

KINGDOM OF BELGIUM

**SECOND REPORT IN THE FRAME OF ART. 9
OF THE EUROPEAN DIRECTIVE
2009/71/EURATOM**

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Summary:	As required by article 9 of the European Directive 2009/71/Euratom, this report gives an overview of the measures taken in Belgium to ensure compliance with the Nuclear Safety Directive.
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I. Introduction

Nuclear installations falling within the scope of the Directive

The Belgian nuclear installations falling within the scope of the Directive (Article 3 (1)) are currently the following:

- the 4 nuclear power reactors at the Doel site and the 3 nuclear power reactors at the Tihange site, representing a total installed capacity of around 3000MWe at each of the two sites.
- the spent fuel storage facilities at Tihange (called "DE Building") and Doel ("SCG Building"). These storage facilities accommodate spent fuel from the power units since the suspension of reprocessing contracts in 1993;
- the VENUS / Guinevere (500KWth), BR1 (2MWth) and BR2 (120 MWth) research reactors of the Atomic Energy Study Center in Mol (SCK • CEN);
- two Belgoprocess (the Belgian centralized waste treatment and storage facility) buildings where very limited quantities of spent nuclear fuel from two Belgian research reactors that have been dismantled (BR3 and Thetis) are stored.

According to Belgian regulations, nuclear installations falling within the scope of the Directive are ranged in a group of facilities called "Class I". This class is nevertheless broader than the installations falling within the scope of the Directive as it also includes, for example, facilities (mainly) intended for the treatment and the management of radioactive waste, the final repositories of radioactive waste and any facility where an amount greater than the minimum critical half-mass of fissile isotopes is present.

Since the previous report (2014), the two Belgian nuclear fuel manufacturing plants (Belgonucleaire - MOX manufacturing plant and FBFC UO₂ manufacturing) plant have been dismantled and their regulatory control is (being) lifted. The 'Thetis' research reactor of Ghent University has been dismantled and its regulatory control lifted. A research reactor (BR3) at SCK-CEN is also in the final phase of dismantling, as there is no longer any fissile material nor non-fixed contamination present in the buildings.

a) Belgian Nuclear Energy policy

With the law of January 31, 2003, Belgium chose to gradually phase out industrial production of electricity by nuclear energy. This law stipulated that the construction of new nuclear power plants is prohibited and that the lifetime of nuclear power plants is limited to 40 years. This law was amended in 2012 and 2015 to allow for an extension of 10 years of the period of industrial production of electricity of the Tihange 1 and Doel 1 & 2 power plants. The currently planned legal shutdown dates for the seven Belgian power plants in operation are between October 2022 and December 2025.

b) Reference reports

More details or concrete application on the information contained in this report can be found in the following reports:

- [The Belgian national report for the eighth review meeting of the contracting parties to the Convention of Nuclear Safety \(September 2019\).](#)
- [The Belgian National report for the sixth review meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management](#)
- [The report of the 2017 IRRS follow-up in Belgium](#)

II. Descriptions for the Articles of the Directive

Article 4 – Legislative, regulatory and organisational framework

1. Member States shall establish and maintain a national legislative, regulatory and organisational framework ("national framework") for the nuclear safety of nuclear installations.

A national legislative, regulatory and organizational framework for the nuclear safety of nuclear installations exists in Belgium. The Belgian legal laws and decrees relevant for the safety of nuclear installations covered by the Directive are the following:

- The Law of 15 April 1994 on the protection of the population and the environment against the hazards of ionizing radiation and on the Federal Agency for Nuclear Control (last amended in 2018),
- The Royal Decree of 20 July 2001 laying down the "General Regulations regarding the protection of the public, the workers and the environment against the hazards of ionising radiation" (GRR-2001, last amended in 2020),
- The Royal Decree of 30 November 2011 on the Safety Requirements for Nuclear Installations (SRNI-2011, last amended in 2020).

Besides these, other legal documents relate to aspects covered by the Directive, such as:

- The legislation with respect to Nuclear and Radiological Emergency Planning and Preparedness (Royal Decree of 1 March 2018),
- The Nuclear Energy Phase Out Law (31 January 2003),
- The legislation on nuclear liability (law of 22 July 1985).

Since 2017, the Belgian Safety Authority, the FANC can also issue binding "technical regulations", provided that these are explicitly foreseen in a Royal Decree. These technical regulations must be of a purely technical nature. They are issued by the FANC General Manager and published in the Belgian official Gazette.

The texts of all the regulations currently in force and relevant for nuclear safety and radiation protection can be consulted on the FANC website (<http://www.jurion.fanc.fgov.be>).

Belgium is also contracting party to the following international conventions:

- the Convention on Nuclear Safety,
- the Joint convention on the safety of spent fuel management and on the safety of radioactive waste management,
- the Convention on assistance in the case of a nuclear accident or radiological emergency,
- the Paris convention on nuclear third party liability and the Brussels supplementary convention, and subsequent amendments,
- the Convention on early notification of a nuclear accident,
- the Convention on physical protection of nuclear material.

The FANC and Bel V are also actively involved in other international groups and activities such as the IAEA, WENRA, HERCA, OECD/NEA.

The national framework shall provide in particular for:

(a) the allocation of responsibilities and coordination between relevant state bodies;

Nuclear safety and radiation protection are the exclusive competence of the FANC, which is a federal authority. The Law of 15 April 1994 on the protection of the population and the environment against the hazards of ionizing radiation and on the Federal Agency for Nuclear Control assigns to the FANC its legal missions in the fields of radiation protection, nuclear safety and radiological monitoring of the Belgian territory. Moreover, articles 14bis and 14ter of the law of April 14, 1994, authorize the FANC to partially or fully delegate, by decision of its board of administrators, its oversight function to an entity which it has created for this purpose. The FANC used this possibility by creating Bel V in order to delegate certain oversight missions to it: on-site inspections and safety assessments of Class I and IIA facilities. The tasks that can be delegated to Bel V are listed in article 38.1 §1 of the GRR-2001, introduced by the royal decree of 6 December 2018. The FANC Board of Administrators formally decided to delegate these tasks to Bel V on March 1st, 2019, for a renewable period of six years. There is no other organization or authority involved in the oversight of nuclear safety and radiation protection in Belgium. The recognized organizations “organismes agréés”, which formerly carried out surveillance missions in radiation protection and safety on behalf of the FANC, were deprived of this role by the law of May 7, 2017.

In addition :

- a. The management of national emergencies (off-site - last level of defense in depth), including radiological and / or nuclear emergencies, is attributed the Minister of Home affairs, through the National Crisis Center. The FANC and Bel V have active roles in the management of radiological / nuclear emergencies, which are defined in the royal decree of 1 March 2018.
- b. Conventional safety aspects aimed at ensuring the protection of workers against non-radiological risks (electrical installations, flammable liquids, pressure equipment, etc.) are regulated by the Minister of Employment and Labor. These aspects are governed by the law of 4 August 1996 related to the well-being at work and its implementing decrees: (<https://emploi.belgique.be/fr/themes/bien-etre-au-travail>) .
- c. Environmental regulation such as water intake, chemical discharges, etc., but excluding the effects of ionizing radiation, are the responsibility of the regions (Flemish region, Brussels region and Walloon region). Cooperation agreements are developed between the regions and the federal authority (the FANC).

(b) national nuclear safety requirements, covering all stages of the lifecycle of nuclear installations;

The basic Belgian legal texts regarding the safety of nuclear installations covered by the Directive are listed in the beginning of this section under article 4 :

- the Law of 15 April 1994,
- the Royal Decree of 20 July 2001 (GRR-2001)
- The Royal Decree of 30 November 2011 (SRNI-2011)

The scope of the GRR-2001 is very wide and covers practically all human activities and situations which involve a risk due to the exposure to ionizing radiation, encompassing the protection of the workers as well as at the level of the protection of the public and the environment. In particular, the risks associated with natural radiation (e.g. radon) are integrated in the regulations. This royal Decree ensure the transposition of the European directives regarding radiological protection, in particular the 2013/59/Euratom Basic Safety Standards directive laying down the standards for protecting the public, the

workers and the environment.

The FANC is a (founding) member of WENRA since 1999. Before 2011, there were no national legal safety requirements in Belgium apart from those in the authorizations, which made the provisions of the safety reports binding. In 2006, the decision was taken to legally impose the WENRA Safety Reference Levels by means of a Royal Decree. The "Royal Decree on the Safety Requirements for Nuclear Installations" (referenced SRNI-2011 in this report) was signed by the King on 30 November 2011 and has been published in the Belgian official Gazette of 21 December 2011. This Royal Decree incorporates all the WENRA RHWG reference levels into Belgian regulations. This Royal decree has a wider scope than the NPPs, as some reference levels were found applicable to other nuclear facilities (for example, the obligation to proceed to periodic safety reviews, to have a Safety Analysis Report, to have an integrated Management system, ...), which were included in a chapter "Generic Safety Requirements" applicable to all Class I facilities, which includes the installations under the scope of the Directive.

This royal Decree has been updated several times with new safety requirements :

- In August 2015, with the WENRA safety requirements for decommissioning
- In May 2018, with the WENRA safety requirements for waste and spent fuel storage facilities
- In October 2018, to include the Nuclear Safety objective of the Directive, as well as requirements related to safety culture and defence in depth
- In February 2020, to include the revised WENRA reference levels 2014 for existing reactors

The FANC policy is to systematically amend the safety regulations with the new published WENRA reference levels, as they are appropriate to transpose the licensee's obligations as stipulated in the Directive, ensuring also the required transparency.

The current consolidated versions of the regulations in force can be consulted on the website of the FANC (<http://www.jurion.fanc.fgov.be>).

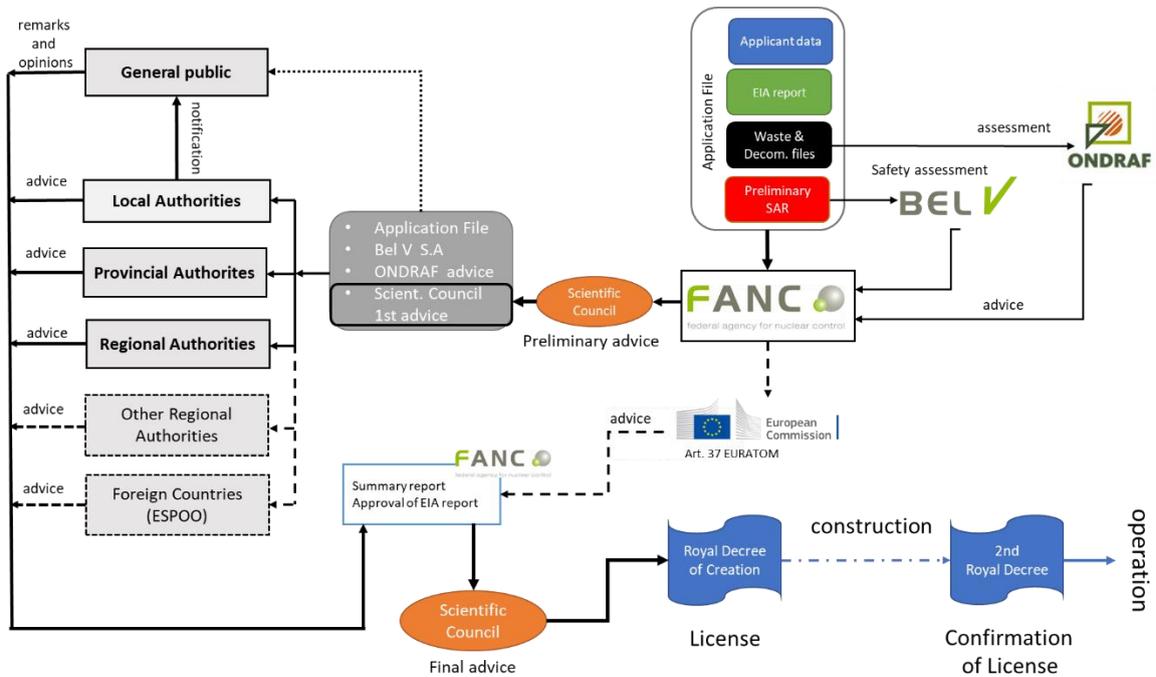
c) a system of licensing and prohibition of operation of nuclear installations without a licence;

Prohibition of operation of nuclear installations without a licence is explicitly stated in article 5.1 of section II "general licensing system" of the GRR-2001.

The figure below shows the licensing process for the nuclear installations. The licensing process has been last updated on 29 May 2020 to align it with the transposition of the European Directive 2014/52/EU in the Law of 15 April 1994.

This licensing process applies:

- to the creation (build) of a new nuclear facility;
- when a modification to an existing facility is deemed important in application of article 12 of the GRR-2001;
- to the issuing of a dismantling license, in application of article 17 of the GRR-2001.



