Country Nuclear Power Profiles
2020 Edition

BELGIUM

(Updated 2020)

PREAMBLE

This report provides information on the status and development of nuclear power programmes in Belgium, including factors related to the effective planning, decision making and implementation of the nuclear power programme that together lead to safe and economical operations of nuclear power plants (NPPs).

The CNPP summarizes organizational and industrial aspects of nuclear power programmes and provides information about the relevant legislative, regulatory and international framework in Belgium.

There are seven nuclear power reactors in commercial operation in Belgium, four in Doel and three in Tihange. Having been connected to the grid between 1974 and 1985, they have an average age of 40 years.

In 2003, the federal Parliament passed a law prohibiting the construction of new nuclear units intended for the industrial production of electricity by nuclear fission in Belgium, while limiting the operation of existing reactors to 40 years. According to this law, nuclear fission energy was to be phased out between 2015 and 2025. However, successive governments have amended the law in order to ensure the security of supply of electricity — extending the operating licences of the three oldest reactors by ten years — but always confirming the decision to phase out all nuclear power reactors by 2025.

Together, these plants can generate about 55% of the country's electricity needs. In 2019, they produced 43 524 GW?h or 46.6% of total electricity production.

1. COUNTRY ENERGY OVERVIEW

1.1. ENERGY INFORMATION

1.1.1. Energy policy

Each of the three regions of Belgium (Flanders, Wallonia and Brussels Capital Region) and each of the three linguistic communities (Dutch, French and German speaking) has its own executive and legislative bodies, at the same hierarchical level as the federal Parliament and Government.

The (linguistic) communities are primarily responsible for cultural affairs and education, which includes most research and development (R&D) funding.

The economic and energy policy responsibilities are distributed between the federal State and the three regions.

However, policy related to the nuclear sector, the nuclear fuel cycle and R&D in both nuclear fusion and fission remains exclusively under the federal Government.

The federal Government is responsible for the following:

- Security of supply;
- National prospective studies;
- Nuclear fuel cycle and nuclear R&D programmes;
- Large stockholding installations;
- Production and transmission/transport of energy (electricity grid >70 kV), including large storage infrastructure;
- Transport tariffs (federal regulator — Commission for the Regulation of Electricity and Gas (CREG));
- Energy statistics and balances;
- Offshore wind energy.

The regional competencies include:

- Promotion of the efficient use of energy;
- New and renewable sources of energy (not including nuclear);
- Non-nuclear energy R&D;
- Market regulation for distribution;
- Distribution and transmission of electricity (electricity grid <70 kV);
- Public distribution of natural gas;
- Distribution tariffs (regional regulators — Flemish Regulation Entity for Electricity and Gas markets (VREG), Walloon Commission for Energy (CWaPE) and Commission for Energy Regulation in the Brussels Capital Region (BRUGEL));
- District heating equipment and networks;
- Recovery of waste energy from industry or other uses;
- Regional energy statistics and balances.

At the federal level, energy matters are handled by the Directorate-General for Energy, which is a part of the Federal Public Service (FPS) Economy, SMEs, Self-Employed and Energy (SMEs refers to small and medium sized enterprises); environmental issues are handled by the FPS Health, Food Chain Safety and Environment; while the FPS Mobility and Transport is responsible for most matters which relate to the mobility related use of energy.

At the end of 2019, Belgium submitted to the European Commission its final 10 year integrated national energy and climate plan (NECP) under the Regulation on the Governance of the Energy Union and Climate Action (EU/2018/1999), indicating the most important objectives and measures for energy and climate policy for the period 2021–2030.

1.1.2. Estimated available energy

Table 1 shows estimated available energy by source.

TABLE 1. ESTIMATED AVAILABLE ENERGY SOURCES

	Estimated available energy sources					
	Fossil fuels			Nuclear	Renewables	
	Solid	Liquid	Gas	Uranium	Hydro	Other renewable
Total amount in specific units*	0	0	0	0	<0.1	<0.1
Total amount in exajoules (EJ)	0	0	0	0	<0.1	<0.1

* Solid, liquid: million tonnes; gas: billion m^3; uranium: metric tonnes; hydro, renewable: TW

Note: Solid and gas reserves are not economically exploitable.

Source: FPS Economy — DG Energy (&EMES@economie.fgov.be).

1.1.3. Energy statistics

Table 2 contains selected energy statistics.

TABLE 2. ENERGY STATISTICS

Compound annual growth rate CAGR = $(EV/BV)^{1/n} - 1$

where:

EV = Ending value;BV = Beginning value;n = Number of years (10 years usually).

									Average annual growth rate (%)
	1980	1990	2000	2005	2010	2015	2017	2018*	2010–2018*
Energy consumption [EJ]**									
- Total	2.04	2.01	2.43	2.44	2.56	2.25	2.37	2.29	-1.38
-Solids***	0.52	0.44	0.34	0.22	0.16	0.14	0.13	0.13	-2.56
- Liquids	0.90	0.74	0.95	0.99	1.03	0.98	0.96	0.96	–0.88
- Gases	0.41	0.34	0.56	0.62	0.70	0.59	0.61	0.62	–1.51
- Nuclear	0.14	0.47	0.53	0.52	0.52	0.28	0.46	0.31	-6.26
- Hydro	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—
- Other renewables	0.07	0.03	0.05	0.07	0.11	0.16	0.17	0.18	+6.35
Energy production									
- Total	0.30	0.45	0.57	0.58	0.65	0.44	0.62	0.48	-3.72

- Solids***	0.18	0.04	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—
- Liquids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—
- Gases	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	—
- Nuclear	0.12	0.40	0.53	0.52	0.52	0.28	0.46	0.31	-6.26
- Hydro	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—
- Other renewables	0.00	0.01	0.04	0.06	0.10	0.13	0.13	0.14	+4.30
Net import (Import–Export)									
- Total	1.81	1.71	2.12	2.25	2.26	2.13	2.01	2.22	-0.22

* Latest available official data.

** Energy consumption = Primary energy consumption + Net import (Import–Export) of secondary energy.

*** Solid fuels include coal, lignite.

—: Data not available.

Source: FPS Economy — DG Energy (&EMES@economie.fgov.be).

1.2. THE ELECTRICITY SYSTEM

1.2.1. Electricity system and decision making process

Owing the fact that Belgium is a federal State with energy responsibilities distributed between the federal State and the regions, the Belgian electricity market is subdivided into a Flemish, Walloon and Brussels market, with each of these markets being only partly dependent on the legal framework of the federal level.

As part of its duties, Belgium's high voltage transmission system operator ELIA drew up a multiannual plan for the development of the federal transmission grid in 2015. It did so in partnership with the Belgian Directorate-General for Energy and the Federal Planning Bureau.

The development plan covers a ten year period (2015–2025); is compatible with the European Network of Transmission System Operators for Electricity (ENTSO-E) Ten Year Network Development Plan (2014–2024) and takes account of the latest prospective study carried out by the Directorate-General for Energy in cooperation with the Federal Planning Bureau (in French).

Belgium is also reinforcing interconnection capacities with its neighbours:

- The project ALEGrO involves the realization of a 90 km high voltage direct current (HVDC) link with a bidirectional rated power of approximately 1000 MW capacity, as the first interconnection between Belgium (Lixhe) and Germany (Oberzier). Commissioning is expected at the end of 2020.
- The 1 GW HVDC NEMO Link interconnector between the United Kingdom and Belgium commenced commercial operations on 31 January 2019.
- The BRABO project is upgrading the high voltage grid and improving security of supply at the Port of Antwerp and is part of greater efforts to upgrade Belgium's electricity grid and to increase import capacity from the Netherlands. Commissioning of phase II is expected by the end of 2021.

1.2.2. Structure of the electric power sector

Each region has its own regulatory institution for electricity and gas markets: VREG, CWaPE and BRUGEL. The three regional regulators are responsible for the licensing and regulation of the distribution of natural gas and electricity, the transmission of electricity below 70 kV, technical regulations for the management and extension of natural gas networks, the monitoring of retail market competition in the regional electricity and gas markets and the green certificate schemes, the arbitration of grid access disputes and the advising of the respective regional governments.

The federal regulator for the electricity and gas markets is CREG. This commission advises public authorities on the functions of the electricity market and monitors the application of related laws and regulations. It also regulates and licenses electricity transmission above 70 kV, approves transmission tariffs and monitors the wholesale market at the national level. The operating costs of the CREG are covered by licensing fees and levies on electricity and natural gas.

The four Belgian regulators for electricity and gas launched a structural consultative process in the framework of the Forum of Belgian Energy Regulators (FORBEG). It is an informal platform for discussion and voluntary collaboration and information exchange between the regulators, with a plenary session and several working groups focusing on the following issues: technical questions, information, complaints, green power, tariffs and strategy.

The management of the Belgian electricity transmission system, on the other hand, is overseen by a single transmission system operator (TSO): ELIA.

According to Article 8 of the Law of 29 April 1999 on the organization of the electricity market, ELIA has sole responsibility for operating, maintaining and developing the high voltage transmission system, including interconnections to other grids, in order to ensure continuity of supply.

The legal separation between companies involved in production, transmission and distribution of electricity was completed in 2007 and both the TSO ELIA and the regional distribution system operators (DSOs) are fully legally unbundled from supply/production

companies. Each DSO has a monopoly over the territory in which it operates.

The DSOs, which are owned by municipal shareholders, are the following:

- ORES, RESA, Réseau d'Energies de Wavre, AIESH and AIEG in Wallonia;
- SIBELGA in the Brussels Capital Region;
- FLUVIUS in Flanders, since the merger of EANDIS and INFRAX on 1 July 2018.

SYNERGRID, the Belgian Federation of Electricity and Gas Network Operators, represents the common interests of the transmission system operators ELIA and FLUXYS (for gas) and the DSOs.

FEBEG is the 33 member association of Belgian electricity and gas companies (i.e. electricity generators, traders and shippers of electricity and gas, electricity and gas suppliers and suppliers of energy services).

FEBELIEC, the Federation of Belgian Industrial Energy Consumers represents the industrial energy consumers in Belgium on issues of energy and climate politics on the Belgian and European level.

AGORIA is the employers' federation which brings together and defends the interests of companies in the technology industry, including nuclear technology.

ELECTRABEL, a wholly owned subsidiary of ENGIE, has the dominant position on the Belgian market. The Tihange and Doel NPPs are operated by Electrabel, though EDF Belgium owns 50% of Tihange Unit 1 (450 MW) and Luminus has a stake of 10.2% in four other nuclear reactors (Tihange 2 and 3 and Doel 3 and 4).

1.2.3. Main indicators

By the end of 2018, some 22 790 MW of electricity generation capacity was installed in Belgium, including 3 987 MW of photovoltaic, 3 261 MW of wind (2 075 MW onshore and 1 186 MW offshore) and 5 918 MW of nuclear (Table 3).

Electricity production amounted to 75.1 TW?h in 2018, or 13.5% lower than in 2017. Nuclear plants produced 28.6 TW?h in 2018, 38.1% of total generation, a significant decrease of 13.6 TW?h over 2017. In 2019, nuclear energy accounted for 47.6% of national electricity production.

Monthly data on Belgium's electricity generation and consumption are available on the web site of ELIA, though only the production of plants connected to the ELIA grid is taken into account.

TABLE 3. INSTALLED CAPACITY, ELECTRICITY PRODUCTION AND CONSUMPTION

		1980	1990	2000	2005	2010	2015	2017	2018*	Average annual growth rate (%) 2010–2018*
Capacity of electrical plants (GW(e))[1]	G/N									
- Thermal	N	8.21	7.24	8.55	8.71	9.52	8.51	8.48	8.20	-1.85
- Hydro	N	1.13	1.40	1.41	1.41	1.43	1.42	1.42	1.42	-0.1
- Nuclear	N	1.67	5.50	5.71	5.80	5.93	5.91	5.92	5.92	+0.0
- Wind	N	0.00	<0.01	0.01	0.17	0.91	2.18	2.80	3.26	+17.29
- Geothermal	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—
- Other renewable	N	0.00	0.00	0.00	<0.01	0.90	3.12	3.60	3.99	+20.46
- Total	N	11.01	14.14	15.69	16.10	18.69	21.15	22.23	22.79	+2.51
Electricity production (TWh)[2]	G/N									
- Thermal	G	40.26	27.30	34.14	37.33	43.47	33.25	33.32	33.79	-3.10
- Hydro	G	0.83	0.90	1.70	1.60	1.67	1.42	1.40	1.33	-2.81
- Nuclear	G	12.55	42.72	48.16	47.60	47.94	26.10	42.23	28.60	-6.25
- Wind	G	0.00	<0.01	<0.01	0.23	1.29	5.57	6.51	7.46	+24.53
- Geothermal	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—
- Other renewable	G	0.00	0.00	0.00	0.27	0.82	3.09	3.31	3.90	+21.52
- Total**	G	53.64	70.92	84.01	87.03	95.19	69.85	86.78	75.09	-2.92
Total electricity consumption (TWh)[3]		51.02	67.56	79.82	83.64	85.92	83.14	83.87	84.38	-0.23

* Latest available official data.

