre le bio-terrorisme.

7 Règlement (Euratom) n°3954/87 du Conseil en date du 22 décembre 1987 fixant les niveaux maximaux admissibles de contamination radioactive pour les denrées alimentaires et aliments pour le bétail après un accident nucléaire ou dans toute autre situation d'urgence radiologique.

Règlement (Euratom) n°944/89 de la Commission en date du 12 avril 1989 fixant les niveaux maximaux admissibles de contamination radioactive pour les denrées alimentaires de moindre importance après un accident nucléaire ou dans toute autre situation d'urgence radiologique.

Règlement (Euratom) n°770/90 de la Commission en date du 29 mars 1990 fixant les niveaux maximaux admissibles de contamination radioactive pour les aliments pour bétail après un accident nucléaire ou dans toute autre situation d'urgence radiologique.

Règlement (CE) n°616/2000 du 20 mars 2000 modifiant le règlement (CEE) n°737/89 du 22 mars 1990 relatif aux conditions d'importation de produits agricoles originaires des pays tiers à la suite de l'accident survenu à la centrale nucléaire de Tchernobyl.

8 100 mSv for the technical and medical staff who intervene (300 mSv if the intervention aims at protecting people) with a lifetime effective dose limit of 1 Sv, 10 mSv for other professionals who could participate to the intervention (article R. 1333-75 to R.1333-93 from Public Health Code, see decree no 2003-295 of March 31st 2003 on interventions in radiological emergency cases and occupational exposure; JO n° 78 du 2 avril 2003n page 5776).

The article 43-85 of this decree clearly states that in case of long-standing exposures to radioactive substances, the police authority (generally speaking, the prefect[9] or sub-prefect of the affected region) must take one or several of the following measures (according to the radiological risks he has to appreciate with the help of the competent technical supports of the radiological protection and safety authorities) :

- information of the population on the risks,
- delimitation of the area where the protective measures will be implemented,
- implementation of an internal and external doses follow-up,
- access restriction and limitation of the landscape and dwellings uses,
- implementation of emergency response planning - especially on food and water supplies - to reduce public exposures (after having received the advice of the DGSNR).

Finally, the decree indicates that a long-term assessment of the evolution of radiological risks (presence of radioactivity) must be made by the competent authorities and their technical supports.

9 Governor of the county

2. THE ORGANISATION DURING THE CRISIS PHASE AFTER A RADIOLOGICAL ACCIDENT IN FRANCE

2.1. General organisation at the local level

At the local level, in case of a nuclear accident, only two bodies are legally in a position to take operational decisions at the local level during the very short-term post-accidental phase :

- the **utility** (Electricité de France, CEA, AREVA, etc) operating the NPP where the accident has occurred is responsible for the organisation of the short-term control of the situation, the evaluation and mitigation of the consequences, the protection of people who are working on-site, the emergency (and then, a regular) information of the authorities by implementing the so called On-Site Emergency Plan (« PUI »[10]). The PUI is mandatory, and is checked and validated by the French authorities. EDF will also provide its help in the decision making process.

- the **prefect**[11] - who is the local administrative representative of the government - will decide what measures are needed in order to guarantee the protection of people environment and goods by implementing the so called Off-Site Emergency Plan (« PPI »[12]) and, if necessary, he will co-ordinate the action of the neighbouring affected counties. He is also responsible for alerting people and implementing emergency countermeasures (eg. sheltering, evacuation, distribution of iodine tablets…), and he will give all the available information to allow people to estimate the gravity of the situation and its possible evolution.

In case of an accident, the prefect implements a crisis organisation structure with fixed (PCF) and operational (PCO) headquarters. The PCF is the local place where the decision are taken by the prefect (at the prefecture facilities). On the spot, as close to the installation as possible, the operational headquarter is under the leadership of a sub-prefect (in France, there is one sub-prefect per district) and he implements the decisions taken by the prefect. PCO id divided into three groups of persons: the headquarter which is responsible for the management of the

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10 Plan d'Urgence Interne

11 Continental France is divided into 95 counties or « deparments », each of them under the administrative responsability of one prefect.

12 Plan Particulier d'Intervention.

situation and the implementation of necessary means (PCM), a cell which constitutes a strong link with local elected people (eg. mayors), and a local press center. PCM puts together operational services such as firemen department (several firemen specific mobile units named « CMIR »[13] have the adequate equipments to detect radioactivity, to measure doses with WBCs, and to take food/earth/plants samples…), the regional police department (« Gendarmerie ») and mobile emergency medical services (« SAMU[14] »). PCM is in charge of off-site radioactivity measurements, access controls in contaminated areas, and alert people and professionals of the health care system (eg. hospitals and medical services, local and regional - DDASS - social services).

Moreover, the French authorities encourage the mayors of town located close to nuclear installations to prepare - and implement – « local action plan for anticipating, organising, and structuring accompanying measures. Local action plans are not mandatory but, if they do exist, they are very useful to reinforce PPIs.

2.2. General organisation at the national level

At the national level, the main stakeholders are :

- *the Ministry of the Interior (Home Office) represented during a crisis by the Civilian Defence and Security Directorate (DDSC) and the Nuclear Risk Management Support Mission (MARN)[15]*: the DDSC helps (with reinforcements and further supplies) the prefect to implement operational measures for safeguarding people and goods.

- *the Ministries of Industry, Environment and Health represented by the French Authority for safety and radiological protection (DGSNR[16]) with the technical support of the French Radiological Protection and Safety Institute (IRSN[17])*: DGSNR with IRSN are responsible of the control of the safety and radiological protection of nuclear installations. Especially, they will check the usefulness and efficiency of the mitigating measures taken by the utilities. The Ministry of Industry will also coordinate the national communication in case of an accident.

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13 Cellule Mobile D’Intervention Radiologique.

