

Kingdom of Belgium

**National report on the implementation of Council Directive
2011/70/Euratom establishing a Community framework
for the responsible and safe management of spent fuel and
radioactive waste**

This report meets the requirement of Article 14.1 of 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. Pursuant to Article 8 of the Law of 3 June 2014 transposing the directive, it has been written under the coordination of the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS), with input from the Federal Agency for Nuclear Control (FANC), the Directorate General for Energy of the Federal Public Service Economy, SMEs, Self-Employed and Energy, Belgian Nuclear Research Center (SCK•CEN), the Commission for Nuclear Provisions, Synatom SA and Electrabel SA . It has been notified to the European Commission by the Ministers in charge of Energy and Economy.

This report, which describes the state of affairs at 31 May 2018, is available on www.ondraf.be, www.niras.be and www.cpnpc.be (website of the National Programme Committee).

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A. Introduction

Belgium, as a country with a nuclear tradition, had and still has an extensive range of activities using radioactivity across its territory, including activities relating to the nuclear fuel cycle, to research, and to medical and industrial applications of radioactivity (Table 1). These activities generate spent nuclear fuel and radioactive waste, with highly diverse characteristics, which must be managed safely. Other activities — the historical radium and uranium production and activities of industries using naturally occurring radioactive materials (NORM) — are the source of radium-bearing and NORM substances, part of which — that is currently being assessed — will have to be managed as radioactive waste in the future.

Table 1 – Principal activities generating spent fuel and radioactive waste and main associated facilities or main types of associated waste (situation at 31 December 2017).

Principal activities	Main facilities or types of radioactive waste
Activities related to the nuclear fuel cycle	
<i>Fuel reprocessing</i>	
Eurochemic (1966–1974, Dessel, end of dismantling)	Pilot reprocessing plant (built as part of an OECD project)
<i>Fuel fabrication</i>	
FBFC International (1973–2015, Dessel, end of dismantling)	Fabrication facilities for UO ₂ fuel assemblies from enriched UO ₂ and fuel assembly facilities for MOX from rods of MOX fuel
Belgonucleaire (1973–2006, Dessel, end of dismantling)	Fabrication facilities for rods of MOX fuel from UO ₂ and PuO ₂
<i>Electricity production</i>	
Electrabel (Doel and Tihange) (Synatom owns the fuel)	7 PWR reactors (net installed capacity, industrial commissioning date and deactivation date stipulated by the Law of 31 January 2003 (as amended) to phase out nuclear energy) [Belgian Official Journal 2003a] Doel 1 (433 MWe): 15 February 1975 – 15 February 2025 Doel 2 (433 MWe): 1 December 1975 – 1 December 2025 Doel 3 (1006 MWe): 1 October 1982 – 1 October 2022 Doel 4 (1039 MWe): 1 July 1985 – 1 July 2025 Tihange 1 (962 MWe): 1 October 1975 – 1 October 2025 Tihange 2 (1008 MWe): 1 February 1983 – 1 February 2023 Tihange 3 (1046 MWe): 1 September 1985 – 1 September 2025 Treatment, conditioning and storage facilities, including storage facilities for spent fuel
Research	
Belgian Nuclear Research Centre (SCK•CEN, Mol)	6 reactors: BR1, BR2 and VENUS-F (operational), BR02 (dismantled), BR3 (being dismantled) and VENUS (changed into VENUS-F for GUINEVERE), laboratories
Joint Research Centre Geel of the European Commission	1 linear accelerator, laboratories
Belgian universities and university hospitals	Thétis reactor (Ghent University, decommissioned), 12 cyclotrons (including 4 attached to university hospitals), 4 linear accelerators (including 2 put out of service)
Radioisotope production for medical and industrial use	
National Radioelements Institute (IRE, Fleurus)	Radioisotope production facilities
SCK•CEN (Mol)	Radioisotope production in the BR2 reactor
Private companies	6 cyclotrons (including 2 put out of service)
Radium and uranium production (from 1922 to 1977)	
Umicore (formerly Union Minière, Olen)	Three storage facilities (UMTRAP, Bankloop and Storage facility 2016), subject to nuclear licences and containing radioactive substances Radioactively contaminated industrial landfills and diffuse radioactive contamination, likely to require remediation generating waste to be managed as radioactive waste
Activities of certain NORM industries	
	Radioactive waste from the operation and dismantling of the facilities of certain NORM industries Radioactively contaminated industrial landfills and diffuse radioactive contamination, likely to require remediation, but that may not generate waste to be managed as radioactive waste
Old domestic devices	
	Ionising smoke detectors, lightening conductors, etc.

The Federal State has exclusive jurisdiction over all nuclear issues, including the nuclear fuel cycle, radioactive waste management, radiation protection, and research, development and demonstration (RD&D) in these fields.

A.1 Main actors and responsibilities

Spent fuel and radioactive waste management may be seen as essentially involving four groups of actors (Figure 1):

- the owners of the spent fuel (Section A.1.2);
- the radioactive waste producers (Section A.1.1);
- the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) and its subsidiary Belgoprocess (Section A.1.1);
- the Federal Agency for Nuclear Control (FANC) and its subsidiary Bel V (Section A.1.3).

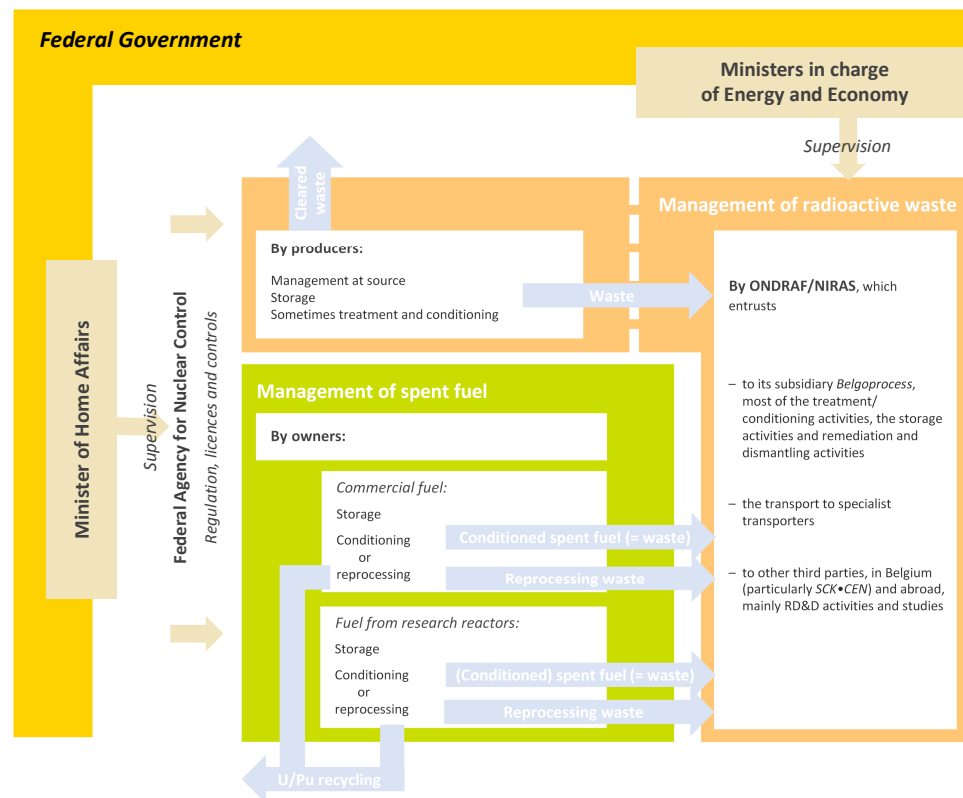


Figure 1 – Main actors in the management of spent fuel and radioactive waste.

ONDRAF/NIRAS' competences as the organisation responsible for managing radioactive waste and those of FANC are distinct, yet complementary, and the two parties carry out their tasks within their respective competences. A consultation agreement between them enables them to collaborate and reach common positions on, in particular, the strategic aspects of radioactive waste management and interdependencies, in a context separate from that of discussions relating to the nuclear licences requested by ONDRAF/NIRAS as a nuclear operator.

A.1.1 Radioactive waste management

ONDRAF/NIRAS, which was given responsibility for the management of radioactive waste by the legislature, is a public body with legal personality. Its missions and functioning rules are set out by Article 179, § 2, of the Law of 8 August 1980 and the Royal Decree of 30 March 1981 (Section E.1–Article 5(1)(b)). ONDRAF/NIRAS is supervised by the Ministers in charge of Energy and Economy. It presents an annual activity report to Parliament.

ONDRAF/NIRAS may conduct its radioactive waste management mission and its other missions using its own resources or allow these missions to be carried out by third parties under its responsibility. Its radioactive waste management system comprises a series of steps that can be grouped into short-term (primarily waste acceptance, treatment and conditioning), medium-term (primarily storage) and long-term (primarily disposal) management activities. ONDRAF/NIRAS is, however, the only actor appointed to ensure the long-term management of radioactive waste.

ONDRAF/NIRAS handles the general coordination of the necessary industrial and RD&D activities for the long-term management of radioactive waste and ensures the continuity and integration of knowledge. Its role of radioactive waste manager is separate from its role of nuclear operator. When it acts as a nuclear operator¹, ONDRAF/NIRAS is controlled by FANC as any other nuclear operator.

In accordance with the provisions of the Law of 8 August 1980, ONDRAF/NIRAS must allocate its costs, estimated at cost price and in proportion to its services, between the beneficiaries of those services, namely the radioactive waste producers and financially liable institutional entities (Federal State, Walloon Region and European Commission).

ONDRAF/NIRAS is the parent company of the limited company Belgoprocess, which operates the nuclear sites BP1 (Dessel) and BP2 (Mol) and acts as ONDRAF/NIRAS' industrial branch in the frame of long-term agreements. The members of the Board of Belgoprocess are proposed by the Board of ONDRAF/NIRAS. A representative of the Directorate General for Energy of the Federal Public Service Economy, SMEs, Self-Employed and Energy, attends the Board's meetings as observer.

The radioactive waste producers are not required to ask ONDRAF/NIRAS to take charge of their waste immediately after its generation. They can treat, condition and (temporarily) store their waste on their site, subject to their facilities being licensed by FANC and their equipment for storing, treating, conditioning and characterising radioactive waste being qualified by ONDRAF/NIRAS, in the frame of its waste acceptance system. These qualifications must ensure that the generated waste will comply with ONDRAF/NIRAS' acceptance criteria for its future management. Furthermore, producers who wish to have waste treated and conditioned abroad must ensure that the radioactive waste that returns to Belgium will comply with ONDRAF/NIRAS' acceptance criteria. In practice, the limited company Electrabel, which operates the seven Belgian commercial nuclear reactors, treats and conditions² some of its own operational waste, some other producers have certain treatment operations carried out abroad, and hospitals and research laboratories store their very short-lived radioactive waste for clearance after decay, in accordance with the requirements of the general regulations for radiation protection or GRR-2001 (Section E.1–Article 5(1)(b)). The cleared waste is then managed as conventional industrial waste.

¹ ONDRAF/NIRAS is since October 2012 the nuclear operator of the facilities of the former Best Medical Belgium (bankrupt since May 2012) that were not transferred to NTP Radioisotopes (Europe). It is in charge of their remediation and decommissioning.

² ONDRAF/NIRAS withdrew Electrabel's qualifications for the treatment and cementation, in Doel, of evaporator concentrates and ion exchange resins, following the discovery by Belgoprocess in 2013 of non-conformities in previously accepted waste packages.

A.1.2 Spent fuel management

Spent fuel from commercial nuclear power plants and research reactors is managed by its owners.

Spent fuel from commercial nuclear power plants Pursuant to Article 179, § 1, of the Law of 8 August 1980 [Belgian Official Journal 1980], the limited company Synatom manages the spent fuel from commercial nuclear power plants before ONDRAF/NIRAS takes charge of it, in the form of reprocessing waste or as radioactive waste.

Synatom, a wholly owned subsidiary of Electrabel, owns the nuclear fuel throughout the entire fuel cycle, including while in the reactors of the nuclear power plants at Doel and Tihange. The Federal State has a golden share in Synatom giving it certain special rights within Synatom's Board of Directors and General Assembly.

Synatom can conduct its mission to manage spent fuel using its own resources or allow it to be carried out by third parties under its responsibility.

Spent fuel from research reactors³ The Belgian Nuclear Research Centre (SCK•CEN), a foundation of public utility supervised by the Minister in charge of Energy, manages its own research spent fuel before ONDRAF/NIRAS takes charge of it, in the form of reprocessing waste or as radioactive waste.

A.1.3 Regulation, licences and controls

Created by the Law of 15 April 1994, FANC is the public institution with legal personality responsible for protecting the population, workers and the environment against the dangers arising from ionising radiation (see also Section F). Its missions and functioning rules are set out by the Law of 15 April 1994 and its implementing royal decrees (Section E.1—Article 5(1)(b)). FANC is supervised by the Minister of Home Affairs. It presents an annual activity report to Parliament.

FANC is specifically responsible for proposing regulations in terms of radiation protection and safety that comply with international recommendations and European directives, and to ensure their application. It grants construction and operation licences for nuclear facilities as well as dismantling licences, except for construction and operation licences and dismantling licences for class I facilities (Section E.1—Article 5(1)(c)), which are issued by royal decree, on FANC's proposal to its supervisory authority, after a positive opinion from its Scientific Council for ionising radiation. FANC also grants nuclear transport licences to transport companies of radioactive materials. It inspects nuclear facilities, controls compliance with the licence provisions and, more generally, compliance with the provisions of the legal and regulatory framework for radiation protection, nuclear safety and nuclear security. If necessary, licences can be suspended or withdrawn by the authorities that have issued them. FANC also assesses notification files relating to work activities using naturally occurring sources of ionising radiation (NORM issue).

FANC's running costs are covered by taxes and fees that it charges to the beneficiaries of its services, primarily licence holders, in accordance with the conditions set out by the legal and regulatory framework.

In September 2007, FANC created a subsidiary, called Bel V, in the form of a foundation of private law. Bel V, FANC's technical support organisation, performs regulatory missions delegated by FANC,

³ From 1967 to the end of 2003, Ghent University operated the Thétis research reactor. Its decommissioning was acknowledged by the Royal Decree of 26 December 2015 [Belgian Official Journal 2015b]. Its spent fuel was declared as radioactive waste to ONDRAF/NIRAS by Ghent University.

such as inspections in the nuclear power plants and certain other facilities and evaluations of safety cases submitted to FANC.

A.2 Opening remarks on the national report

This second edition of the national report on the implementation of Council Directive 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (hereafter the 'national report') meets the requirement of Article 14.1 of the directive. Pursuant to Article 8 of the Law of 3 June 2014 transposing the directive [Belgian Official Journal 2014b], it has been written under the coordination of ONDRAF/NIRAS, with input from FANC, the Federal Public Service in charge of Energy, SCK•CEN, Synatom and Electrabel: together, these actors possess the competences covering the topics to be discussed in the national report. After it was notified to the European Commission by the Ministers in charge of Energy and Economy, the national report was uploaded on www.ondraf.be and www.niras.be and on the website of the National Programme Committee (www.cpnpc.be) (Section E.1–Article 5(1)(a)).

This national report describes the state of affairs at 31 May 2018. By contrast to the first edition of the national report ('national report 2015'), which adopted a mainly legal angle, this second edition focuses on implementation of the directive. In doing so, it follows as closely as possible for its structure and content the January 2018 guidelines established by the European Nuclear Safety Regulators Group (ENSREG): the general introduction and the overview of the recent developments and main challenges are followed by an article-by-article approach and the report ends with future plans to improve safe and responsible management of spent fuel and radioactive waste, followed by a list of acronyms and bibliographic references. The national report uses as much as possible information from the first edition of the national programme ('national programme 2015') [Kingdom of Belgium 2015] and from the sixth report established in the framework of the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management [Kingdom of Belgium 2017].

Throughout the text, the national report adopts the following conventions:

- the designation 'radioactive waste' encompasses non-reprocessed spent fuel considered as waste;
- the designation 'owners of spent fuel' refers to the holders of the rights referred to in Article 87 of the Euratom Treaty;
- the designation 'nuclear facilities' refers to all licensed facilities (Section E.1–Articles 5(1)(b) and 5(1)(c)), as is the case, for instance, in the Joint Convention and in Article 179, § 2, of the Law of 8 August 1980 on the budgetary proposals for 1979–1980 (ONDRAF/NIRAS law);
- the translations of titles of official sources such as laws, royal decrees or resolutions as well as the translations of the quoted extracts are non-certified translations. Only the original texts in French and Dutch are authentic;
- bibliographic references are limited to national references.

Major elements on national policies and the national programme are provided in Sections D.1 and K, respectively.

B. Main developments since 31 December 2014 and main challenges

The main developments since 31 December 2014 (reference date of both the national programme 2015 and the national report 2015) listed below are limited to key topics for which there have been significant final or intermediate results in that period. Main challenges for implementing the national programme are also listed.

B.1 National policies

The situation regarding national policies on spent fuel and radioactive waste management (Section D.1) is formally unchanged since 31 December 2014.

The main challenges as far as national policies are concerned are thus the adoption of the bases of the national policy on the long-term management of B&C waste (conditioned high-level and/or long-lived radioactive waste) (see Section C.1 for the Belgian waste classification) and the adoption of policies on the management of part of the spent fuel from SCK•CEN's reactors. In addition, the owners of the spent fuel from the commercial nuclear reactors and of the spent fuel from some SCK•CEN research reactors will have to propose hypotheses regarding the further use of their spent fuel, with a view to the later integration of these proposals in the national policies (Article 179, § 6, of the Law of 8 August 1980) (Table 4 in Section D.1). The proposals of national policy have, as foreseen in the article 179 of the law of 1980, to be presented to FANC for advice.

The bases of the future national policy on the long-term management of B&C waste were submitted by ONDRAF/NIRAS to its supervisory authority in February 2018: geological disposal on Belgian territory, the national policy being adopted in steps and the next step being the adoption of the decision-making process according to which the geological disposal solution will be developed. In particular, this decision-making process must make provisions for a pre-licensing process with FANC. The 2018 proposal was drawn up in consultation with FANC and other stakeholders. By contrast to what was announced in the national programme 2015, it does not specify a type of host formation.

