BELGIUM

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1. GENERAL INFORMATION

1.1. General Overview

Belgium is a country of 30,514 square kilometres with 10.2 million inhabitants (1999). It has a high population density of 335 persons per square kilometre (over 95 per cent of the population is classified as urban) and high electricity consumption per capita. Belgium's natural population increase during the 1980s was only about 0.1%. By the end of the decade the birth rate increased so that the population grew from 9.98 million in 1991 to the present 10.2 million (Table 1). Belgium is situated in the heart of Western Europe, bounded on the north by the Netherlands and the North Sea, on the east by Germany and Luxembourg and on the south and southwest by France. The climate is temperate. The country has no gas, no uranium, or no oil and very limited hydraulic resources. The mining of coal ended in 1978 in the south of the country and in the early 1990s in the north. Coal mining was no longer economically viable.

TABLE 1. POPULATION INFORMATION

	1960	1970	1980	1990	2000	2001	Growth rate (%) 1980 To 2001
Population (millions)	9.2	9.7	9.9	10.0	10.2	10.3	0.2
Population density (inhabitants/km²)	300.0	316.4	323.1	326.7	335.9	336.4	

Predicted population growth rate (%) 2001 to 2010	0.3
Area (1000 km²)	30.5
Urban population in 2001 as percent of total	

Source: IAEA Energy and Economic Database.

1.2. Economic Indicators

The historical Gross Domestic Product (GDP) statistics are shown in Table 2.

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1970	1980	1990	2000	2001	Growth rate (%) 1980 To 2001
GDP (millions of current US$)		121,563	197,285	226,648	217,468	2.8
GDP (millions of constant 1990 US$)	117,914	163,777	197,100	243,475	251,155	2
GDP per capita (current US$/capita)		12,330	19,793	22,113	21,188	2.6

Source: IAEA Energy and Economic Database.

1.3. Energy Situation

Belgium has terminated all mining activities. The main domestic source used to be coal, but the last pits closed in 1991, after the decision was made to withdraw subsidies from this industry (proved reserves of bituminous coal in 1993 were 715 million Mt., see Table 3). Hydraulic resources are estimated to be 2,873 TJ. In the early 1980s, nuclear power replaced coal as the main indigenous energy source. Presently (1999), nuclear power provides 19.1% of total primary energy consumed in Belgium, compared with only 7% in 1980. Over the same period (1980-1999), the share of oil

declined from 50% to 41.1%, while coal fell from 25% to 13%. Gas increased during the same period from 20% to 25.8%. Missing 1% relates to import/export differences, alternatives, etc. (Table 4).

In 1999, per capita gross primary energy consumption in Belgium was 5.61 tons of oil equivalent (toe), or 234.8 GJ. The total gross primary energy consumption rose slightly with 0.1% compared to 1998.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in 1999 (Exajoule)					
	Solid	**Liquid**	**Gas**	**Uranium (1)**	**Hydro (2)**	**Total**
Total amount in place					0.10	0.10

(1) This total represents essentially recoverable reserves.

(2) For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 2002) by a factor of 10.

Source: IAEA Energy and Economic Database.

TABLE 4. ENERGY STATISTICS(*)

							Average annual growth rate (%)	
	1960	**1970**	**1980**	**1990**	**2000**	**2001**	**1960 To 1980**	**1980 To 2001**
Energy consumption								
- Total (1)	1.05	1.69	1.98	1.93	2.35	2.48	3.21	1.08
- Solids (2)	0.75	0.55	0.51	0.46	0.31	0.31	-1.93	-2.26
- Liquids	0.30	0.98	0.96	0.72	0.94	0.94	6.01	-0.06
- Gases		0.16	0.41	0.38	0.67	0.78	33.40	3.06
- Primary electricity (3)		0.01	0.10	0.36	0.43	0.44	21.42	7.34
Energy production								
- Total	0.66	0.31	0.34	0.46	0.47	0.45	-3.23	1.32
- Solids	0.66	0.31	0.22	0.07	0.01	0.01	-5.37	-12.44
- Liquids								
- Gases							-2.41	-19.05
- Primary electricity (3)			0.12	0.40	0.45	0.44	24.08	6.21
Net import (Import - Export)								
- Total	0.35	1.51	1.79	1.71	2.19	2.56	8.53	1.70
- Solids	0.02	0.23	0.29	0.40	0.31	0.30	13.14	0.12
- Liquids	0.33	1.12	1.09	0.92	1.14	1.14	6.23	0.22
- Gases	0.00	0.16	0.41	0.38	0.73	1.12	-33.97	4.85

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

(2) Solid fuels include coal, lignite and commercial wood.

(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind.

(*) Energy values are in Exajoule except where indicated.

Source: IAEA Energy and Economic Database.

1.4. Energy Policy

Belgium is highly dependent on foreign countries for its energy supply and, therefore, it has to integrate its energy policy into a larger frame on the international level. Working towards this goal implies finding a dependable energy supply on viable economic conditions that also sustains environmental quality (balancing of the three E's - energy, economy and environment).

Coal, the main energy source in the 1950's, was replaced by oil, which today (1999) represents

about 41% of the total primary energy consumption. Gas, nuclear energy and coal each represent approximately 26%, 19% and 13% of the total primary energy. Keeping this in mind, special attention is now given to the rational use of energy both on the demand and supply side.

2. ELECTRICITY SECTOR

2.1. Structure of the Electricity Sector

The legal and administrative context of the distribution of electrical power in Belgium is determined by the law of March 10, 1925, which stipulates:

i) that the distribution of electricity is the exclusive right of the local municipalities for all supplies that do not exceed 1000 kWe (increased to 10,000 kWe in one region); and,

ii) that for larger customers, there is no monopoly right for the municipality and the power can be supplied by the local municipality or by any private or public electric utility.

There is no law governing production and transmission of electricity and as a consequence these activities can be considered to be free, although in the course of time these activities have been subject to subsequent conventions.

This context has lead to a situation where a large number of power generation companies developed across the country. In 1955, 47 generating companies existed in Belgium, most of them private. After World War II, a long chain of mergers reduced private suppliers to three companies (Ebes, Intercom and Unerg) by 1980. In 1979, public utilities regrouped into one public utility (SPE). Finally, in 1990, the three private utilities merged to create Electrabel.

In 1999, Electrabel accounts for 86.6% of the total electricity production capacity in Belgium and the publicly owned generating facilities (SPE) for 8%. The autoproducers (mainly active in the chemical and metallurgy sector) and autonomous producers (mainly active in the service sector) account for respectively 4.1% and 1.3%. Both Electrabel and SPE have a total market share of 96.7%. The autoproducers take 3% of the production and the autonomous generators represent 0.3% of the market.

Pursuant to the Convention reached in 1994 between Electrabel and SPE, both companies have pooled in 1995 their electricity generating and transmission resources by transferring them to the co-operative company CPTE (Company for Co-ordination of Generation and Transmission of Electrical Energy). This company is the result of the merger of the limited liability company of the same name, which owned the national dispatching centre, and the co-operative company Gecoli that owned the national 380, 220 and 150 kV electricity grids.

At the latest in 2005, it was foreseen that CPTE will become the owner, or will have the exclusive right of operation, of all power production at its own power stations and those brought in by Electrabel and SPE, together with imported power. Pursuant to the Convention, SPE has the right to increase, before the end of the year 2005, its participation in CPTE up to 15%, or about 14% of the current total electricity production capacity in Belgium (the part of SPE in the total electricity production capacity in CPTE was 8.5% in 1999).

CPTE sells the power produced by the pooled plants to Electrabel and SPE, which in turn supply it to their own customers, trading under their own names. Both Electrabel and SPE take over responsibility for operating CPTE's power stations, and Electrabel for electricity transmission, under management contracts.

On the distribution side, only a few municipalities have exercised their right to create "régies" (public, autonomous bodies). In the beginning of the 20th century many régies granted concessions or

franchises to private companies, and later on regrouped to form "intercommunales" or groups of municipalities. Intercommunales are either "pure", i.e., without collaboration of private partners; or "mixed", i.e., associated with the private company, Electrabel. Today, most Belgian distribution companies are mixed.

The electricity sector is fully integrated in the Belgian economy.

2.2. Decision Making Process

2.2.1. Legal Framework

Under the Act of 8 August 1988, Belgium became a federal state with significant attribution of powers to the three regional governments. However, the nuclear sector policy remains principally in the hands of the federal (national) government.

Even though Belgian electricity generation is mainly in the hands of the private sector, both federal and regional governments have an influence on it. This influence is marked by partnership arrangements with shares held jointly by the government and the private sector; by the activities of semi-official bodies and by arrangements, which enable the government to influence the main strategies of the energy industries. Management of the gas and electricity sectors is based on a continuing dialogue between the government and the Belgian federation of gas and electricity companies.

The agreements between government and the energy industries have enabled the government to set general strategies for the energy sector while standing back from detailed management. Supplies of oil and gas have been secured from diversified sources. A large nuclear programme has been implemented, and high cost coal production has been successfully eliminated.

Since 1955, the electricity sector's activities have been under the concerted control of labour organizations, the confederation of Belgian industry (VBO/FEB), and various Government bodies. Two agreements signed in 1955 led to the establishment of two Committees.

The Management Committee, which is composed of the representatives of the electricity companies, co-ordinates at management level the sector, particularly regarding investment choices in the development of the generating resources and in electricity pricing matters. The government supervised Controlling Committee, which is composed of the employers' organization (VBO/FEB) and labour representatives, makes recommendations regarding electricity costs, prices, depreciation and investment policies and the operation of the "inter-municipal" distribution companies.

In 1964, when the above two agreements expired, a new agreement was signed for another ten years, and again renewed in 1974. The new agreement extended the Controlling Committee to include the gas sector. A "Common Chamber" was added to the Management Committee to study the sector's development plans regarding generation, interconnection and transmission facilities. The municipal directors of the mixed (i.e., private/public) intercommunales, and the municipalities in charge of electricity distribution within their territory, were represented in the Controlling Committee.

