Kingdom of Belgium

Third meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

May 2009

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 ONDRAF/NIRAS, Electrabel, Bel V and the SCK•CEN.

Content

1 Section A: Introduction

1.1 General context

On 8 December 1997 Belgium has signed the Joint Convention. The Belgian legislator has expressed its consent with the obligations resulting from the Convention by the Law of 2 August 2002. The ratification followed on 5 September 2002. The Convention became effective on 4 December 2002, i.e. 90 days after the Ratification.
Belgium belongs to the group of Contracting Parties having at least one operational nuclear power plant on their territory. Belgium has indeed developed an important nuclear energy programme, which includes at present 7 operational nuclear power plants producing a joint electric potential of approx. 6116 MWe (end 2006). The political authorities have regularly assessed the future of this nuclear energy programme, for instance according to the progress made in the management of the radioactive waste produced by these nuclear power plants. Already in 1975, the Belgian Government has installed an important committee of experts, better known as the "Commissie van Beraad inzake Kernenergie" (deliberation committee on nuclear energy). One of the recommendations of this committee was to assess the continuation of the nuclear energy programme once every ten years.
Since then, these assessments have been organised on several occasions, for instance during the Parliamentary Energy Debate in the period 1982-1984 and by the 'Parlementaire Commissie van Informatie en Onderzoek inzake Nucleaire Veiligheid' (Parliamentary Information and Investigation Commission in the field of Nuclear Safety) between 1988 and 1990. Through its approval - in October 1990 - of the recommendation mentioned below, the Senate has clearly expressed the wish to pursue these assessments:

“Once every ten years the waste issue should be thoroughly assessed. This assessment will be contributory to the future of the nuclear programmes.”

This tradition of assessing the nuclear energy programme was extended through the establishment of a "parlementaire onderzoekscommissie naar de opportuniteit van de opwerking van de bestraalde splijtstof en het gebruik van MOX-splijtstof" (Parliamentary Investigation Commission on the Opportunity of the Reprocessing of Spent Fuel and the Use of MOX fuel), which has deposited its conclusions in December 1993. Finally, the activities of the ‘Commission for the Analysis of the Means of Producing Electricity and the Re-evaluation of Energy Vectors', better known as the Commission AMPERE have to be mentioned. This Commission was installed by the Government in April 1999; its final report - containing a new assessment of the future of the nuclear electricity production – was published in October 2000.

By means of the Law of 31 January 2003, the Political Authorities have finally chosen to abandon the use of fission nuclear energy for industrial electricity production; this was done by prohibiting the building of new nuclear power plants and by limiting the operational period of the existing nuclear power plants to 40 years. This law will indeed have considerable consequences for the future of the nuclear sector in Belgium, but, in the short term, it will not have any implications for the radioactive waste management sector.

Belgium is a member of the IAEA and the NEA. Its representatives take an active part in the activities regarding radioactive waste management, such as the Radioactive Waste Management Committee (RWMC) of the NEA and the Waste Safety Standards Committee (WASSC) of the IAEA.

1.2 Structure and content of the report

This national report, submitted to the third review meeting of the contracting parties to the Joint Convention, is established pursuant article 32 of the Convention. It is based on its first and second edition. Particular emphasis has been put to clearly include relevant elements related to the questions which were raised during the second review meeting by other contracting parties, facts and events that occurred during the last two and a half years and that characterize the evolution in that period of time, as well as updates of the action devoted to the improvement of safety, related to section K of the report.

In addition, in order to underline relevant evolution since the last review meeting, a new section, 1.3 has been added, focusing on new developments since the last report.

The following nuclear actors have participated in drafting and review:

- ONDRAF/NIRAS, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials, in charge of the management of radioactive waste,
- FANC, the Federal Agency for Nuclear Control, the nuclear safety authority,
- Bel V (created by the FANC and staffed with experts transferred from Association Vinçotte Nuclear), subsidiary of the FANC,
- Electrabel, the operator of the seven nuclear power plants and responsible for the interim storage on site of the spent fuel,
- Synatom, the owner of the nuclear fuel from its fabrication to its transfer to ONDRAF/NIRAS when declared as radioactive waste,
- SCK•CEN, the Belgian Nuclear Research Centre, operating research reactors and dismantling a former PWR research reactor.

Together these actors gather the legal and practical competence necessary to collect and structure the information required to elaborate the national report.

The report is structured according to revision 1 of the guidelines INFCIRC/604 (19/7/2006).

The report will be available on different Belgian Websites, such as www.fanc.fgov.be, www.nirond.be, www.belv.be.

1.3 Main achievements since the last report (2005)

This section intends to highlight the main evolutions that have occurred since the last report:

a) The decision of the Council of Ministers for a Surface Repository for SL-LILW at Dessel;
b) The reorganisation of the Federal Agency for Nuclear Control;
c) The change of the status of AVN and the creation of Bel V as the new Belgian technical support organisation;
d) The WENRA harmonization initiative;
e) The Decommissioning License of Belgonucleaire;
f) The Operating License of the PAMELA installation;
g) The Royal Decree transposing the European Directive 2003/122/Euratom;
h) The Royal Decree reorganizing the Civil Safety;
i) progress in the remediation of the OLEN site;
j) progress in the dismantling of the EUROCHEMIC Facility;

k) The first Periodic Safety Review of Belgoprocess.

The table at the end of this section gives an overview of the current liabilities in Belgium.

a) Decision of the Council of Ministers for a Surface Repository for SL-LILW at Dessel

The council of Ministers, in its decision of 23 June 2006 regarding the disposal of category A waste (short lived low and intermediate level radioactive waste) on the Belgian territory, requested the National Agency for Radioactive Waste and enriched fissile materials (ONDRAF/NIRAS) to develop an integrated project of a surface disposal facility for category A waste in Dessel. As a result of this decision, ONDRAF/NIRAS launched an integrated project. This integrated project entails not only a disposal facility but also a waste post-conditioning facility and the realisation of the accompanying conditions set out by local stakeholders. A global view on the future disposal facility implanted on the Dessel site near to Belgoprocess is given in Figure 1. An overview of the disposal facility is given in Figure 2. The aims of the project phase are:

- to prepare and submit a license application for a disposal facility in Dessel, based on regulatory guidance on disposal from the FANC that is currently under development,
- to prepare and submit a license application for production facility for monoliths in Dessel,
- to reach a binding agreement between all parties concerned.

These aspects are treated more in detail in sections 2.3, 2.4.2 and 8.3.2.

Figure 1: Global view on the future disposal facility (during the operational period) implanted on the Dessel site near to Belgoprocess.

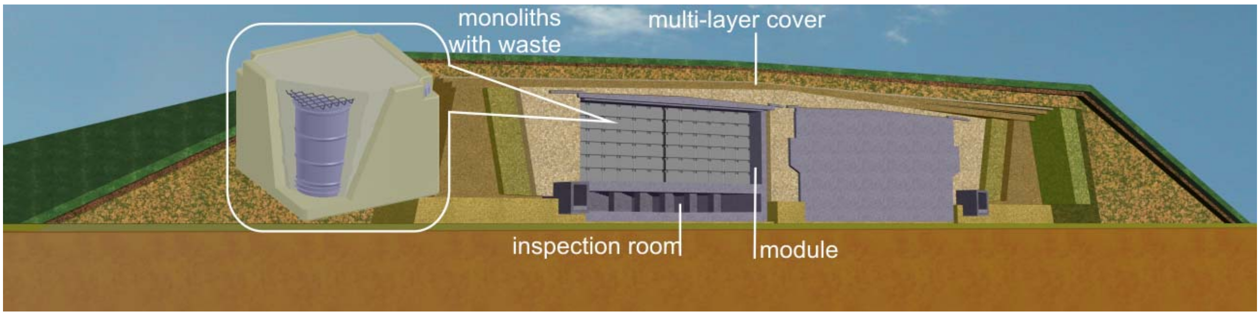

Figure 2: General overview of disposal facility with multi-layer cover installed (during the operational period, there is a fixed steel roof attached to the modules)

In the decision of 23 June 2006 of the council of Ministers, the Federal Agency for Nuclear Control (FANC) was requested to develop a licensing process taking into account the specific character of a surface repository for radioactive waste, to develop and communicate to ONDRAF/NIRAS the elements that the FANC deems necessary to proceed with the safety assessment (development of regulatory guidance).

In addition it was requested to prepare and present to the government the modalities deemed necessary to organize in the future the collaboration with the regional authorities competent for environmental protection.
The FANC was also mandated to conduct a formal and documented follow-up of the work of ONDRAF/NIRAS and a systematic analysis of issues concerning the safety of the selected integrated project (the concept of the association STOLA-Dessel, "STudie and Overleggroep Laagactief Afval Dessel", the partnership between the municipality Dessel and ONDRAF/NIRAS concluded in 1999).
In order to carry out these tasks, an addendum to the cooperation agreement of 1 October 2003 between ONDRAF/NIRAS and the FANC was signed by the two parties on February 14, 2007. It sets the modalities related to the planning of work, the documents to be supplied and the documentation management.

For managing these tasks in an effective and efficient way a specific project was launched by the FANC.
The implementation of the assessments of the long-term and operational radiological safety requires the FANC to complete and develop a number of formal elements of regulation. These elements should be available as early as possible in the process and ideally remain unchanged during the entire assessment process.
They will constitute the basic requirements that ONDRAF/NIRAS must take into account in the preparation of the license application, scheduled to be introduced by 2010.

This work is presently ongoing in the FANC and has a high priority.

b) The reorganisation of the FANC (September 2007)

A new organisation of the FANC became into force on 1 September 2007. It is now subdivided into four operational departments.

The department `*Regulation, International Affairs & Development*' is in charge of the development and the follow-up of the regulations. It is also in charge of:

- stimulating, following and carrying out studies and the developments necessary 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.

The missions of the department `*Facilities & Waste*' are specifically related to the safety of nuclear facilities, the safety of radioactive waste management, the recognition of qualified experts in health physics control as well as the supervision of Bel V and the Recognized Bodies for health physics control.
The first mission includes the review and assessment of the license applications. This mission consists in ensuring that ionizing radiation can be used in a safe manner and that a license can be granted.
A second mission involves the inspections and the investigations to verify that the activities are carried out in compliance with the licensing conditions and, in a more general way, with the regulations in force.
In addition, the department must also track down any illegal activity carried out without authorization.
A third mission includes the preparation of a legal and regulatory framework for the long-term management of radioactive waste of different categories, and in the future the licensing of disposal facilities.