B.2 National framework

The national framework has seen different kinds of development since 31 December 2014. The main challenges are those related to the implementation, in the legal and regulatory framework, of the proposals that were approved by the Federal Council of Ministers in July 2017 regarding the clarification of the roles and responsibilities of FANC and ONDRAF/NIRAS (Sections B.2.4 and M.2) and of measures to improve the coverage of management costs in Belgium (Sections B.2.5 and M.2).

B.2.1 Extension by ten years of deactivation date of two commercial nuclear reactors

To ensure electricity supply in Belgium, and in accordance with the provisions of the Law of 31 January 2003 on nuclear energy phase-out [Belgian Official Journal 2003a], the Government and the Parliament decided in 2015 to delay the deactivation date of the Doel 1 and 2 reactors by 10 years.

Article 4 of the Law of 31 January 2003 was amended as a result on 28 June 2015. As consequence, this will lead to the production of an additional 177 tHM spent fuel.

B.2.2 Formalisation of Belgium's agreement to take charge of Luxembourg's radioactive waste

In order to take account of the new context imposed by Directive 2011/70/Euratom, the Belgian and Luxembourg Governments agreed to formalise in a bilateral agreement the 1994 agreement by which ONDRAF/NIRAS was authorised by its supervisory authority to treat and condition a quantity of radioactive waste (mostly B, or intermediate-level, waste) from the Grand Duchy of Luxembourg every year as long as the waste volume after conditioning does not exceed 0,1 m³. The 1994 agreement followed up on a previous agreement by ONDRAF/NIRAS' supervisory authority, in 1990, for Belgium to treat and condition the radioactive waste of the Grand Duchy of Luxembourg, as requested by the Luxembourg Minister for Health.

The formal agreement between both countries was signed on 4 July 2016 [Gäichel 2016] and was ratified by the Grand Duchy of Luxembourg on 15 May 2018. It establishes the technical and financial framework for the management and the disposal by Belgium of Luxembourg radioactive waste. The ratification process in Belgium follows its course.

B.2.3 New legal requirements associated with decommissioning

The Royal Decree of 10 August 2015 [Belgian Official Journal 2015a] on the decommissioning of nuclear facilities introduces a section 'Decommissioning' in the generic safety requirements of the Royal Decree of 30 November 2011 on the safety requirements for nuclear facilities or SRNI-2011 (Section E.1—Article 5(1)(b)). It requests in particular from nuclear operators that they comply with a range of obligations regarding their radioactive waste from both operation and decommissioning. They must, for instance, develop, optimise, implement and document processes aimed to categorise, characterise, sort or condition decommissioning waste or to send it for conditioning and to optimise volumes and activity levels by decontamination techniques, reuse or clearance.

B.2.4 Clarification of the roles and responsibilities of FANC and ONDRAF/NIRAS

The Federal Council of Ministers entrusted in November 2016 a task force with the mission to propose improvements or modifications at the legal and regulatory levels to follow up on recommendation R7 of the IRRS mission conducted in Belgium in December 2013. This recommendation emphasised the need for a clear separation of the roles and responsibilities of FANC and ONDRAF/NIRAS to ensure that FANC decisions are not unduly influenced by prior governmental or ONDRAF/NIRAS decisions.

The task force, composed of representatives of the supervisory authorities of FANC and ONDRAF/NIRAS and of the general managers of both agencies, identified all interfaces between FANC and ONDRAF/NIRAS and the domains where roles and responsibilities were either not clearly separated or not allocated.

After analysis, the task force submitted proposals for improvement on the following four topics to the Federal Council of Ministers:

- ONDRAF/NIRAS' acceptance system for radioactive waste;

- the management of interdependencies of the successive waste management steps and the transfer of waste to ONDRAF/NIRAS;
- national policies on radioactive waste disposal and their implementation through the national programme;
- interventions and site remediation.

The Federal Council of Ministers approved the four proposals on 20 July 2017 [Council of Ministers 2017] and instructed the supervisory authorities of FANC and ONDRAF/NIRAS to propose, each within the boundaries of their competences, the draft laws and royal decrees to implement these proposals in the national framework. This work is ongoing (see also Section M.2).

B.2.5 Measures to improve the coverage of management costs

The need to improve the legal and regulatory framework related to the coverage of the costs of managing spent fuel and radioactive waste and the costs of decommissioning operations, referred to globally as ‘management costs’, that is, the need to ensure the existence and sufficiency of the provisions (to be) established by the financially liable entities and the availability in due time of the corresponding financial resources, has been acknowledged at various levels, on several occasions, in particular:

- by the Federal Council of Ministers in January 2014, on the occasion of the transposition of Directive 2011/70/Euratom; the Council created a working group comprising the Energy Administration, ONDRAF/NIRAS and Synatom and entrusted it with the task to, in particular, propose the legal and regulatory changes deemed necessary to improve the coverage of management costs, using the work already done by the Energy Administration and by ONDRAF/ NIRAS in the frame of its inventory mission of nuclear liabilities (Section E.1–Article 5(1)(h));
- by ONDRAF/NIRAS in its successive inventory reports on nuclear liabilities, the last report having been published in February 2018 [ONDRAF/NIRAS 2018a] (Sections I.2 and I.3);
- by the Commission for Nuclear Provisions, in charge of controlling the establishment and management of the provisions for the dismantling of nuclear power plants and the management of the associated spent fuel, in its 2016 activity report [CNP 2016] (Sections E.1–Article 5(1)(h), I.3 and J.1.3).

B.3 National programme

Three challenges in particular have been identified as key to the implementation of the national programme:

- the management of non-conform conditioned waste, and in particular of waste packages affected by an alkali-silica reaction (ASR), including the necessary RD&D on the physico-chemical phenomena causing these non-conformities, adequate interim storage solutions, and the development and implementation of appropriate measures with a view to safe disposal;
- the improvement of the waste acceptance system, through integration of the recommendations of FANC, the lessons learnt during the management of non-conform conditioned waste and integration of additional elements and steps pertaining to disposal activities, for instance integration of the additional and revised waste acceptance criteria necessary to ensure compliance of the waste intended for surface disposal with the requirements of the nuclear licence for the future surface disposal facility in Dessel.

Improvements to the present waste acceptance system also include increasing the number of inspections by ONDRAF/NIRAS, according to a graded approach, of radioactive waste production on the sites operated by the main waste producers and developing an inspection programme aiming at the supply chain of the treatment and conditioning processes;

- the implementation, by 1 January 2019, of the so-called ‘guiding principles’, that is, new principles for the financing of ONDRAF/NIRAS’ long-term fund, that will in particular provide for a stricter application of the polluter pays principle.

Since these topics are ongoing work, they are not reported in this section, but in Sections K.3–Article 12(1)(f), D.3 and I.1.2, respectively.

The main developments regarding implementation of the national programme since 31 December 2014 are summarised hereafter.

B.3.1 Update of the radiological and physico-chemical inventory

ONDRAF/NIRAS has updated its radiological and physico-chemical inventory of existing and planned conditioned waste at 31 December 2017. It includes the waste production forecasts up to when this production has decreased to zero or can be considered to be negligible [ONDRAF/NIRAS 2018b] (Section C.2.3).

B.3.2 Progress in the decommissioning of the former fuel-fabrication facilities

The two former Belgian fuel-fabrication facilities, Belgonucleaire and FBFC International, both located in Dessel, are being dismantled since, respectively, 2009 and 2011. The dismantling works are nearing completion, with Belgonucleaire having transferred most of its radioactive waste to ONDRAF/NIRAS in 2017 and FBFC International expected to do so during the course of 2018.

B.3.3 Progress in the licensing process for the surface disposal facility for category A waste

The many exchanges between FANC and ONDRAF/NIRAS in the period 2014–2017, after the review by FANC and Bel V of the licence application for the surface disposal facility for category A waste in Dessel and the ensuing questions to ONDRAF/NIRAS, led to the need for ONDRAF/NIRAS to revise the safety case, in particular in the following respects:

- following the FANC guidelines, making a (systematic) multi-attribute optimisation analysis of radiation protection on some of the design choices, which resulted in several design refinements;
- documenting more explicitly the expected phenomenological long-term evolution of the disposal system; the long-term safety concept and long-term safety assessment models were adapted on the basis of the expected evolution to make the three elements more coherent with one another;
- revising the argumentation behind the defence in depth provided by the disposal system in the long term, based on the changes in design and in the long-term safety concept;
- refining the long-term safety assessment methodology as regards derivation of radiological limits, development of altered-evolution scenarios and management and treatment of uncertainties;

- updating the operational risk analysis, so that it reflects the latest changes in design and some details of disposal operations that were not yet fixed at the time of the previous operational risk analysis.

FANC declared on 8 December 2017 that all the questions that needed answering prior to the next step in the licensing process, namely the preliminary provisional opinion of FANC's Scientific Council on the licence application, have been answered. ONDRAF is currently completing its license application file. The licence is expected by the end of 2019.

B.3.4 Assessment of the anticipated volumes of radium-bearing and NORM substances to be managed as radioactive waste in the long term

With a view to preparing regulatory decisions and policy proposals for the long-term management of radium-bearing and NORM substances to be managed as radioactive waste, FANC and ONDRAF/NIRAS are currently assessing the fraction of these materials to be managed under the Extractive Industries Directive 2006/21/EC and the fraction to be managed as radioactive waste by ONDRAF/NIRAS (Directive 2011/70/Euratom). To this end, both agencies established a common inventory of the main contaminated sites that could need radiological remediation, including their relevant characteristics [FANC and ONDRAF/NIRAS 2018] (Section C.2.4).

As far as the long-term management of radium-bearing substances is concerned, FANC and OVAM — the Public Waste Agency of Flanders — have recently started to envisage that part of the radium-bearing substances contained in Umicore's licensed storage facilities and landfills in Olen could be transferred to a conventional landfill under certain conditions.

B.3.5 Update of the inventory of nuclear liabilities

ONDRAF/NIRAS' fourth inventory report on nuclear liabilities [ONDRAF/NIRAS 2018a] gives an update, at 31 December 2015, of the situation regarding the quality of the coverage of the management costs. In other words, it provides an extensive assessment of the existence and sufficiency of the provisions established (or not) by the financially liable entities to cover their management costs and of the availability in due time of the corresponding financial resources. To do so, the report first assesses the costs of all *existing* financial obligations in terms of spent fuel and radioactive waste management and in terms of decommissioning operations (Section K.3—Article 12(1)(h)).

C. Articles 2 and 12(1)(c) — Scope and inventory

According to the Law of 3 June 2014 transposing Directive 2011/70/Euratom, radioactive waste is *“radioactive material in gaseous, liquid or solid form for which no further use is foreseen or considered by the State or by a legal or natural person whose decision is accepted through the approval of a national policy related to that material, as referred to in § 6 and § 7 of this article, and which is regulated as radioactive waste by the competent regulatory authority or if this material must be considered as radioactive waste on the basis of a legislative or regulatory provision”*.

C.1 Classification system and scope

Article 2(1) *This Directive shall apply to all stages of:*

- (a) *spent fuel management when the spent fuel results from civilian activities;*
- (b) *radioactive waste management, from generation to disposal, when the radioactive waste results from civilian activities.*

Article 2(2) *This Directive shall not apply to:*

- (a) *waste from extractive industries which may be radioactive and which falls within the scope of Directive 2006/21/EC;*
- (b) *authorised releases.*

Article 2(3) *Article 4(4) of this Directive shall not apply to:*

- (a) *repatriation of disused sealed sources to a supplier or manufacturer;*
- (b) *shipment of spent fuel of research reactors to a country where research reactor fuels are supplied or manufactured, taking into account applicable international agreements;*
- (c) *[...]*

Article 2(4) *This Directive shall not affect the right of a Member State or an undertaking in that Member State to return radioactive waste after processing to its country of origin where:*

- (a) *the radioactive waste is to be shipped to that Member State or undertaking for processing; or*
- (b) *other material is to be shipped to that Member State or undertaking with the purpose of recovering the radioactive waste.*

This Directive shall not affect the right of a Member State or an undertaking in that Member State to which spent fuel is to be shipped for treatment or reprocessing to return to its country of origin radioactive waste recovered from the treatment or reprocessing operation, or an agreed equivalent.

For the long-term management of radioactive waste (see Table 1 in Section A for an overview of its origins), ONDRAF/NIRAS has adopted a classification in three categories⁴, defined in accordance with the classification proposed in 1994 by the IAEA and that recommended in 1999 by the European Commission: waste is classified according to its activity and half-life.

- **Category A waste** is short-lived, low-level and intermediate-level conditioned waste containing limited quantities of long-lived radionuclides. It poses a risk to people and the environment for several hundreds of years. It can be considered for surface or near-surface disposal. It corresponds to low-level waste (LLW) in the IAEA 2009 classification. The radiological criteria and limits for category A waste will be defined in the safety report and licensing conditions for

⁴ These categories do not cover the radioactive radium-bearing substances contained in Umicore’s licensed storage facilities in Olen (Section C.2.4).

the planned surface disposal facility in Dessel (licensing process ongoing). ONDRAF/NIRAS considers short-lived, very low-level waste that cannot be cleared to be category A waste.

- **Category B waste** is low-level and intermediate-level conditioned waste contaminated with such quantities of long-lived radionuclides that it poses a risk to people and the environment for several tens to several hundreds of thousands of years in some cases⁵. Its thermal power is potentially significant at the time of its conditioning, but it will emit too little heat after the storage period to be classified as category C waste. It corresponds to intermediate-level waste (ILW) in the IAEA 2009 classification.
- **Category C waste** is high-level conditioned waste containing large quantities of long-lived radionuclides and which, like category B waste, poses a risk for several tens to several hundreds of thousands of years in some cases. After the period currently considered for its storage (around 60 years of cooling required in the event of subsequent disposal in poorly-indurated clay), its thermal power still causes a significant increase in the temperature of the disposal facility's host formation. It corresponds to high-level waste (HLW) in the IAEA 2009 classification. Category C waste includes vitrified waste from the reprocessing of spent fuel from commercial nuclear reactors and from the BR2 research reactor and non-reprocessed spent fuel declared as waste

For the processing of non-conditioned waste and the storage of conditioned waste, ONDRAF/NIRAS uses a more detailed classification system, based on the physico-chemical and radiological characteristics of the waste, that determine the processing route (evaporation, incineration, (super)compaction, solidification process, etc.) and the appropriate storage facility.

The radium-bearing substances from the historical radium and uranium production by Umicore in Olen during the period 1922–1977, which are very low-level, low-level or intermediate-level radium-bearing substances, and part of which will have to be managed as radioactive waste, fall within the scope of the national report.

The small quantities of NORM substances, for instance from the dismantling of certain NORM facilities or identified by radiological detection equipment, that end up in ONDRAF/NIRAS' radioactive waste management system, and are expected to become category B waste after conditioning, similarly fall within the scope of the national report. By contrast, the large quantities of NORM substances in Belgium, which were produced mainly by the phosphate industry, are not within the scope of the national report, except for NORM substances from remediation that would appear, as a result of a FANC decision, to have to be managed in the long term as radioactive waste by ONDRAF/NIRAS. The large quantities of NORM substances are indeed currently managed according to the provisions of the environmental protection framework, at the regional level, with appropriate control of the radiological risks by FANC, for instance during operational activities, site remediation activities and post-remediation site surveillance.

C.2 Inventory

Article 12(1)(c) *an inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;*

⁵ Sealed sources that must be managed as radioactive waste end up in category B after treatment and conditioning.

C.2.1 Existing spent fuel

Spent fuel from nuclear power plants

Until the Parliamentary Resolution and the decision of the Federal Council of Ministers of December 1993 [Council of Ministers 1993], the spent fuel from the Belgian nuclear power plants was sent to France for reprocessing. Four contracts were concluded by Synatom with COGEMA (which became AREVA NC in 2006, and then Orano Cycle in January 2018) for the reprocessing of 672 tHM spent fuel. This fuel was reprocessed on the site of la Hague (France) between 1980 and 2001.

At 31 December 2017, 4 322 tHM of spent fuel, including 66 tHM of MOX fuel, have been definitively unloaded from the Doel and Tihange reactors since they started operating:

- 25% of this fuel is stored in the reactors' cooling ponds;
- 60% is stored in the storage facilities built at Doel (dry storage in metal casks) and Tihange (wet storage) (see also Section M.3.4);
- 15% has been reprocessed at la Hague:
 - ▶ The recovered uranium has been integrated into the fabrication of fuel assemblies for Belgian commercial nuclear reactors between 1994 and 2009.
 - ▶ The recovered plutonium has been integrated into the fabrication of MOX fuel assemblies for Doel 3 and Tihange 2 between 1995 and 2010, or transferred to third parties.
 - ▶ Reprocessing waste, conditioned at la Hague, has been almost entirely repatriated to Belgium and is stored in building 136 at Belgoprocess, awaiting an solution for its long-term management. The repatriation of the remaining reprocessing waste will be completed in 2018.

Spent fuel from research reactors

At 31 December 2017, the inventory of existing spent fuel from research reactors is as follows⁶:

- The spent fuel from the BR3 reactor, entirely declared as radioactive waste to ONDRAF/NIRAS by SCK•CEN, amounts to 2,4 tHM. It has been dry stored in seven CASTOR casks in

⁶ The BR1 reactor is still using its first fuel load.

Fuel that was definitively unloaded from other research reactors does not have the status of spent fuel anymore.