In 1980, by the law of 8 August, the Controlling Committee became a public establishment, overseen by the federal Minister for Economic Affairs, and the same law imposed that the national energy investment plan ("National Equipment Plan") has to be approved by the Minister, based on recommendations by the Controlling Committee and the National Committee for Energy.

In 1981, the private electricity companies, the public electricity companies and the Belgian State signed a new agreement. All parties to the agreement, the State included, committed themselves to guarantee utility companies' uninhibited access to the domestic and international capital markets, without public subsidies, for the financing of their investments.

Under the above described legal framework, investment decisions of the electricity sector, particularly those regarding the construction of nuclear units, are proposed by the Management Committee with the collaboration of the public electricity sector and under the supervision of the Belgian confederation of industry, labour organizations, municipal authorities and the Government (see Figure1).

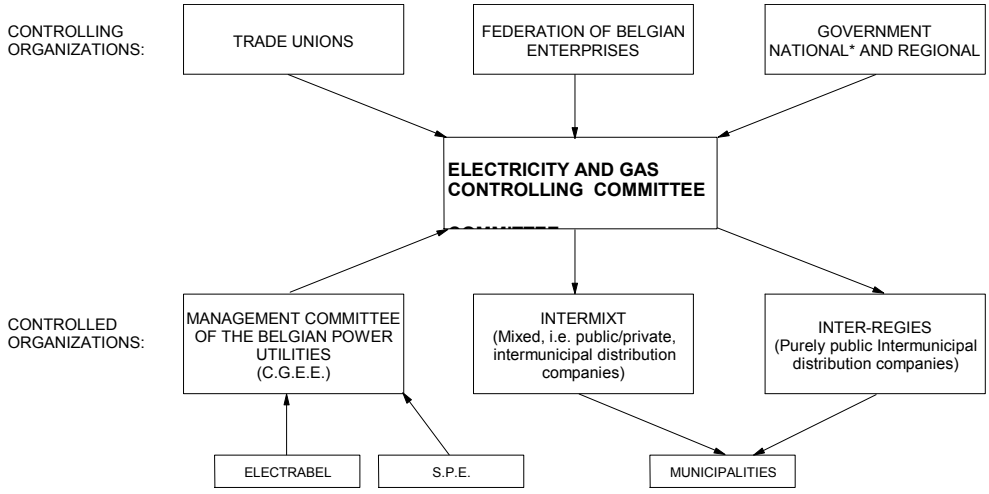

FIG. 1. Controlling Committee

2.2.2. The Role of the Controlling Committee and the Management Committee

The Controlling Committee oversees the gas and electricity sector operation and makes sure that it is in agreement with the general interest of the nation and the national energy policy; it sets tariffs and ensures electricity supply to customers; it encourages rationalization; establishes uniform bookkeeping scheme and examines annual accounts; examines technical and economic aspects of fuel supply to power plants; examines investment plans (ten-year plan for generating facilities, and five-year plan for high voltage transmission lines); acts as an advisory body to the Government.

The Controlling Committee also formulates "Recommendations" to the controlled sectors; collects information, reports, and studies concerning the controlled sectors; audits their accounts, and appeals to external experts. When the new regulatory body for generation and transmission will be operational, the role of the Controlling Committee will get more and more limited.

The Management Committee specializes in problems arising from the generation, interconnection, transmission, and distribution of electricity and proposes electricity rate structures and levels; establishes and updates accounting procedures; is in charge of the integrated operating account of the sector; and, standardizes distribution voltages and distribution equipment.

2.3. Main Indicators

Since the 1980's nuclear overtake of coal, nuclear power in 2000 provides 57% of Belgium's gross electricity production, third only to France and Lithuania in relative importance. Of the total gross electricity produced, thermal energy sources account for 40.2%, hydro for 1.8%.

Total net installed capacity of electricity generating plants in 2000 was 15,569 MW(e), of which thermal accounted for 8,442.7 MW(e), nuclear for 5,713 MW(e), hydro for 1,404 MW(e), and wind for 9.3 MW(e).

In 2000, total gross electricity consumption in Belgium rose with an average 2.9% compared to 1980 to 93.9 TW·h with a per capita gross consumption of 8,747 kW·h. Table 5 lists the historical gross electricity production and net installed capacity up to 2000 and Table 6 gives the main indicators.

TABLE 5. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

							Average annual growth rate (%)	
	1960	1970	1980	1990	2000	2001	1960 To 1980	1980 To 2001
Electricity production (TW.h)								
- Total (1)	15.15	30.52	53.13	70.85	80.00	76.00	6.47	1.72
- Thermal	14.98	30.22	40.26	29.54	33.10	30.39	5.07	-1.33
- Hydro	0.17	0.25	0.32	0.90	1.49	1.49	3.09	7.66
- Nuclear		0.06	12.55	40.40	45.40	44.10		6.17
- Geothermal								
Capacity of electrical plants (GWe)								
- Total	4.52	6.26	11.01	14.14	15.74	15.92	4.55	1.77
- Thermal	4.47	6.18	8.21	7.02	8.60	8.76	3.09	0.31
- Hydro	0.05	0.06	1.13	1.40	1.42	1.43	16.41	1.13
- Nuclear		0.01	1.67	5.71	5.71	5.71		6.04
- Geothermal								
- Wind					0.01	0.03		

(1) Electricity losses are not deducted.

Source: IAEA Energy and Economic Database.

TABLE 6. ENERGY RELATED RATIOS

	1960	1970	1980	1990	1997	1998	1999	2000
Energy consumption per capita (GJ/capita)	115.0	175.4	196.3	190.2	230.9	235.1	224	225
Electricity consumption per capita (kW·h/capita)	1,659.7	3,038.3	4,858.6	6,375.3	7,569.6	7.784.1	8,448	8,747
Electricity production/Energy production (%)	22.0	89.6	163.2	150.1	169.2	171.7	174	187
Nuclear/Total electricity (%)	0.00	0.2	24.8	60.2	60.1	55.5	54	50
Ratio of external dependency (%)[(1)]	33.1	89.0	92.8	90.4	89.0	92.0	94	97
Load factor of electricity plants								
- Total (%)	38.3	55.7	55.1	57.2	58.3	59.0	68	71
- Thermal	38.3	55.8	56.0	48.0	43.3	47.1	60	68
- Hydro	36.4	45.3	3.2	7.3	10.3	12.1	13	14
- Nuclear	0.00	59.2	86.0	80.7	90.1	87.8	93.3	91

(1) Net import / Total energy consumption

Source: IAEA Energy and Economic Database and Country Information.

2.4. The implementation of the European Electricity Directive

As other European member states, Belgium has transposed the European Union Electricity Directive 96/92 of 19 December 1996 into national law. Although an extra year was initially granted to Belgium to achieve compliance (19 February 2000 instead of 19 February 1999), the government, backed by major private utility Electrabel and under pressure from large industrial companies, decided to push ahead with compliance as soon as possible.

The new Belgian electricity law was passed on 29 April 1999 and published on 11 May 1999. In order to implement the law fully, a substantial number of Royal Decrees are required. The Royal Decrees concerning the following topics have in the meantime been published: entry into force of the federal law, designation and organisation of the regulator "Electricity and Gas Regulatory Commission" (CREG), corporate governance rules applicable to the transmission system operator, further opening of the market, authorisation procedure for generation and direct lines.

Given the federal structure of the Belgian state, the regions are competent to regulate the distribution of electricity. Currently only the Flemish region has published a Decree (22 September 2000) organising the Flemish electricity market. This decree has not yet entered into force. The key points of the law are:

- TRANSMISSION – The law requires the appointment of an independent transmission system operator (TSO), which will be responsible for the operation and maintenance of the transmission network, technical management, dispatch, complying with the development plan (established by himself and the regulator) and providing security of supply. The transmission system operator, who must be a commercial company based in a member state of the European Union, is not allowed to engage in production or sale of electricity, and must ensure non-discriminatory treatment of all network users. The law specifies independence requirements for the transmission system operator, who will be designated for a renewable period of 20-years. Transmission tariffs will have to be approved by the regulator (CREG). The appointment of the independent transmission system operator by the Belgian Federal Government is still pending.

- NETWORK ACCESS –. Belgium has opted for the regulated third party access system. Eligible clients will have a right of access by paying the applicable published transmission tariffs. A provisional list has been published in February 2000.

- CUSTOMER ELIGIBILITY – All clients connected to the transmission network (direct customers) consuming more than 100 GW·h per year on a per site basis are eligible to choose their supplier (about 33% of the Belgian electricity market)[1]. Direct customers consuming more than 20 GW·h per year per site will be eligible from 1 January 2001 onwards and direct customers consuming more than 10 GW·h from 1 January 2003 onwards. The remaining direct customers (excluding distribution) will become eligible in a manner to be determined, but no later than 12 December 2006. Distribution companies are eligible, up to the extent of any eligible clients they may have, in order to supply those clients, and will become fully eligible from 1 January 2007 onwards.

- OTHER ISSUES – A large number of other issues are addressed by the law. The most important of these are:

  - Belgium adopted a licensing procedure for new generation capacity and for direct lines, although the minister responsible for energy can award renewable 30-year concessions for offshore wind projects;
  - The Minister of Economic Affairs can fix maximum prices for the sale of electricity to eligible clients;
  - Any productivity gain resulting from the market opening must be shared on a equitable basis with domestic and small business consumers (i.e. non-eligible clients);
  - The concept of stranded costs is recognized. These will be calculated according to a methodology established by the regulator and will be financed by a surcharge on tariffs, on the condition of approval of the European Commission.

- A NEW REGULATORY BODY FOR GENERATION AND TRANSMISSION – The law states that a new body will be set up to regulate the activities of production and HV-transmission. The "Electricity and Gas Regulatory Commission" (CREG) will be an autonomous organization based in Brussels. It will be responsible for overseeing the organization and functioning of the market, and for surveying and controlling the application of the relevant laws and rules. Its principal responsibilities include :

[1] From 1 May 2000 onwards, the utility Electrabel has given access to its networks to all Belgian customers who consume at least 40 GW·h per annum and per site and who are connected to the grid. This decision resulted in an increase of the degree of liberalisation in the Belgian power market from 33% to 38% during the year 2000.

