

**FRANCE**



## FRANCE

### 1. GENERAL INFORMATION

#### 1.1. General Overview

France is situated in Western Europe and is nearly hexagonal in shape, with an extreme length from north to south of 965 km and a maximum width of 935 km. The total area of metropolitan France, including the island of Corsica in the Mediterranean, is 552 000 km<sup>2</sup>. In addition to the European or metropolitan territory, the country includes several overseas “*départements*”, territorial “*collectivités*”, and overseas territories. The climate of metropolitan France is temperate, with wide regional contrasts. The average annual temperature is about 12 degrees. Precipitation is evenly distributed, averaging about 760 mm annually.

The total population is about 60 million in 2000 and the population density around 107 inhabitants per km<sup>2</sup> (Table 1). Population growth rate is around 0.5% per annum.

TABLE 1. POPULATION INFORMATION

	1960	1970	1980	1990	1998	1999	2000	Ann. av. growth rate (%)
								1980 to 2000
Population (millions)	45.7	50.8	53.9	56.7	58.8	58.9	59.1	0.5
Population density (inhabitants/km <sup>2</sup> )	83	92	98	103	107	107	107	0.5
Urban population as percent of total	62	71	73	74	75	75	75	
Area (1000 km <sup>2</sup> )	551.5							

Source: IAEA Energy and Economic Database.  
Data & Statistics/the World Bank.

France has sizeable deposits of various metals and little fossil fuel resources. Owing to high recovery costs, production of fossil fuels has decreased to a rather low level and is not expected to provide a significant share of the country energy supply in the future. Most hydropower resources are already exploited. Therefore, the French energy policy places high emphasis on improving energy independence through the development of domestic technologies, including nuclear power, alternative energies and renewables, in order to alleviate the country vulnerability to the volatility of fossil fuel international markets and to meet the Kyoto commitments.

#### 1.2. Economic Indicators

Table 2 shows the historical trend of Gross Domestic Product (GDP). Economic growth in France improved in the recent years, with GDP growth rates of 1.1% in 1996, 1.9% in 1997 and 3.4% in 1998, 2.9% in 1999 and 3.1% in 2000.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1995	1996	1997	1998	1999
GDP at market prices (current billion US\$)	1,550	1,550	1,410	1,450	1,430
GDP growth (annual %)	1.67	1.1	1.9	3.07	2.92
Agriculture, value added (% of GDP)	3	2.91	2.89	2.84	n.a.
Industry, value added (% of GDP)	24.36	23.65	23.64	23.26	n.a.
Services, etc., value added (% of GDP)	72.63	73.44	73.47	73.9	n.a.

Source: Data & Statistics/The World Bank.

### 1.3. Energy Situation

The French domestic energy reserves as of end 1998 are listed in Table 3. Table 4 provides statistical data on energy and electricity supply and demand between 1960 and 2000. It illustrates the long term trend of substituting nuclear power to imported fossil fuels and the improvement of energy independence. Since 1993, primary energy consumption undergoes a slight but regular increase. Domestic production accounts for some 51.5% of that consumption (with an accidental deterioration in 1998 due to failures in some power plants). The energy balance improved in the last two decades, mainly due to the raise of electricity exports, that reached nearly 70 TW·h in 2000. The energy intensity has lowered owing to structural changes in the economy, i.e. reduction in the share of energy intensive industries in total GDP, and to a lesser extent, to efficiency improvements.

TABLE 3. ESTIMATED ENERGY RESERVES

	Exajoule					
	Solid	Liquid	Gas	Uranium <sup>(1)</sup>	Hydro <sup>(2)</sup>	Total
Total amount in place	3.23	0.76	0.78	7.37	19.28	36.28

<sup>(1)</sup> Reasonably assured resources recoverable at less than 80\$/kgUs.

<sup>(2)</sup> For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 1998) by a factor of 10.

Source: IAEA Energy and Economic Data Base and Country Information.

TABLE 4. ENERGY STATISTICS

								Exajoule	
	1960	1970	1980	1990	1998	1999	2000	Average annual growth rate (%) 1960 to 1980	1980 to 2000
Energy consumption <sup>(*)</sup>									
- Total <sup>(1)</sup>	3.68	6.56	8.41	8.73	10.47	10.61	10.80	4.2	1.2
- Solids <sup>(2)</sup>	2.01	1.79	1.70	1.10	0.67	0.61	0.59	-0.8	-5.0
- Liquids	1.16	3.79	4.46	3.51	4.16	4.17	4.13	7.0	-0.4
- Gases	0.12	0.38	1.00	1.12	1.43	1.48	1.56	11.2	2.0
- Primary electricity <sup>(3)</sup>	0.39	0.60	1.25	2.99	3.72	3.85	3.98	6.0	6.2
Energy production									
- Total	2.28	2.30	2.41	4.19	5.04	5.17	5.28	0.3	4.2
- Solids	1.67	1.30	0.81	0.53	0.15	0.14	0.10	-3.6	-8.9
- Liquids	0.10	0.12	0.09	0.14	0.09	0.09	0.08	-0.5	0.0
- Gases	0.12	0.27	0.29	0.08	0.08	0.07	0.06	4.5	-6.9
- Primary electricity <sup>(3)</sup>	0.39	0.61	1.22	3.43	4.24	4.39	4.54	5.9	7.2
- Renewables					0.48	0.49	0.50		
Net import (import - export)									
- Total	1.54	4.63	6.39	5.33	5.25	5.32	5.37	7.4	-1.1
- Solids	0.40	0.44	0.92	0.58	0.49	0.48	0.51	4.3	-3.4
- Liquids	1.13	4.06	4.72	3.62	4.03	3.97	4.02	7.4	-0.9
- Gases		0.13	0.75	1.13	1.27	1.45	1.47		3.0
- Primary electricity <sup>(3)</sup>				-0.42	-0.54	-0.59	-0.65		

<sup>(\*)</sup> Climate corrected

<sup>(1)</sup> Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

<sup>(2)</sup> Solid fuels include coal, lignite and commercial wood.

<sup>(3)</sup> Primary electricity = Hydro + Nuclear + windmills.

Source: IAEA Energy and Economic Database and Country Information.

### 1.4. Energy Policy

During the post World War II reconstruction period, France's economic and social development relied mainly on the deployment of energy intensive industries. The rapidly increasing energy needs were partly met by domestic coal and hydropower resources. However, French domestic fossil fuel resources being limited and costly, the country had to rely heavily on imports for its energy supply.