The department `*Security & Transport*' is responsible for the physical protection of nuclear materials as well as Non Proliferation and Safeguards, and for the transport, import, transit and export of radioactive material. Here also, the licensing activities as well as the inspection activities have been integrated in the same department, 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 related to the protection of man and his environment (including the management of the radiological monitoring 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 surveillance of the territory, the national nuclear emergency plan and the clean up/restoration of contaminated sites.

c) The creation of Bel V

Although there has been a good operational cooperation between the FANC and the former recognized body for health physics control AVN on the practical field, the legal status and the relations between the FANC had to be strengthened and clarified.
Up to recently, this recognized body had the status of a non-profit organisation. It performed mainly the following tasks :

- safety inspections (health physics control activities) at mainly Class 1 facilities, by delegation of the FANC;
- handling of small modifications to the installations (approval of the modification, verification of the commissioning of the modification, approval of the modification of the safety analysis report);
- verification of commissioning of new installations or major modifications authorized by Royal Decree;

- review and assessment of new license 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.

This situation, although having a good working record, raised some issues needing improvement:

- the mandate of AVN, which acted by delegation from the FANC, was under the transitory regime foreseen by the Law of 15 April 1994; it had to be renewed on an annual basis. This situation made it difficult for AVN to manage a technical expertise and a qualified inspection team on the long term;
- AVN supervised the Belgian Class 1 facilities for more than 30 years. It is clear that this unique knowledge of the Belgian nuclear installations must be preserved;
- due to the independency and the private status of AVN, the FANC should normally have to proceed to a 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);
- AVN charged directly the licensees for its inspection activities.

In addition, the Parliamentary Commission of Internal Affairs in charge of Nuclear Safety recommended that the recognized bodies for health physics control should get the status of a subsidiary of the FANC, being in charge of the tasks that they currently carry out under the responsibility and control of the FANC.

The "Bel V" foundation, a 100% subsidiary of the FANC has been created on 7 September 2007. On 11 April 2008, AVN and Bel V have concluded an agreement for the transfer of the health physics control activities of AVN to Bel V.
On 14 April 2008, this transfer became effective: 45 people from AVN, from wich 35 high-level scientists have been transferred to Bel V. The total staffing of the Belgian regulatory body (FANC + Bel V) amounts now up to approximately 200 people.

This change in the regulatory structure was presented at the 4th meeting of the Contracting Parties to the Convention on Nuclear Safety (April 2008) and was considered as an improvement.

d) The WENRA harmonization initiative

WENRA is a non-governmental association set up by the Heads of the Nuclear Regulatory Authorities of European countries with nuclear power plants. Currently, the regulatory authorities of 17 countries are members of WENRA. WENRA has two active working groups: the RHWG (Reactor Harmonization Working Group) and the WGWD (Working Group on Waste and Decommissioning).

The WGWD made an extensive study on the nuclear safety requirements related to waste and spent fuel storage and to the decommissioning of nuclear facilities. This resulted in the publication of two reports which present the safety reference levels for radioactive waste and spent fuel storage facilities and for the decommissioning of nuclear facilities. These safety reference levels are thought to be a good basis for harmonization of safety approaches on a European level.

For waste and spent fuel storage, 77 reference levels were issued in December 2006, for 4 safety

areas: Safety management, Design, Operation and Safety verification.
For decommissioning 81 reference levels were issued in March 2007, for 4 safety areas: Safety management, Decommissioning strategy and planning, Conduct of decommissioning and Safety verification.
More information can be found on: www.wenra.org.
A benchmarking of the WENRA reference levels has been going since 2007. Every country assessed the conformity of the existing national regulations with the safety reference levels and guides and the implementation of the reference levels in the existing facilities.

As expected, the global result of the benchmarking exercise for Belgium is similar to that of the RHWG. On the legal side, a minority of the safety reference levels are already included in the Belgian nuclear safety regulations. The Belgian legal and regulatory system is specific: there is no regulation regarding Nuclear Safety, but the License (Royal Decree) contains obligations to conform to the SAR. The SAR was not considered as a legal implementation in the WENRA benchmarking, because it is not public.
On the implementation side, the large majority of the safety reference levels are complied with in the facilities.
In the near future, the regulatory body will start projects to adapt the regulations and the practices on the field to the WENRA reference levels.

e) End of Operation and Decommissioning License for Belgonucleaire

BELGONUCLEAIRE has been operating a MOX-fuel manufacturing facility in Dessel from the mid-80's at industrial scale. In this period, over 35 tons of plutonium was processed into almost 100 reloads of MOX fuel for commercial West-European Light Water Reactors.
At the end of 2005, it was decided to halt the production because of the shortage of MOX fuel market remaining accessible to Belgonucleaire after the successive capacity increases of MOX-plants in France and the UK. Belgonucleaire definitively ended its production activities in the MOX-factory in mid-2006.
According to the Royal Decree of 20 July 2001 a decommissioning license must be granted before starting the actual decommissioning activities of nuclear facilities. A decommissioning license application was submitted to the FANC in April 2006. Such license application also deals with the disposal, the recycling or the reuse of the materials which can be removed, after possible decontamination, from these installations. The decommissioning safety case contained a risk evaluation of the potential decommissioning risks: criticality, fire and loss of containment, in addition to the common risks of industrial activities (load drops, injuries, etc).
Following review of this license application by the FANC and the Scientific Council, and following consultation of the local authorities, a decommissioning license was granted by Royal Decree on 26 February 2008. This decommissioning license sets the conditions to ensure the safe decommissioning of the MOX-plant, with specific attention to:

- the use of subcontractors with necessary training and experience;
- the use of best available glove box cutting and dismantling techniques;
- the clearance of decommissioning waste and final release of the site.

As a significant part of the decommissioning project of this Dessel plant, about 170 medium-sized glove-boxes are to be dismantled. Different options for the decommissioning of the alpha-contaminated glove boxes were investigated by Belgonucleaire. The selected strategy consists in using cold cutting techniques and manual operation in shielded disposable glove-tents, and packaging alpha bearing waste in 200-liter drums for off-site conditioning and intermediate storage.

The aim of the decommissioning project is to dismantle all the installations within the buildings of the MOX-plant. Immediately after ending the production activities, a number of technical risk-reducing measures were taken (removal of remaining fissile materials, disconnection of electricity cables in glove boxes,…). In the transition period between operation and the start of decommissioning the safety and security of the facility is ensured by remaining staff members.

Because decommissioning is a specialized activity and not part of the core business of Belgonucleaire, it was decided early on to subcontract the decommissioning work to specialized companies. The actual start of the decommissioning activities, after selection of the contractors, is expected to begin at the earliest in late 2008.

f) The operating License for the PAMELA installation (Belgoprocess)

Building 131X (better known as PAMELA: "Pilot Anlage Mol zur Erzeugung von Lagerfähige Abfälle") was built in the early eighties on Site 1 of Belgoprocess. It was originally built as a vitrification facility for high level liquid waste from the former Eurochemic reprocessing facility. The last vitrification occurred in 1991 and shortly afterwards the normal production activities in the building were stopped.

A license application was submitted in May 2004 to refurbish the Pamela installation and reuse it as a multifunctional treatment and conditioning installation for alpha-bearing and intermediate-level and high-level waste. The modifications to the installation included the adaptation of several cells in the building (installation of a press, a cementing installation, a drying installation, docking systems,…) and the construction of additional rooms to allow waste to be transferred to and accepted in the installation.

A new operating license was granted in February 2006 for the Pamela installation. In January 2007 the installation was successfully commissioned as the new processing plant for alpha-bearing and intermediate level and high-level waste. The commissioning went smoothly without technical problems and the functionalities, including the volume reduction factors, processing speeds, remote-controlled cutting of glove boxes etc. were all achieved.

g) Royal Decree related to the disused and orphan sources

The King signed on 26 May 2006, the Royal Decree transposing the European directive 2003/122/Euratom. This decree completes and updates the General Regulation GRR-2001 with respect to:
- high-activity sealed sources;
- disused high-activity sources;
- orphan sources.

More details about the content of this decree are given in section J of this report.

h) The Law of 15 May 2007 on Civil safety

The law of 15 May 2007 on Civil safety redefines in general terms the role and missions of the Civil Protection and the fire departments.

i) The first Periodic safety review of Belgoprocess

Belgoprocess is the operator of radioactive waste processing and storage installations in Mol (site 1) and Dessel (site 2).

A periodic safety review of the nuclear installations on site 2 was performed in 2006. The results of this safety review were submitted to the regulatory body in July 2006. A similar periodic safety review of the installations on site 1 has been performed before 1 July 2008.

The periodic safety review covered both general safety topics and the different individual nuclear installations on site 2.

The general topics included training and qualification, radiological protection, fire safety, external hazards, emergency planning, operational experience feedback, etc... For each of the general topics the current situation was assessed and possible improvements were defined, taking into account the current and future use of the site.

For each of the individual nuclear installations on the site a detailed assessment was performed. The different risks related to each nuclear installation (e.g. fire, explosion, loss of containment, flooding, ageing, chemical risks,…) were considered and an assessment of the existing safety measures was made. In this way, for each installation safety improvement measures could be defined in a systematic manner.

Some of the more important actions that were defined as a result of the periodic safety review for the nuclear installations are:

- Storage facilities for radioactive waste:
    - establishment and implementation of an evacuation programme for existing waste in the Stelcon-hall;
    - assessment of the further use of the Stelcon-hall, and in relation to this, re-assessment of the safety measures of this storage facility;
    - Study of the explosion risks of the remaining sodium bearing waste;
- Waste treatment installations:
    - assessment of the fire safety of the Mummie installation (building 234H);
    - HAZOP analysis of the Mummie installation (building 234H);
    - Inspection of underground liquid waste pipes;
- Public utilities
    - assessment of fire compartmentalization of the steam room;
    - Selectivity of the electric supply network;
    - Renewal of alarm system.

In conclusion, the periodic safety review has shown that overall the situation of the nuclear installations on site 2 is in conformity with the current safety standards. Large progress in safety has been clearly made compared to the situation 10 years ago.
Some additional actions to further improve the safety of the installations were defined and an action plan was defined in agreement with the regulatory body.

A detailed overview of the first Periodic Safety Review of the Belgoprocess facilities is given in Annex, Appendix 5.

j) <u>Progress in decommissioning work of EUROCHEMIC</u>

The dismantling works of the former fuel reprocessing plant EUROCHEMIC continued. Presently, almost all internal parts of the reprocessing building have been removed and one third of the building has been prepared for controlled demolition. This demolition of the eastern part of the building has started in June 2008. The complete demolition of the reprocessing building will be finished by 2012.

k) Remediation of the OLEN contaminated site.