- Providing proposals and opinions in respect of maters relating to the electricity law, or any decrees to implement it;
- Providing a mechanism for arbitration in the event of a dispute in respect of network access;
- Establishing and adapting the 10-year programme for the development of generation capacity ('Indicative Programme'). The Indicative Programme shall be reviewed every three years for the following ten years;
- Controlling the application of the technical rules (grid codes) relating to transmission and the execution of the network development plan;
- Managing the mechanisms to promote the use of renewable energy sources and to recover any stranded costs that are allowed;
- Approving the tariffs for the use of the transmission network; and
- Examining industry accounts to ensure the separate accounting of the activities and the absence of cross-subsidies.

The two organs of the CREG are the Management Committee, which conducts the operational management, and entered into effect on 10 January 2000, and the General Council.

The current regulatory organization, the Controlling Committee for Electricity and Gas will continue to operate in the electricity sector, although its responsibility will be limited to the distribution of electricity to tariff customers.

The main points of the Flemish Decree can be summarised as follows:

- DISTRIBUTION - The Decree imposes the appointment of separate distribution network operators, who cannot supply eligible clients. These operators will be appointed for a renewable period of 12 years.

- ACCESS TO THE DISTRIBUTION NETWORK – Access will be organised according to the regulated third party access principle. Tariffs will be established according to the procedure established by the federal government.

- CUSTOMER ELIGIBILITY – The clients connected to the distribution grid consuming more than 20 GW·h per year on a site basis will be eligible from the moment that the Decree enters into force (not yet decided). The Decree also provides for an immediate partial eligibility for customers purchasing green electricity or heat and for customers that produce green electricity (on the basis of renewable energy).

- SUPPLY LICENCE – Suppliers in the Flemish electricity market will have to apply for a licence.

- PROMOTION OF RENEWABLE ENERGY – The Flemish Decree introduces a green certificate system limited to the Flemish market in order to support the development of renewable energies. Certificates will be issued for the production of electricity in installations that fulfil specific requirements and the green producer will be able to sell the certificates to suppliers and distributors of electricity who have an obligation to comply with a quota. In 2004, the quota will amount to 3 % and non-compliance will be sanctioned by a fine of 12 eurocents/missing kW·h.

- VREG - The decree also foresees the establishment of a Flemish regulator, who will have similar powers as the national regulator.

In the meanwhile the Walloon and Brussels government are equally preparing draft Decrees in order to liberalise their regional markets. Similar provisions as in the Flemish Decree can be expected.

3. NUCLEAR POWER SITUATION

3.1. Historical Development

First nuclear power development began during World War II, when Belgium started uranium production in its mines in Africa and signed a nuclear technical co-operation agreement with the US. Nuclear power development was accelerated after the 1970's oil crisis. The main milestones are:

1949	Government of Belgium grants purchasing priority of the uranium resources in Congo to the governments of the UK and the US.
1957	Belgian engineers took part in the commissioning of the first commercial nuclear plant in the United States.
1960	Franco-Belgian convention and creation of SENA (Société Nucléaire franco-belge des Ardennes): the principle was that everything from funding to studies and energy production should be shared equally.
1962	Commissioning of the BR3 PWR prototype plant (11 MW) in Mol. This reactor was the first imported from the United States.
1965	Creation of Synatom (Syndicate for the design of large capacity nuclear power plants).
1966	Commissioning of the Franco-Belgian (Chooz A) power plant (305 MW).
1966	Decision to build Doel 1 and 2 (ordered in 1968) and Tihange 1 (ordered in 1969)
1973	Oil crisis and decision to build Doel 3 and 4, Tihange 2 and 3 (ordered in 1974).
1974 - 1975	Commissioning of Doel 1 and 2 and Tihange 1.
1977	Synatom becomes a nuclear fuel management company (Belgian company for nuclear fuel).
1980	Creation of the National Organization for Radioactive Waste and Fissile Materials (Ondraf/Niras).
1982 - 1983	Commissioning of Doel 3 and Tihange 2.
1985	Commissioning of Doel 4 and Tihange 3.
1985	Exhaustive backfitting process for Doel 1, 2 and Tihange 1.
1986	Architect-engineering companies Electrobel and Tractionel merge to create Tractebel.
1988	The construction of an 8th unit (N8) of 1400 MW (50 per cent Electrabel - 50 per cent EDF) is indefinitely postponed by the Government.
1990	Private electricity producers Intercom, Ebes and Unerg merge to create Electrabel.
1991	Decommissioning of CHOOZ A.
1993	First steam generator replacement in Belgium at Doel 3 NPP.
1993	The first Belgian Parliament's debate on reprocessing and use of MOX fuel led to the suspension of the reprocessing contract signed between Synatom and Cogema in 1991. The active reprocessing contract signed in 1978 could be further carried out, but no new reprocessing contracts could be signed. From 1993, both options for the back-end of the fuel cycle are to be considered on an equal basis and must be assessed in detail during the next five years. The authorization to use MOX in Belgian NPPs is granted in order to consume plutonium obtained from past and active reprocessing contracts for Belgian spent fuel.
1994	Royal Decree authorizing the loading of MOX fuel in Doel 3 and Tihange 2 NPPs.
1994	Promulgation of the law with respect to the Federal Agency for Nuclear Control.
1995	First loading of MOX fuel in Tihange 2 (March) and Doel 3 (June) NPPs.
1995	Commissioning of the dry interim spent fuel storage facility on the Doel NPP's site.
1995	Creation of the co-operative company CPTE (Company for co-ordination and Transmission of Electrical Energy) by Electrabel (91.5%) and SPE (8.5%).
1997	Commissioning of the wet interim spent fuel storage facility on the Tihange NPP's site.
1997	In April, Niras/Ondraf presents the various options for the final disposal of low level and short-lived waste to the authorities.
1997	A new law of December 12 defines a new mission for Niras/Ondraf to establish the

inventory of all nuclear facilities and sites containing radioactive waste and its financing.

1998 The Belgian Government decides on a new approach for the search of disposal sites for low level and short-lived radioactive waste; it limits the research to existing nuclear zones or areas where the municipalities have shown interest.

1998 In December, the Belgian government ordered the cancellation of the reprocessing contract signed in 1991 between Synatom and Cogema and which was suspended in 1993. It postponed the debate about spent fuel management for a year pending the results of ongoing technical and economic studies. The government's decision doesn't ban further reprocessing of Belgian spent fuel, but forbids Synatom to conclude a new contract without its formal approval. In addition, an expert commission will be set up to assess the country's future electricity supply options.

1999 Installation in February of the government-appointed commission AMPERE (Commission d'Analyse des Modes de Production d'Électricité et de Redéploiement des Énergies). The commission has been given eighteen months to assess the electricity demand and the options for the future of power generation in Belgium in the 21st century.

1999 In July, the new government announces the closure of all Belgian nuclear power plants when they reach their 40-years lifetime and introduces a moratorium on reprocessing.

2000 In April, the first 28 containers with vitrified high-level radwaste, resulting from the reprocessing of Belgian spent fuel in La Hague (France), returned to Belgium. The second and third repatriations took place on 17 November 2000 and 20 February 2001.

2000 In December, the Commission AMPERE published its report[2], containing more than 1000 pages. Among its key messages, we mention its recommendations to keep the nuclear option open and to take other measures therefore. The report will be evaluated by a group of five international experts selected by the Government.

2001 In May, the group of five international experts published the conclusions of their evaluation of the report of the Commission AMPERE[3]. The experts corroborate the standpoints of the Commission AMPERE on a large number of points, in particular the preservation of the national know-how regarding nuclear energy.

3.2. Status and Trends of Nuclear Power

Belgium has seven operating nuclear power plants; see Table 7 for details about their status. During the year 2000, the seven Belgian nuclear power stations supplied the high voltage network with 45.8 TW·h or 55.3% of total electricity generated (82.8 TW·h). In the record year 1999, these figures were respectively 46.7 TW·h and 58.3%. The average load factor of the Belgian nuclear power plants reached 91.3% in 2000 against 93.3% for the record year 1999. These results confirm the reliability of the Belgian nuclear power stations, which belong to the best performers in the world.

The steam generators of the Tihange 2 plant will be replaced in 2001 during the next maintenance and refuelling outage. These operations are part of a replacement programme of the steam generators that started in 1993 in Doel 3 and continued during the years in the different Belgian nuclear power stations. The Japanese company Mitsubishi manufactured the new steam generators for Tihange 2. They left Kobe's harbour in Japan on the 25th of February 2001 and arrived in Tihange in the course of April.

Although the government decision of December 1988 brought a moratorium on the construction of new NPPs, Electrabel is allowed to upgrade the capacity of its NPPs. The upgrades have increased the total Belgian nuclear generation capacity with 263 MW(e) (+4.8%) from 1994 until 1997. Moreover, Belgian utilities have a 25% share in the output of the two 1,400 MW(e) PWR French units at Chooz. The new governmental policy of a limited 40-years lifetime will lead to a decrease in nuclear electricity generation while the share of fossil fuelled power plants, especially through the commissioning of new combined-cycle gas turbine units, is estimated to increase.