- The spent fuel from the BR02 zero-power reactor was reconditioned by CERCA, a subsidiary of AREVA (now Orano), which fabricated new assemblies for the BR2 reactor.
- The spent fuel from the BR2 reactor is considered a resource and, hence, is subject to reprocessing. The intermediate-level and high-level reprocessing waste generated so far has been conditioned on the sites of the reprocessing facilities (first at UKAEA Dounreay (now DSRL), then at COGEMA la Hague (now Orano Cycle)), repatriated to Belgium and taken charge of by ONDRAF/NIRAS. It is stored in ONDRAF/NIRAS' building 136 at Belgoprocess. The contract with COGEMA, signed in 1997, required a bilateral agreement between France and Belgium, that was ratified in 2014 [Belgian Official Journal 2014c]. It provides for the reprocessing of the BR2 spent fuel delivered at la Hague by 31 December 2025 and for the repatriation of the corresponding reprocessing waste before the end of 2030. It also provides for the transfer of ownership of the residual quantities of uranium and plutonium to Orano Cycle.
- The spent fuel from the Thétis reactor was declared as radioactive waste to ONDRAF/NIRAS by Ghent University and conditioned by Belgoprocess with a view to geological disposal. It is stored in ONDRAF/NIRAS' building 155 at Belgoprocess.

The fuel from the VENUS-F reactor of the GUINEVERE subcritical reactor project does not belong to SCK•CEN. It is supplied by the French *Commissariat à l'énergie atomique et aux énergies alternatives* (Alternative Energies and Atomic Energy Commission) and will eventually be returned to France.

ONDRAF/NIRAS' building 156 at Belgoprocess since 2002. It is still the property of SCK•CEN. In accordance with the terms of the agreement between ONDRAF/NIRAS and SCK•CEN, ONDRAF/NIRAS provides safe storage for a maximum duration of 50 years, pending an operational solution for the fuel long-term management.

- The fuel from the VENUS zero-power reactor, which is similar to the BR3 fuel, but with a very low burnup, was unloaded in 2008 for further use when the reactor was transformed into VENUS-F. This fuel is stored at SCK•CEN.

C.2.2 Existing radioactive waste

The inventory of conditioned radioactive waste stored at Belgoprocess at 31 December 2017 is given in Table 2 [ONDRAF/NIRAS 2018b].

Table 2 – Main characteristics of the storage buildings for conditioned waste at Belgoprocess (all on site 1, except the buffer facility) in terms of capacity and the waste they contain at 31 December 2017 (disused sealed sources included).

Buildings	Commissioned	Type of conditioned waste	Waste categories	Capacity (m ³)	Filling rate (%)	Volume (m ³)	Activity (Bq)	
							α	β-γ
127	1976	Bituminised and cemented ILW (mainly category B waste, 220 and 400 litre packages) mostly (76%) from the Eurochemic reprocessing plant	A + mainly B	4 700	83	3 893	3,4 10 ¹⁴	4,6 10 ¹⁶
129	1985	Conditioned ILW (60 and 150 litre packages) from the vitrification, in PAMELA, of the 860 m ³ Eurochemic liquid waste and cemented ILW from the BR2 and BR3 reactors and from the partial dismantling of the PAMELA vitrification facility	B	250	86	215	1,7 10 ¹⁵	3,7 10 ¹⁷
136-Zone C	2000	HLW from the reprocessing of commercial spent fuel by COGEMA/Orano Cycle	C	106 (590 canisters)	66	70 (vitrified)	8,1 10 ¹⁶	5,9 10 ¹⁸
136-Zone D	2009	ILW from the reprocessing of commercial spent fuel by COGEMA/Orano Cycle	B	600	25	151	1,9 10 ¹⁴	4,5 10 ¹⁶
150	1986	LLW (400, 500, 1000, 1200, 1500, 1600, and 2200 litre packages) (mainly category A) from the Doel and Tihange nuclear power plants (filters, concentrates, resins, etc.) and the former SCK•CEN Waste department	A + B	1900	100	1900	1,9 10 ¹²	2,2 10 ¹⁴
151	1988	Same types of waste and origins as in building 150	A + B	14 700	94	13 797	5,4 10 ¹³	1,1 10 ¹⁵
155	2006	Alpha- and radium-contaminated waste and conditioned Thétis spent fuel	B	4 221	85	3 585	1,8 10 ¹⁵	1,7 10 ¹⁶
156	2002	Spent fuel from the BR3 reactor (non-conditioned)	C	8 CASTOR	88	7 CASTOR	2,0 10 ¹⁵	1,0 10 ¹⁷
270 (buffer facility)		Packages that have to be transferred to building 155, if necessary after reconditioning. These are mainly conditioned radium-bearing waste packages and conditioned waste packages (under characterisation) from the former SCK•CEN Waste department	A + B	temporary buffer	n.a.	126	3,5 10 ¹¹	6,0 10 ¹⁰

No radioactive waste has been disposed of in a final repository in Belgium at 31 December 2017.

C.2.3 Estimates of the total future inventory of radioactive waste

The estimated total inventory of existing and planned conditioned waste is updated periodically by ONDRAF/NIRAS on the basis of, on the one hand, its knowledge of existing waste and spent fuel and

of the estimated waste from the decommissioning of existing nuclear facilities and, on the other hand, the waste producers' reference programmes, containing their estimates of the waste they intend to transfer to ONDRAF/NIRAS.

The estimated inventory, at 31 December 2017, of existing and planned conditioned waste (over a realistic period, variable depending on the (type of) waste producer) [ONDRAF/NIRAS 2018b], is provided in Table 3. The main assumptions are as follows:

- the Doel 1 and 2 and the Tihange 1 commercial nuclear reactors will be operated during 50 years and the four other reactors will be operated during 40 years;
- a total of about 1000 tHM spent fuel from commercial nuclear reactors will still be reprocessed (including 66 tHM MOX spent fuel), in addition to the 672 tHM UOX that have already been reprocessed in the past.

Table 3 – Estimated total inventory of existing and planned conditioned waste (rounded figures) **at 31 December 2017, considering the above main assumptions.**

Waste category	Number of packages, monoliths or assemblies	Waste volumes or tHM
Category A		
Packaged wastes	69 300 packages	28 300 m ³
Bulk conditioning	8 900 monoliths	26 600 m ³ ^[1]
Category B		
Packaged wastes	31 300 packages	10 900 m ³
Category C		
Vitrified wastes	1 400 canisters	250 m ³
Nuclear power plants spent fuel	8 500 assemblies	3 800 tHM

^[1] Calculated on the basis of the net internal volume of the disposal containers (monoliths).

The inventory includes

- the decommissioning waste from all existing nuclear facilities;
- the limited amounts of radioactive waste currently abroad and to be repatriated;
- the disused sealed sources.

It does not include

- the operational and decommissioning waste from future facilities;
- radium-bearing and NORM substances from remediation (Section C.2.4).

C.2.4 Radium-bearing and NORM substances to be managed as radioactive waste

According to the ongoing assessment, the inventory of radium-bearing substances on the Umicore site in Olen and in its vicinity that would have to be managed as radioactive waste could be between 55 000 m³ and about 275 000 m³, divided up as follows:

- the contents of the UMTRAP licensed storage facility: 55 000 m³ of non-conditioned substances, including radium needles and tailings. The total alpha-activity (mainly radium-226) is about 38 000 GBq. Activity concentration levels vary largely, up to 30 000 000 Bq/kg.
- depending on FANC's decisions, a fraction of the contents or the total contents of Umicore's two other licensed storage facilities:

- ▶ Bankloop storage facility: 30 000 m³ of non-conditioned substances from the remediation of the Bankloop brook. The total alpha-activity (mainly radium-226) is about 140 GBq. The activity concentration level is about 3 200 Bq/kg.
- ▶ Storage facility 2016: 9 000 m³ of non-conditioned substances from remediation activities on the site. The activity concentration level ranges between 500 and 10 000 Bq/kg.
- depending on FANC's decisions, part or all of the radioactive substances that would be removed during possible future remediation activities on the Umicore site, possibly in the order of 50 000 m³.
- depending on FANC's decisions, part or all of the radioactive substances that will be removed during the future remediation of the D1 landfill, in the vicinity of the Umicore site, which could amount to up to 130 000 m³.

FANC and ONDRAF/NIRAS are currently assessing the fraction of NORM substances to be managed under the Extractive Industries Directive 2006/21/EC and the fraction to be managed as radioactive waste by ONDRAF/NIRAS (Directive 2011/70/Euratom).

D. Article 4 — General principles and policies

D.1 National policies

Article 4(1) *Member States shall establish and maintain national policies on spent fuel and radioactive waste management. Without prejudice to Article 2(3), each Member State shall have ultimate responsibility for management of the spent fuel and radioactive waste generated in it.*

At 31 May 2018, the national policies on spent fuel and radioactive waste management were unchanged with respect to the situation at 31 December 2014. They were as follows (Table 4):

for radioactive waste:

- management by decay and subsequent clearance of very short-lived radioactive waste;
- centralised short-term and medium-term management in Mol–Dessel of radioactive waste which, after treatment and conditioning, becomes category A, B or C waste (de facto policy resulting from a succession of historical choices and events);
- surface disposal in Dessel for the long-term management of category A waste (two decisions by the Federal Council of Ministers, in 1998 and 2006 — Section E.1–Article 5(1)(b)).

for spent fuel:

- safe storage followed by reprocessing or disposal for the spent fuel from commercial nuclear reactors;
- reprocessing for the spent fuel from SCK•CEN’s BR2 research reactor (ratification in 2014 by law of the 2013 bilateral agreement between Belgium and France related to the reprocessing contract, signed in 1998 with COGEMA (now Orano Cycle)) [Belgian Official Journal 2014c];
- safe storage for the spent fuel from SCK•CEN’s BR3 research reactor.

As a corollary, the following national policies were still to be established at 31 May 2018 (see Section M.1 for information on the plans to establish the missing policies):

- the policy on the long-term management of category B&C waste;
- the policies on the long-term management of radium-bearing and NORM substances to be managed as radioactive waste;
- the policies on the management of part of the spent fuel from SCK•CEN’s reactors.

In addition, the owners of the spent fuel from the commercial nuclear reactors and of the spent fuel from some SCK•CEN reactors will have to propose hypotheses regarding the further use of their spent fuel, with a view to the later integration of these proposals in the national policies, after consultation with ONDRAF/NIRAS and FANC (Article 179, § 6, of the Law of 8 August 1980).

Table 4 – Overview of the existence of national policies on the management of spent fuel and radioactive waste, at 31 May 2018. The situation is unchanged compared with that presented in the national programme 2015 [✓: yes; ✗: no].

	NATIONAL POLICIES ON THE MANAGEMENT BY PRODUCERS / OWNERS	TRANSFER OF WASTE	NATIONAL POLICIES ON THE MANAGEMENT BY ONDRAF/NIRAS	
			SHORT AND MEDIUM TERMS (treatment, conditioning and storage)	LONG TERM (disposal)
Very short-lived waste	✓	not app.	not applicable	not applicable
Category A waste	not applicable ^[1]	⇒	✓	✓
Category B waste	not applicable ^[1]	⇒	✓	✗
Category C waste (reprocessing waste)	not applicable	^[2]	✓	✗
Category C waste (spent fuel)	not applicable		✓	✗
Spent fuel from Synatom	✓ ^[3]		not applicable	not applicable
Spent fuel from SCK•CEN	✓		not applicable	not applicable
Ra-bearing substances in Umicore's licensed storage facilities	not applicable	⇒	✗	✗
Ra-bearing substances to be managed as radioactive waste by ONDRAF/NIRAS	not applicable	⇒	✗	✗
NORM substances to be managed as radioactive waste by ONDRAF/NIRAS	not applicable	⇒	✗	✗

^[1] The management of radioactive waste by producers must comply with a set of principles and obligations, but is not subject to an actual national policy.

^[2] Decisions on the future of spent fuel will have to be made before it is transferred to ONDRAF/NIRAS.

^[3] Policy for the management of spent fuel from Synatom: safe storage followed by reprocessing or disposal.

D.2 Ultimate responsibility

Article 4(2) *Where radioactive waste or spent fuel is shipped for processing or reprocessing to a Member State or a third country, the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, shall remain with the Member State or third country from which the radioactive material was shipped.*

If radioactive waste or spent fuel is transferred to a foreign country for treatment or reprocessing, the final responsibility for safe disposal of these substances, including any waste created as a by-product, remains with the Belgian State (Article 179, § 7, of the Law of 8 August 1980, inserted by Article 4 of the Law of 3 June 2014).

D.3 Principles

Article 4(3) *National policies shall be based on all of the following principles:*

- (a) *the generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;*
- (b) *the interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;*
- (c) *spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;*
- (d) *implementation of measures shall follow a graded approach;*
- (e) *the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;*
- (f) *an evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.*

Table 5 provides an overview of how national policies on radioactive waste management implement the general principles.

Table 5 – Overview of how national policies on radioactive waste management implement the general principles.

GENERAL PRINCIPLES ON WHICH POLICIES MUST BE BASED					
(a) Minimisation of radioactive waste	(b) Interdependencies	(c) Safe management / Passive safety features for the long term	(d) Graded approach	(e) 'Polluter pays' principle	(f) Evidence-based and documented decision-making process
Very short-lived waste: management through decay followed by clearance					
The waste never gets declared as radioactive waste to ONDRAF/NIRAS	n.a. (one management step only)	Nuclear licensing according to GRR-2001 ^[1] Clearance according to GRR-2001 Passive features: n.a.	Solution proportionate to risks	Section I	Nuclear licensing process
Category A, B and C waste, short and medium term: centralised management					
Reduction in the number of facilities and, hence, in decommissioning waste	Based on ONDRAF/NIRAS' acceptance system + IMS Taking into account of logistic interdependencies is favoured by centralisation	Nuclear licensing according to GRR-2001 Centralisation of controls, competences, etc. Storage can be safe for decennia Passive features: n.a.	Processes and facilities designed in function of the physical, chemical and radiological characteristics of the waste	Section I	Nuclear licensing process Qualification process Respect of the environmental regulations
Category A waste, long term: surface disposal in Dessel					
n.a.	Based on ONDRAF/NIRAS' acceptance system + IMS	Nuclear licensing according to GRR-2001 Passivity of the disposal system inherent to the system as a result of its design	Solution designed in function of the physical, chemical and radiological characteristics of the waste Solution different than that proposed for B&C waste (geological disposal)	Section I	Participation through partnerships Nuclear licensing process

^[1] Royal Decree of 20 July 2001 relating to the general regulations for the protection of the population, workers and the environment against the dangers arising from ionising radiation, also known as 'general regulations for radiation protection'.

Radioactive waste producers endeavour to limit their radioactive waste generation at source. These efforts rely on optimising industrial practices and limiting volumes of materials that meet the definition of radioactive waste, for example by improving decontamination techniques, optimising dismantling techniques, using recycling and reuse options as well as clearance possibilities, in

accordance with the applicable regulations. This is a general practice for all decommissioning programmes.

To ensure interdependencies (operational and long-term safety, management of radioactive waste streams, logistics, roles and responsibilities, etc.) between the different steps of the management of radioactive waste as best as possible and specifically to guarantee that all requirements ensuing from the need to ensure long-term safety are passed on across the previous management steps, ONDRAF/NIRAS is implementing an integrated management system for all the steps in the management of radioactive waste (Figure 2). This system is based on the IAEA recommendations and on the legislation (SRNI-2011).

The backbone of the integrated management system is the waste acceptance system, which aims to ensure that at each step in the management chain, the characteristics of the radioactive waste comply with the requirements ensuing from the subsequent steps in its management. It includes in particular the establishment, by ONDRAF/NIRAS, of the acceptance criteria which non-conditioned and conditioned waste must satisfy for ONDRAF/NIRAS to take charge of it. Currently, these criteria are based on the general rules and take into account the provisions of the nuclear licences for the transport of radioactive waste and the operation of treatment, conditioning and storage facilities for this waste, as well as generic requirements for disposal.

The licensing process for the future surface disposal facility for category A waste in Dessel requires ONDRAF/NIRAS to review, improve and extend its waste acceptance system so that it allows the waste-related requirements and criteria in, respectively, the future licence (for instance, radiological limits) and the safety case (for instance, maximum cellulose concentrations) to be taken into account in the acceptance criteria. This work was prepared in concertation with FANC as far as FANC's competences are concerned; its now ongoing implementation involves FANC for controlling compliance of the acceptance criteria with the general rules for establishing those criteria (Section E.1–Article 5(1)(b)). The work covers not only the management of revisions of waste acceptance criteria, but also issues related to the presence at Belgoprocess of a significant number of conditioned waste packages that have become non-conform as a result of various physico-chemical phenomena, including phenomena of incompatibility between the waste and the matrix. Examples of such issues are the follow-up of non-conform waste and the development of sampling and control systems for conditioned waste.

According to the provisions of the Royal Decree of 18 November 2002, all facilities in Belgium in which radioactive waste is treated, conditioned, stored or characterised must be qualified by ONDRAF/NIRAS in order to ensure compliance of the corresponding waste with ONDRAF/NIRAS' acceptance criteria. As for facilities located abroad and contracted by a Belgian owner of radioactive waste with a view to treatment, conditioning or storage of its waste, the royal decree specifies that *“any contract concluded between a Belgian owner of radioactive waste and a foreign operator for treatment, conditioning and storage of its radioactive waste must be qualified beforehand by ONDRAF/NIRAS with a view to ONDRAF/NIRAS taking charge of this waste at a later stage and in particular to the quality system applicable to the technical equipment in order to guarantee the conformity of the waste with the acceptance criteria”*.

The radiological and physico-chemical inventory of existing and planned waste (characteristics, volumes and production forecasts) (Sections C.2.2 and C.2.3) is another key element for managing waste streams and associated facilities.