An important part of the site remediation at the UMICORE site in Olen and surroundings has been executed in the period September 2006 – June 2008 and followed-up by both the regional environmental protection authorities and the FANC, namely the remediation of the Bankloop brook. The resulting contaminated materials (chemically and radiologically), approximately 30000 tons, have been put in storage on the UMICORE site.
The clean-up of the Bankloop fits within an overall plan. A specific regulation on interventions and clean-up is being developed by the FANC in collaboration with ONDRAF/NIRAS.

Summary table of current liabilities in Belgium

<table>
<tr><th>Type of Liability</th><th>Current practices/ Facilities</th><th>Long-term management policy</th><th>Funding of Liabilities</th><th>Planned Facilities</th></tr>
<tr><td>Spent Fuel</td><td>SF: on-site wet or dry storage;
BR2 R.R. : reprocessing
HLW: storage by Belgoprocess</td><td>Moratorium on reprocessing (NPP only); interim storage; long term management policy still being developed (reprocessing or direct disposal)</td><td>NPP contribute to the fund managed by SYNATOM; various funds for historical liabilities fed by state</td><td>Under investigation as reference solution: geological repository in Boom Clay</td></tr>
<tr><td>Nuclear fuel cycle waste</td><td>Interim storage at Belgoprocess site</td><td>SL-LILW : Near surface disposal
LL-LILW : no decision yet</td><td>Producer pays, contribution to ONDRAF/NIRAS long-term fund; Capacity reservations; Insolvency funds</td><td>Surface Disposal for SL-LILW at Dessel. (Decision taken in 2006, operational in 2016)

Under investigation as reference solution: geological repository in Boom Clay</td></tr>
<tr><td>Non-power reactors waste</td><td>Interim storage at Belgoprocess site</td><td>SL-LILW: near surface disposal
LL-LILW: no decision yet</td><td>dito</td><td rowspan="2">Surface Disposal for SL-LILW at Dessel. (Decision taken in 2006, operational in 2016)

LL-LILW Under investigation as reference solution: geological repository in Boom Clay</td></tr>
<tr><td>Decommissioning Liabilities</td><td>Present projects : BR3 R.R; Eurochemic reprocessing plant; SCK•CEN waste department; BN Mox fuel fabrication plant</td><td>Responsibility of operator; verification of arrangements and management of decommissioning wastes by ONDRAF/NIRAS

SL-LLW: near surface disposal
LL-LILW: no decision yet</td><td>NPP contribute to the fund managed by SYNATOM; various funds for historical liabilities fed by state</td></tr>
<tr><td>Disused Sealed Sources</td><td>Return to supplier, decay storage or transfer to ONDRAF/NIRAS</td><td>Implementation of EU directive, recovery of orphan sources</td><td>If no return, holder has to set up financial guarantee</td><td>dito</td></tr>
</table>

dito= same as previous

2 Section B: Policies and Practices

2.1 Spent fuel management policy

Seven commercial nuclear reactors of the PWR type are operated in Belgium, leading to a total installed capacity of 6116 MWe and to approximately 5 000 t_{HM} spent fuel to be unloaded during 40 years of operation. Until the mid-nineties the Belgian strategy for the management of the back end of the fuel cycle was the reprocessing of spent fuel from all commercial nuclear power reactors. This policy led to the reprocessing of 670 t_{HM} of the spent uranium-oxide fuel type by COGEMA (now AREVA) at La Hague: the last Belgian fuel elements sent to La Hague have been reprocessed in late 2001.

Due to the changing international context, and especially the collapse of the uranium prices from the mid-eighties onwards, a parliamentary debate was launched in 1993, focussing on spent fuel management and plutonium recycling. This lead to a parliamentary resolution on 22 December 1993 urging the government to take action in order to temporarily prevent the implementation of new reprocessing contracts for a five-year period and to take profit of that time to make a thorough comparison of the back-end strategies, namely direct disposal and reprocessing of spent fuel. The Council of Ministers implemented this resolution by its decision of 24 December 1993. To give effect to this decision, an overview report was produced in 1998 by the Administration for Energy, in which the two management options were compared.

In 1998 the Council of Ministers specified in its session of 4 December 1998 that the data available at that time and presented in the above-mentioned report were not sufficient to make a global evaluation of the benefits of both options. Therefore they decided that the moratorium on the conclusion of any new reprocessing contract should be confirmed until new data were available and reported to them, allowing them to make this global evaluation. They also urged Synatom to cancel a reprocessing contract concluded in 1991. The global evaluation has not been finalised up to now.

Besides spent fuel from commercial power reactors, there is also a small amount of spent fuel resulting from research reactors at SCK•CEN (Nuclear Research Centre in Mol) and at the University of Ghent. The back-end policies for the spent fuel from these research reactors differ. For the spent fuel from the high-flux-test-reactor BR2 at SCK•CEN, using highly enriched U (HEU) as fuel, reprocessing is the current back-end option. For the spent fuel from the 10 MWe PWR BR3 reactor at SCK•CEN, in decommissioning since 1987, a dry interim storage in CASTOR casks is applied. Finally, for the spent fuel resulting from the other research reactors (the graphite moderated BR1 reactor using natural uranium and the zero power Venus reactor using UO_2 and MOX both at SCK•CEN and the pool type Thetis reactor at the University of Gent, using UO_2) no final back-end strategy has yet been defined. In the framework of the GUINEVERE-project (2007-2014) at VENUS, uranium metal fuel rodlets are used coming from CEA Cadarache. Since this fuel is on loan from CEA and will return finally to CEA no spent fuel issues for Belgium are related to the use of this fuel in VENUS. During the GUINEVERE-project, (part of) the UO_2 and MOX VENUS fuel will be temporarily stored at the BR2 facility for storage of fresh fuel, in order to allow for the storage of the CEA fuel at VENUS.

2.2 Spent fuel management practices

The reprocessing of 670 t_{HM} spent fuel was executed in accordance with four contracts concluded by Synatom (Belgium) and COGEMA, France (now AREVA) during the period 1976-1978. These foresee the gradual sending back of the resulting waste to Belgium. The sending back of the following quantities of different waste types is presently foreseen or has been ended:

- 387 canisters of vitrified high level waste;
- 528 canisters of compacted technological and structural (hulls and end pieces) waste;
- 1100 drums of bituminised residues.

All vitrified waste has been sent back to Belgium since April, 3, 2007. The transports of the compacted waste are foreseen from 2009 onwards. At the moment the sending back of bituminised waste to Belgium is still unclear and under negotiation between Synatom and AREVA.

By the end of 2007, fourteen nuclear shipments between France and Belgium have been undertaken, sending already 390 canisters of vitrified high-level waste back (387 canisters from Synatom and 3 canisters from SCK•CEN). These canisters are stored in a specially designed surface storage building at Belgoprocess in Dessel, pending their future final disposal. Belgoprocess is ONDRAF/NIRAS' industrial daughter company (see also section E).

At the end of 1993, the Belgian parliament voted a five-year moratorium on further reprocessing contracts. After this period and up to now, the government confirmed the ban of reprocessing. As the available storage capacities were becoming short in the existing spent fuel storage pools, interim storage facilities needed to be built. Technical and economical studies were started in order to find the most appropriate solution for every nuclear site. Flexible and reversible solutions for the temporary storage of the spent fuel had to be found. Another condition put forward by Synatom was that the technologies to be implemented needed to be safe, reliable and proven.

Two different solutions have been selected for the nuclear sites in operation: dry storage in metallic dual-purpose casks on the Doel site and a centralised storage pond on the Tihange site. A detailed description of both installations is provided under section L (appendix 1). On the Doel site construction of the modular storage buildings started in May 1994 and the first cask was loaded in June 1995. The buildings in their present layout are able to house 165 storage casks. Additional modules can be added, if necessary. Metallic casks are periodically ordered by Synatom and loaded by the operators of the power plant in order to allow the transfer of spent fuel elements from the three deactivation pools of the site to the centralised dry casks storage facility. Such casks are designed both for storage and transport purposes.

On the Tihange site the centralised storage pond received its operating license in May 1997 and the first fuel elements have been transferred in July 1997. The total capacity of the pond is approximately 3700 spent fuel assemblies divided in eight sections. Six sections are presently equipped with racks. The safe power supply and cooling capacity for the storage pond are provided by the corresponding systems of the neighbouring Tihange 3 reactor unit.

Spent fuel in storage pending a decision regarding its future is at this moment neither regarded nor declared radioactive waste by its owner Synatom. Consequently its management is not included in the scope of responsibility of ONDRAF/NIRAS (see also section E).

SCK•CEN has concluded a contract with COGEMA, covering the whole remaining life of the BR2 reactor, without a limit in time and in quantities. The processing of the fuel includes the dilution of uranium to less than 1.2% in U-235 and the interim storage of waste prior to conversion into residues. The waste is returned to Belgium and stored in an existing building - foreseen for vitrified waste from power plants - on the Belgoprocess site for several decades before final disposal.

All the spent fuel (some 2 tons of HM) from the BR3-reactor is dry-stored in 7 CASTOR BR3 type casks at the Belgoprocess site.

2.3 *Radioactive waste management policy*

The foundation of the '*Organisme national des déchets radioactifs et des matières fissiles / Nationale instelling voor radioactief afval en splijtstoffen*' or ONDRAF/NIRAS (Belgian National Agency for Radioactive Waste and Fissile Materials) by law on 8 August 1980 is the result of a decision of the Belgian authorities to entrust the management of radioactive waste to one single institution under public control. This was done in order to ensure that the public interest would play a crucial part in all decisions on the subject. This law was modified by the law of 11 January 1991, which also slightly changed the name of the institution towards 'Belgian National Agency for Radioactive Waste and Enriched Fissile Materials'.

The tasks and modes of operation of ONDRAF/NIRAS were laid down by the Royal Decree of 30 March 1981 and supplemented by the Royal Decree of 16 October 1991.

In general terms, ONDRAF/NIRAS is responsible for the management of all radioactive waste on the Belgian territory. The task laid down for it by law is to outline a policy for the coherent and safe management of radioactive waste covering the following aspects:

1. Compiling an inventory of radioactive materials (and enriched fissile materials) and of all sites containing radioactive materials, and assessing the decommissioning and remediation costs of all sites containing radioactive materials (inventory of nuclear liabilities);
2. Compiling an inventory of all radioactive waste streams;
3. Collection and transport of the waste;
4. Processing of the waste;
5. Interim storage of all conditioned waste;
6. Long-term management with disposal as the option in preparation (category A waste) or under investigation (category B&C waste);
7. Tasks relating to the management of enriched fissile materials and to the decommissioning of nuclear facilities.

ONDRAF/NIRAS has a centralised waste management policy, by making use of processing facilities and interim storage facilities centralised on the sites of Belgoprocess in Dessel (site 1) and Mol (site 2). Some waste producers have their own processing facilities and they transfer conditioned waste to Belgoprocess site for interim storage.