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2 Available at http://mineco.fgov.be/energy/ampere_commission/home_fr.htm

3 http://mineco.fgov.be/energy/ampere_commission/Revision_ampere_commission_report_en.pdf

TABLE 7. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Capacity	Operator	Status	Reactor Supplier
BR-3	PWR	11	CEN/SCK	Decommissioned	WESTINGHOUSE
DOEL-1	PWR	392.5	ELECTRABEL	Operational	ACECOWEN[a]
DOEL-2	PWR	392.5	ELECTRABEL	Operational	ACECOWEN
DOEL-3	PWR	1,006	ELECTRABEL	Operational	FRAMACECO[b]
DOEL-4	PWR	985	ELECTRABEL	Operational	ACECOWEN
TIHANGE-1	PWR	960	ELECTRABEL	Operational	ACECOWEN
TIHANGE-2	PWR	960	ELECTRABEL	Operational	FRAMACECO
TIHANGE-3	PWR	1,015	ELECTRABEL	Operational	ACECOWEN

[a] ACECOWEN: ACEC-COCKERILL-WESTINGHOUSE; [b] FRAMACEC: FRAMATOME-ACEC-COCKERILL

Station	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BR-3	01-Nov-57	29-Aug-62	10-Oct-62	10-Oct-62	30-Jun 87
DOEL-1	01-Jul-69	18-Jul-74	28-Aug-74	15-Feb-75	
DOEL-2	01-Sep-71	04-Aug-75	21-Aug-75	01-Dec-75	
DOEL-3	01-Jan-75	14-Jun-82	23-Jun-82	11-Oct-82	
DOEL-4	01-Dec-78	31-Mar-85	08-Apr-85	01-Jul-85	
TIHANGE-1	01-Jun-70	21-Feb-75	07-Mar-75	01-Oct-75	
TIHANGE-2	01-Apr-76	05-Oct-82	13-Oct-82	06-Jun-83	
TIHANGE-3	01-Nov-78	05-Jun-85	15-Jun-85	01-Sep-85	

Source: IAEA Power Reactor Information System, as of 31 December 2001.

3.3. Current Policy Issues

3.3.1. Current Government Policy

The Government:

i) does not include the construction of a new nuclear power plant in the National Equipment Programme for Electricity Generation and Transmission Facilities after the Chernobyl accident. Since then, no new plants are planned for construction;
ii) authorises power upgrading following steam generators replacement and turbine refurbishment;
iii) authorises the use of MOX fuel in Belgian nuclear power plants;
iv) prolongs the time schedule for the study comparing the different options related to the back end fuel cycle (open or closed cycle) with one year;
v) creates a Federal Nuclear Control Agency responsible for the licensing of nuclear installations and activities (this unifies the former specialised sections of the Ministries of Labour and of Health);
vi) authorises the return of the vitrified high-level waste of reprocessed Belgian spent fuel from the reprocessing plant of Cogema in La Hague, France to Belgium.

3.3.2. Radioactive Waste Management

The current major developments in radioactive waste management in Belgium are mainly related to the return of vitrified high-level waste, the selection of final radwaste disposal sites and R&D on disposal of various waste categories.

A. Return of Vitrified High-Level Radwaste

In view of the return of the vitrified high-level waste resulting from the reprocessing in France of Belgian spent fuel, the preliminary test and transfer programme with an empty transport container was successfully completed on 24 February 2000.

Following the authorization for three return shipments granted by the Minister of the Interior,

the first 28 canisters with vitrified high-level waste returned to Belgium on 5 April 2000. Transport by railway, transfer on and transport by lorry to Belgoprocess and the ultimate reception, after adequate control, in the interim storage building on the site of Belgoprocess in Dessel all went smoothly. A second return transport took place on 17 November 2000. Control at the reception in the interim storage building confirmed that the containers complied with the norms and characteristics that are imposed by the authorities. The communication actions with regard to these transports were jointly taken care of by Ondraf/Niras, Synatom and the Minister of the Interior, the latter acting as competent authority in this matter. Webcameras in the storage building on the site of Belgoprocess allowed following through internet all the operations dealing with the reception and manipulation of the containers. A third return transport took place on 20 February 2001.

At the request of the federal government, who wants the vitrified waste canisters' quality to be guaranteed and to comply with the safety requirements of long-term radioactive waste management, an additional scientific programme requiring both destructive analyses of a glass sample and non destructive analyses of a vitrified waste canister will have to be carried out in close cooperation between Ondraf/Niras, SCK·CEN and Cogema. The execution of the remaining return shipments will probably depend on the results of this additional scientific programme.

B. Selection of Radioactive Waste Disposal Sites

As far as low-level and short-lived waste is concerned, Ondraf/Niras continued to concentrate its activities on the existing nuclear zones in Belgium, following the decision of the Belgian federal government of 16 January 1998. Among these zones, those of Dessel (where Belgoprocess is located) and Mol (SCK·CEN) witnessed considerable progress with the establishment of local partnerships. The aim of these local partnerships is to involve the various local actors (political, social, cultural, etc.) in the development of activities that may result in a disposal project proposal that can be integrated in a more global project with a positive impact for the zone concerned and that can be accepted by the local population and authorities.

After the creation of a partnership in Dessel in September 1999 (called STOLA), a second partnership was established in Mol in February 2000 (called MONA). In 2000, both partnerships reached their cruising speed and created several working groups to study various aspects an integrated disposal project might involve (location, social-economical impact on the region, local development compensations, environment, safety, etc.). They also developed their own websites to inform the local public.

In Fleurus, a local information committee was created to follow and assess the results of a preliminary geological survey on the nuclear site of the IRE that was carried out at the request of the local authorities. The decision to create a local partnership in this zone will among others depend on the results of this campaign. The authorities of the nuclear zones of Tihange and Doel have not changed the opinion they already formulated in 1999 (no participation in a local partnership).

C. Research and Development on Radioactive Waste Disposal

Research on deep geological disposal in clay layers of high-level waste was performed according to the 1998-2003 research and development programme that was signed in 1998 by the various parties involved. Significant progress was made with regard to the PRACLAY demonstration experiment, particularly with the "Ophélie" mock-up and the preparation of the excavation of the connecting gallery to the existing HADES underground laboratory. According to the time schedule, the connecting gallery should be completely excavated before the end of 2001.

Since January 2001, the Economic Interest Grouping "EIG PRACLAY" is in charge of the management of both the HADES underground research laboratory and the PRACLAY project implying a joint operation of all the underground and aboveground research facilities. Consequently, the articles of association and the name of the EIG were changed on 21 November 2000 into "European

Underground Research Infrastructure for Disposal of Nuclear Waste in Clay Environment", in short EURIDICE.

The results of the research conducted on the feasibility of geological disposal of vitrified high-level waste in the Boom clay layer during the period 1990-1999 will be described in the report SAFIR 2 (SAFIR = Safety Assessment and Feasibility Interim Report) that will be submitted to the government. In order to assess the final editing of the report the Board of Directors of Ondraf/Niras decided to create an advisory scientific reading committee composed of various experts from Belgian universities and research institutions. The committee has to advise the Board of Directors on the content, conclusions and recommendations of the SAFIR 2 report that will be submitted to the Board for approval by the end of 2001. The committee held its first meeting on 2 May 2000 and will probably conclude its activities in June 2001.

Besides, the Belgian government has also requested the NEA to submit the SAFIR 2 report to a peer review, once the report will have been approved by the Board of Directors of Ondraf/Niras.

3.4. Organizational Charts

Figure 2 shows the nuclear energy sector organization and its shareholdings among the main companies, research centres and the Belgian state. Electricity supply is carried out by Electrabel with Tractebel as reference shareholder (41.4 % of the shares at the end of 2000). The main organizations in the nuclear sector are listed in Table 8 (status 31 December 2000).

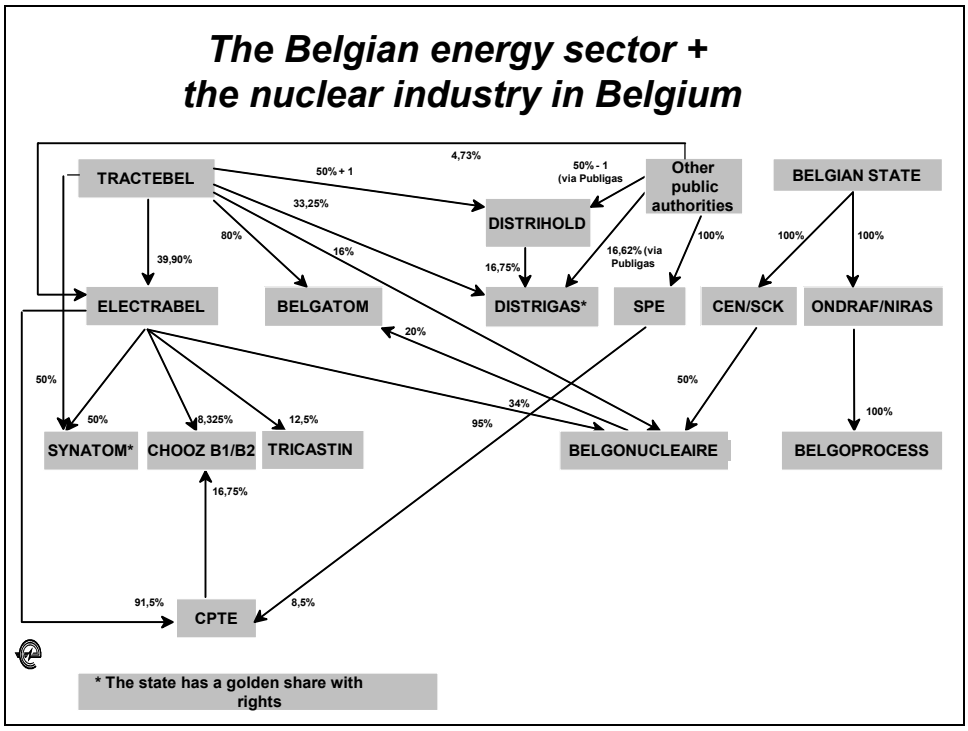

FIG. 2. Belgian Nuclear Sector Organization

Tractebel, the energy arm of Suez, is a Belgian industrial group with international scope provides public utility services; community services; engineering and industrial construction and services. It is organized into five operating units including the "Electricity and Gas Europe" (EGE) unit (Electrabel and Distrigas), the "Electricity and Gas International" (EGI) unit and the "Engineering" unit (Tractebel Engineering).