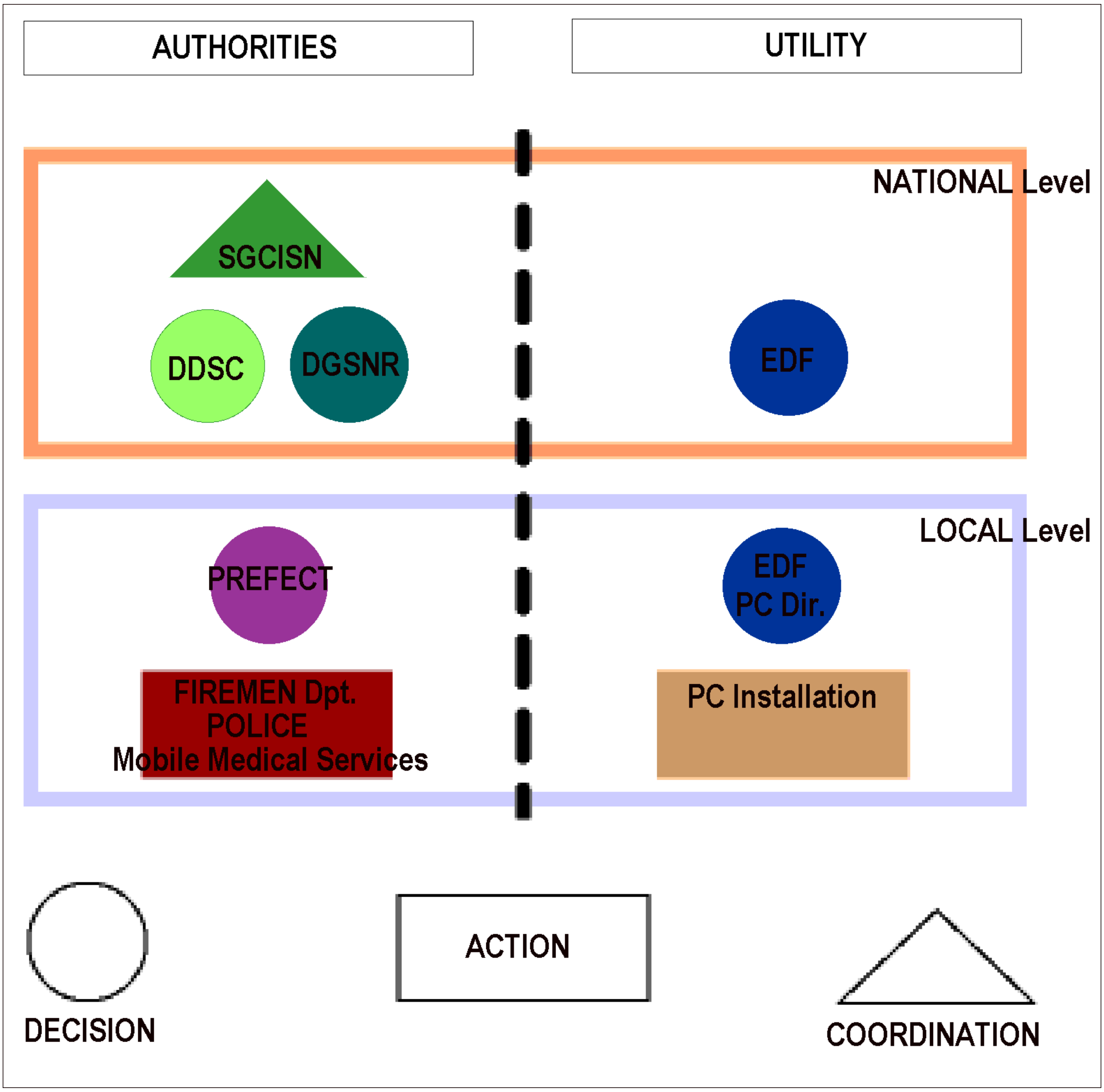
14 Service d’Aide Médical d’Urgence.

15 Mission d’Appui à la gestion du Risque Nucléaire.

16 Direction Générale de la Sûreté Nucléaire et de la Radioprotection.

17 Institut de Radioprotection et de Sûreté Nucléaire (the former IPSN).

- *the General Secretariat of the Interdepartmental Committee of Nuclear Safety (SGCISN)*: he has in charge the information of the French President and Prime Minister, the coordination of the action of all concerned ministries, and the information of other countries (by following the international conventions in case of radiological emergency) .



http://www.asn.gouv.fr/temp/faq/responsabilites.html (translation by CEPN)

Figure 1. Identification, organisation and roles of stakeholders after a nuclear accident[18] in France

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18 The figure presents the organisation in case of an accident occurring in a nuclear power plant: EDF is the unique utility in France operating NPPs.

In case of an emergency, the IRSN's technical emergency centre comprises four units:

- a management unit with the task of co-ordinating the work of the two technical units, collating the results obtained and transmitting (using video-conference) the necessary information and recommendations to the DGSNR emergency team.
- A secretariat unit with the task of dispatching the information received and transmitting the previously-validated advice and data obtained
- Two technical units – « installation assessment unit » and « radiological consequences unit » - with the task of processing the information received and analysing it.

A description of the diagnosis and analysis tools (specifically, the SESAME and CONRAD systems) which are used in case of emergency by IRSN can be found in the litterature.[19]

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19 « Organisation and Operation of the IPSN crisis centre in case of accident in a French PWR » by K. Herviou, D. Winter (IRSN) ; EUROSAFE 1999.

3. FEEDBACK EXPERIENCE AND LESSONS LEARNT FROM NUCLEAR ACCIDENT SIMULATIONS

To anticipate and solve difficulties which could appear during real accident, the French Authorities periodically organise exercices (drills) to train the crisis staff and to test the envisaged means and organisations. These drills are performed at the three professional, national and international levels. Recent such exercices – and particularly, the « Becquerel exercice »[20] organised in October 1996 - have led to interesting feedback experiences as far as the medium and long-term management of the post-accidental situation are concerned. Although it is very difficult to compare this drill with the Chernobyl accident because of its very potential low levels of doses and the absence of real health consequences, the Becquerel exercice has shown different lacks and problems to be solved.