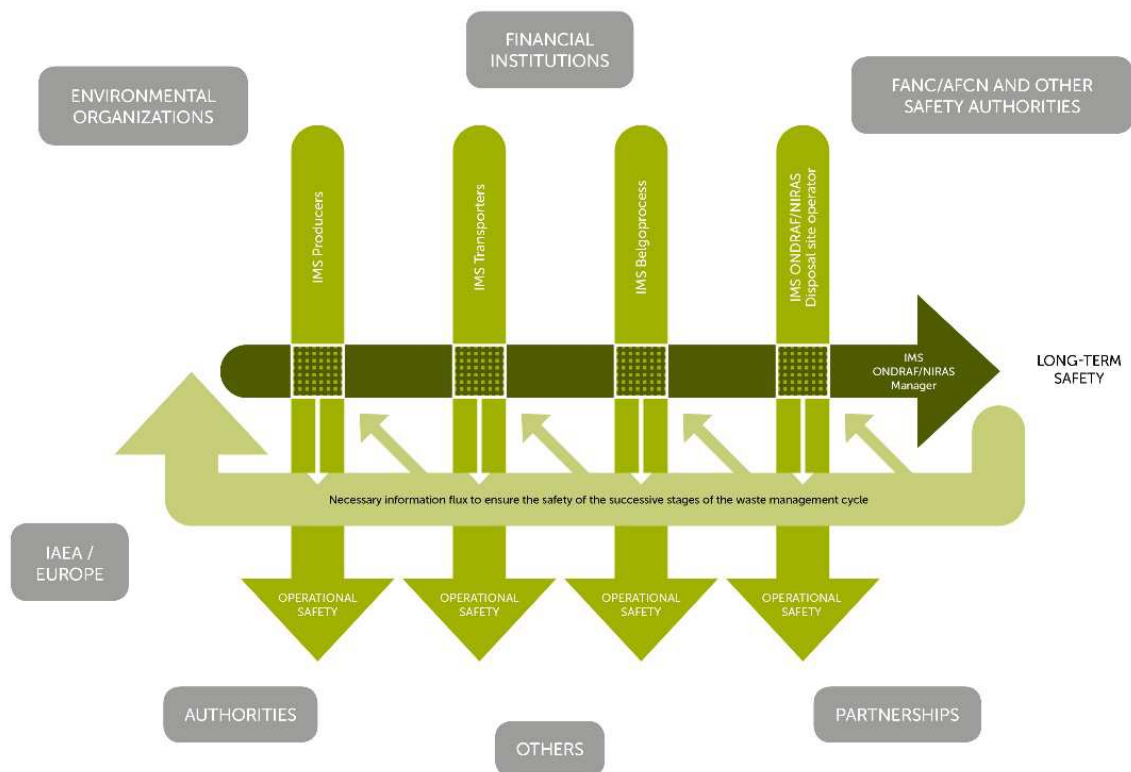


Figure 2 – ONDRAF/NIRAS’ integrated management system (IMS) and waste acceptance system as tools to ensure interdependencies between the successive steps in radioactive waste management.

D.4 Disposal of waste in other Member States or in third countries

Article 4(4) *Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.*

Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:

- (a) the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ('the Joint Convention');*
- (b) the country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this Directive; and*
- (c) the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination.*

Article 4(4) of Directive 2011/70/Euratom has been transposed by Article 4 of the Law of 3 June 2014.

Belgium is currently not exporting radioactive waste to other countries for disposal.

E. Article 5 — National framework

E.1 Legislative, regulatory and organisational framework

Article 5(1) *Member States shall establish and maintain a national legislative, regulatory and organisational framework ('national framework') for spent fuel and radioactive waste management that allocates responsibility and provides for coordination between relevant competent bodies. The national framework shall provide for all of the following:*

National programme

Article 5(1)(a) *a national programme for the implementation of spent fuel and radioactive waste management policy;*

The first edition of the *National Programme for the Management of Spent Fuel and Radioactive Waste* or 'national programme 2015' was drafted by the National Programme Committee (*Comité du Programme national / Comité van het Nationale Programma* or CPNPC) created by Article 6 of the Law of 3 June 2014 modifying the ONDRAF/NIRAS law (see below, under Article 5(1)(b)) to transpose Council Directive 2011/70/Euratom of 19 July 2011. The National Programme Committee is composed of representatives of the Federal Public Service in charge of Energy (chair), ONDRAF/NIRAS (secretary) and Synatom.

The National Programme Committee decided to limit the national programme 2015 to a description of the existing situation at 31 December 2014 in terms of national policies, the implementation of these policies and the national framework for this implementation, without new normative content.

The national programme 2015 was adopted by the Federal Council of Ministers on 30 June 2016 and notified to the European Commission on 20 July 2016. It was sanctioned by ministerial decree on 3 October 2016 and published in the Belgian Official Journal on 15 June 2017. The French and Dutch versions, as well as the English courtesy translation, are available on a dedicated website of the Federal Government: www.cpnpc.be.

National arrangements for the safety of spent fuel and radioactive waste management

Article 5(1)(b) *national arrangements for the safety of spent fuel and radioactive waste management. The determination of how those arrangements are to be adopted and through which instrument they are to be applied rests within the competence of the Member States;*

The main texts of the national legislative and regulatory framework for nuclear safety and radiation protection, thus in particular for safety of spent fuel and radioactive waste management, are given below. The complete set of Belgian, European and international regulations in relation with these issues can be found on www.jurion.fanc.fgov.be.

Law of 15 April 1994 *on the protection of the population and the environment against the dangers arising from ionising radiation and on FANC* (hereafter the 'FANC law') [Belgian Official Journal 1994b], which, in particular,

- establishes FANC;
- defines its missions, including that of proposing draft royal decrees implementing the FANC law;
- states that licence holders are responsible, in all circumstances, to ensure the protection of the workers, the population and the environment against the hazards or health disadvantages which could arise from their practices and that this responsibility cannot be delegated (Article 28, § 1, introduced by the Law of 7 May 2017).

Royal Decree of 20 July 2001 *relating to the general regulations for the protection of the population, workers and the environment against the dangers arising from ionising radiation* (hereafter the ‘general regulations for radiation protection’ or ‘GRR-2001’) [Belgian Official Journal 2001], which, in particular,

- classifies the facilities in which activities are performed that involve the use of radioactive substances or ionising radiation into four classes, ranging from I to IV, with class I facilities being the highest risk facilities (Article 3). Class I facilities include the following radioactive waste and spent fuel management facilities:
 - ▶ the facilities where radioactive waste is collected, treated, conditioned, stored or handled, provided these activities are the main activities of the company;
 - ▶ the facilities for radioactive waste disposal;
 - ▶ the facilities where the amount of fissile materials used or held is higher than half of the minimal critical mass, thus facilities where (irradiated) fissile materials are processed, stored and disposed of;
- establishes the licensing system for class I treatment, conditioning and storage facilities for radioactive waste and establishes the general provisions for the licensing system for disposal facilities (Article 6);
- establishes the basic standards regarding protection against exposure to ionising radiation (Chapter III, Section I);
- contains various articles relating to radioactive waste (Chapter III, Section IV);
- provides the possibility for operators to request authorisation from FANC for the discharge, disposal, recycling or reuse of liquid and solid radioactive waste (Article 18);
- describes the concept of ‘work activity’ (use of NORM), lists work activities and requires that these are declared to FANC.

The Royal Decree of 20 July 2001 is currently being brought into line with the European radiation protection Directive 2013/59/Euratom.

Royal Decree of 30 November 2011 *on the safety requirements for nuclear facilities* (hereafter the ‘SRNI-2011’) [Belgian Official Journal 2011], which is the result of the WENRA harmonisation activities with respect to regulations, providing for a wide range of obligations, among which the obligations for the holders of class I licences to

- document their organisational structure and adopt a graded approach for nuclear safety management to ensure a safe operation of the facility by sufficiently qualified people (Article 4);
- establish, implement, assess and improve on a continuous basis an integrated management system giving priority to safety; this system must cover all the activities and processes which can have an impact on the nuclear safety of the facilities, including the activities carried out by subcontractors or suppliers, with licence holders having to determine and allocate the

necessary resources (financial resources, sufficient and sufficiently qualified human resources, etc.) (Article 5);

- establish and maintain a safety analysis report (Article 13);
- proceed to periodic safety reviews (Article 14).

The SRNI-2011 is currently being complemented by a new chapter applicable to waste and spent fuel storage facilities.

In addition to the safety regulations mentioned above, the management of radioactive waste and spent fuel is subject to a specific legal framework.

Law of 8 August 1980 (Article 179) *on the budgetary proposals for 1979–1980* [Belgian Official Journal 1980], which, in particular,

- creates ONDRAF/NIRAS (§ 2 — hereafter the ‘ONDRAF/NIRAS law’);
- assigns it various missions (in particular, the inventory and management of radioactive waste, including non-reprocessed spent fuel declared as waste, and missions relating to decommissioning) (§ 2);
- recognises the need for societal integration of a disposal facility at the local level and allows ONDRAF/NIRAS to create a medium-term fund for covering the societal costs of integration (§ 2);
- stipulates that national policies on the management of radioactive waste and spent fuel are to be established and maintained by royal decree, debated in the Federal Council of Ministers, on ONDRAF/NIRAS’ proposal and after FANC’s opinion (§ 6).

Royal Decree of 30 March 1981 *determining the missions and setting out the functioning rules for ONDRAF/NIRAS* (hereafter the ‘ONDRAF/NIRAS royal decree’) [Belgian Official Journal 1981], which implements the ONDRAF/NIRAS law.

Parliamentary resolution of 22 December 1993, confirmed by the Federal Council of Ministers the same year [Council of Ministers 1993], which, in particular, orders that the government, in the future, no longer prioritises the reprocessing strategy compared with the conditioning and direct disposal strategy (once through cycle). The government can therefore no longer consider reprocessing as the obvious reference strategy. It must create the conditions to allow the conditioning and direct disposal strategy to be developed as an alternative. This was reconfirmed by the Council on 4 December 1998;

Decision of the Federal Council of Ministers of 16 January 1998 [Council of Ministers 1998], through which, in particular, it

- opts for a solution that is definitive or can become definitive, and one that is progressive, flexible and reversible, for the management of short-lived, low-level and intermediate-level waste (category A waste);
- orders ONDRAF/NIRAS’ supervisory authority to give ONDRAF/NIRAS the mission to limit itself, in its exploratory activities, to existing nuclear zones and to sites where the local authorities show an interest.

Ministerial letter of 10 February 1999 [Van den Bossche 1999] concerning the General Rules for the establishment of waste acceptance criteria by ONDRAF/NIRAS for conditioned and non-conditioned waste.

Law of 2 August 2002 *containing assent to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, signed in Vienna on 5 September 1997* [Belgian Official Journal 2002a].

Royal Decree of 18 November 2002 governing the qualification by ONDRAF/NIRAS of facilities for the storage, treatment and conditioning of radioactive waste [Belgian Official Journal 2002b] and also concerning the facilities and equipment (including methodologies) for radiological characterisation of radioactive waste, which, in particular,

- requires licensees to establish a quality management system for their waste storage and treatment facilities (Article 5, § 1);
- sets out requirements for this quality management system (Article 5, § 2).

Decision of the Federal Council of Ministers of 23 June 2006 [Council of Ministers 2006] determining in particular that the long-term management method for category A waste will be surface disposal on the territory of the municipality of Dessel, as part of a project incorporating the technical and societal aspects and developed through a participative process.

Section A.1 of the present report provides a short description of the responsibilities allocated by the national framework to the Federal Government, FANC and its subsidiary Bel V, the waste producers and spent fuel owners, and ONDRAF/NIRAS and its subsidiary Belgoprocess, in relation to one another.

Section D.3 of the present report provides a short overview of the taking into account of interdependencies.

Licensing system (FANC)

Article 5(1)(c) *a system of licensing of spent fuel and radioactive waste management activities, facilities or both, including the prohibition of spent fuel or radioactive waste management activities, of the operation of a spent fuel or radioactive waste management facility without a licence or both and, if appropriate, prescribing conditions for further management of the activity, facility or both;*

All facilities in which an activity is performed that involves the use of radioactive substances or ionising radiation, except the facilities holding radioactive substances in quantities or concentrations under the exemption levels set in the GRR-2001, are subject to a licensing procedure described in the GRR-2001.

The licensing procedure varies with the class of the facility. In particular, licence applications for class I facilities, namely the class to which radioactive waste and spent fuel management facilities belong, have to be accompanied by an environmental impact assessment, drawn up in agreement with the European Directive 1985/337/EEG and the Commission recommendation 2010/635/Euratom on the application of Article 37 of the Euratom Treaty (Figure 3).

Licence applications for the creation and operation of facilities are submitted to FANC, for nuclear safety verification by Bel V or FANC. Depending on the class of the facility, they are also submitted for advice to certain other authorities, such as the local authorities (municipality and province level), FANC's Scientific Council and the European Commission. Creation and operation licences are granted by FANC, with the exception of licences for class I facilities, which are granted by royal decree.

After construction, a facility can only be put into operation after its conformity with the conditions of the licence has been verified. For class I facilities, this verification is conducted by Bel V and FANC and entails checking compliance with the licence conditions, with the regulation in force (in particular the SRNI-2011) and with the safety analysis report. A positive verification leads to the confirmation of the initial licence by a royal decree called 'confirmation decree' and allows the facility to be operated.

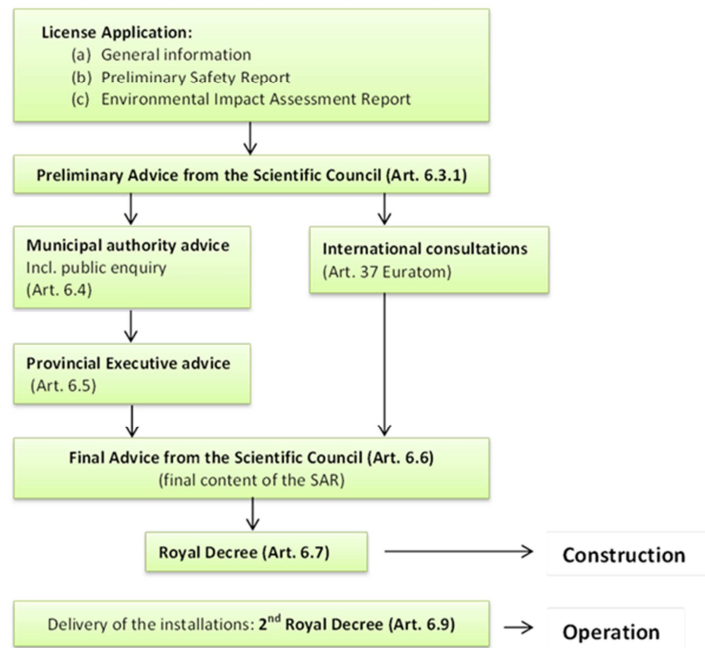


Figure 3 – Licensing procedure for class I facilities.

Institutional control, regulatory inspections, documentation and reporting (FANC)

Article 5(1)(d) *a system of appropriate control, a management system, regulatory inspections, documentation and reporting obligations for radioactive waste and spent fuel management activities, facilities or both, including appropriate measures for the post-closure periods of disposal facilities;*

FANC inspects nuclear facilities, controls compliance with the licence provisions and, more generally, compliance with the provisions of the legal and regulatory framework for radiation protection, nuclear safety and nuclear security, in particular the provisions of the GRR-2001. If necessary, licences can be suspended or withdrawn by the authorities that have issued them (see below, under Article 5(1)(e)).

During the operational period of class I facilities, a three-level control scheme is in place.

- The first level of control is ensured by the licensee's *Health Physics Department* (HPD): the HPD ensures the existence and effectiveness of the necessary measures to guarantee nuclear safety and the radiological protection of the workers, the public and the environment.
- The second level of control is ensured by *Bel V*: among other tasks, Bel V verifies the proper functioning of the HPD, commissions new or modified facilities and approves some of the HPD's decisions related to safety or radiation protection. To this end, Bel V assigns at least one specific expert to each nuclear site or to each commercial nuclear reactor, who is in charge of the operational control of that specific site or reactor. This expert is assisted by a back office of several specialised experts with thorough knowledge and expertise in various domains such as safety analysis, criticality, emergency planning, fire protection, systems and components. Bel V has the power to make recommendations to operators, but has no enforcement power. If an

operator violates the conditions of the licence and fails to correct the situation, or if the operation evolves towards an unsafe situation, Bel V reports the situation to FANC.

- The third level of control is ensured by *FANC*, which also verifies the proper functioning of Bel V. The FANC nuclear inspectors are legally entitled to take the necessary and urgent measures for protecting the workers, the public and the environment.

Licensees are required to report regularly to FANC the inventory of radioactive substances, including radioactive waste, present in their facilities.

Enforcement actions (FANC)

Article 5(1)(e) *enforcement actions, including the suspension of activities and the modification, expiration or revocation of a licence together with requirements, if appropriate, for alternative solutions that lead to improved safety;*

The procedures for enforcing regulatory requirements are based on FANC's legislative framework. The enforcement tools and measures are provided in the following legal texts:

- the FANC law;
- the GRR-2001 and the SRNI-2011;
- the Royal Decree of 20 December 2007 related to administrative fines.

The FANC nuclear inspectors are nominated by royal decree. They have the powers of enforcement inspectors and can take any measure they consider necessary to reduce or eliminate hazards for workers, the public and the environment. These measures are chosen primarily on the basis of the significance for safety of the infraction or situation, applying the principle of graded approach. They can include warnings and requests for corrective actions within six months (Articles 9 and 9bis of the FANC law). In extreme cases and if a practice may result in a specific danger, such as a detriment to health, nuclear inspectors have the power to suspend the activity. They can intervene at the request of Bel V inspectors.

In addition, FANC's Scientific Council or the FANC services in charge of the controls can, on their own initiative and at any moment, propose additional conditions to be included in the licence in order to improve safety (Article 13 of the GRR-2001).

Finally, if the licensee does not comply with the regulations or with its licence, the competent authority (namely the King for class I facilities and FANC for the other licensed facilities) can suspend or withdraw the licence, after advice of the Scientific Council for class I facilities (Article 16 of the GRR-2001).

Two types of coercive measures can be used to reinforce FANC's orders: legal penalties (requiring a legal procedure by the Court) or administrative fines (nevertheless requiring an information to and a decision by the Prosecutor for the standard procedure) (Articles 50 to 64 of the FANC law).

Allocation of responsibilities to the bodies involved

Article 5(1)(f) *the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management; in particular, the national framework shall give primary responsibility for the spent fuel and radioactive waste to their generators or, under specific circumstances, to a licence holder to whom this responsibility has been entrusted by competent bodies;*

See Sections A.1 and F.1.