TABLE 8. MAIN NUCLEAR ORGANIZATIONS

	Turnover (million BEF)	Number of people	Status	Activity
ELECTRABEL	339,240	14,760	private	owner/operator
SPE	19,260	250	public utility	owner/operator
TRACTEBEL ENGINEERING*	16,300	2,700	private	architect-engineer/contractor
BELGONUCLÉAIRE	2,760	362	50 % public/50 % private	fuel manufacturer/ architect-engineer
SYNATOM	10,560	23	private (with public golden share)	nuclear fuel supplier
FBFC	976	251	private	fuel manufacturer
ONDRAF/NIRAS	3,400	49	public	radioactive waste management
BELGOPROCESS	1,100	236	public	radioactive waste facilities
CEN/SCK	2,700	586	public	R & D
LABORELEC	1,500	250	co-operative	R & D
ASSOCIATION VINCOTTE NUCLEAR	2,500	60	non profit	licensing/ inspection

* Division of TRACTEBEL Group, which has a total consolidated turnover of 760,700 million BEF and employs 75,830 people worldwide.

In 1999, Electrabel generated 88.8% of Belgian electricity, the balance being produced by the public utility company SPE (Société coopérative de Production d'Electricité) and small self-producers. Electrabel provided, either directly or through the local inter-municipal organizations, about 89% of the electricity supply to the end-users. Electrabel operates the Tihange and Doel nuclear power plants.

The Belgian NPPs require yearly over 350,000 man-hours of nuclear engineering services. Nuclear engineering services are provided by the engineering division of Tractebel (Tractebel Energy Engineering) for the Belgian NPPs and by the engineering division of Belgonucléaire for the fabrication of MOX fuel. The nuclear technical know-how of both Tractebel and Belgonucléaire is commercialized for other customers by Belgatom, a joint subsidiary.

Fuel fabrication plants are at Mol-Dessel; the uranium-plutonium mixed-oxide fuel (MOX) factory is owned and operated by Belgonucléaire (35 tHM/yr), the uranium fuel factory by FBFC International (400 tU/yr). Belgonucléaire is currently the only MOX-producer that manufactures MOX-fuel for BWRs. In the period 1996-98, FBFC commissioned new workshops for assembling MOX-fuel elements and gadolinium containing fuel elements; In 1996 it has been to manufacture BWR MOX- fuel assemblies for the Japanese market.

Synatom, a joint subsidiary of Electrabel and Tractebel, is responsible for the enriched uranium procurement and spent fuel management for all Belgian nuclear power plants.

Ondraf/Niras (National Agency for Radioactive Wastes and Fissile Materials Management) is entrusted by law with the safe transportation, treatment, conditioning, storage and disposal of all radioactive waste produced in the country and with some aspects of decommissioning. Belgoprocess, a subsidiary of Ondraf/Niras, operates the radwaste treatment, conditioning and storage facilities of the Mol-Dessel site; and it manages the former Eurochemic site.

Belgian companies supplied about 80% of the systems and equipment for the country's nuclear facilities. The nuclear steam supply systems (NSSS) were provided by Westinghouse and Framatome (now Framatome ANP), associated with Alstom Acec Energie and Cockerill Mechanical Industry (CMI).

The reactor vessels, reactor internals, primary pumps, steam generators, pressurizers, piping, and instrumentation and control (I&C) systems were made in Belgium. The manufacturers and contractors participate in servicing the operating Belgian nuclear power.

Association Vinçotte Nuclear (AVN), a non-profit organization, is licensed by the Belgian Government to carry out safety assessments and inspections of the nuclear facilities in Belgium.

4. NUCLEAR POWER INDUSTRY

4.1. Location of Nuclear Sites in Belgium

Figure 3 shows the location of the nuclear sites in Belgium.

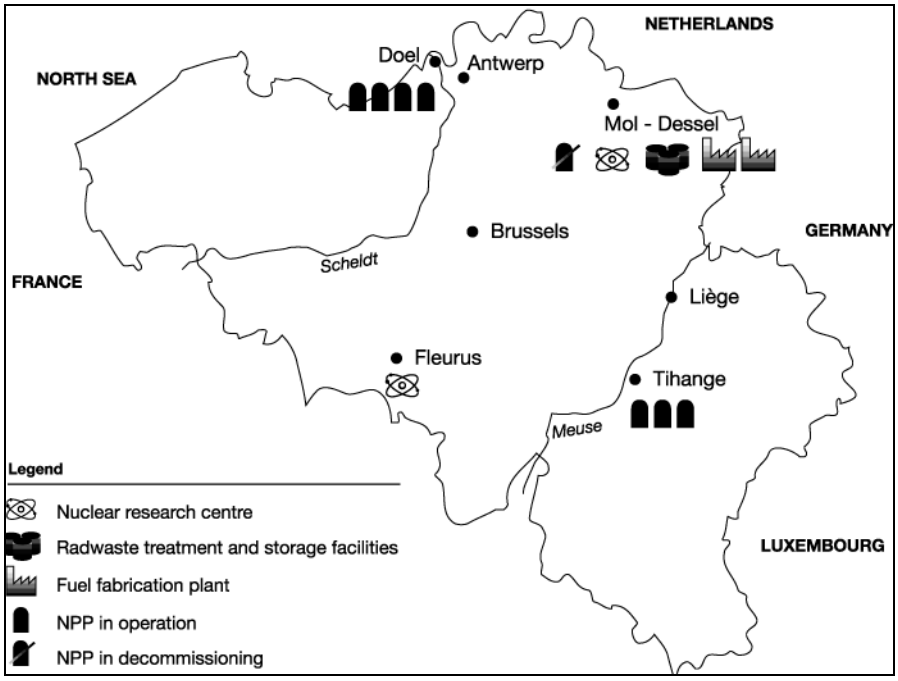

FIG. 3. Locations of nuclear sites in Belgium

4.2. Supply of Nuclear Power Plants

There are no Belgian companies supplying Nuclear Steam Supply Systems (NSSS). Architect engineering is performed by three companies:

- Tractebel Engineering (among the leading design firms in the world) provides contractor and architect-engineer services (pre-project studies, site selection and qualification, feasibility and optimization studies, basic and detailed engineering, construction, supervision and start-up), and full Engineering, Procurement and Construction (EPC) solutions. Power systems engineering, under the responsibility of Tractebel Energy Engineering, represents about 50% of the activities, half of which accounts for nuclear engineering services for NPPs, including turnkey projects.
- Belgonucléaire, a subsidiary of Tractebel (16%), Electrabel (34%) and CEN/SCK (50%) has engineering expertise in uranium-plutonium mixed-oxide fuel (MOX) utilization, manufacturing and manufacturing plant design, and radwaste treatment, storage and disposal facilities.
- Belgatom, jointly owned by Tractebel (80%) and Belgonucléaire (20%), provides worldwide nuclear engineering services to the international market. The contracts signed by Belgatom are performed by the Energy Engineering division of Tractebel (Tractebel Energy Engineering) and by the engineering division of Belgonucléaire. Belgatom has a close and continuous relationship with the key players in the Belgian nuclear energy sector, including Electrabel, CEN/SCK, Laborelec, Synatom, Ondraf/Niras and Belgoprocess.

Most of the companies involved in nuclear component manufacturing or supply are grouped in

Agoria, a professional federation covering 100 industrial companies in metal working, mechanical engineering, electrical engineering and electronics, transport equipment and plastic conversion. The main nuclear component suppliers, contractors and civil engineering companies are listed below:

ABB*	Mechanical and electrical systems
ABAY-TS*	Electrical and instrumentation systems
ALSTOM ACEC ENERGIE*	Generators, primary pumps
ALSTOM BELGIUM	Pumps, valves, turbines
ALSTOM SYSTEMS&SERVICES*	Specific instrumentation and control systems (reactor protection, rod position indication and control, thermodynamics instrumentation, neutron flux instrumentation)
ALSTOM CONTRACTING*	Instrumentation for site security systems
ASCOM	Mechanical engineering
ATELIERS DE LA MEUSE*	Mechanical construction, fuel containers
CMI	Main mechanical NSSS components (such as steam and diesel generators)
ENI*	Electrical components
FABRICOM*	Piping, electrical equipment, ventilation
G.C.C.N.[1]	Structural systems
IMOP	Piping, electrical, insulation
KABELWERK EUPEN*	Electrical cables
LEPAGE EURONUCLEAIRE	Mechanical equipment
LEMMENS SERVICES*	Decontamination, radioprotection, mechanical works
M.P.E.[2]	Precision machined and mechanically welded assemblies
PAUWELS	Transformers
SIEMENS*	Mechanical and electrical supply systems
SOBELCO	Thermal engineering and construction
STORK MEC	Piping
TCM[3]	Piping
WESTINGHOUSE	Mechanical and electrical supply systems

*: Member of Agoria
[1] Groupe Genie Civil des Centrales Nucléaires
[2] Mecanique de Précision pour Equipements
[3] Tuyauteries & Constructions Mosanes

4.3. Operation of Nuclear Power Plants

Electricity supply (nuclear and non-nuclear) is mainly carried out by Electrabel. Electrabel provided in 1999 about 89% of the electricity supply to end users, 89% of natural gas distribution, 53% of cable television in Belgium and 10% of the water distribution. Electrabel operates the Tihange and Doel nuclear power plants with a total capacity of 5,713 MW(e) (4.6% of the European Union's nuclear installed capacity as of end 1999). As a nuclear operator, Electrabel ranks 12th worldwide in installed nuclear capacity. It owns Doel 1 and Doel 2, 50% of Tihange 1 (the other 50% is owned by EDF, France) and 96% of Doel 3, Doel 4, Tihange 2 and Tihange 3. The other 4% of Doel 3, Doel 4, Tihange 2 and Tihange 3 is owned by the public utility SPE.

Engineering support to operation is provided by Tractebel Energy Engineering, a division of Tractebel, which takes part in important plant modifications, upgrading and backfitting, fuel fabrication procurement, core management and fuel handling and inspection services, Quality Assurance, in-service inspection, A/E services, project management, and technical assistance.