Three years after (1999), a report written by a Working Expert Group[21] in charge of organisation proposals (to SGCISN) points out different problems and establishes an important set of strong recommendations on means, assessment and management procedures in the medical field during the post-accidental phase of a radiological accident. These conclusions give a revealing picture of the French situation as far as the post-accidental management is concerned. Most of these recommendations are given below.

From the expertise point of view:

- A need to check the accuracy of the existing public dose and risks prediction tools, and the reliability of corresponding data *(eg. behaviours in terms of diet including local habits such as mushrooms, berries, and kitchen vegetables consumption, life outside dwellings, occupational exposure, etc)*,
- A need to identify possible specific group of population more risk-exposed than others due to their life habits (and hobbies).

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20 This exercice consisted in the total melting of the research reactor « Osiris » located in Saclay, 50 kms far from Paris, leading to iodine-131 ($1{,}6.10^{13}$ Bq = 400 Ci), caesium-137 ($2{,}5.10^{11}$ Bq = 7 Ci) and noble gases releases. The scenario led to individual doses above 1 mSv for 75000 persons living in the vicinity (10 kms) and also to the contamination of the Rungis national food market. In comparison, the Chernobyl accident led to a iodine-131 release of 7.10^{17} Bq and, the Three Mile Island accident to a iodine-131 release of 10^{12} Bq.

21 *Rapport d'étape du Groupe de Travail n°4 « Suivi Sanitaire et médical des populations en phase post-accidentelle d'un accident radiologique », préparé à l'intention de Monsieur le Secrétaire Général du Comité Interministériel à la Sécurité Nucléaire, Janvier 1999 (rapporteurs Dr. P. VERGER, Pr. M. BOURGUIGNON).*

Note : in this respect, since 2000, IRSN and ADEME are developing the CIBLEX database as a decision-aiding tool in case of an accident. This database contains social (eg. time spent outside, food consumption habits, agricultural practices) and demographical data which can be used to help the implementation of correcting actions after the pollution or contamination of a French region.

From the organisation of the individual dose control point of view:

- A need to propose procedures to identify and record the exposed population,
- A need to check if the internal individual doses and food contamination control, means and procedures are operational or not, according to different accident scenarios and this, taking into account all available human resources and technical equipments in different organisms (utilities, authorities, emergency services, hospitals, veterinary labs, universities, local associations, etc),
- A need to assess the delays and the capacity of measurements (ie. the maximum number of exams per day, per month, and per year),
- A need to prepare the training and train a sufficient number of persons who might be able to realise and interpret measurements,
- A need to organise the co-ordination between all organisms able - and authorised - to make measurements.

From the medical aspects point of view:

- A need to formalise an individual medical consultation protocol (ie. content, type of exams, periodicity, technical needs…) in case of a nuclear accident. Obviously, this protocole has to be adapted to different time periods after the accident,
- A need to prepare what the individual health record and follow-up system should be,
- A need to define health indicators (number of consultations, number of sick leaves, specific prescriptions of medecine) which allow a global surveillance of the evolution of the health care needs in the contaminated villages (and in the vicinity).
- A need to prepare the mechanisms and scientific protocols allowing the data recording needed for the realisation of long-term epidemiological studies (about cancers and other illnesses). In particular, the administrative legal procedures and possible obstacles/limitations must be removed in advance (taking into account the anonymity of victims, the respect of the medical secret, the obligations with regard to the French law on data processing and civil rights…).

From the information needs point of view:

- A need to adapt the health consequences and long-term risk information to the different expectations of stakeholders (public, local medical professionals, social services, mayors…),

- A need to elaborate a set of recommendations and practical guidances in a next future in order to explain to people living in the vicinity of a nuclear installations what are the precautions they would have to take in their day-to-day life after an accident,

- A need to make an international survey on the existing information documents (presenting the effects of ionising radiations, comparison of risks levels…) and tools and if it is considered as necessary, to revise them,

- A need to examine the possibility of the implementation of Local Health Information Centers (« CAIS »[22]), with the following objectives: register and analyse public claims and questions, defuse rumours on the accident health consequences, assure a practical individual information adapted to public concerns, organise psychological and medical consultations, distribute personal dosimeters and radiameters, organise a local network of « informant persons (trainers)», etc.

- A need to prepare the training and train a sufficient number of persons who might be able to welcome people in the Local Health Information Centers, and also those who could have a role in the long-term dissemination of the information (for example medical professionals).

And - last but not least - from the financial point of view,

- A need to establish the corresponding budget and to envisage immediatly financial mechanisms for the implementation of all the above post-accidental needs, and victims compensations (the Gravelines drill performed in May 2001 dealt with that last topic).

In conclusion, the information of the population is one of the key elements and probably one of the most important stake of the long-term post-accidental situation from the health care point of view. The credibility of authorities is conditioned by its capability :

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22 Centre d'Accueil et d'Information sur la Santé.

- to accurately assess the environmental and health situation by using all the available information and surveillance tools, and recording individual data (eg. internal and external doses)

- to provide people with measurments tools (dosimeters, radiameters…) allowing them to judge by themselves (self-control) the exposures levels they are facing to. (This distribution is not envisaged in the legal framework.)

- to inform continuously the persons living in the contaminated area (or in the vicinity) on the radiological risks and dangers. The information system has to provide people with very practical recommendations, adapted to the individual demands and fears.

- to drive a network of informed and well trained people (especially belonging to the health care system) who would be able to inform people on the possible health consequences of the accident.