Nuclear facilities are licensed according to article 6 of GRR-2001. The license application consists of several parts:

- The first part consists mainly of administrative information, describing amongst others responsibilities, names and legal status of the (future) licensee, its human and financial resources, ...
- The second part of the application consists - when applicable - of an environmental impact assessment report, this report must comply with the requirements of the European directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (as amended by European directive 2014/52/EU). The applicant can decide to submit the EIA report for approval before submitting the license application.
- The third part is the "waste and decommissioning file" giving the expected quantities of waste and their foreseen management, including those related to the dismantling, and preliminary plans for the future decommissioning.
- The last part consists of a preliminary safety analysis report containing preliminary data according to the SRNI-2011 and GRR-2001 requirements;

Belgium is a federal state composed of three Regions being legally competent for environmental protection on their territory (radiological aspects excluded) and thus also for the granting of related environmental licenses. To coordinate the process and ensure the coherence of the application files, cooperation exists between the FANC and the competent authorities of the Regions.

The license application is examined by the FANC. Bel V is in charge of performing the safety assessment of the (preliminary) safety analysis report. The advice of the Belgian Waste Management Agency (ONDRAF/NIRAS) is requested on the waste and future dismantling of the facility aspects (waste and decommissioning files). The file is then presented for advice to the Scientific Council of the FANC. A mandatory (in application of Article 37 of the Euratom Treaty on the transboundary impact) or voluntary consultation of the European Commission may take place. Following the advice of the Scientific Council, the application file is submitted to a public enquiry. Municipalities within a radius of 5 km of the site of the projected facility issue a notice of public enquiry. The application file is available in the offices of the municipality where the project is located and in the

FANC's offices. In parallel, other authorities are requested to give their advice:

- Local authorities of the municipalities located less than 5 km from the site of the facility
- Provincial authorities of the province(s) located less than 5 km from the site of the facility
- Regional authorities of the region(s) located less than 5 km from the site of the facility

The FANC collects the advices and remarks and opinions of the public and advices from the consulted authorities. When applicable, the FANC then also approves the EIA report. The completed file is sent back to the Scientific Council for final advice. The Scientific Council can propose particular conditions to be attached to the license, related to the commissioning of the installations or in view of ensuring the safety of the future installation. This construction and operating license allows the applicant to build the installations in conformity with the license.

The second phase addresses the confirmation of the construction and operation license. The licensee's Health physics department of the licensee is primarily in charge of the commissioning of the new installations. This acceptance verify that the constructed installation is fully compliant with:

- the regulations (GRR-2001 and SRNI-2011)
- the license and the license conditions
- the Safety analysis report

Bel V acting on behalf of the FANC verifies the commissioning of the installations before the start up. After a fully favorable commissioning, the FANC can propose to the King a confirmation decree allowing operation of the facility.

d) a system of regulatory control of nuclear safety performed by the competent regulatory authority;

The FANC is responsible for the supervision and control of all the activities concerning radiological protection and nuclear safety.

Since March 31, 2019, Bel V is legally delegated by the FANC to perform technical safety assessments of nuclear facilities and regular on-site inspections.

Since January 2009, FANC and Bel V develop a common strategy for inspections of nuclear installations. This strategy guarantees a more integrated approach in the field of nuclear safety and radiation protection. A 3-year programme is defined. An annual planning for inspections is established, based on this programme and is communicated to the licensees. A revision of the programme is foreseen each year, to take into account experience feedback from the preceding years.

On the basis of its large inspection experience as well as of its well-established know-how in collecting and interpreting operation feedback data, FANC and Bel V have over the years developed an inspection and safety assessment strategy aimed at the assessment of how the licensees manage safety, with specific emphasis on the implementation of the GRR-2001, the SRNI-2011 and the licences of the various installations. This strategy includes the implementation of a permanent monitoring of the licensee, conformity checks of the installations and an inspection programme with various types of inspections. This strategy is evolving with time and safety concerns (e.g. human and organisational performances) and is supported by strong programmes of initial expert training and retraining, of operating experience data collection and analysis and of specific research and development activities.

e) effective and proportionate enforcement actions, including, where appropriate, corrective action or suspension of operation and modification or revocation of a licence.

The enforcement power of regulatory requirements is given to the FANC inspectors by

the Law of 15 April 1994. The enforcement tools and measures are provided in the following legal documents:

- the Law of 15 April 1994;
- the GRR-2001;
- the Royal Decrees of December 20, 2007 related to administrative fines

Various coercive measures are available to FANC inspectors. Two types of sanctions are foreseen in the Law of 15 April 1994 (articles 50 to 64): legal penalties (requiring a legal procedure by the Court) or administrative fines (nevertheless requiring an information to and a decision by the Public Prosecutor).

The FANC nuclear inspectors are nominated by Royal Decree. They have enforcement powers; they can also intervene on the request of Bel V inspectors. The FANC inspectors can also take any measure they consider necessary to reduce or eliminate hazards for workers, the public and the environment. These measures can include warnings and requests for corrective actions with a delay not exceeding 6 months (article 9 of the Law of 15 April 1994).

Bel V is delegated by the FANC to oversee the operator's compliance with the regulations in force and with the conditions attached to the license, but only has the power to make recommendations. Should the operator violate the conditions set in the license and fail to correct that situation, or should the operation evolve towards an unsafe situation, this would be referred to the FANC which can proceed to enforcement measures.

Another possibility to strengthen safety is provided in article 13 of the GRR-2001: The Safety Authority (The Scientific Council or the FANC services in charge of the supervision) can, on its own initiative and at any moment, propose additional conditions to be attached to the license with the aim of improving safety.

Finally, if the licensee does not comply with the regulations or with its license, a process described in article 16 of GRR-2001 allows the FANC to propose to the King the suspension or the withdrawal of the license, for Class I facilities after advice of the Scientific Council.

The determination on how national nuclear safety requirements referred to in point (b) are adopted and through which instrument they are applied remains within the competences of the Member States;

Binding legal instruments to enforce safety requirements are currently in Belgium:

- Laws, that are voted by the Parliament
- Royal Decrees, signed by the King and proposed by the competent minister(s)
- FANC technical regulations, issued by the FANC general Manager

Non-binding guidance with generic application can be elaborated in relation to the general mission of the Regulatory Body or result from regulatory feedback or experience feedback (inspections) or on specific request of the concerned parties.

2. Member States shall ensure that the national framework is maintained and improved when appropriate, taking into account operating experience, insights gained from safety analyses for operating nuclear installations, development of technology and results of safety research, when available and relevant.

The development of regulation and guides in radiation protection, in nuclear safety and in nuclear security is one of the core processes in FANC's management system.

The associated procedure for developing and proposing binding regulation (royal decrees or FANC technical regulations) describes the following steps:

- triggers for the evaluation of and decision on the need for new regulation or modifications or extensions to existing regulation;

- drafting of a regulation proposal;
- stakeholder consultation;
- adaptation of the draft;
- consultation of official advisory bodies, including EU commission in the frame of article 33 EURATOM;
- final draft;
- submission for enacting to the Minister of Home Affairs for royal decrees, enactment by the FANC general manager for FANC technical regulations;
- publication in the Belgian official Gazette.

Possible “triggers” enabling development of new regulation as well as the review and amendment of the existing ones are:

- European Directives;
- European harmonization activities : WENRA, HERCA, ..;
- new international standards (e.g. from R&D);
- feedback from experience (inspections, incidents, accidents, etc.);
- specific demands from authorities, licensees and other stakeholders.
- ...

Belgium is a member state of the European Union. Therefore most of the Belgian regulations are primarily based on (are transpositions of) European Directives, which are revised and updated regularly (e.g. the Basic Safety Standards, Nuclear Safety Directive and Radioactive Waste Directive).

The large involvement of the Belgian Regulatory Body in international activities and cooperation allows consideration of relevant international safety and technical standards and experience gained.

The FANC and Bel V are members of the WENRA, the Western European Nuclear Regulators’ Association, and participate in the various WENRA activities and working groups. The Fukushima Daiichi accident significantly impacted the work of WENRA under the impulse of ENSREG, in particular for developing and harmonizing new approaches for safety requirements and emergencies management. New safety reference levels from WENRA were published in 2014. These reference levels were incorporated in the Belgian legal framework by the royal decree of 19 February 2020.

The FANC and Bel V have representatives and actively participate in sub-working groups of the RHWG (WENRA Reactor Harmonization Working Group) dealing with different technical issues.

In addition, FANC is an active member of HERCA (Heads of Radiation Protection Authorities) which brings together radiation protection Authorities from 31 European countries. For example, the new National Emergency Plan of 1st March 2018 integrates the lessons from past exercises and events (IRE 2008, Fukushima), the results of dedicated working groups, international recommendations and requirements such as GSR-7, GSG-11, the European BSS, the HERCA-WENRA approach and the advice from national Scientific Committees and other stakeholders (local and regional authorities and Greenpeace Belgium).

Article 5 - Competent regulatory authority

1. Member States shall establish and maintain a competent regulatory authority in the field of nuclear safety of nuclear installations.

The GRR-2001 implements many articles of the Law of April 15th, 1994 and made the Federal Agency for Nuclear Control (FANC), created by that Law, operational. The

organization of the FANC is explained under Article 8. **The FANC**, which is endowed with wide competences, **constitutes the Safety Authority**.

The mission of the FANC is the protection of the public, workers and the environment against the hazards of ionizing radiation.

This mission has been entrusted to the FANC by the Law of 15 April 1994. According to articles 14ter of this law (as amended by the law of 7 May 2017), the FANC can create legal entities to assist it in the execution of its missions. The FANC created **Bel V** in September 2007, a subsidiary with the statute of a so-called 'foundation' as defined in Belgian law. The FANC delegates several regulatory tasks to Bel V, a.o. on site routine inspections – albeit without associated enforcement powers – and independent safety assessments

The regulatory function "*development of regulations and guides*" is allocated exclusively to the FANC. The FANC has the duty to make proposals of regulations to the King (i.e. the Government). Since 2017, the FANC can also issue binding technical regulations, of a non-policy nature, in cases foreseen in a Royal Decree. Both FANC and Bel V can also issue non binding technical guidances.

The regulatory function "*licensing*" is ensured by the FANC. For the nuclear installations under the scope of the Directive, the King (the Government) is the competent authority to issue licenses. The FANC investigates the license applications and drafts the licenses and conditions attached to it.

The regulatory function "*Safety assessment*" is allocated to the FANC, which delegates, for the installations within the scope of the Directive, the main part of this function to Bel V.

The regulatory function "*Inspection*" is allocated to the FANC, which delegates, for the installations under the scope of the Directive, the main part of this function to Bel V.

The regulatory function "*Enforcement*" is allocated exclusively to the FANC.

Other additional functions are allocated to the FANC, with possible support from Bel V:

- radiological surveillance of the Belgian territory,
- participation to the national nuclear emergency planning and response,
- communication with the public and political authorities

Nuclear security is also within the scope of the FANC mission and is entrusted to its department "transport and security".

The list of regulatory tasks that can be delegated by the FANC to Bel V is fixed, since December 2018, in article 38.1 of the GRR-2001. These delegated tasks consist of:

- Routine on-site inspections on "Class I" facilities, for the permanent supervision of the good performance of the licensee's Health Physics Department (including approval of some decisions). This permanent supervision in practice consists of systematic, thematic and specific inspections devoted to defined subjects (operation, periodic tests, chemical control, radiological protection ...), reactive inspections, examination of modifications and incident analysis. An inspection report is written following each field inspection, which is sent to the licensee and to the FANC.
- Safety assessments of licence applications and of commissioning of new installations and of modifications
- Safety assessments and on-site inspections of licensee's projects (e.g. PSR, Licensee's action plans)
- Safety assessments of the files and safety analyses related to the SRNI-2011 that are submitted by the licensee.

The Board of Administrators of the FANC formally delegated those tasks to Bel V on March 1st, 2019.

2. Member States shall ensure the effective independence from undue influence of the competent regulatory authority in its regulatory decision-making. For this purpose, Member States shall ensure that the national framework requires that the competent regulatory authority:

(a) is functionally separate from any other body or organisation concerned with the promotion or utilisation of nuclear energy, and does not seek or take instructions from any such body or organisation when carrying out its regulatory tasks;

The Federal Agency for Nuclear Control (the **FANC**) is an autonomous public institution with legal personality. The law of 15 April 1994 defines the statute, the missions of the FANC, as well as requirements about its internal administration.

