KINGDOM OF BELGIUM

FOURTH MEETING OF THE CONTRACTING PARTIES TO THE CONVENTION ON NUCLEAR SAFETY

NATIONAL REPORT

SEPTEMBER 2007

KINGDOM OF BELGIUM

Fourth Meeting of the Contracting Parties to the Convention on Nuclear Safety

September 2007

National Report

This report is produced by the Federal Agency for Nuclear Control on behalf of Belgium. Contributions to the report were also made by "Association Vinçotte Nucléaire", "Electrabel" and "Tractebel Engineering".

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I. INTRODUCTION

I.A. Content of the Present Report

This Belgian national report, submitted to the fourth review meeting of the parties to the Convention on Nuclear Safety, is based on its three previous editions (1998, 2002 and 2005) and has a similar structure. For each article of the Convention, relevant descriptions and explanations are provided on how the principles of the Convention are translated into the Belgian legislative framework and how they are applied to its nuclear installations. In addition, in order to underline relevant evolution since the last review meeting, a new section, I.C has been added, focused on new developments since 2005. Also, specific sections are to be found related, notably, to the periodic safety reviews of Doel 3 and Tihange 2 and the SG replacement of Doel 2.

The report includes information on the issues raised during the Belgian presentation at the last review meeting.

When realising this report, due account was taken of the appropriate guidelines as INFCIRC/572/Rev.2 from 2 September 2002 and of the "Synopsys of the relevant IAEA safety requirement statements reflecting the issues addressed by articles 6 to 19 of the Convention on Nuclear Safety" form 18 may 2006.

Although being based on the previous report of 2005, significant parts of them have been rewritten, in particular part I.C, article 8, article 10 and article 13.

In order to keep the report to a reasonable size, rather than identifying for each Article the particularities and characteristics of the Belgian power plants, it was found preferable to give in Appendix 1 a detailed description of the various units, highlighting their original design and the major modifications brought to them during the periodic safety reviews which are mandatory under the Belgian regulations.

The principal nuclear Belgian actors have participated in its edition:

- FANC, the Federal Agency for Nuclear Control, the safety authority.
- AVN (Association Vinçotte Nuclear), the Authorised Inspection Organisation.
- Electrabel as the operator of the seven nuclear power plants.
- Tractebel Engineering, the engineering support organisation to the operator.

Together, the above-mentioned organisms encompass the legal and practical competencies necessary to collect and to structure the information required to elaborate the national report.
Although not required by the Convention, the report is available on different Belgian Web sites such as www.fanc.fgov.be, www.avn.be.

A list of the abbreviations used in the present Report is given in Appendix 2.
Appendix 3 gives the WEB site addresses of Belgian organisations playing an important role in the nuclear field.
Appendix 4 lists the subjects which have been examined during the 10-year safety reviews of the Doel and Tihange units, and indicates topics to be examined during the next 10-year safety reviews.

I.B. History of Nuclear Energy Development in Belgium

Before the Second World War, Belgium was the world's largest radium producer, which gave rise not only to the related metallurgy, but also, in collaboration with the academic circles, to the development of metrology techniques. In the universities a number of teams worked on the latest discoveries in the field of particle physics and maintained close contact with their counterparts abroad.

By 1945, a Scientific Commission in Belgium examined the possibilities of civil applications of nuclear energy, and the "Institut Interuniversitaire de Physique Nucléaire" was created in 1947 in order to support the existing university laboratories and co-ordinate their activities. In parallel with nuclear physics research, this Institute also supported some related activities such as production of graphite and high-purity metallic uranium.

From 1950 onwards, Belgian engineers were trained in the UK and in the USA.

The Atomic Energy Commission was formed in 1950.

In 1952, a number of personalities of Belgium's scientific and industrial circles set up a private non-profit organisation -the "Centre d'Etude des Applications de l'Energie Nucléaire"-, which was to give birth to the "Centre d'Etude de l'Energie Nucléaire" (SCK•CEN) at Mol (i.e. the Nuclear Research Centre), and which became a public interest organisation in 1957.
Research reactors were built at Mol and became operational between 1956 and 1963. These are the BR1, a uranium/graphite reactor similar to England's BEPO pile, the materials test reactor BR2 (fuel assemblies with enriched uranium placed in a beryllium matrix shaped as an hyperbolic paraboloid, which ensures at the same time a high neutron flux and an easier access to the experiments from the top and the bottom of the reactor) and the 11.5 MWe BR3 which was the first Westinghouse-type pressurised water reactor built in Europe. This reactor, which went critical in 1963, served to develop the technology (e.g. reactivity control by boron dissolved in the water of the primary circuit, introduction of MOX and gadolinium fuel rods as early as 1963…) and to train the first operators of the Belgian nuclear power reactors. This plant is currently under dismantling and the waste produced is immediately conditioned.

Beside these reactors, the Mol Centre has many laboratories for performing and analysing various experiments, for materials testing, fuel research, radiobiology studies, etc. It also has an underground laboratory (HADES) situated at 200 m depth in the Boom clay stratum to investigate the properties and characteristics of a deep geological repository for high level waste in clay.

This laboratory was extended in the framework of EURIDICE, a joint venture between ONDRAF/NIRAS and the SCK•CEN. EURIDICE - which stands for European Underground Research Infrastructure for Disposal of nuclear waste In Clay Environment - was in fact set up back in 1995 under the name EIG PRACLAY.
From 1950, the private industry has also been investing in nuclear technology and participating in the construction of reactors. The "Ateliers de Constructions Electriques de Charleroi" acquired the Westinghouse licence; "Métallurgie et Mécanique Nucléaires" manufactures enriched uranium fuel assemblies, and was later on a part of the "Franco-Belge de Fabrication de Combustibles" (FBFC).

As regards the fuel cycle, the Mol Centre investigated several reprocessing techniques, as a result of which the Eurochemic Consortium, formed under the aegis of the OECD, built its pilot reprocessing plant (adopting the PUREX process) in the Mol-Dessel region. This plant ceased its operations in 1975 and is now mostly dismantled. Dismantling operations should be completed by 2007.

A consortium of industries was formed in 1954 to develop the nuclear technology; later giving birth to Belgonucleaire which developed the plutonium fuel technology and contributed to the development of fast-breeder reactors, working with, among others, the partnerships between Euratom and various national organisations.

Belgonucleaire manufactured the first commercial MOX fuel (Mixed Oxides fuel) batch for the French PWR power station Chooz A in 1986. After having produced MOX fuel during 20 years, for both PWR and BWR reactors, Belgonucleaire definitively stopped its activities in mid-2006. The dismantling of the MOX fuel fabrication plant at Dessel will probably begin 2008. Belgonucleaire produced more than 600 tons of fuel MOX for commercial nuclear power reactors.

The Belgian power utilities and their architect/engineers closely followed-up the evolution in nuclear technology and, confident with their BR3 experience, they decided to take a 50 % stake in the construction of EdF's "Centrale des Ardennes" at Chooz, connected to the grid in 1967. Seven Belgian units, spread over the Doel and Tihange sites, were put into service between 1974 and 1985.

Table 1 gives for each Belgian unit the gross power, the year of first commercial operation, the total gross production for the years 2000 to 2006, and the total gross production since starting the operation. The variations over the years are linked to the fuel cycle length (between 12 and 18 months) or to large modifications (like the steam generators replacement).

Notice that considering an average value of 900 grams of CO_2 equivalent released for each kilowatt.hour produced from fossile fuels, the Belgian nuclear production has enabled not to release in the atmosphere about 1004 million tons of CO_2 (status at the end of the year 2006).

In 1971, the "Institut des Radioéléments" (IRE) was built in Fleurus, manufacturing mainly medical radioactive isotopes.

The "Organisme National des Déchets Radioactifs et des Matières Fissiles Enrichies" – "Nationale Instelling voor Radioactief Afval en verrijkte Splijtstoffen" (ONDRAF/NIRAS) (i.e. the national organisation for radioactive waste and fissile materials) was created in 1981, and waste treatment and storage activities were performed at the Mol-Dessel site through its BELGOPROCESS subsidiary company.

This brief historic overview shows that, in addition to the nuclear power plants which are the subject of the present National Report, various aspects of the fuel cycle are present in Belgium. A full description of the nuclear sector in Belgium can be found in the book published by the Belgian Nuclear Society in 1995 "Un demi siècle de nucléaire en Belgique" (i.e. A half-century of nuclear activities in Belgium: ISBN 90-5201-405-1).

Specific information on the safe management of spent fuel and on the safe management of radioactive waste may be found in the Belgian report presented to the second review meeting of the Joint Convention, Vienna May 2006, available on the FANC, ONDRAF/NIRAS and AVN web sites.

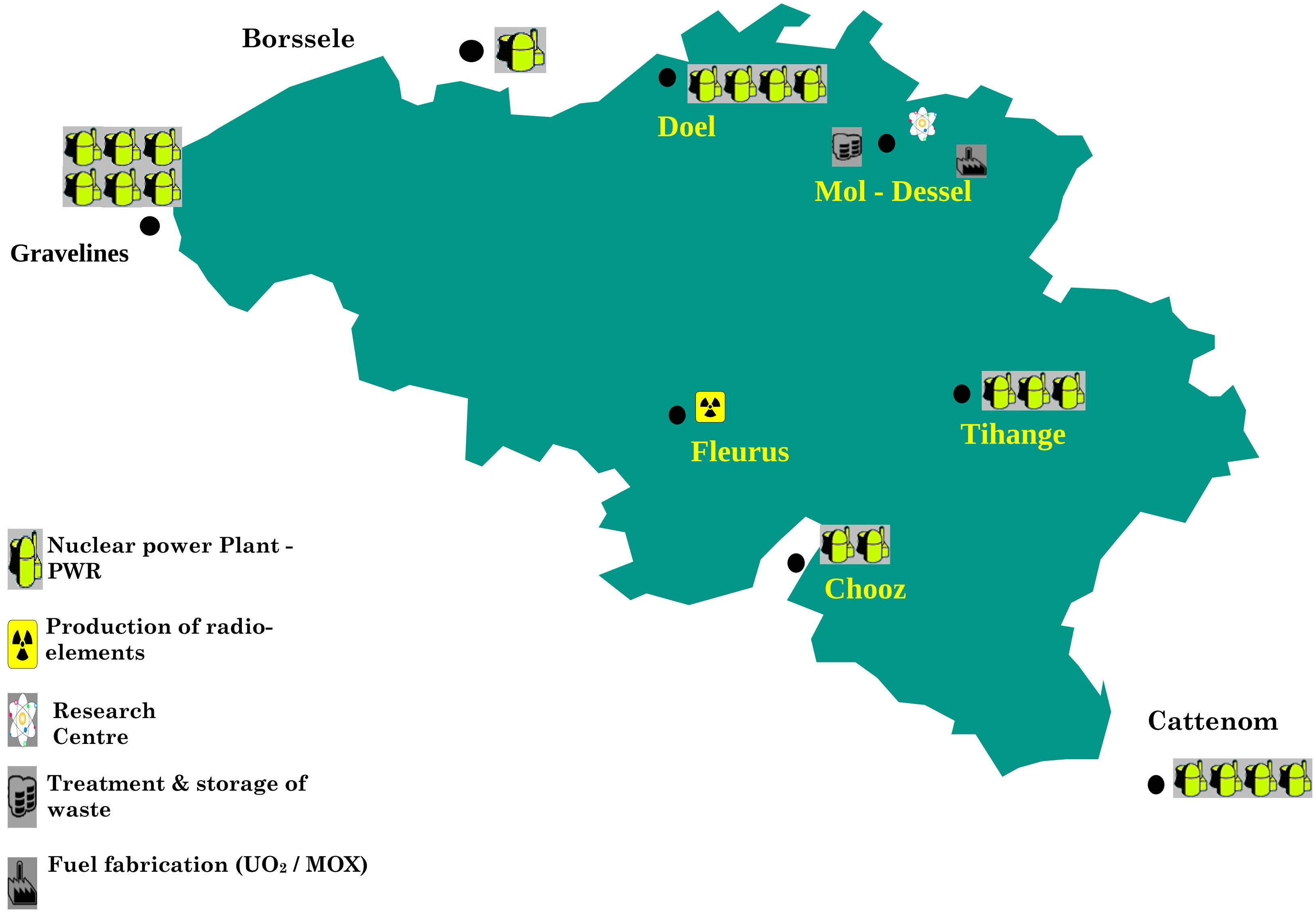

Borssele
Doel
Gravelines
Mol - Dessel
Fleurus
Tihange
Chooz
Cattenom
Nuclear power Plant - PWR
Production of radio-elements
Research Centre
Treatment & storage of waste
Fuel fabrication (UO_2 / MOX)

Table **1 –** Gross production of the Belgian nuclear plants

	Gross capacity end of 2006 (MWe)	**Commercial operation**	**Total gross production in 2004 (TWh)**	**Total gross production in 2005 (TWh)**	**Total gross production in 2006 (TWh)**	**Total gross production up to end 2006 (TWh)**
Doel 1	412.50	1975	3.2	3.2	3.3	99 678.6
Tihange 1	1 009	1975	7.4	7.1	8.6	217 835.0
Doel 2	454	1975	3.1	3.7	3.6	93 071.8
Doel 3	1 056	1982	8.5	8.4	8.2	184 797.1
Tihange 2	1 055	1983	8.9	8.2	7.5	177 841.1
Doel 4	1 064	1985	8.0	7.8	7.9	166 360.0
Tihange 3	1 065	1985	8.3	9.1	7.6	175 592.2
Total	**6 116**	**-**	**47.4**	**47.6**	**46.6**	**1 115 175.8**
% nuclear production			**54.66%**	**52.71%**	**55.42%**	

I.C. Developments since the last report (2005)

This part intends to highlight the main evolutions that have occurred since the last report, especially:

a. The replacement of the steam generators of the Doel 2 nuclear power plant
b. The modification of the recirculation (sump strainers clogging issue)
c. The actions carried out as a result of the Electrabel audit in 2004
d. The WENRA harmonisation
e. The OSART (Operational Safety Review Team) mission at the Tihange 1 nuclear power plant in May 2007.

It will also stress other developments such as:

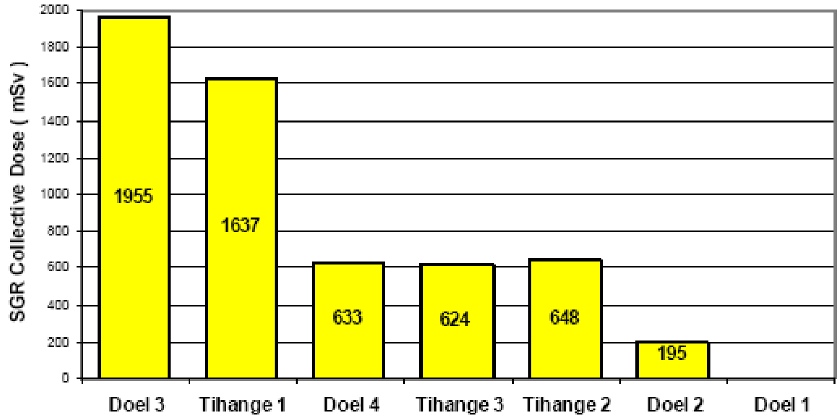
f. Recommendations of the Parliamentary Commission on nuclear safety
g. Future relations between the Federal Agency for Nuclear Control and the Authorized Inspection Organisations (AVN for the nuclear power plants)

a. Replacement of the steam generators and increase of the power of the Doel 2 Unit

The replacement of the two steam generators of the Doel-2 Unit took place during the outage May -July, 2004, within 66 days.

In order to remove the existing steam generators and install new steam generators, it was necessary to make two holes in the primary steel containment and in the dome of the secondary concrete containment. The holes in the primary containment had a diameter of 5.5 m, the steel being 25 mm thick. The square holes in the secondary containment had a side of 5.5 m, the concrete being 80 cm thick.
Before making the holes, the fuel was removed from the core.
The reactor building was maintained in underpressure for as long as possible during the operation. The new steam generators were introduced into the reactor building on 28 May, 2004.

The cumulated dose for this replacement of the steam generators amounts to 195.5 man-mSv which is low as compared with the international experience. This success was the result of experience acquired from previous replacements, a successful decontamination of the primary circuit, a well studied shielding with 70 tonnes of lead, and operational planning with a maximum attention to the ALARA principle, for example: keeping the steam generators that had to be replaced filled with water for as long as possible.



New designed steam generators were installed: Thanks to the use of an hexagonal lattice, the number of tubes was increased from initially 3300 for the old generators to 4800 tubes with lower diameter for the new generators. The thermal power delivered by the reactor was increased by 10%.

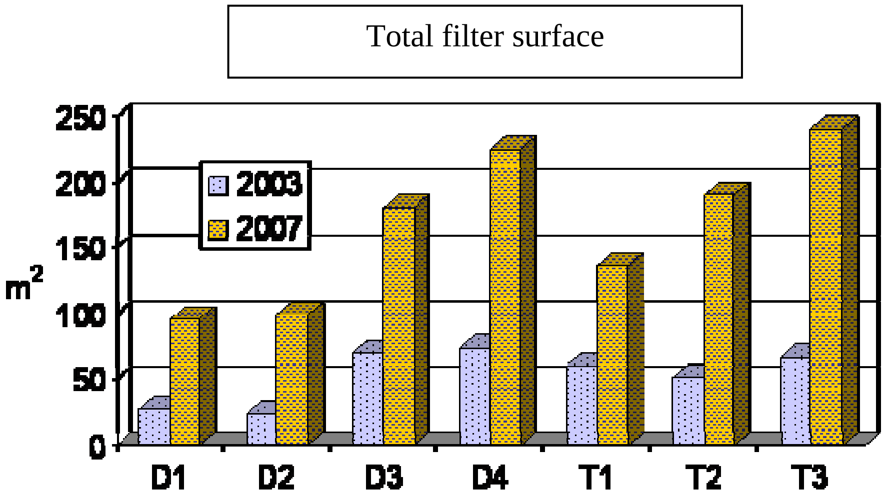
The application for the replacement of the Doel 1 steam generators was introduced to the safety authorities (FANC) in March 2007. This replacement is currently planned for the year 2009.

b. Modification to the recirculation filters in the Belgian nuclear power plants

As a result of the incident in Barsebäck with partial clogging of strainers, the Licensee carried out evaluations on the possibility of clogging of the recirculation filters in PWR Belgian power plants. The risk of clogging could not be excluded, highlighting a weakness in the initial design. Several actions were considered, some of them being already implemented, including:

- Reduction of potential debris inside the reactor building (improved heat insulation material and cover plates, removal or fastening of small parts, …)
- Additional guidance to the operators to cope with potential sump clogging, as well as corresponding training
- Increased surface of the recirculation filters
- Installation of self-cleaning filters

The surface of the recirculation filters for each power plant was increased during the period 2003-2007. The figure hereafter illustrates the work completed (- planned for Doel 3) up to now.



"D1" means Doel – Unit 1
"T3" means Tihange – Unit 3

Besides increasing the surface of the recirculation filters, a second modification, planned up to 2009, will consist in installing Swedish-designed self-cleaning filters. These filters, of internationally accepted design, will be validated by additional experimental tests.

c. Actions carried out as a result of the Electrabel audit in 2004

Signs of a potential degradation of the safety culture at the nuclear power plant sites of Doel and Tihange were observed by the AIO. The FANC was informed and conducted an audit on both sites during the summer of 2004. This audit concluded that many processes on both sites were working satisfactorily and that no urgent specific actions were necessary with respect to radiation protection and safety. However, the audit stated that improvement was possible and needed in some areas such as safety culture.

The FANC identified five areas were improvements were required:

- Full implementation of the reorganisation decided by the Licensee in 2000;
- Role and functioning of the health physics department;
- Relation between the operator and the AIO;
- Feedback given by the operator to AIO remarks and questions;
- Role of the management at the site of Tihange.

The main conclusions can be summarised as follows:

1. Implementation of the reorganisation

The Licensee conducted a major reorganisation of its corporate structure, evolving from an organisation per power unit to a more horizontal organisation with different entities working for all units at the site and at the corporate level. At the time of the audit, this reorganisation was not fully implemented yet; some functions in the organisation chart had still to be filled, due to a lack of available human resources. A thorough analysis of the organisation chart and the relation between the different operational entities was necessary, as well as additional recruitment and training for specialised personnel.

2. Functioning of the internal Health Physics Department.
The Health Physics Department, as foreseen in the Belgian legislation, is responsible for organising and controlling all aspects regarding radiation protection and nuclear safety. This department must be staffed in an appropriate way. The reorganisation consisted in organising these activities on corporate level with local representatives on each power plant site. This organisational change was insufficiently clear as regard to sharing of responsibilities, which created a dip in the efficiency of the health physics department.

3. The relation between the Licensee and the authorized inspection organisation
Although the relation between the operator and AIO relies on an open and transparent communication, some discussions and differences in opinion between the Licensee and AVN were not solved as expected.

4. Feedback given by the operator to AIO remarks and questions
A significant backlog has been identified in the feedback given to questions and remarks formulated by the AIO, as well as – in some cases - a poor quality of the answers provided. An efficient way of dealing with these questions and remarks, together with issuing adequate priorities and making more resources available to reduce the backlog, were needed.

5. Role of the management at the site of Tihange
The relation between the management and the executive personnel and workers had to be improved, and the presence of the management on the field to be increased.

Electrabel issued a detailed action plan for each of the above areas in order to solve within two years all the problems that had been identified by the audit.
The organisation was reassessed and was improved: the roles and responsibilities of the different entities were clarified and a specific engineering department was created to deal with large projects in a more efficient way. Additional recruitment of specialised personnel and engineers was undertaken. The general management issued a Global Plan for Nuclear Safety setting the priority on each aspect of operational safety. In order to reinforce the role of the Health Physics Department, a corporate nuclear safety department was created for implementing and monitoring this global plan. To improve the relationship with the AIO, periodic meetings were organised at each management level to discuss possible issues at the appropriate level. A specific programme has been developed to reduce the backlog of open issues, several open issues have been gathered in global projects and a structural and systematic approach has been developed to avoid future backlog of open issues. In order to get more involvement from the management team at the Tihange site, specific management walkdowns are held on a regular basis and all senior personnel have received specific training by WANO regarding field observations.

d. WENRA Harmonisation

WENRA is a non-governmental organisation composed of the Heads and senior staff members of the Nuclear Regulatory Authorities of European countries with nuclear power plants.
Currently, 17 countries are members of the WENRA organisation. WENRA has two active working groups: the RHWG (Reactor Harmonisation Working Group) and the WGWD (Working Group on Waste and Decommissioning).
The RHWG made an extensive study on the national nuclear safety requirements for the operating NPP's comparing several hundred reference levels, grouped in 18 areas. A benchmarking has been conducted in 2006, when the countries assessed the implementation of the reference levels in their regulations and guides and on the practical field.

More information can be found on: www.wenra.org

In accordance with the commitment of the WENRA members, the Belgian regulator discussed the results of the self-assessment and the benchmarking with the Licensee for all the reference levels issued by WENRA. In collaboration with the Licensee, a Belgian action plan was set up, to be implemented by 2010, both on the legal side, i.e. the nuclear laws and regulations, and on the field.

On the legal side, almost all of the Belgian requirements regarding safety are written down in the safety analysis reports of the Belgian nuclear power plants, but not in national laws and regulations, as demanded by the reference levels. The safety analysis report is a legal requirement for the nuclear power plant and is referenced by the operating license. However, since this safety analysis report is not a public document, it does not correspond to the WENRA requirement of public availability.

On the field, many of the reference levels are met (approximately 85 %). However some gaps and deltas have been identified, and improvement actions are already being implemented:

- A specific training programme for all the personnel (not only for operating personnel) and subcontractors has been started for better communication of the Licensee's safety policy, as well as to have a better understanding from the workers of nuclear safety, radiation safety, personal safety and on-site emergency arrangements.
- As far as the design is concerned, some specific actions have already been launched within the framework of the periodic safety reviews.
- Specific actions have also been taken to comply with the new WENRA reference levels on the Postulated Initiating Events.
- Some operational procedures need to be adapted and some specific actions need to be taken especially concerning severe accident management.
- An ambitious PSA policy has been developed by the Licensee to achieve plant specific PSA for level 1 and level 2, including safety significant operating modes and relevant initiating events and hazards. The PSA policy will also outline the role of the PSA in the decision-making process to support the safety management and its role to assess plant modifications. An extensive fire hazard analysis will be performed, as well as a specific fire PSA.

e. OSART Review of Tihange 1 Nuclear Power Plant

From 5 May till 23 May 2007 the IAEA conducted an OSART (Operational Safety Review) mission in unit nr.1 of the Tihange nuclear power plant, to assist the operator in further enhancing its operational safety. The OSART team reported several good performances and good practices at the plant, but also identified opportunities for improvement in some areas that should be addressed by the operator.

The team considered as major good practices the efforts conducted by the operator for fire prevention and fire fighting, the sensitive radiation control equipment to measure internal and external contamination, the seismically qualified system for easy installation and removal of additional radiation shielding, the database for the follow-up of repair and replacement activities as well as the aids for emergency teams to arrive as quickly as possible at the place of an accident.

The team made several recommendations and suggestions for improvement. The most important are an increase of the presence of the management on the field and the communication of the management expectations, which need to be understood and supported by the whole staff. The process of working with permits needs to be clarified. The analyses of events should be performed in a faster and more efficient way, as well as the implementation of the lessons learned. The tools available to improve human performance should be used more intensively. At

last, the programme to detect and to cope with small deficiencies (such as unclear or missing labelling and tagging of equipment, housekeeping, …) should be more rigorous.
The operator will incorporate these recommendations and suggestions in the action plan, which was developed partly in preparation for this OSART mission and partly for the WENRA harmonisation efforts.

f. Recommendations of the Parliamentary Commission of Internal Affairs in charge of nuclear safety

End April 2007, a Parliamentary Commission in charge of Internal Affairs listed in a public report the following recommendations to improve the working and the effectiveness of the Federal Agency for Nuclear Control. The following list is not exhaustive but gathers the main recommendations concerning the FANC and relating to the nuclear safety control.

As far as the current status of the Federal Agency is concerned, it is recommended to:

- keep the same level of independence and the same status of the FANC as today,
- organise external control on the FANC, both by national and international bodies (parliamentary commission and IAEA auditing for example) and to evaluate the activities of the FANC and the authorized inspection organisations on basis of international standards. In order to improve the control on itself, the FANC has to improve its openness and external communication system.

Improvement of the internal working of the FANC :

The commission recommended to:

- improve/strengthen quality assurance by organising internal auditing and obtaining certification
- set up clear corporate governance rules
- clarify the allocation of financial resources
- develop up-to-date and modern databases linked to other existing national and administrative databases.

Risk prioritization, transfer of safety culture

As a result of the regulation currently in force, nuclear reactors and facilities handling fissile material are categorized as high risk « class 1 » facilities. However, other facilities making use of high-level ionizing radiations (like industrial irradiators, high activity sources, accelerators...) also induce high hazards to workers and/or the public. The FANC shall improve the actual regulation, especially by introducing some provisions to extend the “class 1” safety culture and practices (e.g. improved safety analysis report) to some lower-level risk “class 2” facilities.

Knowledge management and centre of excellence.

The FANC should have highly qualified personnel and should promote both internal and external personnel turnover. The FANC will set up a knowledge management policy in order to keep and attract high-level experts. This policy should enable the experts to maintain and develop their scientific expertise, with the long-term objective of bringing the Agency into a « centre of excellence » in radioprotection and nuclear safety.

Allocation of financial means

The FANC is recommended to allocate the necessary financial means:

- to long-term research and development in the field of nuclear safety.
- to training and internal knowledge management.
- to the recruitment of high-level experts.
- to the improvement of the national radiological monitoring network called “Telerad”.

Openness and external communication

The FANC must improve its internal and external communication plan and strategy in order to ensure:

- its visibility and transparency, especially for the nuclear sector.
- the required level of openness and communication to the public (clear, transparent, verified and high-quality information).

g. Relations between the Federal Authority and the Authorized Inspection Organisations (AVN for the nuclear power plants):

Although there is a good operational cooperation between the FANC and the authorized inspection organisation on the practical field, the legal status and the relations between the FANC need to be strengthened and clarified.
Currently, the authorized inspection organisation has the status of a non-profit organisation. It performs mainly the following tasks :

- Safety inspections at the power plants, in delegation of the Federal Agency (see art. 7).
- Handling of small modifications to the installations (approval of the modification, commissioning of the modification, approval of the modification of the safety analysis report).
- Commissioning of new installations or major modifications authorized by Royal Decree.
- Review of new licence applications introduced to the FANC by the Licensee and reporting to the Scientific Council of the FANC.
- Review of the activities related to the PSR’s and participation in the synthesis report on PSR’s.

The practical arrangements between the FANC and AVN are currently formalized in the document “Directives aux Organismes Agréés”-“Richtlijnen voor Erkende Instellingen”.

This current situation, although good working practically raises some issues needing improvement:

- AVN monitored the Belgian power plants since their construction, for more than 30 years. It is clear that this unique knowledge of the Belgian nuclear installations must be preserved.
- The activities performed by AVN are directly paid by the Licensee (Electrabel).
- The mandate of AVN, witch acts by delegation from the FANC is still under the transitory regime foreseen by the Law of 14 April 1994 and is renewed on a yearly basis.

This situation makes difficult for AVN to manage a technical expertise and qualified inspection team on the long term.

- Due to the independency and the private status of AVN, FANC should normally proceed to European call for public tender for the missions of AVN, leading to additional problems of confidentiality (and physical protection, i.e. related to classified information).

Finally the Parliamentary Commission of Internal Affairs in charge of nuclear safety issued a series of recommendations concerning the future relations FANC-AVN**:**

The authorized inspection organisations should get the status of a subsidiary body of the FANC, which will be in charge of the tasks that they currently carry out under the responsibility and control of the FANC.
The objective is to propose to the minister of Internal Affairs the draft amendments and the other legal mechanisms to bring the inspection organisations into a FANC subsidiary body by the end of 2007.
In the meantime, reinforced control on the authorized inspection organisations and their inspection programmes should be organized and implemented by the FANC. The FANC must set up transparent and objective tools in order to evaluate the inspections carried out by the authorized inspection organisations.

Additional information on further developments will be provided during the Convention meeting.

h. Other initiated modifications and/or safety analyses at the nuclear power plants

- Boraflex racks replacement in Doel
  The racks of the Doel 4 NPP spent fuel storage pool contain Boraflex as a neutron absorbing material. This material is known to have the tendency to become brittle under the influence of radiation and temperature and to be subject to corrosion which can affect its neutron absorbing function, leading potentially to criticality safety concerns. In 2005 the Licensee therefore started a program to gradually replace these spent fuel racks with new spent fuel racks made in borated steel. A similar program for reracking of the spent fuel storage pools of Doel 3, Doel 1 and 2 is under consideration[1].

- Analyses performed following the Forsmark incident
  The Forsmark 1 event on 25 July 2006 revealed a common cause failure of the safety related UPS systems. Although it did not raise any problem requiring immediate corrective action, the FANC demanded to the owner an in-depth analysis of the emergency electrical supply systems for potential vulnerability to a similar common cause failure (diesels, rectifiers, batteries and inverters). The investigation is currently in progress.

[1] The boraflex plates were removed and replaced by borated steel at Tihange 3 in 2004.

II. GENERAL PROVISIONS

II.A. Article 4. Implementing Measures

Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligation under this Convention

After being adopted by the Belgian Parliament, the law endorsing the Nuclear Safety Convention of Vienna of 20 September 1994 was signed by the King on 26 November 1996 and published in the "Moniteur" (i.e. Belgium's Official Journal) of 22 August 1997. As a result, the Convention is included in the Belgian national legislation.