** Electricity transmission losses are not deducted.

—: Data not available.

[1] Net maximum electrical capacity.

[2] Gross production.

[3] Final consumption (observed).

Source: FPS Economy — DG Energy (&EMES@economie.fgov.be).

Yearly electricity demand demonstrated a steady increase from 85 TW?h in 2006 to 89.0 TW?h in 2017. The maximum offtake in 2018 was 13 310 MW.

In general, Belgium has been a net power importer since the beginning of the 1990s. In 2018, net imports totalled 17.3 TW?h, 187.8% higher than in 2017 (6.0 TW?h), covering 20.5% of total electricity consumption in Belgium.

TABLE 4. ENERGY RELATED RATIOS

	1980	1990	2000	2005	2010	2015	2017	2018*
Energy consumption per capita (GJ/capita)	206.80	206.20	240.40	237.70	233.22	198.97	209.45	201.32
Electricity consumption per capita (kW?h/capita)	5 448.80	7 109.10	8 205.10	8 330.90	7 926.10	7 417.60	7 407.25	7 417.69
Electricity production / Energy production (%)	64.37	56.74	53.06	54.97	54.35	56.85	48.50	63.23
Nuclear/Total electricity (%)	23.40	60.24	57.33	54.47	50.40	36.95	48.66	38.08
Ratio of external dependency (%)**	88.73	82.61	86.59	91.13	90.38	95.39	84.71	96.77

* Latest available official data.

** Net import/Total energy consumption.

Source: FPS Economy — DG Energy (&EMES@economie.fgov.be).

2. NUCLEAR POWER SITUATION

2.1. HISTORICAL DEVELOPMENT AND CURRENT ORGANIZATIONAL STRUCTURE

2.1.1. Overview

Nuclear power development in Belgium began after the conclusion of World War II, and Belgium led in adopting nuclear technology for peaceful purposes in the early 1960s. For many years, Belgium's nuclear industry covered almost all activities in the nuclear fuel cycle.

The Belgian Nuclear Research Centre (SCK CEN) was created in 1952. After commissioning the Belgian Reactor 1 (BR1) research reactor and the material testing reactor BR2 in Mol, BR3 was the first pressurized water reactor (PWR) in Western Europe; BR3 went critical for the first time on 19 August 1962 and was connected to the electricity grid on 25 October of the same year. On 30 June 1987, BR3 was also the first PWR in Europe to be shut down.

In the neighbouring town of Dessel, the Eurochemic spent fuel reprocessing pilot plant was in operation from 1966 to 1974.

After the commissioning of the pilot PWR reactor BR3 at SCK CEN in 1962 and an early 305 MW PWR designed by Westinghouse in cooperation with France (Chooz A) in 1966, development of nuclear power for commercial utilization took off in Belgium with the decision to build the NPPs Doel (in Flanders) and Tihange (in Wallonia).

Doel 1 and 2 were ordered in 1968, and Tihange 1 was ordered in 1969. Commercial development was accelerated by the 1970s oil crisis, which led to the construction of four more nuclear reactors. By 1985, 7 nuclear power units — all PWRs — had been connected to the electricity grid, with a total net generating capacity of (then) 5824.5 MW.

Main Historical Milestones

1949	Government of Belgium grants purchasing priority of the uranium resources in Congo to the governments of the United Kingdom and the United States of America.
1952	The Belgian Government establishes STK-CEAEN, the Research Centre for Nuclear Energy Applications (Studiecentrum voor de Toepassingen van Kernenergie — Centre d'Etudes pour les Applications de l'Energie nucléaire; the name would be changed to SCK CEN in 1957).
1956	Commissioning of BR1 by STK-CEAEN.
1957	Belgian engineers take part in the commissioning of the first commercial nuclear plant in the United States of America.
1957	STK-CEAEN name changed to SCK CEN (Studiecentrum voor Kernenergie — Centre d'Etude de l'Energie Nucléaire — Belgian Nuclear Research Centre).
1957	Foundation of Belgonucleaire (mixed oxide (MOX) production and radwaste treatment and conditioning).
1957	Foundation of Eurochemic, international cooperation by 13 European countries sharing their knowledge in recovering and reprocessing spent fuel.
1960	Franco-Belgian convention and creation of SENA (Société d'energie nucléaire franco-belge des Ardennes): the principle was that everything from funding to studies and energy production should be shared equally.
1960	Start of the construction of the Eurochemic reprocessing plant.
1960	First supply of plutonium to Belgium by the United States of America.
1961	Commissioning of BR2 by SCK CEN.
1962	Commissioning of the BR3 PWR prototype plant (11 MW(e)) for SCK CEN. This reactor was the first PWR built outside the United States of America.

1963	Researchers introduce plutonium enriched fuel rods into BR3.
1964	Commissioning of the VENUS research reactor (Vulcan Experimental Nuclear Study).
1965	Creation of Synatom (Syndicate for the design of large capacity nuclear power plants).
1966	Commissioning of the Franco-Belgian Chooz A NPP, then the world's most powerful PWR (305 MW).
1966	Decision to build Doel and Tihange NPPs (Doel 1 and 2 ordered in 1968, Tihange 1 in 1969).
1966	Startup of the installations of Eurochemic.
1969	A Nuclear Safety Department (AVN) was set up within the Association Vinçotte, immediately put in charge of the regulatory control of the Doel and Tihange NPPs.
1971	Creation of the Institute for Radioelements (IRE).
1972	Joint fast breeder programme with Germany and the Netherlands (Kalkar NPP).
1973	Creation of FBFC (Franco-Belge de Fabrication du Combustible) nuclear fuel production company.
1973	Oil crisis and decision to build four more nuclear units: Doel 3 and 4, Tihange 2 and 3 (ordered in 1974).
1974	End of the reprocessing activities of Eurochemic.
1974	SCK CEN launches a research programme on storing radioactive waste deeply underground.
1974	Commissioning of Doel 1 (Unit 1 of Doel NPP).
1975	Commissioning of Doel 2 and Tihange 1 nuclear power units.
1976	Takeover of Eurochemic by the Government of Belgium with the intention for it to provide supply for domestic needs only.
1977	Synatom becomes a nuclear fuel management company (Belgian company for nuclear fuel).
1980	Creation of ONDRAF/NIRAS, the National Agency for Radioactive Waste and Enriched Fissile Materials (Law of 8 August 1980, amended by the Law of 11 January 1991).
1981	The Belgian Nuclear Safety Authority, made up of two services, the SSTIN and the SPRI, is created by royal decree.
1982	Commissioning of Doel 3 and Tihange 2 nuclear power units.
1984	Foundation of Belgoprocess (which at the time stood for Belgium reprocessing), as a subsidiary of Synatom.
1985	Government decision to shut down Eurochemic permanently.
1985	Exhaustive backfitting process for Doel 1 and 2 and Tihange 1 nuclear power units.
1985	Commissioning of Doel 4 and Tihange 3 nuclear power units.
1986	Architectural engineering companies Electrobel and TractioneL merge to create Tractebel.
1986	SCK CEN is involved in the measurements following the disaster at the Chernobyl NPP.
1986	Transfer of the Belgoprocess shares to ONDRAF/NIRAS.
1986	Beginning of industrial production of MOX fuel by Belgonucleaire at the Dessel plant.
1987	Start of decommissioning studies for Eurochemic.
1987	The BR3 PWR is closed down. This leads to the immediate launch of the first western European research programme into the dismantling of this type of nuclear reactor.
1988	The construction of an 8th unit (N8) of 1400 MW (50% EDF) indefinitely postponed by the Government.
1989	Start of the decommissioning of Eurochemic.
1989	Construction of a centralized treatment facility to process low level radwaste from Belgium (CILVA).
1990	Construction of a storage unit for conditioned high and medium level waste (Building 136).
1990	Private electricity producers Intercom, EBES and UNERG merge to create Electrabel.
1991	Decommissioning (by EDF) of Chooz A NPP.
1993	First steam generator replacement in Belgium at Doel 3 NPP.
1993	The first Belgian Parliament debate on reprocessing and use of MOX fuel led to the suspension of the reprocessing contract signed between Synatom and COGÉMA 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 reactors.
1994	Promulgation of the law with respect to the Federal Agency for Nuclear Control (FANC/AFCN).
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 site.
1995	Creation of the cooperative company CPTE (Company for Coordination and Transmission of Electrical Energy) by Electrabel (91.5%) and SPE (8.5%).
1995	An economic interest grouping (EIG PRACLAY, later renamed EIG EURIDICE) is created, involving SCK CEN and ONDRAF/NIRAS, to carry out feasibility studies for the disposal of high level and long lived radioactive waste in clay layers.
1996	BR2 undergoes a major campaign of modernization and refurbishment.
1997	Commissioning of the wet interim spent fuel storage facility on the Tihange NPP site.
1997	In April, ONDRAF/NIRAS presents various options for the final disposal of low level and short lived waste to the authorities. The Law of 12 December 1997 defines a new mission for ONDRAF/NIRAS (i.e. to establish the inventory of all nuclear facilities and sites containing radioactive waste and assess the decommissioning and site remediation costs).

1998	In January, the Government of Belgium decides on a new approach for the search for disposal sites for low level and short lived radioactive waste based on participative methods; it limits the research to existing nuclear zones or areas where the municipalities have shown interest. In December, the Government of Belgium orders the cancellation of the reprocessing contract signed in 1991 between Synatom and COGÉMA and suspended in 1993. It postpons 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 spent fuel from Belgium, but forbids Synatom to conclude a new contract without its formal approval.
1998	The Multipurpose Hybrid Research Reactor for High Tech Applications (MYRRHA) research project begins.
1999	In February, the Government appoints the expert commission AMPERE (Commission d'Analyse des Modes de Production d'Électricité et de Redéploiement des Énergies) to assess the electricity demand and the options for the future of power generation in Belgium in the 21st century.
1999	Law of 29 April 1999 on the organization of the electricity market (The Electricity Act).
1999	In July, the Government announces the closure of all Belgian NPPs when they reach their 40 year lifetime and introduces a moratorium on reprocessing.
1999	SCK CEN removes the reactor vessel from BR3.
2000	In April, the first 28 containers with vitrified high level radwaste, resulting from the reprocessing of spent fuel from Belgium in La Hague (France), are returned to Belgium. The second repatriation takes place in November.
2000	In December, the economic interest grouping European Underground Research Infrastructure for Disposal of Nuclear Waste in Clay Environment (EURIDICE) between ONDRAF/NIRAS and SCK CEN was created to replace EIG PRACLAY. EIG EURIDICE is now responsible for the management and operation of the underground research laboratory High Activity Disposal Experimental Site (HADES) and the realization of the PRACLAY project.
2000	In December, the Commission AMPERE publishes a report more than a thousand pages long, containing, among its key messages, its recommendations to keep the nuclear option open. The report would be evaluated by a group of five international experts selected by the Government.
2001	In February, repatriation of the third batch of containers with vitrified high level radwaste resulting from the reprocessing of spent fuel from Belgium in La Hague (France).
2001	In May, the group of five international experts publish the conclusions of its evaluation of the report of the Commission AMPERE. 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.
2001	During the outage of Tihange 2 from 9 June to 11 August, the three steam generators are successfully replaced. The steam generator replacement itself is executed in the new record time of 17.5 days.
2001	In September, the FANC/AFCN, established by the Law of 15 April 1994, becomes operational, incorporating the former SSTIN and the SPRI.
2001	SCK CEN launches the Master's Degree Course in Nuclear Engineering in collaboration with five universities in Belgium.
2001	In December, an agreement is obtained between the Government of Belgium and the electricity sector on financing the dismantling of old nuclear installations at the sites of Eurochemic (BP1) and the former Waste Department of SCK CEN (BP2), and on the management of the provisions for spent fuel disposal and dismantling of Belgium's nuclear power stations.
2002	In February and September, repatriation of the fourth and fifth batches of containers with vitrified high level radwaste, resulting from the reprocessing of Belgium's spent fuel in La Hague (France).
2002	In July, the SAFIR 2 report (Safety Assessment and Feasibility Interim Report) on high level radwaste disposal in Belgium is presented by ONDRAF/NIRAS to the competent federal authorities. The report confirms Boom clay as a potential host formation, as well as the technical feasibility of the construction of an underground repository in this clay. The report is peer reviewed by the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA).
2002	Belgonucleaire surpasses cumulative production of 500 tonnes of MOX fuel.
2003	Law of 31 January 2003 on the gradual phasing out of nuclear energy for the industrial production of electricity.
2003	ONDRAF/NIRAS submits to the Government the first inventory report of all nuclear sites or facilities containing radioactive substances in Belgium.
2003	Law of 11 April 2003, regulating the provisions for decommissioning of Belgium's NPPs and for the management of spent fuel from these NPPs and establishing the Commission for Nuclear Provisions.
2003	In the same month, the general assemblies of Electrabel and SPE agreed to split their joint venture CPTE with retroactive effect to 1 January 2003.
2003	In September, repatriation of the sixth batch of containers with vitrified high level radwaste, resulting from the reprocessing of Belgium's spent fuel in La Hague (France).
2005	Decision to close the MOX factory (Belgonucleaire) in Dessel.
2006	SCK CEN undergoes a reorganization process which leads to the creation of three scientific institutes. Each institute researches a specific field of nuclear applications. A fourth institute becomes responsible for communications, support services and administration. The Institute for Nuclear Material Sciences conducts research into materials and fuels for current and future nuclear systems. The Institute for Advanced Nuclear Systems develops technological knowledge on innovative nuclear reactors. The Institute for Environment, Health and Safety safeguards the health and safety of humans and the environment for various applications of radioactivity, including the back end of the fuel cycle.
2006	The last fabrication campaign at Belgonucleaire is completed on 15 August.
2007	In September, the FANC/AFCN creates a subsidiary, a foundation of private law, called Bel V.
2008	On 14 April, the regulatory activities of AVN, as well as the concerned staff, are transferred to Bel V. Since that day, this subsidiary of the FANC/AFCN constitutes the technical safety organization of the Belgian Nuclear Safety Authority.
2008	Completion of the first phase of the decommissioning of Eurochemic.