The FANC is institutionally and financially independent. The FANC is led by a non-executive 14-headed Board of Administrators. The members of the Board of Administrators are appointed by Royal Decree, on the proposal of the Council of Ministers. In order to guarantee the independence of these board members, their mandate is incompatible with certain other responsibilities within the nuclear sector and within the public sector. The governance charter of the Board of Administrators is published on the FANC website. The board, which meets about six times a year, is in charge of:

- the overall long-term and short-term strategy, with the approval of the medium-term and annual operational plan;
- the conditions of recruitment and employment of the FANC staff;
- the financing of the FANC.

The Board approves the FANC annual budget and staffing levels.

The FANC is supervised by the Federal Minister of Home Affairs through a government Commissioner who attends the meetings of the Board of Administrators. The Board delegates the management of the FANC to the General Manager (Director-General) who is appointed by Royal Decree for a term of 6 years.

The FANC, as a public body, reports to Parliament through the Minister of Home Affairs, thus ensuring legal independence from other government agencies and ministries that promote the use of ionizing radiation.

The delegation of regulatory functions to **Bel V** and the relationship between FANC and Bel V are embedded in articles 14bis and 14ter of the law of 15 April 1994, as amended by the law of 7 May 2017. In particular:

- Bel V is headed by a board of administrators; the majority of its members are members of the board of administrators of the FANC
- The general manager (Director-General) of the FANC is member of the board of administrators of Bel V
- The general manager of the FANC can attend management committee meetings of Bel V
- The general manager of the FANC can suspend any decision of the Bel V management committee

Article 38 of the GRR-2001, as amended by the royal decree of 6 December 2018 contains several provisions related to Bel V, regarding :

- Bel V activities : i.e. the annual inspection and safety assessment plan is to be approved by the FANC

- The conditions for performing the regulatory missions that are delegated by the FANC to Bel V
- The financing of Bel V : an hourly rate is fixed
- The surveillance of Bel V by FANC : a management agreement is concluded with the FANC and the FANC can perform audits on Bel V performance

Finally, a cooperation agreement has been concluded between the general managers of the FANC and Bel V for aspects related to Bel V activities that are not regulatory functions delegated by the FANC (for example international activities, knowledge management, research and development, support to the FANC communication, ..).

2. (b) takes regulatory decisions founded on robust and transparent nuclear safety-related requirements;

The whole legal framework is published on a specific FANC web site (jurion.fanc.fgov.be), ensuring that all the licensees and the general public have access to all the legal requirements.

In addition, before applying for a license for a new installation, the (future) applicant can request a "pre-licensing" process. During this process, the FANC defines the safety expectations for the future application.

The FANC takes its regulatory decisions according to policies and processes formalized in its management system.

The FANC core processes and support processes were identified and integrated into an ISO-9001 quality system in 2008. A complete reworking of the management system was launched in 2012 during the self-assessment that preceded the IRRS mission (Integrated Regulatory Review Service organized by the IAEA) in 2013, with the objective of complying with the IAEA safety requirements, included in the GS-R-3 safety guide.

During the public consultations associated to the licensing process, interested parties have access to the application files, including :

- The preliminary safety assessment report
- The Bel V safety assessment of the application
- The ONDRAF/NIRAS advice on waste management and (future) decommissioning issues
- The FANC analysis of the application
- The first advice of the Scientific Council.

The final decision (license) has to be motivated. In particular, if the final decision is not fully in line with the advice of the Scientific Council, any deviation has to be explicitly motivated.

Regulation proposals elaborated by the FANC are published (on the FANC web site) or sent to interested parties. They have the opportunity to give comments and remarks. New regulations, including FANC's technical regulations, are published in the Belgian official Gazette.

Licensee's actions plans in relation to safety improvements (from periodic safety reviews, new regulations and standards, other contexts – European stress tests, ..) are also usually published on the FANC web site.

2. (c) is given dedicated and appropriate budget allocations to allow for the delivery of its regulatory tasks as defined in the national framework and is responsible for the implementation of the allocated budget;

The FANC is not financed through a State budget but directly by the licensees by the means of:

- annual taxes for authorized parties.
- administrative fines.
- fees paid at the occasion of an application for a license or recognition.

The amount of the taxes is fixed by article 30bis/1 of the Law of 15 April 1994, the amount of the fees is fixed by royal decree, as stipulated in article 30quater of the law of 15 April 1994; and consequently not subject to discussion with the Licensees nor with the minister in charge of the State budget.

Extraordinary foreseeable additional workload for the FANC (such as pre-licensing of licensee's large projects, e.g. MYRRHA research reactor or cAt-A waste disposal facility) is financed by special fees fixed in article 30 bis/1 §3 and §3bis of the Law of 15 April 1994. Since the 6 December 2018, special fees can also be fixed by royal decree.

In case of unexpected additional workload as a result of a unusual event (for example from the Doel 3 and Tihange 2 Reactor Pressure Vessel issue in 2012), article 31§3 of the Law of 15 April 1994 and the royal decree of 16 October 2009 allow the FANC to charge additional fees to the licensee. The hourly tariff is fixed in the royal decree of October 2009.

Bel V is financed by the licensees. An hourly tariff is fixed in the GRR-2001, article 38. Each year, an annual control and safety assessment programme for the next year is prepared with the FANC. This programme is sent to the concerned licensee before formal approval by the FANC. The licensees are periodically invoiced for the inspections and safety assessments actually performed by Bel V.

As a conclusion, this financing system ensures independence of the Belgian regulatory body. This financing system is appropriate for the delivery of regulatory tasks by the Belgian regulatory Body.

2. (d) employs an appropriate number of staff with qualifications, experience and expertise necessary to fulfil its obligations. It may use external scientific and technical resources and expertise in support of its regulatory functions;

The staff of the FANC and Bel V is mainly composed of highly qualified staff (university degree) for a total of around 220 people. This figure is similar to regulatory bodies of other countries with comparable nuclear programs. The number of employees is determined according to the operational plan, the medium-term plan (3 years) and the annual plan.

Bel V is supervised by a board of administrators appointed by the FANC (on which sits a majority of members of the board of the FANC), ensuring that Bel V has sufficient resources to carry out the functions delegated by the FANC.

Finally, the FANC relies on a Scientific Council, created by article 37 of the law of 15 April 1994, whose duty is to advise the FANC in nuclear safety, in radiation protection and for its control policy. This Council is composed of approximately 16 members with extensive and high level technical, academic or managerial experience.

Human resources, education & training at the FANC

The FANC draws up ten-year strategic plans and three-year and annual operational plans. These operational plans are established per department / unit (MGS-03 process). Based on these operational plans, the staffing requirements (number and qualifications) are defined. The Management Committee submits its staffing plan annually to the FANC Board of Administrators for approval. Competence management at the FANC is carried

out according to the procedure PC003-06 of its integrated management system. FANC experts are subject to formal internal recognition. The procedure is described in the document PC010-01 of the FANC management system. This procedure involves a third-party advisory body, the Scientific Council. The requirements for obtaining the recognition following a positive advice from the Scientific Council are identical to those of a recognized expert in health physics, as described in article 73 of the GRR-2001. In order to be able to be appointed as nuclear inspector, FANC experts then must obtain an accreditation as a candidate nuclear inspector.

Human resources, education & training at Bel V

The Bel V's annual control and safety assessment plan is drawn up at the end of each year. This plan is approved by the FANC. (article 38.1 – GRR-2001). Bel V is responsible for carrying out this plan. Article 38.1 of the RGPRI stipulates that the related skills and resources must be present at Bel V (subcontracting is possible in very specific cases, but must remain exceptional and is subject to approval of the FANC). Bel V therefore has the obligation to adapt its resources according to the regulatory tasks delegated to it by the FANC (article 38.2 §6). FANC audits can assess the adequacy of these resources (article 38.3).

The competence management at Bel V uses the IAEA "SARCON" methodology. According to article 38.2 of the GRR-2001, the inspections carried out by Bel V must be carried out by class I health physics experts, recognized according to the provisions of article 73. This de facto sets high demands in terms of competence. Bel V's training programs is adapted to these requirements. The recognition of Bel V experts is published in the Belgian Official Gazette.

<p><i>2. (e) establishes procedures for the prevention and resolution of any conflicts of interest;</i></p>

Different legal provisions are in place to prevent conflicts of interest:

For the FANC:

- a) Article 10ter of the law of 15 April 1994 explicitly prohibits conflicts of interest for nuclear inspectors, i.e. members of the FANC responsible for surveillance.
- b) the Director General of the FANC has the quality of nuclear inspector (article 1 of the law of April 15, 1994) and is consequently subject to article 10ter of the law of 15 April 1994.
- c) The Director General of the Agency is appointed by royal decree discussed in the Council of Ministers. The functioning of government is subject to parliamentary control by the House of Representatives.
- d) All the members of the FANC are submitted to the code ethics of the Belgian public service. In practice, the Circular No. 573 relating to the ethical framework for public servants of the federal public services applies, via the FANC internal Work Regulations. This includes provisions for conflicts of interest, in its "impartiality" section.
- e) For the members of the Scientific Council of the FANC, article 11 of the royal decree of December 18, 2002 deals with the management of potential conflicts of interest. This decree is applied at each meeting where the Scientific Council is requested for delivering an advice
- f) Concerning the members of the Board of Administrators, the Law of April 15, 1994 lists certain incompatible functions (articles 10ter and 38) with the mandate of FANC administrator.

For Bel V, Article 38.2 of the Royal Decree of July 20, 2001 (RGPRI) – as amended by the Royal Decree of December 6, 2018 lists provisions aimed at preventing conflicts of interest in Bel V.

Additionally, the management contract established between the FANC and Bel V (as provided for in article 38.3 of the RGPRI) provides that the ethical charter of Bel V must be in line with that of the FANC.

2. (f) *provides nuclear safety-related information without clearance from any other body or organisation, provided that this does not jeopardise other overriding interests, such as security, recognised in relevant legislation or international instruments.*

We refer to the description under article 8 (transparency) describing provisions for public information.

3. Member States shall ensure that the competent regulatory authority is given the legal powers necessary to fulfil its obligations in connection with the national framework described in Article 4(1). For this purpose, Member States shall ensure that the national framework entrusts the competent regulatory authorities with the following main regulatory tasks, to:

(a) *propose, define or participate in the definition of national nuclear safety requirements.*

The regulatory function “development of regulations and guides” is allocated to the FANC by the law of 15 April 1994. The FANC has the duty to make regulation proposals to the King (i.e. the Government). Since May 2017, the FANC can also issue binding technical regulations, of a non-policy nature, called “FANC Technical regulations” in cases foreseen in a Royal Decree. Both FANC and Bel V can also issue technical guidance but this guidance is not binding.

At the IAEA level, the FANC participates in the Nuclear Safety Standards Committee (NUSSC), the Waste Safety Standards Committee (WASSC), the Transport Safety Standards Committee (TRANSSC), the Radiation protection Safety Standards Committee (RASSC), the Emergency Preparedness and Response Standards Committee (EPRReSC), the Nuclear Security Guidance Committee (NSGC) and the INES advisory committee.

At the European level, the FANC is an active member of the ENSREG (European Nuclear Safety Regulators group). Belgian representatives are members of the different working groups set up by ENSREG.

In practice, all Belgian regulations (Law and Royal Decree) in nuclear safety and in radioprotection that have been adopted since 2001 have been proposed by the FANC. Recent examples (2014-2020) of regulation prepared by the FANC and relevant for the safety of nuclear installations, that have been adopted and published include :

- The Royal Decree of 10 August 2015 *on the decommissioning of Nuclear installations*
- The Royal Decree of 29 May 2018 *aiming to avoid situations which can give rise to possible liabilities of radioactive waste or of installations to be dismantled*
- The Royal Decree of 29 May 2018 *related to the safety of facilities for storage of spent fuel and radioactive waste*
- The Royal Decree of 9 October 2018 *completing the transposition of the Nuclear Safety Directive 2014/87/EURATOM*
- The Royal Decree of 6 December 2018 *on Health Physics Control organization and regarding Bel V*
- The Royal Decree of 19 February 2020 *related to the design of existing reactors, their protection against natural hazards and other requirements*

- The Royal Decree of 20 May 2020 *amending the royal decree of 20 July 2001 on general regulations for the protection of the population, workers and the environment against the danger of ionizing radiation with regard to the licensing regime of class I facilities*

(b) require that the licence holder complies and demonstrates compliance with national nuclear safety requirements;

Several legal provisions require the license holder to comply with national safety requirements:

- With the license: Article 5.2 of the GRR-2001 also indicates that the licensee is responsible for complying with the conditions set in the license.
- With the GRR-2001 : article 80 states that « Infringements to this Decree shall be investigated, identified and prosecuted in accordance with the provisions of the law of 15 April 1994 concerning the protection of the public and the environment against the hazards of ionising radiations and concerning the Federal Agency for Nuclear Control. »
- The SRNI – 2001, in its article 42 contains a similar provision to article 80 of GRR-2001.