Maintenance service suppliers: Most of the component suppliers and contractors listed under paragraph 4.1 provide also maintenance services. The list below is not exhaustive, as Belgium is an open market and most contracts are concluded after competitive tender procedures.

ALSTOM ACEC ENERGIE	Maintenance of generators, quality control and training in the field of primary components (reactor vessels, internals, primary pumps) and fuel handling equipment and systems
ALSTOM BELGIUM	Maintenance of valves, pumps, fans
ALSTOM SYSTEMS & SERVICES	Instrumentation and control systems
FRAMATOME ANP	Design, training, quality control, maintenance, inspection and repair work of primary components (reactor vessel and internals, steam generators), steam generator replacement, fuel supply, control rod, fuel handling equipment and systems
MITSUBISHI HEAVY INDUSTRIES	Replacement steam generators
TECNUBEL	Maintenance and cleaning, decontamination, radio monitoring
WESTINGHOUSE ELECTRIC EUROPE	Design, training, quality control, maintenance, inspection and repair work of primary components (reactor vessel and internals, steam generators), steam generator replacement, fuel supply (EFG, Westinghouse Atom), control rod, fuel handling equipment and systems

4.4. Fuel Cycle and Waste Management Service Supply

Interfaces regarding the nuclear fuel cycle are shown in Figure 4.

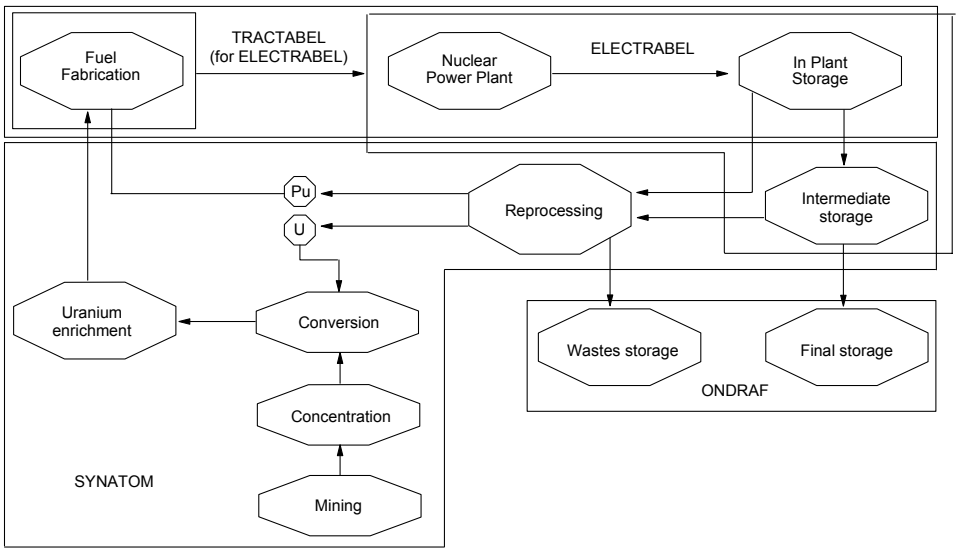

FIG. 4. Organizations covering the nuclear fuel cycle: Interfaces

Fuel cycle and waste management engineering services are provided by Tractebel and Belgonucléaire for the Belgian market, and worldwide by Belgatom.

Two fuel fabrication plants are located at Mol-Dessel; the MOX fuel facility is owned and operated by Belgonucléaire. The uranium fuel facility is owned and operated by FBFC, a subsidiary of Framatome ANP. FBFC manufactures uranium fuel assemblies and pressurized water reactor control rods and provides the final assembly of MOX fuel (all BWR and PWR types).

Synatom, a joint subsidiary of Electrabel and Tractebel, is responsible for the enriched uranium procurement and the spent fuel management for all Belgian nuclear power plants. It maintains ownership of the nuclear materials, at all times, prior, during and after use in nuclear reactors until final disposal. The Belgian State holds a "golden share" in Synatom, which entitles it with special rights.

Transportation services are provided by:

TRANSNUBEL	Fresh and spent fuel (uranium and MOX) transportation; design of handling systems for fuel containers.
TRANSRAD	Radioactive waste transportation ; uranium transportation

Ondraf/Niras, National Agency for Radioactive Waste and Fissile Materials Management is entrusted by the law with the safe management of all radioactive wastes produced in the country, including their transport, treatment, conditioning, storage and disposal.

Belgoprocess, a subsidiary of Ondraf/Niras, operates the radwaste treatment plant, conditioning and storage facilities of the Mol-Dessel site, as well as managing the Eurochemic site.

Engineering services to Ondraf/Niras and Belgoprocess are supplied by Tractebel Energy Engineering and Belgonucléaire via their joint subsidairy Belgatom.

4.5. Research & Development Activities

Nuclear research and development in Belgium is co-ordinated by the Ministry of Economic Affairs of the Federal Government and carried out mostly by the SCK/CEN (Belgian Nuclear Research Centre) at Mol. Nuclear research done by SCK/CEN is mainly confined to reactor safety experiments, reactor fuel and reactor materials examinations, radioactive waste disposal, decommissioning, radiation protection and health physics.

In April 1997, the BR-2 nuclear research reactor has been restarted after two years of refurbishing.

Research and development for the support of both nuclear and non-nuclear power plant operations is carried out by Laborelec, a central research laboratory of the utilities, Electrabel and SPE, and by Tractebel Energy Engineering.

4.6. International Co-operation in the Field of Nuclear Power Development and Implementation

Belgium is active in a number of international nuclear organizations including the International Atomic Energy Agency (IAEA), Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development (OECD) as well as other bilateral and multilateral organizations such as WANO.

Belgium is also involved in a number of European organizations set up to improve safety of nuclear power plants in countries of the former Soviet Union and Eastern Europe:

- RAMG (Regulatory Assistance Management Group) is formed of Western Safety Authorities to assist for setting up of Eastern Safety Authorities. [AVN]
- TSOG (Technical Safety Organisation Group) is an association of technical support organisations in EU member countries to advise the Eastern European Safety Authorities. [AVN]
- CASSIOPEE (Consortium d'Assistance Operationnelle aux Pays d'Europe de l'Est) is an EEIG of the EU agencies responsible for radioactive waste management and storage. [Ondraf/Niras]
- EFCC (European Fuel Cycle Consortium) is a consortium grouping European reprocessing companies and fuel fabricators for improving the operation of nuclear fuel cycle facilities in

Eastern Europe. [Belgonucléaire]

Belgium participates in programmes and projects for developing and promoting new advanced NPP technology:

- EUR (European Utility Requirements) common requirements for building future LWRs in Europe, written by European electricity producers [Tractebel]
- EPRI programme for ALWR Certification in the US [Tractebel]
- EPP (European Passive Plant) programme for developing Westinghouse type passive nuclear plants in Europe. [Tractebel]
- EFET (European Fusion Engineering and Technology) – industrial consortium for fusion reactor research [Belgatom]

Belgium participates in several international R&D programmes:

- Pressure vessel steel projects (materials behaviour in the frame of plant lifetime extension) with IAEA, "Kurchatov Institute" of Russia, and VTT of Finland [Tractebel]
- Halden reactor project (Norway) project runs under the auspices of OECD/NEA. [SCK/CEN, Belgonucléaire, Tractebel, AVN]
- Benchmarking of the RELAP (thermohydraulic) code in the frame of the international user's group (member of the Code Assessment and Maintenance Programme - CAMP).
- VIP (Venus International Programme) - with Tractebel participation - to assess neutronics codes for MOX fuel by performing experimental tests in the VENUS reactor with UK and Japan as scientific partners. VENUS is operated by the Belgian nuclear research center SCK/CEN. [SCK/CEN, Belgonucléaire]
- RASPLAV project to study melt core cooling inside the reactor vessel, a joint research programme with the Federation of Russia and 14 other countries. RASPLAV is sponsored by the Nuclear Energy Agency (NEA) of the OECD. [Tractebel]
- FIGARO: Irradiation and examination of two high burnup MOX fuel rods for fission gas release analysis. [Belgonucléaire, Tractebel]
- ARIANE: Evolution of isotopic composition of MOX fuel during irradiation. [Belgonucléaire, Tractebel]

5. REGULATORY FRAMEWORK

5.1. Safety Authorities and Licensing Process

Licensing takes place under the authority of the Minister of Labour and the Minister of Interior (Royal decree of August 7, 1995), which have the guardianship over the Federal Agency for Nuclear Control. This Minister and the Agency are responsible for promulgating and enforcing regulations designed to protect the employees of the nuclear plants and the population against the hazards of ionising radiations. The Agency is assisted in technical matters by a Scientific Council of experts and representatives from various authorities responsible for nuclear safety; they have only an advisory role. The Commission gives recommendations by absolute majority. State approved agencies, such as the Association Vinçotte Nuclear (AVN), carry out official acceptance procedures for installations prior to commissioning and exercise supervision over installations during operation. Final authorization for nuclear plant commissioning rests with the King.

The main steps in the Belgian licensing procedure are in following:

- Filing of an application: the request for the licence is first sent to the Director General of the Federal Agency for Nuclear Control, together with the relevant information (characteristics of the installation, planned safety measures, an Environmental Impact Assessment, and a study of the premises and the demographic, geological, meteorological, etc. characteristics of the area of

the installation). The request has to contain a preliminary safety report and a report describing the incidences of the environment;

- The Scientific Council is consulted a first time. After the Council has given its preliminary advice, it is sent to the applicant. Then the European Commission is also consulted (if necessary) according to article 37 of the Euratom Treaty, as well as all the municipalities in a radius of 5 km around the installation (who inform their population) and the Province involved. After the advice of the municipalities, of the Province and of the European Commission have been received, the file is submitted to the Scientific Council once more, which then gives its definitive advice;
- The Minister of Labour and the Minister of Interior then decide by submitting a Royal Decree to the King. This Royal Decree gives the erection and operation licence. It contains the conditions to be respected. These stipulate, among other things, the content of the safety report;
- After the erection of the installation, and before the start of the operation, the Agency or the state approved agency designated by her, proceeds with the acceptance of the installation. This acceptance must establish the conformity of the installation with the general regulation, the stipulations of the erection and operation licence and the safety report. If the acceptance is favourable, the Minister of Interior proposes to the King to confirm the erection and operation licence, which are granted for an unlimited period.