Provisions for public information and participation

Article 5(1)(g) *national requirements for public information and participation;*

The right of the public to access information is regulated by the following legal provisions:

- **Article 32 of the Constitution**, which gives everyone the right to consult any administrative document and to obtain a copy of it, allowing for exceptions;
- **the Law of 11 April 1994 on administrative publicity** [Belgian Official Journal 1994a];
- **the Law of 17 December 2002 containing assent to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters and Annexes I and II, signed in Aarhus on 25 June 1998** [Belgian Official Journal 2003b];
- **the Law of 5 August 2006 on public access to environmental information** [Belgian Official Journal 2006b], which transposes Directive 2003/4/EC.

The participation process in the environmental impact assessments related to plans and programmes (including foreign parties) is regulated by the following laws:

- **the Law of 9 June 1999 containing assent to the Convention on Environmental Impact Assessment in a Transboundary Context and Appendices I, II, III, IV, V, VI and VII, signed in Espoo on 25 February 1991** [Belgian Official Journal 1999b];
- **the Law of 13 February 2006 on the assessment of the effects of certain plans and programmes on the environment and on public participation in respect of the drawing up of certain plans and programmes relating to the environment** (the so-called 'SEA law') [Belgian Official Journal 2006a], which transposes Directive 2001/42/EC and Directive 2003/35/EC, the latter amending itself the Council Directives 85/337/EEC and 96/61/EC.

In addition, FANC and ONDRAF/NIRAS must comply with specific legal and regulatory provisions:

- **the Royal Decree of 30 March 1981 (ONDRAF/NIRAS royal decree)** requires ONDRAF/NIRAS to establish and implement an information and communication programme covering all its activities;
- **the Law of 15 April 1994 (FANC law)** requires FANC to disseminate neutral and objective information in the nuclear domain;
- **the Royal Decree of 20 July 2001 (general regulations for radiation protection or GRR-2001)**, which establishes the licensing system for class I, II and III facilities, contains provisions for the compulsory consultation of the public by FANC in the frame of the licensing process of the class I facilities and of some class II facilities and for public participation in decision-making processes through the strategic environmental assessments that are compulsory for the

licensing of class I facilities and that may be required by FANC for the licensing of some class II facilities;

- **Article 179, § 2, of the Law of 8 August 1980 (ONDRAF/NIRAS law)** foresees in the possibility of public participation in disposal projects, since it allows ONDRAF/NIRAS to create a ‘medium-term fund’ to cover the costs incurred in creating and maintaining the required societal support to ensure the integration of a disposal project into a local community, particularly costs related to the activities and projects of the local community which, through a participative process, ensures the continuity of societal support for the disposal facility (surface or geological).

Financing provisions

Article 5(1)(h) *the financing scheme(s) for spent fuel and radioactive waste management in accordance with Article 9.*

The legal and regulatory framework concerning the coverage of the costs of managing spent fuel and radioactive waste and the costs of decommissioning operations, referred to globally as ‘management costs’, is currently composed of the different regulations that organise the financing of these activities, as well as of the general elements of law (civil law, accounting law, administrative law, tax law, company law, etc.) and of provisions relating to specific cases where the Federal State has already been held financially liable.

The main texts specifically related to the financing of spent fuel and radioactive waste management are listed below.

Article 179, § 2, of the Law of 8 August 1980 (ONDRAF/NIRAS law), which, in particular,

- stipulates that the costs of ONDRAF/NIRAS’ activities, including RD&D costs, are charged to the beneficiaries of its services;
- allows ONDRAF/NIRAS to create a ‘long-term fund’ to finance radioactive waste storage and disposal;
- allows ONDRAF/NIRAS to create a ‘medium-term fund’ to cover the costs of integrating disposal projects into the local communities concerned;
- allows ONDRAF/NIRAS to create an ‘insolvency fund’ mainly intended to compensate for the potential bankruptcy or insolvency of waste producers and licence holders;
- gives ONDRAF/NIRAS the mission of evaluating every five years the existence and sufficiency of the provisions established by nuclear facilities operators and the holders of radioactive substances to finance their decommissioning costs, including the costs of managing spent fuel and radioactive waste, and their remediation costs (‘inventory of nuclear liabilities’).

Royal Decree of 30 March 1981 (ONDRAF/NIRAS royal decree), which

- implements the ONDRAF/NIRAS law and, in particular,
- stipulates the obligation for radioactive waste producers to sign an agreement with ONDRAF/NIRAS focusing on, among other things, the financial terms for taking charge of their waste, and
- establishes a range of principles, called ‘guiding principles’, that will govern the financing of the long-term fund from 1 January 2019 on.

Royal Decree of 16 October 1991 on the regulations for the control and method of subsidising the Belgian Nuclear Research Centre and amending the statutes of this centre [Belgian Official Journal 1991a], which, in particular,

- defines the technical (or nuclear) liabilities of SCK•CEN as being “the obligations resulting from the decommissioning of facilities, as well as the treatment, conditioning, storage and discharge or disposal of radioactive waste arising from the decommissioning of facilities, related to the Centre’s nuclear activities up to 31 December 1988” and
- stipulates that the Federal State is responsible for financing this liability.

Royal Decree of 16 October 1991 establishing the regulations for the control and method of subsidising the National Radioelements Institute and amending the statutes of this institute [Belgian Official Journal 1991b], which, in particular,

- defines the technical (or nuclear) liabilities of the IRE as being “the obligations resulting from the decommissioning of facilities, as well as the treatment, conditioning, storage and discharge or disposal of accumulated radioactive waste, including radioactive waste arising from the decommissioning of facilities, related to the Institute’s nuclear activities” and
- stipulates that the Federal State is responsible for financing this liability.

Law of 29 April 1999 on the organisation of the electricity market [Belgian Official Journal 1999a], which, in particular,

- structures the financing, through a federal contribution, for the obligations resulting from the decommissioning of the BP1 site (former pilot reprocessing plant Eurochemic), or BP1 liabilities, and BP2 site (former SCK•CEN Waste department), or BP2 liabilities, and from the management of radioactive waste, including radioactive waste from decommissioning.

Law of 11 April 2003 on the provisions created for the dismantling of nuclear power plants and the management of fissile materials irradiated in these power plants [Belgian Official Journal 2003c], which, in particular (see also inset 4 in the national programme 2015 [Kingdom of Belgium 2015]),

- makes Synatom responsible for ensuring coverage of the costs of dismantling nuclear power plants and managing the spent fuel from these power plants;
- requires Synatom to establish provisions in its accounts for dismantling and for the management of spent fuel and requires the nuclear operator (Electrabel) and holders of a share in nuclear production to pay Synatom the amounts corresponding to the requested provisions;
- regulates Synatom’s management of the financial resources that represent the equivalent value of the established provisions;
- assigns control over the establishment and management of the provisions for the dismantling of nuclear power plants and the management of the spent fuel to a commission called the Commission for Nuclear Provisions.

E.2 Improvement of the national framework

Article 5(2) Member States shall ensure that the national framework is improved where appropriate, taking into account operating experience, insights gained from the decision-making process referred to in Article 4(3)(f), and the development of relevant technology and research.

See Section M.2.

F. Article 6 — Competent regulatory authority

F.1 Competent regulatory authority

Article 6(1) *Each Member State shall establish and maintain a competent regulatory authority in the field of safety of spent fuel and radioactive waste management.*

Created by the Law of 15 April 1994 and operational since 1 September 2001 (Section E.1–Article 5(1)(b)), FANC is the regulatory authority in the field of safety of spent fuel and radioactive waste management. More generally, FANC must ensure that the population, the workers and the environment are efficiently protected against the dangers arising from ionising radiation. It does so in particular through controlling all facilities with activities involving the use of radioactive substances or ionising radiation.

FANC created in September 2007 a subsidiary called Bel V, in the form of a foundation of private law, to assist it in its missions. Bel V, FANC’s technical support organisation, performs regulatory missions delegated by FANC. Bel V is notably responsible for conducting routine inspections in class I facilities, such as nuclear power plants, research reactors and waste management facilities, and in certain class II facilities, and for evaluating safety cases submitted to FANC.

F.2 Functional separation

Article 6(2) *Member States shall ensure that the competent regulatory authority is functionally separate from any other body or organisation concerned with the promotion or utilisation of nuclear energy or radioactive material, including electricity production and radioisotope applications, or with the management of spent fuel and radioactive waste, in order to ensure effective independence from undue influence on its regulatory function.*

FANC is an autonomous public institution with legal personality, institutionally independent (see Section F.3.2 for financial independence).

FANC is placed under the supervision of the Minister of Home Affairs and reports annually to Parliament through its supervising Minister. This ensures its independence from the Ministries and public organisations connected with the uses of nuclear energy or radioactive materials and with the management of spent fuel and radioactive waste. The public organisations dealing with questions related to nuclear energy and radioactive materials, namely SCK•CEN and IRE, are indeed under the supervision of the Minister in charge of Energy, whereas ONDRAF/NIRAS, which is responsible for the management of radioactive waste, is under the supervision of the Ministers in charge of Energy and Economy. FANC has no connections with the private sector.

Although FANC plays no part in nuclear energy promotion, it must “stimulate and co-ordinate research and development” and “[establish] privileged relationships with the public organisations working in the nuclear field, with the scientific research networks and with the relevant international organisations.” (Article 23 of the FANC law).

FANC’s Board of Directors, whose 14 members are appointed by royal decree for a fixed term of six years, on the basis of their particular scientific or professional qualities, are forbidden to take on

certain other responsibilities within the public sector or in entities that are under FANC's control for the duration of their mandate and until the end of the year following the year during which their mandate ended. They meet approximately six times per year, in the presence of a Government commissioner also appointed by royal decree. They can be dismissed by royal decree.

The Board delegates the management of FANC to the General Manager, who is appointed by royal decree for six years, it nominates and evaluates the senior management, and approves the annual budget.

FANC is advised by a 'Scientific Council for ionising radiation' on its control policy, more specifically as far as (renewals of) licence applications are concerned. The Council's composition — high-level experts in the fields of radiation protection, nuclear energy and nuclear safety — and competences are determined by royal decree.

FANC exercises its authority with regard to the nuclear operators through unilateral administrative legal acts such as the granting, refusal, modification, suspension and withdrawal of licences, recognitions or approvals. It organises inspections to verify compliance with the conditions stipulated in these acts and with the applicable regulations. FANC can claim documents in whatever form from the companies and organisations it controls. Infractions with regard to its decisions can be sanctioned.

F.3 Legal powers and human and financial resources

Article 6(3) *Member States shall ensure that the competent regulatory authority is given the legal powers and human and financial resources necessary to fulfil its obligations in connection with the national framework as described in Article 5(1)(b), (c), (d) and (e).*

F.3.1 Legal powers

See Section E.1—Articles 5(1)(d) and 5(1)(e).

F.3.2 Human and financial resources

FANC's staff level is around 160 persons. More than 60% of them are university graduates in different fields of science (physics, chemistry, biology, medicine, etc.), engineering, law, economics, social sciences and communication. Bel V employs around 70 university graduates in technical functions.

FANC's operation is entirely and directly financed by the companies, organisations or persons to whom it renders services. In practice, this is done through annual taxes charged to the holders of licences and recognitions and through non-recurrent fees charged to the applicants of licences and recognitions or approvals. The amount of the taxes is set in Article 30bis of the FANC law; the amount of the fees is fixed by royal decree, as foreseen in Article 30quater of the same law.

The taxes and fees enable FANC to be independent from licence holders. Indeed, whatever the sanction imposed by FANC on a licence holder, it does not affect the tax owed and, hence, the financing of FANC. The temporary shutdown of a nuclear facility does not influence FANC's revenues either, which enables it to rule on cases with complete independence.

The revenues and expenditures of FANC must be in equilibrium.

G. Article 7 — Licence holders

G.1 Prime responsibility for safety

Article 7(1) *Member States shall ensure that the prime responsibility for the safety of spent fuel and radioactive waste management facilities and/or activities rest with the licence holder. That responsibility can not be delegated.*

Article 28, § 1, of the FANC law, as introduced by the Law of 7 May 2017 with a view to implement recommendation R8 of the IRRS mission conducted in Belgium in December 2013, states explicitly the prime responsibility of licence holders for the safety of spent fuel and radioactive waste management (Section E.1–Article 5(1)(b)).

In addition, licensees have to comply with the regulation in force dealing with nuclear safety and radiation protection. The regulatory framework expresses the prime responsibility of operators for safety in several statements.

G.2 Regular assessment, verification and improvement of safety of existing facilities or activities

Article 7(2) *Member States shall ensure that the national framework in place require licence holders, under the regulatory control of the competent regulatory authority, to regularly assess, verify and continuously improve, as far as is reasonably achievable, the safety of the radioactive waste and spent fuel management facility or activity in a systematic and verifiable manner. This shall be achieved through an appropriate safety assessment, other arguments and evidence.*

Safety assessments during operation

Modifications during the operational lifetime of a facility are subject to safety assessments. Depending on their safety significance, the proposals are classified into one of the following three categories, to which different measures are attached:

- major modifications changing the basic characteristics of the unit, which are subject to a licence according to the provisions of Article 12 of the GRR-2001;
- minor modifications having a potential impact on safety; commissioning the modification is subject to a positive acceptance report and then to a final acceptance report by Bel V allowing implementation of the modification when all the files, procedures and the safety analysis report have been adequately updated;
- modifications without impact on safety, which have to be approved by the HPD only, without formal involvement of Bel V.

Periodic safety reviews

According to Article 14 of the SRNI-2011, all class I facilities are subject to ten-yearly periodic safety reviews.

The general objectives of the periodic safety reviews are as follows:

- to demonstrate that the facility has at least the same level of safety as it had when the licence to operate was granted, or since its latest periodic safety review;
- to inspect the condition of the facility, devoting particular attention to ageing and wear and to other factors which may affect its safe operation during the next ten years;
- to justify the facility's current level of safety, taking into account the most recent safety regulations and practices and, if necessary, to propose appropriate improvements.

In practice, since 31 December 2014, Belgoprocess submitted the final synthesis report of the periodic safety review of the BP2 site to FANC. As a result of the safety review, an action plan is ongoing to further enhance the safety level of the site. Some of the noteworthy actions of this action plan include the planned renewal of the water treatment facility and a complete update of the existing safety assessment reports.

Stress tests

Following the Fukushima Daiichi accident, all class 1 facilities, including nuclear power plants, spent fuel storage facilities and waste treatment and storage facilities, were asked to conduct stress tests. The stress tests included topics such as safety functions, earthquake, flooding, extreme weather conditions, forest fire, explosive gas and shock wave, cyber-attack, loss of electrical power and loss of ultimate heat sink, and severe accident management.

The action plans following the stress tests of the class I facilities were approved by FANC in July 2013.

The current status of the actions plans can be found on the FANC website. In particular, all deactivation pools in Doel and Tihange were provided with independent external cooling capacities in addition to the normal or accident cooling capacities as foreseen by design.

G.3 Safety demonstration and prevention of accidents for planned facilities or activities

Article 7(3) *As part of the licensing of a facility or activity the safety demonstration shall cover the development and operation of an activity and the development, operation and decommissioning of a facility or closure of a disposal facility as well as the post-closure phase of a disposal facility. The extent of the safety demonstration shall be commensurate with the complexity of the operation and the magnitude of the hazards associated with the radioactive waste and spent fuel, and the facility or activity. The licensing process shall contribute to safety in the facility or activity during normal operating conditions, anticipated operational occurrences and design basis accidents. It shall provide the required assurance of safety in the facility or activity. Measures shall be in place to prevent accidents and mitigate the consequences of accidents, including verification of physical barriers and the licence holder's administrative protection procedures that would have to fail before workers and the general public would be significantly affected by ionising radiation. That approach shall identify and reduce uncertainties.*

The pre-licensing process between Electrabel and FANC for the construction of two new spent fuel storage facilities in Doel and Tihange started in 2013 (Section M.3.4). The licence applications are planned in 2018.

The FANC guideline *"Safety demonstration of new class I nuclear installations — Approach to Defence-in-Depth, radiological safety objectives and application of a graded approach to external*

hazards” provides for more stringent reference accidents for new class I facilities, thus in particular for the future reception and storage centre for non-conditioned waste and for the future storage facility for waste (potentially) affected by an ASR. Both facilities are currently in the design review phase, with licence applications expected in 2019. These licence applications will be accompanied by safety assessments.

ONDRAF/NIRAS is currently adapting the safety case that supports the licence application for the surface disposal facility for category A waste with its answers — discussed with FANC — to FANC’s questions (Section B.3.3). After a positive control by FANC, the case will be submitted to FANC’s Scientific Council for a first opinion on the licence application.

The proposed royal decree on the licensing system for disposal facilities includes provisions for all the licensing steps, thus also for the closure of disposal facilities and for their post-closure phase (Section M.2).

G.4 Integrated management systems

Article 7(4) *Member States shall ensure that the national framework require licence holders to establish and implement integrated management systems, including quality assurance, which give due priority for overall management of spent fuel and radioactive waste to safety and are regularly verified by the competent regulatory authority.*

Licence holders of class I facilities are required to have an integrated management system (Article 3 of the SRNI-2011).

To fulfil its mission and achieve its objectives, Electrabel establishes, implements, assesses and continually improves a management system that meets the following basics:

- nuclear safety is the overriding priority within the management system, taking precedence over all other considerations;
- it fosters the development of, and promotes the improvement of, a strong nuclear safety culture by improving behaviour and attitudes both among individual workers and line management;
- it identifies and integrates coherently all requirements that are applicable to its activities and processes, especially about nuclear safety, quality, nuclear security, health and safety, environmental protection and economic considerations;
- it is based on the identification, development, implementation, assessment and continuous improvement of the processes needed to achieve the goals and meet all requirements applicable to Electrabel.

The integrated management system applies to any safety-related structure, system or component as well as to activities or processes affecting nuclear safety, for instance human performance, organisational performance, safety culture, radiological protection, radioactive waste management, fire detection and protection, environmental monitoring, nuclear fuel management, emergency intervention and site security.

The ONDRAF/NIRAS integrated management system is an instrument meant to contribute to ONDRAF/NIRAS’ objectives. ONDRAF/NIRAS has been further implementing it to ensure that interdependencies between the different steps of the management of radioactive waste are taken into account as best as possible (see also Section D.3). This system includes such elements as safety,

environment, quality, economy, and human and organisational factors, in line with the IAEA Safety Requirements and Safety Guides concerning integrated management systems.