After the ratification, the national legislator decided that the existing legislative and regulatory framework was sufficient to implement the Convention, without adaptations or completions deemed necessary. This does not alter the fact that the efficiency and efficacy of the regulations are permanently evaluated by the public bodies involved and that they will be altered if necessary, in order to take into account the scientific, technological and social evolutions or in compliance with obligations resulting from other international or supranational conventions. Since the signing of the Convention, the nuclear laws and regulations have undergone important modifications, among other things, as a consequence of the operational start up of the Federal Agency for Nuclear Control (see art. 7 and 8), the adoption of the Law of 31 January 2003 concerning the phasing-out of nuclear power and the management of fissile materials irradiated in these nuclear power plants.

II.B. Article 6. Existing Nuclear Installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of the Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Belgium's seven nuclear generating units in operation are equipped with pressurised water reactors built either by Westinghouse or by Framatome, each time in partnership with Belgian manufacturers for the major equipments of the primary and secondary systems. These units were put into service between 1974 and 1985.

The Belgian operators and their architect/engineers had already gained experience in that technology with the BR3 reactor of the Nuclear Research Centre at Mol, and with their participation in the Ardennes Nuclear Power plant (SENA) at Chooz (France).

Belgium did not develop national nuclear safety regulations, but instead adopted the American regulations. Furthermore, for the four most recent generating units, the "Commission Spéciale des Radiations Ionisantes" - "Speciale Commissie voor Ioniserende Stralingen" (the official name of Belgium's Nuclear Safety Commission) stipulated that external accidents had to be taken into account, such as an aircraft (civil and military) crash, a gas explosion, a major fire and the effects of toxic gases. These requirements resulted in a duplication of a significant number of safety systems, installed in bunkerised structures to withstand an aircraft crash, which is the most demanding loading case.

Moreover, explosive or toxic gases detection systems isolate the ventilation systems in a redundant way in order to prevent the introduction of such gases in the installations.

The way these different rules were implemented during the design and the construction of the nuclear units is explained in article 18, where the implementation of USNRC rules, and the related codes and standards (ASME code, ANSI standards, IEEE…), are specifically addressed.

The technical characteristics of each generating unit are described in detail in Appendix 1 to this Report. The original design is described together with the main modifications made since their construction.

In particular, it can be observed how the protection against accidents of external origin has been done and has resulted in a greater redundancy, or diversity in some cases, of the protection and engineered safety systems. For example, the Doel 3 and 4 units, as well as Tihange 2 and 3, are three loop plants equipped with 3 independent and redundant safety trains (each train having its own safety Diesel group in a non-bunkerised building) and with 3 emergency trains to mitigate accidents of external origin (each train with a Diesel located in a bunkerised area and built by a manufacturer different from the one of the normal safety Diesels, ensuring diversity). The safety trains and the emergency trains are not designed to cope with the same accidents (of internal origin for ones, of external origin for the others) but the emergency trains provide an equipment diversity which can be very useful even for some accidents of internal origin, according to the probabilistic safety studies results.

In Belgian law, the operating licences are granted by Royal Decrees that do not impose a time limit, but the Safety Authorities can at any time suspend the licence should a major safety problem be detected.

The licence given for each unit individually makes it mandatory to conduct periodic safety reviews. These safety reviews must "*compare on the one hand the condition of the installations and the implementation of the procedures that apply to them, and, on the other hand the regulations, codes and practices in force in the United States and in the European Union.*

The differences found must be highlighted, together with the necessity and possibility of remedial action and, as the case may be, the improvements that can be made and the time-schedule for their implementation".

The obligation to perform periodic safety reviews has been in force since 1975 in the Belgian regulations, making Belgium a pioneer in this respect.

During the first periodic safety reviews, which took place in 1985 for Doel 1 and 2 and for Tihange 1, i.e. ten years after the beginning of their commercial operation, the objectives have been defined as follows:

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

These objectives are those that have now been recognised by all the European countries (EUR 15555 report) or that have been included in the international safety guides (guide O12 of IAEA's NUSS programme – now replaced by NS-G-2.10).

As nuclear safety rules had substantially evolved in the 1970-1980 period, the first periodic safety reviews of Belgian generating units examined a wide spectrum of topics, including the taking into consideration of external accidents for the first three constructed units and bringing them to the level of the four most recent units.

For instance, at Tihange 1, considering a design earthquake of 0.17 g intensity (value of the Safe Shutdown Earthquake detained in the safety analysis of Tihange 2 and 3) instead of the original value of 0.1 g detained in the design of unit 1, resulted in recalculating with much more elaborate methods the seismic behaviour of all the buildings, and strengthening a number of structures. Also, the resistance to earthquake of many equipments and components had to be reviewed, based on feedback from experience with equipment which had undergone a real earthquake. Similarly, external accidents due to human activity were considered. Other fields treated included protection against high-energy line breaks, protection against primary system overpressure, improvement of fire protection, improvements to the reliability of systems, more effective training of operators (training centres with several simulators), improvements to the man-machine interface, systematic utilisation of both national and international feedback of operating experience.

Similar steps were followed for Doel 1 and 2. In the design and during the construction of Doel 1 and 2, earthquakes had not been considered as a factor influencing the design requirements, due to the weak seismic activity of the region. For Doel 3 and 4, applying the USNRC rules has imposed a minimum of 0.1 g for the Safe Shutdown Earthquake (SSE). For Doel 1 and 2, the same methodology for defining the SSE has been followed, except the requirement of a minimum value of 0.1 g.

The resulting SSE retained for the design has an intensity of 0.056 g.

As for Tihange 1, this led to check the resistance of buildings and equipments. Moreover, to cope with accidents of external origin, a bunkerised and seismically resistant building has been erected, containing so-called emergency safeguard systems, which allow maintaining primary water inventory, ensuring reactor sub-criticality and residual heat removal and coping with accidents like a fire in the electrical auxiliaries building (including the loss of the main control room), the total loss of electric power (external grid and the safety Diesels), the SSE, a high-energy line break.

During the second periodic safety reviews of these units (1995) and during the first ones of the more recent units (1992 and 1995), probabilistic safety assessments have been systematically conducted. Taking into account severe accidents, for instance, resulted in the installation of (autocatalytic) hydrogen recombiners inside the reactor containment.

Shutdown states have also been considered, according to deterministic rules (for example pressurised cold thermal shock, spurious dilutions, procedures to face the loss of the residual heat removal system, procedures to manage severe accidents), as well as in the probabilistic safety analysis (e.g. mid-loop operation).

Systematic analysis of experience feedback from the Belgian units and from units abroad resulted, among other things, in improvements to systems and/or replacements of components, in the verification of the coherence of past modifications, and in implementation of certain large projects.

Appendix 1 gives for each nuclear installation a more detailed description of the major improvements and modifications implemented since they were first built. Appendix 4 gives also a detailed list of the topics considered during the periodic safety reviews of the Doel and Tihange units.

As a conclusion, the permanent in-service monitoring and inspection of the installations, combined with the periodic safety reviews during which the changes in regulations and practices and the systematic use of feedback of operating experience are also taken into account, ensures that the safety of the installations is maintained and even improved. Ageing is systematically investigated in order to demonstrate the safety of the installations during the next decades.

Summary of the main projects and modifications to the installations		
Year	**Unit**	**Description**
1993	Doel 3	Replacement of the 3 steam generators + power uprate
1994	Tihange 2	Introduction of MOX fuel
1994	Doel 3	Introduction of MOX fuel
1994	Tihange 2	Power uprate
1995	Tihange 1	Replacement of the 3 steam generators + power uprate
1996	Doel 4	Replacement of the 3 steam generators
1998	Tihange 3	Replacement of the 3 steam generators
1999	Tihange 1	Replacement of the pressure vessel head
2001	Tihange 2	Replacement of the 3 steam generators + power uprate
2004	Doel 2	Replacement of the 2 steam generators + power uprate

II.C. Article 7. Legislative and Regulatory Framework

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:
- **(i) the establishment of applicable national safety requirements and regulations;**
- **(ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;**
- **(iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;**
- **(iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.**

II.C.1. Introduction:

The two basic Belgian regulations regarding nuclear safety are the Law of 15 April 1994 and, since September 2001, the Royal Decree of 20 July 2001 known as the "General Regulations regarding protection of the population, the workers and the environment against the dangers of ionising radiation (GRR-2001).

The scope of the new GRR-2001 is wider than the previous one and covers practically all human activities and the situations with a risk resulting from the exposure to ionizing radiation, and this at the level of 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 the natural radioactivity (e.g. radon) are integrated in the regulations. This new rule ensures the transposition of all the European directives regarding radioprotection and in particular the 1996 and 1997 directives reinforcing considerably the standards protecting the population, the workers and the environment, and, in particular, the protection of the patients in the frame of medical exposures.

The Royal Decree of July 20th 2001 enforces many articles of the Law of April 15th 1994 and therefore makes operational **the Federal Agency for Nuclear Control (FANC)** created by that Law. The structure of the public organisation will be explained in Article 8. This organisation, which is endowed with wide competences, **constitutes the Safety Authority.**

The texts of the regulations now in force can be consulted on the website of the FANC (www.fanc.fgov.be).

Regulations concern the licensing of nuclear facilities, the measures to protect the health of the workers and of the public, nuclear civil liability, safeguards, nuclear materials transport, waste management, emergency plans, etc.

A brief overview of the legislation is given below in chronological order and for each main topic. After this summary the legislation regarding the nuclear installations covered by this National Report is presented in more details. The texts referred to are not frozen, in the sense that they are likely to be replaced, completed or modified at any time by further regulations that amend the original texts, so as to limit the volume of texts to be referred to.

In this Article 7 most of the text is composed of excerpts of the Belgian laws and regulations, but these excerpts are not specifically identified.

Information concerning the management of spent fuel and radioactive waste can be found in the 2006 National Report issued according the "Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management".

II.C.2. Nuclear Safety (Protection of the Population and Workers against Ionising Radiation)

The GRR-2001 was signed by the King on 20 July 2001. Its publication in the Belgian Official Journal ("Moniteur Belge") in August 2001 makes the Federal Agency for Nuclear Control (FANC), established by the law of 15 April 1994, legally operational on 1 September 2001.

This new Royal Decree replaces the previous one of 20 February 1963 (as modified) but keeps the coherence with the previous text (same topics treated in articles keeping the same numbering), introduces all the missions of the FANC instead of those of the previous Services and implements several Euratom Directives.

The GRR-2001 bundles the licence procedures for diverse practices and professional activities implying the use of radioactive substances or ionising radiations, it specifies the protective measures to be taken into account and organises control operations. The main provisions of this Royal Decree are described in § II.C.4 of this article of the National Report.

The GRR-2001 regulates the transposition of the ruling European Conventions, Directives and Regulations into Belgian Law[2], such as :

- the Directive 84/466/Euratom on the fundamental measures related to the radiological protection of persons subjected to medical examinations and therapies,
- the Directive 89/618/Euratom on the information of the population about the applicable health protection measures and on the adequate behaviour in case of radiological emergency,
- the Directive 90/461/Euratom on the operational protection of outside workers exposed to the risk of ionising radiations during their intervention in a controlled zone).
- the Basic Safety Standards Directive 1996/29/Euratom,
- the modified Directive the Directive 1992/3/Euratom on the transboundary movements of radioactive 1985/337/EEC on the environmental impact assessment of projects,
- the Directive 1997/43/Euratom on the health protection of persons exposed for medical purposes, replacing the Directive 84/466/Euratom;
- the obligations resulting from the Euratom Treaty (e.g. article 37), etc.

Belgium is a member State of the European Union and of the European Atomic Energy Community (EURATOM), since the foundation of these supranational instances in 1957. The Belgian rules and regulations mainly within the field of radiation protection have been developed in implementation of and in accordance with the European Treaty and directives concerned, as mentioned above.

[2] The directives 84/466/Euratom, 89/618/Euratom, 90/461/Euratom and 1992/3/Euratom were already transposed in Belgian law by the Royal Decree of 2 October 1997 which modified the GRR-1963.

Since 1 September 2001 the surveillance of nuclear activities is under responsibility of the ***Federal Agency for Nuclear Control (FANC)***. According to the Law of April 1994, the FANC may call upon the assistance of authorised inspection organisations (AIO) for the execution of certain tasks. The FANC makes use of this provision and, in the case of NPP's and also other installations, delegates to **Association Vinçotte Nuclear (AVN** for nuclear facilities) different tasks, a.o. routine inspections.

It is through the association of the FANC on one side, and AVN on the other that the function of regulator as stipulated in article 8, is ensured. With the creation of the FANC, the legislator aimed at redefining the mutual relations between the nuclear operators, the authorised inspection organisations and the nuclear regulator (See part I.C for the recent developments)

II.C.3. Law of 15 April 1994 creating the Federal Agency for Nuclear Control (FANC)

A description of the contents of the various chapters and the main articles linked to nuclear safety and radiological protection is given below.

II.C.3.a. Chapter I - General Clauses

- Article 1
  Defines a number of terms used in the text of the law: ionising radiation, radioactive substance, Competent Authorities, general regulations, Authorised Inspection Organisations, Health Physics Department, the Agency, nuclear materials, physical protection measures….

- Article 2
  Establishes the public interest organisation having legal status, called "Federal Agency for Nuclear Control", abbreviated as "FANC".

- Article 2bis
  Nuclear materials and related documents are excluded from the law regarding administration transparency.

II.C.3.b. Chapter II – Competent Authorities

- Article 3
  The King is the Competent Authority, excluding the Communal county authority, to take the measures to protect the workers, the public health or the environment. These measures apply to import, export, production, manufacture, possession, transport, transit, sale, utilisation for commercial, industrial, scientific, medical or other purposes, of equipment, installations or substances capable of emitting ionising radiation. These measures can also cover the accessories of equipments or installations and the safety-related software.

- Article 4
  The transport of substances mentioned in article 3 can only be done by persons licensed accordingly by the Agency. The King decides, after taking note of the advice of the Agency, the clauses of the licence.

- Article 5

  The competent authority can, at any time, suspend and rescind the decisions of decentralised administrations which have a direct or indirect effect on the transport of radioactive substances or equipments containing such substances.

- Article 6

  The King, excluding the communal council authority, may take all measures aimed at safeguarding the population and the environment when an unforeseen event puts the health of the population or the environment in jeopardy.

  The King, excluding the communal council authority, may also prescribe all measures in order to avert the hazards which could result from the accidental contamination of any places, materials or products by radioactive substances.

- Article 7

  The King nominates the persons in charge of supervising the respect of this law and its implementation decrees are respected, for what concerns the medical supervision of the workers and the health conditions at work.

- Article 8

  The King nominates the persons in charge of the missions mentioned in articles 7 and 14, according as it refers to the civil or military domain.

- Article 9

  The members of the supervision service of the Agency appointed by the King to supervise this law and its implementation decrees are considered as judiciary police officers, auxiliaries of the King’s Attorney. They search for infractions to the law and establish them by official entry.

  They can give a warning accompanied by a period (of maximum 6 months) in which the infractions must be resolved.

- Article 10

  The persons mentioned in article 9 have at any time free access to the installations. They can proceed to the seizure of the indicated equipments or substances and can officially take all necessary measures to avert the hazards.

- Article 11

  The concerned persons, compagnies, institutions or organisations can appeal to arbitration against the measures mentioned in article 10 by the Ministries responsible for the Agency; this appeal is not a stay. If no decision is taken within three months, the measures appealed against are no more applicable.

- Article 12

  The King can determine through a decree discussed in the Council of Ministers the fees which are collected:

  1. for the benefit of the Agency to cover its costs
  2. to the benefit of the State to cover the costs resulting from article 6, in particular those related to the emergency plan for nuclear hazards.
  3. for the benefit of the Federal Agency for the safety of the Food Chain to cover its costs.

  The King fixes the amount of these fees and the way they are paid. This article also indicates the ways to attribute and use these fees.

- Article 13
  The clauses of the present law are not at all detrimental to the application of the law of 4 August 1955 on State security in the field of nuclear energy and of the decrees implementing that law.

II.C.3.c. Chapter III– Missions of the Agency

- Article 14
  The Agency is in charge of the control and the supervision, as well as accompanying the IAEA when performing inspection and verification activities on Belgian territory.

- Article 15
  In a general way, the mission of the Agency includes the investigations useful to define all the operating clauses and to the safety and security studies relative to the facilities where ionising radiation is used. It also includes surveillance, controls and inspections which follow, radiological protection, training and information, contacts with the Authorities and national organisations concerned and interventions in case of emergency. The Agency gives its technical support to the Minister of Foreign Affairs.

- Article 16
  - § 1. The King grants or refuses the authorisation of creation and operation which precedes the creation of any facility, installations for the industrial production of electricity from nuclear fission excluded, where substances or equipments capable of emitting ionising radiation are present.
    The Agency examines the applications to obtain the authorisation mentioned in the first paragraph. The Agency obtains on this subject the opinion of the Scientific Council mentioned in article 37.
    The authorisation determines, among others, the rules relative to the periodic safety reviews of the installations and the time of the acceptance report mentioned in § 2.
    The King determines the conditions under which the authorisation mentioned in the first paragraph is granted. He can modify these conditions during the lifetime of the facility, including during its dismantling.

  - § 2. The operation of a facility mentioned in § 1 cannot start before that the King has confirmed the authorisation of this facility by ascertaining that the conditions of the authorisation are respected. This confirmation is preceded by a favourable acceptance report established by the Agency. This acceptance takes place before the introduction of the radioactive substances being authorised in the installation.

  - § 3. The Agency controls the respect of the conditions imposed by the authorisation of creation and operation. The King can suspend or withdraw the authorisation upon advice by the Agency.

- Article 17
  The King determines, via a decree discussed in the Council of Ministers, the clauses of implementation of article 16. He categorises the facilities mentioned in

article 16, § 1 as a function of the hazard they present. He may not delegate the granting authorisations for the facility which are in the class of highest hazard.

- Article 18
  The Agency examines the documents for the transport of radioactive substances. It controls the respect of the specific clauses imposed by the authorisation or acceptance acts delivered by the competent authorities.

- Article 18bis
  Every person that stores, uses or transports nuclear materials or possesses documents related to nuclear materials, is not allowed to give those materials or documents to other persons than those entitled by their function, without approval by the Agency.

- Article 19
  Under the conditions and within the limits and according to the modalities of article 3, the Agency:
  - grants the acceptance of equipments for medical use emitting ionising radiations and ensure their control.
  - grants the acceptance of the pharmacists and physicians using sources of ionising radiation, of the physicians in charge of the medical control of the workers professionally exposed to ionising radiation, as well as of the experts in charge of the health physics department of the facilities.
  - examines the documents for the use and grants the authorisations to use radioactive substances in the medical field, as well as those for the manufacture and the distribution of these substances. It controls the respect of the specific clauses imposed by the authorisation acts.

- Article 20
  Under the conditions and within the limits and according to the modalities of article 3, the Agency examines the documents for the use and grants the authorisations to use ionising radiation in order to sterilise medical equipments and to treat foods. It controls the respect of the specific clauses imposed by the authorisation acts.
  The inspections concerning the treatment of food is done in cooperation with the Federal Agency for the safety of the Food Chain.

- Article 21
  The Agency ensures the surveillance and the control of the radioactivity on the whole territory in normal conditions and during emergencies. In normal conditions, this mission includes the regular measurement of the radioactivity in the air, in water, of the soil and of the food chain, as well as the evaluation and the surveillance of the doses of ionising radiation received by the population.
  To this end, the Agency can rely on the assistance of competent private or public organisations.

- Article 22
  The Agency provides technical assistance to the Minister of Internal Affairs for the elaboration of the emergency plans. It organises an intervention cell for emergencies.

- Article 23

The Agency is in charge of setting up a scientific and technical documentation in the field of nuclear safety. The Agency can ask any document, under any form, from the companies or organisations that it controls.

It stimulates and coordinates the research and development works. It establishes privileged relationships with the public organisations working in the nuclear field, with the scientific research circles and with the international organisations concerned.

- Article 24
  The Agency makes proposals to the responsible ministers about the measures that the King imposes under the terms of this law.

- Article 25
  In the limits of its competencies the Agency controls the respect by the operators of their obligations related to training, information and protection of the workers.

- Article 26
  The Agency is in charge of delivering a neutral and objective information in the nuclear field. It circulates technical information about nuclear safety and radiological protection.

  It collaborates, on the initiative of the minister of Internal Affairs, to the information about the emergency plans that this minister works out.

  It presents an annual report about its work, to be transmitted to its overseeing authorities, to the attention of the Parliament.

- Article 27
  By derogation to article 1676 of the Judiciary Code, the Agency is competent to submit any disagreement by convention to arbitration.

II.C.3.d. Chapter IV – Delegation of some Missions by the Agency

- Article 28
  Under its own responsibility the Agency can rely, for exercising some of its missions, to the collaboration of organisations it specifically recognizes (“organismes agréés” commonly translated into English as “authorised inspection organisations”).

  Missions aimed at, totally or partially, are those relative to the permanent supervision of the adequate implementation of the Health Physics Department’s tasks, the acceptance of new installations, the approval of decisions made by the Health Physics Department.

  The Agency may also, for the transport of fissile materials, delegate to an organisation that it specifically recognises the permanent supervision of the loading, the transport and the delivery of these materials.

- Article 29

The specific recognitions mentioned in article 28 are delivered on the basis of criteria fixed by the Agency and relative especially to:

- the qualification of the organisation’s personnel
- the necessary means that the organisation must have at its disposal to accomplish its missions
- detailed rules related to the working methods of the organisation and to the execution of the entrusted missions

The King determines, via a decree discussed in the Council of Ministers, after having taken the advice of the Agency, the procedure for granting and withdrawing the specific recognition of the organisations.

Any first recognition granted by virtue of this law to an organisation aimed at in the present chapter is valid for a maximum of five years. That duration can be extended for a period of maximum five years.

- Article 30
  The missions mentioned in article 28 are entrusted on the basis of specifications. These specifications determine in particular the way the recognized organisation will be paid for its services.
  The King approves the specifications established by the Agency. The Agency selects the organisation on the basis of the specifications and the regular offers received.

II.C.3.e. Chapter V – Resources, Budget and Accounts

- Article 31
  The Agency receives the fees, according to the modalities of article 12 of this law.
  As the case may be, the Agency adds to the fees paid by the persons or the organisations mentioned in article 12 of this law the cost of some supplementary work mandatory for exercising its mission.

  The Agency must balance its budget.

- Article 32 to 34
  These articles deal with the accountancy of the Agency and its financial audit.

II.C.3.f. Chapter VI – Administration of the Agency (h2)

- Article 35
  Describes the rules applying to the composition of the Board of the Agency.

- Article 36
  Determines the length in time of the mandates of the Agency’s members of the Board.

- Article 37
  A Scientific Council is established, whose mission is to advise the Agency with respect to its surveillance policy and more in particular to give, according to article 16, an opinion previous to the authorisations to be delivered for new installations or for the renewal of authorisations. The composition and the powers of the Scientific

Council, a group of persons highly competent in the nuclear field and in safety, are determined by the King.

The Board ensures the consultation between the Agency and the interested parties and in particular with the operators of nuclear installations.

- Article 38
  Lists a number of incompatibilities between the mandate of member of the Agency's Board and other mandates.

- Articles 39 to 41
  Define the powers of the Board and those delegated to the Director General.

- Article 42
  The Agency is amenable to the legislation relative to public contracts for works, supplies and services.

- Article 43
  The Agency is organised so that the regulatory missions and the surveillance missions are exerted independently.

- Articles 44 to 46
  Define the statute of the Agency's personnel and of the persons transferred from existing services (SPRI, SSTIN…) or from public interest organisations active in the nuclear sector.

- Article 47
  The Agency's personnel takes all necessary measures to secure the confidentiality of the data known to them.

- Article 48
  Determines the Ministers responsible for the Agency.

II.C.3.g. Chapter VII – Penal Clauses

- Articles 49 to 50
  Define the amounts of the fines and the prison sentences which can be applied in case of infringement to the present law and which clauses of the Penal Code are applicable.

II.C.3.h. Chapter VIII – Final Modalities

- Article 51
  Modifies article 10 of the law of 20 July 1978 in order to give to the Agency's personnel the mission of accompanying the IAEA inspectors.

- Article 52
  Rescinds the law of 29 March 1958 and its subsequent modifications in order to replace it by the present law.

The Royal Decrees implementing the previous law remain applicable as long as they have not been modified or abrogated by virtue of the present law.

- Article 52bis
  § 1. The operators of nuclear installations must entrust the authorised inspection organisations ("organismes agréés") for an indefinite period, by virtue of the law of 29 March 1958 relative to the protection of the population against the dangers of ionising radiation, with the specific missions mentioned in article 28, alinea 2, up to the moment these missions are taken, either by the Agency itself according to articles 15 and 16, or by an authorised inspection organisation, according to articles 28 to 30.
  § 2. The existing authorised inspection organisations must carry on, in total independence, the above mentioned missions which are entrusted to them, up to the moment these missions are taken, either by the Agency itself according to articles 15 and 16, or by an authorised inspection organisation, according to articles 28 to 30.
  For this purpose, they keep their existing recognition. Notwithstanding article 29, their recognition and their missions come legally to an end at the moment these missions mentioned in article 28, alinea 2 are performed either by the Agency itself according to articles 15 and 16, or by an authorised inspection organisation, according to articles 28 to 30.
  § 3. The period during which this transitory regime is applicable is limited to a maximum of 2 years. The King can determine, via a decree discussed in the Council of Ministers, conditions and more detailed rules for the transfer of specific control missions.
  He can in the same way extend the duration of this transitory regime, by a maximum of one year at each time.

- Article 53
  The King can modify the existing legal clauses to adapt them to the clauses of the present law.

- Article 54
  The King determines, via a decree discussed in the Council of Ministers, the date at which the clauses of the present law come into force.

II.C.4. Royal Decree of 20 July 2001

This Royal Decree provides the basic nuclear safety and radiological protection regulations and will be constantly amended and updated by the Safety Authorities in order to introduce new concepts, take into account the European directives, etc.
The main modifications as a result of this new general regulation, adopted by the Royal Decree of 20 July 2001, result on the one hand from the enforcement measures of the law of 15 April 1994 and on the other hand from the transposition of several European Directives. In addition to the modifications related, amongst others, to the reinforcement of the basic radioprotection norms and the new strict rules concerning the clearance or the recycling of very low level solid waste that also have an important impact at the level of the design, the operation and the dismantling of the nuclear installations concerned by the Convention, the new regulation deeply modifies the licensing procedure for those facilities.

From now on, the new procedure to obtain a construction and operation licence for facilities of class 1 will have two phases, each ending with a Royal Decree, replacing the single licensing decree of the previous regime of the GRR-1963. The license application consists of three parts.

The first part consists mainly of administrative data, defining amongst others responsibilities, names and legal status of the applicants, …

The second part includes a preliminary safety analysis report containing amongst others:

1. the safety principles that will be applied for the construction, the operation and the design basis accidents,
2. the already available probabilistic safety analysis,
3. the qualification of the mechanical and electrical equipment,
4. the principles that will be applied for quality assurance,
5. the expected quantities of waste and their management, including those related to the dismantling,

The third part of the application file consists of an environmental effects report, including mainly the data as prescribed in the European recommendation 99/829 (description of the data needed in the frame of Art. 37 EURATOM) and data relative to the European directive 85/337 (as modified by 97/11).

As Belgium is a federal state composed of several “Regions”, these regions have legal competency concerning the environmental incidence of the projects in their territory. Future cooperation agreements are being discussed in order to avoid work duplications and incompatibilities.

The file is first presented for advice to the Scientific Council of the FANC (previously known under the name Special Commission). A mandatory international consultation (required by the Article 37 of the Euratom Treaty and/or required by the Directives on the trans-boundary impact) and/or a voluntary consultation of the European Commission may take place. Afterwards, the file is submitted to a public enquiry and to the concerned local authorities for advice, and then to the standing committee of the concerned provinces. The whole file returns to the Scientific Council for final advice. A positive advice of the Scientific Council is necessary for a positive decision with conditions. This construction and operation licence allows the applicant to realise the installations in conformity with the Authorisation Decree.

The second phase aims at obtaining the decree confirming the construction and operation licence. The Federal Agency for Nuclear Control (FANC) or the authorised inspection organisation acting on behalf of the FANC proceeds to the acceptance inspection before the starting-up and the introduction of radioactive substances. A fully favourable acceptance report leads to the confirmation decree allowing the operation of the facility.
The picture at the end of this Article 7 shows this licensing procedure.

Appeal against the FANC decisions and Authorisation decrees.

The construction and operation licence of class 1 facilities is granted in an authorization decree, signed by the King and by the minister of internal affairs. Like any decree, anybody can introduce an action for cancellation of the decree, during 60 days after the publication of the authorisation decree.

The administration in charge of treating the appeal against the administrative decision is the "Council of State". If the situation is urgent or if it is needed, on request of the applicant, the council of state can suspend immediately the administrative decision.

A description of the contents of the various chapters and the main articles linked to nuclear safety and radiological protection is given below.

II.C.4.a. Chapter I - General Clauses

- Article 1: Field of application

The present regulation applies to :

1. import, production, manufacture, possession, transit, transport, utilisation for commercial, industrial, scientific, medical or other purposes, of equipment, installations or substances capable of emitting ionising radiation;
2. offering for sale, transfer against payment or for free, of substances, equipment or installations capable of emitting ionising radiation;
3. treatment, handling, storage, elimination and disposal of radioactive substances and waste;
4. any other activity entailing a risk resulting from ionising radiation.

It does not apply to :

1. military equipment and installations;
2. transport of equipment or substances capable of emitting ionising radiations, ordered by the Minister of National Defence.

These two points are covered by specific regulations.
It does not concern natural background radiation.

- Article 2 - Definitions

The physical terms, sizes and units, radiological, biological and medical terms, as well as a number of specific terms used in the Royal Decree are defined.

II.C.4.b. Chapter II – Categorised Facilities Policy

- Article 3 – Facility Categorisation
  The facilities are categorised in four classes :
  - class 1 comprises the nuclear reactors, the facilities in which are used or stored quantities of fissile substances (excluding natural thorium and natural or depleted uranium) in quantities more than half of their minimal critical mass, the enriched or not enriched spent fuel reprocessing plants, the facilities for which the main activity is intended for collection, treatment, conditioning, or disposal of radioactive waste, and the final repositories of nuclear waste.

  - class 2 comprises the facilities where radioactive substances are produced from irradiated fissile materials and where they are packaged for sale, the particle accelerators, the facilities where are used or stored any quantities of fissile substances other than class 1 (excluding natural thorium and natural or depleted uranium), the facilities using X-ray sources operated at a peak voltage of more than 200 kV, the facilities where are used or detained quantities of radioactive nuclides of which the total activity is larger than the 50 000 (sealed sources) or 500 (non-sealed sources), (with other factors for some specific isotopes) time the exemption values given in an annexed table of this Royal Decree. Class 2 also includes the nuclear medicine (injection in the human body of radionuclides for therapeutic or diagnostic use).

- class 3 comprises the facilities where are used or held quantities of radioactive nuclides of which the total activity ranges between the “exemption values” and “class 2 values” the facilities using X-ray sources operated at a peak voltage of 200 kV or less.

- class 4 comprises the facilities using very low quantities of radioactive substances (i.e. below the exemption values) or using equipment emitting ionising radiation at a very low rate.
  The facilities in which are used or held natural or depleted uranium and natural thorium are categorised in class 4 providing the corresponding quantities are equal to or less than respectively 5 MBq and 50 kBq (otherwise they fall in class 3).
  A weighting formula is specified concerning mixtures of radionuclides, in order to determine the class of the facility where such mixtures are used or hold.

- Article 4 - is relative to the professional activities involving natural sources of radioactivity.
  It concerns, for example Radon, phosphate industries, zircon industries, rare earth industries, for witch special provisions can be defined by the Agency.