Article 9 of the law of 15 April 1994 appoints FANC inspectors to ensure the surveillance: *"Without prejudice to the powers of the police officers referred to in article 8 of the Code of Criminal Procedure, the statutory and contractual staff members of the Agency appointed by the King for this purpose monitor compliance with European Union regulations which fall within the competence of the Agency, the provisions of this law, in its implementing decrees, as well as compliance with the conditions set out in the licenses, authorizations or recognitions, in application of these provisions"*

In addition, the SRNI-2011 impose that the nuclear facilities must comply with the Safety Analysis Report (art. 13.1) « *The licensee ensures that the installation, the activities that are carried out, the equipment, the organisation, the qualification and training of the personnel, the quality assurance programme, and the safety systems and instructions comply with the safety report.*».

Modification to the Safety analysis report are subject to the approval by the Health Physics Department of the Licensee and Bel V, by delegation of the FANC, after a safety assessment performed according to a graded approach. The FANC and Bel V continuously monitor the compliance with the Safety analysis report.

In practice, the licensee has the first responsibility to ensure compliance with safety requirements. The licensee of each nuclear facility has to set up an internal Health Physics Department (HPD) which is in charge of the following:

- Oversight of compliance with the regulations.
- Oversight of compliance with the license.
- Specific control tasks that are listed in article 23 of GRR-2001.

(c) verify such compliance through regulatory assessments and inspections;

Review and assessment of the safety of facilities and activities during the different stages of their lifetime is a legal task of the regulatory body, as follows from the following articles of the law of 15 April 1994:

- Article 15 and 16 enable review and assessment for facilities;
- Article 16 introduces the concept of periodic safety reviews.

The main work related to activities on review and assessment for nuclear installations (NPPs, FCFs and RRs) is delegated to Bel V by the FANC. The members of the NRA (Nuclear safety and radiation protection Assessment) Department of Bel V are involved in review and assessment work.

Bel V also has a transversal structure organised in Technical Responsibility Centres (TRCs). These TRCs have been created with the objective to use the staff as effectively as possible. About 20 TRCs are operating. The goal is to involve all people, having expertise in a technical domain, in review and assessment work for that domain, wherever the staff member is positioned in the Bel V organisation chart.

Review and assessment of the safety of facilities of nuclear facilities is performed at all stages in the lifetime of the facility by the Belgian regulatory Body :

Licensing process: a list of documents to be submitted by the applicant is defined in art. 6.2 of the GRR-2001. As a part of this and in SRNI-2011 for Class I facilities, the content of the preliminary Safety Analysis Report is defined. The FANC verifies the acceptability and completeness of the application documents, while the technical documents (Safety Report and supporting documents) are reviewed in depth by Bel V. The results of this analysis are presented to the FANC's Scientific Council, which delivers its conclusions and proposes conditions to be attached to the license.

For projects with a specific/innovative character which are presently in a licensing or a pre-licensing phase, an import effort is being made to produce guidance in the frame of a pre-licensing process. Specific guidance is developed for topics such as seismic hazards, accidental aircraft crashes, external flooding hazards,...

Commissioning: the initial license must be confirmed by a second royal decree (art. 6.9 of the GRR-2001). Bel V performs acceptance inspections and verifies the actual (as-built) state of the facility, the conformity with the regulations in force, the license and the Safety Analysis Report (that has to be finalized at this stage).

Modifications: modifications must be notified to FANC, according to art. 12 of GRR-2001. A categorisation of modifications for nuclear installations, according to a graded approach, is described in a FANC guidance. Major modifications require a procedure similar to the initial licensing. For less important modifications, it is required (art. 23 of GRR-2001) that an analysis, approval and verification of the delivery of the modification is performed by the Licensee's Health Physics Department and verified/approved by Bel V.

During operation:

Major findings discovered during inspections (for instance design deficiencies in a safety system,...) are subject to specific review and assessment efforts by the department NRA of Bel V which employs more or less 25 experts in different technical areas.

A main process for review and assessment is the **Periodic Safety Review**, required for all class I facilities by the license, with a periodicity of 10 years. Belgium has a longstanding experience in Periodic Safety Review. Even the licenses of the 3 oldest NPP (Doel 1&2 and Tihange 1) issued around 1974-1975 already included an obligation to perform a global safety reevaluation every 10 years. Since then, the process has been repeatedly applied and has been extended to all nuclear facilities, including during their decommissioning phase.

Decommissioning, dismantling: a list of documents/information to be submitted by the licensee is defined in GRR-2001 (art. 17.2) which includes a safety analysis reports, as defined by the SRNI-2011, and a review and assessment similar to the one performed for the initial licensing is performed. The relevant safety requirements, including the obligation to perform periodic safety reviews during the decommissioning are laid down in articles 17/1 to 17/11 of SRNI-2011.

Regulatory Inspections

The FANC inspections for nuclear facilities are carried out by a section consisting of 10 members. Each nuclear facility and particularly each NPP has two single points of contact, who carry out announced inspections (which are included in the inspection program). Inspections on a specific subject (cross-subject for each facility like releases) are led by one coordinator and supported by the "Single Point of Contact" (SPOC).

The Bel V inspections are carried out by a specific department (NRI) composed of approximately 25 people. To perform these missions in an effective way, Bel V dedicates one specific expert (inspector) to each nuclear site or one to each reactor for the NPP-sites, who is in charge of the operational supervision of that specific site or reactor.

(d) propose or carry out effective and proportionate enforcement actions.

The enforcement power of regulatory requirements is assigned to the FANC by the law of 15 April 1994.

Various coercive measures are used to reinforce FANC's orders. Two types of sanctions are foreseen (articles 50 to 64): legal penalties (requiring a legal procedure by the Court) or administrative fines (nevertheless requiring an information to and a decision by the Public Prosecutor).

The FANC nuclear inspectors are nominated by Royal Decree. They have enforcement powers; they can also intervene on the request of Bel V inspectors. The FANC inspectors can also take any measure they consider necessary to reduce or eliminate hazards for workers, the public and the environment. These measures can include warnings, requests for corrective actions with a delay not exceeding 6 months (article 9 of the Law of 15 April 1994).

The choice of the enforcement measures is based primarily on the safety significance of the infraction or situation where corrective measure are required, applying the principle of graded approach. The enforcement policy is presented in the FANC management system.

The nuclear inspectors can take any necessary and urgent measures to avoid or eliminate a risk. Examples of those measures are:

- Impose technical modifications to the installation (additional shielding, installation of additional detection or measurement device);
- Proceed to the seizure or evacuation of radioactive sources, contaminated material or devices that present ionising radiation;
- Impose an administrative modification (as far as procedures, instructions or operating modes are concerned) or an organisational modification (obligation of additional personnel in relation to safety and/or radiological protection);

Other possibilities of enforcement are described under article 4, 1^o, e)

Section I.C.4 (Main safety events 2016-2019) of the Belgian report for the eighth review meeting of the contracting parties to the Convention of Nuclear Safety (September 2019) gives several examples of response of the Belgian regulatory body to main safety events that occurred at the NPPs within the period 2016-2019.

Article 6 – Licence holders

(a) the prime responsibility for the nuclear safety of a nuclear installation rests with the licence holder. That responsibility cannot be delegated and includes responsibility for the activities of contractors and sub-contractors whose activities might affect the nuclear safety of a nuclear installation;

The Law of 15 April 1994 has been amended by the Law of 7 May 2017. Article 28 of this amended law explicitly states the prime responsibility of the licence holder:

"Art. 28. § 1.

The licence holder is 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 the exercise of its practice. This responsibility cannot be delegated."

In addition, the licensee has to comply with the regulations in force dealing with nuclear safety and radiation protection. The legal and regulatory framework expresses in several statements the prime responsibility of the operator for safety:

- According to article 28 of the Law of 15 April 1994, the licensee must organise a Health Physics Department (HPD) in charge of nuclear safety and radiological protection and must also organise the health and safety at the workplace as well as in the surrounding area. A detailed description of the duties is given in Article 23 of the GRR-2001.
- Article 5.2 of the GRR-2001 also indicates that the licensee is responsible for complying with the conditions set in the licence. For nuclear Class I facilities, the licence requires conformity with the Safety Analysis Report. Moreover, the operator must commit himself in the licence application to register with ONDRAF/NIRAS – the Belgian Radioactive Waste Management Agency - and to conclude with this organisation an agreement on radioactive waste management.
- The operator must also conclude a civil liability insurance (Article 6.2.5 of the GRR-2001); the law of 22 July 1985, which makes the conventions of Paris and Brussels and their additional protocols applicable, and the law of 13 November 2011 set the maximum amount of the operator's liability for damage at some Euro 1.2 billion per site and per nuclear accident.

Other obligations of the operator include information and training of the workers (including workers not belonging to its own personnel) who might be exposed to ionizing radiation, and implementing the policy to limit individual and collective doses (respectively Articles 25 and 20 of the GRR-2001).

(b) when applying for a licence, the applicant is required to submit a demonstration of nuclear safety. Its scope and level of detail shall be commensurate with the potential magnitude and nature of the hazard relevant for the nuclear installation and its site;

The licencing process is provided under 4.1.(c). The list of documents to be submitted by the applicant for a license is defined in art. 6.2 of the GRR-2001 for Class I facilities. As a part of this, the content of the preliminary Safety Analysis Report is defined.

The preliminary Safety Analysis Report, to be included in the license application file shall contain the following elements :

- a) *Introduction and context.*
- b) *General description of the site, the installation, its normal operation and its safety, brief description of the main circuits (fluid and electrical circuits) and of the control-command system; the nature and quantities of radioactive substances used.*
- c) *Detailed description of the site:*
 - i) *a topographic survey of the region located within a radius of 500 m around the facility as well as the indications relating to the population density within this perimeter*
 - ii) *geology, seismology, hydrology, meteorology, climatology and other relevant natural features*
 - iii) *economic activities, including agriculture, transportation, and other relevant aspects related to human activity.*
- d) *General aspects of the design and fundamental safety objectives, description of defense in depth.*
- e) *Detailed description of the safety functions and of the structures, systems and components important for nuclear safety with their design bases and their operation in all states of the installation (in normal operation, at standstill, in incident and accidental conditions).*
- f) *Codes and standards applicable to the installation and the structures, systems and components important for nuclear safety;*
- g) *Safety demonstration:*
 - i) *deterministic analyzes demonstrating compliance with safety criteria and radiological limits, including a description of the margins,*
 - ii) *preliminary probabilistic safety analyzes for the establishments referred to in articles 3.1.a) .1;*
- h) *Organization of the operation and description of the management system.*
- i) *Operational aspects, including:*
 - i) *a description of the objectives of the accident management procedures,*
 - ii) *the principles of maintenance, tests and inspections,*
- j) *Staff qualification and training,*
- k) *Principles of ageing management.*
- l) *Main operating limits and conditions with their technical justifications.*
- m) *Description of radiation protection, including, inter alia, the measures and means implemented to ensure compliance with the basic standards as defined in Chapter III.*
- n) *Radioactive releases in normal and accidental situations and the planned operational limits; proposal for an on-site and off-site environmental monitoring program.*
- o) *Preparation to emergency situations: actions at the site level and liaison / coordination with external organizations.*
- p) *The radioactive waste sub-file and the dismantling sub-file referred to in article 5.8*

The content and format of the final SAR which will be applicable during the operation of a NPP is described in article 28 of the SRNI-2001 for NPPs, in article 17/10 for dismantling, and in article 40 for radioactive waste and spent fuel storage facilities, in accordance with the related WENRA reference levels.

As part of the commissioning process of new installations, Bel V performs delivery inspections and verifies the conformity with the existing regulations and with the Safety Analysis Report.

(c) licence holders are to regularly assess, verify, and continuously improve, as far as reasonably practicable, the nuclear safety of their nuclear installations in a systematic and verifiable manner. That shall include verification that measures are in place for the prevention of accidents and mitigation of the consequences of accidents, including the verification of the application of defence-in-depth provisions;

Article 14 of the SRNI-2011 (and before the publication of this decree, a license condition) requires to perform ten-yearly periodic safety review for each nuclear facility. The general objectives of these periodic safety reviews are as follows:

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

The first of these periodic safety reviews took place in 1985 for the Doel 1 & 2 and Tihange 1 units. At the time of design of these units, i.e. in the early 1970s, the safety rules were less numerous and less detailed than they were for the later Belgian units that were started between 1980 and 1985.

These 1st periodic safety reviews were conducted very comprehensively and were an in-depth review of the safety of the nuclear power plants. This allowed to identify coherent solutions and, at that time, to simultaneously solve several problems (an example is the emergency building of Doel 1 & 2). It also demonstrated that it is even possible to strongly improve design- and lay-out dependent systems of the nuclear power plant taking into account a higher-intensity earthquake, protection against external accidents, a new reactor protection system...