By 1973, imports were covering more than 75% of national energy consumption, compared to 38% in 1960. After the 70's oil crisis, the country was in need of better energy independence. At that time, implementation of a large nuclear power programme became a major element of France's energy policy, including also energy saving measures, efficiency improvement and research and development in the field of renewable energies. The share of nuclear power in primary energy supply increased from less than 2% in the late seventies to about one third in the mid nineties.

The main macro-economic impacts of France's energy policy are : drastic improvement in the energy trade balance, stabilization of domestic energy prices at a rather low level, increased competitiveness of French companies on international markets and deployment of a nuclear industry sector covering reactor construction and the whole of the fuel cycle. Increasing awareness of environmental problems reflects in the French energy mix, aiming to reduce the negative impacts of energy production on health and environment. In this regard, substitution of nuclear power to fossil fuel for electricity generation resulted in a drastic reduction of atmospheric emissions from the energy sector.

## 2. ELECTRICITY SECTOR

The Industry Division of EDF produces and markets high-voltage electricity either directly to 600 major customers or to distribution networks or foreign utilities. The transmission grid operator RTE (*Réseau de transport d'électricité*) has been individualized inside EDF according to the European rules and manages the load dispatch system independently. Regarding distribution activities, local authorities grant the concession of well-defined areas. There are about 200 distribution companies featuring municipality or joint ownership, with a 5% share of total electricity billing. However, most of the electricity consumed in France is distributed by EDF

EDF is involved in activities in the European Union and abroad (Eastern European countries, Far East and Latin America) and is associated with foreign companies (e.g. electricity distributors in Argentina and thermal generators in Africa).

### 2.1. Structure of the Electricity Sector

The European directives on the liberalization of the electricity market have been transposed into the French legislation. However the state-owned utility *Electricité de France* (EDF) remains the main operator for production, distribution, import and export of electricity. EDF owns and operates all nuclear and part of the fossil-fuelled and hydro-power plants. The main other suppliers are CNR (*Compagnie Nationale du Rhône*) which operates most of the hydro plants along the Rhône river, SNET (*Société nationale d'électricité et de thermique*) for the coal-fired plants and private manufacturers operating back-up or combined heat and power production units, as well as operators of small and medium size hydropower plants. EDF is due by law to purchase all electricity proposed by the authorized independent producers at government determined prices.

### 2.2. Decision Making Process

The General Directorate for Energy and Raw Materials (DGEMP), under the Secretary of state for industry, is in charge of implementing the French government policy on energy. The Minister for Environment and the Minister for Health are to control health and environmental impacts of industrial facilities, including energy production and transformation plants.

EDF is the main investor in the power sector. The respective commitments between the now industrial group EDF and the government are stated in the "Contrat de Groupe", setting the objectives to be met by EDF in a given time schedule. The French government also appoints EDF's chairman.

With regard to nuclear safety, the Directorate for Nuclear Installations Safety (*Direction de la Sûreté des Installations Nucléaires - DSIN*) is responsible for studying, drawing up and implementing nuclear safety regulations. It is also responsible for authorizing the construction and approving site licenses for power units. DSIN reports to the Minister for Industry and to the Minister for Environment. Regarding radiation protection, the Board for Protection against Ionizing Radiation (*Office de Protection contre les Rayonnements Ionisants - OPRI*) under the joint supervision of the Minister for Health and the Minister for Labour, is in charge of surveying radioactive emissions and releases in order to prevent occupational as well as population hazards.

A regulatory reform is to come into operation in the course of 2002 which will recombine nuclear safety and radioprotection and organize a more open information system. The new regulatory authority in charge of both nuclear safety and radioprotection, the DGSNR (*Direction générale de la sûreté nucléaire et de la radioprotection*) will take over DSIN and the regulatory part of OPRI. At the same time a new expert institution, the IRSN (*Institut de radioprotection et de sûreté nucléaire*) combining competence on nuclear safety and radiation-protection, will result from the fusion of the actual IPSN and OPRI. The secret (military) nuclear installations are also concerned by this reform.

### 2.3. Main Indicators

Table 5 shows the history of electricity production and Table 6 the energy related ratios from EEDB. At present, over 90% of France's electricity are of nuclear and hydraulic origin, the remaining 10% coming mainly from fossil fuels. Electricity demand grows in line with GDP, though at lower rate.

TABLE 5. ELECTRICITY PRODUCTION AND INSTALLED CAPACITIES

	1960	1970	1980	1990	1998	1999	2000	Average ann. growth rate (%)	
								1960 to 1980	1980 to 2000
Electricity production (TW-h)									
- Total <sup>(1)</sup>	72.12	146.79	245.71	420.13	510.0	524.0	540.2	6.3	3.9
- Thermal	31.64	83.86	118.91	64.10	55.8	52.1	52.2	6.8	-4.5
- Hydro	40.34	57.22	68.86	58.32	66.6	77.6	72.8	2.7	-0.2
- Nuclear	0.13	5.71	57.95	297.70	387.6	394.3	415.2	35.7	10.8
- Geothermal					0.023	0.020	0.	-	-
- Wind					0.040	0.049	0.094	-	-
- Waste and wood					3.007	3.506	3.683	-	-
Capacity of electrical plants (GWe)									
- Total	21.85	36.22	62.71	103.41	107.4	109.5	109.5	5.4	3.3
- Thermal	11.52	19.58	29.03	22.51	20.6	21.5	21.5	4.7	-0.7
- Hydro	10.23	15.00	19.29	24.75	25.1	25.1	25.1	3.2	1.5
- Nuclear	0.10	1.65	14.39	55.92	61.7	62.9	62.9	28.2	8.4

<sup>(1)</sup> Electricity losses are not deducted.

Source: IAEA Energy and Economic Data Base and Country Information.

## 3. NUCLEAR POWER SITUATION

### 3.1. Historical Development

Historically, the development of nuclear power fell into four phases. During the 1960's, in line with the overall target of industrial independence and domestic technological development, indigenous reactor designs were promoted (mainly gas cooled and fast breeder). However, a PWR unit (Chooz-A) was built jointly with Belgium and a heavy water reactor in Brittany (Brennilis).

International developments in the nuclear industry led in the late sixties to the recognition that the French reactor designs could not compete with LWRs. In 1969 the decision was made to build LWRs under license, whilst restructuring the domestic industry for improved competitiveness. Subsequently, the French government envisaged a construction program of one or two PWRs yearly.