- Article 5 - Authorisation regime - General
  5.1. Classes 1, 2 and 3 require prior licensing by the Authority as specified by this regulation.
  5.2. The operators or managers of these facilities must comply with the conditions stipulated in the licensing decree (i.e. the decree that grants the licence)
  5.3. The licences can be issued for an unlimited or for a limited time period; they cannot be issued “on trial”.
  5.4 Transfer of licence(s); 5.5 : change of the facility operator and 5.6 (dispenses) Those Articles further regulates possible transfers of the licence, changes of the operator or manager of the facility, and derogation from obligations to supply certain information.
  5.7 : Mobile installations and/or temporary activities.
  It is also specified that the facilities where ionising radiation is only occasionally used (e.g. for non-destructive inspection of welds, …) do not fall within a class in the sense of this regulation but these activities must be performed by a duly licensed for such activities outside facility .

- Article 6 - Licensing regime for class 1 facilities.
  6.1. The King is the competent Authority; accordingly, the licence will be issued in the form of a Royal Decree countersigned by the relevant Minister. The relevant minister is the Minister of Interior Affairs.

  6.2. This section details the information and the documents to be supplied in support of the licence application, and to whom the application must be sent. These include mainly (for the exhaustive list, refer to the regulation itself) three parts:

<u>Part 1</u> :
– the applicant's identity,
– the description of the planned facility, with the characteristics of the installed equipment, the quantities of radioactive substances, the protection and safety measures, designation of the responsibilities regarding nuclear safety and radiological protection in order to meet the basic standards,
– the qualification and competence of the personnel, as well as the presumed numbers of personnel occupied in the various sections of the facility,
– the engagement of concluding a civil liability insurance
– the engagement of concluding a cooperation agreement with ONDRAF/NIRAS (the National institution in charge of nuclear wastes and fissile material)

Part 2 : A Preliminary Safety Report including :
– the drawing of the site and its installations,
– the geographical, and topographic data of the site area,
– a short description of the installations,
– the safety principles, including the design base accidents (from internal or external origin),
– the choice of construction engineering rules,
– the already made probabilistic safety assessments (only for nuclear reactor and reprocessing plants),
– a short description of the electrical and fluid circuits and of the control-command system,
– the foreseen equipments qualification procedures,
– the quality assurance principles,
– an evaluation of the produced amounts of radioactive wastes (including those from the future dismantling), the proposed measures for disposal, treatment and /or temporary storage before their transfer to ONDRAF/NIRAS.

Part 3 : An environmental impact assessment study :
– Comprising at least the data for the European directive 1999/829 (application of Art. 37 EURATOM), the evaluation of the radiological impact of the installation on the environment, the justification of the choices (regarding to the different alternatives).
– This study should be performed by approved authors (by the FANC) and should include a non-technical abstract.

6.3. is relative to the preliminary consultations :
- Preliminary advice of the Scientific Council
  The Council examines and states its advice on the licence application. It may seek opinions from outside, -national or international-, experts or foreign organisations.
- International consultations (if applicable)

6.4. and 6.5.

These sections relate to the public inquiry, the advice of the municipality and of the provincial authorities.

6.6. Final Scientific Council Advice

This section deals with the definitive advice of the Scientific Council.

A favourable advice of the Scientific Council may stipulate particular conditions or restrictions to operation in order to ensure the safety of the facility and mitigate its environmental impact. The decision is transmitted to the applicant; witch has the right to be heard by the Council.

The Scientific Council is composed of the Director of the Federal Agency and their two operational department managers (but without voting rights), 16 personalities selected in view of their scientific or technical knowledge in nuclear safety, radiological protection and environmental fields. Each of the three Regions that compose Belgium may also delegate 2 representatives which have a consultative capacity but have no say in the final judgment.

6.7. Final Decision.

A “Class 1” licence requires a Royal Decree, countersigned by the Minister of Internal Affairs.

The licence cannot be delivered if the advice of the Scientific Council is negative.

If the Scientific Council’s advice is positive, a denial of the licence must be motivated.

6.8. relates to notification of the decision to the civil, local, and federal authorities and to the public administrations and services.

6.9. Confirmation Decree :

Before the effective exploitation of a Class I installation/facility, a second Royal Decree must be issued. The Agency or the delegated authorised inspection organisation must confirm that the installation/facility fully comply with the conditions of the first Decree and with the legal Regulations in force.

If the certificate of acceptance is positive, a second Royal Decree confirms the first exploitation licence.

This Decree must occur before the introduction of radioactive materials inside the installation/facility.

- Articles 7 and 8

  These Articles deal with the licensing regime for class 2 and 3 facilities.

- Article 9

  This article relate to the authorisation procedure for activities involving naturally occurring radioactive materials (NORM).

- Articles 11

  This Article deal with facilities of mixed Class or with installations involving Regional competence. (“non nuclear aspects”).

- Articles 12 and 13

  These Articles deal with modifications or extensions of the facility. The Federal Agency decides if a modification is significant (i.e. a new authorisation procedure is required) or not (i.e. a new authorisation procedure is not required). Art. 13 deals with additional conditions and changes to conditions laid down regarding operation.

- Article 15 - Confirmation licence of installations of class 2 and 3 facilities.
  Prior to first start-up, these installations must be inspected by the Agency or an authorised inspection organisation with regard to compliance with the regulations and with the particular operation conditions set in the licence. They may be started-up only if the inspection report issued by the authorised inspection organisation is completely positive and formally authorises the start-up or, as the case may be, the industrial operation.

- Article 16
  The competent Authority may suspend or withdraw the licensing decree, (after consultation of the Scientific Council for the "Class 1" facilities) , when the regulations and/or the particular operation conditions set in the licence are not complied with.
  Appeal against the decision of the Authority by the licensee is always possible.

- Article 17:Cessation of activities and decommissioning
  When the facility ceases its activities, the radioactive substances that it holds at that time must be given a destination that guarantees their reuse or disposal under satisfactory conditions. The same applies when the competent Authority refuses, suspends or withdraws the licence and its decision is definitive.
  The new regulation requires also a licence for the decommissioning of those installations. This licence mainly covers the methods, the safety of dismantling and of elimination of active or contaminated material as well as their destination.

- Article 18 : "Clearance" (elimination; recycling, re-use) of solid radioactive waste.
  Radioactive waste can be relieved from regulatory control, in short "Cleared", if their activity concentration levels fall below the clearance levels mentioned in annex IB of GRR-2001. These clearance levels are derived from European Standards ("Radiation Protection nr 122"). For radioactive waste which do not comply these clearance levels but are still below the exemption levels mentioned in annex IA of the GRR-2001, a special clearance authorisation may be delivered by the Agency.

- Article 19
  Refusal, suspension or withdrawal of the licence, or seizure of radioactive substances, will not entitle the facility to any compensation.

II.C.4.c. Chapter III - General Protection

- Article 20 - Limitation of doses
  The limitation of individual or collective doses is based on the general principles of justification, of keeping the doses as low as reasonably achievable, and of compliance with the limit doses.
  These doses are specified in detail for professionally exposed people, for trainees and students, and for members of the public.
  The doses limitations comply with the European 96/29 directive.

Concerted exceptional exposure, accidental exposure and emergency exposure of the workers are also addressed in this Article.

- Article 23 - Health physics
  - The facility's general manager must organise a "protective physical control department", i.e. Health Physics Department, in charge of nuclear safety and radiological protection.
    The tasks of this department are listed; they include, among other, the definition of controlled zones, the prior approval of modifications that do not require applying for a new licence, prior approval of experiments, tests, treatments and handling that it had not already been approved in the past, commissioning of new installations, supervision of handlings and transfer of radioactive or fissile substances inside or outside the site, the determination of the intensities of radiation and contamination, liaising with the physician in charge of monitoring the follow-up of individual dose and contamination of people, the studies to prevent any incident, accident, loss or theft of radioactive or fissile substances.

    This department must be headed by a class1- Health Physics authorised expert.
  - The facility general manager must entrust a class 1-authorised inspection organisation with the permanent supervision of the adequate implementation of the Health Physics Department's tasks, and the acceptance inspection of the installations, the examination and approval of the decisions made by the head of the Health Physics Department, the monitoring of transport (see also Article 8 § II.D.1.b of the present National Report).
    The facility general manager must supply to the authorised inspection organisation all the information and documents needed by that organisation to accomplish its mission.

- Articles 24 to 26
  These Articles respectively deal with the medical checks of workers professionally exposed to radiation, with information and training of workers and of people possibly exposed and with the obligation of the workers to conform to the instructions and regulations.

- Articles 27 to 32
  These Articles relate to the general protection equipment and arrangements, including signalling.

- Articles 33 to 36
  These Articles deal with radioactive waste emitting radiation higher than the natural background radiation. They concern the collection, treatment and evacuation of liquid waste, forbidding effluent discharge in the soil (always), and to surface waters, to the sewers as soon as the concentration in the effluent exceeds one thousandth (at the discharge point) of the limit on the annual ingestion level by adults of the general public.
  Short-living radioactive waste should have sufficiently decreased (at least 10 half-lives) before evacuation/clearance.
  Exceptions to these limits may be included in the licensing decrees of class 1 or 2 facilities, based on performed surveys or studies of radiological impact.
  The regulation deals in a similar way with gaseous effluent and solid waste.

- Article 37

  This article deals with storage of liquid and solid radioactive waste that may not be moved. These wastes must be contained and kept in solid and tight recipients and stored in fireproof locations.

  Deposit of this waste on, or in the ground is forbidden, except authorised derogations for class I and II facilities.

  Article 37bis forbids the entry of unauthorised people in the facilities mentioned in the law of 4 August 1955 (R.D. of 14 March 1956 and 12 February 1991).

  Articles 37ter, quarter, quinquies are related to the operational protection of outside workers exposed to the risk of ionising radiation when they intervene in a controlled zone.

II.C.4.d. Chapter IV - Import, Transit and Distribution of Radioactive Substances

These subjects are treated in Articles 38 to 44, which take into account the Euratom 92/3 Directive.

II.C.4.e. Chapter V - Radioisotopes used in non-sealed Form in Human and Animal Medicine

These subjects are treated in Articles 45 to 49.

II.C.4.f. Chapter VI - Medical Applications of Ionising Radiation

These subjects are treated in Articles 50 to 55, which take into account the Euratom 97/43, 89/618 and 90/641 Directives.

II.C.4.g. Chapter VII - Transport of Radioactive Substances

This subject is treated in Articles 56 to 60.

II.C.4.h. Chapter VIII - Nuclear Propulsion

Articles 61 to 63 deal with this subject, including as regards visiting/berthing permits to be applied for by foreign nuclear-propelled ships.

II.C.4.i. Chapter IX - Bans and Authorisations

Several uses of radioactive substances are specifically forbidden (Article 64). Some applications (for example sterilisation) are subject to prior authorisation (Article 65).

II.C.4.j. Chapter X - Exceptional Measures

Article 66 concerns the measures against the loss or theft of radioactive substances.

Article 67 concerns the measures relating to accidents, concerted exceptional exposures and accidental exposures.

Article 68 deals with decontamination, and Article 69 with the contaminated mortal remains.

II.C.4.k. Chapter XI – Monitoring of the Territory, the Population and Emergency Planning

Article 70 concerns radioactivity monitoring of the territory, and of the doses received by the population, which is taken care of by the Ministry of Public Health.
This Article details the required monitoring and inspection activities.
Article 71 deals with the (radiological) monitoring of the population as a whole, the collection of all the data, including as regards professionally exposed workers.
Article 72 deals with the emergency plan for nuclear risks and the information of the population.

A specific Royal Decree of 17/10/2003 has set up the general Emergency planning organisation in case of nuclear/radiological accident.

II.C.4.l. Chapter XII – Agreement of the Health Physics Experts and Authorised Inspection Organisations

Article 73 sets all the conditions for the authorisation of experts, Article 74 for the authorisation of the inspection organisations, Article 75 those for the authorisation of doctors in charge of the medical surveillance of the workers professionally exposed to ionising radiation.
The final Articles relate to provision of information, to certain exceptions, to supervision, to enforcement measures (closing of unlicensed facilities), to official reporting and penalising of infringements.

II.C.5. Emergency Plan

The law of 15 May 2007 defines the notion of Civil Safety and describes the roles and missions of the different entities involved. The Royal Decree of 16 February 2006 organises the planning and interventions during emergency situations. The Royal Decree of 17 October 2003 precises the national emergency plan for nuclear and radiological situations as a particular emergency plan and the tasks of each of the parties involved.

It is mandatory for nuclear installation operators to define an internal emergency plan approved by the Regulatory Body and to test regularly this plan to address possible accidents. The intervention of the Authorities outside the affected installations takes place under the authority of the Ministry of Internal Affairs, which oversees the Civil Safety.

Belgium signed two conventions on 26 September 1986 for which the IAEA is the depositary, one concerning early notification of nuclear accidents, the other regarding assistance in the case of a nuclear accident or radiological emergency. Two laws, dated 5 June 1998, ratify these Conventions and introduce them in this way in the Belgian legislation. Belgium applies also the European Directives in these matters.

The Royal Decree of 17 October 2003 defines the national emergency plan and the tasks of each of the parties involved. The relevant infrastructure is being provided accordingly.

This nuclear and radiological emergency plan for the Belgian territory aims at co-ordinating the measures towards protection of the population and the environment in the event of a nuclear accident or any other radiological emergency situation that could lead to an overexposure of the population or to a significant contamination of the environment.

This document will serve as a guide for the protective measures to be implemented, should a radiological emergency occur. It establishes the tasks that the various departments and organisations would have to accomplish if the case arises, each within their legal and regulatory competences.

The provisions of the emergency plan apply in the cases where the risk exists that the population could be exposed to significant radiological exposures in any of the following ways:

- external irradiation due to air contamination and/or deposited radioactive substances;
- internal irradiation by inhalation of contaminated air and/or ingestion of contaminated water or food.

The Nuclear and Radiological Emergency Plan for the Belgian Territory is mainly designed for emergency situations in the major Belgian nuclear installations : the nuclear power plants of Tihange and Doel, the Nuclear Research Centre in Mol, the Institute for Radioelements in Fleurus, the fuel fabrication factory Belgonucléaire (– now stopped since mid-2006) and the waste treatment site (Belgoprocess) in Dessel. This plan is also activated for other emergency situations, which can occur either on the Belgian territory (accident during the transport of radioactive materials or radiological emergency resulting from a terrorist attack or events occurring in other Belgian nuclear installations for instance) or nearby (EdF nuclear power plant of Chooz for instance).

In case of an emergency, the off-site operations are directed by the "Governmental Crisis and Coordination Centre" (CGCCR), under the authority of the Minister of Internal Affairs.

The implementation of the actions decided at the federal level and the management of the intervention teams are under the leadership of the Governor of the Province concerned.

The plan describes the overall organisation. It has to be completed by concrete internal plans based on the intervention, at various intervention levels, of:

- the provincial authorities,
- the municipal authorities,
- all the intervening institutions.

Belgium signed two conventions on 26 September 1986 for which the IAEA is the depositary, one concerning early notification of nuclear accidents, the other regarding assistance in the case of a nuclear accident or radiological emergency. Two laws, dated 5 June 1998, ratify these Conventions and introduce them in this way in the Belgian legislation. Belgium applies also the European Directives in these matters.

II.C.6. <u>Law of 31 January 2003 on Phase out of Nuclear Energy</u>

On 31 January 2003, a law relating to the phase-out of nuclear energy was voted by the Belgian parliament. The main chapter of this law enforces that:

- Article 3
  No new nuclear power stations for industrial generation of electricity from nuclear fission may be constructed or commissioned.

- Article 4
  § 1. Nuclear power stations for industrial generation of electricity from nuclear fission are deactivated forty years after the date of their industrial commissioning and can no longer generate electricity from that moment on.

  § 2. Every individual license for the industrial operation and generation of electricity from nuclear fission, granted by the King with no limitation in time

  a) in accordance with the Law of 29 March 1958 concerning the protection of the population against the dangers of ionising radiations and under article 5 of the GRR-1963 setting forth the general regulation for the protection of the population and the workers against the dangers of ionising radiations, and which remain into force according to article 52 of the Law of 15 April 1994 ;

  b) under article 16 of the Law of 15 April 1994 and under articles 5 and 6 of the GRR-2001 setting forth the general regulation for the protection of the population, the workers and the environment against the danger of ionising radiations ;

  comes to an end forty years after the date of the industrial commissioning of the generating facility.

- <u>Article 9:</u>
  If the electricity supply is threatened, the appropriate measures can be taken by royal decree, in accordance with articles 3 to 7 of this law, except in circumstances outside one's control.

According to article 4 of this law, the first nuclear power plant to be deactivated will be Doel 1 in 2015, the last nuclear power plant to be deactivated will be Tihange 3 in 2025.

II.C.7. Conclusions regarding the Provisions of Article 7

Since it is operational end 2001, the FANC has taken over the tasks performed previously by the SSTIN (Ministry of Labour and Employment) and by the SPRI (Ministry of Public Health and Environment) which enter in the frame of its enlarged competencies, mentioned in the Law of 15 April 1994 and which are aimed at reinforcing the protection of the population and the environment.

- There has been in Belgium a legal and regulatory framework for safety of nuclear installations for more than 40 years.

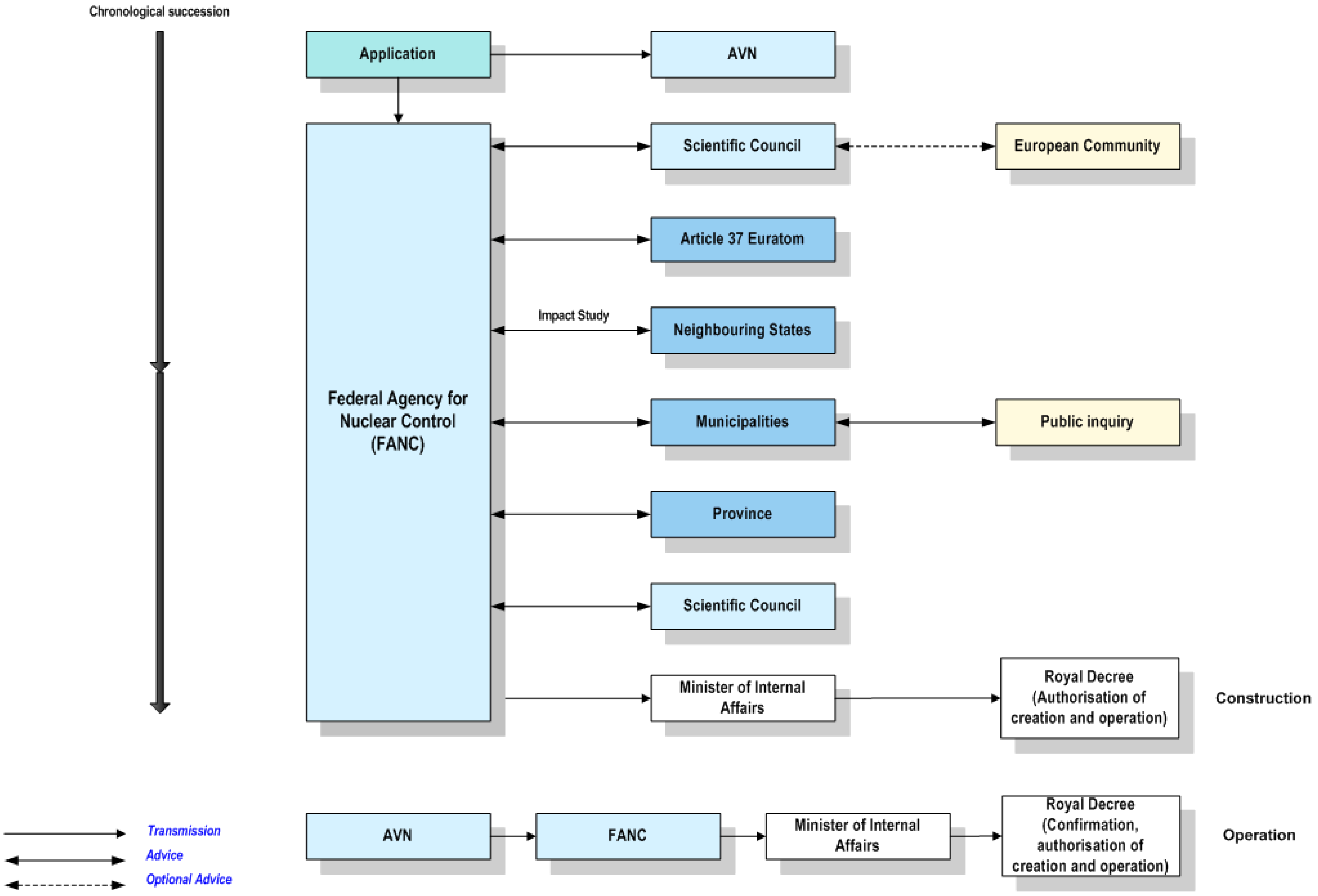
  The laws are regularly updated, and completed or, if necessary, amended (for instance to take into account the Euratom Directives, the international treaties signed by Belgium, etc.).

- The legislative and regulatory framework comprises:
  1. a set of laws and regulations (cf. description in II.C.3/4 above),
  2. a nuclear installation licensing system and the interdiction to operate an installation without a licence (cf. GRR-2001 and, among other, its Articles 5, 6, 15, 16, 79 as well as all the Articles detailing the technical stipulations),
  3. a regulatory inspection and evaluation system of the nuclear installations, for verifying compliance with the regulations and conditions set in the licence (cf. GRR-2001, among other its Articles 6, 12, 13, 15, 16, 23, 78),
  4. measures intended to enforce compliance with the relevant regulations and the conditions set in the licence, including as regards the suspension, amendment or withdrawal of licence (cf. GRR-2001, among other its Articles 5, 12, 13, 16).

- A summary of the licensing process of the nuclear installations, as dictated by the GRR-2001, is depicted on the following picture.

The Commission of the European Communities is indicated in dotted lines because its opinion had formerly been asked for the safety analysis of the first nuclear power plants; it intervenes today only in the frame of Article 37 of the Euratom Treaty.

Procedure for Class 1 Authorisation (since 1 September 2001)



II.D. Article 8. Regulatory Body

1. **Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.**
2. **Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilisation of nuclear energy.**

As mentioned in Article 7, the Safety Authority has been reorganised in 2001 in a single and coherent structure regrouping all official services and the required competences to fulfil its missions.

This public organisation, endowed with wide competences, has a statute and a working mode ensuring a large autonomy and independence from any external influence.

In this context, the control structure with 3 levels (first by the licensee, then by an independent authorised inspection organisation and finally by the Safety Authority) is maintained and reinforced. The authorised inspection organisation for the facilities concerned by the Convention is AVN which performs, by delegation of the FANC, a number of inspection and regulatory tasks.

Traditionally, in Belgium's non-nuclear industrial sector, regulatory inspections are not performed directly by the competent Authorities, but are delegated by these to inspection organisations they have delegated for these tasks. A similar approach has been adopted in the nuclear field, where the Safety Authority delegates a number of these tasks to authorised inspection organisations ("organismes agréés/erkende instellingen").

The authorisation conditions and the duties of these organisations are dealt with in Article 74 of the GRR-2001. The authorised inspection organisation must perform its tasks and duties with experts that have to be authorised as stipulated in Article 73 of the same Royal Decree.

As regards the nuclear installations covered by this National Report (nuclear power stations), the authorised inspection organisation is Association Vinçotte Nuclear (AVN). Other class 1 facilities are watched over in a similar way by AVN.

This description focuses on the tasks relating to the installations covered by the National Report, and thus is not an exhaustive overview of all the regulatory functions assumed by the various organisations.

II.D.1. Mandate and Function of the Regulatory Body

For class 1 nuclear installations (which include nuclear power stations), the GRR-2001 stipulates that the King is the competent Authority; it also specifies a number of tasks to be performed by the Federal Agency for Nuclear Control, which may delegate to the authorised inspection organisation: AVN for the nuclear power plants.

In this way, the regulatory work, and in particular the overseeing and inspection of the operating organisation, is performed at two levels:

a. at the level of general regulation and overseeing:

   The Safety Authorities are in charge of updating the general regulations, of introducing in them the European directives, international treaties, etc. and of maintaining the internal coherence of the general regulations (amending of application Royal Decrees,...).

   As regards the general overseeing of the operating organisation, the Safety Authorities are informally informed of the organisation's operational issues and projects through the meetings of a "Contact Committee" formed of representatives from the Safety Authorities, the operator and the authorised inspection organisation, this Committee meets twice a year on the average.

   The Safety Authorities also systematically hold a control meeting at the end of each core refuelling period, to evaluate the activities and results of that shutdown period. Unexpected visits are also performed. In case of significant operation problems (e.g. generalised corrosion of steam generator tubes, deformation of fuel assemblies, possible contamination of transport containers, …), specific meetings are held between the Safety Authorities, AVN and the operator in order to assess the technical problems and consider and decide remedial action; these actions are in this way approved by the Safety Authorities.

   As a result, if necessary, the latter are in a position to inform the political world or the general public about the technical situation.

   The Safety Authorities can also act as an arbitrator in cases where the operator deems that the technical demands of the authorised inspection organisation are unreasonably high: after having heard the various technical standpoints the Safety Authorities can resolve about what is finally required.

b. at the level of the detailed technical analysis and of the permanent supervision of the operator as required by the regulations.

   When a licence for a nuclear power station is applied for, AVN's Director is generally designated as Rapporteur to the "Scientific Council" according to the authorisation process described in article 7. In consequence, AVN is in charge of conducting a safety review of the Safety Report presented by the applicant, and of presenting its conclusions to the Scientific Council.

   For the four most recent units the Safety Analysis Report was established strictly to the standard format and contents prescribed by Regulatory Guide 1.70 of USNRC, since in 1975 the decision had been taken to adopt the US safety rules.

   The safety analysis was performed according to the Standard Review Plans, verifying the manner in which the safety standards and guides had been followed, and also whether satisfactory answers had been supplied to all the questions raised.

   This process took about five years per unit; the safety analysis conclusions were the subject of a Safety Evaluation Report that comprised a number of recommendations.

This Safety Evaluation Report written by AVN has been referenced in the Royal Decree of Authorisation of the unit, Decree which has requested that a follow-up should be given to all AVN's recommendations, and has put AVN in charge of judging the adequacy of the answers and of closing afterwards the recommendation.

For the first units (Doel 1 and 2, Tihange 1), the US rules had not yet been made strictly mandatory. However, since these units were of either Westinghouse or Framatome design, their Safety Analysis Reports were similar to those of US nuclear power plants. During the first periodic safety reviews of these first units, the completeness of these reports was checked and the Safety Analysis Reports were presented in standard format. For these first units, the Belgian Safety Authorities did ask the advice of the Euratom Commission, which convened experts from the Euratom member countries to examine the safety. For the next units, the Belgian Safety Authorities again asked the opinion of European experts but their analysis focused on a number of specific subjects (bunkerised systems to cope with external accidents, accident analysis …).

These experts formulated a number of recommendations.

AVN presented a synthesis of the European experts' conclusions to the Special Commission, as well as its own evaluations, and proposed a set of particular conditions to be included in the licence. These proposals were discussed within the Special Commission, amended where appropriate, then approved and finally introduced in the Royal Decree that granted the licence.

The next phase concerns the commissioning of the installations.

The installations are subject to an acceptance inspection, i.e. an in-depth verification of their conformity, according to Article 6.9 of the GRR-2001.

These acceptance inspections and conformity checks are performed by AVN, delegated by the FANC.

During the safety analysis, the general principles of the commissioning tests have been approved (chapter 14 of the Safety Analysis Report). The overall programme of the tests and the test procedures, as well as the tests themselves are examined by AVN. If the results are satisfactory, AVN issues the successive operating licences that allow to proceed to the next steps : core loading, criticality, increasing steps in power up to nominal power.

Throughout the operation of the installation, the operator's Health Physics Department monitors nuclear safety and radiological protection, the department's performance being permanently supervised by AVN (GRR-2001 - Article 23).
This permanent supervision in practice consists of systematic and periodic inspections devoted to defined subjects (operation, periodic tests, chemical control, radiological protection …) and specific items follow-up inspections, examination of modifications and incident analysis. An inspection report is written for each visit.
The inspection reports of the nuclear power plants are systematically transmitted to the FANC.

All modifications are notified to AVN. However, AVN and the Safety Authority will follow-up only the safety-related modifications.

This follow-up includes step by step acceptances, i.e. assessments and inspections that authorise proceeding with the next step in the modification implementation process.

Major modifications (power increase, utilisation of MOX fuel, steam generator replacement …) require, under the appreciation of FANC, a procedure similar to that of the initial licensing, and sanctioned by a new Royal Decree of Authorisation.

For the new configuration of the core after each core refuelling, either the previous safety analysis remains valid or new studies have to demonstrate that the safety criteria are complied with.

After verifying that the new configuration is acceptable, AVN follows-up the start-up tests, assesses their results, and authorises (through its acceptance report) operation at nominal power.

II.D.2. Powers and Attributions of the Regulatory Body

After the Royal Decree of Authorisation has been signed and after AVN has approved the successive steps to nominal power, the Safety Authority and AVN permanently supervise whether the operator complies with the conditions set in the licence.

The findings of the inspection visits and the observations made are recorded in the reports established by AVN and transmitted to the Authority (FANC) and to the operator; the latter implements then any necessary corrective action.

At this stage AVN has only the power to make recommendations but should the operator violate the conditions set in the licence and fail to correct that situation, or should the operation evolve towards an unsafe situation, this would be referred to the Safety Authorities, endowed with the power to suspend or withdraw the licence (GRR-2001, Article 16).

As explained in the previous section, AVN issues approvals for implementing modifications to the installations and for re-starting after core refueling outages, only after having verified that the results of the safety analysis and of the tests are satisfactory.

II.D.3. Structure of the Regulatory Body, Financial and Human Resources

II.D.3.a. Safety Authorities

The Federal Agency for Nuclear Control (FANC) is an autonomous government institution with legal personality. The Agency is governed by a 14-headed Board of Directors; its members are appointed by the Federal Government on the basis of their particular scientific or professional qualities. In order to guarantee the independence of these directors, their mandate is incompatible with certain other responsibilities within the nuclear sector and within the public sector. The Agency is supervised by the Federal Minister of Internal Affairs via a government Commissioner who attends the meetings of the Board of Directors.

In order to perform its tasks, the Agency is assisted by a Scientific Council; the composition and the competences of this Council are determined by Royal Decree. The Council consists of experts within the field of nuclear energy and of diverse safety disciplines.

The Agency exercises its authority with regard to the nuclear operators through one-sided administrative legal acts (the consent of the persons involved is not required) such as the delivery, refusal, modification, suspension and withdrawal of licences, authorisations, recognitions or approvals. It organises inspections to verify the observance of the conditions stipulated in these licences, recognitions and approvals. The Agency can claim all of these documents in whatever form, from the facilities and companies under its supervision. Infractions with regard to the decisions of the Agency can be sanctioned.

The operation of the Agency is entirely financed by the companies, organisations or persons to whom it renders services. In practice this is done through non-recurrent or annual retributions at the expense of the holders or applicants of licences, recognitions or approvals; the tariffs are determined by Royal Decree. The receipts and expenditures of the Agency have to be in equilibrium.

The above-mentioned statute attributes to the Agency the indispensable independence to enable it to impartially exercise its responsibilities as a regulator of the nuclear activities - as prescribed in art. 8 of the Convention on Nuclear Safety.

More information is available on the website: www.fanc.fgov.be

The organisation chart of the FANC must take into account the law of 15 April 1994 and in particular article 43 which requires the regulatory missions and the surveillance missions be exerted independently.

Below the Board assisted by an audit Committee and below the General Direction, it is foreseen a General Secretariat, the Department "Authorisations and Regulations", the Department "Control and Surveillance", the Department "Finances and Administration" in charge of financial aspects, human resources, informatics and logistics.