More specific tasks assigned to ONDRAF/NIRAS are the following.

- In the Royal Decree of 16 October 1991 one of the missions entrusted to ONDRAF/NIRAS was the qualification of installations for treatment and conditioning of radioactive waste. Some issues of practical implementation of the qualification of treatment and conditioning installations, but also storage buildings and installations for the radiological characterisation of radioactive waste, are laid down in the Royal Decree of 18 November 2002.
- Another mission of ONDRAF/NIRAS laid down in the Royal Decree of 16 October 1991 was the establishment of acceptance criteria for conditioned and unconditioned radioactive waste based on General Rules to be approved by the safety authority. The set of General Rules was established by ONDRAF/NIRAS, approved by its Board and by the competent minister (Minister of Internal Affairs), and came into force by ministerial letter from 10 February 1999.
- Some aspects concerning the decommissioning of nuclear installations were also entrusted to ONDRAF/NIRAS by the Royal Decree of 16 October 1991. These concerned the collection and evaluation of decommissioning data in order to establish programmes for the waste that will result from it, the approval of the decommissioning programme and the execution of the

decommissioning programme if the operator asks for it or in case of incapacity of the operator. With the law of 12 December 1997 this mission of ONDRAF/NIRAS was extended, by entrusting ONDRAF/NIRAS with the establishment of an inventory of all nuclear installations and sites containing radioactive materials, and with the assessment of their decommissioning and remediation costs.

- ONDRAF/NIRAS is also responsible for drawing up and proposing a programme for the long-term management of all the radioactive waste; with the law of February 13, 2006 this programme is submitted to an environmental impact assessment for plans and programmes, as defined in the European directive 2001/42/EC.

As decided by the Federal Council of Ministers on 16 January 1998, the policy of long-term management of low and intermediate level short-lived radioactive waste is *disposal*. With this decision ONDRAF/NIRAS was not only asked to develop and study possible disposal concepts, but also to develop structures to integrate such project at a local level. Between 1998 and 2006, ONDRAF/NIRAS worked in a participatory process with representatives of municipalities hosting nuclear facilities (partnerships, see section 8.3.2).

The Council of Ministers decided on 23 June 2006 that the disposal of this waste should be carried out in a *surface disposal* facility to be developed in the *municipality of Dessel* in close collaboration with the local stakeholders (co-design). Through this decision ONDRAF/NIRAS was commissioned to:

- Preserve the participatory process, first of all with the municipality of Dessel that will be the first partner for the negotiations on the associated conditions, but also with the neighbouring municipality of Mol that must be able to defend its interests. Extend the participatory process to the neighbouring municipalities that want it and that do have a justified interest in the integrated project (e.g. information, surveillance, safety, environment, …). In the framework of this process, the preliminary integrated surface disposal project for Dessel as developed in the partnership with Dessel in the pre-project phase (1999-2006) constitutes the basis for future negotiations and discussions;
- By the end of 2008, specify the costs of the corresponding accompanying conditions and their financing methods;
- Pursue the further development of the integrated disposal project, with the aim of obtaining the licenses needed, as well as a binding agreement (based on the "polluter pays"-principle) between the involved parties on the financing of the accompanying conditions;
- Make proposals related to a legal and regulatory framework to ensure the legal soundness of the integrated project, especially concerning the financing of the accompanying conditions.

The decision of the Council of Ministers of 23 June 2006 on the disposal of low and intermediate level short-lived radioactive waste commissioned the FANC to:

- Develop a licensing procedure adapted to the specific nature of a disposal project of radioactive waste;
- Inform ONDRAF/NIRAS of the elements that it deems necessary to set about the safety assessments (regulatory guidance);
- Present to the government the stipulations that it deems necessary for organizing the intervention of the regional instances competent for environmental impact studies;

- Conduct a formal follow-up of the activities of ONDRAF/NIRAS in view of a license application;
- Systematically analyze the points of attention to the safety of the chosen integrated disposal project.

For the high-level and long-lived waste, ONDRAF/NIRAS is currently studying the deep disposal in a clay layer as the reference option.

2.4 Radioactive waste practices

2.4.1 Classification: definitions and criteria

For the purpose of its safe management in the short and long term, radioactive waste, which possesses extremely diverse characteristics, is classified according to certain similarities. The internationally recommended classification systems — IAEA and the European Union (EU)—make no distinction between conditioned and non-conditioned radioactive waste. They classify waste according to its activity and half-life.

In Belgium, ONDRAF/NIRAS has adopted a hierarchical classification system for conditioned radioactive waste, oriented towards the long-term management of the waste, and a hierarchical classification for unconditioned waste, directed at the waste processing routes. This classification system is compatible with the IAEA and EU international classification systems and can, if necessary, be adapted to take account of changes that may occur in the waste management.

The three main **categories** (Table 1) of conditioned radioactive waste are defined by a radiological criterion (radionuclide activities in Bq and Bq/m^3) and by a thermal power criterion.

Category A waste is the one of which the radionuclides present specific activities low enough and half-lives short enough to be compatible with surface disposal, in compliance with the generic limits of 400 to 4 000 Bq/g of long-lived alpha activity according to the recommendations of the IAEA and the European Union, and in compliance with the specific limits for the critical radionuclides as determined by the safety assessments for a specific facility on a specific site.

Category B waste is waste that does not meet the radiological criterion for belonging to category A, but does not generate enough heat to belong to category C.

Category C waste contains very high quantities of alpha and beta emitters and generates a thermal power of over 20 W/m^3, a figure that marks the limit between categories B and C for disposal into clay. In fact, this relatively low limit takes into account the low thermal conductivity of the reference host rock, i.e. the Boom Clay. It must, therefore, cool down during a period of interim storage (currently foreseen period of 60 years), and its residual thermal power at the time of the disposal requires either limiting the number of packages per metre of disposal gallery, or increasing the distance between the galleries, or increasing the time during which such wastes are to cool down in aboveground purpose-built facilities.

The waste categories are further subdivided in waste classes and waste streams.

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Table 1: Characteristics of the three categories (A, B and C) of radioactive waste used by ONDRAF/NIRAS.

	Low-level activity	Medium-level activity	High-level activity
Short-lived waste	**A**	**A**	**C**
Long-lived waste	**B**	**B**	**C**

2.4.2 Practices

1. From the year 1997 onwards, the legislator requires ONDRAF/NIRAS to compile a register of the localisation and the state of all nuclear installations and all sites containing radioactive materials, to assess their decommissioning and remediation costs, to evaluate the existence and adequacy of the provisions in order to finance the operations (current or future), and, finally, to repeat this exercise every five years. The official legal name of this task is "inventory of nuclear liabilities". The second inventory was established end 2007 and was, after a review by an international team, presented to the supervising authority (the Secretary of State for Energy and Sustainable Development) on March 26, 2008.

   Besides this inventory of nuclear liabilities, ONDRAF/NIRAS compiles also at regular time intervals (typically also about every five years) an inventory of all radioactive waste, covering both the already produced waste and estimates of expected future waste. This waste inventory contains not only the waste volumes, but also the physical, chemical and radiological characteristics.

2. ONDRAF/NIRAS is also responsible for the shipments of conditioned and unconditioned radioactive waste, mainly towards the centralised conditioning and intermediate storage facilities on the Belgoprocess site (Dessel). These shipments need to be licensed by the Federal Agency for Nuclear Control (FANC), as stipulated in the GRR-2001 (General Regulations for the protection of the workers, the population and the environment against the hazards of ionizing radiations, laid down in 2001 by Royal Decree of 20 July 2001). These shipments are subcontracted by ONDRAF/NIRAS to specialised transport companies.

3. The processing of radioactive waste is partly done by the nuclear operators themselves on the sites of the nuclear reactors at Doel and Tihange, and partly in the centralised processing facility at the site of Belgoprocess (Dessel).

4. The interim storage of the waste constitutes an intermediate level between short-term and long-term radioactive waste management. As already explained above, spent fuel from commercial reactors is stored by Electrabel in thereto especially designed surface storage buildings in Doel and Tihange. Storage of radioactive waste is done in surface storage buildings at the Belgoprocess site. Currently there are seven storage buildings in operation, two buildings for low-level radioactive waste, one for intermediate-level waste, three for high-level waste and one for alpha- contaminated waste and radium-bearing waste (see also section H).

5. For the long-term management, a distinction is made between the category A (short-lived waste) programme and the category B (long-lived waste) and C (high-level waste) programmes.

Disposal of category A waste

An important milestone in the category A programme has been the decision of the Federal Council of Ministers on 23 June 2006 stating that the category A waste will be disposed of in a surface facility on the territory of Dessel. Following this decision, ONDRAF/NIRAS' category A programme has entered the project phase consisting of the detailed design and the safety assessment studies. The integrated disposal project entails not only a disposal facility but also a waste post-conditioning facility (emplacement of waste drums in concrete boxes to form disposal "monoliths") and the realisation of the accompanying conditions set out by local stakeholders. The aim of the project phase is to prepare and submit a license application for a surface disposal facility and a production facility for monoliths in Dessel, as well as at reaching a binding agreement between all parties concerned.

Disposal of category B&C waste

In Belgium, although studies related to the geological disposal in clay have been initiated more than 30 years ago, this solution has not been confirmed on the institutional level as the national policy for the long-term management of category B&C waste. Only the reference solution, i.e. geological disposal in Boom clay as early as possible, has been studied thoroughly and systematically. For the waste from categories B&C, the programme is therefore still in a methodological research, development and demonstration (RD&D) phase, preceding the pre-project phase. The prime aim of methodological RD&D is to establish whether it is feasible, both technically and financially, to design and build on the Belgian territory a deep disposal solution for category B and C waste that is safe, without prejudging the site where such a solution would actually be implemented. The latest formal overview of the conducted RD&D was the SAFIR-2 report – Safety Assessment and Feasibility Interim Report 2 –, that ONDRAF/NIRAS presented to the Government and all other stakeholders in 2001. This overview covered the work carried out during the period 1990-2000. On request of the supervising Minister the SAFIR-2 report was submitted to an international Peer Review by NEA/OECD. The final report of the NEA/OECD Peer Review was published in April 2003. The SAFIR-2 report, the findings of the international Peer Review and the work conducted till now confirm that none of the information obtained from the RD&D has so far indicated any obstacle that might prohibit the disposal of the vitrified waste from the reprocessing of spent nuclear fuel into the Boom Clay. This increases confidence in the studied solution and confirms that disposal in a poorly-indurated clay remains a viable option for the types of waste considered in the SAFIR-2 report. The international Peer Review and the decisions taken on its basis pointed to the need for:

- Pursuing the RD&D efforts to reduce uncertainties and increase safety margins;
- Specific regulatory guidance related to geological disposal;
- A societal legitimisation of the fundaments of the RD&D programme and of the ONDRAF/NIRAS reference solution (i.e. the definition at the governmental level of a policy for the long term management of such waste).