4. AVAILABILITY OF WHOLE BODY CONTAMINATION CONTROL SYSTEMS IN FRANCE

4.1. Equipments available at the French Radiological Prorection and Nuclear Safety Institute (IRSN)

The French Radiological Protection and Nuclear Safety Institute (of which the agency located at Le Vésinet is the former Office of Protection against Ionising Radiation, OPRI, the former SCPRI) is the technical support of the radiological protection and safety Authorities Directorate (DGSNR). IRSN-Le Vésinet is one of the key participant in the post-accidental situation, especially during the organisation of the crisis phase after a nuclear accident in France. For that purpose, IRSN-Le Vésinet has different fixed and mobile means of measurements. As far as gamma-emitters and X-rays whole body counters (WBCs) are concerned,IRSN-Le Vésinet has the following equipments:

Mobile Equipments:

- 5 Renault© Master-Gemini vehicles each of them equipped with 4 seats able to measure thyroid and thorax contamination (four of them are scattered on the French territory: in Avignon, Agen, Angers, and La Hague. One more vehicle has been lended to the Civilian Security Training Center (see hereafter).
- 1 Renault© Master-Gemini vehicle equipped with 2 seats,
- 1 trailers with 12 seats (for the same purpose), with a dosimetric laboratory and a chemical laboratory (see picture),
- 1 trailer with 4 seats (whole body counting),
- 1 wagon equipped with 32 seats (for the same purpose) (capacity 5000 persons/day),
- 1 mobile laboratory equipped with 4 shielded cells (for a real whole body counting).

Le semi-remorque du groupe d'intervention

Figure 2. Intervention trailer with 12 WBCs seats

These equipments are able to measure the body contamination due to incorporations of caesium (^{134}Cs, ^{137}Cs), iodine (^{131}I) and cobalt (^{58}Co, ^{60}Co), and to determine and register the individual contamination spectra. Detection levels given by OPRI in 1999 were 500 Bq of ^{137}Cs (for seats; with a data acquisition time of 10 minutes) and 100 Bq of ^{137}Cs (for cells; with a data acquisition time of 30 minutes). These detection levels are quite good to sort people out (in function of their levels of contamination) but, they are of less quality in comparison with fixed equipments.

The vehicles are also equipped with technical means for the measurement of contamination of water, soil, meat, plants…

If all vehicles are driven and kept in the accident area - which is not evident in a long-term perspective - and by making the whole system available 10 hours a day - which is quite optimistic - a maximum number of about 3000 controls per day can be envisaged. The cost for one examination can be evaluated to about 100 euros. The main problem seems to be the number of people well trained to perform the measurements: IRSN-Le Vésinet (the former OPRI) is probably working with an insufficient staff to effectively face with the number of people to be measured during the crisis phase of a nuclear accident and it is necessarily the same on a longer term perspective. So, it is clear that, in the post-accidental phase, measurements would have to be perfomed by other organisations.

Fixed WBCs Equipment:

IRSN Le Vésinet has also 3 fixed NaI whole body counters (coffin type)

4.2. Equipments available at Electricité de France (EDF)

Electricité de France (EDF) is the unique utility operating nuclear power plants in France, and owns 57 operating reactors distributed on twenty sites. Each of these nuclear sites has its own medical services which are responsible for monitoring intakes of radionuclides by workers (WBCs and bioassays). This represents approximately 200,000 whole body gamma countings per year. Since 1999, the « standard » equipment is:

- two whole body counters with two large NaI detectors (some NPPs has more than one WBC: Gravelines NPP has three WBCs) ; the detection limit is about 150 Bq for ^{60}Co (counting in about one minute).

- one shielded chair with two smaller NaI detectors (one for thyroid, and one for thoraco-abdominal region) designed for contamination with iodine; the detection limit is about 500 Bq for ^{60}Co (counting in about ten minutes).

EDF has also a central radiotoxicology laboratory located in the suburbs of Paris, which analyses all biological samples (urines, faeces, nose blows: 8000 per year).

4.3. Equipments available at the Atomic Energy Commission (CEA)

The French Atomic Energy Commission (CEA) owns one Renault Master-Gemini vehicle (the same than those owned by IRSN) and different WBCs apparatuses are distributed on six different sites:

Table 1. CEA WBCs capacities

CEA Sites	Type of detector	Detection Limit (Bq)			Counting Duration (mn)	Normal & exceptional (crisis) capacity*** (persons/h)
		^{137}Cs	^{131}I	^{60}Co		
Fontenay aux Roses	NaI (x1)	80	100	80	15	3 (10)
Saclay	NaI (x2)	100 140	100 140		12 3	? (8) ? (20)
Grenoble	NaI	100	50	85	15	3 (10)
Cadarache	NaI+Phoswich* (x1) Ge Hp** (x1)	400 130	30		5	12 (20)
Bruyère le Châtel	NaI + CPX* (x1) Phoswich* (x1)	85	90		15 20	3 (10) 3 (15)
Valduc	Ge Hp (x1)	10	10		20	3 (20)

*Phoswich detector (thallium-doped sodium iodide NaI(Tl) detector) and CPX (gaz proportional counter) are used for detection of actinides.
** GeHP : high-pourity germanium detector
***The capacity during crisis is an assessment

4.4. Equipments available in the AREVA Group

The AREVA Group (nuclear consortium which includes COGEMA, CEA, Framatome,…) has three sites where whole body counting are performed: in **Pierrelatte** (where there are a UOX fuel fabrication plant in decommissioning, FBFC UF4/UF6 conversion plant, EURODIF enrichment plant, …), in **Marcoule** (where there are PHENIX research reactor, ATALANTE fuel reprocessing facility, MOX fuel fabrication plant, waste management facilities) and in **La Hague** (where there is the French fuel reprocessing site).