2008	The BR3 reactor chimney is demolished: an important step in the dismantling process.
2009	SCK CEN coordinates Belgium's research on fusion within "the broader approach" to nuclear fusion.
2010	Start of dismantling work of Belgonucleaire (main contractors: Tecnubel N.V., THV Belgoprocess/SCK CEN and Studsvik GmbH; project manager: Tractebel).
2010	GUINEVERE is inaugurated at SCK CEN; one step forward in the research on accelerator driven systems. With the European GUINEVERE project, SCK CEN realizes the world's first demonstration model of an accelerator driven system with a complete lead core. The federal Government announces financial support for the MYRRHA project. Europe views MYRRHA as a priority research infrastructure project for energy security and the fight against climate change.
2010	SCK CEN celebrates 35 years of fusion research.
2011	In the aftermath of the nuclear accident at the Fukushima Daiichi NPP, SCK CEN offers support activities in areas such as analysis, measurements and technical advice.
2011	Stoppage of FBFC.
2012	At its 60th anniversary, SCK CEN establishes the Academy for Nuclear Science and Technology. The Academy combines all education and training activities.
2012	Doel NPP, Unit 3: Temporary stoppage from 1 June 2012 until 5 June 2013. Tihange NPP, Unit 2: Temporary stoppage from 17 August 2012 until 7 June 2013.
2012	On 4 July, the federal Government makes a decision on a timetable for the nuclear power phase-out between 2015 and 2025, providing for the extension by 10 years of the licence of Unit 1 of Tihange NPP.
2013	VENUS exploitation licence for GUINEVERE published by royal decree.
2013	Law of 18 December 2013, amending the Law of 31 January 2003 on the gradual phasing out of nuclear energy for the industrial production of electricity, providing a timetable for the nuclear power phase-out between 2015 and 2025.
2014	Doel 3 and Tihange 2: Temporary stoppage from 26 March because of fault indications discovered in the steel reactor casings.
2014	Complete transposition of Council Directive 2011/70/EURATOM establishing a community framework for the responsible and safe management of spent fuel and radioactive waste by the Law of 3 June 2014.
2014	Doel 4: Temporary stoppage from 5 August to 19 December following an oil leak in the steam turbine.
2015	Law of 18 June 2015, amending the Law of 31 January 2003 on the gradual phasing out of nuclear energy for the industrial production of electricity in view of ensuring the security of the electricity supply, on the long term operation (LTO) of Doel 1 and Doel 2 reactors until 15 February 2025 and 1 December 2025, respectively.
2015	The National Programme Committee drafts a National Programme for the Management of Spent Fuel and Radioactive Waste pursuant to the Law of 3 June 2014 which transposed Council Directive 2011/70/EURATOM of 19 July 2011. It outlines the state of affairs on 31 December 2014 in the field of spent fuel and radioactive waste management.
2016	Approval of the first National Programme for the Management of Spent Fuel and Radioactive Waste.
2016	In July, the material testing reactor BR2 is successfully restarted after thorough maintenance and refurbishment lasting 16 months. SCK CEN takes advantage of the opportunity to invest in the extension of the irradiation capabilities of BR2, including the development of irradiation facilities allowing the irradiation of GEN IV/MYRRHA candidate materials in representative conditions.
2016	Belgium and Luxembourg sign a bilateral agreement for the management and final disposal of radioactive waste from Luxembourg in Belgium. This bilateral agreement was ratified by Luxembourg in 2018.
2017	On 17 March, the European Commission finds Belgium's plans to compensate Electrabel and EDF Belgium for potential financial risks linked to LTO of nuclear reactors Tihange 1, Doel 1 and Doel 2, in line with European Union state aid rules.
2018	In September, Belgium's Government decides to finance the new major research infrastructure MYRRHA for an amount of EUR 558 million, which includes investment for construction of a 100 MeV accelerator and its target facilities (2019–2026) and R&D investment to prepare phase 2 (600 MeV accelerator) and phase 3 (subcritical reactor).

2.1.2. Current organizational structure

Policy related to the nuclear sector, the nuclear fuel cycle and nuclear R&D in both nuclear fusion and fission falls under the responsibility of the FPS Economy, SMEs, Self-Employed and Energy.

Licensing, control and surveillance are the responsibility of the Federal Agency for Nuclear Control (FANC/AFCN) and is supervised by the Minister for the Interior. The FANC/AFCN has legal duties in the field of radiation protection, nuclear safety and radiological surveillance, licensing and de-licensing.

Synatom, a wholly owned subsidiary of Electrabel, is responsible for the fuel cycle front end management (i.e. supplying enriched uranium to the seven nuclear power units) as well as the fuel cycle back end management (i.e. the management of all activities in connection with spent nuclear fuel).

Synatom is the 'exclusive owner' (as defined by EURATOM Treaty Article 87) of the nuclear fuel from its fabrication to its transfer to the National Agency for Radioactive Waste and Fissile Materials (ONDRAF/NIRAS) when declared as radioactive waste. Hence, it is the most important owner and producer of irradiated fissile materials.

In addition, Synatom is entrusted by law with the management of the provisions for dismantling Belgium's NPPs and for the costs related to their spent fuel and is therefore mentioned twice in Fig. 1.

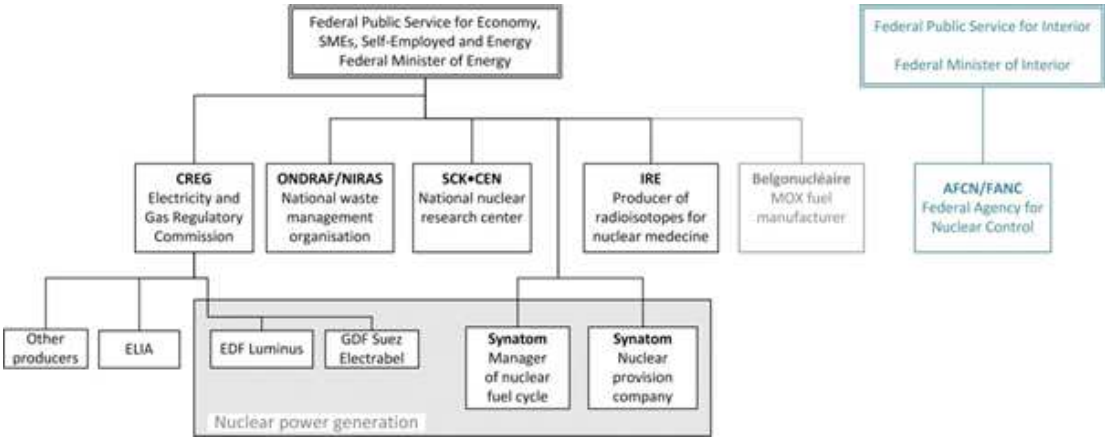

FIG. 1. Organizational chart of the nuclear sector.

CREG regulates and licenses electricity transmission above 70 kV, approves transmission tariffs and monitors the market.

Elia is Belgium's TSO for electricity.

ONDRAF/NIRAS is entrusted by law with the safe transportation, treatment, conditioning, storage and disposal of all radioactive waste produced in the country under supervision of the Minister of Energy and the Minister of the Economy. The legislature also assigned certain responsibilities in the field of decommissioning to ONDRAF/NIRAS; it sees to it that the owners/operators create the necessary provisions for the financing of the future dismantling programme.

ONDRAF/NIRAS must work at cost price and charge those using its services — radioactive waste producers — no more or less than the amounts necessary to ensure the safe management of their waste, in accordance with the 'polluter pays' principle.

ONDRAF/NIRAS also has the main responsibility for R&D on radioactive waste management and its disposal.

Since 1986, ONDRAF/NIRAS has had an industrial subsidiary, Belgoprocess, whose site in Dessel serves as ONDRAF/NIRAS's central processing and conditioning facility as well as a storage facility for conditioned waste of all categories.

Belgoprocess is active in the following three areas:

Industrial activities in the field of radioactive waste management (processing, conditioning and intermediate storage awaiting the final disposal of radioactive waste);

- Dismantling of decommissioned nuclear plants, remediation of contaminated buildings and sites, decontamination of materials and structures;
- Retention and development of new knowledge and know-how, execution of projects and commercial use of the know-how within these areas.

As a foundation of public utility, SCK CEN conducts research into the safety of nuclear installations, the management of radioactive waste and human and environmental protection against ionizing radiation, safeguards of strategic materials and the social implications of nuclear energy.

Since 1998, SCK CEN has been developing the nuclear research infrastructure Multipurpose Hybrid Research Reactor for High Tech Applications (MYRRHA) based on the concept of an accelerator driven system for the necessary research into innovative solutions for high level radioactive waste, the qualification of fusion reactor materials and fundamental nuclear physics research. The National Institute for Radioelements (IRE) is a public utility foundation whose main activity is the production of radioelements used in nuclear medicine for diagnostic and therapeutic purposes. Its R&D department contributes to research in the field of radioelement production, environmental protection and radioactive waste management.

Belgonucleaire S.A. was founded in 1957 and provided nuclear engineering services in the areas of studies concerning the behaviour of nuclear fuels, the back end of the nuclear fuel cycle, and manufacturing equipment for MOX plants. It operated a MOX fuel manufacturing facility in Dessel from 1986 to 2006. The decommissioning of the site commenced in 2010 and conventional demolition was completed in 2019.

2.2. NUCLEAR POWER PLANTS: OVERVIEW

2.2.1. Status and performance of nuclear power plants

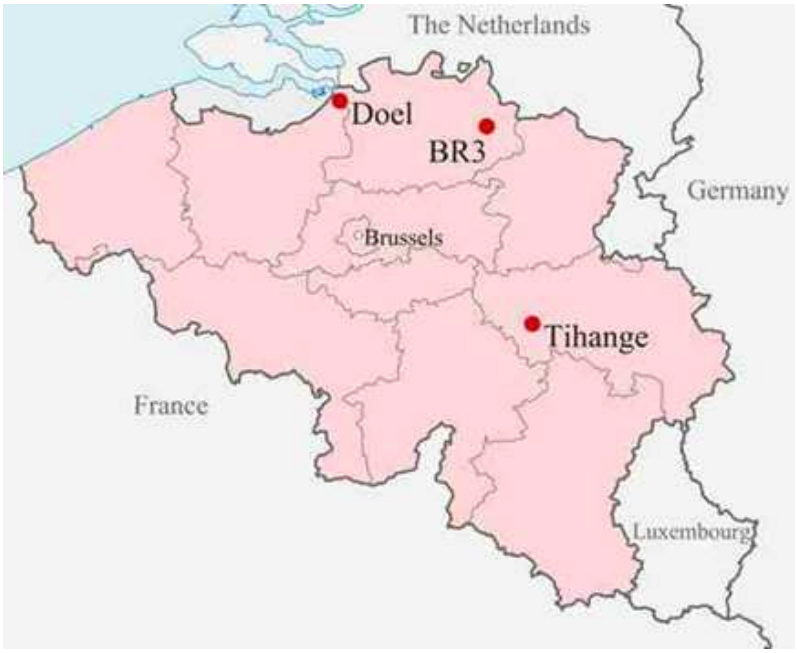

FIG. 2. Location of nuclear power plants in Belgium.(Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons.*)*

The Belgian NPPs are located in Doel (in Flanders) and Tihange (in Wallonia) (Fig. 2). All reactors are operated by Electrabel. Electrabel is a wholly owned subsidiary of ENGIE. BR3, a prototype PWR, was shut down on 30 June 1987 (Table 5).