TABLE 6. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1999	2000
Energy consumption per capita (GJ/capita)	80	130	156	155	168	173
Electricity per capita (kW.h/capita)	1,577	2,755	4,618	6,250	7,313	7,418
Electricity production/Energy production (%)	31	59	100	91	102	101
Nuclear/Total electricity (%)		4	24	74	77	80
Ratio of external dependency (%) <sup>(1)</sup>	42	71	76	61	62	62
Load factor of electricity plants						
- Total (%)	38	46	45	46	51	51
- Thermal	31	49	47	33	32	26
- Hydro	45	44	41	27	29	27
- Nuclear	15	40	46	61	68	71

<sup>(1)</sup> Net import / Total energy consumption.

Source: IAEA Energy and Economic Database.

From 1974 to 1981 emphasis was put on adaptation of the Westinghouse design for the development of a French standard. The nuclear programme accelerated the pace with the 1970's oil crisis. The unit-capacity of French reactors increased from 900 MWe to 1,300 MWe and later to 1,450 MWe. France developed and implemented, in parallel with the nuclear power plant programme, a strong domestic fuel cycle industry, built upon the infrastructure originally established by CEA.

In 1981, Framatome terminated its license with Westinghouse and negotiated a new agreement, giving greater autonomy. Framatome developed a wide range of servicing expertise and capabilities in reactor operation and maintenance services. In the same year, France had to adapt its energy policy to a lower than expected economic growth, together with the occurrence of over-capacity in the national electricity supply system. The achievement of the 1450 MWe N4 model was the landmark for a totally autonomous French reactor design.

### 3.2. Status and Trends of Nuclear Power

The share of nuclear power in the French electricity supply has reached its technical and economic maximum, amounting to about 63,000 MWe. It consists of fifty-nine units, fifty-eight being pressurized water reactors (34 PWRs 900, 20 PWRs 1300, and four 1450's), all constructed by the French manufacturer Framatome, and one 230 MWe fast breeder reactor, Phenix.

The nuclear plants accounted for 77% of total electricity production in 2000, setting France the world's second largest nuclear power producer. Table 7 lists the status of the power plants as of year-end 2000. The nuclear electricity generation represents about one third of total primary energy supply, and over 80% of the domestic energy production, making EDF by far the number one nuclear operator and the first electricity producer in the world.

### 3.3. Current Policy Issues

The main objectives are presently to optimize the utilization of existing equipment, i.e., power plants and fuel cycle facilities, design and implement a policy with regard to final disposal of high level radioactive waste, and develop the next generation of reactors improving the use of natural uranium and minimizing waste production.

TABLE 7. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Capacity	Status	Operator	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BELLEVILLE-1	PWR	1310	Operational	EDF	FRAM	01-May-80	09-Sep-87	14-Oct-87	01-Jun-88	
BELLEVILLE-2	PWR	1310	Operational	EDF	FRAM	01-Aug-80	25-May-88	06-Jul-88	01-Jan-89	
BLAYAIS-1	PWR	910	Operational	EDF	FRAM	01-Jan-77	20-May-81	12-Jun-81	01-Dec-81	
BLAYAIS-2	PWR	910	Operational	EDF	FRAM	01-Jan-77	28-Jun-82	17-Jul-82	01-Feb-83	
BLAYAIS-3	PWR	910	Operational	EDF	FRAM	01-Apr-78	29-Jul-83	17-Aug-83	14-Nov-83	
BLAYAIS-4	PWR	910	Operational	EDF	FRAM	01-Apr-78	01-May-83	16-May-83	01-Oct-83	
BUGEY-2	PWR	910	Operational	EDF	FRAM	01-Nov-72	20-Apr-78	10-May-78	01-Mar-79	
BUGEY-3	PWR	880	Operational	EDF	FRAM	01-Sep-73	31-Aug-78	21-Sep-78	01-Mar-79	
BUGEY-4	PWR	880	Operational	EDF	FRAM	01-Jun-74	17-Feb-79	08-Mar-79	01-Jul-79	
BUGEY-5	PWR	900	Operational	EDF	FRAM	01-Jul-74	15-Jul-79	31-Jul-79	03-Jan-80	
CATTENOM-1	PWR	1300	Operational	EDF	FRAM	29-Oct-79	24-Oct-86	13-Nov-86	01-Apr-87	
CATTENOM-2	PWR	1300	Operational	EDF	FRAM	28-Jul-80	07-Aug-87	17-Sep-87	01-Feb-88	
CATTENOM-3	PWR	1300	Operational	EDF	FRAM	15-Jun-82	16-Feb-90	06-Jul-90	01-Feb-91	
CATTENOM-4	PWR	1300	Operational	EDF	FRAM	28-Sep-83	04-May-91	27-May-91	01-Jan-92	
CHINON-B-1	PWR	920	Operational	EDF	FRAM	01-Mar-77	28-Oct-82	30-Nov-82	01-Feb-84	
CHINON-B-2	PWR	920	Operational	EDF	FRAM	01-Mar-77	23-Sep-83	29-Nov-83	01-Aug-84	
CHINON-B-3	PWR	920	Operational	EDF	FRAM	01-Oct-80	18-Sep-86	20-Oct-86	04-Mar-87	
CHINON-B-4	PWR	920	Operational	EDF	FRAM	01-Feb-81	13-Oct-87	14-Nov-87	01-Apr-88	
CHOOZ-B-1	PWR	1455	Operational	EDF	FRAM	01-Jan-84	25-Jul-96	30-Aug-96	15-May-00	
CHOOZ-B-2	PWR	1455	Operational	EDF	FRAM	31-Dec-85	10-Mar-97	09-Apr-97	29-Sep-00	
CIVAUX-1	PWR	1450	Operational	EDF	FRAM	15-Oct-88	29-Nov-97	24-Dec-97	01-Aug-99	
CIVAUX-2	PWR	1450	Operational	EDF	FRAM	01-Apr-91	27-Nov-99	24-Dec-99	01-Jan-00	
CRUAS-1	PWR	915	Operational	EDF	FRAM	01-Aug-78	02-Apr-83	29-Apr-83	02-Apr-84	
CRUAS-2	PWR	915	Operational	EDF	FRAM	15-Nov-78	01-Aug-84	06-Sep-84	01-Apr-85	
CRUAS-3	PWR	915	Operational	EDF	FRAM	15-Apr-79	09-Apr-84	14-May-84	10-Sep-84	
CRUAS-4	PWR	915	Operational	EDF	FRAM	01-Oct-79	01-Oct-84	27-Oct-84	11-Feb-85	
DAMPIERRE-1	PWR	890	Operational	EDF	FRAM	01-Feb-75	15-Mar-80	23-Mar-80	10-Sep-80	
DAMPIERRE-2	PWR	890	Operational	EDF	FRAM	01-Apr-75	05-Dec-80	10-Dec-80	16-Feb-81	
DAMPIERRE-3	PWR	890	Operational	EDF	FRAM	01-Sep-75	25-Jan-81	30-Jan-81	27-May-81	
DAMPIERRE-4	PWR	890	Operational	EDF	FRAM	01-Dec-75	05-Aug-81	18-Aug-81	20-Nov-81	

Source: IAEA Power Reactor Information System as of 31 December 2000.