In addition, additional safety improvements (action plans) result from non-recurrent situations :

- Safety improvements resulting from experience feedback
- Safety improvements resulting from the European Stress tests
- "Regulatory driven" improvements :
 - Safety improvements for complying with WENRA requirements
 - Safety improvements for Long term operation (design upgrades imposed by license)
- Improvements from peer reviews :
 - Safety improvements from European peer reviews (TPR)
 - Safety improvements from peer reviews (SALTO, WANO).

Stress Tests of NPPs:

Following the Fukushima Daiichi accident, ENGIE Electrabel was asked to conduct Stress Tests. Safety evaluation reports for the Doel and Tihange sites have been established by ENGIE Electrabel and reviewed by the FANC and Bel V and external experts. Within the scope of the Stress Tests, an assessment of design bases, existing safety margins and cliff-edge effects was performed for the risks related to the Site Characteristics such as earthquake, flooding and bad weather conditions.

An action plan was launched as a result of the assessment, including:

- A probabilistic seismic hazard assessment for Doel and Tihange by ENGIE Electrabel (in collaboration with Royal Observatory of Belgium and external experts for peer review)
- A seismic safety margin assessment of the Structures, Systems and Components was performed.
- Reinforcements of Structures, Systems and Components to improve their resistance against beyond design earthquakes;
- A site peripheral protection for Tihange, in relation to an upgraded design basis flood;
- Improvements of the protections against beyond-design-basis floods: in Doel, volumetric protections of sensitive buildings and adapted procedures; in Tihange, water supplies (involving pipes, pumps, additional electrical diesel generators, etc.) to the primary circuit, the steam generators and the spent-fuel pools, with adapted procedures and training;
- Improvements of the sewage systems for protecting the sites against rains with return periods much larger than considered in the design.

Stress tests of Research Reactors:

The installations of the SCK•CEN are located in the north-east of the province of Antwerp, which is one of the lesser populated regions of the northern part of Belgium. This was one of the major reasons for the choice of the location, together with the availability of sufficient free terrain. The site has a low risk for the occurrence of natural phenomena.

Following the Fukushima Daiichi accident, all Belgian "Class 1" nuclear installations (including the power reactors and the research reactors), were asked to conduct Stress Tests. The safety evaluation report for SCK•CEN has been established by the licensee and reviewed by the FANC and Bel V.

In the frame of the Stress Tests, an assessment of design bases, existing margins and cliff-edge effects was performed in relation to risks related to the site characteristics like earthquake, flooding and bad weather conditions. A graded approach was used.

(d) licence holders establish and implement management systems which give due priority to nuclear safety;

Article 5 of SRNI-2011 requires the licensees of nuclear facilities to establish and implement a management system and states that *"an integrated management system giving priority to safety shall be established, implemented, assessed and improved on a continuous basis. This management system shall cover all the activities and processes which can have an impact on the nuclear safety of the facility, including the activities carried out by the subcontractors or suppliers."*

This article is applicable to all nuclear facilities, including NPPs, Research reactors, Fuel Cycle Facilities and is based on the WENRA 2008 reference level "issue C – Management System", which is itself derived from the IAEA Safety guide GS-R-3.

This article has been modified by the royal decree of 19 October 2018 which introduced

requirements for safety culture in the management system, as defined by the updated WENRA 2014 reference levels.

Thematic inspections of the regulatory body focus on licensee's management systems.

(e) licence holders provide for appropriate on-site emergency procedures and arrangements, including severe accident management guidelines or equivalent arrangements, for responding effectively to accidents in order to prevent or mitigate their consequences. Those shall in particular:

- (i) be consistent with other operational procedures and periodically exercised to verify their practicability;*
- (ii) address accidents and severe accidents that could occur in all operational modes and those that simultaneously involve or affect several units;*
- (iii) provide arrangements to receive external assistance;*
- (iv) be periodically reviewed and regularly updated, taking account of experience from exercises and lessons learned from accidents;*

Article 16 (Internal Emergency Plan) of the Royal Decree of 30 November 2011 requires the licensees of nuclear facilities to set up internal emergency procedures and planning. Article 31 contains an additional provision applicable to nuclear power reactors. Article 27 of the same decree requires operators of nuclear power reactors to have accident procedures and severe accident management guides. These requirements are in line with the WENRA reference levels, 2006 and 2014.

- Article 16.1 requires taking into account situations that simultaneously involve several units of a site.
- Article 16.2 deals with external assistance and coordination with external organizations
- Article 16.5 deals with training of staff involved in emergency management and of regular exercises. An annual exercise is mandatory for each authorized facility. In addition, the first exercise shall take place before the actual operation of a (new) facility.
- Article 27.1 states that emergency procedures and guides shall address accidental situations in all operational states
- Article 27.4 requires that the emergency procedures and guides shall be regularly reviewed and updated

In addition, as required by Article 14, the provisions of the internal emergency plan are also reviewed within the framework of the 10-yearly periodic safety reviews, as safety issue No. 13.

Article 11 on operating experience feedback also requires a review of procedures and emergency plans after the analysis of relevant events.

In practice, the stress tests carried out after the Fukushima accident have led to changes in these matters.

The Belgian NPPs, except Tihange 1, have implemented the Emergency Response Guidelines (ERG) approach developed by the Westinghouse Owners Group (WOG). These standard procedures have been adapted to the plant-specific elements and systems, especially the systems for protection against external events.

Specific procedures have been written to give guidance to the operators after an earthquake that could occur during normal operation or in shutdown state.

Severe accident management procedures, inspired by the "Severe Accident Management Guidelines" developed by the Westinghouse Owners' Group, were implemented, adapted to the specificities of each unit. The training programme for the control room operators was developed in parallel.

For Tihange 1, the Framatome approach has been followed. The accident management procedures combine event-based and symptom-based approaches, using the surveillance of key safety functions or parameters. Severe accident management procedures were developed as for the other units, on the basis of the Westinghouse Owner's Group Guidelines.

1. f) licence holders provide for and maintain financial and human resources with appropriate qualifications and competences, necessary to fulfil their obligations with respect to the nuclear safety of a nuclear installation. Licence holders shall also ensure that contractors and subcontractors under their responsibility and whose activities might affect the nuclear safety of a nuclear installation have the necessary human resources with appropriate qualifications and competences to fulfil their obligations.

The Licensee of NPPs

a) NPP Operator's financial and human resources to operate the installation throughout its industrial life

The main activities of ENGIE Electrabel, the licensee of Belgian NPPs, are the generation and commercialisation of electricity and gas in Europe. In Belgium, ENGIE Electrabel is the owner of the twin units 1 and 2 (100%) and the units 3 and 4 (89.8%) in Doel, and of the unit 1 (50%) and of the units 2 and 3 (89,8 %) in Tihange. Belgium's nuclear generating units account for some 40% of electricity production in Belgium.

About 2200 people (about 300 at corporate level and the remaining equally distributed on the NPP sites) are devoted to nuclear power plant operation among Electrabel's total workforce in Belgium of around 4300. The business unit ENGIE Benelux, of which ENGIE Electrabel is a part, has around 16700 employees in Belgium.

The ENGIE group also has an Engineering division, Tractebel ENGIE, which is the Architect-Engineer of the Belgian nuclear power units (and of most of the fossil fired plants) and which houses know-how accumulated over fifty years of nuclear technology, which started with the construction of the first research reactors at the SCK•CEN.

b) Financing of safety improvements during operation

Major safety improvements to the Belgian nuclear power stations emanate from the periodic safety reviews (ten-yearly) and are financed through annual provisions (1/10th each year). Cost of specific projects and for replacement of aged or obsolete components are amortized on the remaining lifetime of the concerned power plant.

c) Financial and human provisions for future decommissioning and for management of the waste produced by the installations

The existing mechanisms are described in the Belgian report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. More details can be found in that report, available on the FANC and IAEA web sites.

The Belgian research centre SCK/CEN

The SCK•CEN, the Belgian Nuclear Research Centre is a "Foundation of Public Utility" (FPU) with a legal status according to private law, set up according to the law on non-profit organisations, under the supervision of the Belgian Federal Minister in charge of Energy. Since January 2005 the SCK•CEN, like any other non-profit organization, has to apply the principles and rules prescribed by Belgian accounting rules. The turnover and the operating profit of the previous years are defined in accordance to this law. The adequacy of the SCK•CEN's financial system and its internal controls is assessed by an external auditor. According to the safety and security charter, the management is committed to provide all necessary financial means to enhance safety and to ensure all required security measures.

The future cost for dismantling is covered by funds. With respect to these technical

liabilities, the following rules for funding apply. All dismantling costs for installations built and in operation before 1989 are covered by a special 'Technical Liabilities Fund', which is administered outside the SCK•CEN. All new technical liabilities after January 1989 are financed by the SCK•CEN by means of setting up the necessary provisions. The total liabilities are periodically reassessed and the total amounts have to be available at the moment of dismantling and decontamination. The necessary financial means are funded by means of annual government grant and by revenues from contract research and services to third parties.

Contractors and subcontractors are managed under the responsibility of the license holders.

According to SRNI-2011:

- The licensee shall clearly define and document the competence requirements for the various functions.
Only people with the needed competences, qualifications and attitudes for safety can be authorised to carry out tasks important to safety. The licensee shall ensure that all the personnel in charge of safety-related tasks, including subcontractor staff, have been duly trained and qualified.
The work performed by subcontractors on structures, systems and components important to safety shall be authorised and supervised by the licensee's personnel having the necessary competences and qualifications. (article 6.2)
- All the site technical staff, including the subcontractors, shall have appropriate basic knowledge of nuclear safety and the internal emergency plan. (article 6.3)
- The licensee shall employ a sufficient number of trained staff having the necessary knowledge and skills to specify, manage, monitor and assess safety work carried out by subcontractors. (article 4.3)

Article 7 - Expertise and skills in nuclear safety

Member States shall ensure that the national framework requires all parties to make arrangements for the education and training for their staff having responsibilities related to the nuclear safety of nuclear installations so as to obtain, maintain and to further develop expertise and skills in nuclear safety and on-site emergency preparedness.

Article 6 of SRNI-2011 deals with training and habilitation of staff. Article 6.2 of SRNI-2011 (WENRA Reference Level D.2.1) states: "Only qualified persons that have the necessary knowledge, skills, and safety attitudes shall be allowed to carry out tasks important to safety. The licensee shall ensure that all personnel performing safety-related duties including contractors have been adequately trained and qualified".

For NPPs, the training programmes are defined in the Safety Analysis Report, which includes a "function-programme" correlation chart. Chapter 13 of the Safety Analysis Report lists exhaustively all posts for which an authorization is required. This authorization is based on the positive opinion expressed by an Assessment Committee, which examines the candidate's knowledge. This qualification is reviewed every two years or when an authorized person has ceased for four months or more to perform the function for which he/she was qualified. It is renewed on the condition of, among other, a favourable advice of the Assessment Committee on the basis of the individual's training and activity file

Each licensee of a nuclear facility in Belgium has to set up an health physics department. Art. 23 of GRR-2001 describes the role and duties of the Health Physics Department (HPD). Under the licensee's primary responsibility, the HPD is in charge of supervising the activities and organizing measures to ensure the protection of the population, the

workers and the environment. Specific tasks to be performed by the HPD are listed in Art. 23.1.5, some of them under the responsibility of “experts in health physics” who must be recognized by the FANC according to criteria and conditions set out in Art. 73. The head of the Health physics department must also be a recognized expert in health physics. In particular, for being recognized, the expert in health physics shall be a university graduate in (applied) science and shall demonstrate an education consisting of :

- 12 ECTS (European Credit Transfer System) in radiation protection
- 24 ECTS in nuclear safety for experts in charge of nuclear reactors or 18 ECTS for experts in charge of other nuclear facilities.

In a joint effort to maintain and further develop a high quality programme in nuclear engineering in Belgium, the Belgian Nuclear higher Education Network (BNEN) was founded in 2001 by six Belgian universities and the SCK•CEN (the Belgian Nuclear Research Centre).

In the framework of the new architecture of higher education in Europe, the BNEN created a 60 ECTS “Master of Science in Nuclear Engineering” programme. To be admitted to this programme, students must already hold a university degree in engineering or equivalent education.

At European level, the European Nuclear Education Network (ENEN) (www.enen.eu) has been established as an international association of 67 member organisations including universities and other stakeholders (industry, regulators and research centres) and is strongly supported by the European Commission. BNEN is the Belgian pole of this network. Students registering to any of the participating institutions are offered the opportunity to coherently take a part of their basic nuclear education at different places in Europe while cumulating credit units.