The FANC and ONDRAF/NIRAS regularly interact, since 2003, to discuss the safety related aspects of the category B&C disposal programme and the themes and elements of regulatory guidance to be developed.

National waste plan

ONDRAF/NIRAS has carried on preparing the National Plan for the long-term management of all radioactive waste types, called Waste Plan, in conformity with its legally required tasks. A new law has meanwhile been promulgated on 13 February 2006 adding complementary requirements to the planning activities of ONDRAF/NIRAS and similar organization: the first requirement is to establish future plans and programmes in participation with the public, the second one is to present each proposed solution accompanied with a set of reasonable substitution solutions and to evaluate the impact on the environment of all those solutions. This evaluation may be assimilated to the international concept of Strategic Environmental Assessment.

One of the first challenges was to identify methods allowing effective and significant public consultation including all kind of potential stakeholders and experts. Best available methods for public and experts consultations (World Café's, Experts round table) have been selected and a work programme has been established aiming to produce the Waste Plan in close interaction and dialogue with the Belgian population. The original planning had to be revised to take into account the requirements of the law of 13 February 2006. The company in charge of the environmental impact analysis has been selected and the first evaluations have been launched on the 1st of July 2008.

As the future of low and intermediate short lived waste has been fixed by the governmental decision of 23 June 2006, the National Waste Plan of 2010 will focus on the long-term management of intermediate and high level long-lived waste. A decision in this domain is necessary to allow ONDRAF/NIRAS to complete its waste management system. More specific domains of the waste management in Belgium could later become the subject of future Waste Plans when safe and credible solutions are ready.

An informative management report presenting the actual national waste management system has been established to serve as one of the starting documents for the dialogue.

According to the current programme, public consultations using selected participation methods are scheduled to start in January 2009. A draft of a Waste Plan "in development" will be diffused at the same time and submitted, in parallel, to the comments and suggestions from the public, the Advisory Committee created by the law of 13 February 2006 and from the regional or federal authorities imposed by the same law. Authorities of neighbouring countries may be also consulted. As allowed by the law, ONDRAF/NIRAS has decided to also submit the Waste Plan to the Federal Agency for Nuclear Control.

If approved by the ONDRAF/NIRAS board of directors, the final version, taking into account those last comments of the public, will be sent mid 2010 to the federal government for adoption.

6. The tasks of ONDRAF/NIRAS relating to the management of enriched fissile materials are currently limited to studies relating to the possibilities of direct disposal of spent fuel and to the estimation of management costs. The sites and storage facilities containing the spent fuel are part of ONDRAF/NIRAS' inventory of radioactive materials and sites.

7. For the different research and development, short term management and long term management activities, different financing mechanisms have been developed, each based on the same basic principle of ‘polluter pays’. ONDRAF/NIRAS is a non-profit company; its financing has to cover the actual costs made or foreseen.

    a. The research and development programmes on disposal are financed by specific agreements between the main waste producers and ONDRAF/NIRAS. For the disposal programme of high-level and long-lived waste the current contractual agreement covers the period 2004 - 2008. The R&D programme has benefited from its inception from EC contributions, especially regarding the construction of the HADES URL and the performance of in situ experiments. Currently, ONDRAF/NIRAS is actively participating in the EC framework programme 6.

    b. Short-term management of radioactive waste is financed by two kinds of five-year-long contracts for waste processing on the one hand, and for intermediate storage on the other hand. Since 1996, a system of capacity reservation is applied, in which each waste producer makes a reservation of the capacity of the facility, and subsequently pays a part of the fixed costs of the installation. Besides, the variable operation costs of the installation are paid according to the actual amount of waste that is transferred to the installation.

    c. Long-term management (disposal) will only be established in the future, but in order to respect the principle of intergenerational equity, current generations should not only guarantee technical means to future generations for a safe management of radioactive waste, but also financial means. On request of ONDRAF/NIRAS, the waste producers have started to pay provisions from 1985 onwards. Since 1999 a long-term fund of ONDRAF/NIRAS is operational and gradually takes over the provisions set aside by the waste producers since 1985. The fundamental ideas from the financing scheme of short-term waste management are retained in this fund-system, i.e. capacity reservation and the payment of variable costs with the transfer of waste to ONDRAF/NIRAS.

    d. In 1992 an insolvency fund has been set up, in order to be able to mitigate the consequences of bankruptcy or insolvency of a waste producer. This fund is fed through a levy of 5% on the sums that waste producers deposit for the management of their waste (with the exclusion of the R&D work, which is financed by the waste producers by separate agreements)

    e. Following the publication of the European Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources and its transposition in the Belgian regulatory framework, the question of financing the treatment of recovered sealed orphan sources as waste became more prominent.

       A new agreement between the FANC and ONDRAF/NIRAS, transposed into regulations by two Royal Decrees of 13 June 2006, arose from the concern that the protection of the population and the environment is not favoured by imposing the associated costs on the finders of these sources, who already contributed to their detection and recovery. Before this new agreement, when a radioactive orphan source was discovered and no responsible person or operator could be identified, the costs for the management as radioactive waste had to be covered by the finder himself.

       When a radioactive source, sealed or not, is discovered, the FANC will try to identify the real polluter in order to be able to charge to him all related costs. ONDRAF/NIRAS will charge him with the associated costs for waste management by applying the “polluter pays” principle. In case a polluter cannot be identified the associated costs will be covered by a fund managed by the ONDRAF/NIRAS, that was previously fed by a special contribution levied on the tariff for the normal radioactive waste treatment operations and that originally aimed at covering the risk of insolvency. The operators of the facilities must also follow the guidelines of the FANC to protect their facilities from the entrance of radioactive orphan sources and to prevent the presence of such sources in the supply of goods and bulk materials. Orphan sources that are detected in shipments coming from outside Belgium will not be compensated.

In collaboration with the stakeholders and the environmental administrations of the three Belgian Regions (the Flemish, Walloon and Brussels-Capital Regions) the FANC is establishing a list of facilities for which the monitoring of radioactivity could be made compulsory. In order to do so, a careful study of the flows of scrap and waste is being made so as to identify the nodal points in the scrap recycling network where a monitoring system would be the most appropriate choice. The goal is to keep a balance between the need to monitor as much scrap flow as possible without imposing heavy burdens on small facilities.

Discussions have been undertaken with orphan sensitive sectors in order to conclude an agreement defining the responsibilities of each of the parties involved. On 19 October 2007, the FANC, ONDRAF/NIRAS and most of the professional federations from the metal works, the waste treatment and the recycling sectors signed this agreement regarding the tracking and management of radioactive materials and objects outside of the nuclear sector. Undertakings wanting to profit from the financial arrangement for orphan sources have to register their facilities at the FANC. The operators of these facilities are obliged to take measures in order to prevent the presence of orphan sources on their sites, in their installations or in the supply of goods and bulk materials. In the event of the detection of such a source the operator has to follow the guidelines of the FANC and accept its investigation to verify if its guidelines are observed and to determine possible responsibilities. It is expected that with this instrument more orphan sources will be recovered and declared at ONDRAF/NIRAS.

The relevant aspects of the decommissioning funds are dealt with under Article 22.

3 Section C: Scope of Application.

Belgium has concluded several reprocessing contracts for its spent fuel (see Section B: policies). The waste arising from this reprocessing (vitrified high-level waste, bituminised waste and structural waste) that is repatriated to Belgium falls within the scope of the Convention. Currently, both options (direct disposal of the spent fuel or reprocessing) remain open and under study (see also section B: policies).

The protection of the population, the workers and the environment against the hazards of radiation emitted by naturally occurring radioactive materials (NORM) is also regulated by the GRR-2001. Work activities involving NORM must be notified to the FANC and licensed in case the radiation hazards are not negligible. Only waste generated by such licensed work activities is considered as radioactive waste. In this case, these materials are regulated by the waste management rules, as described in this report.

The armed forces have no nuclear fuel, either fresh or spent. The radioactive waste produced by the armed forces is managed according to laws and regulations similar to those applicable for civilian radioactive waste.

4 Section D: Inventories and lists

4.1 Spent and reprocessed fuel coming from nuclear power plant: management facilities and inventories.

4.1.1 Reprocessed fuel

In total, Belgium has reprocessed 670 t_{HM} of spent fuel. The reprocessing contracts stipulate that conditioned waste is repatriated to Belgium. By end 2007, 390 canisters containing on the average 150 litre glass – amounting to an average mass of 493 kg per canister and a total volume of 59 m³ of vitrified high-level waste (fission products are immobilised in a borosilicate glass matrix) - had been returned to Belgium (12 shipments of 28 canisters each were organised, and two shipments of 27 canisters).
The average activity of the canisters produced in the COGEMA (now AREVA) plant in La Hague, determined at the time of the glass casting, is 1.5 10^{16} Bq for beta-gamma emitters and 2.1 10^{14} Bq for alpha emitters. Radioactive materials (mainly fission product oxides and actinide oxides) represent about 17% of the glass mass in the canister..
These canisters are temporarily stored in building 136 (see also section H), which was specially designed to that purpose, on the Belgoprocess site in Dessel until a solution for the final disposal is operational.

The number of canisters that must still be repatriated is estimated at 224 units, representing a volume of about 40 m³.

4.1.2 Non-reprocessed spent fuel

The spent fuel which is not reprocessed is currently stored on the sites of the two nuclear power plants in Belgium operated by Electrabel SA, namely the Tihange nuclear power plant (pool storage) and the Doel nuclear power plant (dry storage).

As far as spent fuel storage is concerned, the dry storage building at Doel contained (on 30 April 2008) 60 containers, in which 1765 fuel assemblies are stored, i.e. about a third of the current storage capacity.
The wet storage building at Tihange contained (on 30 April 2008) 1703 fuel assemblies, i.e. about the half of the total capacity.

4.2 Spent and reprocessed fuel coming from research reactors: management facilities and inventories.

Beside the seven power reactors, Belgium also possesses research reactors:

Reactors BR1, BR2, BR3 and VENUS, all located on the SCK•CEN site in Mol.

a) Since reactors BR1 (natural uranium) and VENUS (enriched UO_2 and MOX) are still working with their initial fuel load, this report does not consider these reactors. In the GUINEVERE-project at VENUS, uranium metal fuel rodlets are used as mentioned before (see paragraph 2.1).

b) The BR2 reactor fuel (uranium enriched to more than 90%) is considered by this report. A part of its spent fuel is stored in the pool next to the reactor; another part of the spent fuel is transferred to the plant in La Hague to be reprocessed. Dounreay is no longer an option.
c) As the BR3 reactor (PWR type) is currently being decommissioned, its fuel (175 assemblies stored in 'CASTOR' containers, having very different enrichments up to 11%), is stored in building 156 at Belgoprocess.