TABLE 7. CONTINUED, STATUS OF NUCLEAR POWER PLANTS

Station	Type	Capacity	Status	Operator	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
FESSENHEIM-1	PWR	880	Operational	EDF	FRAM	01-Sep-71	07-Mar-77	06-Apr-77	30-Dec-77	
FESSENHEIM-2	PWR	880	Operational	EDF	FRAM	01-Feb-72	27-Jun-77	07-Oct-77	18-Mar-78	
FLAMANVILLE-1	PWR	1330	Operational	EDF	FRAM	01-Dec-79	29-Sep-85	04-Dec-85	01-Dec-86	
FLAMANVILLE-2	PWR	1330	Operational	EDF	FRAM	01-May-80	12-Jun-86	18-Jul-86	09-Mar-87	
GOLFECH-1	PWR	1310	Operational	EDF	FRAM	17-Nov-82	24-Apr-90	07-Jun-90	01-Feb-91	
GOLFECH-2	PWR	1310	Operational	EDF	FRAM	01-Oct-84	21-May-93	18-Jun-93	01-Jan-94	
GRAVELINES-1	PWR	915	Operational	EDF	FRAM	01-Feb-75	21-Feb-80	13-Mar-80	01-Dec-80	
GRAVELINES-2	PWR	915	Operational	EDF	FRAM	01-Mar-75	02-Aug-80	26-Aug-80	01-Dec-80	
GRAVELINES-3	PWR	915	Operational	EDF	FRAM	01-Dec-75	30-Nov-80	12-Dec-80	01-Jun-81	
GRAVELINES-4	PWR	915	Operational	EDF	FRAM	01-Apr-76	31-May-81	14-Jun-81	01-Oct-81	
GRAVELINES-5	PWR	915	Operational	EDF	FRAM	01-Oct-79	05-Aug-84	28-Aug-84	15-Jan-85	
GRAVELINES-6	PWR	915	Operational	EDF	FRAM	01-Oct-79	21-Jul-85	01-Aug-85	25-Oct-85	
NOGENT-1	PWR	1310	Operational	EDF	FRAM	26-May-81	12-Sep-87	21-Oct-87	24-Feb-88	
NOGENT-2	PWR	1310	Operational	EDF	FRAM	01-Jan-82	04-Oct-88	14-Dec-88	01-May-89	
PALUEL-1	PWR	1330	Operational	EDF	FRAM	15-Aug-77	13-May-84	22-Jun-84	01-Dec-85	
PALUEL-2	PWR	1330	Operational	EDF	FRAM	01-Jan-78	11-Aug-84	14-Sep-84	01-Dec-85	
PALUEL-3	PWR	1330	Operational	EDF	FRAM	01-Feb-79	07-Aug-85	30-Sep-85	01-Feb-86	
PALUEL-4	PWR	1330	Operational	EDF	FRAM	01-Feb-80	29-Mar-86	11-Apr-86	01-Jun-86	
PENLY-1	PWR	1330	Operational	EDF	FRAM	01-Sep-82	01-Apr-90	04-May-90	01-Dec-90	
PENLY-2	PWR	1330	Operational	EDF	FRAM	01-Aug-84	10-Jan-92	01-Feb-92	01-Nov-92	
PHENIX	FBR	233	Operational	CEA/EDF	CNCLNEY	01-Nov-68	31-Aug-73	13-Dec-73	14-Jul-74	
ST. ALBAN-1	PWR	1335	Operational	EDF	FRAM	29-Jan-79	04-Aug-85	30-Aug-85	01-May-86	
ST. ALBAN-2	PWR	1335	Operational	EDF	FRAM	31-Jul-79	07-Jun-86	03-Jul-86	01-Mar-87	
ST. LAURENT-B-1	PWR	890	Operational	EDF	FRAM	01-May-76	04-Jan-81	21-Jan-81	01-Aug-83	
ST. LAURENT-B-2	PWR	890	Operational	EDF	FRAM	01-Jul-76	12-May-81	01-Jun-81	01-Aug-83	
TRICASTIN-1	PWR	880	Operational	EDF	FRAM	01-Nov-74	21-Feb-80	31-May-80	01-Dec-80	
TRICASTIN-2	PWR	880	Operational	EDF	FRAM	01-Dec-74	22-Jul-80	07-Aug-80	01-Dec-80	
TRICASTIN-3	PWR	880	Operational	EDF	FRAM	01-Apr-75	29-Nov-80	10-Feb-81	11-May-81	
TRICASTIN-4	PWR	880	Operational	EDF	FRAM	01-May-75	31-May-81	12-Jun-81	01-Nov-81	

Source: IAEA Power Reactor Information System as of 31 December 2000.