Table 2. Pierrelatte WBCs capacities

Type of detector	Detection Limit (Bq)			Counting Duration (mn)	Normal & exceptional (crisis) capacity (persons/h)
	^{137}Cs	^{131}I	^{60}Co		
NaI (diameter 80)	600	670	400	10	5 - 10 ***(in 5 minutes)***
NaI (diameter 32) for **thyroïd**		180			5 - 10 ***(in 5 minutes)***
Ge Hp X 4	30	25	25	30	2
Ge Hp X 4	50	45	40	10	5

4.5. Other available WBCs in France

4.5.1. French Army

The Radiological Protection Service of the French Army (SPRA) has one Renault® Master-Gemini vehicle (it is the same type than those owned by IRSN).

SPRA has also a fixed measurement cell to make thyroid, lung and whole body countings. This WBC is located at the Percy Hospital (suburbs of Paris. The detection limit is 43 Bq (for ^{137}Cs) and 34 Bq (for ^{131}I).

4.5.2. French Firemen Units

The firemen units are directly involved in case of nuclear accident (see §1). For that purpose, specialized intervention staff named CMIR (Mobile Units of Radiological Intevention) are equipped with Master-Gemini vehicles, each of them equipped with 4 seats able to measure thyroid and thorax contamination. Like IRSN's vehicles, all these vehicles have an embarked software which allows examinations of caesium (^{134}Cs, ^{137}Cs), iodine (^{131}I), cobalt (^{58}Co, ^{60}Co), chromium (^{51}Cr) and bismuth (^{214}Bi) contaminations. In order to determine the contamination levels with other radionuclides, evaluations have to be made by IRSN from the results of measurements made « on the spot ».

The location of the 5 available Master Gemini vehicles have been chosen with regards to the risk of nuclear accident (taking into account the number of NPPs in the vicinity):

- Agen (SDIS47)
- Avignon (SDIS84)
- Thionville (SDIS57)
- Lille (SDIS59)
- Nogent le Rotrou (28, Civilian Security Training Center, US C1)

About 20 French firemen are trained to use Geminis.

It is possible to perform examination for 40 to 50 persons each day with one vehicle.

Three persons are allocated to each car: one medical doctor, one specialised fireman officer, and one specialised fireman. The specialisation of the firemen corresponds to a one-week of training given by IRSN-Le Vésinet experts.

Figure 2 gives the map of fixed and mobile whole body counters location in France. Fixed WBCs are located in the nuclear installations (NPPs, fuel cycle plants, research centres). In normal situation, most of the mobile vehicles (about 75% of the capacity of measurement) are parked in the suburbs of Paris.

Table 3. Whole Body Counters in France

Type of apparatus	Mobile	Fixed	
Whole Body Counters (WBCs)	89 (seats)	26 (sites)	
Vehicule 1 seat	*1*		
Vehicule 4 seats	*11*		
Vehicule 12 seats (truck)	*1*		
Vehicule 32 seats (wagon)	*1*		
TOTAL			115