TABLE 5. STATUS AND PERFORMANCE OF NUCLEAR POWER PLANTS

Reactor Unit	Type	Net Capacity [MW(e)]	Status	Operator	Reactor Supplier	Construction Date	First Criticality Date	First Grid Date	Commercial Date	Shutdown Date	UCF for 2019
DOEL-1	PWR	445	Operational	EBL+EDF	ACECOWEN	1969-07-01	1974-07-18	1974-08-28	1975-02-15		56.4
DOEL-2	PWR	433	Operational	EBL+EDF	ACECOWEN	1971-09-01	1975-08-04	1975-08-21	1975-12-01		63.5
DOEL-3	PWR	1006	Operational	EBL+EDF	FRAMACEC	1975-01-01	1982-06-14	1982-06-23	1982-10-01		85.3
DOEL-4	PWR	1038	Operational	EBL+EDF	ACECOWEN	1978-12-01	1985-03-31	1985-04-08	1985-07-01		97.2
TIHANGE-1	PWR	962	Operational	EBL	ACLF	1970-06-01	1975-02-21	1975-03-07	1975-10-01		99.3
TIHANGE-2	PWR	1008	Operational	EBL	FRAMACEC	1976-04-01	1982-10-05	1982-10-13	1983-06-01		37.7
TIHANGE-3	PWR	1038	Operational	EBL	ACECOWEN	1978-11-01	1985-06-05	1985-06-15	1985-09-01		99.4
BR-3	PWR	10	Permanent Shutdown	CEN/SCK	WH	1957-11-01	1962-08-29	1962-10-10	1962-10-10	1987-06-30	

Data source: IAEA - Power Reactor Information System (PRIS).

Note: Table is completely generated from PRIS data to reflect the latest available information and may be more up to date than the text of the report.

+ Date when first major placing of concrete, usually for the base mat of the reactor building, is done.

++ Date of the first connection to the grid.

* UCF (unit capability factor) for the latest available year (only applicable to reactors in operation).

** Electrabel.

Source: The data for Table 5 (list of nuclear power reactors that are operational, under construction, cancelled/suspended construction, and long term/permanent shut down) have been generated automatically and updated via the PRIS database. (www.iaea.org/pris/).

On 31 January 2003, the federal Parliament passed a law codifying the national policy of Belgium to phase out nuclear energy for commercial electricity production. This law prohibits the construction of new NPPs intended for the industrial production of electricity by nuclear fission in Belgium and sets a 40 year limit on the operational period of existing plants. This legislation does not apply to nuclear research reactors.

On 4 July 2012, the Government of Belgium, while authorizing the LTO of Tihange 1 until 2025 (conditional on approval by the FANC/AFCN), confirmed this decision, and by the Law of 18 December 2013 it established a timetable for the nuclear power phase-out between 2015 and 2025. At the same time, the law eliminated the possibility of invoking force majeure to change the timetable for the nuclear power phase-out by royal decree if Belgium's security of supply is threatened.

On 18 December 2014, the federal Government confirmed the decision to phase out all nuclear power plants by 2025. However, in order to ensure security of supply of electricity, it allowed the Doel 1 and 2 reactors to continue operating for an additional ten years — conditional on the approval of the regulator FANC/AFCN and an agreement with the operator and owner of the reactors, Electrabel — until 15 February 2025 and 1 December 2025, respectively.

Taking into account these amendments, the timetable for the nuclear phase-out is as follows:

TABLE 6. INTENDED NUCLEAR PHASE-OUT TIMETABLE

Reactor	Net capacity	Start of commercial operation	Off-line
Doel 1	433.0 MW(e)	15 February 1975	15 February 2025
Doel 2	433.0 MW(e)	1 December 1975	1 December 2025
Doel 3	1 006.0 MW(e)	1 October 1982	1 October 2022
Doel 4	1 033.0 MW(e)	1 July 1985	1 July 2025
Tihange 1	962.0 MW(e)	1 October 1975	1 October 2025
Tihange 2	1 008.0 MW(e)	1 February 1983	1 February 2023
Tihange 3	1 038.0 MW(e)	1 September 1985	1 September 2025

2.2.2. Plant upgrading, plant life management and licence renewals

The initial licences of the seven reactors were granted for an unlimited time. The safety of the installations is continuously reviewed through different processes, the most important and systematic being the series of periodic safety reviews. In addition, many other projects with important modifications have been executed, including steam generator replacements at all units, in some cases accompanied by power increases. Such major modifications to the NPPs are subject to licence amendments following a procedure similar to the initial one.

2.2.3. Permanent shutdown and decommissioning process

BR3, a prototype PWR, operational from 1962 to 1987, was shut down on 30 June 1987. SCK CEN is entrusted with its decommissioning. At present, the major components of the BR3 reactor are dismantled, and concrete cleaning work has started. The major remaining tasks are related to the demolition of the buildings. It will be the first complete decommissioning of a PWR in Europe.

2.3. FUTURE DEVELOPMENT OF THE NUCLEAR POWER SECTOR

The Law of 31 January 2003 on the nuclear power phase-out progressively phases out the production of electricity using nuclear fission energy by limiting the operation of existing reactors to 40 years and prohibits the construction of new nuclear units intended for the industrial production of electricity by nuclear fission in Belgium. Subsequently, successive governments have amended this law in order to ensure the security of supply of electricity, allowing for the units Tihange 1 and Doel 1 and 2 to remain operational until 2025.

2.3.1. Nuclear power development strategy

Not applicable.

2.3.2. Project management

Not applicable.

2.3.3. Project funding

Not applicable.

2.3.4. Electric grid development

Not applicable.

2.3.5. Sites

Not applicable.

2.3.6. Public awareness

Not applicable.

2.4. ORGANIZATIONS INVOLVED IN CONSTRUCTION OF NPPs

Tractebel is the engineering division of Engie and was the architectural engineer/owner’s engineer for the construction of the seven Belgian nuclear power units in Doel and Tihange. It currently employs over 1000 employees on nuclear projects in 28 countries.

The Westinghouse Electric Belgium office provides engineering support to nuclear power utilities in Europe and worldwide.

2.5. ORGANIZATIONS INVOLVED IN OPERATION OF NPPs

Electrabel, a wholly owned subsidiary of ENGIE, operates seven nuclear units: four in Doel and three in Tihange, with a total capacity of almost 6000 MW. Moreover, Electrabel owns 50% of Tihange 1, 89.8% of Tihange 2 and 3, 100% of Doel 1 and 2 and 89.8% of Doel 3 and 4.

Luminus, Belgium's second largest gas and electricity supplier, has a stake of 10.2% in four nuclear power units (Tihange 2 and 3 and Doel 3 and 4). EDF Belgium owns a 63.5% stake in Luminus and also holds a direct 50% stake in Tihange 1.

2.6. ORGANIZATIONS INVOLVED IN DECOMMISSIONING OF NPPs

FANC/AFCN

FANC/AFCN, established by the Law of 15 April 1994, is the regulatory body in charge of nuclear safety, licensing and de-licensing, under the supervision of the Minister for the Interior.

The classification of nuclear installations in Classes I to IV is defined by Article 3 of the Royal Decree of 20 July 2001, executing the Law of 15 April 1994 and laying down the General Regulations regarding the protection of the public, workers and the environment against the hazards of ionizing radiation. The decommissioning of nuclear installations belonging to the Class I facilities, as well as some belonging to the Class II facilities, is subject to prior authorization by the FANC/AFCN.

For Class I installations, the decommissioning licence is granted by a royal decree, countersigned by the minister responsible for nuclear safety and radiological protection, but the licence application must be submitted to the FANC/AFCN. For Class II installations, the licence is granted by the FANC/AFCN. The decommissioning strategy is specified by the licence applicant and submitted to the FANC/AFCN for approval.

ONDRAF/NIRAS

The legislature assigned certain responsibilities in the field of decommissioning to ONDRAF/NIRAS by law. Among others, the agency has to collect and to evaluate information related to the decommissioning programmes of nuclear installations, to approve those programmes, and to execute decommissioning programmes at the demand of third parties or in the case of failure of an operator. For the purpose of standardization of decommissioning planning, ONDRAF/NIRAS issued recommendations for the elaboration of decommissioning plans, following the IAEA Safety Standards, requirements and guides in the field of decommissioning. ONDRAF/NIRAS is responsible for the elaboration of an inventory of all nuclear installations and all sites containing radioactive substances within the country, including the verification of the existence of sufficient financial provisions for the execution of decommissioning and remediation programmes.

Commission for Nuclear Provisions

The Commission for Nuclear Provisions was established by the Law of 11 April 2003, regulating the provisions for the decommissioning of Belgium's NPPs and for the management of spent fuel from these NPPs, in particular regarding the existence, adequacy and availability of the provisions.

CREG

The Law of 24 December 2002 provided for the levy of an excise tax, called federal dues, which is calculated on the basis of kW?h consumed. Part of these dues are paid to funds earmarked to finance nuclear liabilities resulting from the decommissioning of the sites of the former Eurochemic plant (BP1) and the former Waste Department of SCK CEN (BP2), as well as the treatment, processing, storage and evacuation of accumulated radioactive waste. CREG collects the amount owed as dues and transfers it to ONDRAF/NIRAS.

Belgoprocess

Founded in 1984, Belgoprocess was incorporated as a subsidiary of ONDRAF/NIRAS in 1986; it is in charge of decommissioning the shutdown nuclear facilities on the sites of the former Eurochemic plant (BP1) and the former Waste Department of SCK CEN (BP2).

Belgoprocess uses this operational expertise to offer waste management and decommissioning services to national and international clients on a commercial basis.

Synatom

Synatom was entrusted by the Law of 11 April 2003 on the provisions for the decommissioning of NPPs and the management of the irradiated nuclear fuel from these plants, amended by the Law of 25 April 2007, with the management of all the provisions for the nuclear liabilities, the dismantling of the nuclear power plants and the management of the spent fuel. The main characteristics of the applied methodology for dismantling provisions are the following:

The provision must be accrued over the life expectancy of the NPPs (as defined by the Law of 31 January 2003, i.e. 40 calendar years). The current scenario is a dismantling approach based on the dismantling of each unit separately, but in a series, and the decommissioning of the common facilities well after the decommissioning of the last unit on each site.

- The initial provision is equal to the net present value of all future decommissioning expenses (based on a study performed by engineering company Tractebel).

Tractebel

Tractebel offers a full range of integrated concepts to assist with the safe and cost effective decommissioning of nuclear installations and has executed the following projects:

Decommissioning plan and preparatory work for the shutdown and dismantling of the first NPP units in Doel (Belgium);

- Complete studies of two subsystems for final repository project Cigéo (Centre industriel de stockage géologique, France);
- Demolition, decontamination and dismantling plan for Bohunice V1 NPP (Slovakia);

- Architectural engineer for the dismantling of high activity waste tanks (Belgium);
- Studies for wet and dry spent fuel storage (Belgium, France, United Kingdom).

Tecnubel

Tecnubel is part of the Benelux Business Unit of Engie. Its expertise covers a wide range of services in the maintenance, decontamination and dismantling of nuclear installations and the rehabilitation of the surrounding sites. It played a key role as the main partner in the dismantling of the Belgonucleaire MOX fuel plant in Dessel.

SCK CEN

SCK CEN has accumulated almost 25 years' experience in decommissioning and decontamination of reactors, hot cells, radioactive contaminated laboratories and 'exotic' installations.

SCK CEN was entrusted with the decommissioning of BR3 and has also been strongly involved in the management of the dismantling of the Thetis research reactor at Ghent University and the dismantling of the former Belgonucleaire MOX production plant in Dessel.

The dismantling work on the Thetis reactor was completed in 2014 and the reactor was formally declared dismantled in 2015, its licence being ended by the Royal Decree of 26 December 2015. Thetis thus became the first nuclear reactor in Belgium to be declassified.

2.7. FUEL CYCLE, INCLUDING WASTE MANAGEMENT

Uranium Conversion and Enrichment

No conversion or enrichment activities take place in Belgium.

Fuel Fabrication

Belgium's experience with MOX fuel goes back as early as 1963, with the loading of 12 MOX fuel rods in its pioneer BR3 PWR, though MOX fuel was only introduced in NPP units Doel 3 and Tihange 2 in 1995.

The material testing reactor BR2 and the research laboratories of SCK CEN are licensed and equipped to handle MOX fuels and have been involved in most of the international MOX research projects.

SCK CEN and Belgonucleaire performed MOX fuel research and developed the Micronized Master Blend production process presently applied for almost all of the MOX used in NPPs.

From 1986 to 2006, Belgonucleaire operated an industrial scale MOX fuel manufacturing facility in Dessel. The plant had a yearly production capacity of 32 tonnes of MOX fuel for commercial western European light water reactors and has produced more than 600 tonnes of MOX for 21 NPPs worldwide. Production was stopped on 15 August 2006 after successive capacity increases of MOX plants in France and the United Kingdom. A decommissioning licence was granted by Royal Decree on 26 February 2008 and decommissioning operations started in 2010. Conventional demolition was completed in 2019.