The General Secretariat mains poles of activities are:
- Health effects and basics safety standards,
- Research and development.
- International relations.
- Information and Communication.

- Quality Assurance and internal audit.

The Department “Regulatory and Licensing” has four poles of activity:
- the categorised facilities (classes 1, 2 and 3 licensed facilities, according to chapters 2 and 3 of the GRR-2001)
- the transport, import and export of radioactive substances (chapters 4 and 7 of the GRR-2001)
- the medical applications (chapters 5 and 6 of the GRR-2001)
- the implementation of the “physical protection” and of the “safeguards” agreements.

The Department “Control and Surveillance” has five poles of activity:
- the 4 poles cited above for the Department “Authorisations”
- the territory surveillance (operation of the Telerad network measuring the radioactivity on the whole Belgian territory) and the emergency planning.

At the present, the personnel of the FANC is composed of about 110 persons. More than 60 % of them are university graduates in different fields, science (physics, chemistry, biology…), engineering, law, economics, social science, communication.

The FANC is actively involved in relevant international activities. At the IAEA it is member of the Belgian delegation to the Board of Governors, member of the RASSC, WASSC, TRANSSC, NUSSC (this last representation is delegated to AVN). It participates to the steering committee of the NEA as well as to the RWMC, CRPPH, CNRA (accompanied by AVN as technical support). At the European Union level it is member of the Belgian delegation in different working groups of the Council (atomic question group, working group on nuclear safety…) or of the Commission, some of its experts are member of article 31, 35, 37, or to the scientific and technical committee …

The FANC, accompanied by AVN, is also member of WENRA which gathers the EU Safety Authorities (+ Switzerland) and works on different common projects including the development of a harmonised approach of safety, based on in-depth analysis of the legislations and practices within WENRA’s member States.

The results of the WENRA benchmarking exercise conducted in 2005 by the Reactor Harmonization Working Group as well as resulting actions are discussed in section I.C of this report.

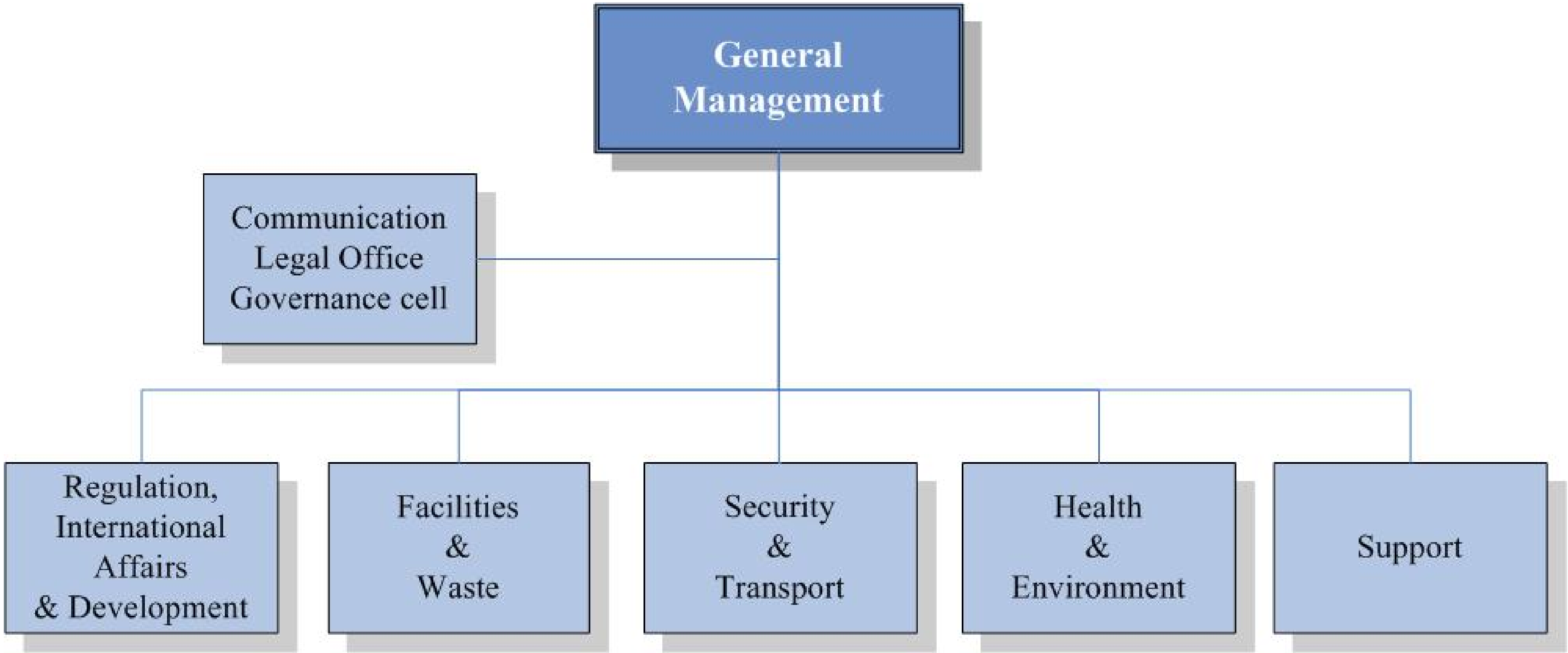
Towards a new organisation

A new organisation of the FANC has been prepared since the beginning of 2007 and came into force on 1 September 2007. It should be fully operational by end 2007.
Although the legal separation between 'regulatory activities' on the one hand and 'licensing and control activities' on the other hand will remain, the new structure will enforce the following characteristics :

- More openness, transparency
- Licensing and control activities performed by the same operational entities
- More activity-oriented structure

Additional information will be provided during the CNS review meeting.

The new organisation can be drawn as follows:


General Management
Communication
Legal Office
Governance cell
Regulation, International Affairs & Development
Facilities & Waste
Security & Transport
Health & Environment
Support

The department `Regulation, International Affairs and Development' is in charge of developing and the following up the regulation. The department is also in charge of:

- stimulating, following and carrying out the studies and the developments necessary in all fields to improve the safety and the protection of the population.
- managing, maintaining and developing a high level of knowledge.
- Coordination of all FANC projects
- International Affairs

On top of these tasks, the department is in charge of all the activities requiring the collaboration of several departments (horizontal activities, projects coordination).

The missions of the department `Facilities and Waste' are specifically related to the nuclear facilities, the management of the radioactive waste, the licensing of qualified experts in health physics control as well as the supervision of the Authorized Inspection Organisations. The first mission includes the inventory, the analysis and the evaluation of the licensing applications. This mission consists in ensuring that ionizing radiation can be used in safe conditions and that a licence can be delivered.
A second mission involves the control, the inspections and the investigations that ensure that the activities carried out comply with the licensing requirements and, in a more general way, with every regulation in force.
In addition, the department must also track down any illegal activity carried out without authorization. Synergy between these two missions mainly aims at improving: 1) the safety in general, and 2) the protection of the workers, the public and the environment against the dangers of ionizing radiation.
A third mission includes the preparation of a lawful framework for the storage of waste of different categories, as well as the future licensing for the sites dedicated for surface storage of low-level radioactive waste and geological storage of high-level radioactive waste.

The department `Safety & Transport' is responsible for the physical protection (implementation in the nuclear installations and safeguards policy) regarding the nuclear materials, and for the transport and the importation of radioactive material. Here also, the licensing activity as well as the control and the inspections of a specific activity have been integrated in the same pillar, with the objective of optimizing the exchange of information and setting up a more effective control policy.

The department `Health & Environment' is in charge of the activities relating to man and his environment (including the radiological measurement network Telerad) . This operational entity is directed towards the protection of the public, the workers and the environment in all fields, namely the medical applications, the natural radiation sources, the radiological monitoring of the territory, the national nuclear emergency plan and the cleaning/restoration of contaminated sites.

The department `Support' gathers all support activities: financial services, information technology, human resource management, ...

II.D.3.b. Authorised Inspection Organisation: overall Organisation

Being an authorised inspection organisation, AVN meets the requirements of Article 74 of the GRR-2001.
These requirements include, among other :

- having the status of a non-profit organisation possessing legal personality according to the law of 27 June 1921.
- reporting quarterly on its activities to a “Commission de Surveillance” (i.e. a watchdog) chaired by a representative of the FANC and comprising representatives of the employers’ organisations and of the workers’ organisations (trade unions). This report is discussed at the quarterly meetings and summarised in an annual report.
- performing its missions, use only experts that have been authorised (Article 73 of the GRR-2001).
  Note that an expert must have at least three years’ experience in the nuclear field before he can be authorised as a class 1 expert. AVN’s personnel training budget amounts to about 10 % of its overall budget in man.hours.
- being covered for civil liability for all the objects that do not fall within the application field of the law of 18 July 1966 on nuclear civil liability.

AVN’s General Management reports to a Board whose members are mainly composed of former experts in the nuclear or radiation domain or of professors of Belgian Universities, and quarterly reports to the “Commission de Surveillance”.
Furthermore, AVN took itself the initiative to establish a “Scientific and Technical Committee” composed of representatives of most of the Nuclear Safety Authorities of the European countries and of international organisations (IAEA, OECD/NEA, EU Commission), as well as Belgian University professors active in the nuclear field.
An annual activity report is prepared for this Committee and discussed at its annual meeting. The Committee assesses AVN’s work and formulates recommendations. It exists since 1991 and is an application of the peer-review principle.

At the end of 2006, the organisation of AVN was changed to a process oriented organisation. Among these processes, the most important ones as regard to safety are: Manage the projects/missions (manage safety assessment projects and inspection projects), Perform the inspections during operation, Provide and manage expert services (perform safety evaluation activities), Management of expertise and technical quality, Manage and develop human resources. These processes are managed by directors who are accountable for the realisation of goals and the quality of the activities performed in the process they are in charge of.

AVN’s technical personnel is composed of some 50 university graduates (engineers and scientists), and recruitment is in step with the foreseeable workload. The workload consists of a more or less constant portion relating to inspection of installations, and a more variable load in time relating to the progress of the Licensee’s projects and the number of studies to be examined, and also to the assessment of incidents or specific safety problems taking place in the installations (steam generator tubes corrosion, incomplete insertion of control rods, …).

The inspections and analyses carried out by AVN are invoiced to the operator on the basis of hours actually worked. This system is similar to that applied by, for example, the USNRC which, in addition to a set fee per installation, charges to the operators the time actually spent on their problems.

Due to AVN being a non-profit organisation, its financial resources are used for paying its personnel and related costs, for participating in national or international working groups, for personnel training, for its research and development activities, for maintaining a technical and regulatory documentation.

II.D.3.c. Authorised Inspection Organisation: Technical Activities

Before the completion of the most recent nuclear units, AVN was composed of an Inspection Department and a Safety Studies Department which was in charge of safety analysis of the units under construction and of analysis in support of inspections of the units already in industrial operation.

After all nuclear units had become operational and with the development of many projects, the organisation had to be adapted: a more project-oriented structure was adopted, the technical sections of the Safety Studies Department were dissolved, and AVN's technical personnel, regardless of what Department they hierarchically belonged to, have been attached to "Technical Responsibility Centres" (TRC), "horizontal" cells in charge of exercising nuclear and safety expertise and of maintaining the knowledge in the various technical specialities.

At the end of the year 2006, AVN's technical personnel and the technical activities have been distributed into several operational processes as described above.

All TRC have been grouped under the process "Provide and manage expert services", managed by a director in order to give it better support in case of possible organisation problems.

- The process "**Perform inspections during operation**" is in charge of inspections in all nuclear installations supervised by AVN.
  For the nuclear power plants, one AVN engineer is assigned to one nuclear unit (hence 3 engineers for Doel, as the Doel 1 and 2 twin units are considered as a single unit, and 3 engineers for Tihange) and the managerial staff examines the problems common to a site as a whole, oversees the coherence of approaches between the sites and ensures experience feedback between all the Belgian units.

  Moreover additional thematic inspections are conducted for all the units.

  With the opening of the electricity market and the deregulation, supplementary efforts are devoted to the reorganisation problems by the licensee, in order to verify that all previous safety requirements (described in Chapter 13 of the Safety Analysis Report) are still met (for example licensing of the control room operators, composition of the shift teams, qualification of the personnel, guard role for the emergency preparedness plan,…).

  The activities performed in this process include also inspections in installations other than nuclear power plants: the Mol Nuclear Research Centre (two research reactors, many laboratories, the first PWR built in Europe with a 11.5 MWe power presently in the course of dismantling), the MOX fuel fabrication plant of Belgonucléaire (presently stopped), the conditioning and storage of wastes done by Belgoprocess, the Institute of Radio-elements (IRE), the Thetis research reactor at the Ghent University (permanently stopped since 1 January 2004 and still waiting for dismantling), as well as class 2 and 3 facilities (universities, hospitals,…).

- The follow-up of all national and international projects linked to the operation of the installations is performed in the framework of the process "**Manage the projects/missions**".

At the national level, examples are the periodic safety reviews, the power uprate and the replacement of steam generators, the increase of the length of the cycles and the higher burn-ups.

At the international level, it is mainly the assistance to the Safety Authorities of Eastern European countries (bilateral aid or Phare-Tacis contracts of the European Commission) or specific collaborations with Western Europe safety organisations.

In the frame of the periodic safety reviews, AVN follows the evolution of the safety rules in the world (USA, Member States of the European Union, IAEA…) and examines with the licensees which new rules should be followed, in order to define the new safety reference rules, in agreement with the FANC.

- Safety analysis is performed by the process "**Provide and manage expert services**". It covers support to inspection activities, the analysis of important modifications, and analysis having a more general character: generic studies valid for all nuclear power plants, probabilistic safety assessment developed specifically for each unit but where the analysis methodologies must be identical, applications of these probabilistic studies in particular to the analysis of operational events, severe accident management, safety requirements for future reactors, safety analysis for the disposal of high level or low level radioactive waste.
  The process includes AVN activities in the frame of its participation in the national emergency plan at the level of the evaluation cell (see article 16, paragraph II.L.2.c). It also provides for the participation in the emergency plan exercises taking place in the Belgian nuclear installations (nuclear power plants and other facilities), as well as in the exercises of foreign nuclear power plants located near the Belgian border, through bilateral or international collaborations.

- Research and Development activities in which AVN participates (international projects, bilateral and own developments in AVN) are managed in the process "**Management of expertise and technical quality**". This process includes the analysis of operating experience feedback from Belgian and foreign nuclear power plants (DIANE and ARIANE data bases) and from other installations (ANCES data base).

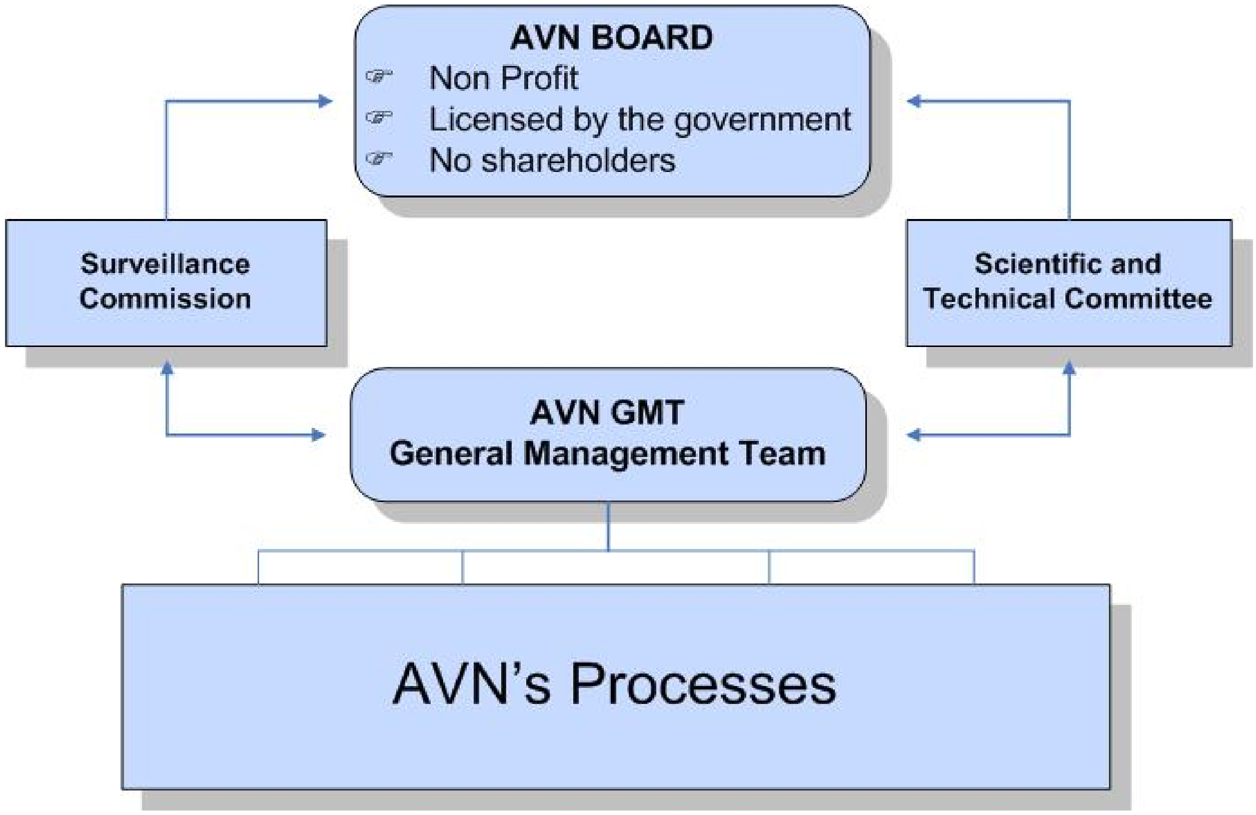
  A brief organisation chart of AVN is given below.

Alongside its own experts, AVN calls on services from outside specialists only very exceptionally (universities, research centres): on the one hand these should not have worked in the past on behalf of the operator on the subject, and, on the other hand, full definition of the scope, framework and precise objectives of the task or studies that would be subcontracted represents a non negligible part of the overall effort and time that can be devoted to the job. An example of AVN's calling on outside expertise concerns the evaluation of neutron-ageing of an aluminium reactor vessel.

In addition to the activities related to the nuclear installations, AVN participates in numerous international committees. For instance, AVN is the national co-ordinator for the Incident Reporting System (IRS) of OECD/IAEA, the Incident Reporting System for Research Reactors (IRSRR) of IAEA and the technical officer for the FINAS system of OECD regarding the fuel cycle, the International Nuclear Event Scale (INES) of IAEA.

AVN personnel are members of CNRA, CSNI and the Sciences Committee of OECD/NEA, as well as of all the main groups of CSNI and CNRA, the Western European Nuclear Regulators Association (WENRA) and the reactor safety Working Group (ENIS-G) within the E.U., of

IAEA's NUSSC Committee.



II.D.4. Position of the Regulatory Body in the Governmental Structure

- The Safety Authority (FANC) is a public interest body, with a large independency and that reports to its Competent Ministry, the Ministry of Internal Affairs. See also para.III.D.3.

  They answer any questions and requests for information received from the Government, Members of Parliament or from others.
  The FANC annually presents its activities report to the Parliament. This obligation did not exist in the past.

- AVN is a private non-profit organisation that is not part of the Administration. It is designated by the Public Authority and quarterly reports to its "Commission de Surveillance", chaired by a representative of the FANC as stipulated in the regulations. This quarterly report is also sent to the FANC.

AVN also annually reports to its Scientific and Technical Committee and publishes an annual activity report available on its WEB site.

II.D.5. Relations between the Regulatory Body and the Organisations in Charge of Nuclear Energy Promotion and Use

In Belgium the nuclear power stations are operated by a private operator, and there is not really any particular organisation in charge of promoting nuclear energy.

The organisations dealing with questions relating to nuclear energy use, such as the "Centre d'Etudes Nucléaires" SCK•CEN at Mol, or the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) report to the Ministry of Economic Affairs (State Secretary for Energy).

As said before, the Safety Authorities report to the Ministry of Internal Affairs.

The Safety Authorities and the Regulatory Body play no part in nuclear energy promotion, but the legal mission of FANC stipulated up by Art. 23 of the law of April 1994 is to "stimulate and coordinate the research and development works. It establishes privileged relationships with the public organisations working in the nuclear field, with the scientific research circles and with the international organisations concerned".

II.D.6. Relations between the Safety Authorities and the Authorised Inspection Agency (FANC –AVN).

The legal framework and system described in chapter 7 and in this chapter offer solid basis for effective and efficient implementation of regulatory responsibilities and duties.

Independence of the regulator is strengthened by the legal structure of the FANC and by clear and well defined relationship with the Government. As extensively discussed during the last review meetings of the CNS, while recognising that a regulatory body cannot be absolutely independent, it was stated and commented that both aspects of independence, de jure and de facto, are essential. It can be found in literature[3] that those concepts rely on different important parameters like:

- clear safety objectives
- appropriate financing mechanisms
- defined accountability procedure and reporting
- transparency, adaptability to industry and society changes
- available competence
- quality assurance
- management of human resources in the regulatory body
- access to expertise

Since September 2001, when the FANC became fully operational, particular attention has been devoted to implement the national structure in accordance with those values and concepts.

In the next future, AVN will get the status of a subsidiary body of the FANC, as highlighted in part I.C.

[3] i.e. : INSAG-17 Independence in regulatory body decision making

II.E. Article 9. Responsibility of the Licence Holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

The Royal Decree (R.D.) of 20 July 2001 indicates that the facility general manager (i.e. the person who applied for the licence) is responsible for complying with the conditions set in the licence (Article 5.2). For the nuclear power stations the Royal Decree of Authorisation stipulates conformity to the Safety Analysis Report and to the document established consistent with Article 37 of the Euratom Treaty.

Modifications are nevertheless acceptable if they improve the safety of the nuclear installations or have no impact on their safety. The Safety Analysis Report, established to the standard US format, describes not only the overall installations, but also refers to specific documentation during operation such as operation procedures during normal, incidental or accidental operation, and to the Internal Code and Reference Guide, which are conform with the IAEA requirements GSR-3. The Technical Specifications are also part of the Safety Analysis Report.

The operator must organise a Health Physics Department generally in charge of nuclear safety and radiological protection, and must also organise the safety and health at the workplace as well as in the neighbourhood. A detailed description of the duties is given in Article 23 of the GRR-2001, and the main duties are recalled in Article 7 § II.C.7 of the present National Report. The operator must also take out an insurance cover for his nuclear civil liability (Article 6.2.5 of the GRR-2001); the law of 22 July 1985 which ratifies the conventions of Paris and Brussels and their additional protocols and the law of 11 July 2000 set at some Euro 300 million per site and per nuclear accident the maximum amount of the operator's liability for the damage. 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 radiation, and implementing the policy to limit individual and collective doses (respectively Articles 25 and 20 of the GRR-2001).

The Belgian law also requires that the Regulatory Body permanently controls the proper implementation of the duties of the operator's Health Physics Department. Article 23.8 of the GRR-2001 indicates a number of specific tasks in that respect.

As referred to in Article 8 of the present National Report, an AVN inspector is assigned to each nuclear unit. The inspection visits that he makes at the unit (where he has total freedom of movement, regardless whether or not he is accompanied by unit personnel) take up about half of his working time; the rest of the time, the inspector is at the AVN offices where he follows-up the inspections, writes the inspection reports, collects and analyses relevant information, discusses with the technical experts and exchanges information and gets feedback from the other nuclear generating units. In this way the AVN inspector can verify daily how the operator assumes his obligations and responsibilities.

II.F. Article 10. Priority to Safety

Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

II.F.1. Licensee and his Contractors

Consistent with Belgian legislation the operator has a Health Physics Department (see Article 9 of the present National Report) which deals with safety and radiological protection matters. The Head of this Department reports directly to the CEO of Electrabel, making him independent with respect to the other departments.

In order to state precisely the nuclear safety policy during operation, the General Direction of Production at Electrabel has established and backs up the following "Policy Declaration on Nuclear Safety", which is now included in the Safety Analysis Reports of the nuclear units:

"*We attach the greatest importance to the protection of all members of personnel involved in operation of our power plants, of the public and the environment. We therefore actively support a strong nuclear safety policy in all phases of the operating process of our power plants.*

Together with our partners and contractors we work towards the practical application of this safety policy, based on the following principles:

Safety = the first priority
- *We make safety take precedence over production, in all circumstances.*
- *We ensure that safety is everywhere present in all operational processes.*
- *We anticipate the laws and regulations concerning nuclear safety, apply them and follow them scrupulously.*
- *We develop and promote a high level of safety culture.*

Safety = a process of continuous improvement
- *We set objectives and corresponding action plans so as to continually improve nuclear safety.*
- *We constantly assess the level of safety of our activities, and compare them with the best practices and international standards.*
- *We involve all our members of personnel in this process of continuous improvement, and ensure that they participate actively in it.*

Strict controls
- *We maintain a constructive dialogue with the authorities and safety institutions, and also with the other parties involved.*
- *We constantly measure the effectiveness with which our safety policy is applied.*
- *We regularly have external audits and international comparisons carried out.*"

A Safety Evaluation Committee has been set up at each site (Doel and Tihange). This committee comprises the managers of the various services and a few external experts in nuclear safety. It meets a few times a year to examine the operational record of the unit and

possibly draw lessons from it for safety improvements, which are then recommended to the Site Manager.
As regards experience feedback, this is organised at each site, and the work is monitored by the Safety Evaluation Committee.

The Belgian power stations are members of WANO and of the Owners Groups set up by Framatome and Westinghouse, which provide a valuable source of information. They also participate to some task groups set up by the EPRI.

The Authorisation decrees of the Belgian power stations also stipulate that the feedback from experience should be taken into account and, in particular, the USNRC's Bulletins (or other equivalent documents).

As Belgium participates in the Incident Reporting System (IRS), AVN has granted access to the IRS web based system for the operating experience experts from both sites as well as to experts from the Architect Engineer (Tractebel Engineering).

All the information is available at both sites, and the operator analyses its applicability to his own units.

Any safety significant incident occurring at a Belgian power station is the subject of a deeper (root cause) analysis in order to determine possible corrective action.

In case of incidents or accidents, there are of course procedures that the operator must follow in order to bring the plant to a safe condition.

After each reactor or turbine trip, a procedure (Post Trip review) lists the conditions to be fulfilled before resuming operation (the cause has been identified, the sequence of events understood, the evolution of the main parameters understood, the required safety functions have been fulfilled or the anomalies have been corrected and tested, unacceptable damages on the installation did not exist or have been repaired) and, in case of need, long term corrective actions are defined.

The Technical Specifications also list the organisations to be informed by the operator in case of incidents; for example the AVN's inspector receives information about each trip of the unit that he inspects.

The organisations which work for Electrabel (Contractors) are selected on the basis of past experience and/or more formal certification according to the missions they are in charge of. These organisations must follow the quality assurance programmes (cf. article 13), and the rules applicable to the design and construction (article 18) and during operation (article 19).

II.F.2. Regulatory Bodies

The FANC is responsible (amongst other duties) for the surveillance and control of all the activities concerning radiation protection and nuclear safety.

Inspections and controls are exercised by the FANC and by AVN, under the responsibility of the FANC.

Radiation protection, and implicitly nuclear safety, is emphasised in the general principles of the GRR-2001. However, special emphasis has been put on safety by the FANC.

End 2003, the FANC established its "*General Inspection and Control Policy*". This document is quite explicit regarding priority to safety, and is reproduced hereafter:

"The basic principles of the General Inspection and Control Policy

The inspections and controls serve to verify that the activities performed by the operator/company are undertaken in a safe manner. For this purpose, it is necessary that:

1. *the operator/company has a management and a policy aimed at safety and its improvement, pursued in a fairly continuous manner. The necessary measures have to be taken, on the one hand, to prevent accidents and, on the other, to limit the consequences of possible accidents;*
2. *the operator/company disposes of competent and well-trained personnel;*
3. *the operator/company pursues (and preserves) safety, reliability and quality while designing, constructing, operating, maintaining, closing down and dismantling his/its facilities/installations;*
4. *the operator/company is able to prove at all times that he/it complies with all of the provisions of the regulation and the operating conditions stipulated in the licences;*
5. *the operator/company disposes of a system enabling him/it to draw lessons from internal and foreign experiences.*

The operational measures for the implementation of the General Inspection and Control Policy

The inspections and controls are thus a targeted assessment of the activities of the operator/company in order to bring to light the possible problems, shortcomings or violations of the operator with regard to the above-mentioned obligations. However, these inspections and controls shall in no way release the operator/company from his/its fundamental and entire obligation and responsibility to guarantee the safety of his/its facilities/installations and the protection of his/its workers, the population and the environment. The inspections and controls may include the following: analyses, studies, assessments, observations, measurements, tests taken by, or on behalf of the FANC/AVN in order to verify if materials, components, systems and structures, as well as operational activities, processes, procedures, competences and performances of the persons involved are in conformity with the prescriptions of the regulation on ionising radiation, the operating conditions stipulated in the licences and safety in general. Within the framework of continuous improvements, the services of the FANC and AVN which perform the inspections and controls, will obtain a quality certification.

…

AVN elaborates control strategies for the implementation of this general policy of the FANC. The FANC will establish, in consultation with AVN, objectives (which AVN will have to *pursue) and indicators (specifying the extent to which AVN is achieving the intended objectives).*

The FANC will periodically evaluate its general inspection and control policy."

As a matter of fact, on the basis of its large inspection experience as well as of its well-established know-how in collecting and interpreting operation feedback data, AVN has, in the course of the years, developed an inspection and safety assessment strategy aiming at the assessment of how the licensees manage safety, with specific emphasis on the implementation of the GRR-2001 and of the licenses of the various installations.

This strategy contains the implementation of a permanent monitoring of the licensee and of conformity checks of the installations, general objectives 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 supported by strong programmes of expert initial training and retraining, of operating experience data collection and analysis, of specific research and development activities.

This strategy is imbedded in the various processes of the ISO-9001:2000 quality system of AVN (certification obtained at the end of 2003 – recertification granted in 2006), which is based on expert assessment and judgement. The system allows a clear definition of responsibilities and a better tracing of the performances. Processes assessments, which are difficult to be realised in the field of expertise, are being developed.

From the origin, AVN was aware of the necessity to make the best possible use of feedback from foreign incidents. For instance, at Chooz A a spurious opening of a pressuriser relief valve took place: the operator diagnosed the incident and controlled it within minutes by closing the blocking valve upstream. AVN (which at the time was the nuclear safety department of Association Vinçotte) reacted by requesting in the safety analysis to consider a break in the steam phase of the pressuriser. This happened in 1971.

During the start-up of Doel 1 and 2 and Tihange 1 in 1975, certain modifications were introduced in order to address this postulated accident. For example, safety injection was initiated by the signal low pressure in the pressuriser instead of coincidence low pressure/low level. That modification was introduced by the USNCR a few years after the Three Mile Island accident, of which the Chooz A incident was a precursor.

Other events worth mentioning are the Browns-Ferry fire, which led to a number of fire prevention measures, the Salem ATWS event, the degradation of a 48 V board at Bugey 5 which led in Tihange 1 to the addition of two 115 V D.C. boards and four 220 V A.C. boards and complete separation between the control and the protection functions (modifications made in 1986 during the first periodic safety reassessment), the TMI accident with the implementation of the post-TMI actions (new accident procedures, organisational measures, not many hardware changes), the Chernobyl accident with the consideration of severe accident mitigation measures (hydrogen passive autocatalytic recombiners).

After TMI, AVN systematised experience feedback and created databases for Belgian and foreign incidents, grouping similar types of incidents and recording the implemented corrective action taken following them. A link can easily be established between these databases and the structure of the Safety Analysis Reports, to take the events into account in the safety analysis. All this information is made available to the operators.

Since a few years, AVN also makes incidents analysis with the help of the probabilistic safety studies available for the units (PSA-based event analysis) and discusses the results with the licensees to assess the need for corrective measures.