TABLE 7. CONTINUED, STATUS OF NUCLEAR POWER PLANTS

Station	Type	Capacity	Status	Operator	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BUGEY-1	GCR	540	Shut Down	EDF	VARIOUS	01-Dec-65	21-Mar-72	15-Apr-72	01-Jul-72	27-May-94
CHINON-A1	GCR	70	Shut Down	EDF	LEVIVIER	01-Feb-57	16-Sep-62	14-Jun-63	01-Feb-64	16-Apr-73
CHINON-A2	GCR	210	Shut Down	EDF	LEVIVIER	01-Aug-59	17-Aug-64	24-Feb-65	24-Feb-65	14-Jun-85
CHINON-A3	GCR	480	Shut Down	EDF	GTM	01-Mar-61	01-Mar-66	04-Aug-66	04-Aug-66	15-Jun-90
CHOOZ-A(ARDENNES)	PWR	310	Shut Down	SENA	A/F/W	01-Jan-62	18-Oct-66	03-Apr-67	15-Apr-67	30-Oct-91
CREYS-MALVILLE	FBR	1200	Shut Down	NERSA	ASPALDO	13-Dec-76	07-Sep-85	14-Jan-86		31-Dec-98
EL-4 (MONTES D'ARREE)	HWGCR	70	Shut Down	EDF	GAAA	01-Jul-62	23-Dec-66	09-Jul-67	01-Jun-68	31-Jul-85
G-2 (MARCOULE)	GCR	38	Shut Down	COGEMA	SACM	01-Mar-55	21-Jul-58	22-Apr-59	22-Apr-59	02-Feb-80
G-3 (MARCOULE)	GCR	38	Shut Down	COGEMA	SACM	01-Mar-56	11-Jun-59	04-Apr-60	04-Apr-60	20-Jun-84
ST. LAURENT-A1	GCR	480	Shut Down	EDF	VARIOUS	01-Oct-63	07-Jan-69	14-Mar-69	01-Jun-69	18-Apr-90
ST. LAURENT-A2	GCR	515	Shut Down	EDF	VARIOUS	01-Jan-66	04-Jul-71	09-Aug-71	01-Nov-71	27-May-92

Source: IAEA Power Reactor Information System as of 31 December 2000.

## 4. NUCLEAR POWER INDUSTRY

A vast reorganization of the French nuclear industry has been launched in 2001 with the aim of achieving more efficiency and better legibility of the sector. Framatome-ANP, Cogéma, FCI (Framatome Connectors International), STMicroelectronics, will be set on the same footing under a single state-controlled holding structure, called “AREVA”. The subsidiaries will be organized in two main industry poles, the nuclear pole (Framatome-ANP, Cogéma and their subsidiaries) and the information/communication pole (FCI, STMicro). Each subsidiary could be introduced on the market independently, with the possibility that the holding itself opens partially to the French stock market on a later stage.

### 4.1. Supply of NPPs

The leading companies in the plant construction industry for PWR’s are Framatome, which supplies the nuclear island, and Alstom for the conventional part. There have been changes in the ownership and scope of business of these companies as they expanded to meet the needs of the French programme in the last decade. In 1981, Framatome terminated its licence with Westinghouse and negotiated a new agreement to achieve greater autonomy. Framatome developed a wide range of expertise and capabilities in reactor operation and maintenance services. After Alcatel withdrawal from Framatome’s ownership, the decision has been taken in 1999 to transfer most of its shares to Cogéma and CEA. In counterpart, Framatome will take over Cogéma’s activities in uranium fuel manufacturing. The nuclear sectors of Framatome and Siemens have merged into a new company called Framatome-ANP (Advanced nuclear power) owned at 64% by Framatome and 36% by Siemens.

### 4.2. Operation of NPPs

The electricity utility *Electricité de France* (EDF) was nationalized in 1946 along with the national coal, oil and gas companies. EDF owns and operates all the French PWR nuclear power plants.

### 4.3. Fuel Cycle, Spent Fuel and Waste Management Service Supply

CEA, through its subsidiary CEA-Industrie, is the main shareholder of the *Compagnie générale des matières nucléaires* (Cogéma) which controls most of the fuel cycle industry, with the exception of UO-fuel manufacturing (Framatome) and of waste management and disposal, run by the independent public agency ANDRA. Cogéma is an industrial and commercial leader in all phases of the fuel cycle, including prospecting and running uranium mines, enrichment, MOX-fuel fabrication, reprocessing, and waste packaging.

### 4.4. R&D Activities

In 1945 the French government created a national agency, the *Commissariat à l’Energie Atomique* (CEA), for the development of all aspects of atomic energy, including both civil and military applications. Although its responsibilities changed through time, particularly with the transfer of some industrial activities to newly created subsidiaries, CEA has retained most of its early activities and interests in mean and long term R&D, notably in reactor design, fuel concepts, enrichment, waste transmutation and disposal as well as in technology transfer and fundamental research.

Framatome ANP has completed the basic design for a 1545 MW(e) European Pressurized Water Reactor (EPR) in 1998, which meets European utility requirements. The EPR’s higher power level relative to the latest series of PWRs operating in France (the N4 series) and Germany (the Konvoi series) has been selected to capture economies of scale. Framatome ANP with international

partners is also developing the basic design of the SWR-1000, an advanced BWR with passive safety features.

The CEA has launched R&D programme to study promising technologies for future nuclear energy systems, addressing in the first place the issues of enhanced safety, sustainability, and economics. The reference concept is based on a gas-cooled fast reactor with on-site closed fuel cycle. France is also collaborating with other countries to develop a 280 MWe Gas Turbine Modular Helium Reactor (GT-MHR) for electricity production and consumption of weapons grade plutonium.

#### **4.5. International Cooperation in the Field of Nuclear Power Development and Implementation**

France is member of several international organizations, including the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) as well as other bilateral and multilateral organizations such as the World Association of Nuclear Operators (WANO).

### **5. NUCLEAR LAWS AND REGULATIONS**

#### **5.1. Safety Authority and Licensing Process**

Nuclear legislation in France has developed in successive stages in line with technological advances and growth in the atomic energy field. Therefore, many of the enactments governing nuclear activities are to be found in the general French legislation on environmental protection, water supply, atmospheric pollution, public health and labour.

However, the French Parliament has adopted a number of specific enactments. Examples include Act No. 68-493 (30 October 1968), setting special rules as to third party liability in the field of nuclear energy, which is distinct from the ordinary French law on third party liability, the 19 July 1952 Act, now embodied in the Public Health Code, specifying licensing requirements for the use of radioisotopes, Act No. 80-572 of 25 July 1980 on the protection and control of nuclear materials, and more recently Act No. 91-1381 concerning research on radioactive waste management.

Although French nuclear law is characterized by its variety of sources, as in other countries where nuclear energy has developed, the original features of this legislation derive chiefly from international recommendations or regulations. For example, radiation protection standards are derived from the Recommendations of the International Commission on Radiological Protection (ICRP) and Directives issued by the European Union (formerly the European Community). Likewise, the French Act of 1968 on the liability of nuclear operators is directly derived from the Paris Convention of 29 July 1960.