The most important evolutions since 31 December 2014 are as follows:

- development of a structured risk management system (define scope, identify risks, describe risks and consequences, propose measurements and ensure follow-up) suitable at every management level;
- documentation and description of all ONDRAF/NIRAS internal processes (using a graded approach), with focus on the interaction between the processes, the roles and responsibilities and the interaction with Belgoprocess and other stakeholders;
- review of the safety policy in line with the IAEA safety standard GSR part 2 and development of an action plan mainly aimed at improving and optimising the safety culture.

Belgoprocess has implemented for its activities a quality management system that complies with the IAEA safety standard GSR part 2 and works continuously towards a total integration of quality, safety and environmental protection issues into one management system.

G.5 Licence holders' financial and human resources

Article 7(5) *Member States shall ensure that the national framework require licence holders to provide for and maintain adequate financial and human resources to fulfil their obligations with respect to the safety of spent fuel and radioactive waste management as laid down in paragraphs 1 to 4.*

See Sections H and I.

H. Article 8 — Expertise and skills

Article 8 *Member States shall ensure that the national framework require all parties to make arrangements for education and training for their staff, as well as research and development activities to cover the needs of the national programme for spent fuel and radioactive waste management in order to obtain, maintain and to further develop necessary expertise and skills.*

The acquisition, maintenance and development of the necessary expertise and skills are concerns that are taken into account by all actors. The existing provisions of the legal and regulatory framework transposing Article 8 of Directive 2011/70/Euratom (Section E.1–Article 5(1)(b)) are not yet fully applicable, because the implementing rules of Article 5 of the Law of 3 June 2014 have not yet been established by royal decree.

Generally speaking, ONDRAF/NIRAS, FANC and Bel V are involved at the international (IAEA and OECD/NEA) and European levels to share best practices, knowledge and resources on all kinds of issues related to spent fuel and radioactive waste management, such as geological disposal, integrated management systems, safety culture, radiation protection, preservation of records, knowledge and memory, and update of existing standards and development of new ones. They also have bilateral agreements with, respectively, foreign radioactive waste management agencies and regulatory bodies.

H.1 Education and training

Examples of education and training activities related to the management of spent fuel and radioactive waste are as follows:

- ONDRAF/NIRAS and Belgoprocess stimulate their staff to attend regular training in specific technical fields (radiation protection, waste conditioning techniques, disposal of radioactive waste, etc.);
- the Belgian Nuclear Higher Education Network (BNEN), a consortium of six Belgian universities and SCK•CEN, organises a post-graduate qualification in nuclear engineering, which comprises in particular a course on the nuclear fuel cycle and a course on MOX and thorium fuels, radiochemistry and dismantling;
- the 'SCK•CEN Academy' organises courses in all SCK•CEN's RD&D fields, especially radioactive waste management;
- FANC has organised a training course on waste disposal in collaboration with the SCK•CEN Academy and a training course on waste management in collaboration with ONDRAF/NIRAS and the SCK•CEN Academy;
- FANC and ONDRAF/NIRAS organise information meetings on specific topics for their staff (waste acceptance system, on-site inspections of spent fuel and waste management activities, etc.);
- ONDRAF/NIRAS, SCK•CEN and EURIDICE organise exchange meetings to share information about their research activities in the fields of surface and geological disposal.

Finally, the retention of the nuclear knowledge in the Mol–Dessel area is a condition set by the local communities for constructing the surface disposal facility for category A waste in Dessel.

H.2 Research and development

RD&D in terms of the management of spent fuel and radioactive waste is essentially that conducted on behalf of Synatom, Electrabel and ONDRAF/NIRAS, and that conducted by Belgoprocess and by FANC and Bel V.

Synatom is, for instance, represented within a network of international experts who address various subjects directly related to the evolution of spent fuel, including modelling of heat exchanges in dry storage, the behaviour of the structure materials of fuel assemblies or determining the residual heat of the fuel after its unloading. Since 2014, Synatom has also developed an encapsulation and drying process for the safe management of defective fuel rods. This first-of-a-kind technology was qualified and demonstrated in Doel in 2017.

Electrabel has R&D on resins and concentrates conditioning processes conducted on its behalf.

RD&D on behalf of ONDRAF/NIRAS is mostly conducted by SCK•CEN, whose pioneering role in RD&D for radioactive waste management, and in particular long-term management, dates back to the 1960s, namely before the first commercial nuclear reactors were commissioned. Since its creation, ONDRAF/NIRAS has played a major role in the steering of SCK•CEN's RD&D in radioactive waste management. ONDRAF/NIRAS and SCK•CEN created in 1995 the EIG PRACLAY, which became the EIG EURIDICE (European Underground Research Infrastructure for Disposal of Nuclear Waste in Clay Environment), primarily to manage the HADES underground research laboratory, recognised by the IAEA as a centre of excellence for disposal technologies and training of scientists (see also Section K.3—Article 12(1)(f)).

ONDRAF/NIRAS also commissions R&D to universities, research centres and industries worldwide.

Belgoprocess conducts applied RD&D to further develop treatment and conditioning techniques, notably on plasma technology.

FANC and Bel V conduct independent R&D related to radioactive waste management to establish the tools necessary for the independent review of the (preliminary) safety cases for disposal facilities set up by ONDRAF/NIRAS and to develop and retain expertise in the field. In this framework, FANC and Bel V have developed a programme called SRN, that is Strategic Research Needs — Strategic Issues Underlying the Development of Expertise and Skills of FANC/Bel V in Geological Disposal. This programme is executed through a deployment plan that is regularly updated. FANC is also a member of the Mont Terri URL consortium.

I. Article 9 — Financial resources

Article 9 *Member States shall ensure that the national framework require that adequate financial resources be available when needed for the implementation of national programmes referred to in Article 11, especially for the management of spent fuel and radioactive waste, taking due account of the responsibility of spent fuel and radioactive waste generators.*

The organisation of the coverage of the costs of managing spent fuel and radioactive waste and the costs of decommissioning operations, referred to globally as ‘management costs’, can be divided in two: the financing mechanisms set up by ONDRAF/NIRAS for managing the transferred waste (Section I.1) and the financing mechanisms used by radioactive waste producers and spent fuel owners to cover the costs of managing their waste or spent fuel before transfer to ONDRAF/NIRAS, the costs of their decommissioning operations and the costs of transferring their waste to ONDRAF/NIRAS (Section I.2). The existence and the sufficiency of the established and planned provisions to cover the management costs are assessed every five years by ONDRAF/NIRAS in the frame of its mission to draw up the so-called ‘inventory of nuclear liabilities’ (Sections I.2 and I.3). In addition, ONDRAF/NIRAS assesses the availability of the corresponding financial resources (Section I.3). For the commercial power plants, the Commission for Nuclear Provisions is in charge of controlling the establishment and management of the provisions for the dismantling of nuclear power plants and for the management of the associated spent fuel (Section I.3).

I.1 Financing mechanisms for radioactive waste management set up by ONDRAF/NIRAS

ONDRAF/NIRAS takes charge of radioactive waste from producers after acceptance and against payment of a fee intended to cover the costs of managing the transferred waste. In accordance with the provisions of the ONDRAF/NIRAS law, ONDRAF/NIRAS must divide its costs, estimated at cost price, proportionally between the beneficiaries of its services, namely the radioactive waste producers. The allocation of responsibilities between ONDRAF/NIRAS and the producers is set out in the contracts between them.

The costs of managing radioactive waste can be divided into three main areas, which are financed using separate methods:

- short-term management activities (Section I.1.1),
- medium-term and long-term management activities (Section I.1.2),
- other services, particularly RD&D (Section I.1.3).

An insolvency fund is intended to cover financial obligations regarding decommissioning and radioactive waste management of defaulting producers and licence holders (Section I.1.4).

I.1.1 Financing of short-term management activities

Schematically, financing for the treatment and conditioning of radioactive waste is provided via two different mechanisms.

- The so-called ‘main’ radioactive waste producers concerned by treatment and conditioning, namely Electrabel, FBFC International, Belgonucleaire, IRE and SCK•CEN on the one hand and the Federal State as the financially liable entity for historical nuclear liabilities on the other

hand, finance the treatment and conditioning of their waste in accordance with the provisions of the agreements between them and ONDRAF/NIRAS. Since 1996, these agreements have been based on a capacity reservation system that stipulates that each 'main' producer guarantees the payment to ONDRAF/NIRAS of an agreed fraction of the fixed costs for the treatment and conditioning facilities and the payment of the variable operating costs for the management of its waste as it is accepted by ONDRAF/NIRAS. In practice, the 'main' producers pay their share of the fixed costs according to a contractual schedule and pay the fees corresponding to the variable portion of the costs for the treatment and conditioning of their non-conditioned waste as ONDRAF/NIRAS takes charge of it. Pursuant to the provisions in the agreements, these fees can be revised every five years.

- The 'small' radioactive waste producers finance the treatment and conditioning of their waste through so-called 'all-in' fees that cover ONDRAF/NIRAS' services (treatment, conditioning, storage, disposal, transport, RD&D, etc.).

I.1.2 Financing of medium-term and long-term management activities

Financing for the medium-term and long-term management of radioactive waste must cover the costs of technical activities and the costs of the projects associated by local communities with the implementation of disposal projects in order to ensure that the global projects — or integrated projects — present added value for the region concerned. In accordance with the ONDRAF/NIRAS law, technical costs are covered by fees paid by producers into a centralised fund, the long-term fund, and the costs of associated projects will be covered by the medium-term fund.

Long-term fund The long-term fund is ONDRAF/NIRAS' responsibility. Its mechanism is based on a capitalisation system. It is financed by producers every time they transfer radioactive waste to ONDRAF/NIRAS, according to a mechanism which ensures that ONDRAF/NIRAS should be able to cover its fixed costs and enables it to cover its variable costs as they arise.

The provisions of the Royal Decree of 25 April 2014 [Belgian Official Journal 2014a], which amends the ONDRAF/NIRAS royal decree, by 31 December 2018 specifies in particular the guiding principles for financing the long-term fund, stipulates indeed that, from then on, fee increases will be passed onto producers based on their full programme for generating radioactive waste, in other words, both the waste already transferred to ONDRAF/NIRAS and the waste still to be transferred.

Medium-term fund The medium-term fund will be financed by contributions from the producers, calculated on the basis of the total capacity of the disposal facility (surface or geological) and the total waste quantities from each producer that are intended to be disposed of within the facility. The obligation for producers to contribute to the fund begins as soon as the first disposal facility has received its nuclear construction and operation licence and the necessary non-nuclear permits. The fund must be fully established no later than three months after the disposal facility has been allowed to start operation.

I.1.3 Financing of other services, particularly RD&D

Other services (RD&D, acceptance system, transport, radiological and physico-chemical inventory, communication, etc.) are financed based on the terms set out in bilateral agreements with waste producers. These usually provide for quarterly advance payments with settlement based on the closure of ONDRAF/NIRAS' annual accounts.

I.1.4 Insolvency fund

The insolvency fund is, in accordance with the provisions of the ONDRAF/NIRAS law, mainly intended to finance services for the management of radioactive waste and the decommissioning of nuclear facilities that are not covered following the bankruptcy or insolvency of the financially liable entities, which are implicitly identified as not including the financially liable entities for class I nuclear facilities. The insolvency fund also covers the costs of managing sources declared by FANC as orphans and waste. It does not cover services resulting from the bankruptcy or insolvency of entities that are financially liable for radium-bearing waste from old radium extraction activities and for NORM waste to be managed as radioactive waste.

The insolvency fund is financed by invoicing producers a reserve of 5% calculated on the costs of the transport, treatment, conditioning and storage services provided by ONDRAF/NIRAS.

I.2 Financing mechanisms used by producers in general and specific financing mechanisms

ONDRAF/NIRAS has identified, in the frame of its five-yearly inventory of nuclear liabilities [ONDRAF/NIRAS 2018a], four types of financing mechanism used in Belgium to cover the management costs, with which it associates different degrees of availability of the financial resources:

- **annual budget:** the relatively immediate nature of an annual budget gives the financial resources a high level of availability;
- **budget plan over several years:** the inconsistency between the use of this short-term financing mechanism and the aim of covering medium- or long-term commitments gives the financial resources an insufficient or even almost zero availability;
- **establishment of accounting provisions:** this mechanism, which is the most frequently used, gives the financial resources an almost zero availability. One or more additional measures can however be associated with the establishment of the provisions, for example in the form of conditions on the management of financial resources, which increase the availability of these resources;
- **establishment of an internal or external fund:** this mechanism gives the financial resources a low to high availability, depending on its characteristics. One or more additional measures can also be associated with the establishment of a fund, which increase the availability of these resources.

Although there are no general provisions in the legal and regulatory framework ensuring the existence, the sufficiency and the availability of financial resources to cover the management costs, some specific legislation and regulation exist, principally

- **the Law of 11 April 2003** on the provisions relating to the dismantling of nuclear power plants and the management of spent fuel, that makes Synatom responsible for ensuring coverage of the costs of dismantling nuclear power plants, including the costs of managing the resulting radioactive waste, and of managing the spent fuel, and that assigns control over the establishment and management of the corresponding provisions to the Commission for Nuclear Provisions (Section E.1–Article 5(1)(h));
- **laws and royal decrees relating to the three historical nuclear liabilities to be borne by the Federal State** (Section E.1–Article 5(1)(h)):
 - **Belgoprocess** The nuclear liabilities cover all historical obligations associated with the BP1 site, or BP1 liabilities, and the BP2 site, or BP2 liabilities: management of historical waste, decommissioning of facilities and sites remediation.

- **SCK•CEN** The nuclear liabilities cover all obligations related to SCK•CEN's nuclear activities up to 31 December 1988.
- **IRE** The nuclear liabilities cover all obligations related to IRE's nuclear activities, without any limitation in time, and cover thus also the management of operational radioactive waste.

The financing of the three historical nuclear liabilities to be borne by the State is ensured through the creation of three separate funds within ONDRAF/NIRAS, which manages them.

I.3 Sufficiency and availability of the provisions

As part of its legal missions, ONDRAF/NIRAS draws up every five years an inventory of all nuclear facilities and sites containing radioactive substances, estimates the management costs that will have to be borne by each financially liable entity and evaluates the existence and sufficiency of the provisions established to cover these costs (see Table 6 for a summary of key elements of the report 2013–2017). In addition, it evaluates the availability of the corresponding financial resources. The inventory report 2013–2017, which ONDRAF/NIRAS submitted to its supervisory authority in February 2018, does not reveal significant changes with respect to the previous inventory report. ONDRAF/NIRAS also made recommendations to government to further improve the sufficiency and availability of the provisions.

In particular, the ceasing of economic activities of nuclear operators, such as Belgonucleaire and FBFC International, is problematic when applying the polluter pays principle to the financing of long term radioactive waste management.

Pursuant to the Law of 11 April 2003, the Commission for Nuclear Provisions controls the establishment and management of the provisions for the dismantling of nuclear power plants and for the management of the associated spent fuel. After receiving the advice of ONDRAF/NIRAS, the Commission for Nuclear Provisions assessed and evaluated on 12 December 2016 the methodology and adequacy of the provisions of Synatom, for the commercial nuclear power plants. The Commission for Nuclear Provisions also made recommendations to government to further improve the sufficiency and availability of the provisions for the commercial nuclear power plants.

Table 6 – Summary, drawn up from ONDRAF/NIRAS' inventory report 2013–2017 on nuclear liabilities, of the (main) entities responsible for covering the management costs associated with a selection of significant sites in Belgium and the main financing mechanisms they have established, and similar information for several specific waste groups (update of Table 3 of the national programme 2015).

Sites (or groups of waste)	Financially liable entities (main)	Main financing mechanisms
Sites for which there are no historical nuclear liabilities or for which there are historical nuclear liabilities for part of the costs only		
Electrabel (Doel and Tihange)	Operational waste: Electrabel Spent fuel and dismantling: Synatom	Annual budget 'External' accounting provisions with additional measures
FBFC International (Dessel)	FBFC International	Accounting provisions with additional measures
Belgonucleaire (Dessel)	Belgonucleaire	Accounting provisions with additional measures
SCK•CEN (Mol)	SCK•CEN (for part of the management costs)	Accounting provisions with additional measures
JRC Geel	European Commission	Budget planning
Universities and university hospitals	(The associated) Universities	Accounting provisions, annual budget or none depending on who is responsible
Private radioisotope production companies	The companies concerned	Accounting provisions
Belgoprocess (Mol and Dessel)	ONDRAF/NIRAS (for part of the management costs)	Internal funds with additional measures
Best Medical Belgium (Fleurus), declared bankrupt (2012) and no longer having financial resources	Walloon Region (for the management costs referred to in agreements prior to the bankruptcy)	External fund with additional measures
Umicore's authorised storage facilities and radium-bearing substances to be managed as radioactive waste (Olen)	Umicore	Accounting provisions
Orphan sources	—	Insolvency fund
NORM substances that would have to be managed as radioactive waste	Site operator, user or owner	Environmental accounting provisions, not specific to potential costs for management of NORM substances as radioactive waste
Sites where management costs are, in part or in full, historical nuclear liabilities		
Belgoprocess (Mol and Dessel)	Federal State (for part of the management costs)	External fund, without separate legal personality, with additional measures
SCK•CEN (Mol)	Federal State (for part of the management costs)	External fund, without separate legal personality, with additional measures
IRE (Fleurus)	Federal State	External fund, without separate legal personality, with additional measures
Best Medical Belgium (Fleurus), declared bankrupt (2012) and no longer having financial resources	-	Insolvency fund (for the management costs not referred to in the agreements with the Walloon Region prior to the bankruptcy)

J. Article 10 — Transparency

In addition to the general provisions regarding public information and participation, the legal and regulatory framework imposes specific obligations to FANC and ONDRAF/NIRAS in these fields (Section E.1—Article 5(1)(g)) and to the Commission for Nuclear Provisions. Pursuant to its statutes, SCK•CEN is tasked with information and documentation activities. Finally, Electrabel and Synatom, as key stakeholders in the management of spent fuel and radioactive waste, also provide information to the general public.