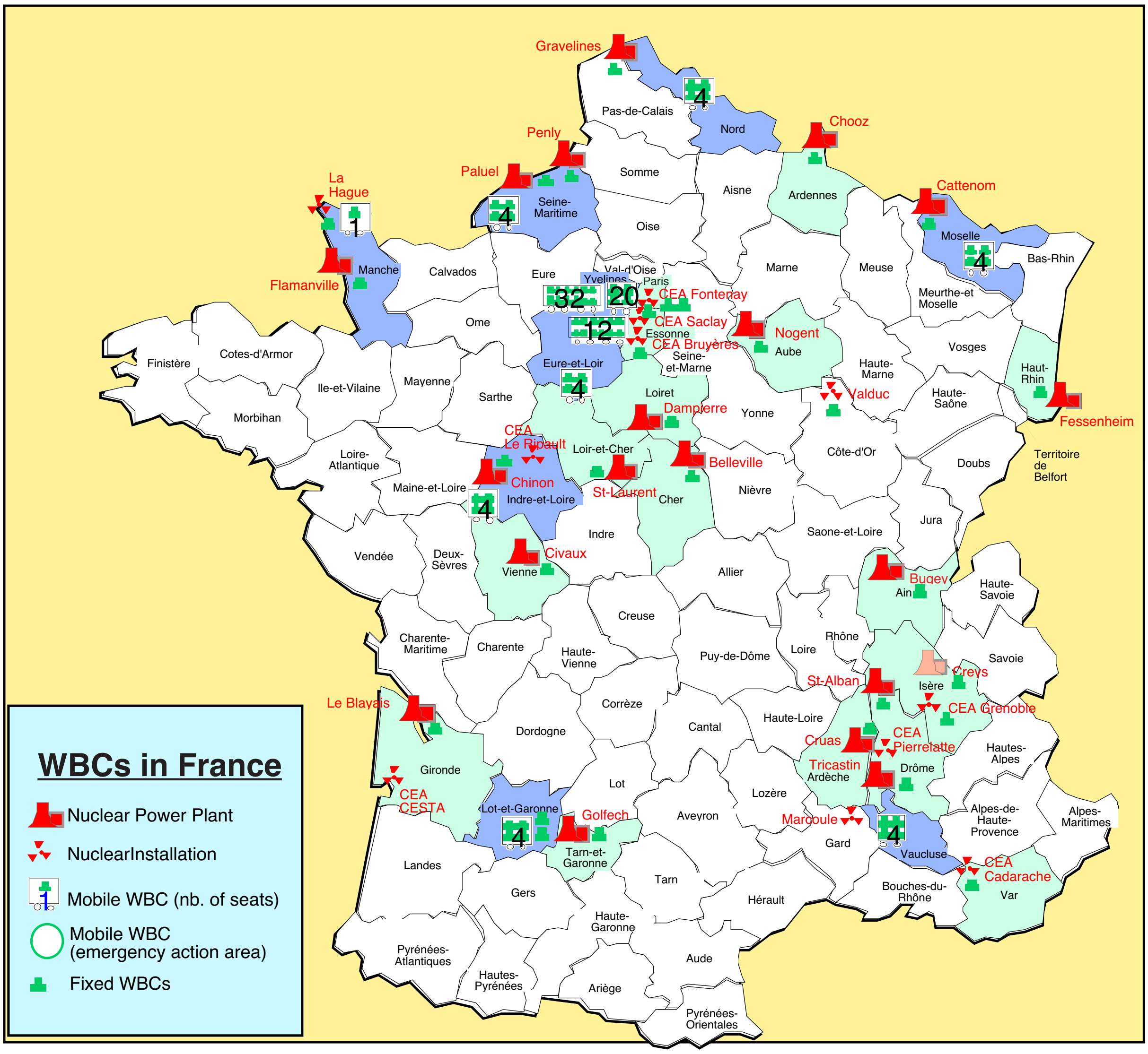
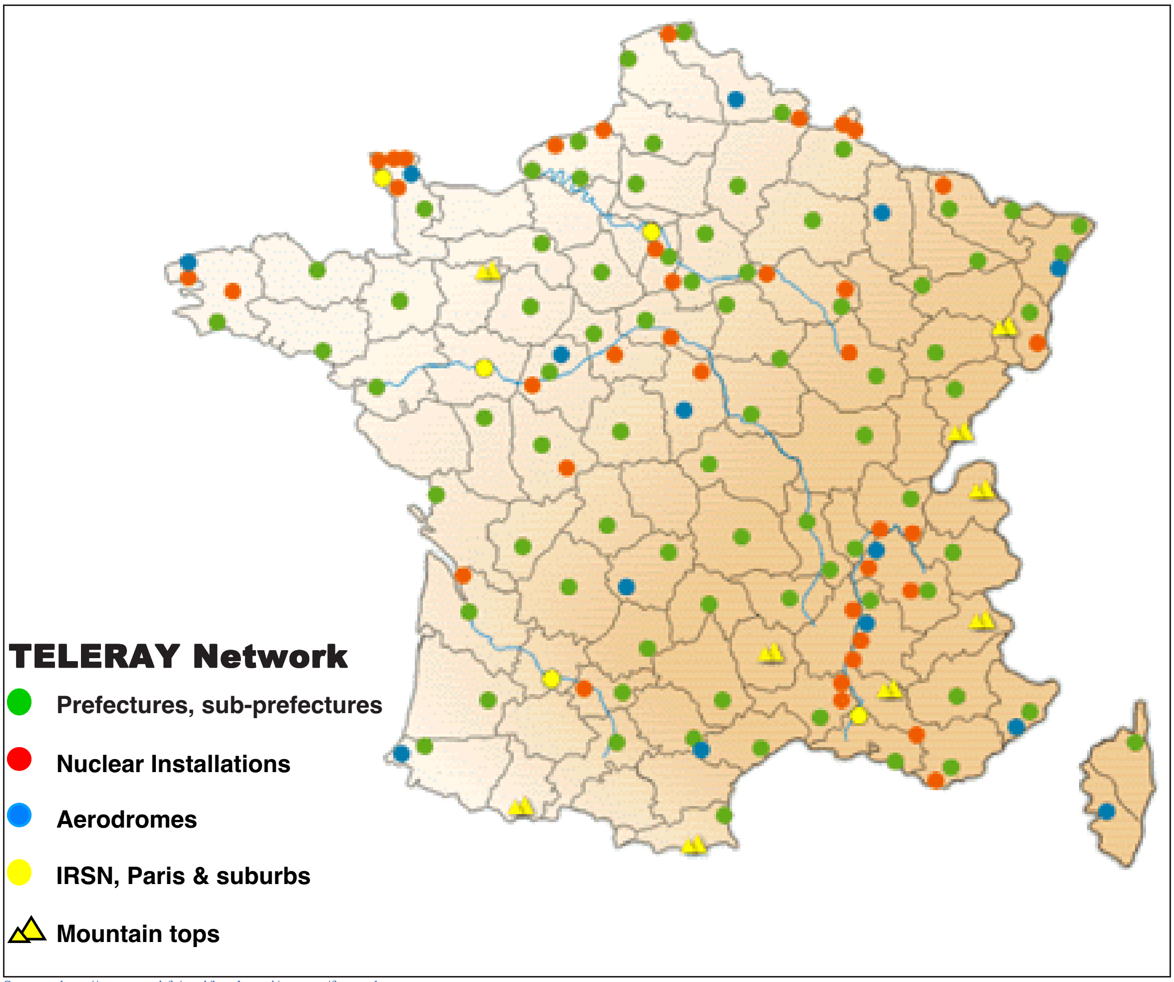


Figure 3. **Location of Whole Body Counters in France (1999)**

5. AVAILABILITY OF DOSERATES AND FOOD CONTAMINATION CONTROL SYSTEMS IN FRANCE

5.1. Routine gamma ambiant doserates surveillance

Since 1991, IRSN has installed about 180 Geiger-Müller stations to follow the gamma ambient doserates (in the range 10 nGy/h-10 Gy/h), coupled with the domestic telephone network. They are widely scattered on the French territory: 9 on mountain tops, 85 in prefectures and sub-prefectures, 10 in Paris and suburbs, 38 in the nuclear installations, 14 in aerodromes (plus 22 in DOM-TOMs and abroad). The network is one of the decision-aiding tools that could be used in case of an accident to determine some of the interventions and countermeasures.