French nuclear legislation began to develop from the time the Atomic Energy Commission (*Commissariat à l'énergie atomique* - CEA), the public agency set up by the State in 1945 [Ordinance No. 45-2563 of 18 October 1945] and formerly reporting directly to the prime minister, no longer held a monopoly for nuclear activities, in other words from the time nuclear energy applications entered the industrial stage, thus requiring the involvement of new nuclear operators. This development had several landmarks: in 1963, a system for licensing and controlling major nuclear installations was introduced, setting government responsibility in matters of population and occupational safety (Decree of 11 December 1963). Prior to this, procedures concerning the licensing and control of industrial activities were dealt with by the *Préfet* for each *Département*. In 1973, this system was expanded to cover the development of the nuclear power programme, and better define the role of government authorities. Finally, the decree of 20 June 1966 included Euratom Directives as part of the French radiation protection regulations.

In the course of the 1980's, the enactments setting up the CEA were amended so as to strengthen its inter-ministerial status and a tripartite Board of Administration including staff

representatives was created. However governmental decisions are prepared by the Atomic Energy Committee, which acts as a restricted inter-ministerial committee on nuclear energy matters. CEA is now answerable to the Minister for Industry and to the Minister for Research [Decrees No. 93-1272 of 1 December 1993 and No. 93-796 of 16 April 1993]. The main task of CEA was laid down in September 1992 by the Government: concentrate on developing the control of atom uses for purposes of energy, health, defence and industry, while remaining attentive to the requests made by its partners in industry and research. More specifically, the inter-ministerial committee of 1 June 1999 requested CEA to “strengthen long-term research on future reactors capable of reducing, and even eliminate the production of long-lived radio-active waste”. In addition CEA was given a particular responsibility for R&D on alternative and renewable energies.

The regulations for large nuclear installations, referred to above, have been supplemented with regard to procedures by an Instruction of 27 March 1973 and a Decision of the same date (amended by a Decision of 17 December 1976), which are internal instruments issued by the Minister for Industry. The authorities primarily involved in the licensing procedure for the setting up of large nuclear installations are the Minister for Industry and the Minister for Environment. For this purpose, the Central Service for Nuclear Installations Safety (SCSIN), set up in 1973 within the Ministry of Industry, has been reshuffled as the Directorate for Nuclear Installations Safety (*Direction de la Sûreté des Installations Nucléaires, DSIN*) and now reports to both the Ministers for Industry and for Environment.

The licensing procedure is governed by Decree No. 63-1128 of 11 December 1963. Under this procedure the Decree authorizing the setting up of a installation lays down the technical requirements and other formalities which its operator must comply with. For nuclear reactors, for instance, there are generally two stages: first, fuel loading and commissioning tests, and second, entry into operation - both conditional on joint approval by the Ministers for Industry and for the Environment. The consent of the Minister for Health is requested.

DSIN is mainly responsible for:

- i) studying problems raised by site selection;
- ii) establishing the procedures for licensing large nuclear installations (licenses for setting up, commissioning, disposal, etc.);
- iii) organizing and directing the control of these installations;
- iv) drafting general technical regulations and following their implementation;
- v) establishing plans in the event of an accident occurring in a large nuclear installation;
- vi) proposing and organizing public information on nuclear safety.

At the local level, DSIN's actions are relayed through the nuclear divisions of the Regional Directorates for Industry, Research and Environment (DRIRE). These Directorates are responsible for the survey of nuclear installations and monitoring reactor shutdowns and all pressurized components. They also provide technical support to the “*préfet*”, the Government local representative, in particular in case of accident.

DSIN is assisted in its decisions by the Institute for Nuclear Protection and Safety (*Institut de Protection et de Sûreté Nucléaire - IPSN*), set up in 1976 within the Atomic Energy Commission (CEA). The Institute can also undertake studies or research on protection and nuclear safety problems on request of any concerned ministerial department or agency. A recent reorganization strengthened the autonomy of IPSN, which is due to become totally independent of CEA.

The Central Board for Protection against Ionizing Radiation (*Office de Protection contre les Rayonnements Ionisants, OPRI*), under the Ministries for Health and Labour, is responsible for carrying out measurements or analytical work in order to determine the level of radioactivity or ionizing radiation that might become hazardous to health in various environmental situations, for individuals or the population as a whole. It co-ordinates and defines controls for the radiation

protection of workers and is involved in the plans to be put in action in case of radioactive incident. The main part of it will join IPSN to constitute an autonomous public body in the next months, joining expertise capacities in the fields of radioprotection and nuclear safety (Law n°2001-398 AFSSE of 9 May 2001).

As mentioned in Section 2.2, a major regulatory reform is to come into force during 2002.

## 5.2. Main National Laws and Regulations

### *Organization and structure*

- Decree 69-724 of 1969 setting the powers and duties of the Ministry of Industrial and Scientific Development.
- Decree 70-878 of 29 September 1970 setting the powers and duties and organization of the *Commissariat à l'Énergie Atomique* (CEA) and Regulatory Authority.
- Decree 72-11582 of 14 December 1972; further amended in 1982, 1984 and 1994; decree 82-734 of 24 August 1982; decree 84-279 of 13 April 1984 and decree 94-451 of 3 June 1994.
- Decree 73-278 of 13 March 1973 providing for the creation of the Higher Council of Nuclear Safety and Central Service for Safety of Nuclear Installations, further amended in 1977, 1981, 1982, 1985 and 1987 : decree 77-623 of 6 June 1977; decree 81-978 of 29 October 1981; decree 82-531 of 22 June 1982; decree 82-918 of 26 October 1982; decree 85-140 of 28 January 1985 and decree 87-137 of 2 March 1987.
- Decree 75-713 of 4 August 1975 providing for the formation of an Interministerial Committee of Nuclear Safety, amended in 1978 : decree 78-1193 of 18 December 1978.
- Resolution of 2 November 1976 providing for the establishment of the Nuclear Safety and Protection Institute. Further amended in 1981, 1983, 1990 and 1993 : resolution of 29 October 1981; resolution of 29 April 1983; resolution of July 1983; resolution of 28 May 1990 and resolution of 20 August 1993.
- Decree of 1979 creating a National Agency for Radioactive Waste Management (ANDRA); amended by a decree of 1984 and by the law of 31 December 1991 on high level waste management.
- Decree 81-300 of 1981 authorizing CEA and COGEMA activities in matters of mineral substances and fossils.
- Determination of Jurisdiction of the Ministry for Industry in nuclear matters : decree 93-1272 of 1<sup>st</sup> December 1993 and decree 97-710 of 11 June 1997.
- Decree n° 95-19 of 9 January 1995 determining the powers and duties and the organization of the General Delegation for Armament (DGA).
- Decree n° 97-715 of 11 June 1997 related to the powers and duties of the Minister for Regional Development and Environment.
- Decree n° 97-728 of 18 June 1997 related to the powers and duties of the Secretary of State for Industry.
- Law n° 98-217 of 27 March 1998 authorizing the ratification of the CTBT.
- Law n°2001-398 of 5 May 2001 related to the creation of the "Agence Française de Sécurité Sanitaire Environnementale, AFSSE".