AVN shares also the feedback of operating experience through its participation to international organisations (IAEA, OECD/NEA, Working Party on Nuclear Safety-WPNS of the EU) and in smaller groups of Regulatory Bodies (NERS, FRAREG, bilateral collaborations). AVN, in collaboration with FANC, actively participates to the WENRA harmonisation groups as well as to the task force on safety critical software.

Since November 2001, monthly coordination meetings are held between FANC and AVN to discuss current issues and safety priorities in the Belgian NPPs. In addition, in order to improve the cooperation between the FANC and AVN and to optimise the information flows between the FANC and AVN, the FANC has elaborated a Directive towards AVN, officially issued by the end of 2003. Twice a year, there are also meetings between the management of the FANC, AVN and the operator of the Belgian NPP’s.

II.G. Article 11. Financial and Human Resources

1. **Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.**
2. **Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.**

II.G.1. Operator's Financial and Human Resources to use the Installation throughout its Industrial Life

The Doel and Tihange power stations are operated by the Electrabel a member of the listed Suez group. At the end of 2006, Suez Group owned 98,6% of Electrabel, increasing to 100% at mid-2007. Main activities of Electrabel are the generation and commercialisation of electricity and gas in Europe. In Belgium, Electrabel generates some 85% of all electric energy consumed and distributes heat (via cogeneration units) and gas. It is the owner of the units 1 and 2 of Doel, of 96% (4% being held by the "Société Publique d'Electricité") of the units 3 and 4 of Doel, the units 2 and 3 of Tihange, and is owner of a part of 50% in Tihange 1 (France's Electricité de France holding the remaining 50%). The installed power of Belgium's nuclear generating units accounts for some 40 % of all installed power in Belgium. Nuclear electricity accounts for some 55% of all electricity produced in Belgium (see table 1 of the Introduction of this Report).

About 1600 personnel are devoted to nuclear power station operation among the 2700 personnel working for electricity generation as a whole, of Electrabel's total workforce of 8500. In September 2002, the company Elia System Operator was designated by the Belgian Government, for a period of 20 years, as the Manager of the electricity transmission network. This activity is now completely separated from the activity of electricity generation. Electrabel has signed with Elia specific connection contracts. Recently, in accordance with the legislation on deregulation of the electricity sector in Europe, all distribution activities in the three regions of Belgium have been separated and turned into independent companies.

The Suez group has also an Engineering division, Tractebel Engineering, which is the Architect-Engineer of the Belgian nuclear power stations (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 Mol Research Centre.

II.G.2. Financing of Safety Improvements during Operation

The major safety improvements to the Belgian nuclear power stations are implemented during the periodic safety reviews, financed through annual provisions (1/10th each year). Replacement of equipment aimed at improving plant availability and safety (e.g. steam generator replacement, turbine rotor replacement) is financed through investment and depreciation.

II.G.3. Financial and Human Provisions for Future Decommissioning and for Management of the Waste produced by the Installations

Since 1985 the nuclear electricity generators have been setting up provisions for the dismantling and decontamination of the Doel and Tihange nuclear power station sites. The basic principles for calculating these provisions are the subject of an agreement between the Belgian State and Electrabel. Taking into account the degree of uncertainty remaining when estimating the decommissioning cost, it has been agreed to periodically reassess the question (every five years) to see whether the provisions that are being set up need to be revised considering the most recent information that has become available. The setting up of these provisions has been phased in time according to the principle of capitalisation: on the one hand, annuities are deposited and, on the other hand, capitalisation interests are generated by the cumulated amounts as at the end of the previous year. The total amounts intended to finance these decommissioning had to be available 40 years after the beginning of commercial operation.

Moreover the licensee must submit his initial decommissioning plans to ONDRAF/NIRAS, which must approve them in the frame of its legal missions.

These decommissioning plans are reviewed and approved every five years.

Since July 2003, a new law establishes the applicable rules for the constitution of a "Company for nuclear provisions" which has to manage the funds progressively build up by the Nuclear Utilities and a "Follow-Up Committee" which has the missions both to control the company and to indicate the manner the funds must be managed.

"*The provisions for the decommissioning will be constituted so that, for each nuclear power plant, the total amount updated with the costs of dismantling will be available at the moment of the planned final shutdown of the concerned power plant, in fact, at latest forty years after the Commercial Operation Date*". The decommissioning of the plant will be realised by the Utilities at the expense of the "Company for nuclear provisions".

"*The provisions for the management of the spent fuel are annually raised by the Company of nuclear provisions in relation of the spent fuel produced during the same year*". The management of the spent fuel is exclusively assumed by the Company of the nuclear provisions and the costs of this management are covered by the provisions made.

If these provisions for spent fuel management or installation decommissioning is found to be inferior to the real cost, the Utilities will remit to the Company with the sum so that the difference will be covered.

II.G.4. Rules and Requirements for Qualification, Training and Re-training of Personnel

The Safety Analysis Report (chapter 13) deals particularly with personnel qualification, training and re-training. Qualification of the personnel (at the origin or later replacement) is inspired from the ANS 3.1 standard, though adapted to the Belgian educational system. The Safety Analysis Report defines the level of qualification corresponding to each of the safety-related functions. It does not state the individual qualifications of each person in the organisational chart. However, proof of qualification of all the operating personnel is available to the AIO (AVN). The functions and qualifications prescribed by the US regulations are transposed in function of the educational system structure and curricula existing in Belgium.

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 a licence is required. This licence is granted based on the positive opinion expressed by an Assessment Committee, which examines the candidate’s knowledge. This qualification is reviewed every two years or, if a licensed person has ceased during four months or more performing the function for which he/she was qualified. It is renewed conditional to, among other, a favourable advice of the Assessment Committee on the basis of the individual’s training and activity file.

Note that AVN is member of the Assessment Committee, with veto power.

A knowledge re-training programme for all licensed personnel is defined in function of the occupied position. The contents of this programme which is discussed with AVN, is essentially operation-focused and includes, among other, a refresher course regarding the theoretical and practical knowledge (two weeks per year), training on the full-scope simulator (two weeks every two years) and, in teams, a review of the descriptions of the different systems (two weeks per year).

Similar attention is given to the maintenance personnel (“Maintenance” department, see next section).
For all the personnel of the plant, there are training and retraining plans which are adapted according to the missions of the personnel.

Note that the GRR-2001 requires an annual retraining of the whole personnel on the basic rules of radiological protection, including the good practices for an efficient protection and a reminder of the emergency procedures at the work site.

The instructors that give the training are qualified for the particular subjects they teach, and possess a formal instructor certification.
Contractors are responsible for the training of their own personnel; moreover training on radiological protection is legally required and is made specific to the site where they will work. They must pass an examination at the site before they are allowed to the work site. At the Tihange site, an intensive training programme for all personnel of contractors has been put in place, focussing on nuclear safety and work in a nuclear environment. The successful completion of this training is mandatory before being allowed to work on the site of the nuclear power plants. A similar program is also put in place for the personnel of the Operator.

In addition to the individual training and recycling, great care is given to master the knowledge existing in the nuclear domain.

The design bases of the plants, i.e. the knowledge of the design of the plants and the reasons of the choices made in this design are an important part of the knowledge.

II.G.5. NUC 21+ Organisation

The organisation of the Operator, Electrabel, has been, following a re-engineering operation in 2000, organized on the basis of a matrix type. This organisation form, called NUC 21 has been chosen to be more in conformity with the main professional skills and with the collaboration relationship existing between the different actors in the operation and the management of a nuclear power plant.

After the organisational re-engineering operations of NUC 21, an update of the organisation of the nuclear activities of the Business Unit Generation was performed in 2006. Major objectives of the update are to enhance the responsibility of the site managers, to enhance the importance of nuclear safety, to improve the oversight by the management of the performance of the sites and to increase the operational focus of the Operations and Maintenance activities by eliminating the interfaces.

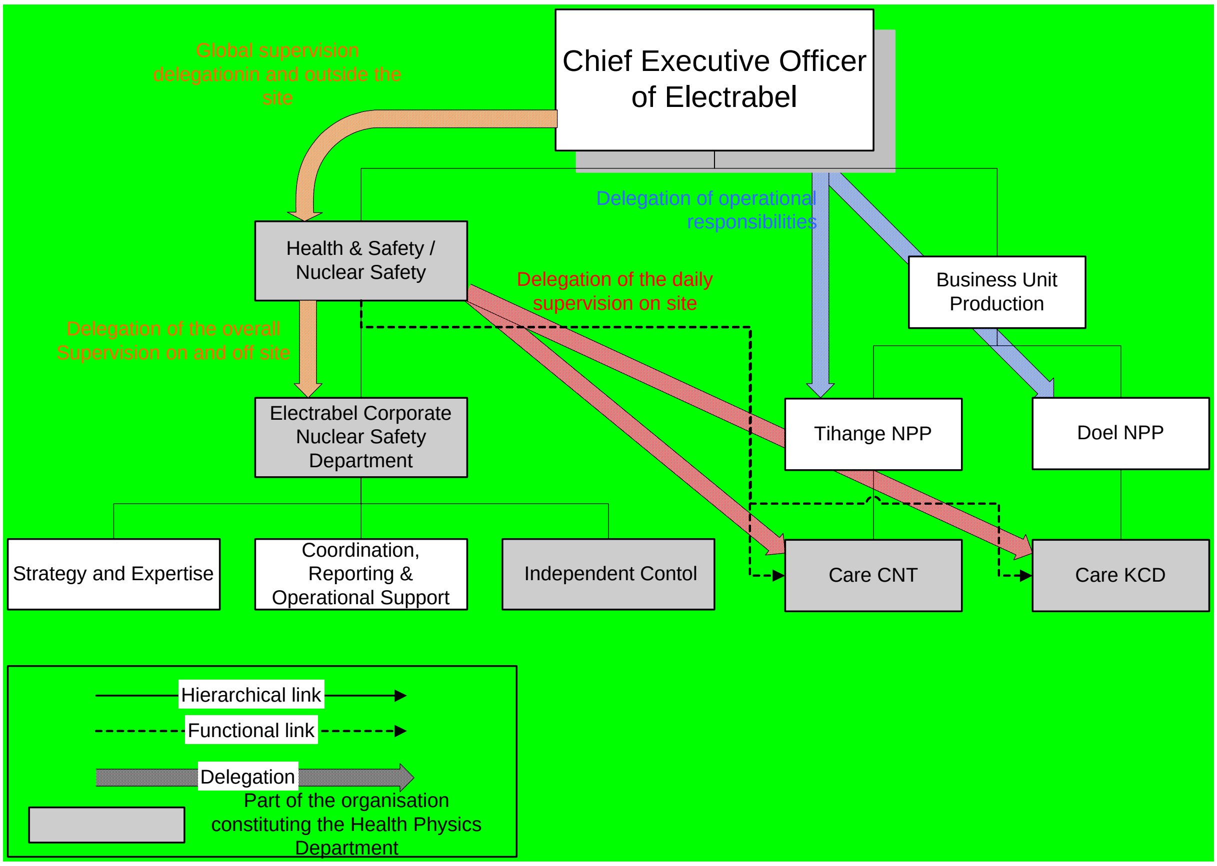
This update has led to the following organisational structure. The nuclear activities are managed on a three level structure : corporate level, business unit level and Nuclear Power Plant level.

The major organisational modification on the corporate level has been the creation of the Electrabel Corporate Nuclear Safety Department (ECNSD), whose activities include the Independent Controlling related to Nuclear Safety, the strategy and expert advice and the reporting. This Department takes the full responsibility of the Health Physics department and delegates appropriate activities to both sites (see below). Through the Health and Safety Manager, this Department reports directly to the CEO.

On Business Unit level, 5 departments are in charge of some activities related to nuclear safety: Process and Performance Management (PPM), Information and Assets Performance (IAP), Electrabel Maintenance Services (EMS), Nuclear Fuel (Fuel BU) and Human Resources. The PPM department is a.o. in charge of the Quality Assurance, Human Factors, Operational Experience activities. The IAP department is a.o. in charge of the strategic assets management and of some support activities, including information management. The EMS department is in charge of the purchasing and sourcing activities. The Fuel BU department is in charge of all the fuel handling operations, the follow-up of the cycles as well as of the relations with Synatom, who remains in charge of all aspects concerning procurement of new fuel and the back-end of the fuel cycle.
The activities of Human Resources are mostly focused on the competency development and knowledge management of the personnel of Electrabel. All before mentioned departments are organised both centrally and locally, with representatives on the sites of the Nuclear Power Plants.

On the Nuclear Power Plant level, the organisation is structured in 4 departments : Maintenance, Operations, Engineering Support and Care. The Maintenance department is in charge of ensuring the availability of the installations and equipments. The Operations department is in charge with the safe conduct of the production and of the installations. Engineering Support is in charge of the management of the modifications and projects on site and of the management of the generic issues and long-term concerns. Furthermore the Engineering Support department has the competency of Design Authority, validating the conformity of proposed changes with the overall safety design basis. The Care department is in charge of all surveillance in radioprotection (Health Physics in the sense of the GRR-2001), measurements, protection of the workers (industrial safety), fire protection and safety of the installations (including the setting up and the management of the emergency planning and preparedness). It is the local representative of the centralized Health Physics Department (Electrabel Corporate Nuclear Safety Department) and has the appropriate delegation from this department to perform the formal approvals required by the regulations. It ensures the respect of the nuclear safety culture by independent technical checks and thus forms the link with the Electrabel Corporate Nuclear Safety Department (as mentioned before).

Chapter 13 of the Safety Analysis Report describes the structure of that organisation which has been approved by the AIO.
The figure below shows the organisation of the ECNSD, the functional links with the CARE departments on the two sites and the corresponding delegations.



II.H. Article 12. Human Factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

Accounting for human factors at the design stage is discussed in Article 18 of the present National Report. The text below is centred on human factors during the operation period of the power stations.

II.H.1. <u>Improvement of Control Room Procedures and Information</u>

In order to avoid human factor related incidents, a great number of the operation, test and maintenance actions are documented in procedures that explain the initial conditions, the various steps to be accomplished and the final status to be achieved.

As a result, these procedures avoid hasty or insufficiently thought-through actions, and the (operation, test, maintenance) personnel are trained in the application of the procedures either in real situations or with the simulator.

Similarly, when an incident or an accident arises, the operator is guided to the appropriate procedure so as to prevent him making a wrong diagnosis.

The Belgian NPPs 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.

The ERG procedures are composed of 3 major elements: (1) the optimal recovery procedures (ORG : optimal recovery guidelines) which are event-based, (2) the critical safety function status trees and (3) the function restoration procedures (FRG : function restoration guidelines) which are both symptom-based, i.e. independent of the event scenario.

The ORG procedures, based on event scenarios with a probability of occurrence greater than 10^{-8}/y, have as main objective to recover the plant and return it to a known safe state (in general the cold shutdown with the RHRS connected). ORG procedures are characterized by a response directly connected to event scenarios, by a preliminary diagnostic and by a constant diagnostic within each specific procedure in order to allow possible reorientation.

The critical safety function status trees explicitly identify the status of the safety functions independent of the event scenario. The trees prioritize challenges to these functions and identify the appropriate FRG procedure to be used to respond to these challenges. The 6 defined critical safety functions are: subcriticality, core cooling, heat sink, integrity of the primary system, containment and primary water inventory.

The FRG procedures are used to restore any challenged critical safety function.

The ORG on one hand and the status trees and the FRG on the other hand are applied in parallel during an event: the first procedures are used by the operators crew (even-based approach) whereas the second ones are applied independently by a Shift Technical Adviser (symptom-based approach).

In conclusion, event-based and symptom-based procedures are used in parallel in Belgium by the NPP staff. The combination of a redundant approach (ORG <> FRG) associated with a human redundancy (operators crew <> shift technical adviser) allows to cover a larger scope of events, ensuring an optimized response for simple event scenarios.

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

In the control room there are many display and alarm windows to inform the operator as soon as possible of any operational anomaly of the power station. The alarm windows have been colour-coded according to their importance.

A file is related to each alarm, indicating to the operator the significance of the alarm, its origin (and possible causes), the automatic actions possibly initiated and the manual response, if any, that is required of the operator.

A process computer exists, that displays a greater number of alarms and information on a display or as a print-out, supplying the control room team with additional information.

As a result of post-TMI review, a mimic panel has been added to follow-up the reactor's critical parameters (SPDS: Safety Parameter Display System). At some plants the safety parameters are clearly identified without having a specific display system. The qualified PAMS (Post Accident Monitoring System) instrumentation has also been specifically identified in the control room.

In case of unavailability of the main control room (for example uninhabitability) a Remote Safety Panel, located in the bunker control room for the last four units or in an appropriate building for the former ones, is fitted with all the controls of the main systems necessary for bringing the reactor to cold shutdown. A specific set of procedures for the remote panel is present in the bunker control room (or equivalent location).

Moreover the bunker control room and the bunker specific equipments have the capability to bring the reactor to a safe state (fallback state) and to go safely to cold shutdown, in case of accident of external origin (aircraft crash, explosion and/or large fire,…). Procedures covering these cases are also available in the bunker control room (or equivalent location).

II.H.2. Training

The normal operation procedures, the incidental and accidental operation procedures are used on the full-scope simulator by the operators and staff who hold an operator licence. Each time the procedures are modified following changes to the installations or experience feedback, the procedures are re-validated on the simulator, and the latter itself modified, if necessary, so that it always reflects the installations.

Training on simulators is only part of the operator training programme, as described in chapter 13 of the Safety Analysis Report (see also Article 11, § II.G.4 of the present Report). It also comprises courses dedicated to explain the modifications made to the installations and changes made to the procedures. Both external as internal Experience Feedback is used as an input to update the training on simulators.

All procedures are periodically updated. Each procedure is evaluated at each use and the comments of the users are formalized. A periodical review is formally made at least every two years; during this review, all the comments are taken into account and a new revision is issued.

For the plant modifications, a special file is established for each one: this file is approved by the Operating Review Committee of the unit or of the site, depending on the fact that it is specific to one unit or applicable to all the units of the site (see article 13). This special file contains all the pertinent information for the realisation and update of the documentation of the modified system: Technical Specifications, procedures, fluid and electric systems diagrams, logic charts, set-points, etc.

The review of the modification by the AIO is explained in Article 14 § II.J.2.a

Next to the above mentioned specific training, a general training programme is set up for all contractors. This general training programme focuses on safety culture (both nuclear and industrial safety), is carried out partly on a theoretical basis and partly on a hands-on approach, though exercises on a mock-up installation. A similar programme has also been started for the personnel of the Operator, where even more focus is put on the nuclear safety culture and on nuclear safety management. Both training courses cover the 4 tools for the efficient application of the human performance principles, as the adherence to procedures (stressing the need for a strict respect of prescribed steps), the interrogative attitude (the principle to correctly apply the instructions using the STAR methodology: Stop – Think – Act – Review), the use of secured communication and the use of the pre-job briefing methodology.

II.H.3. <u>Man-machine interface</u>

An important element in optimisation of the human performance is the management of the interface between man and machine. To evaluate the impact on human behaviour, the Operator systematically reviews all significant events encountered during operation to identify the role of the interface in this event. Focus is hereby put on the operating conditions and lay-out of the control room.

Next to the review of the significant events that have taken place in the installations of the Operator, operating feedback originating from other installations is reviewed on the man-machine interface and on ways to improve these. (cfr. Article II.H.4)

Furthermore, a mandatory evaluation of all work posts is done to identify and to evaluate any industrial safety and environmental risks related to the activities performed.

II.H.4. <u>Organisation</u>

After the TMI accident the organisation of the Operation Department was reviewed, and the “Shift Technical Advisor” (STA) function was introduced.

This function is assumed by a team of engineers so as to permanently have the requisite operational competence available at the power station. The function is mainly aimed at having independent operational supervision during normal operation of the unit and closer supervision of the safety critical functions in accidental situations.

The organisation of the Doel and Tihange sites slightly differs with respect to the implementation of the STA notion.

II.H.5. Experience Feedback

At each site an experience feedback system has been organised (see also Article 10 of the present Report). This system comprises two parts:

II.H.5.a. 1. An internal Experience Feedback Programme

This mainly features:

- the writing of a report for operating incidents, even minor ones;
- the analysis of identified deficiencies and their causes;
- the information of plant staff on the planned corrective actions
- the integration of human elements in the analysis of the events..

For operating incidents of some importance the report describes the circumstances of the incident, the initial conditions of the plant, the incident chronology, the causes, the consequences, the identified anomalies and the lessons that can be drawn from the event (including corrective actions).

Furthermore, the reports will be used for a consolidated review on a yearly basis. This review analyses the recurrence of events as well as underlying causes. On the basis of the determination of the causes, corrective actions may be defined. The reports are also widely communicated to all concerned personnel at the site. This is done at the NPPs through the use of an electronic Intranet Portal, enabling access to all relevant documents for all concerned personnel.

The lessons drawn from these analyses are fed into the feedback of an operating experience system and included in the training and recycling programmes.

Reports of incidents and special events are also transmitted to the AIO, and those with high added value to organisms as WANO.

II.H.5.b. An External Experience Feedback Programme

This mainly features:

- the collection of information originating from various sources (see Article 10 of the present Report);
- the analysis of the applicability to Belgian units,
- the lessons to be drawn, and elaboration/implementation of preventive measures;
- informing of all the relevant personnel.

On the AIO side, AVN performs also an independent analysis of operating events, which have occurred in the Belgian nuclear power plants, with specific attention to causes related to human and organisational factors. The adequateness of the corrective actions, which have been defined by the licensees, is fully reviewed within this process. The lessons learned from these events, including the identification of the applicability of corrective actions to other plants and the need to perform additional inspections, are identified. The results from these analyses are incorporated into an event database. One AVN expert is member of WGHOF (Working Group on Human and Operational Factors) of the OECD-NEA-CSNI.

II.I. Article 13. Quality Assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

As the US safety rules were applied for the 4 most recent Belgian generating units as early as at their design stage, 10 CFR50 Appendix B requirements were adopted for these units, as well as the ASME code quality-assurance stipulations for pressure vessels. Also taken into account were the 50-C-QA codes and the resulting safety guidelines (including 50-SG-QA5) developed in the scope of the IAEA's NUSS safety rules programme.

At the time of putting into service the Doel 1 and 2 and Tihange 1 units, i.e. 1974-1975, that level of quality-assurance formalism was not yet required. However, during the 1st periodic safety review of these units, the request was formulated to apply to them the same quality-assurance rules as were applied to the more recent units: accordingly, any new installations, modifications, repairs and replacement at the earlier units were from 1985 on made consistent with the formal QA requirements. An example of an important modification subject to quality assurance was the construction during the 1st periodic safety review of Doel 1 and 2 of the "bunker" housing the emergency systems (see Appendix 1 paragraph II.C.4.a.1)

The responsibility for applying the quality assurance programme is assumed by the operator who subcontracts the related tasks to his Architect-Engineer during the design and construction phases of the power stations, up to and including their start-up tests.

While following the evolution of the international practices, Electrabel evolved from his quality assurance system during operation to a quality management system, in September 2006. This management system includes the previous applicable quality assurance system. The drafting of the quality management system was based primarily on a general safety requirement published by the AIEA (GS-R-3: "The management System for Facilities and Activities", 2006).

The QA programme is described in chapter 17 of the Safety Analysis Report which deals with the design and construction phases, followed by the operation period. As there is no unit under construction at present in Belgium, emphasis is put on how the quality management system is applied during operation.

II.I.1. Concerned Equipment and Activities

The quality management system applies to any safety-related equipment, components and structure as well as to any activities that may affect their Quality. It applies also to the safety-related activities, e.g. human performance, organisational performance, safety culture, radiological protection, radwaste management, fire detection and protection, environmental monitoring, nuclear fuel management, emergency intervention and site security.

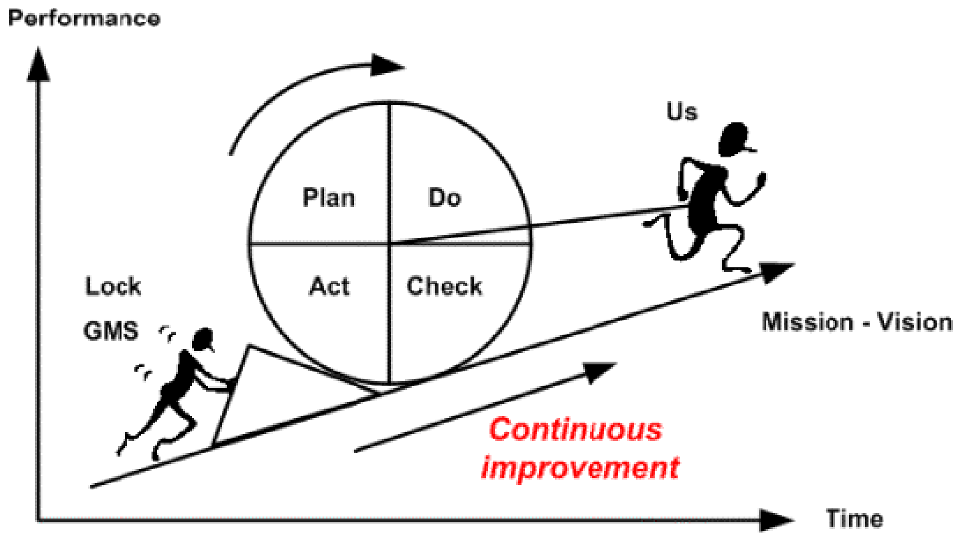
These equipment, components, structures and activities are known as Quality Monitored (Q.M.)
Quality Monitored items are identified in the Safety Analysis Report of each unit.

II.I.2. <u>Quality Management System</u>

II.I.2.a. Objective and origins

Electrabel's quality management system principal goal is to ensure and increase safety at Electrabel's Doel and Tihange power stations through a common approach and via power stations-specific approaches. The system accomplishes this by establishing policies and related objectives.

The Deming diagram, which specifies the following recursive four-step cycle, is the basis for this management system: plan, do, check, act.



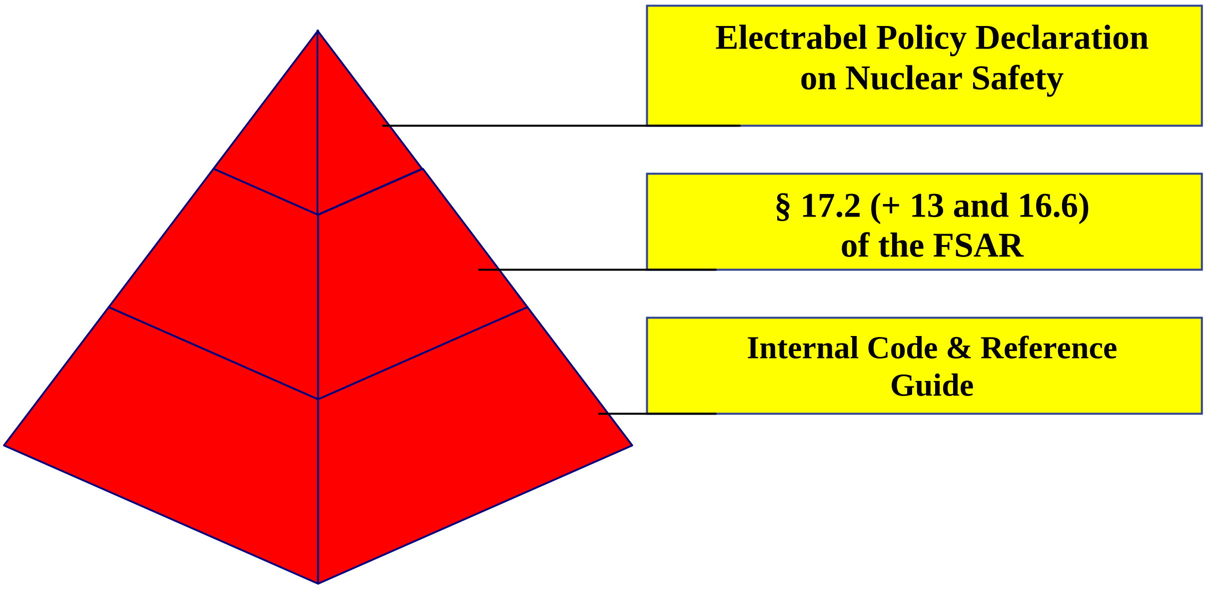
The management system also integrates the requirements of the following regulations and guidances:

- Royal decrees of authorization to operate a nuclear site, inclusive the norms, codes and standards they refer to
- Nuclear safety regulations enforced by the Belgian government
- Other international standards and codes adapted and implemented for Electrabel's Generation Business Unit

II.I.2.b. Key documents

Electrabel's quality management system is described in a number of documents that move downwards from broad principles towards technical specifications and daily practices:

- Chapter 17.2 of FSAR
- Electrabel Internal Nuclear Safety Code
- Electrabel Nuclear Safety Referential
- Execution documents



II.I.2.c. Nuclear Safety Policy Chart

Protecting all members of staff involved in the operation of a power station, as well as the surrounding population and environment, is of the utmost importance. That is why a power station actively promotes a strong nuclear safety policy at all levels of the plant.
Electabel Policy for Nuclear Safety follows the Plan-Do-Check-Act principles of continuous improvement. It is implemented in collaboration with the site's partners, suppliers and contractors. This policy is detailed in Article II.F.1

II.I.2.d. Focus and application

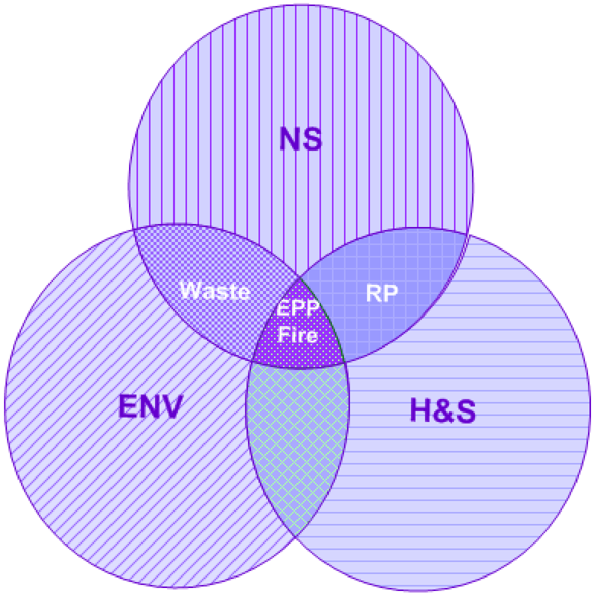
The quality management system supports the general objectives of safety management recognized at the international level and described in the IAEA report INSAG 13: "Management of Operational Safety in Nuclear Power Plants", 1999. The two objectives are as follows:

- Focus on the performance of the organisation to ensure and continuously improve safety, through planning, supervision and monitoring of safety processes in all situations (normal, incident and emergency)
- Stimulate and support a strong safety culture by developing and reinforcing good safety attitudes, values and behaviour in individuals, teams and organisations, in order to allow them to carry out their activities in a safe way

The quality management system is applicable to every Electrabel entity that exercises any activity related to safety, even if the entity is not within the management hierarchy of the Doel and Tihange sites. Moreover, the structure of separate quality management systems at each site has been replaced by a single unified system covering both sites.
The management system ensures that all elements are not considered separately. This is to ensure that no decisions are taken that could possibly impact negatively on safety.

Safety is of primary importance in the management system and always takes priority over any other demand, for example production.

The next scheme represents the three management systems : Nuclear Safety (NS), Health and Safety (H&S), Environment (ENV), which are integrated in one common management scheme



II.I.2.e. Electrabel Internal Code and Reference for Nuclear Safety

The Internal Code defines all directives and general principles related to the implementation of the nuclear safety policy within Electrabel. Electrabel Corporate Nuclear Safety Department (ECNSD) verifies it and the CEO approves it.