The THETIS reactor on the site of the University of Ghent. Both options (dry storage or reprocessing) are still open and are under investigation. The THETIS reactor was permanently shut down on 31 December 2003. The University of Gent prepared the final decommissioning plan which has been submitted to ONDRAF/NIRAS for approval.

4.3 Radioactive waste: management facilities and inventories.

Processing and storage facilities in Belgium are spread over several sites:

- Belgoprocess Sites 1 and 2 in Dessel and Mol respectively
- Tihange and Doel nuclear power plants sites
- Umicore site in Olen
- Institut des Radioéléments (IRE in Fleurus), universities, hospitals, research centres, laboratories.

4.3.1 The Belgoprocess sites 1 and 2

ONDRAF/NIRAS has subcontracted the industrial aspects of the management to its 100% subsidiary company, Belgoprocess. In that respect, Belgoprocess operates in Mol (site 2) and Dessel (site 1) radioactive waste processing and storage installations.
These installations make it possible to process most of the radioactive waste produced and to be produced in Belgium (solid or liquid, low, intermediate or high level waste).

These processing facilities are:

1. **EUROBITUM**, started up in 1978, on site 1 of Belgoprocess for the processing and the conditioning into bitumen of low and intermediate level sludge and evaporator concentrates coming from the processing of liquid waste. Up till now, no further bituminization in this facility is foreseen and alternative waste processing options will be evaluated for these types of liquid waste.

2. **BRE**, started up in 1980 on site 2 of Belgoprocess to process high and intermediate level liquid waste.

3. **MUMMIE** (site 2) does the same for low-level waste effluents only. It was constructed in the late 60's. A new conditioning campaign for low-level effluents is scheduled for 2009.

4. **CILVA** (site 1) is the infrastructure for the processing of solid and liquid low-level waste. This installation was started up in 1994 and is composed of five units:

    - The reception and pre-storage unit for unprocessed radioactive waste (weighting, control of radiation levels and external contamination).

    - The pre-treatment unit (waste sorting, cutting, and pre-compaction).

    - The supercompaction unit with a 2000 ton press to compact the 200 litre carbon steel drums containing the unconditioned radioactive waste into 15 to 40 cm³ thick compaction disks (compaction capacity: 8 000 drums/year).

    - The incineration unit has a capacity of 7.5 ton solid waste per week. Organic and aqueous liquids containing a lot of organic compounds or complexing agents are incinerated together with the solid waste.

    - The conditioning unit to immobilise with cement the supercompacted disks inside the 400 litre drums (capacity: 2 000 drums/year).

5. **Pyrolysis installation** (site 2) for the thermal decomposition of alpha contaminated organic effluents coming from the former Eurochemic reprocessing plant. The remaining solid waste is then cemented. This installation was started up in 1999.

6. **PAMELA** (site 1) was put into service in 1985 and was used until 1991 for vitrifying the 860 m³ liquid high-level waste coming from the Eurochemic reprocessing plant. Afterwards, the PAMELA cementation unit conditioned into cement solid intermediate-level waste arising from its own operation and the waste arising from the dismantling of its vitrification unit as well as solid intermediate and high-level waste coming from the refurbishment of the BR2 reactor and the dismantling of the BR3 reactor. The facility has been modified for the conditioning of alpha-contaminated waste and medium-high level solid waste streams. After licensing and testing, the facility became operational early 2007.

7. **ALPHA-KAMER** (site 2) for the treatment of low Ra-contaminated waste.

8. **HRA-Solarium** (Building 280x, site 2) for the processing of alpha and beta-gamma waste and radium-bearing waste. This solid and liquid historical waste results from former SCK•CEN research programmes, from Electrabel, from the IRE and from the dismantling of the Union Minière plant (now UMICORE) in Olen.

9. **Building 110X** (site 1) for the sorting and separation, in operation since 2005, of alpha-contaminated solid low-level waste coming mainly from the nuclear fuel fabrication (mainly Belgonucleaire, in Dessel), in view of its conditioning in the PAMELA facility from 2006 on. The installation will be put out of operation in 2008 after having dealt with the foreseen sorting operations.

The conditioned waste (listed in table 2 hereafter) is stored in different appropriate buildings on sites 1 and 2 (see also section H and appendix 3).

1. **Building 150**, started up in 1986, for the storage of low-level waste (mainly category A). It is now filled with packages of different volumes (400, 500, 1000, 1200, 1500, 1600, and 2200 litre). It has 25 cm thick reinforced concrete walls. This building has a storage

capacity of 2 000 m³ and is divided in three areas: the North hall, the South hall and the central hall. The stored waste arises from the Doel and Tihange nuclear power plants (filters, concentrates, resins …) and from the former SCK•CEN Waste department (waste arising from the Belgoprocess site 2).

2. **Building 151**, put into service in 1988, to store the waste of the same types and origins as in building 150, but with a larger capacity (14 000 m³).

3. **Building 127**, has a capacity of 5 000 m³ for the storage of bituminised and cemented intermediate-level waste (mainly category B, 220 and 400 litre packages) coming mainly (76 %) from the operational Eurochemic reprocessing pilot plant. It has 80 cm thick reinforced concrete walls.

4. **Building 129** for the storage of high-level waste (category C). It contains 195 m³ of conditioned high-level waste (60 and 150 litre packages) arising from the vitrification, in the PAMELA installation, of the 860 m³ Eurochemic liquid waste, the waste coming from the partial dismantling of this vitrification installation and the cemented high and intermediate-level waste coming from the reactors BR2 and BR3.

5. **Building 136**, modularly designed, for the storage of high and intermediate-level waste coming from the reprocessing by COGEMA of spent irradiated fuel. It can currently contain 590 canisters of vitrified waste, about 820 canisters with compacted hulls and end pieces mixed with technological waste and up to 2 000 containers (210 l) of bituminised waste (sludge). The final capacity of the building for the two last waste types still has to be defined.

6. **Buildings 155 et 156**, for the storage of conditioned alpha- and radium- contaminated waste (building 155) and the irradiated fuel coming from the BR3 reactor (building 156).

7. **Building 270**, is not a storage facility, but a buffer containing packages which have to be transferred to building 155 immediately or after having been reconditioned. The packages in this building are mainly filled with radium-bearing waste conditioned in the MUMMIE installation or arising from the Umicore plant in Olen. A large number of different waste packages (under characterisation) coming from the passive of the former SCK•CEN Waste department is also temporarily stored in this building.

Table 2: volume and activity per storage building as of December 31, 2007.

Buildings	Waste categories	Number packages (#) / volume (m³)	Capacity (#) / filling rate (%)	Activity [1](Bq)	
				Alpha	Beta-gamma
127	A + mainly B	16475 / 4104	18393 / 90 %	4 10^{14}	4 10^{16}
129	C	2335 / 215	2572 / 91 %	2 10^{15}	3 10^{17}
136	C	390[2] / 59	590 / 66 % (vitrified) ≈ 820 / 0 % (hulls and end pieces/technological waste) ≈ 2000 / 0 % (bituminised)	8 10^{16}	4 10^{18}
150	A + B	3317 / 1914	3424 / 97 %	2 10^{12}	1 10^{14}
151	A + B	29473 / 11691	37267 / 73 %	5 10^{13}	2 10^{14}
155	B + R	848 / 339	9 %	1 10^{14}	1 10^{15}
156	C	7 castors	8 / 88 %	2 10^{15}	1 10^{17}
270	A + B + R	773 / 300	4899 / 16 %	4 10^{12}	1 10^{13}

4.3.2 The sites of the Doel and Tihange nuclear power plants

The Tihange and Doel nuclear power plants have their own processing facilities qualified by ONDRAF/NIRAS. The waste processed on the production site is composed of the waste (ion-exchange resin, filters and other diverse waste) with a dose rate higher than 2 mSv/h and the evaporator concentrates. Non-conditioned waste with a dose rate lower than this limit is sent to Belgoprocess where it is conditioned in CILVA.

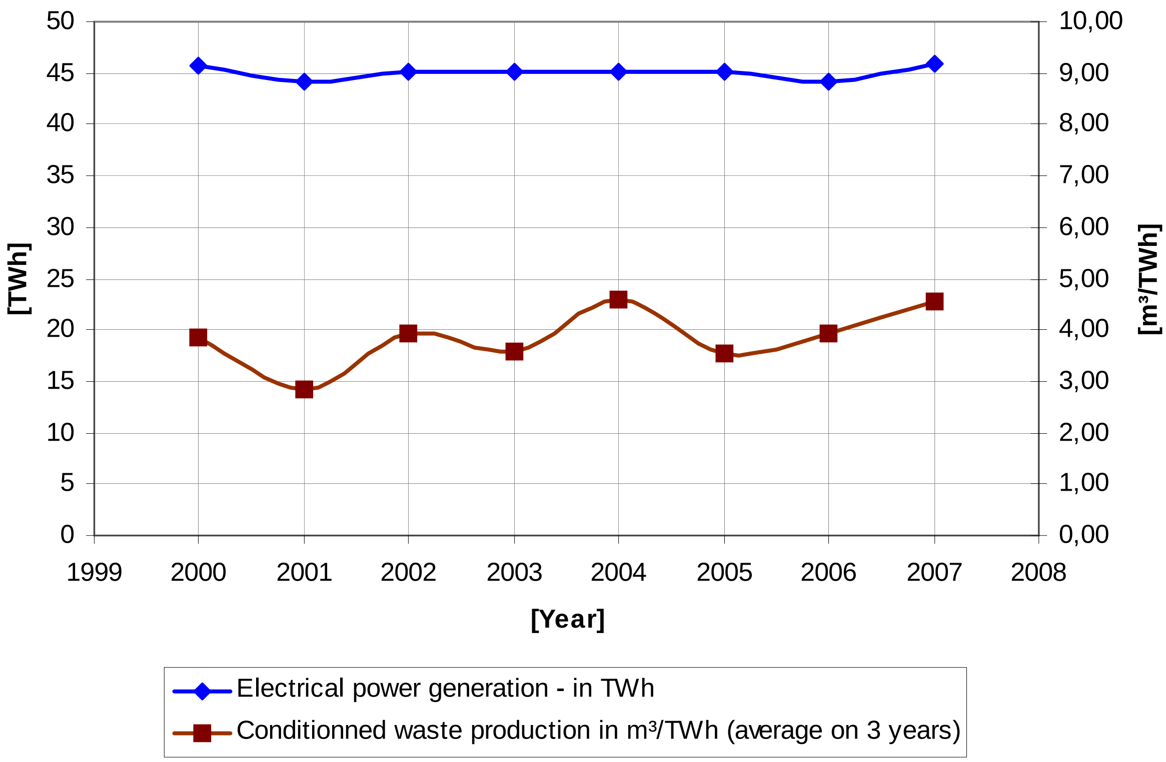
The storage on the nuclear power plant sites is only temporary until ONDRAF/NIRAS removes the waste and transfers it to Belgoprocess.