FBFC (Franco-Belge de Fabrication du Combustible), a subsidiary of AREVA, had a fresh fuel production capacity of 500 tonnes per year and a MOX fuel production capacity of 200 tonnes per year, to provide for fuel assemblies for pressurized as well as boiling water reactors. In May 2012, AREVA officially notified the FANC/AFCN that it would stop all its activities in the Dessel facility. The fresh fuel facility was shut down in 2012 and a dismantling licence was granted by royal decree in October 2013. Decommissioning of this facility is in its final stages. The MOX fuel fabrication facility ceased activities at the end of 2015.

Interim Storage of Spent Fuel

Commercial spent fuel is separately stored in dedicated facilities on the sites of the NPPs (pool storage in Tihange and dry storage in Doel). At the end of 2019, the dry storage building in Doel contained 112 containers in which 3306 spent fuel elements were stored, while the wet storage building in Tihange contained 3023 such elements. The spent fuel of BR3 is kept in dry storage at Belgoprocess.

Reprocessing

Reprocessing of commercial spent fuel was carried out by AREVA (formerly COGÉMA) in France starting in 1978, when Synatom entered into a reprocessing contract with COGÉMA.

Also in 1978, the Government of Belgium concluded an agreement on the takeover of the Eurochemic reprocessing plant with the intention for it to supply and meet domestic needs only.

In 1984, the Government of Belgium transferred Eurochemic to Belgoprocess (which at the time stood for Belgium reprocessing), then a subsidiary of Synatom. However, in 1986, the decision was made to close the factory. The demolition of the Eurochemic reprocessing plant was completed in 2014.

In December 1993, the federal Parliament imposed a moratorium for a period of five years on further reprocessing of spent fuel. In 1998, the Council of Ministers requested Synatom not to sign any new reprocessing contract without formal approval.

Reprocessing of spent fuel of the BR2 research reactor is carried out by AREVA. Waste Management

European Union Council Directive 2011/70/EURATOM imposed a major policy change with its special emphasis on the obligation to define national policies for the safe management of all radioactive waste and spent fuel as well as to define a national programme

aiming at implementing these policies. It was transposed by the Law of 3 June 2014, amending Article 179 of the Law of 8 August 1980 on the budgetary proposals for 1979–1980.

Article 6 of the Law of 3 June 2014 created the National Programme Committee, whose members are the following:

Directorate-General for Energy, FPS Economy, SMEs, Self-employed and Energy;

- ONDRAF/NIRAS;
- Synatom, the company which is responsible for the fuel cycle for Belgium's NPPs, with the exception of activities assigned to ONDRAF/NIRAS; and the 'exclusive owner' (as defined by EURATOM Treaty Article 87) of the nuclear fuel from its fabrication to its transfer to ONDRAF/NIRAS when declared as radioactive waste.

In 2015, the National Programme Committee drafted a National Programme for the Management of Spent Fuel and Radioactive Waste pursuant to the Law of 3 June 2014. It outlines the state of affairs on 31 December 2014 in the field of spent fuel and radioactive waste management.

The FANC/AFCN gave its advice on the draft on 10 April 2015, and the Strategic Environmental Assessment (SEA) Committee of the Federal Public Service Health, Food Chain and Environment provided its advice on 11 September 2015.

On 30 June 2016, a ministerial decree was approved, fixing the first National Programme for the Management of Spent Fuel and Radioactive Waste. This instrument serves as a strategic scoreboard for the short, medium and long term management of radioactive waste and spent fuel in Belgium.

Radioactive waste generated during routine operations of nuclear facilities in Belgium is processed and conditioned on-site by the operator of the relevant facility or by ONDRAF/NIRAS in central processing and storage and conditioning facilities located mainly in Dessel and managed by Belgoprocess, its industrial auxiliary subsidiary. It is responsible for the safe processing of radioactive waste produced in Belgium that cannot be handled by the producer, and for storage of this waste, pending final disposal. Foreign waste can also be processed in Belgoprocess installations, but such waste should return to the country of origin.

Belgium and Luxembourg signed a bilateral agreement for the management and final disposal of Luxembourg's radioactive waste in Belgium. This bilateral agreement was ratified by Luxembourg in 2018 and by Belgium in 2019.

Low level solid waste is either incinerated or compacted in the CILVA facility, which began industrial operation in 1994 and was certified according to the ISO 9001 quality management standard of 1995.

Low level liquid waste is treated chemically by flocculation and precipitation. After processing, the waste is encapsulated in cement in 400 litre drums and then stored inside a building designed specifically for the purpose. Bitumen was also used for this purpose until 2004. Annually, an average of 700 mł of waste is supercompacted and 180 tonnes of waste is incinerated in the CILVA facility.

Since 2007, medium level and long lived alpha bearing waste as well as Pu-contaminated gloveboxes are encapsulated in cement in 400 litre drums in the PAMELA installation. About 1300 mł has been treated and about 722 mł of conditioned waste produced up to the end of 2019.

The HRA/Solarium facility (Building 280X), built on Site 2 at Belgoprocess and put into operation at the end of February 2005, is intended for the processing and conditioning by compression and cementation of historical medium level waste and radium bearing waste. By the end of 2019, 342 mł of waste had been processed in the HRA/Solarium facility.

A simplified representation of the organization of radioactive waste management in Belgium is sketched in Fig. 3.

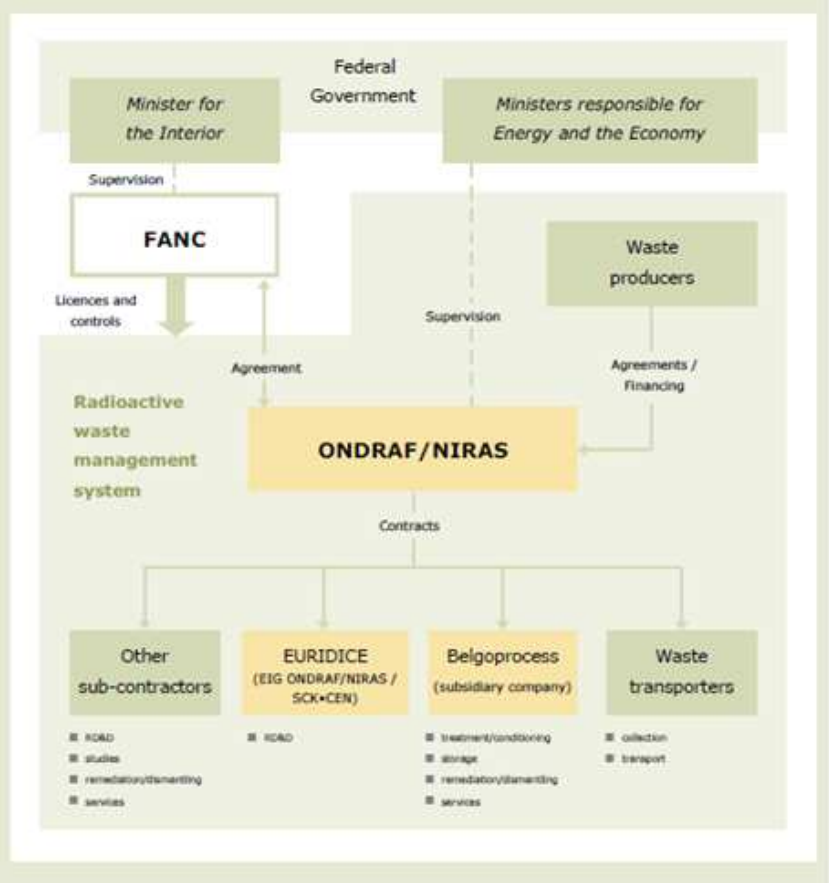

FIG. 3. Organization of radioactive waste management (*source: ONDRAF/NIRAS).*

Storage of Low Level Waste

Building 150 was commissioned in 1986 after Belgium joined the international moratorium on sea disposal of conditioned low level waste. Capable of holding 1 929 mł, it has been filled to near capacity since the end of the 1980s. At the end of 2019, it contained 1 922 mł of conditioned waste, or 3 330 packages.

Building 151 was commissioned in 1988. This is a modular building, initially featuring two storage halls. Two more halls were added in 1993, increasing the total capacity from 6 300 mł to 14 700 mł. In 2019 a permit was issued for extra storage of conditioned waste. This resulted in an increase of capacity to a total capacity of 15 300mł. The drums are stored by means of a remotely controlled roller bridge. By the end of 2019, Building 151 housed 14 681 mł of conditioned waste (36 228 packages).

Storage of Medium Level Waste

Building 127 was commissioned in 1978. This building has undergone two phases of extension and adaptation, the last of which was in 1988. Since then, its total capacity has been 4 650 mł, split between four bunkers of the same size with reinforced concrete walls 80 cm thick. The drums are stored by means of a remotely controlled roller bridge. At the end of 2019, 3 897 mł of conditioned waste (15 954 packages) was housed in Building 127.

Building 155 is a storage facility specially designed to store low level radium and plutonium bearing waste following processing and conditioning. Commissioned in 2005, it consists of two separate storage rooms: one for housing radium bearing waste and the other for plutonium bearing waste. Although it would be possible to extend its storage rooms, its capacity should be adequate for all the drums of radium and plutonium bearing waste currently in existence and for those whose production is forecast. At the end of 2019, Building 155 housed 3 956 mł of conditioned waste (9 214 packages).

Buildings 270M and 270L used to be buffer storage facilities on Site 2 of Belgoprocess. At the end of 2017 they were completely dismantled.

Storage of Medium Level and High Level Waste

Building 129 was commissioned in 1985. This building has a capacity of 250 mł, split between two shielded bunkers with reinforced concrete walls 1.2 m thick. The containers, which are handled remotely from a shielded control room, are placed in vertical steel shafts. The building contains 195 mł of conditioned high level waste from the vitrification in the PAMELA facility of liquid waste derived from the reprocessing of spent fuel in the former Eurochemic reprocessing plant. Since 1995, it has also housed medium level and high level cemented waste from SCK CEN's BR2 and BR3 reactors and from the operation and partial decommissioning of PAMELA. Ever since, Building 129 has contained 215 mł of conditioned waste (2 335 packages). Although heat emitted by waste stored in Building 129 is quite low, the storage shafts are ventilated to accelerate the dissipation of whatever heat is being generated.

Building 136 was constructed between 1990 and 1994 and is capable of accommodating 590 containers of high level vitrified waste and about 1 000 mł of medium level cemented or compacted waste (additional modules may, if necessary, increase its capacity). The high level waste containers, which are handled remotely from a shielded control room, are placed in vertical steel shafts equipped with a constant ventilation system designed to dissipate the generated heat. This building is designed to resist extreme external

disturbances such as earthquakes, explosions, or the crash of a military aircraft. It was built for the storage of medium level and high level waste resulting from the reprocessing (by AREVA) of spent fuel from Belgium's NPPs. Medium level waste arising from the reprocessing (in Dounreay, United Kingdom) of spent fuel of the SCK CEN research reactor BR2 is also stored in Building 136. The project of returning the cemented waste from Dounreay (21 shipments) was successfully completed at the end of 2015.

At the end of 2019, 390 containers (70.20 mł) of high level vitrified waste, 468 containers (83.16 mł) of compacted medium level waste (hulls and end fittings) — repatriated from France — as well as 123 drums (68.90 mł) of waste from Dounreay were stored inside this building.

Disposal of Category A Waste

In 2012, ONDRAF/NIRAS filed a request to obtain a license for a near surface disposal facility for low level and intermediate level short lived waste ("Category A") at the municipality of Dessel with the nuclear safety authority FANC/AFCN in accordance with the conditions laid down in the decision of the federal Government of 23 June 2006.

The disposal project is integrated into a broader project that offers added value for the region, taking into account the concerns and aspirations of the local community. To this end two local partnerships — STORA in Dessel and MONA in Mol — have participated in all further steps in the decision making process and in the development of all aspects of the integrated disposal project.

The licensing process was continued in 2020. Once the license is granted, the repository could be in operation after four years; disposal and closure operations would last about 100 years.

Long Term Management of Category B and C Waste

ONDRAF/NIRAS is legally obliged to prepare a plan for the long term management of the radioactive waste under its responsibility. According to the Law of 13 February 2006 (which transposes European Commission Directives 2001/42/EC and 2003/35/EC into Belgian legislation), this plan has to be accompanied by an SEA and submitted for public consultation.

R&D activities related to geological disposal are carried out in an extensive international and bilateral framework. ONDRAF/NIRAS is active in a number of international nuclear organizations, including the IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA). In particular, ONDRAF/NIRAS is heavily involved in the European Technology Platform Implementing Geological Disposal (IGD-TP).

EIG EURIDICE, which stands for Economic Interest Grouping European Underground Research Infrastructure for Disposal of nuclear waste in a Clay Environment, is a joint venture between ONDRAF/NIRAS and SCK CEN. EURIDICE manages and operates the underground research laboratory known as High Activity Disposal Experimental Site (HADES), where experts develop and test industrial technologies for building, operating and sealing a waste repository in deep clay.