The goals of the Internal Code are to:

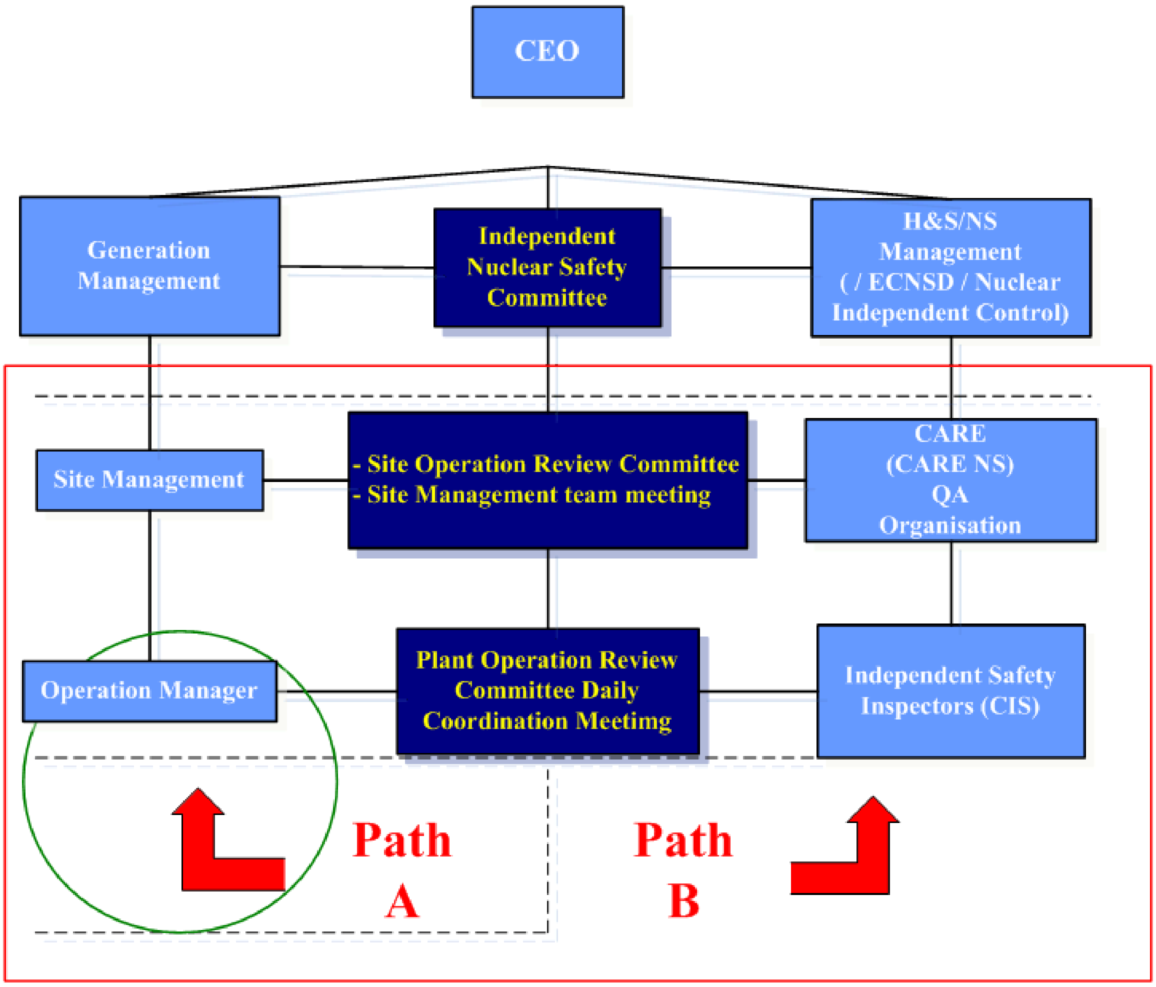
- Define Electrabel's strategy and policy in terms of nuclear safety.
- Define responsibilities regarding nuclear safety.
- Ensure the systematic and formal management of all aspects related to nuclear safety.

In addition, the Nuclear Safety Reference Document (Référentiel Sûreté Nucléaire) describes the quality assurance requirements levels for the nuclear safety management system. It complements the Internal Code. Electrabel Corporate Nuclear Safety Department verifies it and the Generation Management approves it.

Each Electrabel entity must translate the directives and general principles of the Internal Code into local procedures and instructions taking into account the QA minimal requirements levels defined in the Safety Reference.

II.I.3. Monitoring & Assessment of safety performance

In order ensure optimum efficiency, the internal assessment of Safety is organised into different levels of control where each level corresponds to the different levels of the operational hierarchical line.



The operational line performs its own self-assessment.

Path A represents the operational line assuming final responsibility for nuclear safety. Path B represents the path entrusted with monitoring and supervision. In order to ensure its independent control mission, Path B is totally independent hierarchically from the operational hierarchical line.

There are three independent levels of Quality Control (QC1, QC2, QC3) and one level of Quality Assurance (QA)

QA : performed by QA organisation, to check compliance with the quality requirements indicated in the nuclear safety reference system and to monitor compliance with the management systems,

QC1 : performed by and in the operational departments, to ascertain the technical quality of interventions (Self-control Point, Witness Point and Hold Point) and to control compliance with their processes,

QC2 : performed by independent safety inspectors (CIS), by using the Key Performance Indicators, the internal and external Operational Feedback, benchmarking, follow-up of corrective actions, “external” data (AIO, external audits, etc.), self-assessments, etc., together with its own controls, to measure the effectiveness of Nuclear Safety management and to present proposals to further improve Nuclear Safety,

QC3 : performed by the Nuclear Independent Control (NICo), which uses the results of the abovementioned controls, together with its own assessments, to draw up an overall picture of Nuclear Safety of EBL and to propose areas for improvement.

II.I.4. Safety Culture and Human Performance

Tihange and Doel power plants have developed a common human performance policy which is based on two approaches:

- A bottom-up approach, that analyses the root causes of events (including the human factor)
- A top-down approach, that relies on human performance tools, safety culture awareness, and tasks observation.

Efficient implementation of the human performance policy in the field requires training and coaching, as well as transparency, trust, and mutual respect (no blame culture).

II.I.4.a. Bottom-up approach

Analysing errors and malfunctions is a basis for continuous improvement. Root cause analysis should cover both technical aspects and human factors in order to reinforce defence barriers. It must therefore:

- Highlight and explain all deviations linked to an event
- Identify the real and potential consequences of these deviations
- Define corrective actions to be implemented to avoid recurrence of the event

The root cause analysis is carried out jointly by a person from the department most affected by the event, and by a person from the Human Performance Section of the Process Performance Management Service (PPM). The goal of this joint analysis is to ensure that operating experience feedback is properly shared within Tihange NPP, and that corrective actions are implemented in a voluntary manner. It also enables PPM HP agents to provide coaching in the field.
The various root cause analyses are used as a basis to define the top-down part of the human performance policy.

II.I.4.b. Top-down approach

The top-down human performance approach is based on operating experience feedback and on the direction indicated by continuous improvement initiatives. It is thus linked to change management, leadership, values, and organisational behaviour.

The focus is to ensure the integration of four tools for appropriate human behaviour:

- Adherence to procedures.
- Interrogative attitude: pause before starting an activity if anything is uncertain.
- Secured communication: always make sure the other has a clear understanding of the message.
- Pre-job briefings.

All operating experience feedback must be communicated as extensively as possible. That is why it is integrated as soon as possible into the training courses of all parties concerned: newly hired staff members, experimented collaborators, and subcontractors.

In addition, tasks observation visits are held in order to:

- Identify and value good practices.
- Identify and correct deviations.

- Reinforce contacts with the field

II.I.5. Training regarding Quality Assurance Objectives

A general training is given regarding the quality assurance objectives and the means for achieving these to all personnel who perform in the various services quality-related activities. This training is maintained and updated with time.

II.I.6. Periodic Evaluation

The Plant Operating Review Committees (PORC), the Site Operating Review Committees (SORC) and the Independent Nuclear Safety Committee (INSC) perform a periodical assessment of the nuclear safety effectiveness, the way it is implemented, the possible improvements to be brought to the programme, ... The Generation Management approves the written action plan.

As regards the regulatory control activities, AVN examined in the frame of the licensing process of each unit the quality assurance system to be implemented during the design, construction and operation phases (chapter 17 of the Safety Analysis Report, Electrabel Internal Code, ...) and verified the practical implementation of the various regulations (10 CFR 50 Appendix B, ASME code,...) throughout these phases.

As regards pressure vessels for which the ASME code or the conventional Belgian regulations (RGPT) are applicable, the intervention of an Authorised Inspection Agency (AIA) is required as an independent inspection organisation, and AVN has taken into account the results of those inspections.

During power plant operation, AVN performs systematic inspections, including some dedicated to quality assurance procedures assessment during operation. The quality assurance aspects are also reviewed during examination of modifications to the installations, incident reports, etc.

II.J. Article 14. Assessment and Verification of Safety

Each Contracting Party shall take the appropriate steps to ensure that:

(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

II.J.1. Licensing Process

The legislative and regulatory framework has been described in Article 7, and the licensing process under point 1 of Article 8 of the present Report.

As said before, the applicant for the licence supplies the information required by Article 6 of GRR-2001, as well as the Safety Analysis Report drawn up according to the US standard format (Regulatory Guide 1.70 revision 2 or 3).

These documents, together with the numerous technical supporting documents are examined by AVN and give rise to an intense exchange of questions and answers, the resulting information and data being used to update the Safety Analysis Report until it eventually becomes the “Final Safety Analysis Report “ (FSAR).

The report which AVN presents to the Scientific Council of the FANC gives the conclusions of the performed safety analysis and proposes a number of conditions to be stipulated in the Royal Decree of Authorisation.

These conditions include, among others:

- conformity to the FSAR as it was at the date of its presentation to the Special Commission (this will be the reference version of the FSAR),
- conformity to the report established under Article 37 of the Euratom Treaty,
- the possibility to modify the installations if the modifications have no adverse impact on safety,
- updating of the FSAR, which throughout the life of the installations has to exactly reflect these,
- the obligation to perform periodic safety reviews,
- the follow-up of all the recommendations made in the “Safety Evaluation Report” established by AVN and which gives a synthesis of the performed safety analysis. AVN is responsible for assessing the satisfactory nature of the responses of the operator to those recommendations,
- specific identification of the recommendations that must be met at specified stages of the commissioning process (core loading, criticality, various levels of power rise, reaching of nominal power),

- a time-schedule for meeting the other recommendations, and the obligation to annually report on the progress made in implementing those recommendations.

Indeed, a number of recommendations relate to the commissioning tests programmes or the acceptance criteria of the tests, and therefore these recommendations have to be satisfied before the tests may be started. Other recommendations are more long term. For instance, at the time of the starting-up of the Doel 3 and Tihange 2 units in 1982, the Decree of Authorisation stipulated that qualification programmes be established for equipment due to operate during accidents, which at the time was a new requirement. The results of these programmes, i.e. the proof of the qualification of these equipments, were expected within the next few years. Considerable investments were made in post-accidental test and qualification facilities, so that prototype tests could be performed.

Another example relates to simulators. Initially, Belgian power station operators were trained on simulators abroad, and these foreign simulators did not exactly reflect the Belgian units. As a result the decision was taken to install at each site simulators that truly mimicked the characteristics of the units at the Belgian sites. The recommendation further specified that the validity and the extent of the simulations of these simulators be demonstrated, so that its limitations would be known as well as their consequences on operator training.

These simulators have been subjected to an acceptance inspection procedure similar to that applied to the nuclear power plant, including examination of the simulation models and their results when simulating major transients and certain accidents. The results of the simulations were compared either to the results of real tests at the units (major transients) or to the results generated with best estimate thermal-hydraulic codes (RELAP5 or equivalent).

Experience has shown the interest of such simulator validation approach. Later, when modifications are made to the installations and the simulator is updated accordingly, non-regression tests prove the correct nature of the actions taken.

After having been discussed at the Special Commission, a proposal of the Decree of Authorisation is prepared by the Safety Authorities and presented to the King for signature.

The later phases of the conformity examination, the start-up tests and gradual rise to full power are conducted under the acceptance inspection procedures and after conformity checks of the installations by the Regulatory Body as explained in Article 8 of the present Report.

II.J.2. <u>Main Results of Continuous and Periodical Safety Monitoring</u>

a. During operation of the installations, experience feedback leads the operator to envisage modifications to the installations or launch major projects such as replacement of the steam generators or power upgrade.

   The nuclear power plant is also subject to periodic safety reviews.

   The proposals for modifications to the installations are examined by the Health Physics Department of the operator, and the AIO (AVN) is informed. The proposal is classified into one of the three following categories:

   - major modifications that change the basic characteristics of the unit. These modifications are subject to the application for a licence under the provisions of Article 6 of the GRR-2001. The safety analysis performed by AVN is presented to the FANC,

and an additional clause will be added to the Royal Decree of Authorisation. The implementation of that modification will be authorised by the Health Physics Department and approved by AVN.
Examples of such modifications are a power increase of the reactor, steam generator replacement, utilisation of MOX fuel.

- less important modifications that have a potential impact on safety. In a first phase, the requesting department, indicating the justification for the intervention, presents a proposal for modification. In a second phase, the proposal is examined on its technical merits, and later on also by a multidisciplinary team including a.o. the Health Physics Department. After agreement by the involved departments, the proposal is submitted to the management, who can decide to continue final studies for the proposed modification. In the next phase, studies are completed and approval of both the Health Physics Department and of the AIO is sought to prepare the implementation of the modifications. The proposal is thus also examined by the inspector of the AIO, and if necessary by its technical responsibility centres, which may result in amendments being requested to the modification file. Further activities then imply the implementation, and testing of the modifications. Commissioning of the completed modification is subject to a positive acceptance report, issued after validation of the modification and re-qualification of the portion of the installation that was modified, plus updating of the operational documents. The Health Physics Department formally approves of the modification when all the files, procedures and the Safety Analysis Report have been adequately updated and the AIO can then deliver a final acceptance report. Such modification can either be a hardware modification or an organisational modification.

- modifications without impact on safety, that usually do not imply modification of the Safety Analysis Report and which comply with all the safety rules of the installation.
These modifications have to be approved only by the Health Physics Department of the unit, without formal involvement of AVN, except for the possible modified pages of the Safety Analysis Report.

b. The Decrees of Authorisation of each Belgian unit make its periodic safety review mandatory. The general purposes of these periodic safety reviews are discussed in Article 6 of the present Report.

The first of these periodic safety reviews took place in 1985 for the Doel 1 and 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. For instance, physical separation was less strictly applied, seismic and post-accidental qualification were less developed, the notion of high-energy line break did not apply to all systems, external accidents were not systematically taken into account.

This is why during the first periodic safety reviews of Doel 1 and 2 and Tihange 1 in 1985 a great number of subjects had to be addressed, involving for each unit about 800 000 engineer-hours and a cost of the order of Euro 100 million.

The different subjects examined during the periodic safety reviews are detailed in Appendix 4.

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

The safety level of these units was in this way raised towards that of the most modern units. All the analyses were conducted according to deterministic safety rules, and complemented with reliability analysis of the various systems.

The 1st periodic safety reviews of the most recent units (Doel 3 and 4, Tihange 2 and 3) and the 2nd periodic safety reviews of Doel 1 and 2 and Tihange 1 did not require reviewing the design bases, since post-TMI actions had already been taken into account and there had been no major evolution in the regulations in that period.

During these safety reviews, national and international feedback were examined; the results of probabilistic safety studies made for power operation or for shut down states were taken into account, the severe accident consequences were analysed in order to infer prevention and mitigation measures, structural and equipment ageing were evaluated, as well as qualification problems, and the field of accidents that are considered as design-basis accidents was broadened.

The second periodic safety reviews of the most recent units (Doel 3 and 4, Tihange 2 and 3), and the third periodic safety reviews of the oldest ones (Doel 1 and 2, and Tihange 1) include two sets of topics: the first one is made of topics common to all units ("fleet approach"), the second one addresses aspects specific to one unit.

All these periodic safety reviews include two parts: one part "studies", one part "implementation", that one relying on the results of the studies. A large number of modifications have been made on the first Belgian units.

The most important modifications resulting from these periodic safety reviews are indicated in Appendix 1 of this Report, in the description of each unit.

c. Certain studies relating to the modifications or initiated in the scope of the periodic safety reviews were so substantial that they had to be tackled as projects having their own specific structure.

- Severe accident analysis addressed several aspects: ultimate strength of the containment in case of internal overpressure, installation of autocatalytic recombiners to prevent containment hydrogen build-up (installed in all the Belgian units), containment venting systems, reactivity accidents during operation and during shut down states.
- Power increase and burn-up cycle extension studies led to the redefining of the key parameters for the power capacity studies and accident analysis.
  Mixed core composition (presence in the core of fuel assemblies from different suppliers) had also had to be taken into account, requiring detailed studies regarding

mechanical, neutronic and thermal-hydraulic compatibility. Fuel cycle extension led to higher burn-up and made necessary more in-depth studies of the thermal-hydraulic behaviour of fuel rods in normal operation and during limiting transients.

In case of significant power increase, the capacity of the various systems also needs to be re-assessed.

- Studies relating to the utilisation of MOX fuel consider the same questions as those involved in the power increase mentioned here above.
- Replacement of the steam generators, whether or not linked to a power increase, implies more often than not a larger heat exchange surface between the primary and secondary systems, a modification of the primary and secondary inventories, and changes in piping layout.

  This requires reviewing of the analyses of transients, accidents and capacities of the systems. In case of a power increase, all the above mentioned studies also have to be repeated.
- Replacement of technologically obsolescent systems mainly addresses the instrumentation and control systems, as new equipment most often includes new software of which the qualification in safety-related functions has to be demonstrated.
- The utility has set up an integrated ageing management system, in order to assure that, among other, safety related structures, systems and components remain qualified within their defined service life. Main issues are the maintaining of the qualification and the anticipation of the loss of qualified suppliers and spare parts. The utility uses a methodology which follows the recommendations of the IAEA. The ageing management produces recommendations which are used to define the needed investments in the middle and long term.

The probabilistic safety analyses (PSAs) for the Doel and Tihange nuclear power plants (NPPs) are performed by Tractebel Engineering (TE), on behalf of the utility Electrabel. AVN is performing an "on-line" review of the development and the updating of the PSA models and discusses its findings with TE and the utility on an interactive basis. After the issue by TE of the final report, AVN establishes a PSA evaluation report.

At present the PSA level 1 includes power and non-power states, covering about 99% of the operating profile of the NPPs. A wide scope of internal initiating events is covered, including LOCAs, secondary line breaks, transients and loss of particular functions (electric sources, heat sink, etc.). Internal hazards (fire and flooding) and external hazards are not yet covered.

All level 2 analyses performed for the Belgian NPPs are limited to the analysis of the containment response, with the aim to investigate dominant containment failure modes. No source term analyses have been performed and only power states are covered. The main applications of the PSA are the evaluation of the design as a complementary tool to the deterministic safety analysis, the evaluation of the accident management and the PSA-based event analysis.

As an example of the results of the first level 1+ PSAs performed for the Doel 3 and Tihange 2 plants, one can mention the installation of catalytic hydrogen recombiners in the containment, for all 7 nuclear power plants.

The PSA-based event analysis has been integrated in AVN's operational experience feedback process, focussing on the quantitative importance of well-selected operational events and on the subsequent identification of potential safety issues, using the best-estimate case as well as relevant what-if questions.

An action plan for the further development of the PSA of all nuclear power plants has been set up on the basis of the WENRA reference levels and its implementation has started.

- Taking into account the evolution of knowledge and of the available analysis tools, a framework of generic studies has been defined. The aim is to define in detail analysis methodologies that can be applied to all units. Topics of interest are for example the calculation of radiological consequences of a feedwater line break accident, of a steam generator tube rupture, of a steam line break accident, or the analysis of the risk linked to sump strainers clogging. In the frame of these generic studies, a position paper on the practical application of the single failure criterion in safety analysis has been produced..

II.J.3. Verification Programmes

The technical specifications (chapter 16 of the Safety Analysis Report) were examined at the time of the licensing process; their amendment during operation falls under the stipulations for the less important modifications that are subject only to approval by the operator's Health Physics Department and by the AIO. These technical specifications are reviewed in the frame of the period safety reviews. They have been completely rewritten at least once during the life of the each nuclear power plant.

These specifications indicate for each status of the unit the operational limits and conditions, specifying also the actions to be taken if limits are exceeded. They also list the inspections and tests to be performed and their periodicity.

Specific programmes are established, in particular for:
- inspections and tests required by the ASME Code.
- inspection and repair of the steam generator tubes.
- fire protection.
- tests of ventilation filters.
- inspection of the primary pump fly-wheels.
- examination of irradiation samples of the pressure vessel.

Each safety-related equipment has a qualification file that contains all the qualification test requirements and results. In this file are also recorded the results of ageing tests or experience feedback of similar equipment, so defining the qualified life of the equipment. The qualified life determines the frequency of replacement of that equipment, which can be re-assessed in function of the real operation conditions and location of that equipment.

The reactor coolant pressure boundary is treated in a specific way. It was originally designed to ensure a minimum useful life taking into account a limited number of transients during normal, incidental and accidental operation. As for the reactor vessel, it is monitored according to the transition temperature evolution (NDTT) based on an irradiated samples withdrawal programme. The occurrence rate of the design transients is strictly recorded under the close supervision of the AIO.

With regard to all passive components important to safety on one hand, and the components important for the availability of the plant on the other hand, it is foreseen to inventory and to follow in a systematic way all phenomena which have an impact on the lifetime of these components.
An In-Service Inspection programme is permanently implemented by personnel specifically qualified for these inspections, which are carried out during power operation of the unit or in shut down states.

All these tests and inspections are performed under fully detailed documented procedures.

II.K. Article 15. Radiation Protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

II.K.1. Regulations

Chapter III "General Protection" of the GRR-2001 introduces in the Belgian law the radiological protection and ALARA-policy concepts.

Article 20 of this Royal Decree sets among others the general principles for justifying and keeping the exposures as low as reasonably achievable, and the requirements to comply with the dose limits. Other Articles of that chapter are described in Article 7 § II.C.3 of the present National Report.

Article 23 of this Royal Decree describes the key role of the Health Physics Department (HPD). This department is, in a general way and amongst other duties, responsible for the organisation and the supervision of the necessary means for operational radiation protection.

II.K.2. Design

Chapter III “General Protection” of the GRR-1963 introduced from the very beginning in Belgian law the radiological protection and ALARA-policy notions.

Belgian nuclear power plants design was done according to that legislation and, furthermore, consistent with the US regulations and in particular 10 CFR50 Appendix I and the related Regulatory Guide 1.21. In fact, as demonstrated in the Safety Analysis Reports of Belgium’s generating units, the objectives of the US regulations were amply met, considering that the doses to the population computed according to the US rules are smaller by a factor of at least 3 than the criteria prescribed by these rules.

The release limits, in annual mean or in instantaneous value, were presented in the Article 37 - Report of the Euratom Treaty and are discussed in the Safety Analysis Report (chapter 11). Let us bear in mind that at the Belgian units the liquid effluents are released via a single pipe that groups the primary and secondary effluents and which is redundantly and automatically isolated in case an instantaneous limit is exceeded.

II.K.3. Operation

II.K.3.a. ALARA Policy

The evolution has been taken into account, e.g. the introduction of the recommendations of the ICRP documents and the implementation of the Euratom 96/29 Directive into the Belgian regulations.

To anticipate the implementation of these regulations the licensee has, on a voluntary basis, limited the individual dose at about the half of the dose limit (20 mSv for 12 consecutive months, in accordance with the GRR-2001).

Besides this ALARA approach with respect to the individual dose, dedicated ALARA procedures were set up, aiming to reduce the collective dose. They propose a set of additional protective actions as soon as one of the following criteria is met:

- estimated collective dose higher than 0.5 man.mSv,
- or, work under an average dose rate higher than 0.1 mSv/h.

When any of these two criteria is reached, the procedures stipulate:

- an initial dosimetric estimate,
- consulting between the work supervisor and the radiological protection agent in order for them to jointly agree about the protective means to be used,
- a new dosimetric estimate that takes into account the decided protective means and that serve as an objective for the job to do,
- a dosimetric monitoring of the work, with check points or hold points at 75% and 125% of the estimated dosimetry,
- feeding back the experience gained.

For substantial or unusual works, there is a specific safety/radiological protection preparation of the work, through consultation between the Head of the Safety - Radiological Protection Section and the work supervisor, well ahead of the planned date of the work.

II.K.3.b. Follow-up of the Doses

Various measures have been taken over the years to reduce the collective annual dose: the mean value for the 7 Belgian units has been reduced by a factor of more than 4 during the 1990-2006 period.

For instance, the primary system chemical conditioning procedure applied in preparation of the core refuelling outages proved very effective to reduce the dose rates induced by the contaminated systems: a continuous decrease in mean dose rates has been recorded for the primary loops. This procedure was developed thanks to operational experience feedback from pressurised water reactors.

Shielding is systematically installed at various locations during core refuelling outages: primary pump cell floor, between steam generator and primary pump, around pressure vessel-head on its stand, vessel-well decompression piping, corridor at the hot penetrations, places of passage and waiting (access locks to the steam generators...), hand-holes of the steam generators...

Specific shields are also installed when dictated by the size of the work: pressuriser dome, valves, detected hot points...

Systematic measurement is done daily of the surface contamination of the floors in representative locations during the outage. Immediate decontamination action is taken should a problem be detected. Supplementary focus has been put on the effectiveness of the housekeeping activities inside the controlled area.

Additional portable means for measuring the volumic activity (aerosols, iodine, gases) are placed at the pool floor of the reactor building and at the access locks to the steam generators.

Signalling of the hot points and the ambient dose rates informs the workers about the ambient radiological conditions in which they will carry out the work: access is denied to certain locations without specific permission of the Radiological Protection Department, specific ALARA signalling that forbids remaining stationary, signalling of very low dose-rate areas (“green” area) which the workers may use as an identified falling-back station.

Throughout the outage period, the actual-versus-estimated dosimetry trends are monitored daily, and any significant deviation is analysed and may result in corrective action being taken.

For sizeable works, more detailed estimates are made, per phase of work or per equipment worked on.

Other measures include the increased exchange of good practices both between Doel and Tihange as well in international fora; including contact with foreign nuclear operators. Further focus is also put on the management of radioactive sources by reducing its number and the exposure.

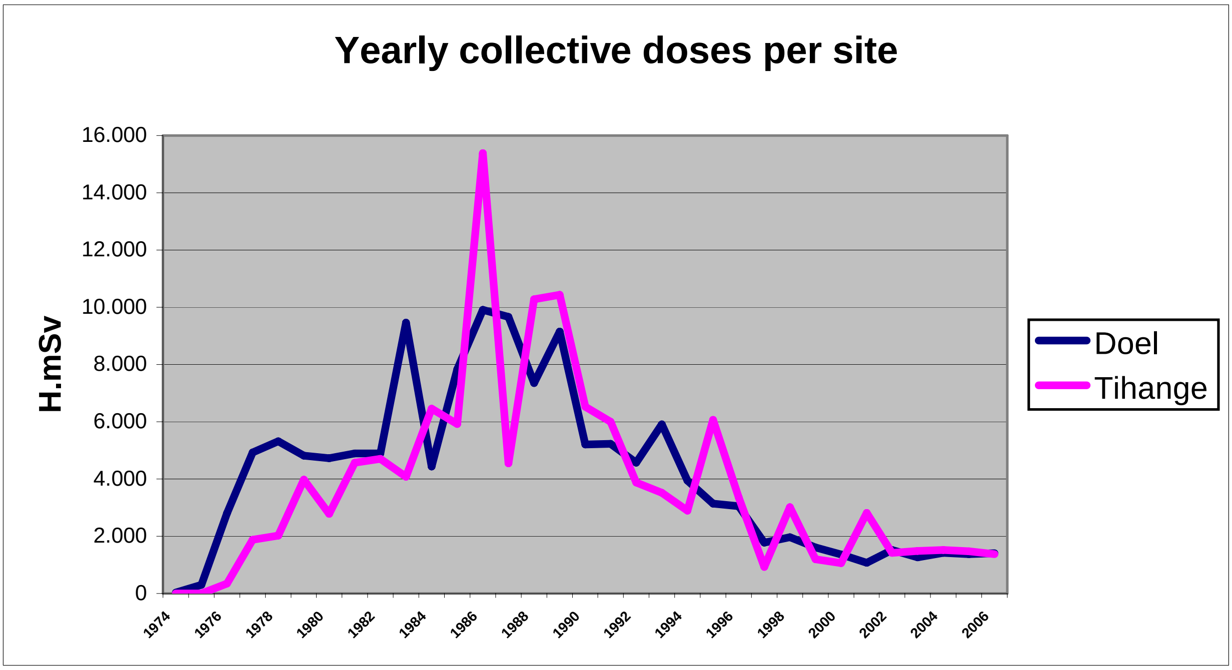
The figure below represents the evolution of the collective doses of the Doel and Tihange sites since 1974.

The rise between 1974 and 1985 corresponds to the progressive start-up of the new units. The Tihange peak in 1986 is due to the extensive works linked to the first periodic safety review.

As the Tihange units operate along cycles up to 18 months, the number of refuelling outages varies from one year to the other, what introduces variations on the yearly collective doses. Another factor of variation is the cumulated dose due to the replacement of steam generators. Due to the introduction of an outage cycle of 18 months for Doel 4, a slight variation in annual dosimetry can be expected for the Doel NPP.

From 2004 on, the further reduction of annual collective dose is explained by the supplementary focus on :

- the pre-job briefing,
- the training in radioprotection and in nuclear safety,
- the development or the improvement of the site dose rate databases,
- the radiological risk analysis.



II.K.3.c. Large Works

Very substantial work such as relating to steam generator replacement is prepared several years in advance, accurately planning all the operations; any modification to the planning envisaged during execution of the work is translated in terms of estimated dose, and is taken into account in the decision process.

Experience feedback is of great importance to such work: the collective dose that resulted of replacing the Doel 3 steam generators amounted to some 1.9 man.Sv in 1993; for the same work in 1998 at Tihange 3 it was 0.625 man.Sv; i.e. lower by a factor more than 3. This value was confirmed for the Steam Generator Replacement of Tihange 2 in 2001 with 0.648 man.Sv. A further important reduction has been observed during the Doel 2 replacement where the collective dose due to the SGR has been limited to 0.195 man.Sv.
More details are given in the following table for the different steam generators replacements that took place in Belgium.:

	Doel 3	**Tihange 1**	**Doel 4**	**Tihange 3**	**Tihange 2**	**Doel 2**
Year	**1993**	**1995**	**1996**	**1998**	**2001**	**2004**
Injuries	0	0	0	0	0	1
Outage duration (days)	96	93	92	76	63	65
SGR duration (days)	>40	31	27	20	17	15
Dose due to SGR (man.mSv)	1 955	1 637	633	1240	648	195
Outage total dosis (man.mSv)	3 169	3 089	1 231	1 086	1 446	409

II.K.3.d. Radioactive Releases

Discharges are defined as authorised and controlled releases into the environment, within limits set by the Authority. In addition there are operational release limits (limiting the release on time based assumptions), related with a scheme to notify the operators, the Health Physics Department, AVN, and the FANC.
The limits mentioned in the authorisations of the both sites and the effective liquid and gaseous releases since 1985 are given in the tables on next page. The release limits were determined so that the radiological consequences are lower than:

- gaseous releases:	50 µSv/year	whole body dose
	150 µSv/year	equivalent dose to any organ or to the skin
- liquid releases:	30 µSv/year	whole body dose
	100 µSv/year	equivalent dose to any organ

One can see that the releases that took place effectively are only a few percent of the limit values, except for tritium where the limit values had been chosen based on the operational experience of similar plants.