Waste conditioned (in the NPP or in the CILVA installation) is stored in buildings 151 or 127.

[1] As of 30 September 2007 (while volumes in storage as of 31 December 2007)

[2] Up to now, it contains only vitrified waste canisters .

Power generation of the Belgian nuclear power plants



4.3.3 The Umicore site in Olen

<u>Context and overview</u>

A production unit for radium was started in Olen in 1922 by Union Minière (now UMICORE). Radium was extracted from rich uranium ores from the former Belgian colony Congo, where "Union Minière du Haut Katanga" operated a mine in Shinkolobwe, Katanga. Because of the development of nuclear reactors, starting in the 1950's other radioactive substances, with shorter half-lives, could be produced, which gradually reduced the use of radium. In Olen, a stock of pure radium remained behind in the "use packaging". The production process for radium and the various purification stages gave rise to a dispersed pollution inside and outside the premises of the UMICORE plant. In the middle of the 1950's, a central storage facility was built for all final products (Ra-needles), intermediate products and wastes. In the 1970's, the Ra production activity was stopped and all the production installations were dismantled. However, the storage facility and the local contamination within and outside the plant grounds remained.

Today, the "Olen radioactivity file" consists of 3 subfiles as schematically presented below.

- The UMTRAP facility is the authorized class II storage facility built on the plant grounds for radioactive waste from the Ra-production activity. It is the result of a remediation activity of the former storage facility built in the 1950's, a.o. with an emplacement of a multi-layer cover on the former storage facility, realised by UMICORE in the eighties and licensed by the safety and radiation protection authorities. This licensed storage facility has a covered storage area for radium sources (Ra-needles emplaced in a tight container), contaminated materials and soils. It is composed of concrete bunkers with a copper confinement for radium-bearing waste and sources and of silos for low-radium waste. The contaminated soils fill the gaps between the silos and the bunkers. All this is covered with clay, sand and gravel multilayer. It has a total ^{226}Ra inventory of 3 10^{13} Bq and a total waste volume of about 55 000 m³, with the following specific waste streams:

- 200 g of Ra-226 in the form of encapsulated Ra-needles;
- 2 000 ton of *tailings*, with a total of about 700 g of Ra-226 and with Ra-226 activities up to about 30 000 Bq/g;
- 4 000 ton of Ra-bearing residues, with a total of about 110 g of Ra-226 and with Ra-activities up to about 7 500 Bq/g;
- 60 000 ton of Ra-contaminated soil and scrap material with a mean Ra-activity of about 15 Bq/g.

The principle applied for the multilayer covering is generally used in the USA (Uranium Milling and Tailing Remediation action) and was accepted by the involved national ministries as affording better protection for humans and the environment. The existing licenses from the production period were converted by the government into a license with special conditions for this storage facility of radioactive waste. These special conditions were formulated in the Royal Decree of June, 20 1995 and in one of these conditions UMICORE is required to perform a study of the long term management option for the storage facility. This study is still on-going, and the final report will be submitted to the FANC, accompanied with the advice of ONDRAF/NIRAS.

In order to advance with respect to the decision on the long-term management of the storage facility, ONDRAF/NIRAS is issuing a document in which the possible options for the long-term management of the UMTRAP facility are assessed and a proposed option is presented for further discussion with the safety authorities (FANC) and UMICORE. The discussion of this document is planned in the second half of 2008, in view of a decision by the competent authorities on the long-term management of the facility in 2009.

- The second file (BRAEM) relates to the radioactive waste and radioactive contamination outside the plant grounds:
    - radioactive (and chemical) contamination of the Bankloop brook
    - the D1 landfill site north of the canal.

  Studies commissioned by the federal government and performed in the early nineties have shown that the present-day risks are very limited, mainly because the D1 landfill is fenced and there is no direct access for the public. However, the radiation protection authorities asked Umicore to proceed to a cleanup "not because there is any danger at present for public health, but rather in order to substantially improve the isolation of the contaminated materials from the environment, which will keep the dose impact for the local population very limited in the future as well." In May 2000, Umicore was entrusted with the task to propose a site remediation project. The current situation is described below.

- The third file (SIM) deals with the residual pollution within the plant grounds besides the UMTRAP facility. Due to the many years of activities there are remaining contaminations present within the plant enclosure as well. During the decommissioning and cleanup of the old radium factory, not all pollution on the plant grounds could be removed. However, there are no radiation risks for the personnel or the environment.

This file has three major components, namely

- The old dump site in the NE corner of the plant, with a limited quantity of radioactive material;
- The local contamination of the subsoil;
- A former measurement lab.

Situation mid 2008

For the UMTRAP storage facility the process to come to a decision on the long-term management of the UMTRAP facility has been re-launched by ONDARF/NIRAS on the basis of a document comparing the possible options and presenting a reference option. It is the intention of ONDRAF/NIRAS and the FANC to come to decision on the long-term management of the facility by the competent authorities in 2009. The principle of long-term safety based on a passive isolation and containment system and the principle of not transferring undue burdens to future generations should form the basis of a decision on the long-term management of the facility. But also due account has to be taken of the socio-economic factors.

In November 2001, a common statement of the FANC and ONDRAF/NIRAS concerning the radiological aspects[3] of the remediation of the radioactively contaminated Umicore sites at Olen and in the vicinity, has been issued. This document highlights the general approach for the remediation of the Olen site and presents an approach for long term management of the resulting radioactive waste, coherent with other waste categories dealt with by ONDRAF/NIRAS.

After the publication of the common statement by the FANC and ONDRAF/NIRAS, Umicore has developed a site remediation project to clean up the radioactively polluted grounds outside of the Umicore plant at Olen (D1 landfill and the Bankloop brook) and to build a surface disposal facility for the very low level long-lived waste generated by the cleanup works with the aim of transferring this disposal facility to ONDRAF/NIRAS.

In the execution of the project plan, the question was raised by Umicore, whether the solution envisaged for the remediation of the D1 landfill, i.e. the removal of the contaminated materials and the transfer to a new surface disposal facility in the vicinity of the landfill, is the optimal solution from a cost-benefit point of view. Therefore, UMICORE proposed to give priority to the remediation of the Bankloop brook (period 2007 – 2008) and to re-evaluate the approach to be taken for the D1 landfill.

This proposal was discussed with the FANC and with the regional authorities responsible for environmental protection, and it was agreed to start the remediation of the Bankloop brook as soon as possible and to re-assess the possible remediation scenarios for the D1 landfill. In a convention signed by UMICORE and the regional authorities a start of the remediation activities for the D1 landfill before 2014 was agreed upon; in the meanwhile protective measures to avoid further contamination of the groundwater underneath and around the landfill were imposed by the regional authorities.

UMICORE started the remediation of the Bankloop in 2007 and the remediation will be completed by the end of 2008. The removed radioactively contaminated materials are stored in an licensed storage facility on the plant grounds, awaiting a final destination. This has to be integrated in the site remediation scenario selected for the remediation of the D1 landfill.

[3] In Belgium, the regional authorities are responsible for all non-radiological aspects of waste management.

In order to prepare the D1 landfill remediation project UMICORE has launched mid 2008, in consultation with the FANC, ONDRAF/NIRAS and the regional authorities, a study on the possible site remediation scenarios. UMICORE plans to present to the authorities by the end of 2008 a site remediation project for the D1 landfill.

4.3.4 Others

Some universities (Katholieke Universiteit Leuven, Université catholique de Louvain-la-Neuve, Vrije Universiteit Brussel and Université de Liège), hospitals and other important companies (pharmaceutical research) have their own buildings to temporarily store non-conditioned waste. When practicable, waste is stored until its radioactivity decays below the clearance level and is then released as 'conventional waste'. If not practicable, waste is transferred to Belgoprocess. The Catholic Universities of Leuven and Louvain-la-Neuve centralise in their buildings the radioactive waste coming from neighbouring companies and hospitals.

The Institut des Radioéléments (IRE in Fleurus) is involved in the collection, pre-conditioning and temporary storage of sealed sources. These pre-conditioned sources will be transferred to Belgoprocess as soon as it has defined a conditioning technique specific to sealed sources.
There were some 156 000 sealed sources on 1 January 2006 on the Belgian territory, comprising:

- 11 837 sealed sources for general industrial and medical purposes (namely 1 353 high active sealed sources and 10 484 low active sealed sources);
- about 143 200 ionizing smoke detectors;
- some 1 000 ionizing lightning rods.

Specific actions were organised by ONDRAF/NIRAS and the FANC in order to collect radioactive sources at secondary schools and pharmacist. Furthermore, the management of ionizing household smoke detectors is now organized via a collection at waste facilities and a centralised dismounting of the radioactive sources, followed by a further management as radioactive waste by ONDRAF/NIRAS. The industrial ionizing smoke detectors are directly collected by ONDRAF/NIRAS as radioactive waste and also the radioactive sources are dismounted. Typical types of disused radioactive sources were also collected throughout Belgium, i.e. Am241-sources and Ra226-needles.

4.4 Nuclear facilities being decommissioned.

Four main facilities are concerned:

- the reactor BR3 of SCK-CEN is being decommissioned (the reactor and its building should be completely dismantled in 2015 and serves as a pilot project for this activity;
- the spent fuel reprocessing pilot plant, EUROCHEMIC, will be demolished (first part) mid 2008; the last part should be demolished till green field in 2013;
- the dismantling of the former SCK•CEN Waste department (site 2 of BELGOPROCESS) started in 1998 and should end in 2050;
- the MOX fuel production plant of BELGONUCLEAIRE obtained the authorisation for decommissioning in February 2008; the decommissioning period will take at least 5 years.

Moreover, some smaller buildings of BELGOPROCESS and SCK•CEN were decontaminated and some of them decommissioned.

5 Section E: Legislative and Regulatory System

5.1 Article 18: implementing measures

On 8 December 1997 Belgium has signed the Joint Convention. With the Law of 2 August 2002 the Belgian legislator has expressed its consent with the obligations resulting from this Convention. The ratification process was completed on 5 September 2002 by the deposition of the instrument of ratification to the IAEA. The Convention became effective 90 days later on 4 December 2002.