J.1 Information to the general public and workers

Article 10(1) *Member States shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority inform the public in the fields of its competence. Information shall be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, recognised in national legislation or international obligations.*

J.1.1 FANC

FANC is required by the Law of 15 April 1994 to disseminate neutral and objective information in the nuclear domain. It informs the general public and workers through various channels:

Corporate website FANC's corporate website (www.afcn.fgov.be or www.fanc.fgov.be), respectively in French and in Dutch, is FANC's main communication tool. It is a comprehensive source of information, for both general and professional audiences, in all of FANC's areas of competences, including the aspects related to spent fuel and radioactive waste management. It contains many downloadable synthesis reports, often available in English. It is updated on a continuous basis and flash news are published regularly. A specific section, JURION, contains the entire national, European and international legal and regulatory framework related to radiation protection. The FANC website allows the general public to ask questions to FANC and to request access to information provided it is non-classified and it does not jeopardise the general interest or the interest of a specific third party.

Public events Training sessions and workshops.

Printed information Annual report and information brochures.

Media information Press releases and conferences.

Bel V has its own website (www.belv.be) and also publishes an annual report.

Information for the general public about emergency planning in case of a nuclear accident is provided on the following website:

www.risquenucleaire.be or www.nucleairrisico.be or www.nuklearrisiko.be.

J.1.2 ONDRAF/NIRAS

ONDRAF/NIRAS is required by the Royal Decree of 30 March 1981 to establish and implement an information and communication programme covering all its activities. It informs the general public

through a variety of channels, sometimes in collaboration with other actors. Examples of information channels are as follows:

Corporate website ONDRAF/NIRAS' corporate website (www.ondraf.be or www.niras.be), respectively in French and in Dutch, provides general information on ONDRAF/NIRAS' activities in radioactive waste management, including downloadable documents going from general information sheets to comprehensive reports, in particular the five-yearly inventory report on nuclear liabilities [ONDRAF/NIRAS 2018a], the so-called 'Waste Plan' [ONDRAF/NIRAS 2011] and the so-called 'RD&D Plan' [ONDRAF/NIRAS 2013].

Printed information

- annual report, also distributed digitally since 2016;
- bi-annual ONDRAF/NIRAS magazine (in French and in Dutch);
- quarterly 'NIRAS-Belgoprocess newspaper' (in Dutch), distributed door-to-door to the inhabitants of Dessel, where the surface disposal facility is to be built, and of the four surrounding municipalities. This newspaper's content, that was originally limited to the surface disposal project, was broadened in 2016 to all of ONDRAF/NIRAS' and Belgoprocess' activities.

Visits and public information evenings

- visits to ONDRAF/NIRAS' information centre on radioactive waste management in Dessel (www.isotopolis.be): 11 000 visitors per year on average (75% from schools, 23% from associations, 2% from companies), where visits include
 - ▶ since 2017, the demonstration tests of the surface disposal project;
 - ▶ for schools, the possibility to visit the EURIDICE exhibition space;
- visits to the EURIDICE exhibition space and the HADES underground research laboratory: 2 500 visitors per year on average (50% education and training, 30% technical visits, 20% associations), with a 25% increase in the number of visitors over the period 2015–2017;
- local public information evenings related to various aspects of the surface disposal project.

Media information Annual encounters with the press, that contribute to building thrust among this target group, complemented by dossier-related press conferences.

Belgoprocess, EURIDICE and the STORA and MONA partnerships (Section J.2) each have their own website — respectively www.belgoprocess.be, www.euridice.be, www.stora.org and www.monavzw.be — and provide information to the public, too, with STORA and MONA playing a key role in informing the local communities.

J.1.3 Others

Commission for Nuclear Provisions

The Commission for Nuclear Provisions must submit an annual activity report to the Minister in charge of Energy, who hands it over to Parliament and ensures it receives adequate publicity. The report is published on the website of the Federal Public Service Economy:

<https://economie.fgov.be/fr/themes/energie/sources-denergie/nucleaire/centrales-nucleaires/demantelement-des-centrales> (in French) or
<https://economie.fgov.be/nl/themas/energie/energiebronnen/kernenergie/kerncentrales/ontmanteling-van-kerncentrales> (in Dutch).

SCK•CEN

Pursuant to its statutory mission to maintain a centre of excellence on nuclear energy and ionising radiations, SCK•CEN, among other things, gathers, keeps up to date and spreads scientific, technical, technological and socially relevant documentation, acting as a centre of knowledge, and

promotes the knowledge of the various nuclear sciences, techniques and technologies among the population. It has a corporate website (www.sckcen.be) and distributes printed information (annual highlights and other (mainly scientific) publications).

Electrabel

Each year, the nuclear power plants issue an environmental declaration, available on the corporate website (corporate.engie-electrabel.be), listing the various ways in which their activities have affected the environment and outlining the measures taken to guarantee safety, preserve the environment and secure the well-being of their workers. These data are complemented by environmental results and objectives, including those dealing with the creation and management of radioactive waste and effluents. Any significant impact is covered in an action plan intended to reduce said impact.

Synatom

Synatom informs the general public through its corporate website (synatom.be) and printed information (annual report and other publications).

National Programme Committee

The National Programme Committee publishes the national programme for the management of spent fuel and radioactive waste and the national report on the implementation of Directive 2011/70/Euratom on its website (www.cpnpc.be).

J.2 Public participation

Article 10(2) *Member States shall ensure that the public be given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.*

J.2.1 FANC

FANC consults the general public ('public inquiry') in the frame of the licensing process of the class I facilities and of some class II facilities as described in the GRR-2001, offering the possibility to attend information meetings, and consults the European Commission according to the provisions of Article 37 of the Euratom Treaty.

Public participation in decision-making processes is foreseen in the GRR-2001 through the strategic environmental assessments that are compulsory for the licensing of class I facilities and that may be required by FANC for the licensing of some class II facilities.

J.2.2 ONDRAF/NIRAS

ONDRAF/NIRAS is, since December 2010, entitled by law to take the necessary initiatives intended to create and maintain the societal support that is necessary to ensure the integration of a disposal project into a local community, including through participative processes and structures (Section E.1–Article 5(1)(b)). The active participation of stakeholders of the local communities concerned by the surface disposal of category A waste has however been a reality for 20 years already.

- **Category A waste disposal** The local partnerships STORA (in Dessel) and MONA (in Mol) continue to follow the ongoing licensing process for the disposal facility and to accompany the

development of both the associated technical surface facilities and the societal projects that will bring added value to the region.

- **Category B&C waste disposal** ONDRAF/NIRAS' proposal for the bases of a national long-term management policy makes provisions for a decision-making process that must, in particular, be participative, fair and transparent. This is in order to create and maintain the societal support necessary to develop the long-term management solution with one or more local communities that will have been informed and will have agreed to it, and, in the long run, to ensure the integration of a radioactive waste disposal project at local level.

Some initiatives have already been taken, such as the involvement of the partnerships STORA and MONA in European projects related to geological disposal (for instance, the Modern2020 project discussing the monitoring of geological disposal during the operational phases). This participation includes discussions with foreign experts during the Modern2020 working meetings as well as home sessions led by ONDRAF/NIRAS with academic partners (University of Antwerp).

K. Articles 11 and 12 — Progress in the implementation of the national programme since 31 December 2014

K.1 Implementation

Article 11(1) *Each Member State shall ensure the implementation of its national programme for the management of spent fuel and radioactive waste ('national programme'), covering all types of spent fuel and radioactive waste under its jurisdiction and all stages of spent fuel and radioactive waste management from generation to disposal.*

The first edition of the national programme and giving the situation at 31 December 2014, was adopted by the Federal Council of Ministers on 30 June 2016. The proposal was communicated to the European Commission on 22 August 2015. The ministerial decree of 3 October 2016 sanctioning this adoption was published in the Belgian Official Journal on 15 June 2017. The French and Dutch versions, as well as the English courtesy translation, are available on a dedicated website of the Federal Government: www.cpnpc.be.

The existing national policies are listed in Section D.1, together with those that should still be defined. Table 8, in Section K.3, provides an overview of the state of progress towards implementation of the national programme.

K.2 Review and update

Article 11(2) *Each Member State shall regularly review and update its national programme, taking into account technical and scientific progress as appropriate as well as recommendations, lessons learned and good practices from peer reviews.*

According to the provisions of the Law of 3 June 2014, the national programme must be updated regularly, and whenever a national policy is adopted or modified. This update, whose frequency is not set, is the task of the National Programme Committee (CPNPC) created by the same law (see also Section E.1—Article 5(1)(a)). Significant changes to the national programme must be notified to the European Commission within the month following their adoption.

The methods for following up the implementation of the national policies, which, according to the Law of 3 June 2014, must be part of these policies, have not been adopted yet. However, the proposal for the bases of the national policy on the long-term management of B&C waste that was submitted by ONDRAF/NIRAS to its supervisory authority in February 2018 foresees the establishment of a decision-making process that includes in particular the follow-up methods of that policy (Section B.1).

Belgium has yet to organise a self-assessment and to receive an international peer review mission covering the topics under Article 14(3).

With no new national policies or modifications of existing ones to take into account, the national programme 2015 has not been updated.

K.3 Contents

Article 12(1) *The national programmes shall set out how the Member States intend to implement their national policies referred to in Article 4 for the responsible and safe management of spent fuel and radioactive waste to secure the aims of this Directive, and shall include all of the following:*

Article 12(1)(a) *the overall objectives of the Member State's national policy in respect of spent fuel and radioactive waste management;*

The overall objectives of Belgium's national policies on spent fuel and radioactive waste management are unchanged (Sections D.1 and D.3).

Article 12(1)(b) *the significant milestones and clear timeframes for the achievement of those milestones in light of the overarching objectives of the national programme;*

Table 7 summarises the timeframes for the achievement of the significant milestones mentioned in the national programme 2015, together with other milestones for which the programme does not announce a timeframe, and gives the current estimated timeframes. Although there has been some progress in the implementation of the national programme 2015, this progress is generally not reflected at the level of the significant milestones.

Based on the current implementation planning proposed by ONDRAF/NIRAS for surface and geological disposal and the discovery of non-conformities, extra storage capacities are under evaluation (see also Section M.3.4). ONDRAF/NIRAS monitors the situation in two complementary ways:

- continuous short-term follow-up of the remaining storage capacity for category A and B waste on the basis of short-term predictions of the volumes of conditioned waste produced on the Belgoprocess sites and on the sites of Doel and Tihange, with reporting on the remaining storage capacity on a regular basis to FANC/Bel V and to the main waste producers; interactions with FANC/Bel V are required to be allowed to use some of the reserve capacity;
- five-yearly update of the necessary investments for extra storage capacity for every type of waste, on the basis of the production forecasts for operational and dismantling waste, which the main waste producers are requested to provide.

Table 7 – Overview of progress in the implementation of the national programme 2015.

Significant milestones		Timeframe according to the national programme 2015	Current estimated timeframe
Adoption and implementation of (parts of) national policies			
Bases of the policy on the long-term management of B&C waste		proposal to be submitted in 2015	proposal 2015 not approved; new proposal submitted in 2018;
Policy on the long-term management of radium-bearing and NORM substances to be managed as radioactive waste		no timeframe set	no timeframe set, assessment of the situation in progress
Policy on the management of part of the spent fuel from SCK•CEN's reactors by its owner		no timeframe set	no timeframe set
Proposals, by the respective owners, regarding the further use of the spent fuel from the commercial nuclear reactors and from some SCK•CEN reactors		no timeframe set	no timeframe set
Implementation of the national programme			
Management of spent fuel by its owners			
Update and finalisation of the 1994–2001 Synatom security and feasibility studies for the industrial conditioning of spent fuel		2016	finalised in 2016
Return of the last waste from the reprocessing of Doel and Tihange spent fuel		2017	2018
Commissioning of new spent fuel storage facilities in Doel and Tihange		2022	Tihange: 2023 Doel: 2024
Centralised short- and medium-term management of radioactive waste			
Commissioning of the reception and storage centre for non-conditioned waste		2018	2024
Commissioning of the storage building for ASR-affected waste packages		2018	early 2023
Long-term management of category A waste			
Caisson plant	start construction	$T_0^{[1]}$	2018
	start operation	$T_0 + 2$ years	2021
Monolith production facility ^[2]	start construction	T_0	2018
	start operation	$T_0 + 4$ years	2021
Disposal facility	nuclear licence	$T_1 - 3$ months	end 2019
	start construction	T_1	end 2019
	start operation	$T_1 + 4$ years	2023
	end operation	$T_1 + 54$ years	2073
	complete closure	$T_1 + 104$ years	2123
Communication centre	start construction	mid-2016	end 2018
	start operation	end 2019	autumn 2022
Long-term management of B&C waste			
	nuclear licence	T_0	$T_0^{[3]}$
	start of disposal of category B waste	$T_0 + 15$ years	$T_0 + 20$ years
	start of disposal of category C waste	$T_0 + 55$ years	$T_0 + 60$ years
	end of operation	to be decided	$T_0 + 80$ years
	complete closure	$T_0 + 100$ years minimum	to be decided

^[1] T_0 = positive opinion of FANC's Scientific Council on the licence application file for the disposal facility + 3 months.

^[2] (Non-nuclear) construction and environment permits issued early 2013 and nuclear construction and operation licence issued 11 April 2014.

^[3] T_0 is considered to be 2050, assuming that the bases of the policy on the long-term management of B&C waste are adopted in 2018.

Article 12(1)(c) *an inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;*

See Section C.2.

Article 12(1)(d) *the concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;*

The concepts or plans and technical solutions for spent fuel and radioactive waste management have remained mostly unchanged since 31 December 2014. Key examples of the changes brought are as follows:

Short-term management:

- implementation of an innovative encapsulation technology developed by Synatom to safely manage the defective fuel rods from commercial nuclear reactors.

Medium-term management:

- with a view to optimisation, revision, at the end of 2017 — on the basis of a better understanding of the characteristics of the (potentially) ASR-affected waste packages and of the associated physico-chemical reactions — of the capacity of the planned storage facility for those packages and of the concept for their storage: the storage capacity would be reduced from 10 000 packages to 6 000 packages and the packages would be stored in racks vertically instead of horizontally, to reduce the risks of overflow of the gel substance produced by the ASR.

Article 12(1)(e) *the concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;*

A 300 year post-closure surveillance period is foreseen in the licence application for the future Dessel surface disposal facility for category A waste. Possible markers have also been the subject of a product development study and a long-term archiving strategy for important information has been fixed.

In the absence of a national policy on the long-term management of B&C waste, developing concepts or plans for the post-closure period of the future geological disposal facility for B&C waste is premature. Studies are nevertheless underway on monitoring, reversibility and retrievability, which are legal requirements.

Article 12(1)(f) *the research, development and demonstration activities that are needed in order to implement solutions for the management of spent fuel and radioactive waste;*

The RD&D activities needed to implement solutions for the management of spent fuel and radioactive waste continue in an international and European framework. Examples of key RD&D topics since 31 December 2014 or in the near future are as follows:

Short-term and medium-term management:

- R&D on resins and concentrates conditioning processes (Electrabel);
- participation in the European project “THERAMIN” aimed at identifying and testing thermal treatment techniques for potentially problematic waste types and at evaluating their end products with respect to long-term safety (ONDRAF/NIRAS and SCK•CEN);
- continuation of the first R&D phase (2016–2020) on the waste packages presenting an ASR (ONDRAF/NIRAS):
 - ▶ study of the gel formation mechanisms;
 - ▶ development of non-destructive control techniques for following up gel formation;
 - ▶ assessment of the consequences for disposal;
 - ▶ development of solutions for retreatment and reconditioning.

Long-term management, surface disposal:

- destructive and non-destructive controls of conditioned waste packages prior to surface disposal (to begin shortly);
- control of the groundwater flow direction and speed on the surface disposal site and its direct surroundings, in order to verify that the local hydrogeological model predicts the direction well and that it does not underestimate the speed.

Long-term management, geological disposal:

- continuation of the PRACLAY heater experiment, that has been running according to plans since November 2014 and indicates so far that the properties of Boom Clay, favourable for the confinement of high-level waste, are not significantly affected by heating;
- preparation of a methodological safety and feasibility case for geological disposal, planned for 2020 and considering several depths between 200 and 600 metres in poorly-indurated clays, thereby taking advantage of ONDRAF/NIRAS’ 35 years of RD&D on Boom and Ypresian clays;
- at the request of FANC, studies with a view to applying the optimisation principle to the future choice of the host formation for the geological disposal facility through the development of safety attributes;
- launch of an iterative revision process, with independent review, of the layout of the disposal facility to identify an optimised solution taking into account long-term safety, operational safety, and reversibility and retrievability aspects. The 2018 layout is compatible with depths from 200 to 600 metres, in poorly-indurated clays (Boom Clay and Ypresian clays). The process is still ongoing.

Article 12(1)(g) *the responsibility for the implementation of the national programme and the key performance indicators to monitor progress towards implementation;*

Implementing the national programme is the responsibility of the various (groups of) actors involved (mainly ONDRAF/NIRAS, FANC, the spent fuel owners and the radioactive waste producers), each within its competences, and provided the competent federal authorities adopt the necessary national policies and develop the legal and regulatory framework as required. These responsibilities are unchanged and are not expected to change, but the repartition of roles and responsibilities between FANC and ONDRAF/NIRAS is being clarified (Sections B.2.4 and M.2).

The key performance indicators selected to monitor progress in, on the one hand, management by waste producers and spent fuel owners and, on the other hand, ONDRAF/NIRAS are as follows:

- the existence of a national policy;
- the existence of general and dedicated radiation protection and safety regulation;
- the existence of operational management;
- the existence of a financing mechanism;
- the existence of RD&D.

The values of these indicators are unchanged. They are given in Table 8.

Table 8 – Overview of the state of progress towards implementation of the national programme, at 31 May 2018, according to the key indicators used in the national programme 2015. Their values are unchanged [✓ : yes; ✗ : no; ● : interim situation].