The Euratom 96/29 Directive has been implemented in the Belgian legislation into the GRR-2001. As mentioned in Article 81.2 of the GRR-2001, the present authorised discharge limits (gaseous and liquid releases) have been re-evaluated since 2002. The evaluation has been formally agreed by the Scientific Council of the FANC in December 2006. These discharge limits, based on this evaluation, respect at least the annual dose to the public of 1 mSv. There is no intention to modify in the short term the authorized release limits.

The results are given in the following table :

	Calculation of the annual exposure to the most exposed individual resulting from the authorized releases :			Calculation of the annual exposure to the most exposed individual resulting from the average actual release between 1991-2000 :		
	Gazeous	Liquid	**Total (*) maximum**	Gazeous	Liquid	**Total (*) maximum**
Tihange Site (3 units)	190µSv	80µSv	**210µSv**	47 µSv	2.5 µSv	**49 µSv**
Doel Site (4 units)	180µSv	230µSv	**370µSv**	18µSv	2.3 uSv	**19 µSv**

(*) the Total maximum is not the sum of the dose due to the gaseous and the dose due to the liquid releases because the most exposed individual by each type of release in not in the same age category.

Gaseous and Liquid Releases

		TIHANGE NUCLEAR POWER PLANT					DOEL NUCLEAR POWER PLANT				
		Gaseous releases			Liquid releases		Gaseous releases			Liquid releases	
		Noble gases	iodine	aerosols	beta-gam	tritium	Noble gases	iode	aerosols	beta-gam	tritium
		GBq	MBq	MBq	GBq	GBq	GBq	MBq	MBq	GBq	GBq
	limit:	2 220 000	14 800	111 000	888	148 000	2 960 000	14 800	148 000	1 480	103 600
1	1985	17 900	159.0	29.9	50.1	46 300	77 800	560.0	326.0	14.0	46 700
2	1986	46 000	610.0	75.0	57.2	54 000	18 500	222.0	529.0	21.9	46 400
3	1987	30 300	144.0	62.0	62.4	59 000	8 000	41.8	182.0	3.7	49 400
4	1988	49 500	1 360.0	95.0	66.3	69 200	16 900	152.7	123.5	10.9	72 800
5	1989	13 000	316.0	72.0	77.0	49 500	3 400	179.3	34.9	22.4	56 800
6	1990	34 300	295.7	135.9	45.6	56 600	15 600	485.3	162.0	15.5	63 000
7	1991	16 700	86.4	76.6	55.4	37 100	31 271	657.0	99.7	30.2	38 067
8	1992	10 900	38.5	16.9	53.7	34 900	26 440	192.0	74.9	4.6	45 200
9	1993	40 500	26.6	20.0	41.1	35 200	5 186	97.0	8.0	23.6	34 325
10	1994	11 700	15.7	31.6	30.7	38 574	972	9.5	6.0	9.3	33 922
11	1995	4 100	5.5	51.4	26.9	41 200	4 116	31.7	3.6	37.8	47 020
12	1996	14 600	51.6	33.1	73.5	44 700	2 050	8.2	2.8	18.9	31 311
13	1997	9 800	15.9	15.3	29.6	47 300	74	5.7	1.5	26.4	38 383
14	1998	7 800	4.6	28.7	24.1	32 890	3 312	13.7	2.4	16.1	47 135
15	1999	4 300	5.9	13.8	15.9	66 600	2 664	3.1	0.0	27.8	48 425
16	2000	3 500	0.6	4.0	18.9	33 060	95	8.5	0.0	15.0	30 905
17	2001	4 700	7.7	31.5	37.6	41 100	33	4.2	1.4	6.7	37 507
18	2002	8 400	0.8	78.1	31.0	59 622	331	9.4	5.0	11.7	27 485
19	2003	32 400	446.9	60.0	30.9	43 518	775	2.8	10.3	8.4	34 331
20	2004	18 400	69.4	0.5	38.4	45.460	25	5.5	0.7	5.2	42 108
21	2005	14 000	53.3	37.2	23.4	46.000	71	18.4	0.6	4.5	39 877
22	2006	18 100	66.7	16.7	32.7	44.100	115	36.3	51.9	1.71	46 080
Average		**18 677**	**171.9**	**44.8**	**41.9**	**46 633**	**9 897**	**124.7**	**73.9**	**15.3**	**43 508**

II.K.4. International Exchanges

The regulatory body and the Belgian operators participate actively since 1991 in the ISOE (Information System on Occupational Exposure) programme of OECD's Nuclear Energy Agency.

II.L. Article 16. Emergency Preparedness

1. **Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.**

2. **Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of a nuclear installation are provided with appropriate information for emergency planning and response.**

3. **Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.**

II.L.1. Regulatory Framework

The GRR-1963 in its Article 72 has from the beginning stipulated an emergency plan for the regulated installations potentially presenting a serious radiological risk. This document was updated and replaced by the GRR-2001. The Royal Decree of 17 October 2003 defines a nuclear and radiological emergency plan for the Belgian territory.

This text has already been described in Article 7, § II.C.5 of the present National Report.

II.L.2. Implementation of Emergency Organisation in the Event of an Emergency

II.L.2.a. Classification of Emergency

The Royal Decree of 17 October 2003 defines three levels for the notification of emergencies, which are in ascending order of seriousness N_1 to N_3, which the operator must use when warning the “Centre Gouvernemental de Coordination et de Crise - CGCCR” (i.e. the Governmental Centre for Co-ordination and Emergencies) which assembles under the authority of the Minister of Internal Affairs. In addition, a fourth notification level (‘reflex’ level or N_R) has been considered to cope with events with fast kinetics. In case that an emergency situation is quickly developing (fast kinetics) and might lead within 4 hours to a radiation exposure of the population above to an intervention guidance level, immediate protective measures 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. The “automatic” protective actions taken under this “reflex”-phase are limited to **warning**, **sheltering** and **keep listening** within a predefined **reflex zone**. Once the crisis cells and committees are installed and operational, the Emergency Director of the authorities will decide to cancel the reflex phase and to replace it by the proper alert level. In such case the governor of the province hosting the nuclear site is immediately notified in parallel to the warning message to the CGCCR. For each of these 4 notification levels (N_1 to N_3 + N_R) the notification criteria are defined in the Royal Decree of 17 October 2003. In addition, for each concerned nuclear installation, a set of particular types of events is established for each of the notification levels. In the specific case of the ‘reflex’ notification level, the activation criteria are based on predefined scenarios.

For example, the criterion associated with the N_1 level is defined as follows: “Event which implies a potential or real degradation of the safety level of the installation and which could further degenerate with important radiological consequences for the environment of the site. Radioactive releases, if any, are still limited and there is no immediate off-site threat (no action requested to protect the population, the food chain or drinking water). Actions to protect workers and visitors on site might be necessary.”

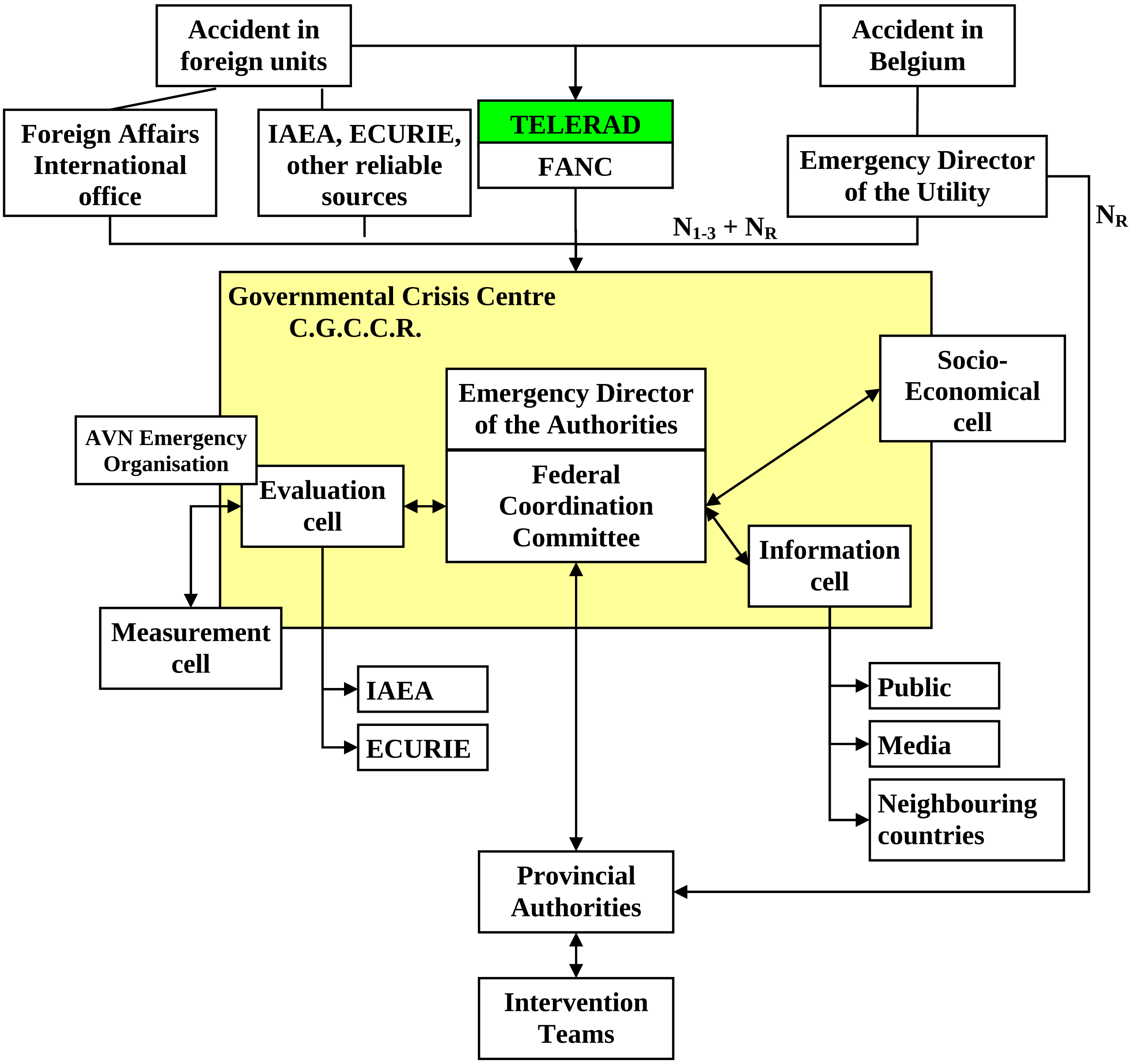
Each of these 4 notification levels (N_1 to N_3 + N_R) activates the federal emergency plan. In addition to these four levels, a “N_0” level is defined for notifying the Authorities in case of an operational anomaly. This last level does not activate the emergency plan.

All emergencies (N_1 to N_3 + N_R) have to be notified to the CGCCR. This permanently manned centre alerts the cells involved in the crisis management at the federal level (Emergency and Co-ordinating Committee, evaluation cell, measurement cell, information cell, socio-economical cell) and houses these cells during the crisis situation as well.

The “Emergency Director” of the Authorities transforms the notification level into an alarm level (U_1 to U_3), putting into action the corresponding phase of the National Emergency Plan. In the case of N_R, the U_R alarm level is automatically triggered and the Governor of the province hosting the nuclear site immediately takes the ‘reflex’ protective actions (warning, sheltering and keep listening) in a pre-defined ‘reflex’ zone around the affected site. As soon as all the CGCCR’s cells are in place and operational, the UR alarm level will be converted to an appropriate alarm level by the emergency director of the authority according to the evaluation of the situation and possible consequences. At that time the responsibility of the conduct of the operations returns to the Federal Minister of Internal Affairs (or his representative).

II.L.2.b. National Master Plan for Organisation in the Event of Emergencies

The CGCCR is composed of the “Federal Co-ordination Committee” chaired by the Emergency Director of the Authorities, of the evaluation cell, of the measurement cell, of the information cell and the socio-economical cell, as indicated in the figure below.



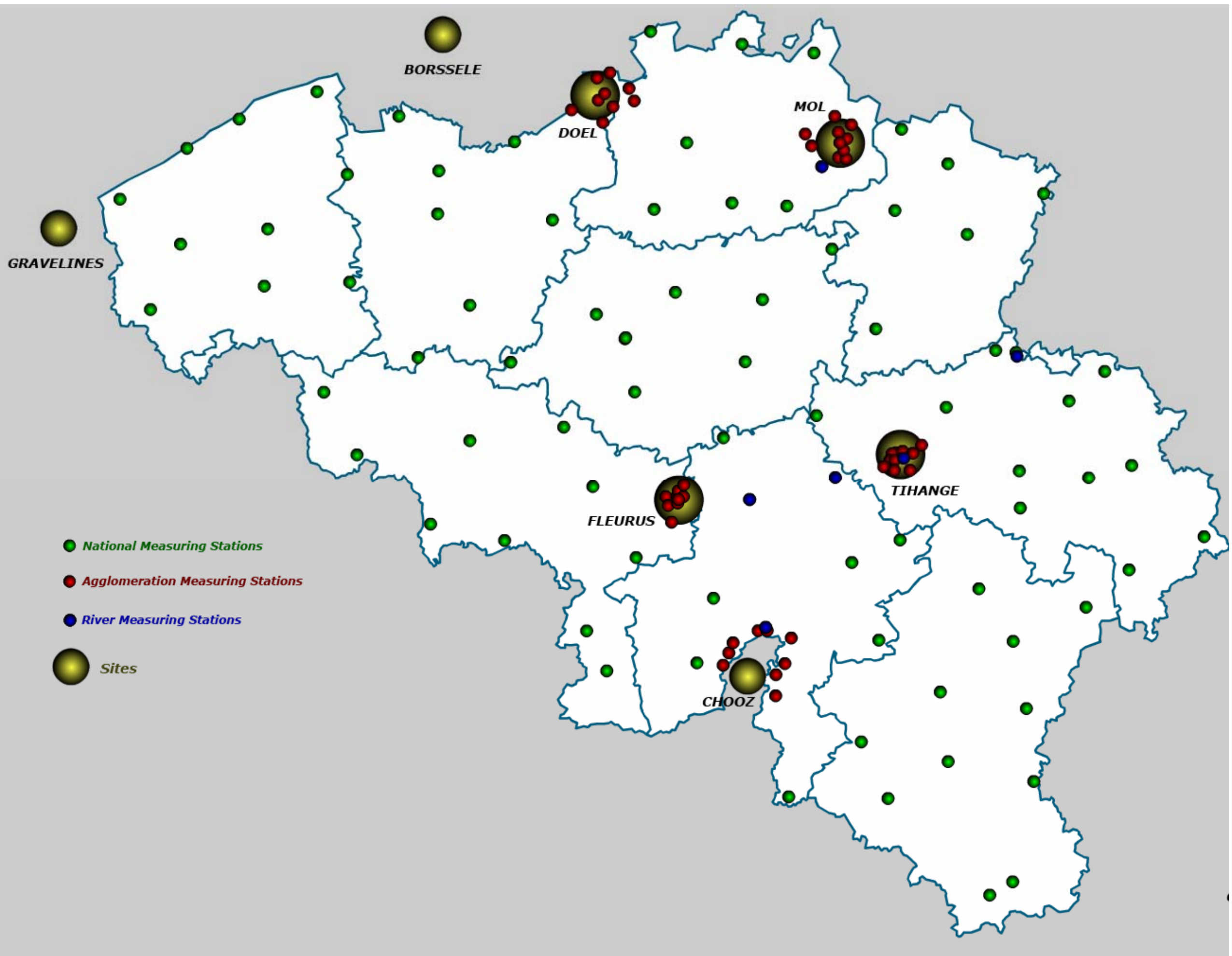
In case of an accident abroad, the CGCCR, as National Warning Point (NWP), is informed by the Ministry of Foreign Affairs, IAEA (through quick information exchange system EMERCON), European Union (through European Commission Urgent Radiological Information Exchange system) or other reliable sources. The "Emergency Director" of the Authorities as National Competent Authority for accidents Abroad (NCA-A) could also be informed by IAEA and/or EU. This information channel provides possible redundancy. In case of an accident at a Belgian installation, the operator's "Emergency Director" informs the CGCCR and supplies all the information that becomes known to him as the accident evolves.

The data received through Belgium's Telerad network for automatic radiological monitoring can also be accessed by the CGCCR. Telerad is a network with the principal aim to measure routinely the emissions and make measurements in case of an accident occurring in a Belgian nuclear site or abroad (183 measurements of ambient radioactivity in air and water are collected, treated and sent to the FANC, responsible for the management of this automatic network). The monitoring of the territory consists in a measurement network having a 20 km mesh (176 air dose rate counters, 7 stations measuring activity α and β and iodine in aerosols, 9 meteorological masts). Around the Belgian nuclear sites, the network is arranged in two rings: the first ring is on the site border and measures ambient radioactivity around the site, the second ring covers the near residential zone, between 3 and 8 km from the site, depending on the direction.

In addition to the square lattice, there are measurements along the Belgian border, in the vicinity of foreign plants (Chooz B, Gravelines, Borssele).

The figure hereafter depicts the TELERAD network :

TELERAD network: location of the measuring stations



The Federal Co-ordination Committee is the official leader of the conduct of the operation in case of an emergency. It defines the general strategy to deal with the emergency, takes the basic decisions (need and extent of direct protective measures for the population and/or for the food chain or the drinking water supply) and assumes the political responsibilities. The Decision cell leans notably on the advices of the Evaluation and Socio-economical cells. The taken decisions are then transmitted for practical implementation and execution to the Provincial Crisis Centre, managing all the multidisciplinary intervention teams (fire brigades, civil protection, police, medical emergency services ...).

The evaluation cell is composed of representatives of the relevant departments (in particular the FANC which chairs the cell), the Federal Public Service of Public Health, the Federal Public Service of Foreign Affairs (for accidents abroad), the Department of Defence, the Royal Institute of Meteorology, and of experts of the Mol Nuclear Research Centre, the "Institut de Radioéléments", and of AVN as the authorised inspection organisation that supervises these installations, as well as of a representative of the operator of the installation. 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. It evaluates the installation status and its estimated time evolution in order to assess the real or potential impact of the event. Then, it advises the decision cell on protective measures for the population and the environment. The recommendations of protective measures are elaborated on the basis of intervention guidance levels, published as a Decision of the FANC (24 November 2003). The evaluation cell is also responsible to prepare the relevant information to be communicated to neighbouring countries and to the international organisations (EU Commission, IAEA) in accordance with the "Early Notification of Accidents Convention" and "Ecurie" convention.

The measurement cell co-ordinates all the activities related to the gathering of field radiological information (external radiation of the air and of the deposits, samples measurements ...) transmitted either by the automatic radiological measurements network, TELERAD, or by the field teams. The measurement cell transmits then the collected and validated information to the evaluation cell.

The information cell is in charge of communications with the media and the population as well as with the neighbouring countries and specific target groups.

The socio-economical cell advises the Federal Co-ordination Committee on the feasibility and economic and social consequences of their decisions; it informs the Federal Co-ordination Committee about the follow-up and ensure the management of the post-accidental phase and an as prompt as possible return to normal life.

In function of the scope, the cells which compose the CGCCR (Emergency and Coordination Committee, Evaluation Cell, Measurement Cell and Information Cell) participate in exercises of the emergency plans at the relevant installations.

The Royal Decree of 17 October 2003 defines the emergency planning zones relative to the direct measures to protect the population (evacuation, sheltering, iodine prophylaxis). These evacuation and sheltering zones have a 10 km radius around the nuclear plants; the stable iodine tablets pre-distribution zones extend to 20 km around the nuclear plants.

The intervention guidance levels are defined in the text of the Decision of the FANC of 24 November 2003. They are 5 to 15 mSv expected total effective doses integrated over 24 hours e.g. taking into account all direct exposure pathways (cloudshine, inhalation and groundshine) for sheltering, 50 to 150 mSv expected total effective doses integrated over 7 days (1 week), i.e. by taking into account all direct exposure pathways (cloudshine, inhalation and groundshine) for evacuation. For intake of stable iodine, the intervention guidance levels are 10 to 50 mSv thyroid equivalent dose for children less than 18 years and pregnant or nursing women and 50 to 100 mSv for adults.

For off-site radiological calculations, focusing on the urgent protective actions, the licensee has to implement a radiological evaluation model. For that purpose a dose/dispersion model developed by the Belgian Nuclear Research Centre (SCK•CEN) is used. The model is a segmented Gaussian plume model, based on the Belgian (also called Bultynck-Malet or SCK•CEN) turbulence typing scheme and the associated dispersion ('sigma') parameters [4]. These parameters were obtained using extended tracer experiments on each site during the years sixties/seventies. The calculation domain extends up to 50 km around the release point. For the Tihange site empirical correction factors were introduced to take the more complex topography into account. Calculations are done per time step of 10 minutes, extrapolations (projections) over time can be made as well. In addition to the dispersion model, a set of standard scenarios has been developed in order to perform quick assessments at early stages. In the latest version of the diffusion model [5], the parameters associated with the standard scenarios have been stored in a database allowing rapid projections for any of the pre-defined scenarios. In addition, in its emergency room, AVN uses simple user-friendly prediction tools elaborated on the basis of standard scenarios and/or pre-calculated standard releases.

The exposure pathways considered for urgent protective actions are cloudshine dose, inhalation dose and groundshine dose (instantaneous and integrated up to one day and two weeks). Ingestion pathway would be covered by implementing measures on the food chain (food ban...).

Effective adult doses and thyroid doses to adults and children are calculated. Deposition of iodine (limited to I-131) and caesium (limited to Cs-137) are also calculated. Related to forecasts, the total doses as well as the projected doses are calculated.

The National Emergency Plan is a continuously evolving issue on which is worked on a permanent basis. On the one hand this effort incorporates lessons learned from emergency exercises and aims at a steady progress in the development of standardized working procedures and tools for diagnostic purposes, radiation monitoring strategy and decision making on the other hand.

II.L.2.c. Internal and External Emergency Plans for Nuclear Installations, Training and Exercises, International Agreements

The emergency plan of each Belgian unit is described in its Safety Analysis Report (chapter 13, § II.I.3) and has been approved at the time of licensing. In complement, an "internal emergency plan" details the instructions for all the actors.

These emergency plans take into account the related post-TMI actions.

In case of accident the unit's "Centre Opérationnel de Tranche" (COT - Tihange) – "Staffkamer (Doel) (i.e. the On Site Technical Centre) is activated and manages all the

[4] H. Bultynck and L.M. Malet, Evaluation of atmospheric dilution factors for effluents diffused from an elevated continuous point source, TELLUS Vol 24, N°5 (1972).

[5] A. Sohier, Experience et evaluation des codes de calcul de doses actuels utilisés en temps de crise nucléaire, Annales de l'Association belge de Radioprotection, Vol 24, N° 4 (1999).

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 consequences, liaises with the CGCCR, and informs the media.

The nuclear power plant conducts internal exercises several times a year, and the Internal Affairs Ministry's General Directions of Civil Safety and of Crisis Centre organises one internal and external exercise yearly for each nuclear power plant and every two years for other sites.

Consistent with the intended objectives, the Ministry involves in these exercises the various disciplines (fire brigade, medical help, police force, civil protection, measurement teams ...).
The operator is requested to build a scenario with which the objectives can be tested.

During the exercise, the information corresponding to the scenario is gradually forwarded to the various participants; the Training Centre full-scope simulator may in certain cases also be used on-line during exercise to deliver needed information.

Information exchange at international level is performed through the CGCCR, which has contacts with the competent Authorities of the neighbouring countries, and which is the "national contact point" for Nuclear Accident Early Notification Convention (IAEA) for the similar European Union system (ECURIE).

Agreements also exist at local and provincial level. The protocol Agreement between the province of "Noord Brabant" (The Netherlands) and the province of Antwerp (Belgium) provides for a direct line between the alarm station of Roosendaal (The Netherlands) and that of Antwerp, informing it as soon as the notification level N2 is decided. This direct line is also used when certain accidents occur in the chemical industry (installations subjected to the European post-Seveso Directive). A direct information exchange can also take place between the alarm station of Vlissingen (The Netherlands) and that of Ghent should an accident occur at the Borssele nuclear power plant. For the Chooz B and Tihange power stations, there are agreements between the Prefecture of the Ardennes department (France) and the province of Namur (Belgium).

In the frame of the agreement between the French Republic Government and the Kingdom of Belgium Government about the Chooz nuclear power plant and the exchange of information during incidents or accidents, a mutual alarm is foreseen between the two countries in case of an accident occurring in the nuclear plants at Tihange, Chooz or Gravelines. This alarm takes place between the CGCCR on the Belgian side and the CODISC ("Centre opérationnel de la Direction de la sécurité civile" which has now become the "COGIC","Centre opérationnel de gestion interministérielle des crises") on the French side.

During the exercises of Chooz and of Gravelines that transborder collaboration is regularly tested at the local and national levels. In addition a direct exchange of technical and radiological information takes place between the organisations in charge of the expertise (IRSN on the French side, AVN on the Belgian one) and of the advice (Nuclear Safety Authority in France, Evaluation Cell of CGCCR in Belgium) and is quite successful. Based on these experiences, information exchanges have been developed as well as their implementation modalities between the French and Belgian involved parties with the view to be operational for further exercises and in case of incidents and accidents.

As regards independent evaluation in the event of an emergency, the AIO (AVN) which oversees the affected installation sends a representative to that site, a representative to the evaluation cell of the CGCCR, and activates its own emergency plan cell. This cell has dedicated telephone and facsimile lines to the affected installation and to the evaluation cell. Based on the technical information supplied directly by its representatives and all the information about the unit that it has at its head office, AVN proceeds with a technical analysis of the situation, evaluates the radiological consequences from the releases indicated in the scenario, and produces release forecasts from the estimated situation of the unit.

These evaluations of the consequences to the environment are made either with the same computer codes as those of the operator, or with tools developed in AVN, so as to allow a validation of the results provided by the licensee. These various computer codes have been compared in terms of assumptions and calculation methodologies.

On April 28, 2004 an agreement was signed between Luxembourg and Belgium concerning the exchange of information in case of incidents or accidents with potential radiological consequences.

II.L.2.d. Information of the Public

The GRR-2001 specifies in its Article 72 all the obligations regarding training and information of the public pursuant to the Euratom 89/618 Directive.

During the accident itself, information is supplied to the media by the information cell of the CGCCR. At local level the provincial emergency plan includes the ways to inform the population (sirens, police equipped with megaphones, radio and television) and following-up the instructions given to the population (iodine tablets, sheltering, evacuation ,…).

II.M. Article 17. Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

(i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

(iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

(iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety

(v) impact on their own territory of the nuclear installation.

II.M.1. Characteristics taken into Account in the Sites Selection

The Doel and Tihange nuclear power station sites were originally evaluated according to the requirements set by the US rules (Chapter 2 of the Safety Analysis Report, Standard Review Plan, 10 CFR 100).

These requirements apply to the phenomena of natural origin (earthquakes, floods, extreme temperatures…) and to the phenomena of human origin (industrial environment, transports…).

With regard to the natural phenomena:

- The geological and seismic characteristics of the sites and their environment were specifically investigated so as to identify the soil characteristics and the earthquake spectrums in order to define the design bases to be considered when sizing the structures and systems.
- The hydrological characteristics of the rivers Meuse (Tihange) and Scheldt (Antwerp) were surveyed, not only to quantify the risk of floods and possible loss of the heat sink, but also in order to develop the river flow models in order to evaluate the impact on dilution of released liquid effluent.
- Meteorological and climatic surveys allowed defining the atmospheric diffusion and dispersion models to be used when assessing the short-term and long-term environmental impacts of atmospheric releases taking into account the local characteristics. These studies were complemented with demographic surveys in the vicinity of these sites.
- Concerning the population density around the sites, no detailed criterion was imposed originally. But the design of the installations made allowance for the existing situation: the “low population zone” of the USNRC rules is in fact within the site. Consequently the radiological consequences of incidents or accidents are calculated for the critical group living at the site border or in any other location outside the site where the calculated consequences are the largest.

Due to the very high source terms imposed by the U.S. safety rules, the design of the Belgian units incorporates strict demands on the containment leak rate (double containment with a steel liner for the primary containment) and systems to prevent liquid or gaseous leaks through the containment penetrations.

With regard to the external events of human origin:

- Due to the population density in the vicinity of the sites, and also considering the impact the local industrial activities may have on the power stations, specific requirements were adopted in 1975 : protection against external accidents such as civil or military aircraft crash, gas explosion, toxic gas cloud, major fire.
- The Tihange 2 and 3 and Doel 3 and 4 units were equipped with ultimate emergency systems aimed at automatically tripping the reactor, keeping it in hot shutdown during three hours so that after that period of time it may be possible to bring the unit to cold shutdown and remove residual heat, after a design basis external accident as referred to above, or during any loss of the normal control room or any of the systems that are controlled from it.
  These ultimate emergency systems are called "bunkerised systems" as they are installed in specifically reinforced buildings. They comprise an autonomous protection and instrumentation system supplied with electric power from dedicated emergency diesel-generator sets, as well as primary make-up (water with boric acid to control the reactivity) and steam generator feedwater systems.
  Measures were also taken to guarantee the emergency heat sink. At the Tihange site, the preferred option was to bore wells from where groundwater can be pumped, whereas at Doel three artificial lakes were created.
- Following the 2001 September 11 events, Electrabel and the Safety Authorities were brought to:
  - consider the eventuality of a voluntary aircraft crash on the Belgian Nuclear Power Plants,
  - identify which type of impact these plants would encounter,
  - determine the potential consequences of such impact,
  - consequently, adapt the in-depth defence strategy.

  From the studies performed on the potential consequences of an impact on each of the buildings of the plants of Doel and Tihange, it appears that:
  - the initial design of the last four units is good: no perforation of the external containment even with a Boeing 767 at a speed of 150 m/s,
  - the initial design of the reactor buildings of Tihange 1 and Doel 1-2 is relatively less resistant than those of the other more recent units: partial perforation of the external containment but without any consequence on the safety systems, even with a Boeing 767.
  - it is necessary to be able to fight a kerosene fire in order to avoid any damage at the structure of the building due to high temperature exposure. In accordance with the fire department and AVN, new equipments were bought and are now operable (special fire fighting truck with high pressure foam pumps) and are approved by the regulatory body.

II.M.2. Periodic Reassessment of the Site Characteristics

These reassessments are systematically performed during the periodic safety reviews of each unit.

During the 1st periodic safety review of Doel 1 and 2, as external accidents had not been considered in the initial design, additional emergency systems were installed in a reinforced building (the Bunker).

For the Tihange site, the safe shutdown earthquake originally considered (in the early seventies) for Tihange 1 was of 0.1 g intensity. This value was increased to 0.17 g following the Tihange 2 safety analysis (end of the seventies). As a consequence, the latter value was adopted for the site as a whole; it did not need to be modified when the Liège earthquake of 1983 was analyzed. The seismic reassessment of Tihange 1 was performed during its 1st periodic safety review in 1985.

This resulted in a considerable number of reinforcements being made in certain buildings, and in the seismic qualification of the equipment being re-examined (using the methodology developed by the US Seismic Qualification Utility Group).

Also, a review of the protection of Tihange 1 against external accidents was performed: the probability was assessed that an aircraft crash would result in unacceptable radiological consequences; taking into account the specificities of the buildings, that probability was found sufficiently remote.

During the periodic safety reviews of each of the units, studies are performed and, where necessary, measures are implemented to ensure that the residual risk following external accidents remains acceptable taking into account the environment of the site with respect to the risks resulting from transport (including by aircraft) and from industrial activities.

The protection against potential floods is being re-evaluated in the framework of periodic safety reviews as well as the possible rise in temperature due to climate changes.