Human resources of **the Regulatory Body**: See description under article 5 2. (d) related to the human resources of FANC and Bel V.

Article 8: Transparency

1. Member States shall ensure that necessary information in relation to the nuclear safety of nuclear installations and its regulation is made available to workers and the general public, with specific consideration to local authorities, population and stakeholders in the vicinity of a nuclear installation. That obligation includes ensuring that the competent regulatory authority and the licence holders, within their fields of responsibility, provide in the framework of their communication policy:

(a) information on normal operating conditions of nuclear installations to workers and the general public; and

The **FANC** is legally appointed to disseminate objective and neutral information about radiation risks, as stipulated in article 26 of the law of 15 April 1994.

The general public and the media are informed by the FANC :

- the FANC and Bel V have their own web sites. The FANC web site allows the general public to contact and ask questions to the FANC;
- the media are informed by the FANC management and the FANC communication office. Important events give rise to press releases and conferences;
- laws and regulations, as well as notification of decisions (licensing of class I facilities, recognition of experts in health physics ...), are published in

the Belgian official Gazette ("Belgisch Staatsblad-Moniteur Belge"). A consolidated version of the regulations is available on the FANC web site (<http://www.jurion.fanc.fgov.be>);

- the general public is consulted ("public inquiry") in the frame of the licensing process of high risk facilities (Class I and some Class II), with the possibility to attend information meetings organized by the FANC;

The government and the public are also informed by the annual report of the FANC. This report is published on the FANC web site, together with the Bel V annual report.

The main communication tool of the FANC is its web site www.fanc.fgov.be. Several reports, information files about the radiation risk of different facilities and activities or about particular subjects are available. News Flashes are also regularly published on the web site.

Since 2012, the radioactive releases of all Belgian nuclear and waste facilities with their calculated radiological impact are published annually on the FANC web site.

Information about the Periodic Safety Reviews is given on a dedicated page.

ENGIE Electrabel, the licensee of Belgian NPPs, has taken several initiatives to inform the general public, in particular in the vicinity of the NPPs:

Doel and Tihange NPP's external communications are aimed at:

- Informing the public about their nuclear activities;
- Communicating its commitment to environmental protection and nuclear safety to the public at large;
- Increasing the public acceptance of the power plant.

The Belgian power plants pursue a pro-active and open communication policy in order to achieve these goals. Both Doel and Tihange NPP have a specific dedicated webpage on the ENGIE-website. On this webpage key figures on the plants can be found, as well as information on current big projects, press releases, publications, currently relevant information, ... In case of specific subjects and questions on social media, the social media channels of ENGIE are also being used to give information on nuclear topics.

The bi-yearly information magazines 'Doelbewust' and 'Tihange Contact' are distributed freely to respectively 77,000 and 47,000 people living in the vicinity of the power plants.

The 'Klankbordraad' and 'Comité de Riverains' are consultative bodies set up to reinforce the relations between the power plants and local residents (people living or working in the area). This consultative body is made up of members from various sectors: education, environmental organizations, social sector, etc. It meets several times a year. The members are kept informed of current news regarding the power plants on a regular basis.

Every year the Belgian power plants distribute an environmental report in which the environmental results and objectives are being explained to the public.

1. (b) prompt information in case of incidents and accidents to workers and the general public and to the competent regulatory authorities of other Member States in the vicinity of a nuclear installation.

A technical regulation of the FANC of 5 July 2019 determines the criteria and modalities for notification of events and the use of INES. This technical regulation replaces a convention between the licensees, the FANC and Bel V. As the convention did before, the technical regulation stipulates in which circumstances and how INES is to be used. The licensee has to perform the INES-analysis according to the latest INES manual, and this level has to be approved by Bel V and the FANC. Depending on the INES-level, a specific notice is issued. For events of level 1 or higher, the FANC publishes a short notice on its website. For events of level 2 or higher, besides the notice on the website of the FANC, the licensee has to issue a press release about the event and the INES National Officer notifies the IAEA.

Prompt exchange of information with competent regulatory authorities of other Member States in the vicinity of Belgian nuclear installations is ensured through bilateral agreements signed with neighboring countries that are listed below for article 8, 3°.

2. Information shall be made available to the public in accordance with relevant legislation and international instruments, provided that this does not jeopardise other overriding interests, such as security, which are recognised in relevant legislation or international instruments.

Regulation of the security of nuclear installations, nuclear substances and nuclear documents is allocated to the FANC by the Law of 15 April 1944. Similar processes exist for security as for safety, for example proposal of security regulations, approval of security plans, security inspections belongs to the FANC mission.

The law of 5 August 2006 on the publicity of environmental public sector information explicitly excludes information on the physical protection of radioactive materials from its scope.

This ensures that the information available to the public is in line with nuclear security requirements.

3. Member States shall, without prejudice to Article 5(2), ensure that the competent regulatory authority engages, as appropriate, in cooperation activities on the nuclear safety of nuclear installations with competent regulatory authorities of other Member States in the vicinity of a nuclear installation, inter alia, via the exchange and/or sharing of information.

Several bilateral agreements are in force and the FANC has extended collaboration, with foreign regulatory bodies.

Amongst others, Belgium has formal agreements with all its immediate neighbors:

- France: various exchanges and agreements exist since the 1980s;
- Luxembourg: an agreement was signed in April 2005 and completed in 2013;
- Netherlands: a Cooperation Agreement between FANC and ANVS was signed on 14 September 2017;
- Germany: a bilateral agreement was signed on December 6, 2016.

Under these agreements, bilateral meetings are held at least on an annual basis.

These bilateral exchanges systematically address the operation of nuclear units that may have a transnational impact: in particular Chooz (France-Belgium), Gravelines (France-Belgium); Tihange (Belgium-France-Luxembourg-Germany) and Doel (Belgium-France-Netherlands).

Collaborative activities and exchanges of information are continuous and include:

- exchanges of information of technical nature. For example, technical files related to the flaw indications in the vessels of Tihange 2 and Doel 3 were transmitted to the German authority and debated between Belgian and German experts;
- exchanges of media information, with the aim of informing and answering the questions of residents and/or local and national elected representatives;
- exchange of information on the licensing processes of nuclear installations (or of modifications thereof) that are in progress;
- cross inspections: A Belgian nuclear inspector accompanies an inspection in a nuclear power plant in the foreign country, and vice versa.
- exchanges of training: experts from the safety authority participate in training courses organized by the French safety authority, and vice versa;
- cross-participation of experts in national emergency plan exercises, in addition to the collaborations at the level of various local, regional and federal authorities, in particular for the Chooz French power station, considering its proximity to the Belgian border.

With respect to emergency planning and response, the Belgian provincial authorities are also regularly involved in foreign emergency exercises for the nuclear power plants that are close to the Belgian border.

4. Member States shall ensure that the general public is given the appropriate opportunities to participate effectively in the decision-making process relating to the licensing of nuclear installations, in accordance with relevant legislation and international instruments.

The licensing process of nuclear facilities ("Class I" facilities in the Belgian regulatory framework) is fixed in article 6 of the GRR-2001. This article has recently been (29 May 2020) modified to align it with the transposition of the European Directive 2014/52/UE in the Law of 15 April 1994. See the description under article 4, 1.

The licensing process is carried out in two stages: A first royal decree (known as of "creation and operation decree") allows the licensee to undertake the construction of the facility. Commissioning can only take place after a second royal decree (known as "confirmation decree") has confirmed the first license. This second decree can only be issued after fully favourable commissioning of the new installations.

The general public has the opportunity to give its remarks and opinions on the application during a one-month public enquiry.

The application can be consulted at the FANC offices and on the FANC web site, or at the municipality where the project is located.

The municipalities located within a 5 km radius of the project issue a notification of public enquiry on their web site or by a notice at the municipality offices.

The FANC centralizes the remarks and observations of the public.

The file which is submitted to the public inquiry includes different parts:

- The description of project (including, where appropriate a preliminary assessment of the FANC)
- The environmental impact assessment report (including a non-technical summary) (when applicable)
- The preliminary safety analysis report
- The safety assessment carried out by Bel V
- The waste and dismantling files
- The advice of ONDRAF (the Belgian agency in charge of radioactive waste management) on the waste and dismantling files
- The first advice of the Scientific Council

The final decision on the application is taken only after and taking into account of the results of the public enquiry.

Article 8a: Nuclear safety objective for nuclear installations

*1. Member States shall ensure that the national nuclear safety framework requires that nuclear installations are designed, sited, constructed, commissioned, operated and decommissioned with the objective of preventing accidents and, should an accident occur, mitigating its consequences and avoiding:
early radioactive releases that would require off-site emergency measures but with insufficient time to implement them;
large radioactive releases that would require protective measures that could not be limited in area or time.*

2. Member States shall ensure that the national framework requires that the objective set out in paragraph 1:

(a) applies to nuclear installations for which a construction licence is granted for the first time after 14 August 2014;

The Directive was published in August 2014. The safety objective set out in Article 8a was directly applicable for new nuclear installations and was transposed in Belgian law by the Royal Decree of 9 October 2018 by inserting article 3/1 and 3/2 in the SRNI-2011. In May 2013, the FANC already published a guidance, namely the "Guideline - Safety demonstration of new class I nuclear installations - Approach to Defense-in-Depth, radiological safety objectives and application of a graded approach to external hazards", reference 2013-05-15-NH-5-4-3-EN.

This guidance in particular introduces the safety objective "SO3", in relation to design accidents of category "C3a": "Severe accidents not practically eliminated" which correspond to accidents for which early and massive releases must be excluded according to Article 8a, 1. of the Directive. The values for radiological safety objectives specified in the guidance are in line with the royal decree of 17 October 2003 establishing the nuclear and radiological emergency plan for the Belgian territory. This decree of 2003 has been replaced by the Royal Decree of 1 March 2018 (same title).

The guidance applies to new Class I installations according to Belgian regulations, which includes nuclear installations falling within the scope of the Directive.

This guidance is currently being translated into a FANC binding technical regulation, which shall be published before the end of 2020.

The only nuclear facility falling within the scope of the Directive that has been licensed since 2014 is the "SF2" spent fuel storage facility at the Tihange site. The design of this storage facility took into account the FANC guidance.

The construction of new nuclear power reactors is forbidden since January 2003.

2. (b) is used as a reference for the timely implementation of reasonably practicable safety improvements to existing nuclear installations, including in the framework of the periodic safety reviews as defined in Article 8c(b).

Articles 14 - Periodic safety reviews and 11 - Event analysis system and operating experience feedback - of the SRNI-2011 make explicit reference to the nuclear safety objective.

A FANC guideline (2010-095) on the conduct of Periodic Safety Reviews specifies the timeframe for implementing the actions results from PSR that is fixed from 3 to 5 years with a possible extension in exceptional cases, in order to avoid overlap between PSRs. This guideline will be transformed in a FANC binding technical regulation mid-2020.

Several other "triggers" can initiate the implementation of an improvement in complement to the periodic safety reviews (PSR), we refer to the description under article 4, 2.

A request from the safety authority can initiate an "unusual" PSR. This possibility to request a PSR at any time is a usual license condition. This mechanism was used to ask the operator to carry out the European stress tests and to implement the action plan that followed.

Results from Operating Experience Feedback, national as well as international, can also initiate safety improvements. Article 11 of the SRNI- 2011, which applies to all Belgian Class I facilities, requires the licensee to take into account the experience feedback from other (similar) installations. Article 11.3 requires in particular the implementation of corrective actions in appropriate deadlines. For example, as a result of the well-known Forsmark (power supply issues) and Barsebäck (recirculation filters issue) incidents, the Belgian operator implemented specific safety improvements.

For implementing "actions plan" for safety improvements, the licensee has to establish and propose the time frame to the regulatory body, taking into account the importance for safety of the improvements, availability of resources and prioritization of actions. The Regulatory Body will discuss the action plan with the licensee. Delays have to be justified. Highly significant action plans may require completion of the actions before restart of the reactor unit. Several recent examples exist for Belgian NPPs : Flaw indications in Doel 3 and Tihange 2 reactor pressure vessels, reparation of concrete of bunkered buildings to withstand airplane crash, ...

WENRA 2014 Reference levels

In accordance with the WENRA 2014 reference levels, the new royal decree of February 19, 2020 amending the royal decree of November 30, 2011 with regard to the design of existing reactors and their protection against natural phenomena explicitly introduced legal requirements related to the design extension, aimed at reducing residual risks outside the design basis for rare and severe situations. It provides, in Article 22/1, for an explicit design reassessment process of the design, including for the design extension, independently of the periodic safety reviews. According to this article, the regulatory body can, if it considers it necessary, ask the operator to reassess the design of its facilities and to introduce an actions plan within a delay of two months.