5.2. Main National Laws and Regulations

Act of March 10, 1925:

Electricity generation is not regulated. Each individual or corporation is free to generate electricity.

Act of March 29, 1958 (Royal Decree of February 28, 1963):

General Regulations for the protection of the population and workers against the hazards of ionizing radiation. Nuclear installations are divided into four classes, in descending order of hazards involved. Class I includes nuclear reactors and large nuclear installations (criticality hazard). Installations in Classes II, III and IV are divided according to the quantity of radioactive materials. Installations in Classes I, II and III require prior licensing, whereas those in Class IV do not.

Royal Decree of October 15, 1979:

Founding of the Inter-ministerial Commission for Nuclear Safety and State Security in the nuclear field against hazards arising from the use of radioactive substances.

Act of August 8, 1980:

Founding of Ondraf/Niras for treating, conditioning, storing and disposal of radioactive waste and for handling some aspects of fissile materials and decommissioning. The Act of January 11, 1991 has replaced the Act of August 8,1980.

Act of February 9, 1981 (Royal Decrees of May 12, 1989 and July 16, 1993):

Regulations for the exportation of nuclear materials, nuclear equipment and nuclear technological data.

Act of July 22, 1985:

Defining third party liability pertaining to nuclear energy generation as outlined in the Paris Convention of 29 July 1960, and the additional Convention of Brussels of 30 January 1963:

- Liability of the power plant operator in the event of a nuclear accident: victims are not required to supply proof of the nuclear power plant operator's fault in order to be compensated for damages arising from a nuclear accident.

- Three-tiered compensation system:

  - by the power plant operator up to a maximum amount of BEF 4 billion. Under Belgian law, the nuclear plant operator must supply proof of an insurance policy or have adequate security deposits to cover potential civil liability suits before the operating license is granted;
  - by the Belgian State for the amount between BEF 4 billion and BEF 9 billion;
  - by the signatories of the Paris and Brussels Conventions for the amount between BEF 9 billion and BEF 15 billion.

Royal Decree of May 16, 1986:

Determines the financial security certificate for the transport of nuclear substances.

Act of April 15, 1994 (replaces the Act of March 29, 1958):

Founding of a Federal Agency for Nuclear Regulation.

Royal Decree of April 25, 1997

Regulations for the protection of workers against the hazards of ionizing radiation (implementation of the European Directive 90/641 of December 4, 1990).

Act of December 12, 1997

Defines the missions for the organization concerning the inventory of all nuclear facilities and sites containing radioactive waste and its financing.

Act of April 29, 1999 (Royal Decrees of May 3, 1999)

Organization of the electricity market in Belgium (implementation of the European Electricity Directive 96/92 of December 19, 1996).

Agreements concluded between the Belgian State and the electric utilities:

- The decommissioning agreement with the State in 1985 regulates the constitution of provisions to cover the dismantling costs of nuclear installations and the decontamination costs of the nuclear sites to be implemented within 30-years. In the agreement it is foreseen to re-evaluate the situation every five years at the request of the Control Committee.
- The agreement in 1990 with the Belgian State defines the contribution of each party of the agreement in the financing of the decommissioning and the cleanup cost of the state owned nuclear facilities at the Mol-Dessel site up to 2000. Parties to the agreement are the State of Belgium, Ondraf/Niras, Synatom and Electrabel and SPE.

5.3. International, Multilateral and Bilateral Agreements

AGREEMENTS WITH THE IAEA

• Improved procedures for designation of safeguards inspectors	Rejected by EURATOM. Offered alternative solutions. Letter of:	16 February 1989
• NPT related safeguards agreement INFCIRC No. 193	Entry into force:	21 February 1977
• Additional protocol to the NPT safeguards agreement	Signature:	22 September 1998
• Agreement on privileges and immunities	Entry into force:	26 October 1965

OTHER RELEVANT INTERNATIONAL TREATIES

• NPT	Entry into force:	2 May 1975
• EURATOM	Member	
• Convention on physical protection of nuclear material	Entry into force:	6 October 1991
• Convention on early notification of a nuclear accident	Entry into force: Ratification:	4 February 1999 4 January 1999
• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force: Ratification:	4 February 1999 4 January 1999
• Vienna convention on civil liability for nuclear damage		Non-party
• Paris convention on civil liability for nuclear damage	Entry into force:	3 August 1966
• Joint protocol	Signature:	21 September 1988
• Protocol to amend the Vienna convention on civil liability for nuclear damage		Not signed
• Convention on nuclear safety	Entry into force:	13 April 1997
• Convention on supplementary compensation for nuclear damage		Not signed
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Signature:	8 December 1997
• ZANGGER Committee	Member	

- Nuclear export guidelines — Adopted
- Acceptance of NUSS Codes — Summary: codes can be used as guidelines when formulating national regulations. Belgium often goes beyond code requirements. Letter of: 8 November 1988
- Nuclear Suppliers Group — Member

BILATERAL AGREEMENTS

- Belgium has nuclear bilateral agreements with Luxembourg (1970), Romania (1974), USA-USNRC (1978), Korea (1981), France (1981 and 1984), Egypt (1984), The Netherlands (1984 and 1990) and China (1985).

- Belgium (or the Belgian-Luxembourgisch economic union) has scientific, industrial and technological agreements with France (1950), USA (1950, 1951), Kuwait (1974), Democratic Republic of Germany (1974), Poland (1974), Bulgaria (1975), Czechoslovakia (1975), Hungary (1975 and 1986), Romania (1976), Cuba (1976), Egypt (1979), China (1979), Algeria (1982 and 1983), Tunisia (1983), Germany (1980), United Arab Republics (1984); USSR (1984), Mexico (1984), Brazil (1985), Kenya (1985), Venezuela (1986), and India (1990).

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[22] Data & Statistics/The World Bank, www.worldbank.org/data.
[23] IAEA Energy and Economic Database (EEDB).
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Appendix

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

NATIONAL ATOMIC ENERGY AUTHORITIES

Ministère des Affaires Économiques
Administration de l'Énergie
Division Applications Nucléaires
North Gate III
Boulevard du Roi Albert II, 16
B-1000 Bruxelles, Belgique
Tel.: +32-2-206 41 11
Fax: +32-2-206 57 11
http://mineco.fgov.be/

Services Fédéraux des Affaires Scientifiques,
Techniques et Culturelles (SSTC)
Rue de la Science, 8
B-1000 Bruxelles, Belgique
Tel.: +32-2-238 34 11
Fax: +32-2-230 59 12

Ministère des Affaires Sociales, de la Santé
Publique et de l'Environnement
Services fédéraux pour les Affaires-
Environnementales
Service de Protection Contre les
Radiations Ionisantes
Rue Ravenstein, 36
B-1000 Bruxelles, Belgique
Tel.:(322-2) 289-21-11/81
Fax: (322-2) 289-21-12/82
Tel.: +32-2-289 21 01
http://minsoc.fgov.be

Secrétariat d'État de l'Énergie et du
Développement Durable
Rue des Colonies, 56
B-1000 Bruxelles, Belgique
Tel.: +32-2-227 07 00
Fax: +32-2-219 79 30

Ministère des Affaires Étrangères,
du Commerce Extérieure et de la
Coopération au Développement
Service Scientifique
Rue des Petits Carmes, 15
B-1000 Bruxelles, Belgique
Tel.: +32-2-238 25 11
Fax: +32-2-230 02 80
http://diplobel.fgov.be

Ministère de l'Emploi et du Travail
Administration de la Sécurité du Travail
Service de la Sécurité Technique
des Installations Nucléaires
Rue Belliard, 51
B-1040 Bruxelles, Belgique
Tel.: +32-2-233 41 11
Fax: +32-2-233 42 31
http://meta.fgov.be

Ministère de la Justice
Service de la Sécurité Nucléaire
North Gate I
Boulevard du Roi Albert II, 6
B-1000 Bruxelles, Belgique
Tel.: +32-2-205 62 38
Fax: +32-2-205 62 37
http://just.fgov.be

BELGIAN NUCLEAR INDUSTRY SECTOR

AIB-Vinçotte Group (Safety Services)
A. Drouart avenue 27
1160 Brussels, Belgium
Tel.: 0032.2.674.57.11
Fax.: 0032.2.674.59.59
www.aib-vincotte.com

AV Nuclear (Authorised Inspection Agency)
Avenue du Roi, 157
1190 Brussels
Tel.: +32-2-536 82 11
Fax: +32-2-536 85 85
http://www.avn.be/

Belgatom (Architect-Engineer)
Avenue Ariane, 7
1200 Brussels
Tel.: +32-2-773 84 96
Fax: +32-2-773 98 20
www.belgatom.com

Belgonucléaire, S.A. (MOX Manufacturer and Architect-Engineer)
Avenue Ariane, 4
1200 Brussels
Tel.: +32-2-774 05 11
Fax: +32-2-774 05 47
www.belgonucleaire.be

Belgoprocess (Waste Treatment)
Gravenstraat, 73
2480 Dessel
Tel.: +32-14-33 41 11
Fax: +32-14-31 30 12
www.belgoprocess.be

CEN/SCK (Research Centre)
Boeretang, 200
2400 Mol
Tel.: +32-14-33 21 11
Fax: +32-14-31 50 21
http://sckcen.be/

Electrabel (Utility)
Boulevard du Régent, 8
1000 Brussels
Tel.: +32-2-518 61 11
Fax: +32-2-511 65 64
http://www.electrabel.be/

FBFC International, S.A. (Fuel Manufacturer)
Europalaan, 12
2480 Dessel
Tel.: +32-14-33 12 11
Fax: +32-14-31 58 45