Although an extensive R&D programme assessing the use of clay formations as potential host rock for the disposal of low activity or medium activity long lived waste ("Category B") and high activity short lived or long lived waste ("Category C") started in 1974, no national policy decision relating to the long term management of those waste categories has been taken yet. In this context, ONDRAF/NIRAS has taken the initiative to compile in an integrated document, the Waste Plan for the Long Term Management of High Level and/or Long Lived Radioactive Waste, all elements necessary to enable the Government to take, with full knowledge of the facts, a decision in principle regarding the long term management of Category B and C waste. The waste plan is accompanied by an SEA in which alternative long term management options to disposal in clay have been assessed. The assessment not only covers environmental impacts but also the scientific and technical bases of the various options, the economic aspects and attendant ethical and social considerations.

The final waste plan, including the results of the public consultation and the accompanying documents, was adopted by the Board of Directors of ONDRAF/NIRAS on 23 September 2011.

Moreover, ONDRAF/NIRAS committed itself to the following:

Ensuring the reversibility of the disposal facility's operations and examining such measures as are likely to facilitate the potential recuperation of the waste after complete or partial closure of the disposal unit;

- Maintaining control functions over the proper operations of the disposal system that will be additional to the regulatory control;
- Preparing as efficiently and effectively as possible the transfer to future generations of the knowledge linked to the disposal facility and the waste contained in it.

ONDRAF/NIRAS also recommended creating an independent monitoring body to ascertain that the decision making procedure progresses as scheduled.

The proposal, which, together with the accompanying environmental impact report, is currently under discussion, is undergoing a legal procedure which requires the advice of several official bodies in addition to public consultation. The public consultation was organised from 15 April to 13 June 2020.

The waste plan will form the basis for establishing the national policy and the national programme on the long term management of Category B and C waste, as requested by the Law of 3 June 2014 transposing the Council Directive 2011/70/EURATOM.

Whatever the option for the long term management of Category B and C waste, the implementation of the technical solution chosen is bound to be a long, step by step, open and participative process that will probably take several decades before the selected solution becomes operational.

From a scientific and technical perspective, the construction of a geological repository facility would take 10 to 15 years after the granting of a licence. In all likelihood, it will take up to a century from the start of construction of the repository to its complete closure.

SCK CEN launched an R&D programme on partitioning and transmutation of high level waste through the accelerator driven system route in a European framework. The purpose is to analyse the feasibility from technical, economical and industrial points of view of such a technology within a European Union strategy.

2.8. RESEARCH AND DEVELOPMENT

Policy related to the nuclear sector, the nuclear fuel cycle and nuclear R&D in both nuclear fusion and fission is the exclusive responsibility of Belgium's federal Government. Nuclear research and development in Belgium is coordinated by the FPS Economy, SMEs, Self-Employed and Energy.

Although it has decided to phase out the production of electricity by nuclear fission energy, the Government of Belgium acknowledges the importance of continuing to invest in nuclear research to support the safe operation of NPPs in Belgium and in Europe, the development of sustainable solutions for the management of radioactive waste, the future decommissioning and dismantling of NPPs and nuclear medical applications. Belgium intends to remain a major player in key areas such as nuclear medicine and radioisotope production, research into new materials, particle accelerators, and the challenging but promising domain of the transmutation of high level waste.

Federal Government funding for nuclear fission and fusion research has more than doubled since the global economic crisis of 2008. Nearly a third of funding goes to SCK CEN to finance research in areas such as nuclear safety and new materials, and a fifth of funding is spent on nuclear waste management (ONDRAF/NIRAS), advanced nuclear technologies (SCK CEN) and the new research infrastructure project MYRRHA, developed by SCK CEN. Finally, nearly 6 million euros are destined for nuclear fusion.

Belgium will also continue to work on the development of nuclear fusion energy in collaboration with the European Atomic Energy Community (EURATOM) and the other Member States in the implementation of the European action plan Fusion Electricity, A Roadmap to the Realization of Fusion Energy.

In 2018, in the field of medical radioisotopes, Belgium's federal Government committed 52 million EUR to fund the IRE project Source of MedicAl RadioisoTopes (SMART). This project aims to develop an alternative technology to produce Molybdenum-99, using an electron beam accelerator. By excluding the use of fissile uranium, this innovative system could reduce radioactive waste by a factor of 100 and considerably shorten its lifetime, while contributing to the worldwide security of supply of radioisotopes.

2.8.1. R&D organizations

Most of the nuclear research in Belgium is carried out at SCK CEN, which also provides training and other services to the nuclear industry, the medical sector and the authorities, and promotes public awareness of nuclear technology. The nuclear research by SCK CEN is mainly aimed at reactor safety experiments, innovative fuel cycles and partitioning and transmutation, advanced nuclear systems, radioactive waste disposal, decommissioning, radiation protection, and health physics and medical and space applications. Research on the safety of nuclear power plants is performed in collaboration with FANC/AFCN and industrial partners such as Electrabel and Tractebel.

R&D for the support of both nuclear and non-nuclear power plant operations is carried out by Engie Laborelec, a technical competence centre in electrical power and energy technology.

The research areas for SCK CEN are authorized by royal decree. The first priority is to maintain the safety of the NPPs. This involves research on the ageing of their main components and the safety aspects of fuel development. The research is carried out in cooperation with Tractebel and the international research community. The second priority is to find an appropriate solution for the long term management of long lived medium and high level radioactive waste.

2.8.2. Development of advanced nuclear technologies

In 2018, the Government of Belgium decided to build a new major piece of research infrastructure called MYRRHA. One of the MYRRHA project's long term objectives is to investigate transmutation of high level radioactive waste. Transmutation aims to reduce its long term radiotoxicity by a factor of 1000 and to shorten its radiotoxicity timeframe from 300 000 to 300 years, which is a timeframe that can be technologically controlled and offers a real benefit in terms of both safety and economic cost. Belgium's federal Government committed in September 2018 to finance the project for an amount of EUR 558 million, which includes investment for construction of a 100 MeV accelerator (2019–2026) and R&D investment to prepare phase 2 (600 MeV accelerator) and phase 3 (subcritical reactor). An international non-profit organization has been set up to invite international partners into this project.

MYRRHA has been identified within the European Strategy Forum on Research Infrastructures (ESFRI) road map and within the European Sustainable Nuclear Industrial Initiative (ESNII) of the Sustainable Nuclear Energy Technology Platform (SNETP) in support of the SET-Plan. MYRRHA will be a subcritical assembly driven by a high power proton accelerator that generates the primary neutrons by means of spallation reactions in the centre of the core to trigger fission reactions in the subcritical core. As well as being able to produce radioisotopes and doped silicon, MYRRHA's research functions would be particularly well suited to investigate transmutation and to demonstrate the efficient operation of the concept of an accelerator driven system at a pre-industrial scale.

2.8.3. International cooperation and initiatives

Belgium is active in a number of international nuclear organizations, including the IAEA and the OECD/NEA, as well as other bilateral and multilateral organizations such as the World Association of Nuclear Operators (WANO).

SCK CEN is coordinator of the Belgian Support Programme to the IAEA for safeguards. It also executes most tasks of the Support Programme. Among these tasks, the most important contributions relate to the development of safeguards approaches for geological repositories and the accelerator driven system MYRRHA. Moreover, SCK CEN makes available its facilities and experts for calibration of IAEA equipment and courses to IAEA safeguards inspectors, helping the IAEA to better perform the safeguards inspections in the framework of the Non-Proliferation Treaty and Additional Protocol.

SCK CEN is a major player in European projects and collaborates in research on the peaceful use of nuclear applications with most 'nuclear' countries/institutes throughout the world.

Belgium participates in the International Energy Agency Technology Collaboration Programmes focusing on fusion indirectly through EURATOM.

As a member state of the EU's Joint Undertaking for ITER and the Development of Fusion Energy and a voluntary contributor to the 'Broader Approach' between the European Union and Japan, Belgium contributes to the development of fusion energy which aims to start producing CO_2-free electricity in 2050, mainly through the Belgian Fusion Association.

2.9. HUMAN RESOURCES DEVELOPMENT

Academic Learning

Belgium pioneered academic learning in the nuclear field through the creation of the Belgian Nuclear Higher Education Network (BNEN) in 2002. BNEN is a 'master-after-master' academic programme in nuclear engineering, organized through a consortium of six Belgian universities and SCK CEN. The lectures are taught in English at the premises of SCK CEN. The modular approach also facilitates the participation of foreign students. The laboratory exercises make use of the nuclear facilities of SCK CEN and are organized by SCK CEN scientists. It served as a role model for the foundation of the European Nuclear Education Network (ENEN).

The SCK CEN Academy for Nuclear Science and Technology was founded in 2012. It contributes to academic learning through collaboration with all Belgian universities and several universities abroad and also contributes to numerous international courses. Among them are the European Master in Radiation Biology, the European Master in Radiation Protection, and several Erasmus exchange programmes.

Technical Training

In addition to academic learning, the SCK CEN Academy also provides customized training courses aimed at improving the knowledge, skills and attitudes of nuclear workers from industry, the medical sector, research organizations and governmental institutions dealing with applications of radioactivity.

Furthermore, SCK CEN Academy organizes scientific events such as conferences and workshops dealing with education and training, like the Education and Training in Radiation Protection (ETRAP) conference series, the workshops of the Platform on European Training and Education in Radiation Protection (EUTERP) and the SCK CEN Topical Days.

2.10. STAKEHOLDER COMMUNICATION

Belgium's nuclear industry created a federation under the name NUCLEAIR FORUM. This federation has the mission to contribute to a high quality discussion on the future of the nuclear industry. Its main goal is to provide factual and practical information on the nuclear industry and its many applications as well as to bring answers to the legitimate questions that are being asked.

Belgoprocess organizes visits to its processing, conditioning and interim storage facilities for the press, professional visitors and occasionally the public. It also publishes an annual report and information leaflets on its activities.

SCK CEN shares its expertise in an active way as an accessible and reliable source of (scientific) information for (local) authorities, the industry, the media and the general public. SCK CEN offers information about its activities and the results of its research through a variety of publications and dedicated web sites for the general public, scientists and students. Every year, SCK CEN welcomes hundreds of visitors (both professionals and members of the general public) in its laboratories.

SCK CEN also analyses the social aspects of nuclear technology, in particular public participation in the decision making process. Every two to three years, SCK CEN conducts opinion polls representative of the adult population living in Belgium, analysing the evolution of its perceptions and knowledge in the field of nuclear technology.

EURIDICE has its own recently renovated communication space within the demonstration hall and organizes visits to both the demonstration hall and the underground laboratory.

In keeping with their mission to serve public welfare, the IRE and its subsidiary IRE-ELiT (Environment and Life science Technology), maintain an open and transparent dialogue with the various parties concerned: authorities, residents in the area, professionals, the general public, partners and clients. Conscious of its social and civic responsibility, the IRE mobilizes the resources necessary to maintain a special relationship with the neighbouring population. The Institute prioritizes communications with residents in the area, neighbouring companies and the municipal administrative departments concerned. Various initiatives illustrate this commitment, such as the organization of open-door days and information sessions, periodic circulation of the newsletter Live from the IRE to residents and the creation of a new web site (www.ire.eu).

ONDRAF/NIRAS operates a radioactive waste information centre, called Isotopolis, on the Belgoprocess site in Dessel. This centre, recently renovated, is open to the public but intended primarily for secondary school students.

STORA is a not-for-profit association composed of organizations and residents of the municipality of Dessel, which monitors all nuclear affairs in the municipality. One of STORA's major objectives is to involve the population of Dessel in all nuclear matters. Several nuclear companies have their head offices in Dessel, and Belgium's radioactive waste is processed and stored on the site of Belgoprocess.

MONA (Mol Consultation on Nuclear Waste or in Dutch: Mols Overleg Nucleair Afval) is a not-for-profit association founded in 2000 to monitor the development of the planned storage facility for low and intermediate level short lived waste (cAt-project). MONA ensures the continued involvement of the population of Mol in the technical development of this disposal project and ensures that the

conditions imposed by MoI are respected.

2.11. EMERGENCY PREPAREDNESS

Emergency preparedness and planning are competencies under the Minister of Home Affairs and his/her administrative services. Off-site operations are directed by the Governmental Centre for Coordination and Emergencies (CGCCR). The implementation of the actions decided at the federal level and the management of the intervention teams are conducted by the Governor of the province concerned. In addition to the duties defined in the Royal Decree of 17 October 2003, FANC/AFCN is one of the main actors within the emergency plan. Its role is defined in articles 15, 21 and 22 of the Law of 15 April 1994, creating the FANC/AFCN, and in articles 70, 71 and 72 of the GRR-2001 (General Regulations regarding the protection of the public, the workers and the environment against the hazards of ionizing radiation, EURATOM Treaty, Article 37). These articles stipulate that the FANC/AFCN is responsible for surveying, controlling and monitoring the radioactivity in the territory and delivering technical assistance to set up the emergency plan. It is also in charge of participating in and/or organizing operational cells (i.e. evaluation cell and measurements cell).