	MANAGEMENT BY PRODUCERS / OWNERS					TRANSFER OF WASTE	MANAGEMENT BY ONDRAF/NIRAS											
							SHORT AND MEDIUM TERMS (treatment, conditioning and storage)					LONG TERM (disposal)						
	National policy?	Regulation		Operational management?	Financing mechanism?		National policy?	Regulation		Operational management?	Financing mechanism?	National policy?	Regulation		RD&D?	Operational management ?	Financing mechanism?	
		general?	dedicated?					general?	dedicated?				general?	dedicated?				
Very short-lived waste	✓	✓	✓	✓	✓	n.a.	not applicable					not applicable						
Category A waste	n.a.	✓	✓	✓	✓	⇒	✓	✓	✓	✓	✓	✓	✓	✓	●	✓	✗	✓
Category B waste	n.a.	✓	✓	✓	✓	⇒	✓	✓	✓	✓	✓	✓	✗	✓	●	✓	✗	✓
Category C waste (reprocessing)	not applicable					⇒ ^[1]	✓	✓	✓	✓	✓	✓	✗	✓	●	✓	✗	✓
Category C waste (spent fuel)	not applicable						✓	✓	✓	✓	✓	✓	✗	✓	●	✓	✗	✓
Spent fuel from Synatom	✓ ^[2]	✓	✓	✓	✓	⇒	not applicable					not applicable						
Spent fuel from SCK•CEN	✓	✓	✓	✓	✓	⇒	not applicable					not applicable						
Ra-bearing substances in Umicore's licensed storage facilities	n.a.	✓	✓	✓	✓	⇒	✗	✓	✓	✗	✓	✓	✗	✓	●	✗	✗	✓
Ra-bearing substances to be managed as radioactive waste by ONDRAF/NIRAS	n.a.	✓	●	✓	✓	⇒	✗	✓	✓	✗	✓	✓	✗	✓	●	✗	✗	✓
NORM substances to be managed as radioactive waste by ONDRAF/NIRAS	n.a.	✓	●	✓	✓	⇒	✗	✓	✓	✗	●	✓	✗	✓	●	✗	✗	●

^[1] Decisions on the future of spent fuel will have to be made before it is transferred to ONDRAF/NIRAS.

^[2] Policy for the management of spent fuel from Synatom: safe storage followed by reprocessing or disposal.

Article 12(1)(h) *an assessment of the national programme costs and the underlying basis and hypotheses for that assessment, which must include a profile over time;*

The best available costs estimate of the full national programme 2015 is the one calculated by ONDRAF/NIRAS in its fourth inventory report on nuclear liabilities (see also Sections I.2 and I.3).

The cost estimates are based on a series of hypotheses, in particular the hypothesis that all the regulatory, technical and economic conditions are those in place on the inventory reference date, namely 31 December 2015. Generally speaking, these estimates were produced as if all the operations took place 'instantly' on that date (overnight costs). The fees applied for calculating the waste management costs are those for the 2014–2018 contractual period, established in 2013. The main hypotheses specific to the fees for storage and disposal for that period are as follows:

- the seven existing commercial nuclear reactors will be operated for 40 years;
- B&C waste will be disposed of in Boom Clay at 200 metres depth (financial hypothesis only);
- spent fuel from commercial reactors will be reprocessed (contractual hypothesis);
- geological disposal of category B waste will start in 2047;
- geological disposal of category C waste will take place over the period 2100–2110.

The total costs as evaluated by ONDRAF/NIRAS in its fourth inventory report, namely EUR₂₀₁₅ 15 107 million, include the following:

- the costs of managing all *existing* radioactive waste and all radioactive waste from the future decommissioning of all *existing* facilities (including the transport, treatment, conditioning, storage and disposal costs);
- the costs of the decommissioning operations of the *existing* facilities, of which EUR₂₀₁₅ 5 403 million for the decommissioning of the nuclear power plants, assuming in particular for nuclear power plants that
 - ▶ dismantling starts (almost) immediately after reactor shutdown;
 - ▶ dismantling of a plant is managed as a unique, integrated project;
 - ▶ the decommissioning costs include the demolition of the buildings and the restoration of the site to the state of undeveloped land;
- the costs of managing all *existing* nuclear materials, of which EUR₂₀₁₅ 4 925 million for the management of spent fuel, assuming in particular for the spent fuel from commercial nuclear reactors that 22% of it will be reprocessed (financial hypothesis Synatom) and that the rest will be conditioned and declared as radioactive waste to ONDRAF/NIRAS, to be disposed of in a geological disposal facility.

As a corollary, the EUR₂₀₁₅ 15 107 million do not take account of future operational waste and spent fuel and of the decommissioning, including the decommissioning waste, of future nuclear facilities.

The cost estimates do not include uncertainties related to major changes in scenarios, typically the final destination of B&C waste, the accepted hypotheses regarding the further use of the spent fuel, the solution for the long-term management of radium-bearing substances to be managed as radioactive waste and the potential reconditioning of non-conform waste.

Article 12(1)(i) *the financing scheme(s) in force;*

The financing schemes in force are unchanged.

However, ONDRAF/NIRAS is preparing the implementation of the so-called ‘guiding principles’ governing the financing of the long-term fund, that will be applicable as from 1 January 2019 (Section I.1.2). This requires a thorough revision of all medium- and long-term management fees (for storage and disposal, respectively) and the revision of all related contracts with producers.

Article 12(1)(j) *a transparency policy or process as referred to in Article 10;*

The transparency policy and processes are unchanged. This topic does not appear to be an issue.

Article 12(1)(k) *if any, the agreement(s) concluded with a Member State or a third country on management of spent fuel or radioactive waste, including on the use of disposal facilities.*

The agreements with Member States or third countries on management of spent fuel or radioactive waste are unchanged, except for the fact that the Belgian and Luxembourg Governments signed on 4 July 2016 an agreement establishing the technical and financial framework for the management and the disposal by Belgium of Luxembourg radioactive waste [Gäichel 2016] (Section B.2.2). The agreement was ratified by the Grand Duchy of Luxembourg on 15 May 2018. The ratification process in Belgium follows its course.

There is currently no identified need to modify existing agreements with Member States or third countries or to reach new ones.

Article 12(2) *The national programme together with the national policy may be contained in a single document or in a number of documents.*

The national programme and the national policies are contained in several self-supporting documents. Indeed, pursuant to the Law of 3 June 2014, the national programme is adopted by ministerial decree, whereas the national policies are since then adopted by royal decree.

L. Article 14.3 — Peer reviews and self-assessments

Article 14(3) *Member States shall periodically, and at least every 10 years, arrange for self-assessments of their national framework, competent regulatory authority, national programme and its implementation, and invite international peer review of their national framework, competent regulatory authority and/or national programme with the aim of ensuring that high safety standards are achieved in the safe management of spent fuel and radioactive waste. The outcomes of any peer review shall be reported to the Commission and the other Member States, and may be made available to the public where there is no conflict with security and proprietary information.*

Self-assessments and international peer reviews of the national framework, FANC and the national programme (including its implementation as far as self-assessments are concerned) must be organised at least every ten years, on initiative of the competent ministers.

Belgium has yet to organise a self-assessment and to receive an international peer review mission covering the topics under Article 14(3).

M. Future plans to improve safe and responsible management of spent fuel and radioactive waste

The main future plans to improve safe and responsible management of spent fuel and radioactive waste involve the preparation of new (parts of) national policies, further developments of the national legal and regulatory framework and the further implementation of the national programme.

M.1 National policies

M.1.1 Status of spent fuel

In view of the existing national policies on spent fuel from commercial nuclear reactors and from SCK•CEN's reactors as stated in Section D.1, the owners of the spent fuel from the commercial nuclear reactors and of the spent fuel from some SCK•CEN reactors will have to propose hypotheses regarding the further use of their spent fuel, this with a view to the later integration of these proposals in the national policies (Article 179, § 6, of the Law of 8 August 1980).).

M.1.2 Long-term management of B&C waste

ONDRAF/NIRAS has submitted a new proposal setting the bases for a national policy on the long-term management of B&C waste to its supervisory authority in February 2018. If this proposal is adopted, under the form of a royal decree, a major focus for the coming years will be to prepare the elements that will have to complement these bases, in particular the decision-making process according to which the long-term management solution will be developed.

M.1.3 Long-term management of radium-bearing and NORM substances to be managed as radioactive waste

With a view to preparing regulatory decisions and policy proposals for the long-term management of radium-bearing and NORM substances to be managed as radioactive waste, FANC and ONDRAF/NIRAS are currently assessing the fraction of these materials to be managed under the Extractive Industries Directive 2006/21/EC and the fraction to be managed as radioactive waste by ONDRAF/NIRAS (Directive 2011/70/Euratom). This assessment is expected to be completed by the end of 2018. It involves the competent regional bodies whenever required.

The assessment will inform some of the regulatory developments listed under Section M.2 and provide ONDRAF/NIRAS with a basis, shared by FANC, for drawing up a strategic plan to support a proposal for a national policy on the long-term management of radium-bearing substances to be managed as radioactive waste and, if need be, for doing the same for NORM substances.

A particular issue within that context is that of the long-term management of the radium-bearing substances, non-conditioned, contained in Umicore's UMTRAP storage facility in Olen. The management of these substances presents indeed a specific challenge in that

- they relate to a historical situation;
- a significant fraction of them are low-level and intermediate-level long-lived substances;

- the anticipated costs of retrieving the substances from UMTRAP and of disposing of them safely are very high.

A specific decisional process will have to be defined for the long-term management of the radium-bearing substances contained in the UMTRAP storage facility, taking due account of the safety of the storage facility in the medium term (order of magnitude 10 years) and of the financial provisions to be established for long-term management.

M.2 National framework

Most plans to improve the national legal and regulatory framework are bundled together in the task force's report that was approved on 20 July 2017 by the Federal Government (Section B.2.4), which then entrusted the supervisory authorities of FANC and ONDRAF/NIRAS with the mission to propose draft laws and draft royal decrees giving shape to the task force's proposals. (Some of these proposals have actually been under development since long before the Government's decision of 20 July 2017.)

The regulatory projects related to FANC competences expected to be finalised in the coming years are as follows:

- the addition in the FANC law of the mission to control the elements of the ONDRAF/NIRAS waste acceptance system related to the safety of radioactive waste management and the corresponding amendments to the FANC royal decree;
- the royal decree on the safety requirements for disposal facilities;
- the royal decree on the licensing system of disposal facilities;
- the law transposing Directive 2013/59/Euratom, and the associated royal decree(s) regarding the management of existing exposure situations;
- the royal decree on the safety requirements for the long-term management of very-low level waste, long-lived, from remediation.

A royal decree on the safety requirements for storage facilities of spent fuel and radioactive waste is in the final stage of approval.

The initiatives to improve the legal and regulatory framework related to ONDRAF/NIRAS competences expected to be finalised in the coming years are as follows:

- the amendments to the ONDRAF/NIRAS law related to the revised general rules for, in particular, establishing the acceptance criteria for conditioned and non-conditioned waste and the corresponding amendments to the ONDRAF/NIRAS royal decree;
- the amendments to the royal decree on the qualification by ONDRAF/NIRAS of the facilities for the storage, treatment and conditioning of radioactive waste to take account of the new provisions regarding the general rules;
- the royal decree laying down the bases of the national policy on the long-term management of B&C waste.

Initiatives to improve the legal and regulatory framework are on-going, as far as the nuclear provisions for the commercial nuclear power plants are concerned. To that end, the Commission for Nuclear Provisions provided on 8 February 2018 an advice to the Minister of Energy in order to further strengthen the Law of 11 April 2003 on the provisions created for the dismantling of nuclear power plants and the management of fissile materials irradiated in these power plants.

M.3 National programme

Belgium has yet to organise a self-assessment and to receive an international peer review mission covering the topics under Article 14(3). Belgium intends to update its national programme before either one of these.

M.3.1 RD&D

Examples of key RD&D topics to improve safe and responsible management of spent fuel and radioactive waste are as follows:

- continuation by ONDRAF/NIRAS of its work programmes on non-conform conditioned waste, including phenomenological studies, development of non-destructive control techniques and assessment of possible disposal solutions, including the potential of retreatment and reconditioning;
- further preparation by ONDRAF/NIRAS of its methodological safety and feasibility case for geological disposal, planned for 2020 and considering several depths between 200 and 600 metres in poorly-indurated clays;
- continuation by ONDRAF/NIRAS of the studies with a view to applying the optimisation principle to the future choice of the host formation for the geological disposal facility;
- continuation by ONDRAF/NIRAS of the iterative revision process of the layout of the geological disposal facility;
- continuation by EURIDICE of the PRACLAY heater experiment;
- continuation by Synatom of
 - ▶ its participation to international expert networks related to the long-term behaviour of spent fuel;
 - ▶ its follow-up of the R&D on dry storage solutions;
- further development by SCK•CEN of the MYRRHA project, a nuclear research infrastructure designed, in particular, to allow the optimal continuation, in association with Belgian and international universities and research centres, of the necessary research regarding fundamental nuclear research and innovative solutions for the long term management of spent fuel.

M.3.2 Waste acceptance system

ONDRAF/NIRAS will continue to improve and extend its waste acceptance system, through integration of the lessons learnt during the management of non-conform conditioned waste, the recommendations of the audit of the FANC and the integration of additional elements and steps pertaining to disposal activities. Improvements to the present waste acceptance system also include increasing the number of inspections by ONDRAF/NIRAS, according to a graded approach, of radioactive waste production on the sites operated by the main waste producers and developing an inspection programme aiming at the supply chain of the treatment and conditioning processes.

M.3.3 Short-term management

Examples of key issues to improve safe and responsible short-term management of radioactive waste are as follows:

Construction of a new, single, treatment facility for low- and intermediate-level effluents at Belgoprocess, to replace the current facilities on the BP1 and BP2 sites:

- studies: 2018–2022;
- investment: 2024–2028.

Modifications to the PAMELA facility to enable homogeneous cementation of chemically contaminated, intermediate-level effluents:

- implementation: 2021–2024.

M.3.4 Medium-term management

Examples of key issues to improve safe and responsible medium-term management of spent fuel and radioactive waste are as follows:

Extension of the storage capacities for spent fuel in Doel and Tihange, which were approximately 61% and 78% full respectively at the end of 2017, and will be saturated before complete phase out in 2025:

- concept chosen by Electrabel: dry storage in casks;
- licence application: 2018;
- start of construction: expected in 2020;
- commissioning: expected in 2023 (Tihange) and 2024 (Doel).

Construction at Belgoprocess of a reception and storage centre for non-conditioned waste, that can be extended to storage of conditioned waste:

- licence application: expected 2019;
- start of construction: expected 2022;
- commissioning: expected 2024.

Construction at Belgoprocess of a storage facility (foreseen lifetime of 75 years) **dedicated to isolating the (potentially) ASR-affected waste packages:**

- licence application: 2019;
- start of construction: expected 2021;
- commissioning: expected early 2023.

Follow-up of the remaining available storage capacity for conditioned radioactive waste at Belgoprocess, taking account of the following key factors, and taking actions as needed:

- the expected volumes of conditioned waste, that originates mainly from nuclear power plants;
- the evolution of the projects for creating additional storage capacity at Belgoprocess, in particular the construction of the facility for the (potentially) ASR-affected waste packages;
- the planned construction of the post-conditioning facility for category A waste, where buffer capacity is foreseen;
- the expected planning for the construction and operation of the surface disposal facility for category A waste.

M.3.5 Long-term management

The licensing procedure for the surface disposal facility for category A waste will continue (see Table 7 in Section K.3 for the current estimated timeframes).

Acronyms

ASR	alkali-silica reaction
BP	Belgoprocess
CNP	<i>Commission des provisions nucléaires / Commissie voor nucleaire voorzieningen</i> (Commission for Nuclear Provisions)
CPNPC	<i>Comité du Programme national / Comité van het Nationale Programma</i> (National Programme Committee)
ENSREG	European Nuclear Safety Regulators Group
EURIDICE	European Underground Research Infrastructure for Disposal of Nuclear Waste in Clay Environment
FANC	<i>Federaal Agentschap voor Nucleaire Controle / Agence fédérale de Contrôle nucléaire</i> (Federal Agency for Nuclear Control)
GRR-2001	Royal Decree of 20 July 2001 relating to the general regulations for the protection of the population, workers and the environment against the dangers arising from ionising radiation, also known as ‘general regulations for radiation protection’
HADES	High-Activity Disposal Experimental Site
HLW	high-level waste
HPD	Health Physics Department
IAEA	International Atomic Energy Agency
ILW	intermediate-level waste
IMS	integrated management system
IRE	<i>Institut national des radioéléments</i> (National Radioelements Institute)
IRRS	Integrated Regulatory Review Service of the IAEA
LLW	low-level waste
MOX	mixed-oxide fuel
NORM	naturally occurring radioactive materials
OECD/NEA	Organisation for Economic Cooperation and Development / Nuclear Energy Agency (France)
ONDRAF/NIRAS	<i>Organisme national des déchets radioactifs et des matières fissiles enrichies / Nationale instelling voor radioactief afval en verrijkte splijtstoffen</i> (Belgian Agency for Radioactive Waste and Enriched Fissile Materials)
OVAM	<i>Openbare Vlaamse Afvalstoffenmaatschappij</i> (Public Waste Agency of Flanders)
PWR	pressurised-water reactor
RD&D	research, development and demonstration
SCK•CEN	<i>Studiecentrum voor Kernenergie / Centre d'Etude de l'Energie Nucléaire</i> (Belgian Nuclear Research Centre)
SEA	strategic environmental assessment (environmental impact assessment as defined by the Law of 13 February 2006 and Directive 2001/42/EC)
SRNI-2011	Royal Decree of 30 November 2011 on the safety requirements for nuclear facilities
Synatom	<i>Société belge des Combustibles nucléaires Synatom / Belgische Maatschappij voor Kernbrandstoffen Synatom</i> (owner of the fuel of the nuclear power plants)
tHM	tonne of Heavy Metal

VLLW	very low-level waste
WENRA	Western European Nuclear Regulators Association

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