To ensure compliance with this new royal decree, the FANC and Bel V started in 2017 a gap analysis, assessing the implementation of the WENRA Reference Levels 2014 in the NPPs. This gap analysis has led to an action plan, which has been discussed with ENGIE Electrabel for implementation.

The main activities that are in progress by ENGIE Electrabel in this frame cover amongst others the following topics:

- Design Basis Envelope for Existing Reactors
 - Develop the list of Postulated Initiating Events (PIE) for Spent Fuel Pools (SFP);
 - Perform SFP PIEs Analysis;
 - Siphon Breakers analysis in reactor building pools;

- Design Extension (DEC) of Existing Reactors:
 - Develop the lists of Design Extension Conditions (DEC) A/B;
 - Develop governance on Mitigation Strategy for the Belgian NPPs;
 - Perform DEC A/B studies including Survivability Assessment of I&C in DEC B;
 - Design and implement a cavity pit injection system (Tihange units);
 - Design and implement an alternative spray system for the reactor building (Tihange units);
- Natural Hazards:
 - Identification and screening of natural hazards including credible combinations;
 - Extended external flooding analysis in DEC;
 - Definition of Maximum Credible Hazard in DEC i.e. "EL2/MCE" for Seism;
- Probabilistic Safety Analysis:
 - Spent Fuel Pool PSA Internal Events, Fires and Floods;
 - Seismic PSA for reactors and Spent Fuel Pools.

This list is non-exhaustive.

Stress tests

Belgium participated in the "Stress Tests" programme initiated by the European Commission after the Fukushima-Daiichi accident. At the request of the Belgian Parliament, the stress test have been extended to all Belgian Class I facilities. As a result of the Stress Tests, the ENSREG action plan and peer review and the findings of the extraordinary meeting of the CNS in 2012, a Belgian national Action Plan (called "BEST" for NPP and "BESTA for other nuclear facilities) was issued in December 2012. More than 300 individual actions have been identified for NPPs.

Since 2011, the sites of Doel and Tihange have witnessed several major achievements: reinforcement of structures, systems and components to face severe earthquakes, construction of protections against flooding, additional mobile means, such as mobile pumps and mobile diesels. Both sites are now adequately protected against natural hazards, such as flooding and earthquakes.

By the end of 2017, the strategy for the Complete Station Black-Out (CSBO) and for the Loss of Ultimate Heat Sink (LUHS) is well-defined on both sites and the related works were finalized.

The construction of filtered venting systems on all reactor buildings at Doel and Tihange was finalized in 2017 for most units, and in 2019 for the two remaining units (Doel 1 & 2) in the framework of their LTO action plan.

The sites are now protected against external hazards and prepared against CSBO and LUHS events.

The last actions are expected to be finalized in 2020.

Article 8b: Implementation of the nuclear safety objective for nuclear installations

1. In order to achieve the nuclear safety objective set out in Article 8a, Member States shall ensure that the national framework requires that where defence-in-depth applies, it shall be applied to ensure that:

(a) the impact of extreme external natural and unintended man-made hazards is minimised;

(b) abnormal operation and failures are prevented;

(c) abnormal operation is controlled and failures are detected;

(d) accidents within the design basis are controlled;

(e) severe conditions are controlled, including prevention of accidents progression and mitigation of the consequences of severe accidents;

(f) organisational structures according to Article 8d(1) are in place.

The defence in depth concept is an integral part of the Framatome or Westinghouse nuclear power plants designs and is also found in the US safety rules.

Accordingly, this concept has been systematically applied in all Belgian nuclear power plants.

Furthermore, the design of all the additional systems to address external accidents adhered to the same principles, and in particular the single-failure criterion was applied. Compared to a conventional-design pressurised water reactor nuclear power plant, the additional systems installed to mitigate the consequences of an external accident in fact strengthen considerably the third level of the defence in depth approach, as they can help during certain internal accidents which might develop unfavourably.

In the framework of periodic safety reviews, for all units, a global evaluation of the safety during low-power and shutdown states is performed.

Defence-in-depth has been formally introduced in the Belgian legal framework by the Royal Decree of 9 October 2018 completing the transposition of the Nuclear Safety Directive 2014/87/EURATOM. This royal decree introduced the Defence-in-depth in article 3/1 of the SRNI-2011.

In complement, the SRNI-2011 has been modified a second time in February 2020, by the introduction of all WENRA 2014 Safety reference levels.

Particular articles of sections of Chapter II (Safety requirement for all Class I facilities) and of Chapter III (Specific Safety requirements for NPPs) of SRNI-2011 cover all the requirements of the Directive:

- Safety management (Section I), including the Nuclear Safety Objective;
- Design (section II), including design basis, design extension and protection against natural phenomena for NPPs (article 22/1)
- Operation (section III)
- Verification of Nuclear Safety (Section IV)
- Emergency preparedness (Section V)
- [Decommissioning (Section VI)]

A difficulty that has to be mentioned is the use of old terminology in the Directive, that complicated the transposition through the WENRA reference levels : The defence in depth principle stated in the Directive is based on the (obsolete) terminology used in the INSAG 10 "Defence in Depth in Nuclear Safety" from 1996. Since then, the IAEA terminology has been reviewed several times (in 2007, and in 2016 and 2018 after the Fukushima accident). The development of WENRA reference levels is based on the latest IAEA safety standards and terminology.

2. In order to achieve the nuclear safety objective set out in Article 8a, Member States shall ensure that the national framework requires that the competent regulatory authority and the licence holder take measures to promote and enhance an effective nuclear safety culture. Those measures include in particular:

(a) management systems which give due priority to nuclear safety and promote, at all levels of staff and management, the ability to question the effective delivery of relevant safety principles and practices, and to report in a timely manner on safety issues, in accordance with Article 6(d);

Article 5 of SRNI-2011, that requires the licensees to establish and maintain management systems has been modified by the royal decree of 19 October 2018 which introduced requirements for safety culture in the management system, as defined by the updated WENRA 2014 reference levels:

C7. Safety culture

C7.1 Management, at all levels in the licensee organization, shall consistently demonstrate, support, and promote attitudes and behaviours that result in an enduring and strong safety culture. This shall include ensuring that their actions discourage complacency, encourage an open reporting culture as well as a questioning and learning attitude with a readiness to challenge acts or conditions adverse to safety.

C7.2 The management system shall provide the means to systematically develop, support, and promote desired and expected attitudes and behaviours that result in a strong safety culture. The adequacy and effectiveness of these means shall be assessed as part of self-assessments and management system reviews.

C7.3 The licensee shall ensure that its suppliers and contractors whose operations may have a bearing on the safety of the nuclear facility comply with C7.1 and C7.2 to the appropriate extent.

The FANC and Bel V have jointly developed and implemented a Safety Culture observations process. Observations are performed by Bel V's inspectors or safety analysts during any contact with a licensee. These observations are filled in an observation sheet aimed at describing fact and context issues. These observations are linked to Safety culture attributes based on IAEA standards.

On a monthly basis the "Safety Culture coordinator" within Bel V analyses observations (with a quality of description and classification perspective) and gives a feed-back to the observation maker. In case of an important SC discrepancy, a direct reporting to the licensee could be considered.

On a quarterly basis, the "Safety Culture coordinator" provides a mainly quantitative synthetic report. The aim of this report is to identify early signs of problem. Then, it could be decided to analyse a plant's performance more deeply in order to understand the underlying causes of a problem or to focus inspections on specific dimensions.

On an annual basis, the "Safety Culture coordinator" provides a detailed report on the observations (with a safety perspective). The aim is to identify persistent signs of problems or good practices. These statements feed the next annual inspection programme. A synthesis is presented to the licensee. The discussion objective is to be sure that the licensee understands the regulator's concerns.

In terms of regulatory body evaluation, Safety Culture observations are then central pieces of a broader oversight process trying to identify and analyse Safety Culture dimensions.

A deep process assessment has been conducted in 2015 (after 3 years of application) and yearly evaluations of the process are performed as well. The process is fully

operational.

There is currently no legal obligation to impose to the FANC to establish and maintain a management system. The obligation of the FANC to establish and maintain such a management system stems directly from the Directive. Article 38 of the GRR-2001 requires Bel V to have a management system. Additionally, the Belgian Government committed in its National Declaration to invite international peer review to assess the Belgian legal and regulatory Framework. Practically, IRRS missions organized by the IAEA are performed at least every 10 years. Within these IRRS missions, a module (n°4) is devoted to the management system of the regulatory body. Inviting such missions and resolving the resulting suggestions and recommendations is a practical way to ensure the correct application of the Directive.

(b) arrangements by the licence holder to register, evaluate and document internal and external safety significant operating experience;

Operating experience feedback is a legal requirement for the licensee of nuclear installations.

Article 11 of SRNI-2011 imposes the licensee to have an operational feedback process in place for collecting, analysing and documenting events that occur in his facility as well as in other similar facilities. Foreign similar facilities also have to be taken into account. This process shall also document the analysis methodologies, notification and distribution of relevant information as well as the process for continuous improvement.

(c) the obligation of the licence holder to report events with a potential impact on nuclear safety to the competent regulatory authority; and,

The obligation of the licence holder to report events with a potential impact on nuclear safety to the FANC and to other authorities is laid down in article 67.2 of the GRR-2001.

A technical regulation of the FANC of 5 July 2019 determines the criteria and modalities for notification of events and the use of INES. This technical regulation replaces a previous convention between the Licensees, the FANC and Bel V. As the convention did before, this technical regulation stipulates in which circumstances and how INES is to be used. The licensee has to perform an INES-analysis according to the latest INES manual, and the proposed INES level has to be approved by Bel V and by the FANC. Depending on the INES-level, a specific notice is issued.

In addition, a specific section of the Safety Analysis Report lists the events that must be notified to Bel V and to the FANC, indicating the deadline for each notification.

The same section also specifies the cases where incident reports must be supplied to Bel V, and within which time period. In function of the significance of the events, the time period ranges from immediately to a month.

Near misses are handled through the operational experience feedback process

(d) arrangements for education and training, in accordance with Article 7.

We refer to description to Article 7 that already gives extensive information on training and education for both the staff of the regulatory authority and the licence holder(s).

Article 8c: Initial assessment and periodic safety reviews

Member States shall ensure that the national framework requires that:

(a) any grant of a licence to construct a nuclear installation or operate a nuclear installation, is based upon an appropriate site and installation-specific assessment, comprising a nuclear safety demonstration with respect to the national nuclear safety requirements based on the objective set in Article 8a;

No new nuclear site has been assigned since the construction of the SCK-CEN and the construction of NPP. All new nuclear facilities are built and foreseen in already existing nuclear sites.

Initial Safety assessment of license application.

The GRR-2001 requires that a safety assessment of a license application must be performed.

The description under article 6, (b) lists the elements that have to be provided in the preliminary Safety Analysis Report.

In practice, the safety assessment is performed by Bel V, by delegation of the FANC.

Bel V is a founding member of ETSO, the European TSO Network. ETSO documents explain the objectives of the safety assessment :

"The basic objective of review and assessment is to determine whether the operator's submissions demonstrate that a nuclear activity complies with the stipulated safety objectives or requirements. For a nuclear facility, review and assessment aim at checking that it complies with the safety objectives throughout its lifetime."
(from ETSO Safety assessment Guide, 2004 - <http://www.etsn.eu/reports-and-publications>)

As an example for the recent SF² facilities (on-site dry spent fuel storage at Doel and Tihange), the specific safety requirements taken into account in the design are listed in the Belgian report for the seventh review meeting of the Joint Convention (to be published – October 2020) under article 8 – Assessment of Facilities – section G.5.3.

Member States shall ensure that the national framework requires that:

(b) the licence holder under the regulatory control of the competent regulatory authority, re-assesses systematically and regularly, at least every 10 years, the safety of the nuclear installation as laid down in Article 6(c). That safety reassessment aims at ensuring compliance with the current design basis and identifies further safety improvements by taking into account ageing issues, operational experience, most recent research results and developments in international standards, using as a reference the objective set in Article 8a.

The initial license of the Belgian NPP in 1975 already required conducting ten-yearly periodic safety reviews, to take into account development of regulations and standards and technical and scientific developments for continuous improvement of the safety.

From 2007 on, the FANC already required (FANC guideline ref. 2010-095) that plant operators perform this periodic safety review following a methodology based on the 14 safety factors described in the IAEA Safety Guides (NS-G-2.10 superseded by SSG-25).

Article 14 of the SRNI-2011 (The Royal Decree of 30 November 2011 on the safety requirements of nuclear installations) requires a ten-yearly periodic safety review for each nuclear installation. The general objectives of these periodic safety reviews are as follows:

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

Article 14.2 of this decree requires that the methodology of the PSR shall include the 14 safety factors consistently with the WENRA 2014 reference level P2.2. The Nuclear Safety Objective (article 8a of the Directive) has to be considered in the PSR.