3. NATIONAL LAWS AND REGULATIONS

3.1. REGULATORY FRAMEWORK

3.1.1. Regulatory authority

The Federal Agency for Nuclear Control (FANC/AFCN)

The regulatory authority in the field of radiation protection, nuclear safety and radiological surveillance is the FANC/AFCN, a public body with legal personality which is supervised by the Minister for the Interior. It was established by the Law of 15 April 1994 but only became fully operational on 1 September 2001. The FANC/AFCN has been given its missions and enforcement powers directly by Parliament, guaranteeing its constitutional independence with respect to the Government within its legal competences. It can organize its internal decision making and can recruit its staff with sufficient autonomy from the political level and can defend its position before court against other interested parties when needed. The FANC/AFCN may propose laws and decrees to the Government and it has to implement laws and decrees to review licence applications, to propose licences or to grant licences, as applicable, to ensure compliance with the regulatory provisions and the licence conditions.

In 2008, Bel V was created as a subsidiary of the FANC/AFCN following a Parliamentary resolution. A management contract between the FANC/AFCN and Bel V delegates a number of tasks to Bel V, such as the control of nuclear facilities and the review and assessment activities for these facilities.

Bel V is a founding member of the European Technical Safety Organizations Network (ETSON). The FANC/AFCN is a founding member of the West European Nuclear Regulators Association (WENRA). Together with Bel V, it participates actively in the Reactor Harmonization Working Group (RHWG) and in the Working Group on Waste and Decommissioning (WGWD) and, in particular, in the working group developing reference levels for waste disposal facilities.

3.1.2. Licensing process

Licensing takes place under the authority of the Minister for the Interior (Royal Decree of 7 August 1995), who oversees the FANC/AFCN. The 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 ionizing radiation. The agency is assisted in technical matters and advised by a scientific council of experts and representatives from various authorities responsible for nuclear safety. The council gives recommendations by absolute majority. Bel V, the subsidiary body of the FANC/AFCN, carries out official acceptance procedures for nuclear installations prior to commissioning and exercises supervision over nuclear installations during operation. Ultimately, final authorization for nuclear plant commissioning rests with the King.

The main steps in Belgium’s licensing procedure for nuclear installations (referred to as Class I installations in the regulations) are described in the GRR-2001.

3.2. NATIONAL LAWS AND REGULATIONS IN NUCLEAR POWER

Main Laws in Nuclear Power

Nuclear law, establishing responsibilities for different areas

- Law of 8 August 1980 on the budgetary proposals for 1979–1980, Article 179 §2 and §3, establishing the National Agency for Radioactive Waste and Fissile Materials (ONDRAF/NIRAS) and entrusting ONDRAF/NIRAS with the safe transportation, treatment, conditioning, storage and disposal of all radioactive waste produced in the country. This law was modified by the Law of 11 January 1991, which also slightly changed the name of the agency to Belgian National Agency for Radioactive Waste and Enriched Fissile Materials; by the Law of 12 December 1997, extending the mission of ONDRAF/NIRAS to establish an inventory of all nuclear facilities and sites containing radioactive waste, and its financing; by the Programme Law of 30 December 2001, modifying Article 179 §2, on the National Agency for Radioactive Waste and Fissile Materials; by the Law of 29 December 2010, modifying inter alia the Law of 8 August 1980, giving ONDRAF/NIRAS additional legal tasks with respect to activities and measures in the domain of the social support for the integration of a disposal facility at the local level; and by the Law of 3 June 2014, completely transposing Council Directive 2011/70/EURATOM of 19 July 2011, establishing a community framework for the responsible and safe management of spent fuel and radioactive waste.
- Royal Decree of 30 March 1981 defining the missions and duties of ONDRAF/NIRAS, as amended by the Royal Decrees of 16

October 1991, 4 April 2003, 1 May 2006, 18 May 2006, 2 June 2006, 13 June 2007, 3 July 2012 and 25 April 2014, determining the tasks and functional modalities of the public body for the management of radioactive waste regarding the providing of resources for the medium and long term funds.

- Law of 31 January 2003 on the gradual phasing out of nuclear energy for the industrial production of electricity, as amended by the Law of 18 December 2013.
- Law of 11 April 2003 regulating the provisions for the decommissioning of Belgium's NPPs and for the management of spent fuel from these NPPs and establishing the Commission for Nuclear Provisions.

Civil nuclear liability

- Law of 22 July 1985 on nuclear liability, which integrates the Paris Convention and the follow-up Convention of Brussels and their additional protocols, as modified by the Laws of 11 July 2000, 13 November 2011, 29 June 2014 and 7 December 2016. This law sets the maximum amount of the operator's civil liability for damages caused by a nuclear accident to about EUR 1200 million (per accident and per site).
- Royal Decree of 28 December 2011 laying down the maximum amount of the damage for which the operator or carrier may be held responsible in the case of transport within the meaning of Article 14 of the Law of 22 July 1985 on third party liability in the field of nuclear energy.
- Arręté royal du 10 décembre 2017 établissant un programme de garantie de la responsabilité civile dans le domaine de l'énergie nucléaire

  http://www.ejustice.just.fgov.be/cgi_loi/change_lg.pl?language=fr&la=F&cn=2017121003&table_name=loi

Establishing a regulatory body

- Law of 15 April 1994 on the protection of the public and the environment against the dangers of ionizing radiation and on the Belgian Federal Agency for Nuclear Control (FANC/AFCN), repealing and replacing the Law of 29 March 1958. This law constitutes the legal basis for the FANC/AFCN as regulatory body, its role being defined in articles 15, 21 and 22, and sets out the basic elements for protecting the workers, the public and the environment against the adverse effects of ionizing radiation, as amended by the Law of 22 December 2008, allowing the FANC/AFCN to create Bel V in order to perform regulatory missions that can be legally delegated by the FANC/AFCN, without having to use a public tender procedure.

Implementing IAEA safeguards

- Law of 26 November 1996 approving the Convention on Nuclear Safety of 20 September 1994.
- Law of 5 June 1998 approving the Convention on Early Notification of a Nuclear Accident of 26 September 1986.
- Law of 5 June 1998 approving the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency of 26 September 1986.
- Law of 2 August 2002 approving the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management of 5 September 1997.

Rules for environmental protection

- Law of 13 February 2006 on the assessment of the environmental consequences of certain plans and programmes and the public participation in the preparation of plans and programmes in connection with the environment and transposing European Commission Directives 2001/42/EC and 2003/35/EC into Belgian legislation, requiring that the plans for the long term management of radioactive waste drawn up by ONDRAF/NIRAS must be accompanied by an SEA and submitted for public consultation.
- Law of 5 August 2006 on public access to environmental information.

Import and export controls of nuclear material and items

- Law of 1 June 2005 on the implementation of the Additional Protocol of 22 September 1998 to the International Agreement of 5 April 1973 on implementation of Article III, Paragraphs 1 and 4 of the Treaty of 1 July 1968 on the NonProliferation of Nuclear Weapons.
- Law of 13 November 2002 approving the Additional Protocol to the Agreement on implementation of Article III, Paragraphs 1 and 4 of the Treaty on the Non-Proliferation of Nuclear Weapons and Annexes I, II and III of 22 September 1998.
- Royal Decree of 24 March 2009 on the import, transit and export of radioactive materials, transposing directive 2006/117 /EURATOM (replacing directive 1992/3/EURATOM) on the supervision and control of shipments of radioactive substances between Member States and suppressing chapter IV of GRR-2001.

Security principles, including physical protection of nuclear material and facilities and protection of sensitive information

- Law of 11 December 1998 on classification and security clearances, certificates and advice.
- Law of 15 July 2008 approving the Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM) of 8 July 2005.
- Law of 10 September 2009 approving the International Convention for the Suppression of Acts of Nuclear Terrorism of 14

September 2005.

- Law of 1 July 2011 relating to the security and protection of critical infrastructures, partially transposing Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection.

Roles of national government, local government, and stakeholders

- Special Law of 8 August 1980 on institutional reform, awarding federal and regional authorities joint responsibility for energy policy.
- Law of 29 April 1999 on the organization of the electricity market (amended by the Law of 8 January 2012).
- Law of 1 June 2005 fully implementing European Union Directive 2003/54/EC on the common rules for the internal electricity market.

Main Regulations in Nuclear Power

Provisions for authorization system, responsibilities of the operator, inspection and enforcement, radiation protection of workers, public and environment

- Law of 4 August 1996 on the welfare of workers in the performance of their work.
- Royal Decree of 20 July 2001 (amended) laying down the General Regulations regarding the protection of the public, the workers and the environment against the hazards of ionizing radiation (GRR-2001, as amended) provides for the general principles set out in the Law of 15 April 1994, replacing the Royal Decree of 28 February 1963 (GRR-1963). The GRR-2001 scope is very wide and covers practically all human activities and situations which involve a risk due to the exposure to ionizing radiation.

  The GRR-2001 includes provisions for establishing an authorization system, responsibilities of the operator, inspection and enforcement, and site selection and approval within the licensing system.

  Article 3 of the Royal Decree defines the classification of nuclear installations (Class I to IV).
- Law of 5 August 2006 on access to environmental information by the general public, which also applies to the nuclear sector.
- Law of 15 May 2007 defining the notion of civil safety and describing the roles and missions of the different entities involved.

Safety of nuclear installations

- Royal decrees of 17 October 2011 on security, addressing categorization and protection of documents, physical protection of nuclear materials, nuclear installations and transport, categorization of nuclear materials and definition of security zones in nuclear installations and nuclear transport organizations, security clearances and certificates, and regulating access to security zones, nuclear material or documents in specific circumstances.
- Royal Decree of 30 November 2011 on the Safety Requirements for Nuclear Installations (SRNI-2011). This royal decree includes all reference levels developed by the Reactor Harmonization Group (RHWG) of the Western European Nuclear Regulators Association (WENRA). It also transposes the European Directive 2009/71/EURATOM into the Belgian regulations.

Radioactive waste and spent fuel management, including storage and disposal

- Royal Decree of 16 October 1991 defining the procedures for the Law of 11 January 1991 and the responsibilities of ONDRAF/NIRAS: the qualification of installations for treatment and conditioning of radioactive waste; the establishment of acceptance criteria for conditioned and unconditioned radioactive waste based on general rules to be approved by the safety authority.
- Ministerial letter of 10 February 1999 concerning general rules for the establishment of acceptance criteria by ONDRAF/NIRAS for conditioned and non-conditioned waste.
- Royal Decree of 18 November 2002 regarding the practical implementation of the qualification of installations for the storage, treatment and conditioning of radioactive waste and installations for the radiological characterization of radioactive waste.
- Royal Decree of 26 May 2006, transposing directive 2003/122/EURATOM on the control of sealed radioactive sources and, in particular, of ‘orphan sources’, amending accordingly the GRR-2001.
- Royal Decree of 14 October 2011 on orphan sources.

Decommissioning, including funding and institutional control

- Law of 24 December 2002 providing for the levy of an excise tax, called federal dues, which is calculated on the basis of kW?h consumed. These dues are paid to a fund earmarked to finance responsibilities resulting from the decommissioning of the sites of the former Eurochemic plant (Site 1 or BP1) and the former waste department of SCK CEN (Site 2 or BP2), as well as the treatment, processing, storage and evacuation of accumulated radioactive waste. The CREG collects the amount owed as dues and transfers it to ONDRAF/NIRAS, which is responsible for the management and clean-up.
- Law of 24 March 2003 creating the legal framework for a structural financing mechanism of the dismantling activities on the BP1 and BP2 sites until their completion by a levy on the transported kW?h. For each period of five years, ONDRAF/NIRAS has to present a financing plan to its supervising minister.

- Royal Decree of 24 March 2003 laying down the detailed rules on the federal contribution for the financing of certain public service obligations and the costs related to the regulation and control of the electricity market.
- Royal Decree of 4 April 2003 determining that ONDRAF/NIRAS's funds available in the medium and the long term must be invested in financial instruments issued by the federal Government. As a result, the board of ONDRAF/NIRAS has decided to invest the assets of the 'long term fund' into Belgian Governmental bonds which will be passively managed.
- Law of 11 April 2003 regarding liabilities and provisions for the decommissioning and dismantling of nuclear power plants and the management of the spent fuel from these nuclear power plants, amended by the Law of 25 April 2007. This law also determines the management of funds built up by Synatom for the decommissioning of the nuclear power plants.
- Royal Decree of 19 December 2003 to determine the amounts allocated to the financing of the nuclear liabilities BP1 and BP2 for the period 2004 to 2008, in implementation of Article 4, §2 of the Royal Decree of 24 March 2003.