### *Radioprotection*

- Decree 67-228 of 15 March 1967 related to protection of workers against ionizing radiation hazards; substituted by decree 86-1103 of 2 October 1986. This decree was amended in 1988, 1991 and 1995 : decree 88-662 of 6 May 1988, decree 91-963 of 19 September 1991 and decree 95-608 of 6 May 1995.
- Decree 66-450 of 20 June 1966 enforcing basic protection rules against radiation. Further amended by decrees of 1988 and 1994 : decree 88-521 of 18 April 1988 and decree 94-604 of 19 July 1994.

- Resolution of 24 August 1967 providing for the creation of the Commission for Protection against Ionizing Radiation.
- Decree 69-50 of 10 January 1969 concerning survey procedures to monitor contamination levels of surface waters.
- Decree 75-306 of 28 April 1975 related to the protection of workers against ionizing radiation hazards in basic nuclear installations (Regulatory decrees). Further amended by decrees of 1988, 1997 and 1998: decree 88-662 of 6 May 1988, decree 97-137 of 13 February 1997 and decree 98-1185 of 24 December 1998.
- Decree 72-819 of 1<sup>st</sup> September 1972 related to the creation of a Defence Body for Civil Protection, amended by decree 90-670 of 31 July 1990.
- Resolution of 2<sup>nd</sup> October 1990 dealing with the definition of control methods established by decree 86-1103 2<sup>nd</sup> October 1986 related to protection of workers against ionizing radiation hazards.
- Directive 96/29 Euratom of 13 May 1996, establishing the basic rules related to health protection against radiation hazards for population and workers.
- Decree of 26 January 1998 listing the institutions appointed to control the radio-protection devices efficiency, as required by decree n° 86-1103 of 2<sup>nd</sup> October 1986, and decree n° 75-306 28 April 1975 on the protection of workers against ionizing radiation hazards.
- Decree of 2<sup>nd</sup> February 1998 concerning water pumping and consumption as well as all kind of emissions by the installations classified for environment protection subject to authorization.
- Decree of 10 February 1998 on the agreement of the institutions licensed for training in radio-protection.
- Decree of 12 May 1998 amending decree of 8 October 1990 modified, setting the list of activities for which use of interim or temporary contract workers is not allowed.
- Decree of 27 August 1998 related to the test use of microprocessor cards by the employees of an external company intervening in a nuclear basic installations, in the purpose of transmitting data between works doctors.
- European Council directive 98/83/CE of 3<sup>rd</sup> November 1998, dealing with the cleanness of human consumption water.
- Decree of 23 March 1999 fixing the rules of external dosimetry for workers under radiation conditions as required by decree of 28 April 1975 modified and decree of 2 October 1986 modified.
- Decree of 23 March 1999, setting the rules applied by the Board of Protection against Ionizing Radiation (OPRI) for licensing some persons to access to personal data regarding workers exposure to ionizing radiation.
- Ordinance 2001-270 of 28 March 2001 related to the transposition of European directives in the field of the ionizing radiation.

#### *Regulatory regime for nuclear installations*

- Decree 67-964 of 24 October 1967 revising the nomenclature of hazardous, unhealthy and uncomfortable facilities.
- Decree 70-440 of 22 May 1970 repealing the authorization regime for nuclear plants and thermoelectric plants authorized by decree of 30 October 1935.
- Decree 63-1228 of 11 December 1963 related to basic nuclear installations, further amended by decrees in 1973, 1985, 1990 and 1993 : decree 73-405 of 27 March 1973, decree 85-449 of 23 April 1985, decree 90-78 of 19 January 1990 and decree 93-816 of 12 May 1993.
- Circular dated 26 February 1974 related to the application of regulations on pressure equipment for pressurized water nuclear reactors. Amended by resolution dated 6 December 1974 and further amended by circular of 5 August 1977.
- Law 76-663 of 19 July 1976 related to the Installations Classified for Environment Protection (*Installations Classées pour la Protection de l'Environnement* - ICPE).

- Resolution and circular of 10 August 1984 concerning building concept and operation of Basic Nuclear Installations (*Installations Nucléaires de Base - INB*).
- Decree of 11 March 1996 setting the limit beyond which factories dealing with radioactive matters, as well as those intended for storage of such matters, including wastes, are classified as Basic Nuclear Installations.
- Decree n° 96-197 of 11 March 1996 modifying the list of classified installations.
- Decree n° 96-972 of 31 October 1996 dealing with the publication of the Nuclear Safety Convention, signed in Vienna, 20 September 1994.
- Decree n° 97-1116 of 27 November 1997 modifying the list of classified installations
- Note of 20 May 1998 dealing with licensing demands, enforcing decree n° 95-540 of 4 May 1995 related to liquid and gas effluent emissions and to water pumping by Basic Nuclear Installations.
- Decree n° 99-873 of 11 October 1999 dealing with Secret (military) Basic Nuclear Installations.
- Decree 2001-592 of 5 July 2001 related to the safety and radioprotection of nuclear facilities and activities in the field of defence.

#### *Regulatory regime for radioactive matters*

- Resolution of 28 March 1977 related to the assistance regime for uranium prospecting.
- Law 80-572 of 25 July 1980 on control and protection of nuclear matters. Further amended by law 89-434 of 30 June 1989.
- Decree 81-512 of 12 May 1981 related to the control and protection of nuclear matters.
- Decree 81-558 of 15 May 1981 related to nuclear matters control and compatibility.
- Resolution of 14 March 1984 related to nuclear elements subject to be declared.
- Decree of 11 March 1996, repealing decree of 24 November 1977 establishing the characteristics of radioactive matters under special forms.
- Decree of 24 September 1996 setting the conditions for the assignment of nuclear matters to military use.

#### *Radioactive waste management*

- Decree 82-193 of 18 February 1982, related to the publication of amendments to Annexes I and II of the 24 September 1972 London Convention.
- Law of 31 December 1991 on high level waste management.