II.M.3. International Agreements

The necessity to inform the neighbouring countries when planning a nuclear installation is stipulated by Article 37 of the Euratom Treaty, and as a consequence is mandatory in Belgium (cf. Article 6 of the GRR-2001). The reports drawn up to meet this requirement have been transmitted to the Commission of the European Union in the scope of the licensing procedures for the Belgian power stations. After discussion with its “Article 37” experts, the Commission issued a favourable advice for the sites of Doel and Tihange. Direct information of the neighbouring countries which might undergo notable consequences on their territory is an obligation deriving from the Euratom 85/337 Directive about the evaluation of the consequences on the environment due to some private or public projects.

II.N. Article 18. Design and Construction

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defense in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

The design of the Belgian nuclear power plants is described in Appendix 1 to the present Report, as well as the major modifications brought during the successive periodic safety reviews.

II.N.1. <u>Rules followed during Design and Construction</u>

As described in Article 7 of the present Report, the “Commission Spéciale Radiations Ionisantes” (i.e. the Belgian nuclear safety Commission, now replaced by the Scientific Council of the FANC) decided in 1975 that the USNRC rules should be followed for the construction of the next four units (Doel 3 and 4, Tihange 2 and 3) and that some accidents of external origin should be considered in the design.

The complete text of that decision was incorporated in Chapter I of the Safety Analysis Report of each unit; it thus becomes mandatory through the Royal Decree of authorisation of the units.

The whole design and safety analysis of these units have been done applying the US rules and all the associated documentation (regulatory guides, standard review plans, ASME Code, IEEE standards, ANSI, ANS, etc.) in order to ensure a consistent approach.

Article 8 of the present Report describes the licensing process. In order to show how the US rules had been followed, two appendices were created in Chapter 3 of the SAR, in addition to the standard format of Regulatory Guide 1.70. The first appendix explains how the mandatory rules have been followed and any deviation is pointed out and fully justified. The second appendix deals with the non mandatory rules and explains how they have been implemented, respecting the safety objectives.

All the US technical rules have been followed, except 10 CFR 20, because the corresponding topics are covered by the Euratom Directive on basic safety standards, which is obligatory for all member States of the European Union.

For pressure vessels which are part of the nuclear installation, a ministerial Decree of derogation has been established in order to replace Belgian pressure vessel regulations (“Règlement général pour la protection du travail”) by the US rules (ASME Code sections III and XI). A few components not covered by the ASME specifications but covered by the Belgian regulations had still to comply with the Belgian regulations.

A transposition of the ASME Code has been written to cover organisational aspects like the definition of an inspector, of the Authorised Inspection Agency (AIA), etc…

That transposition of the ASME Code clarifies also the conditions under which other construction or in service inspection codes (like French or German codes) can be used. Their equivalence must be justified, justification which must be agreed by the AIA and by the AIO (AVN).

The document of the Special Commission has also required that accidents of external origin be considered (i.e. aircraft crash, gas explosion, toxic gases, large fire).

The protection against explosions has been based on German rules.

For the aircraft crash the bunkerised structures have been designed to resist the impact of a civil airplane of about 90 tons at a speed of 85 m/s.

It was afterwards verified that these structures resisted also the impact of a military aircraft of about 13 tons at a speed of 150 m/s.

Taking into account the characteristics of air traffic along the US rules methodology, it was checked that the probability to go beyond the design criteria of the bunkerised structures was smaller than 10^{-7} per reactor year.

Similar verifications have been performed for the accidents of external origin.

It has been shown that the probability to exceed the design criteria was, for each family of external accidents, smaller than 10^{-7} per reactor year, and 10^{-6} per reactor year for all external accidents together.

The residual risk is a fortiori smaller, as exceeding the design criteria does not imply, with a probability equal to one, unacceptable radiological consequences.

II.N.2. <u>Rules followed during the periodic Safety Reviews</u>

As mentioned in Article 6 of this Report, the Royal Decree of Authorisation of each nuclear unit makes it mandatory to conduct periodic safety reviews. These safety reviews must "compare on the one hand the conditions of the installations and the implementation of the procedures that apply to them, and, on the other hand, the regulations, codes and practices in force in the United States and in the European Union.

The differences found must be highlighted, together with the necessity and possibility of remedial action and, as the case may be, the improvements that can be made and the time-schedule for their implementation".

Hence one of the topics of the periodic safety reviews is to examine the new rules, codes and practices at the international level and to decide which ones will be considered in the periodic safety reviews.

The topics to be studied in these safety reviews are detailed in a report submitted jointly by the licensee and AVN to the FANC; in this way the rules retained become obligatory.

The feedback of operational experience of nuclear power plants at the international level is also considered; in this respect the “Bulletins” and the “Generic Letters” of the USNCR, as well as information available from other regulatory bodies, are examined, if their follow-up has not yet been required in the frame of the permanent supervision during operation of the installation.

From this, one can conclude that all the new rules of the USNRC are not automatically applied in the Belgian plants, and that non-American rules, guides and practices can also be retained for implementation in Belgium. The corresponding topic of the periodic safety review must look after the consistency of the new requirements between themselves and with those of the original design.

The formal requirement to follow the U.S. rules for the construction of the nuclear units did not formally exist at the time of construction of Doel 1 and 2 and Tihange 1. However these units were designed respectively by Westinghouse and by Framatome, in the early seventies, and the U.S. rules have been applied de facto.

During their first periodic safety review in 1985, their state has been compared to the latest Belgian units which had just come into operation and in which the U.S. rules were implemented.

The Safety Analysis Reports of Doel 1 and 2 and Tihange 1 have been revised to put them in conformity to the U.S. standard format (R.G. 1.70) and harmonize in this way the information supplied for all Belgian nuclear units.

The list of technical subjects examined during the successive periodic safety reviews is given in extenso in Appendix 4 of this Report.

As new topics introduced in the periodic safety reviews corresponding to international practices, two examples are the probabilistic safety studies and the analysis of severe accidents.

For the latter AVN had in September 1986 requested the licensees to study severe accidents and consider in particular containment ultimate strength versus internal overpressure and identify weak points, hydrogen production problems, containment venting mechanisms and reactivity accidents. For the ultimate strength of the containment, margins were evaluated and some weak points eliminated. The studies on hydrogen production, on the means to counter it and on containment venting concluded that the installation of autocatalytic recombiners was the most adequate solution for these combined issues. The number and location of the recombiners were determined, with an extra margin for uncertainties. That topic of severe accidents was introduced in the periodic safety reviews, and it became in this way an obligation for the licensees to install these types of recombiners, a measure which is now effective in all Belgian plants.

II.N.3. <u>Application of the Defence in Depth Concept</u>

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 the 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 add an extra level of defence in depth 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 being performed.

II.N.4. Accident Prevention and Mitigation of Consequences

Accident prevention and mitigation of consequences are basic principles adhered to in the design of Belgian nuclear power plants, in accordance with the USNRC regulations.
In case of disturbance in the operation parameters of the plant, the control system will respond in order to return the plant to its nominal operation point.
In case of risk of reaching the safety limits, the reactor protection system will shut down the plant.

The engineered safety systems are activated to address the design basis accidents and achieve the safe shut down of the plant.

Consistent with the standard format of the Safety Analysis Reports, all the instrumentation and control systems are described in chapter 7, and incident- and accident analyses are discussed in chapter 15.

We shall bear in mind that the four more recent Belgian units (Doel 3 and 4, Tihange 2 and 3) are three-loop 1 000 MWe units that are designed with three independent safety trains (instead of two interconnected trains in a traditional design).

Apart from the Doel 1 and 2 units, in which the primary containment is a metal sphere, the primary containment of all other units is a prestressed concrete structure with on the inside a steel liner. The secondary containment is in reinforced concrete at all units. The annular space between the two containments is put at negative pressure after an accident, so as to collect possible leaks. There is an internal recirculation and filtration system in the annular space and the air is filtered again prior to release via the stack.

Here again the Belgian nuclear power plants present a significantly greater defence in depth than the traditional designs.

During the 90's, probabilistic safety studies were carried out for all the Belgian units. These studies were either level 1 with analyses of scenarios that could present a risk to the containment integrity, or level 2 studies (in this case with no source term calculation).

These studies considered reactor operation at power as well as in shut down states.

The results showed, among other, the value of having protection systems against external accidents. Indeed, these systems can act also in the event of failure of the traditional engineered safety systems; this considerably reduces the probability that certain initiating events could develop to the point of contributing to a core melt.

II.N.5. Application of Proven or Qualified Technologies

The safety-related structures, systems and components are subject to qualification programmes to the environment in which they are situated and operated (normal, test, incident, accident). The same is applied regarding seismic qualification. The programmes are described in the sections 3.10 and 3.11 of the Safety Analysis Report, and are consistent with the relevant US rules. Significant efforts have been made in this field, with tests in large qualification loops or on high-capacity seismic tables.

The results of all these tests are included in the "Manufacturing Records" of the qualified equipment, and are summarised in synthetic reports for later use.

For the design codes used by vendors or architect-engineers, audits are conducted by the AIO (AVN) to verify the qualification file and examine the experimental bases on which are founded the models and correlations of the code.

Particular attention is given to verifying and validating the software itself and the quality assurance programme applied to software production.

II.N.6. Requirements of Reliable, Stable and Easily Controllable Operation, taking into Account Human Factors and the Man-Machine Interface

In order to make easier the operation of their power stations and increase their availability, the Belgian operators frequently apply the redundancy principle even to the normal control functions, so as to avoid spurious signals in the event of a failure. Similarly, they install additional components in standby that can be quickly started or connected, so as not to have to shut down the power station in the event of significant unavailability of the first components.

As a post-TMI action, following NUREG 0737, the control room and its ergonomics were reassessed. The instrumentation used for post-accidental operation was identified more clearly, and the notion of SPDS (Safety Parameter Display System) was implemented in the control room (or in a room adjacent to it).

In the probabilistic safety studies, the tasks expected of the operators are detailed and modelled during the accident as well as during the post-accidental phase when the safe status of the unit is being restored. Following this critical review the existing procedures are possibly amended to increase their efficiency and ease of use, or new procedures are written (for instance for the no-load states). Furthermore, guidelines have been established to mitigate the consequences of severe accidents.

II.O. Article 19. Operation

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

(iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

(iv) procedures are established for responding to anticipated operational occurrences and to accidents;

(v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

(vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

(vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;

(viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

II.O.1. Initial Authorisation and Commissioning

The licensing process and the related safety analysis have been described in Articles 8 and 14 of the present National Report. For the 7 operating NPPs, the Royal Decree of Authorisation was signed by the King after it has been examined in detail by AVN, the "Commission Spéciale Radiations Ionisantes" (since replaced by the Scientific Council of the FANC) and the Safety Authorities (now the FANC).

The commissioning test programme was discussed and approved by the AIO (AVN), which followed-up the tests, evaluated the test results, verified the conformity to the design and issued the successive permits that allowed proceeding with the next step of the test programme.

This process was complete when the AIO (AVN) authorised the operation of the unit at full power.

II.O.2. Operational Limits and Conditions

As described before, the Technical Specifications are approved in the frame of licensing (chapter 16 of the Safety Analysis Report). They specify the operational limits and conditions, the availability requirements of the systems, the tests and inspections, and the actions to be taken if the acceptance criteria are not met. This applies to any state of the nuclear power plant.
There are procedures related to the respect of the Technical Specifications (T.S.) for maintenance activities during plant outage and plant operation. Each maintenance procedure has its own paragraph dedicated to T.S. requirements and limitations. During plant outages, some safety engineers are monitoring the requirements of the Technical Specifications. This monitoring is not only related to equipment but also to functions, like the integrity of the containment during refuelling, verification of the redundancy of the heat removal ways during RHR operation…

Each modification that may have an impact on safety must be approved by the Health Physics department before it can be implemented as explained in Article 14, § II.J.2.a. In this respect, modifications to procedures, to the Technical Specifications and to the Safety Analysis Report are identified and discussed.

II.O.3. Operation to Approved Procedures

A general description of the operation procedures is given in section 13.5 of the Safety Analysis Report.

The completeness (in format and contents) of the procedures has been examined based on Regulatory Guide 1.33 which lists the subjects for which procedures must be established. This examination was conducted in the scope of licensing and acceptance of the installations by AVN.

During the commissioning tests, the relevant procedures that were used by the operators were verified for adequacy.

II.O.4. Incident and Accident Procedures

A full set of incident and accident management procedures has been developed by the operator, with the help of the Architect Engineer and the designer of the Nuclear Steam Supply System. These procedures cover power operations and shutdown modes.

These procedures are validated on a simulator and are used for operator training. This point was already discussed in Article 12, § II.H.1 of the present National Report.

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 of the control room operators was developed in parallel.

II.O.5. <u>Engineering and Technology Support</u>

The organisation and know how of the operator, defined in chapter 13 of the Safety Analysis Report, must be maintained throughout the useful life of the power station, and even after its definitive shutdown as long as this new status is not covered by a new licence. From the point of view of engineering the licensee gets the help of Tractebel Engineering (TE). TE has indeed an excellent knowledge of the installations as it was the Architect-Engineer during the construction. Moreover TE has been in charge of the studies and their implementation during the periodic safety reviews, which take place on a periodic basis, of the steam generators replacement projects and of a large part of minor modifications projects, which allowed to maintain competence and knowledge of the installations.

The Operator also often asks the advice of TE when the latter wants to proceed to even a minor modification of its installation. TE is also in charge of the follow-up of the provisioning of fuel reloads and of core management. Through its R&D projects, training actions and technological surveys, TE maintains a high competency in conformity with the state of the art. In order to reach these goals, TE participates in international research projects and is a member of various networks (or competency centres).

Recently, the relationship between the Operator and TE has evolved into a close partnership. In this partnership, TE can be considered for a number of activities as a Core Assist, in which the operator gives a mandate to TE to perform the identified activities for the Operator on a structural and on-going basis. Other activities are identified as Core Support in which the Operator will systematically call upon TE in the case of a specific activity may occur. Examples of the first type of partnership (Core Assist) are the safety and licensing, including studies, follow-up, ..; regulatory watch, FSAR update management. Examples of Core Support are General Assistance in Operations and Management of nuclear installations, plant life management studies, …

The design bases of the plants, i.e. the knowledge of the design of the plants and the reasons of the choices made in this design are an important part of the knowledge.

II.O.6. <u>Notification of Significant Incident</u>

Section 16.6 of the Safety Analysis Report lists the events that must be notified to the AIO and to the Safety Authorities, indicating for each notification within what delay it must be notified.

The same section also specifies the cases where incident reports must be supplied to the AIO, and within what time period.

For each incident, a classification with reference to the INES international scale is proposed by the operator, discussed with AVN, and decided by the FANC.
The IRS reports are established by AVN for the incidents it considers interesting (see Article 8, § II.D.3.b) for the international community.

II.O.7. <u>Operational Experience Feedback</u>

Application of experience feedback has always been considered essential to plant safety, by the operators, the AIO and the FANC. In Article 10 and Article 12, § II.H.4 of the present Report, the organisations set up within the operator and within AVN have been described.

It shall be borne in mind that the decrees of authorisation stipulate that experience feedback from the Belgian and foreign units be considered. Incident analysis includes root cause evaluation, the lessons learnt and the corrective actions taken.

Databases have been developed - in particular by AVN - to systematise experience feedback

II.O.8. Generation of Radioactive Waste

See Belgian report in the frame of the Joint convention.

II.O.9. Temporary Storage of Used Fuel

See Belgian report in the frame of the Joint convention.

III. APPENDIX 1 : DESCRIPTION OF THE NUCLEAR INSTALLATIONS

(NOT INCLUDED IN THIS VERSION)

IV. APPENDIX 2 - LIST OF ABBREVIATIONS

IV.A. List of Abbreviations

AIA	Authorised Inspection Agency.
AIO	Authorised Inspection Organisation.
ALARA	As Low As Reasonably Achievable.
ANS	American Nuclear Standards.
ANSI	American National Standards Institute.
ASME	American Society of Mechanical Engineers.
ASSET	Assessment of Safety Significant Events Team (IAEA).
AVN	Association Vinçotte Nuclear.
BS	Basic Standards.
CGCCR	Comité Gouvernemental de Coordination et de Crise, (i.e. the Governmental. Centre for Co-ordination and Emergencies).
CIPR/ICPR	Commission Internationale de Protection Radiologique (i.e. International Commission for Radiological Protection).
CNRA	Committee of Nuclear Regulatory Activities (NEA/OECD).
CNT	Centrale Nucléaire de Tihange (i.e. Tihange Nuclear Power Plant)
CSNI	Committee on the Safety of Nuclear Installations (NEA/OECD).
ECURIE	European Community Urgent Radiological Information Exchange.
EDF	Electricité de France.
EU	European Union.
FANC	Federal Agency for Nuclear Control.
FBFC	Franco-Belge de Fabrication de Combustible (i.e. Franco-Belgian Company for Fuel Manufacturing).
FINAS	Fuel Incident Notification and Analysis System (NEA/OECD).
FRG	Function Restoration Guidelines.
FSAR	Final Safety Analysis Report.
GRR-2001	General Radioprotection Regulation for the protection of the workers, the population and the environment, issued in 2001 by Royal Decree of 20 July 2001.
GRR-1963	General Radioprotection Regulation for the protection of the workers, the population and the environment, issued in 1963 by Royal Decree of 28 February 1963.
HPD	Health Physics Department.
IAEA	International Atomic Energy Agency.
IEEE	Institute of Electrical and Electronics Engineers.
INES	International Nuclear Event Scale (IAEA).
INPO	Institute of Nuclear Power Operations.
INSAG	International Nuclear Safety Advisory Group.
IRE	Institut des Radio-éléments.
IRRT	International Regulatory Review Team (IAEA).
IRS	Incident Reporting System (NEA/OECD-IAEA).
KCD	Kerncentrale Doel (i.e. Doel Nuclear Power Station).
MOX	Mixed-oxide U02-Pu02.
NDA	Non Destructive Analyse.
NDTT	Nondestructive Testing Technology.
NEA (OECD)	Nuclear Energy Agency (OECD).
NORM	Naturally Occurring Radioactive Material.
NPP	Nuclear Power Plant.
NRWG	Nuclear Regulators Working Group.

NUSS	Nuclear Safety Standards programme (IAEA).
NUSSC	Nuclear Safety Standards Committee (IAEA).
ONDRAF/NIRAS	Organisme National pour les Déchets Radioactifs et les Matières Fissiles Enrichies/ Nationale Instelling voor Radioactive Afval en verrijkte Splijtstoffen (i.e. Belgian Agency for Radioactive Waste and Enriched Fissile Materials).
ORG	Optimal Recovery Guidelines.
OSART	Operational Safety Review Team (IAEA).
PAMS	Post Accident Monitoring System.
Q.M.	Quality Monitored.
RASSC	Radioprotection Safety Standard Committee.
R.D.	Royal Decree.
REX	Retour d'expérience (i.e. Operational Experience Feed-back).
RGPT	Règlement Général pour la Protection du Travail (i.e. Belgium's Occupational Health & Safety Regulations).
RHR	Residual Heat Removal.
RHRS	Residual Heat Removal System.
SCK•CEN	Centre d'Etudes de l'Energie Nucléaires/Studiecentrum voor Kernenergie, Nuclear Research Centre, situated at Mol, Belgium).
SENA	Société d'Energie Nucléaire Franco-Belges des Ardennes.
SPDS	Safety Parameter Display System.
SPRI	Service de Protection contre les Radiations Ionisantes (i.e. Department of Protection against Ionising Radiation).
SSE	Safe Shutdown Earthquake.
SSTIN	(i.e. the Technical Safety Department for Nuclear Installations).
STA	Shift Technical Advisor.
STAR	Stop-Think-Act-Review.
TE	Tractebel Engineering.
TMI	Three Mile Island.
TRANSSC	Transport Safety Standard Committee.
TRC	Technical Responsibility Centre (AVN).
USNRC	United State Nuclear Regulatory Committee.
WANO	World Association of Nuclear Operators.
WASSC	Waste Safety Standards Committee (AIEA).
WENRA	Western European Nuclear Regulator's Association.
CNT	Centrale Nucléaire de Tihange (i.e. Tihange Nuclear Power Site).

V. APPENDIX 3 - LIST OF THE WEB SITES OF THE DIFFERENT NUCLEAR ACTORS IN BELGIUM

1. Safety Authority and Authorised Inspection Organisation

Federal Agency for Nuclear Control:	http://www.fanc.fgov.be	(site in French Dutch and English)
Association Vinçotte Nuclear:	http://www.avn.be	(site in French, Dutch and English)

2. Licences, Architect-engineers, Research Centres

Electrabel:	http://www.electrabel.com	(site in French, Dutch and English)
Tractebel Engineering:	http://www.tractebel-engineering.com	(site in English)
Belgatom:	http://www.belgatom.com	(site in English)
SCK•CEN:	http://www.sckcen.be	(site in English)
Belgonucleaire:	http://www.belgonucleaire.be	(site in French, Dutch and English)
Belgoprocess:	http://www.beloprocess.be	(site in English)
ONDRAF/NIRAS:	http://www.nirond.be	(site in French and Dutch)

3. Associations

Belgian Nuclear Society:	http://www.sckcen.be/bns	(site in English)
Association Belge de Radioprotection (ABR):	http://www.bvsabr.be	(site in French and Dutch

4. Others

WENRA (Western European Nuclear Regulators Association) : http://www.wenra.org

VI. APPENDIX 4 – SUBJECTS EXAMINED DURING THE PERIODIC (TEN-YEARLY) SAFETY REVIEWS

VI.A. Subjects examined during the First Periodic Safety Reviews of the Doel 1, 2 and Tihange 1 Units

The following subjects have been examined:

1. protection against accidents of external origin and industrial risks
2. re-definition of the design earthquake
3. high-energy line break
4. fire protection
5. flooding, of internal or external origin
6. high winds and extreme climatic conditions
7. differential settlement between structures
8. systems having safety-related functions to shut the reactor down, for core cooling and for evacuation of residual power:
    - reactor protection system
    - safety systems: emergency feedwater supply to the steam generators,
    - shutdown cooling system, safety injection, spray or internal ventilation inside containment, emergency control room and auxiliary shutdown panel.
    - steam relief to atmosphere
    - ultimate heat sink
    - safety compressed-air
    - emergency electrical power
    - resistance and integrity of various systems
    - safety systems instrumentation
    - primary system leak detection
    - detection of inadequate core cooling
    - seismic and environmental qualification of safety systems
9. primary system integrity:
    - protection against cold and hot overpressure
    - protection against pressurised thermal shock
    - pressure vessel venting
    - integrity of primary pump seals
    - leak detection
    - boric-acid induced corrosion
    - list of actually incurred transients
10. nuclear auxiliary building: protection against post-accident radiation
11. inspection of structures and equipment (mechanical, electrical, civil works)
12. test programme
13. technical specifications
14. operation organisation
15. quality organisation
16. spent fuel handling and storage
17. gaseous effluent treatment and ventilation systems
18. isolation and leak-tightness of primary and secondary containments
19. hydrogen control inside containment

20. operation experience feedback
21. accident analysis review
22. radiation protection and ALARA
23. post-accident sampling in the reactor building
24. updating of documentation, including amendment of the Safety Analysis Report.

VI.B. Subjects examined during the First Ten-yearly Safety Reviews of the Doel 3, 4 and Tihange 2, 3 Units, and Second Ten-yearly Safety Review of Tihange 1

1. conformity to the design bases: re-evaluation of the environment
2. protection of electric safety circuits against lightning
3. verification of extreme climatic conditions
4. impact of the modifications made to the installations on the original “High Energy Line Break” (HELB) study
5. loadings combinations on the structures
6. anchorage of safety equipment
7. use of the results of the qualification of mechanical equipments : components with a limited lifetime
8. verification of the post-accident operability of pneumatic actuators
9. dimensioning of miniflow lines of safety related centrifugal pumps
10. post-TMI II.D.1 recommendation (mechanical resistance of the pressuriser discharge line)
11. instability of the pressuriser safety valves during passage of the water plug
12. qualification of the relief and block valves of the pressuriser
13. taking into account secondary effects in the calculation of pipe supports in “Level D”
14. thermal environment of electric equipment
15. qualification of electric connectors: containment penetrations
16. post-TMI II.F.2 recommendation (RM chains)
17. follow-up of the US rules and practices
18. general procedure for reloads safety justification
19. follow-up of operational transients
20. shift of the setpoint of the pressuriser safety valves
21. pressure vessel embrittlement
22. thermal ageing of stainless steel
23. primary pumps: re-evaluation of the axial bearing
24. risk of recirculation sump clogging during accidents
25. containment spray water chemistry
26. measurement of the containment free volume
27. depressurisation of the safety injection accumulators
28. availability of the LHSI pumps during recirculation
29. manual initiation of the primary containment spray
30. subcooling measurement with core thermocouples to be qualified in the context of post-TMI II.F.2 recommendation
31. verification of the response time of sensors
32. protection of diesel groups in case of emergency signal
33. availability of diesel groups during the sequence “SI signal followed by the complete loss of external electric grid”
34. overspeed protection of the emergency diesels
35. availability of motors under degraded voltage conditions
36. verification of the diesels loads
37. loss of low voltage busses: procedures

38. evaluation of the tightness of pool joints
39. evaluation of the fire detection and protection
40. ALARA policy
41. post-TMI II.B.2 recommendation (post accident accessibility)
42. revision of the programme for the training and licensing of the personnel
43. re-evaluation of the tightness tests of the recirculation lines
44. functional tests of the shock-absorbers
45. assessment of the periodic tests of pumps, valves and check-valves
46. test console for logic and analogic protection signals
47. global tests
48. welding of the safe-ends on the pressure vessel nozzles
49. pressure vessel inspection: underclad defects in the nozzles
50. impact of the stainless steel cladding on the pressure vessel inspections with u.s.
51. wear of the control rods
52. corrosion of the reactor baffle screws
53. corrosion of the guide tube pins
54. follow-up of the internal structures of the pressure vessels by analysis of neutronic noise
55. inspection of the steam generators: tube sheet — evacuation of the risk of underclad cracks
56. welding of the partition plate on the water box on the tube sheet and the bottom of the steam generators
57. steam generators: weld between the upper ring and the transition cone
58. corrosion problems of valve bolts
59. control of the pipe whip restraints
60. internal corrosion of the SI accumulators
61. post-earthquake procedure
62. evolution of the ASME Code section XI
63. ASME code section XI: appendices 7 and 8 (ultrasonic inspections)
64. steam generator problems: limitation of the primary/secondary leak
65. evaluation of the conclusions of generic studies of accidents not considered in the original design
66. consideration of severe accidents
67. probabilistic safety analysis
68. re-evaluation of the Technical Specifications
69. assessment of the implementation of the Q.A. programme
70. software quality assurance
71. quality organisation: Safety Evaluation Committee
72. feedback of operating experience from Belgian and foreign plants
73. assessment of incidents and synthesis of their causes
74. evaluation of the modifications which can impact safety
75. analysis of the influence of the emergency systems
76. evaluation of voluntary inspections
77. operator aids: shutdown mode
78. operator aids during accidents
79. primary breaks in modes 3 and 4

80. thermal stratification in the pressuriser surge line
81. thermal stratification in the main feedwater lines and their connection on the steam generator
82. check valves: generic problems

VI.C. Subjects examined during the Second Ten-yearly Safety Reviews of Doel l and 2

1. ageing of electric equipment
2. ageing of mechanical equipment
3. ageing of the pressure vessel and of the primary circuit
4. ageing of concrete structures
5. ageing of the steam generators
6. pressure vessel irradiation
7. availability of the recirculation function
8. antisiphoning system of the fuel pools
9. seismic qualification
10. qualification of safety related equipments
11. qualification of high energy lines
12. thermal stratification in the pressuriser surge line
13. classification of safety-related equipments
14. thermal stratification of feedwater lines
15. qualification of the auxiliary feedwater system
16. secondary overpressure
17. loadings combinations in the reactor building cells
18. implementation of ASME 1992
19. re-evaluation of the Technical Specifications
20. fire protection re-evaluation
21. toxic gases protection re-evaluation
22. improvement of the availability of the safety diesels
23. dismantling
24. ALARA
25. software QA
26. overlapping of tests for safety instrumentation
27. quality assurance
28. valving systems
29. corrosion due to boron
30. lightning protection
31. operational transients
32. protection of motors (undervoltage)
33. response time of radiological protection chains
34. integrity of underground lines
35. shielding of the radiological protection chains
36. feedback of operating experience
37. in service inspection
38. procedures after earthquakes
39. post accident procedures
40. severe accidents
41. probabilistic safety analysis
42. reassessment of accidents
43. transport container for spent fuel assemblies
44. setpoint statistical study

45. re-evaluation of the environment
46. inter-systems LOCA
47. radiological consequences
48. operational problems: follow-up of the pressure vessel internals

VI.D. Subjects examined during the Second Ten-yearly Safety Reviews of Doel 3 and Tihange 2, subjects to be examined during the Second Ten-yearly Safety Reviews of Doel 4 and Tihange 3, and subjects to be examined during the Third Safety Reviews of Doel 1 and 2, and Tihange 1

1. follow-up of US rules and practices
2. definition of a source term for the reference accident
3. post-'92 evolution of Asme XI Code OM
4. re-evaluation of the conformity of the Single Failure Proof cranes with current standards
5. re-evaluation of the Technical Specifications for the waste treatment building (WAB) et the Doel site
6. re-evaluation of the Technical Specifications of Tihange 1
7. re-evaluation of the Technical Specifications of Doel 1-2
8. evolution of the environment and its impact
9. re-evaluation of the impact of extreme climate conditions
10. re-evaluation of the seismic level on the basis of recent investigations
11. risk related to external flooding
12. risk related to internal flooding
13. systematic approach to assess the fire and explosion risk
14. re-evaluation of ultimate heat sink (wells) at the Tihange site
15. update of the PSA models
16. safety analysis for shutdown modes
17. follow-up of knowledge with respect to severe accidents
18. analysis of the safety impact of flow dissymmetry between primary loops
19. evaluation of main discrepancies w.r.t. the Position Paper on the application of the single failure criterion for the oldest units only :
    - electrical support systems (Doel 1 and 2)
    - safety related systems (Doel 1 and 2)
    - heat sink (Tihange 1)
    - plant air (Tihange 1)
20. updating accident procedures
21. procedure for incidents during fuel handling
22. procedure for loss of ultimate heat sink
23. updating of incident procedures
24. evaluation of PAMS measuring uncertainties
25. availability of safety related components
26. leak tightness of feedwater isolation valves
27. follow-up of prestressing of the primary containment
28. re-evaluation of the safety related ventilation
29. reassessment of containment isolation
30. pressurizing, of isolated piping in containment during accident conditions
31. reassessment of ventilation for emergency building (Tihange 2)
32. reassessment of ventilation for waste treatment building
33. structural integrity reassessment of emergency buildings

34. tests and criteria for safety related valves pumps, and diesels (Doel 1 and 2, and Tihange 1).
35. evaluation of radiation exposure of plant operators during an accident
36. isolation of normal feedwater (Tihange 1)
37. optimization of containment spray lay-out (Tihange 1)
38. containment spray additive (D12)
39. application of ASME XI, Appendix OM to liquid discharging spring loaded safety valves
40. verification of the efficiency of safety related heat exchangers
41. follow-up of the pressure vessel embrittlement and protection against cold overpressure
42. follow-up of ageing of guide tube split pins, of radial guides of the reactor vessel internals, of baffle bolts, of cast elbows, of safety related equipment, of temperature measurement probes in the primary loot by-pass, of CVCS heat exchangers and of elastomer supports
43. follow-up of equipment fatigue (including thermal stratification)
44. follow-up of corrosion phenomena in piping and line mounted equipment
45. renovation of I/C systems and safety related components
46. renovation of structures and buildings
47. renovation of fire protection systems
48. training of personnel and knowledge management
49. design basis retrieval
50. optimisation of ALARA policy
51. qualification of software systems against smoke

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