Emergency preparedness

- Royal Decree of 17 October 2003, defining a nuclear and radiological emergency plan for the territory of Belgium as well as notification criteria from the operators to the Government. Emergency planning is a competency belonging to the Minister of Home Affairs and his/her administrative services.
- Royal Decree of 24 November 2003, setting the emergency planning zones relative to the direct actions to protect the population (evacuation, sheltering and iodine prophylaxis). These evacuation and sheltering zones vary from a 0 to 10 km radius depending on the nuclear plant concerned; the stable iodine tablet pre-distribution zones extend from 10 km up to 20 km around the nuclear plants.
- Royal Decree of 16 February 2006 organizing the planning and interventions during emergency situations.

Transport of radioactive material

- Law of 8 August 1980 on the budgetary proposals for 1979–1980, art. 179 §2 and §3 (as amended by the Acts of 11 January 1991 and 12 December 1997), establishing ONDRAF/NIRAS and entrusting ONDRAF/NIRAS with the safe transportation, treatment, conditioning, storage and disposal of all radioactive waste produced in the country.
- Royal Decrees of 17 October 2011 on security, addressing categorization and protection of documents, physical protection of nuclear materials, nuclear installations and transport, categorization of nuclear materials and definition of security zones in nuclear installations and nuclear transport organizations, security clearances and certificates, and regulating access to security zones, nuclear material or documents in specific circumstances.

BIBLIOGRAPHY

FPS ECONOMY, SMEs, SELF-EMPLOYED and ENERGY, Energy Key Data - aoűt 2020, https://economie.fgov.be/fr/publications/energy-key-data-aout-2020

INTERNATIONAL ATOMIC ENERGY AGENCY, Integrated Regulatory Review Service (IRRS) Mission to Belgium, IAEA, Vienna (2013), www.iaea.org/sites/default/files/documents/review-missions/irrs_belgium_mission_2013_report.pdf

MARIS, M., JAUMOTTE, A., GOVAERTS, P., Histoire du Nucléaire en Belgique, 1990–2005, P.I.E. Peter Lang, Brussels (2007).

NATIONAL PROGRAMME COMMITTEE, National Programme for the Management of Spent Fuel and Radioactive Waste First edition: October 2015, National Programme Committee, Brussels (2015), https://economie.fgov.be/sites/default/files/Files/Energy/National-programme-courtesy-translation.pdf

NUCLEAR ENERGY AGENCY OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, Nuclear Energy Data 2019, Country Reports: Belgium, OECD/NEA, Paris (2019) p. 47, https://read.oecd-ilibrary.org/nuclear-energy/nuclear-energy-data-2019_1786b86b-en-fr#page49

NUCLEAR ENERGY AGENCY OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, Nuclear Legislation in OECD and NEA Countries: Regulatory and Institutional Framework for Nuclear Activities: Belgium, OECD/NEA, Paris (2010), www.oecd-nea.org/law/legislation/belgium.pdf

NUCLEAR ENERGY AGENCY OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, Radioactive Waste Management Programmes in OECD/NEA Member Countries: Belgium 2013, OECD/NEA, Paris (2013), www.oecd-nea.org/rwm/profiles/Belgium_profile_web_2013.pdf

NUCLEAR ENERGY AGENCY OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, INTERNATIONAL ATOMIC ENERGY AGENCY, Uranium 2011: Resources, Production and Demand, OECD/NEA, Paris (2012), www.oecd-nea.org/ndd/pubs/2012/7059-uranium-2011.pdf

APPENDIX 1. INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

AGREEMENTS WITH THE IAEA

Statute of the International Atomic Energy Agency	Entry into force:	29 July 1957

Agreement on Privileges and Immunities	Entry into force:	26 October 1965
NPT related safeguards agreement INFCIRC No. 193	Entry into force:	21 February 1977
Additional protocol to the NPT safeguards agreement	Signature:	22 September 1998
Improved procedures for designation of safeguards inspectors	Rejected by EURATOM, but agreed to alternative solution	16 February 1989

OTHER RELEVANT INTERNATIONAL TREATIES

Treaty on the Non-Proliferation of Nuclear Weapons (NPT)	Entry into force:	2 May 1975
EURATOM	Member	
Convention on the Physical Protection of Nuclear Material	Entry into force: Ratification:	6 October 1991 6 September 1991
Amendment to the Convention on the Physical Protection of Nuclear Material	Ratification:	22 January 2013
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 Nuclear Third Party Liability	Ratification:	3 August 1966
Joint Protocol Relating to the Application of the Vienna and the Paris Conventions	Signature:	21 September 1988
Brussels Convention on Supplementary Compensation	Ratification:	20 August 1985
Convention on Nuclear Safety	Entry into force: Ratification:	13 April 1997 13 January 1997
Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	Entry into force: Ratification:	4 December 2002 5 September 2002
International Convention for the Suppression of Acts of Nuclear Terrorism	Entry into force: Ratification:	7 July 2007 2 October 2009
Zangger Committee	Member	
Nuclear export guidelines	Adopted	
Nuclear Suppliers Group	Member	

BILATERAL AGREEMENTS

Belgium has nuclear bilateral agreements which are currently in force with China (1985), France (1966, 1981, 1984, 2014), India (1965), Republic of Korea (1981), Lithuania (1978, 1998), Luxembourg (1970, 2002, 2004, 2018), the Netherlands (1984, 1990), Romania (1974), the Russian Federation (1993), and the United States of America (1962, 1983).

The BELGO-LUXEMBOURG ECONOMIC UNION (BLEU) concluded bilateral agreements with China (1979) and Poland (1973).

APPENDIX 2. MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

GOVERNMENT	
Federal Public Service Economy, SMEs, Self-Employed and Energy Directorate-General for Energy Nuclear Applications Boulevard du Roi Albert II, 16 1000 Brussels	tel.: +32 (2) 277 89 81 or +32 2 277 61 85 email: nuclear@economie.fgov.be web site: http://economie.fgov.be
Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation Rue des Petits Carmes, 15 1000 Brussels	tel.: +32 (2) 501 81 11 contact: http://diplomatie.belgium.be/en/Contact/ web site: http://diplomatie.belgium.be/en/
Federal Public Service Interior Rue de Louvain, 1 1000 Brussels	tel.: +32 (2) 500 21 11 email: info@ibz.fgov.be web site: www.ibz.be
NUCLEAR SAFETY AUTHORITY	
Federal Agency for Nuclear Control FANC/AFCN Rue Ravenstein, 36 1000 Brussels	tel.: +32 (2) 289 21 11 email: info@fanc.fgov.be web site: https://fanc.be/nl (Dutch) or https://afcn.be/fr (French)
WASTE MANAGEMENT ORGANIZATION	
ONDRAF/NIRAS Avenue des Arts, 14 1210 Brussels	tel.: +32 (2) 212 10 11 email: info@nirond.be web site: www.niras.be/ (Dutch) or www.ondraf.be (French)
COMMUNICATION	

Isotopolis Gravenstraat, 73 2480 Dessel	tel.: +32 (14) 33 40 31 email: isotopolis@belgoprocess.be web site: www.isotopolis.be
R&D	
EIG EURIDICE Boerentang, 200 2400 Mol	tel.: +32 (14) 33 27 84 email: euridice@sckcen.be web site: www.euridice.be/
SCK CEN (Belgian Nuclear Research Centre) (Registered Office Brussels) Avenue Herrmann-Debrouxlaan 40 1160 Brussels (Research Centre Mol) Boeretang, 200 2400 Mol	tel.: +32 (2) 661 19 51 email: info@sckcen.be web site: www.sckcen.be tel.: +32 (14) 33 21 11
OTHER BELGIAN NUCLEAR ORGANIZATIONS	
Belgian Association for Radioprotection Avenue Herrmann Debroux, 40 1160 Brussels	tel.: +32 (2) 289 21 27 email: office@bvsabr.be web site: www.bvsabr.be
Belgian Nuclear Society c/o SCK CEN Avenue Herrmann Debroux, 40 1160 Brussels	email: secretary@bnsorg.be web site: www.bnsorg.be
Fund for Scientific Research Fonds National de la Recherche Scientifique (FNRS) Fonds Wetenschappelijk Onderzoek (FWO) Rue d'Egmont 5 1000 Brussels	tel.: +32 (2) 504 92 11 contact: www.frs-fnrs.be/en/le-fnrs/contacts web site: www.fnrs.be/en/
Inter-University Institute for Nuclear Science Institut Interuniversitaire des Sciences Nucléaires (IISN) Interuniversitair Instituut voor Kernwetenschappen (IIKW) Rue d'Egmont 5 1000 Brussels	tel.: +32 (2) 512 91 10
NUCLEAIR FORUM Avenue des Arts 56 1000 Brussels	tel.: +32 (2) 761 94 50 web site: www.nucleairforum.be
BELGIAN NUCLEAR INDUSTRY RELATED ORGANIZATIONS	
AGORIA Diamant Building Bd. A. Reyers, 80 1030 Brussels	tel.: +32 (2) 706 78 00 web site: www.agoria.be
BELGIAN NUCLEAR INDUSTRY SECTOR	
Belgian companies provide products and services for a wide range of applications in the nuclear industry. Use the app Nuc Tec Bel to find an overview of the Belgian nuclear technology and service providers.	
AREVA See FBFC International	
Association Vinçotte Nuclear (AVN) Chaussée de Waterloo 1151 1180 Brussels	tel.: +32 (2) 528 01 11 email: services@avn.be web site: www.avn.be
Bel V Rue Walcourtstraat, 148 1070 Brussels	tel.: +32 (2) 528 02 11 email: info@belv.be web site: www.belv.be
Belgoprocess S.A. Gravenstraat, 73 2480 Dessel	tel.: +32 (14) 33 41 11 email: info@belgoprocess.be web site: www.belgoprocess.be
Luminus Koning Albert II-laan 7 Avenue Roi Albert II 1210 Brussels	tel.: +32 (2) 229 19 50 email: communication@luminus.be web site: www.luminus.be
Electrabel Boulevard Simón Bolívar, 34 1000 Brussels	tel.: +32 (2) 518 61 11 web site: www.engie-electrabel.be
FBFC International, S.A. (AREVA) (in decommissioning) Europalaan, 12 2480 Dessel	tel.: +32 (14) 33 12 11 email: info@fbfc.be web site: http://areva.com
IRE ELiT (environment and life science technology) Avenue de l'Espérance, 1 6220 Fleurus	tel.: +32 (71) 82 95 56 email: info@ire.eu web site: www.ire.eu
Laborelec (ENGIE Lab) Rue de Rhode, 125 1630 Linkebeek	tel.: +32 (2) 382 02 11 email: nuclear.laborelec@engie.com web site: www.laborelec.com

Synatom S.A. (nuclear fuel procurement) Boulevard Simón Bolívar, 34 1000 Brussels	tel.: +32 (2) 505 07 11 web site: www.synatom.be email: info@synatom.com
Tecnubel S.A. (decontamination) Zandbergen 1 2480 Dessel	tel.: +32 (14) 34 69 11 email: info@tecnubel.be web site: www.tecnubel.be
Tractebel (architectural engineer and contractor) Boulevard Simon Bolivar 34 1000 Brussels	tel.: +32 (2) 773 99 11 contact: www.tractebel-engie.com/en/contact web site: www.tractebel-engie.com
Transnubel S.A. (fuel transportation) Zandbergen, 1 2480 Dessel	tel.: +32 (14) 33 11 11 email: info@transnubel.be web site: www.transnubel.be
Transrad S.A. Zoning Industriel site IRE Avenue de l'Espérance, 1 6220 Fleurus	tel.: +32 (71) 82 97 59 email: info@transrad.be web site: www.transrad.be
Westinghouse Electric Europe, sprl Rue de l'Industrie, 43 1400 Nivelles	tel.: +32 (67) 28 81 11 web site: www.westinghousenuclear.com
BELGIAN NUCLEAR RELATED COMPANIES	
Belgian companies provide products and services for a wide range of applications in the nuclear industry. Use the app Nuc Tec Bel to find an overview of the Belgian nuclear technology and service providers.	
VINÇOTTE SA Business Unit Controlatom Jan Olieslagerslaan 35 1800 Vilvoorde	tel.: +32 (2) 674 51 20 email: controlatom@vincotte.be web site: www.vincotte.be/en/radiation-protection-controlatom
Ateliers de la Meuse (mechanical equipment) Rue Ernest Solvay, 107 4000 Sclessin (Ličge)	tel.: +32 (4) 252 00 30 web site: www.alm.be/english
ENGIE Fabricom (electrical and mechanical contractor) Rue Gatti de Gamond, 254 1180 Brussels	tel.: +32 (2) 370 31 11 web site: www.engie-fabricom.be
Ion Beam Applications (IBA) Groupe Chemin du Cyclotron, 3 1348 Louvain-La-Neuve	tel.: +32 (10) 47 58 11 web site: www.iba.be

COORDINATOR INFORMATION

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