Source : http://www.opri.fr/opri/html_opri/mesure/france.htm

Figure 4. the TELERAY network

5.1. Environmental sampling

IRSN has also a set of stations where aquatic and atmospheric samples are performed in normal situation (in theory, the system is not designed to be used in case of an accident). In fact, this set of 33 stations (named « OPERA » for PEmanent Observatory of the RAdioactivity) can be considered as a complementary tool to the existing legal surveillance network. This represents more than 30 gamma spectrometry detectors and spectrometry analysis chains, about 20 alpha-beta detectors, multi-detectors and liquid scintillation counters. Recently, in 2001, IRSN has extended his surveillance network by implementing 13 stations (the « SARA » network in Brest, Biarritz, Toulouse, Montpellier, Nice, Montélimar, Lyon, Bourges, Tours, Le Vésinet, Lille, Strasbourg, Etain) designed to detect very quickly - in several minutes - the unexpected presence or increase of artificial radionuclides in the atmosphere (alpha emitters such as uranium, plutonium, americium, curium, etc, beta emitters such as cobalt 60 or cesium 137, and radon).
In complement, there are seven stations in France (in Alençon, Bordeaux, La Seyne sur Mer, Dijon, Charleville-Mézières, and Orsay) where air samples are collected and measured by gamma spectrometry. Another one is installed in La Hague COGEMA reprocessing plant) to measure krypton-85 atmospheric releases.

Another computerised and centralised network named « TELEHYDRO-HYDROTELERAY » has been set up recently to detect the contamination of the water purification stations by radioactive effluents from the industrial and research laboratories and, in the near future, from hospitals having a nuclear medicine services. When established, this network will cover a dozen of towns : Rennes, Nantes, Caen, Rouen, Amiens, Achères, Strasbourg, Nancy, Lyon, Marseille, Toulouse, and Poitiers (where a portable equipment is also available). These equipments are designed to perform global counting of gamma emissions and, to measure volumic activities of iodine-131, technetium–99m, and caesium-137, with a limit of detection of about 1 $Bq.l^{-1}$.

5.2. Emergency equipments (radiameters, spectrometers)

Radioactivity counters, radiameters and other doserates measurements equipments can be found almost everywhere widespread in the country but they are most often installed near the nuclear installations. Some regional (county level) firemen units are equipped with a few of apparatuses (often less than 5 and always less than 20).

Table 4 and the following map (Figure 5) shows that there is globally a lot of counties which are not well equipped with that type of material, and this is true even if a nuclear power plant is not far (less than 50 kms). In a long-term post-accidental perspective, it would be probably difficult to envisage the decentralization of the existing equipments.

Sprectrometry apparatuses (mainly gamma spectrometry equipments) can also be found widespread on the French Territory. Most of them are fixed materials located in research or expertise laboratories (utilities, veterinary labs, Fraud Squad facilities, and universities). In normal situation, the existing mobile equipments are concentrated in the suburbs of Paris (mainly in the IRSN-PRI facilities). (see Table 5 and Figure 6)

In conclusion, the control of internal and external doses, and contamination of food, water, landscape and dwellings is certainly a key element for a good management of the post-accidental situation. But, in France, one of the main problem will probably be the availibility of technical material to make measurements, especially as far as mobile equipments are concerned. Although the existing means are quite important, the type of apparatuses are very disparate and the number of people ready to use all these tools is probably insufficient.

Table 4. Doserates measurements apparatuses in France

Type of apparatus	Mobile	Portable	Fixed
Counters (c/S)	127	171	199
Radiameters, Multipurpose-radiameters	7	253	
Teletectors	1	86	
Scintillometers	4	47	41
Other detectors (^{3}H, Rn, neutrons)	1	5	
TOTAL	140	562	240