The regulatory body oversees this process by reviewing the analysis and approving the resulting action plan.

For more information, we also refer to the Belgian national reports (2013, 2016 and 2019) for the Convention on Nuclear Safety, Article 14. Assessment and Verification of Safety, published on the IAEA web site.

To ensure that the most recent developments in international standards are considered in the PSRs, representatives of the Belgian regulatory body participate in several international groups in relation to nuclear safety, making them knowable of the most recent developments:

- At the European level, FANC and Bel V experts participate in WENRA, HERCA, ENSREG and in their working groups.
- At the IAEA level, the FANC with Bel V participate in the Nuclear Safety Standards Committee (NUSSC), the Waste Safety Standards Committee (WASSC), the Transport Safety Standards Committee (TRANSSC) the Radiation protection Safety Standards Committee (RASSC),– the Emergency Preparedness and Response Standards Committee (EPRReSC), the Nuclear Security Guidance Committee (NSGC) and the INES advisory committee

A dedicated page of the FANC web site deals with PSRs of Nuclear Power Plants : <https://afcn.fgov.be/fr/dossiers/centrales-nucleaires-en-belgique/surete/revisions-decennales>

Article 8d: On-site emergency preparedness and response

- 1. Without prejudice to the provisions of the Directive 2013/59/Euratom, Member States shall ensure that the national framework requires that an organisational structure for on-site emergency preparedness and response is established with a clear allocation of responsibilities and coordination between the licence holder, and competent authorities and organisations, taking into account all phases of an emergency.*
- 2. Member States shall ensure that there is consistency and continuity between the on-site emergency preparedness and response arrangements required by the national framework and other emergency preparedness and response arrangements required under Directive 2013/59/Euratom*

Art. 16 of SRNI-2011 sets the requirements related to the internal emergency plan that the licensee has to implement. It specifies the objectives, the preparation and organisational issues. It also states that adequate emergency infrastructure needs to be provided and that the internal emergency plan needs to be exercised at least once per year.

The emergency plan of each Belgian NPP is described in its Safety Analysis Report. In complement, the internal emergency plan details the instructions for all the actors.

In case of accident the unit's "Centre Opérationnel de Tranche" (COT - Tihange) – "Bedrijfskamer" (Doel) (i.e. the On Site Technical Centre) is activated and manages all the technical problems to control the accident and mitigate its consequences. At site level, the "Centre Opérationnel de Site" (COS - Tihange) – "Noodplankamer" (NPK - Doel) (i.e. the Emergency Operations Facility) manages the environmental impact, liaises with the National Crisis Centre, and communicates with the Corporate crisis Organization.

The nuclear power plants conduct internal exercises several times a year, and National Crisis Centre organizes one internal and one external exercise annually for each nuclear power plant and every two years for other sites.

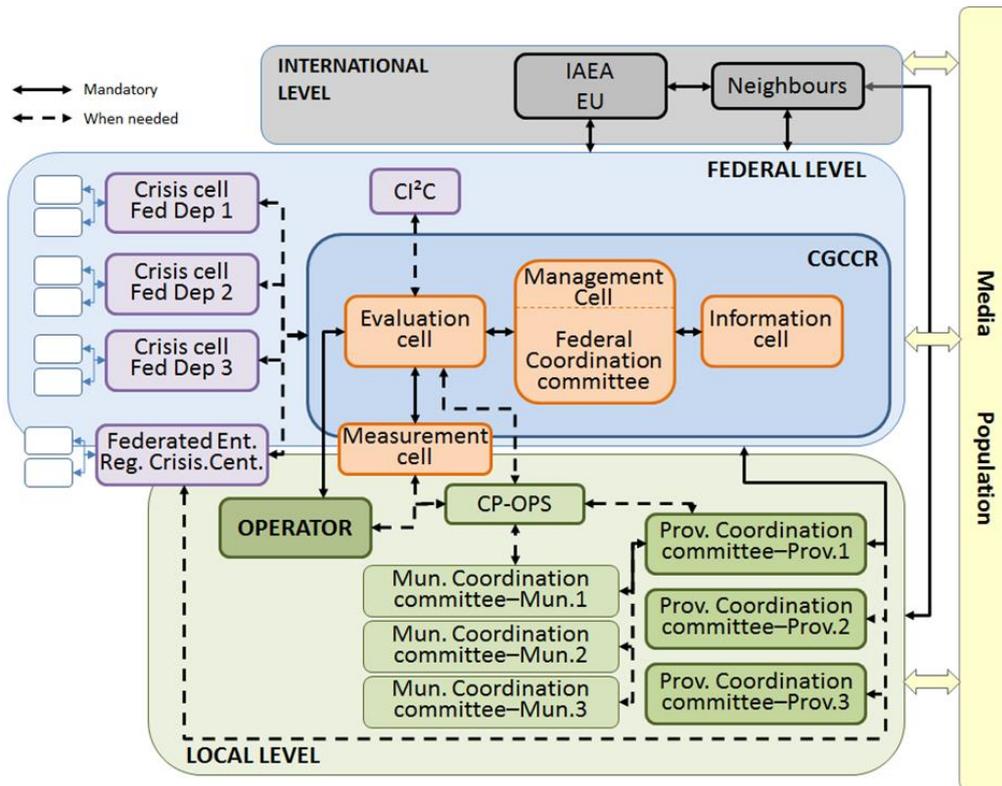
Consistent with the intended objectives, the National Crisis Centre involves the various disciplines (fire brigade, medical help, police force, civil protection, measurement teams ...) in these exercises.

On March 1st, 2018, the new Belgian Nuclear and Radiological Emergency Plan (NEP) was published in the Belgian official Gazette. The new NEP integrates the lessons from past exercises and events (IRE 2008, Fukushima), the results of dedicated working groups, international recommendations and requirements such as GSR-7, GSG-11, the European BSS, the HERCA-WENRA approach and the advice from national Scientific Committees and other stakeholders (local and regional authorities and Greenpeace Belgium).

The new NEP redefines its scope to include all operational Belgian Class I facilities and all foreign facilities within 100 km from the border. It also considers emergencies created by terrorist or malevolent action as well as accidents during the transport of nuclear fuel or waste from fuel reprocessing. To improve the communication with neighbouring countries and international bodies, the new NEP adopts the classification of emergencies system of the IAEA safety guide GSR-7 .

The management structure has been slightly adapted to reinforce the principle of integrated crisis management and graded approach. At the federal level, the decision is entrusted to a Management Cell (Ministers) based on a global analysis of the situation (radiological, socio-economic, available resources...) provided by a Federal Coordination Committee. This committee is also in charge of following up the decision's implementation. The role of local actors (mayors and governors) is reinforced in a way that they can take operational decisions to protect their population provided they consult with the Federal Coordination Committee. More emphasis is also given to the later phases of an emergency (i.e. transition to the declaration of the end of the emergency) and the post-accidental phase, describing the changes in the management structure and the required flexibility to adapt to the evolution of the situation.

The Emergency Planning and Response National Master Plan for Organisation in the Event of Emergencies is depicted in the figure below



The Royal Decree of 1 March 2018 defines three levels for the notification of emergencies according to the classification systems of GSR-7, which are in ascending order of seriousness Facility Emergency, Site Area Emergency and General Emergency, which the operator must use when warning the National Crisis Centre which assembles under the authority of the Minister of Home Affairs. In addition, a fourth notification level (General Emergency in 'reflex' mode) has been considered to cope with events with fast kinetics. In case an emergency situation is quickly developing (fast kinetics) and might lead within 4 hours to a radiation exposure of the population above an intervention reference level, immediate protective actions for the off-site population – without any assessment – are taken by the local authorities (Governor of the Province), waiting for the full activation of the emergency cells.

All emergencies (Facility Emergency, Site Area Emergency, General Emergency and General Emergency in 'reflex' mode) have to be notified to the National Crisis Centre. This permanently manned centre alerts and mobilizes the cells involved in the crisis management at the federal level (Management Cell - Federal Coordination Committee, Evaluation Cell, Measurement Cell, Information Cell) and houses these cells during the crisis situation as well. The Federal Management Cell, together with the Federal Coordination Committee, is the official leader of the conduct of the operation in case of an emergency.

The Evaluation Cell is composed of representatives the FANC which chairs the cell, of the Federal Public Service of Public Health, of the Royal Institute of Meteorology, and of experts of the SCK•CEN, the "Institut des Radioéléments", and of Bel V that supervises these installations, as well as of a representative of the operator of the facility. This cell gathers and evaluates all information received from the affected installation, the off-site radiological measurement results received from the Measurement Cell and information from institutions represented in the evaluation cell.

More detailed information can be found in the Belgian report for the Eighth Meeting of

the Contracting Parties to the Convention on Nuclear Safety (August 2019), section II.L – Article 16 : Emergency Preparedness.

Article 8e: Peer reviews

1. Member States shall, at least once every 10 years, arrange for periodic self-assessments of their national framework and competent regulatory authorities and invite an international peer review of relevant segments of their national framework and competent regulatory authorities with the aim of continuously improving nuclear safety. Outcomes of such peer reviews shall be reported to the Member States and the Commission, when available.

The Belgian government published on August 31, 2018 its National Declaration on Nuclear Safety, Nuclear Security and Radiation Protection. Organization of peer reviews as required by the Directive is stated in this National Declaration

Pursuant to Article 8, sexies, 1), Belgium invited an IRRS (Integrated Regulatory Review Service) mission, organized by the International Atomic Energy Agency in December 2013. The follow up mission took place in November-December 2017. The reports of the missions were sent to ENSREG and to the European Commission. They are also published on the FANC's web site: <https://afcn.fgov.be/fr/lafcn/relations-internationales/services-dexamen-par-les-pairs-en-matiere-de-surete-et-de-securite-0> and on the IAEA's web site <https://www.iaea.org/fr/node/35181>

From the 31 Recommendations and 24 Suggestions of the original 2013 mission, 2 Recommendations and 2 Suggestions remained open. All other Recommendations and Suggestions were either "Closed" (28 out of 55) or "Closed on the basis of progress made and confidence in effective completion" (23 out of 55). The IRRS Follow Up mission identified 3 new Suggestions and 2 Good Practices. All the suggestions and recommendations should be solved by end 2020.

In November 2019, Belgium officially requested the IAEA to organize a new full-scope IRRS mission. Preparations for this mission, which is planned to take place during the first half of 2023 and for its preceding self-assessment, have started.

2. Member States shall ensure that, on a coordinated basis:

- (a) a national assessment is performed, based on a specific topic related to nuclear safety of the relevant nuclear installations on their territory;*
- (b) all other Member States, and the Commission as observer, are invited to peer review the national assessment referred to in point (a);*
- (c) appropriate follow-up measures are taken of relevant findings resulting from the peer review process;*
- (d) relevant reports are published on the above mentioned process and its main outcome when results are available.*

Trough its participation in ENSREG and in its working groups (WG1, WG2, and WG3), Belgium actively participate in the definition and in the organisation of assessments as required by article 8e 2. of the Directive.

Belgium participated in 2017 in the first European Topical Peer review on Ageing management. The main conclusions for Belgium identified are listed below:

For the BR2 Research Reactor:

- BR2 is considered as having the most advanced ageing management program for research reactors in Europe.
- There were no negative findings.
- All positive findings of the Topical Peer Review were allocated to BR2.

Two specific 'Good Practices' were identified:

- The organisation of a SALTO-like Mission for Research Reactor (November 2017,);
- The structured Ageing Management Program for the Reactor Vessel.

For the Belgian NPPs:

- Good ageing management program in comparison to average European level.
- There were no specific negative findings. Only generic 'Areas for Improvement' or challenges valid for all NPPs in Europe.

One Good Practice was identified: The use of reconstruction specimens for strengthening irradiation embrittlement monitoring.

Seven Good Performances were identified.

The main challenges to address were:

- Improving the KPIs dedicated to ageing management;
- Monitoring of non-accessible areas of the containment;
- Ageing Management Program for long outages.

The full reports are available on the ENSREG web site: <http://ensreg.eu/eu-level-reports>

3. Member States shall ensure that arrangements are in place to allow for the first topical peer review to start in 2017, and for subsequent topical peer reviews to take place at least every six years thereafter.

Belgium participate in the Topical Peer Reviews organized by ENSREG with the support of the WENRA.

4. In case of an accident leading to situations that would require off-site emergency measures or protective measures for the general public, the Member State concerned shall ensure that an international peer review is invited without undue delay.

During the reporting period (2014-2020), no accident situation that required off-site emergency measures or protective measures for the general public occurred in Belgium.



federal agency for nuclear control