#### *Civil Liability*

- Law 68-943 of 30 October 1968 on nuclear civil liability.; further amended in 1990 : law 90-488 of 16 June 1990.
- Decree 69-154 of 6 February 1969 related to the publication of the Paris Convention.
- Main reinsurance fund : articles L. 431-4 to 431-7 and articles R. 431-27 and 29 of Insurance Code.
- Constitution of cover funds by insurance companies in case of exceptional expenses related to atomic risk coverage : article R.331-6 of Insurance Code.
- Decisions of exclusion from the AEN Committee of Directors, 10 October 1977:
  - Exclusion of small quantities of nuclear matters out of a nuclear installation [NE/M (77) 2];
  - Exclusion of certain classes of nuclear matters [NE/M (77)2].
- Decree 91-355 of 12 April 1991 related to the characteristics of reduced risks/safe installations (1991).

### 5.3. International, Multilateral and Bilateral Agreements

#### AGREEMENTS WITH THE IAEA

- Agreement on privileges and immunities Non-Party
- Voluntary offer: Agreement with the European Atomic Energy Community for the application of safeguards in France; INFCIRC No: 290 Entry into force: 12 September 1981
- Additional protocol to the Agreement with the European Atomic Energy Community for the application of safeguards in France Signature: 22 September 1998
- Safeguards Agreement under the additional protocol I to the Tlatelolco Treaty; GOV/1998/31 Signature: 21 March 2000
- Tlatelolco Treaty Additional protocol n°1 Entry into force: 24 August 1994  
Additional protocol n°2 Entry into force: 23 March 1974
- EURATOM Member

#### OTHER MULTILATERAL SAFEGUARDS AGREEMENTS WITH IAEA

- Japan / France INFCIRC/171 Entry into force: 22 September 1972
- Republic of Korea / France INFCIRC/233 Entry into force: 22 September 1975
- Pakistan / France INFCIRC/239 Entry into force: 18 March 1976
- Exchange of letters between the governments of France and the Republic of Iraq supplementary to the Franco Iraqi co-operation agreement for the peaceful utilization of nuclear energy INFCIRC/172/add.1 Entry into force: 4 November 1976
- South Africa / France INFCIRC/244 Entry into force: 5 January 1977

#### MAIN INTERNATIONAL TREATIES

- NPT Entry into force: 3 August 1992





## Appendix

### DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

#### ATOMIC ENERGY COMMISSION

Commissariat à l'Énergie Atomique (CEA)  
31-33 rue de la Fédération  
F-75752 Paris Cedex 15

Tel.: +33 (0)14056 1000 or ext  
<http://www.cea.fr/>

*The following institutes are within CEA:*

- Institut National des Sciences et Techniques Nucléaires (INSTN, National Institute for Nuclear Science and Technology; also under the Ministry of Education)
- Institut de Protection et de Sécurité Nucléaire (IPSN, Nuclear Safety and Protection Institute)

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

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

#### OTHER NUCLEAR ORGANIZATIONS

Comité Interministériel de la Sécurité Nucléaire  
13, rue de Bourgogne  
F-75007 Paris

Tel.: +33 (0)1 43 19 56 78

Direction de la Sécurité des Installations Nucléaires (DSIN, under Ministries of Industry and of Environment)  
99, rue de Grenelle  
F-75353 Paris 07  
or:

Tel.: +33 (0)1 43 19 36 36  
<http://www.asn.gouv.fr>

60-68 av. du Général-Leclerc  
B.P. 6  
F-92265 Fontenay-aux-Roses

Tel.: +33 (0)1 46 54 70 80  
Fax: +33 (0)1 42 53 69 04

Office de Protection contre les Rayonnements Ionisants (OPRI, under Ministries of Health and of Labour)  
31, rue de l'Ecluse  
B.P. 35  
F-78110 Le Vésinet

Tel.: +33 (0)1 30 15 52 00  
Fax: +33 (0)1 39 76 08 96  
Telex: 696257  
<http://www.opri.fr/>

Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA)  
Parc de la Croix Blanche  
1-7, rue Jean Monnet  
F-92298 Chatenay-Malabry Cedex

Tel.: +33 (0)1 46 11 80 00  
Fax: +33 (0)1 46 11 82 68  
<http://www.andra.fr/>

## *OTHER ORGANIZATIONS IN THE NUCLEAR INDUSTRY*

Electricité de France (EDF)  
2, rue Louis Murat  
F-75384 Paris Cedex 08

Tel.: +33 (0)1 40 42 22 22  
Fax: +33 (0)1 40 42 13 32  
<http://www.edf.fr/html/fr/index.html>

Compagnie Générale des Matières  
Nucléaires (Cogéma)  
2, rue Paul Dautier  
B.P. 4  
F-78141 Vélizy Cedex

Tel.: +33 (0)1 39 26 30 00  
Fax: +33 (0)1 39 26 27 00  
<http://www.cogema.fr/>

FRAMATOME-ANP  
Tour-Framatome  
La Défense  
F-92084 Paris-La Défense cedex

Tel.: +33 (0)1 47 96 14 14  
Fax.: +33 (0)1 47 96 01 02  
<http://www.framatome.com/>

## *HIGH ENERGY INSTITUTES*

Centre National de la Recherche Scientifique (CNRS)

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

European Synchrotron Radiation Facility – Grenoble  
(ESRF)

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

Institut National de Physique Nucléaire  
et de Physique des Particules (IN2P3)

<http://www.in2p3.fr:80/>

Laboratoire pour l'Utilisation du Rayonnement  
Electromagnétique - CNRS (LURE)

<http://www.lure.u-psud.fr/>

DRFC-CEA Cadarache  
(Département de Recherches sur la Fusion Contrôlée)

<http://www.cad.cea.fr/r50.htm>

## *INTERNATIONAL ORGANIZATIONS*

European Science Foundation

<http://www.esf.org/>

European Space Agency (ESA)

<http://www.esa.int/>

IEA International Energy Agency

<http://www.iea.org/homechoi.htm>

Nuclear Energy Agency of the OECD (NEA)

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

Organisation for Economic Co-operation  
and Development (OECD)

<http://www.oecd.org/>

## *OTHER ORGANIZATIONS*

Société Française de l'Energie Nucléaire  
(SFEN)

<http://www.sfen.org/>

World Council of Nuclear Workers (WONUC)

<http://www.wonuc.org/>