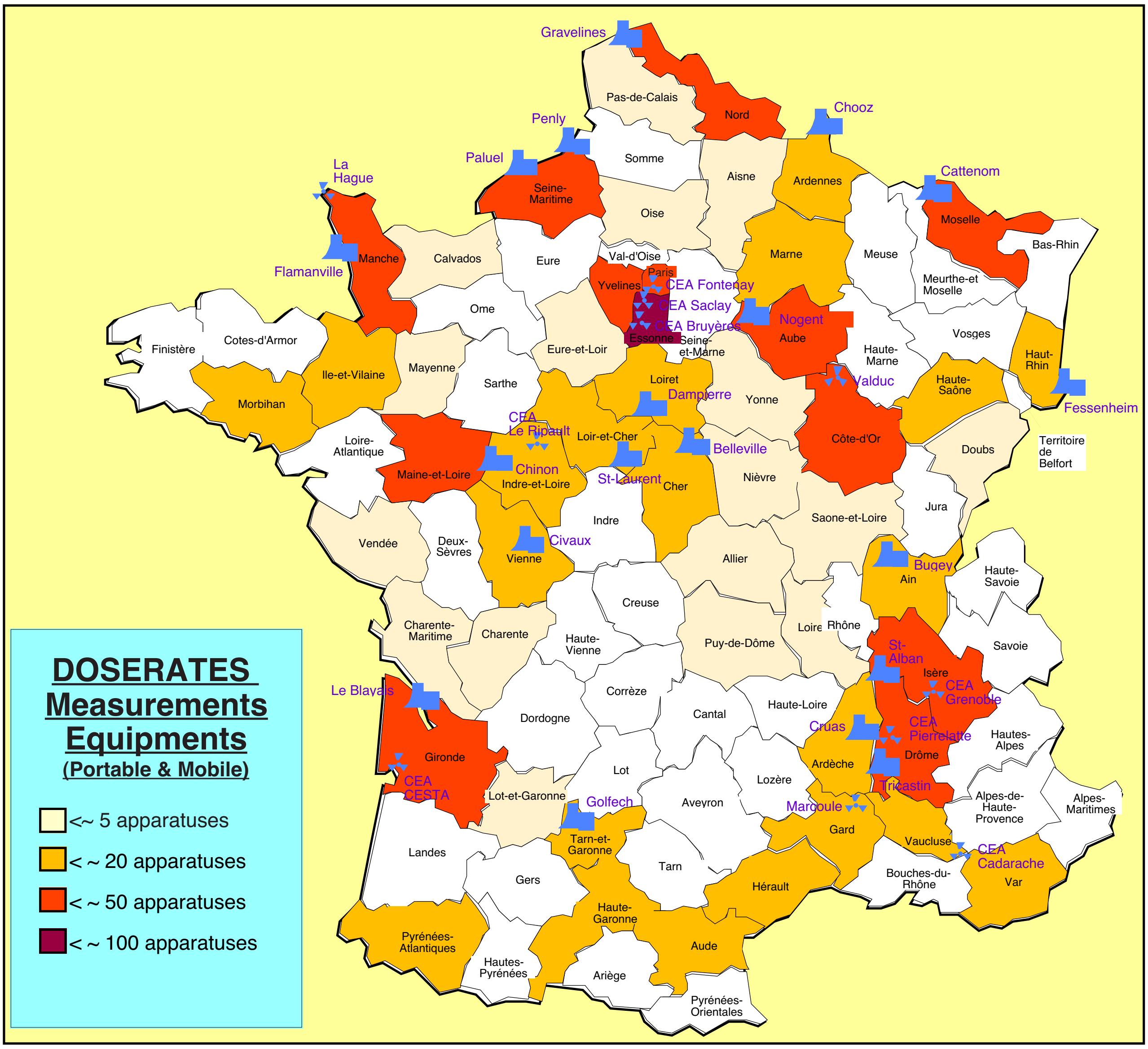


Figure 5. Location of doserates measurements apparatuses in France (1999)

Table 5. Spectrometers in France

Type of apparatus	Mobile	Portable	Fixed
g Spectrometry	4	77	
g (NaI) Spectrometry	1	2	49
g (Ge/High-performance) Spectrometry	3	2	90
A Spectrometry			56
Mass Spectrometry			8
	8	81	213

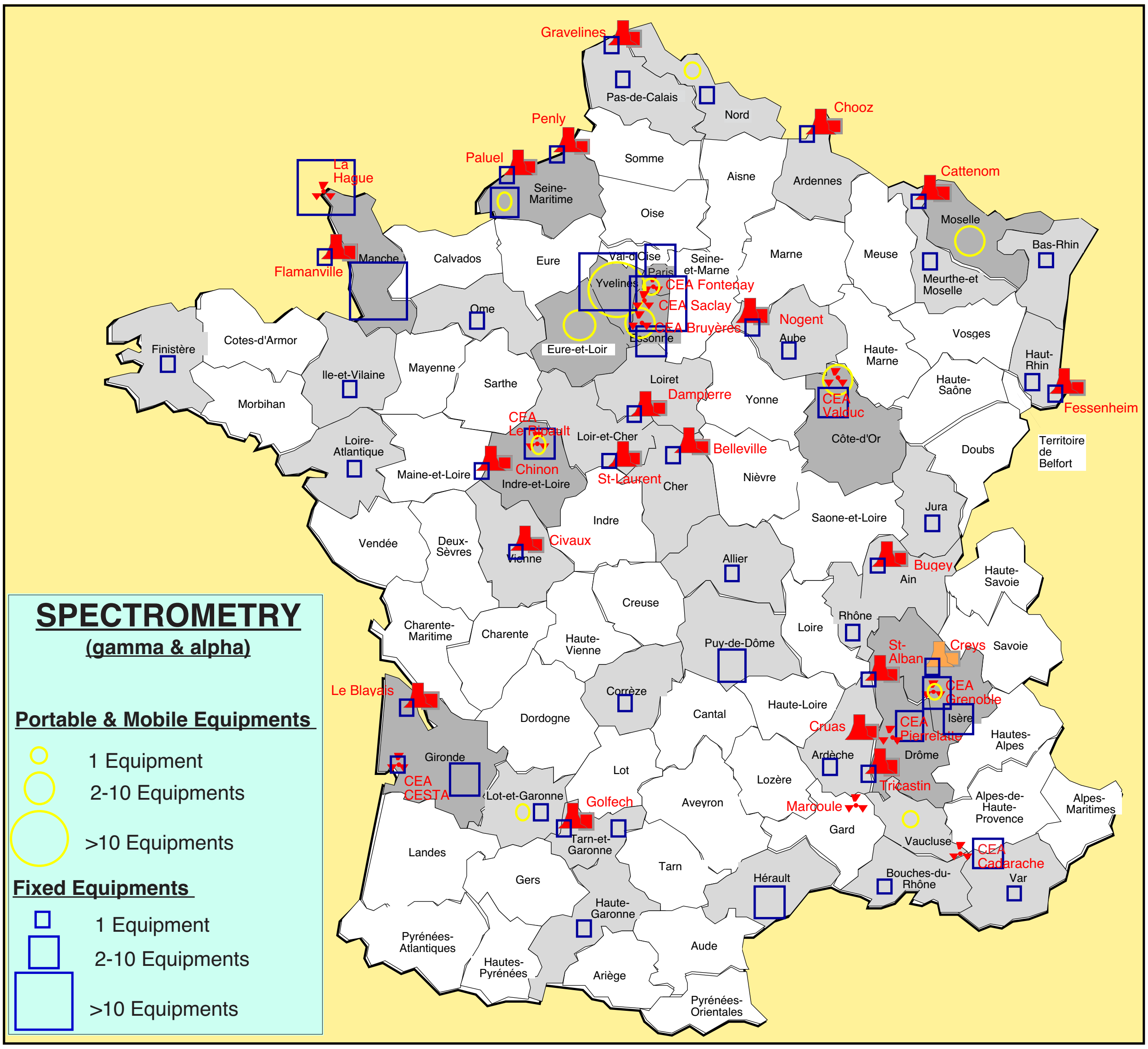


Figure 6. Location of Spectrometers in France (1999)

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