IRE (Production of Radio-Isotopes)
Avenue de l'Espérance 1
6220 Fleurus
Tel.: +32-71-82 92 92
Fax: +32-71-81 38 12

Laborelec (Utility's Laboratory)
Rue de Rhode, 125
1630 Linkebeek
Tel.: +32-2-382 04 97
Fax: +32-2-382 06 46
www.laborelec.be

ONDRAF/NIRAS (Waste Management)
Avenue des Arts, 14
1210 Brussels
Tel.: +32-2-212 10 11
Fax: +32 2 218 51 65
www.nirond.be

SPE-Société Coopérative de Production d'Électricité (Utility)
Rue Royale, 55 (BTE 14)
1000 Brussels
Tel.: +32-2-217 10 30
Fax: +32-2-218 61 34
http://www.spe.be

Synatom, S.A. (Nuclear Fuel Procurement)
Bastion Tower
Place du Champ de Mars, 5
1050 Brussels
Tel.: +32-2-505 07 11
Fax: +32-2-505 07 90

Tractebel s.a. (Energy and Services)
Place du Trône 1
B-1000 Brussels
Tel. : 32 (0)2 510 71 11
Fax : 32 (0)2 510 73 88
www.tractebel.com

Tractebel Energy Engineering (Architect-Engineer and Contractor)
Avenue Ariane, 7
1200 Brussels
Tel.: +32 2 773 8111
Fax: +32 2 773 9900
www.tee.tractebel.com

Tractebel Engineering
www.engineering.tractebel.com

Tecnubel S.A. (Decontamination)
Avenue Ariane, 4
1200 Brussels
Tel.: +32-14-34 69 11
Fax: +32-14-32 00 90
www.tecnubel.be

Transnubel, S.A. (Fuel Transportation)
Gravenstraat, 73
2480 Dessel
Tel.: +32-14-33 11 11
Fax: +32-14-31 89 48

Transrad, S.A. (Waste Transportation)
Zoning Industriel – site IRE
6220 Fleurus
Tel.: +32-71-82 97 59
Fax: +32-71-82 97 68

OTHER NUCLEAR ORGANISATIONS

Abay-TS (Contractor)
Rue de Genève 4, BTE 30
1140 Brussels
Tel.: +32-2-729 61 11
Fax: +32-2-729 61 61
www.abayts.be

Agoria (Group 19)
Diamant Building
Bd. A. Reyers, 80
1030 Brussels
Tel.: +32-2-706 80 10
Fax: +32-2-706 80 18

Asea Brown Boveri (ABB)
Hoge Wei, 27
1930 Zaventem
Tel.: +32-2-718 63 56
Fax: +32-2-718 66 56

Alstom Belgium SA
Rue Cambier Dupret, 50-52
6001 Charleroi
Corr.: BP 4211
6000 Charleroi
Tel.: +32-71-44 54 11
Fax: +32-71-44 57 78

Alstom Belgium SA Energy-MTM
(Mechanical Equipment Supplier)
Leuvensesteenweg, 474
2812 Muizen
Tel.: +32-15-41 29 81
Fax: +32-15-42 33 37

Alstom Acec Energie (Generator Supplier)
Rue Chapelle Beaussart, 80
6030 Charleroi
Tel.: +32-71-44 31 11
Fax: +32-71-36 46 00

Alstom Contracting SA (Instrumentation)
Boulevard de la Woluwe, 60
1200 Brussels
Tel.: +32-2-775 90 20
Fax: +32-2-775 25 96

Alstom Systems & Services SA (I & C Systems)
Rue Vital Françoisse, 205
6001 Charleroi
Corr.: BP 4208
6000 Charleroi
Tel.: +32 71 44 65 11
Fax: +32 71 44 65 15

Asco Industries SA (Mechanical Engineering)
Avenue de la Faisanderie 7
1150 Brussels
Corr.: Weiveldlaan 2
1930 Zaventem

Ateliers de la Meuse (Mechanical Equipment)
Rue Ernest Solvay, 107
4000 Sclessin (Liège)
Tel.: +32-4-252 00 30
Fax: +32-4-252 00 35
www.alm.be/english

Canberra Packard Benelux (Instrumentation)
Research Park
Pontbeeklaan, 57
1731 Zellik
Tel.: +32-2-466 82 10
Fax: +32-2-466 93 53

Belgian Association for Radioprotection
http://www.bvsabr.be

Belgian Nuclear Society
Ravenstein Street, 3
1000 Brussels
Tel.: +32-2-774 05 38
Fax: +32-2-774 05 47
http://sckcen.be/bns/

CMI (NSSS Components Manufacturer)
Avenue a. Greiner, 1
4100 Seraing
Tel.: +32-4-330 21 11
Fax: +32-4-330 22 00

CPTE
www.cpte.be

ENI (Electrical Contractor)
Kontichsesteenweg, 25
2630 Aartselaar
Tel.: +32-3-870 12 11
Fax: +32-3-887 12 98
www.eni.be

Fabricom (Electrical and Mechanical Contractor)
Rue Gatti de Gamond, 254
1180 Brussels
Tel.: +32-2-370 31 11
Fax: +32-2-332 24 55
www.fabricom.be

FEX – Nuclear Fuel Experts (consulting)
Avenue de l'Observatoire, 96
1180 Brussels
Tel.: +32-14 31 25 33
Fax: +32- 14 32 09 52

Forum Nucléaire Belge
Avenue Ariane, 7 — Tel.: +32-2-773 84 96
1200 Brussels — Fax: +32-2-773 98 20

G.C.C.N. c/o S.B.B.M. - Six Construct
(Civil Works Contractors)
Boulevard Louis Mettewie, 74-76
1080 Brussels

Institut Interuniversitaire des Sciences Nucléaires
Rue d'Egmont, 5 — Tel.: +32-2-504 92 11
1000 Brussels — Fax: +32-2-504 92 92

Imop (Mechanical Contractor)
Noorderlaan 119 — Tel.: +32-3-541 21 70
2030 Antwerpen — Fax: +32-3-541 72 52

Ion Beam Applications (IBA) Groupe
Chemin du Cyclotron, 3 — www.iba.be
1348 Louvain-La-Neuve — http://www.iba-sni.com/

Kabelwerk Eupen AG (Cable Supplier) — Tel.: +32-87-59 70 00
Malmedyerstrasse, 9 — Fax: +32-87-59 71 00
4700 Eupen — www.eupen.com

Lemmens Services NV (Decontamination)
Brant Industrial Services Group — Tel.: +32-3-210 97 05
Nieuwe Weg 1/3 — Fax: +32-3-210 97 76
2070 Zwijndrecht — www.bisg.be

Lepage Euronucléaire (Mechanical Contractor)
Rue Chausteur, 66 — Tel.: +32-71-28 57 00
6042 Lodelinsart (Charleroi) — Fax: +32-71-28 57 01

M.P.E. - Mécanique de Précision pour Equipements
(Mechanical Equipment Supplier) — Tel.: +32 2 262 1010
Avenue de Tyras, 51 — Fax: +32-2-262 0241
1120 Brussels — www.mpe.be

Pauwels Trafo Belgium (Transformers Supplier)
Antwerpsesteenweg 167 — Tel.: +32-15-28 33 33
2800 Mechelen — Fax: +32-15-28 35 20

Siemens S.A. (Electrical Contractor)
Chaussée de Charleroi, 116 — Tel.: +32-2-536 21 11
1060 Brussels — Fax: +32-2-536 24 92

Sobelco (Thermal Construction)
Bâtiment 13 - Rue Chapelle Beaussart 80 — Tel.: +32-71 44 31 87
6030 Marchienne-au-Pont (Charleroi) — Fax: +32-71 44 31 96

Stork MEC (Mechanical Contractor)
Haven 269
Oosterweelsteenweg 57 - PB 54
2030 Antwerpen
Tel.: +32-3-540 15 11
Fax: +32-3-540 15 00

Suez
www.suez-lyonnaise.com

TCM (Mechanical Contractor)
Quai d'Arona, 31
4500 Huy
Tel.: +32-85-23 31 52
Fax: +32-85-23 51 78

Westinghouse Electric Europe, sprl
(NSSS Supplier)
Boulevard Paepsem, 20
1070 Brussels
Tel.: +32 2 556 87 09
Fax: +32-2-556 89 35
www.westinghouse.com

Westinghouse European Services
Rue de l'Industrie 43
1400 Nivelles
Tel.: +32-67-28 78 11
Fax: +32-67-28 78 21

MISCELLANEOUS

International Organizations

Euratom Supply Agency at the
European Commission (ESA) http://europa.eu.int/comm/euratom/index_en.html

European Atomic Forum (FORATOM) http://foratom.org/

European Commission
(Brussels, Belgium): http://europa.eu.int/comm/index_en.htm

European Energy Foundation (EEF)[4] http://www.f-e-e.org/

European Union law (including nuclear energy): http://europa.eu.int/eur-lex/en/index.html

International Nuclear Law Association http://www.aidn-inla.be

Joint Research Centre of the
European Commission (JRC)
Institute for Reference Materials
and Measurements (IRMM) http://www.jrc.cec.eu.int/

Union of the Electricity Industry (EURELECTRIC)[5] http://unipede.eurelectric.org/

Prognostic and Statistical Energy Data

Belgian Federation of Electricity
Producers and Distributors http://www.bfe-fpe.be

[4] EEF is an informal and neutral forum where topical energy related subjects linked to the European Union political dialogue are presented.
[5] EURELECTRIC was formed as a result of a merger in December 1999 of the twin Electricity Industry Associations, UNIPEDE and EURELECTRIC.

Controlling Committee for Electricity and Gas	http://cceg.be
Ministry of Economic Affairs Energy Administration	http://mineco.fgov.be/energy
National Institute for Statistics	http://www.statbel.fgov.be/home_en.htm

National Regulatory Organisations

Federal Agency for Nuclear Control	http://www.fanc.fgov.be
Commission for Electricity and Gas Regulation	http://creg.be