The national legislator considered the legislative and regulatory framework existing at that time, as sufficiently developed to ratify the Convention, no adaptations nor completions were deemed necessary. Nevertheless the regulations are permanently evaluated by the public bodies involved and they will be altered if necessary, in order to take into account the scientific, technological and social evolutions or in order to comply with obligations resulting from other international conventions. Since the signing of the Convention in 1997 the legislative and regulatory framework has undergone important modifications, mainly as a consequence of the operational start up of the Federal Agency for Nuclear Control (see art. 19, section 5.2.1.2), the adoption of the Law of 31 January 2003 concerning the phasing-out of nuclear power and the Law of 11 April 2003 on the financial provisions for the decommissioning of the nuclear power plants and for the management of the fissile materials irradiated in these plants.

5.2 Article 19: legislative and regulatory framework

Belgium has participated in the first and second Review Meeting of the Joint Convention, which took place in November 2003 and in May 2006 at the IAEA headquarters.

Belgium is also a contracting party to the *Convention on Nuclear Safety* of 1994. The ruling legislative and regulatory framework concerning nuclear safety was described in extenso in the National Reports, which were elaborated as a result of the four Review Conferences, organised respectively in April 1999, April 2002 , April 2005 and April 2008. Below, attention is paid exclusively to those regulatory aspects relevant for the management of radioactive waste and spent fuel.

5.2.1 Identification of the competent authorities

5.2.1.1 **The federal nature of the competent authorities**

Belgium is a federal state, which means that certain competences are exercised on a centralised (federal) policy level, while others are exercised on a decentralised (regional) policy level, constituted by the Flemish Region, the Walloon Region and the Brussels-Capital Region. Since the State Reform of 1980 (see the Special Law of 8 August 1980 on the Institutional Reforms, completed with the reforms of 1988 and 1993) the competences in the field of environmental protection are exercised by the Regions, such as the surveillance of all industrial activities which may be harmful to man and environment and the waste management policy. However, the regulation of the nuclear industrial activities can be considered as an exception to this regional competence. In fact, the protection of the population and of the environment against the hazards of ionising radiation has remained exclusively a federal matter. In the same line, the management of radioactive waste on the Belgian territory, of whatever origin, is organised on a federal level.

The Regions are also involved in some aspects of the energy policy and in the management of the energy infrastructure. However, the decisions concerning the nuclear fuel cycle, inclusively all activities upstream as well as downstream of the nuclear power plants, explicitly remained a federal competence. Consequently, the management of irradiated and non-irradiated nuclear fuel is in Belgium an exclusively federal policy matter. The federal competence with regard to the management of radioactive waste generated by the nuclear fuel cycle follows from the repartition of the competences within the field of the environmental policy, and more precisely the radiation protection policy (Special law of 8 August 1980).

The involvement of the regional authorities in the regulation of nuclear activities remains limited to consultation (for instance in the framework of the licensing of clearance) and exchange of information, with the aim to ensure a coordinated treatment of the nuclear and non-nuclear environmental aspects. To this end, the Regions are represented in some of the federally competent public bodies (the board of directors of ONDRAF/NIRAS, see sections 5.2.1.2 and 5.2.1.3.). Another way to ensure this coordination is by the conclusion of cooperation agreements, as is the case for the clearance of radioactive waste.

5.2.1.2 **Safety Authority**

Belgium is a member of the European Union and of the European Atomic Energy Community (EURATOM) since the foundation of these institutions. The Belgian rules and regulations in the field of radiological protection have been developed in implementation of and in agreement with the European Treaties and directives concerned. The development of the Euratom Treaty has triggered, in parallel with the construction of national nuclear facilities, the necessary development of national laws and regulations in different nuclear areas not covered by the Treaty or not subject to mandatory provisions under the Treaty.

Since 1 September 2001 the control of nuclear activities is performed by the ***Federal Agency for Nuclear Control (FANC)***. The Agency can call upon the assistance of specialised organisations for health physics control, such as **AVN** and **AVC**, for the execution of certain tasks, like routine inspections in the nuclear facilities. With the creation of the FANC, the legislator aimed to redefine the mutual relations between the nuclear operators, the specialised organisations for health physics control and the public nuclear regulator. A major part of this reform took place in April 2007, the majority of the experts of the former Authorized Inspection Organization (AVN) moved into a 100% FANC subsidiary, called **Bel V**. The association of the FANC on one side, and Bel V on the other side, ensures together all the regulatory functions as stipulated in article 20 of the Convention.

Simultaneously with the operational start up of the FANC on 1 September 2001, the regulations concerning nuclear safety and radiological protection have been modified thoroughly. Up to this date, the regulations were governed by the law of 29 March 1958, and the accompanying Royal Decree of 28 February 1963, known as the “General Regulations for the Radiological protection of the Workers, the Population and the Environment” (GRR-1963). These regulatory texts are abolished since 1 September 2001 and have been replaced by the Law of 15 April 1994 and the Royal Decree of 20 July 2001. In the table below, the distinction between the old and new regulations is presented schematically.

	Former regulation (till 31 August 2001)	New regulation (as of 1 September 2001)
Law	Law of 29 March 1958	Law of 15 April 1994
General Radioprotection Regulation	Royal Decree of 28 February 1963 (GRR-1963)	Royal Decree of 20 July 2001 (GRR-2001), as amended by the royal decrees of 12 March 2002, 24 January 2006, 23 May 2006, 17 May 2007 and 13 June 2007

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

The GRR-2001 sets all the licensing procedures for the different practices and activities involving ionising radiation or radioactive substances, it specifies the safety measures the licensee has to take into account to protect workers and the public, and it organises the health physics control. This regulation transposes the ruling European legislation into Belgian Law, such as the Basic Safety Standards directive 1996/29/Euratom, the directive 1985/337/EEC on the environmental impact assessment of projects, the directive 1992/3/Euratom on the transboundary movements of radioactive waste, the obligations resulting from the Euratom Treaty (e.g. article 37), etc. The GRR-2001 has been amended several times, in particular to regulate the evacuation of lightning rods containing radioactive substances, the transposition of the European Directive on high-active sealed sources and the management of orphan sources.

The GRR-2001 contains general provisions with regard to radioactive waste management in the licensed facilities, including the characteristics of gaseous, liquid and solid radioactive substances which, for reasons of radiological protection, are not allowed to be discharged into the environment, and which have to be managed as radioactive waste. A more detailed description of the provisions concerned is given further in this report (see article 19, section 5.3). The General Regulations are modified regularly in order to take account of the evolution of the scientific, technical and social insights.

Emergency planning is a competence belonging to the Federal Minister of Internal Affairs and his administrative services (Federal Public Service Internal Affairs - FOD Binnenlandse Zaken, General Directorate Civil Security - Algemene Directie Civiele Veiligheid and General Directorate Crisis Centre - Algemene Directie Crisiscentrum). For a nuclear or radiological crisis, its organisation and the role of the various intervening instances is prescribed in the Royal Decree of 17 October 2003. For each nuclear site, the measures to be taken are elaborated further in a nuclear emergency plan, which is approved by the Minister of Internal Affairs and which is regularly tested. The nuclear expertise within the framework of the emergency planning is ensured by the FANC and by some organisations (SCK•CEN, Bel V and IRE) having concluded agreements with the competent Minister. Belgium is a contracting party of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency, both done in 1986 under the auspices of the IAEA. Further information is given in section 6.5 of the present document devoted to article 25 of the Convention.

5.2.1.3 **Radioactive Waste Management Agency (ONDRAF/NIRAS)**

In addition to the safety regulations mentioned above, the management of radioactive waste and excess fissile materials is subject to a specific legal framework, specifying the competences and the tasks of the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS). ONDRAF/NIRAS was created by the law of 8th August 1980. The Belgian authorities, thus, took the decision to entrust the management of radioactive waste to a single body under public control to ensure that the public interest prevails in all the decisions taken in this field. The mission and functioning of ONDRAF/NIRAS were first laid down by the Royal Decree of 30th March 1981. This has been amended and supplemented by the Royal Decree of 16th October 1991 passed in execution of the law of 11th January 1991, itself amended and supplemented by the law of 12th December 1997. The 1991 law also amended the name of ONDRAF/NIRAS to "Belgian Agency for Radioactive Waste and Enriched Fissile Materials". In the table below, the legal framework is summarised.

	Main legal texts governing ONDRAF/NIRAS
Law	the Law of 8 August 1980 on the budgetary proposals for 1979-1980, art. 179 §2 and §3, as amended by the laws of 11 January 1991 and 12 December 1997
Royal Decrees	Royal Decree of 30 March 1981 on the missions and tasks of ONDRAF/NIRAS, as amended by the Royal Decrees of 16 October 1991, 4 April 2003, 1 May 2006, 18 May 2006, 2 June 2006, 13 June 2007
Other legal elements	- ministerial letter of 10 February 1999 concerning General Rules for the establishment of acceptance criteria by ONDRAF/NIRAS for conditioned and non-conditioned waste - Royal Decree of 18 November 2002 regarding the qualification of installations for the storage, treatment and conditioning of radioactive waste - Law of 11 April 2003 regarding provisions for the dismantling of nuclear power plants and the management of the spent fuel from these nuclear power plants.

The legal framework concerning ONDRAF/NIRAS imposes obligations on the producers (or owners) of radioactive waste and excess fissile materials. It establishes the relations between ONDRAF/NIRAS and the waste producers on the one side and between ONDRAF/NIRAS and the Safety Authorities on the other side. The legal missions of ONDRAF/NIRAS are explained below, starting with a short description of the nature of the radioactive materials subject to its management (section 5.2.1.3.1). It is followed by an explanation of the different tasks of ONDRAF/NIRAS with regard to the management of radioactive waste and excess fissile materials: the disposal (section 5.2.1.3.2) and the predisposal activities (section 5.2.1.3.3).

5.2.1.3.1 Nature and origin of the waste and fissile materials to be managed by ONDRAF/NIRAS

The legislator has charged ONDRAF/NIRAS with the management of all radioactive waste, of whatever origin, present on the Belgian territory. Consequently, ONDRAF/NIRAS is not only competent for the management of the waste generated in the nuclear fuel cycle (nuclear power plants, fuel fabrication plants), but also for the waste produced by the medical, industrial and scientific research sector. The residues originating from industrial activities using natural radioactive materials (indicated with the acronyms NORM and TENORM) belongs to the competences of ONDRAF/NIRAS, once the FANC has classified them for reasons of harmfulness for public health as radioactive waste.

According to the ONDRAF/NIRAS legal framework, a substance can only be considered as radioactive waste if the contamination with radionuclides exceeds a determined level, namely if the concentration of radionuclides exceeds the *"values which the Safety Authorities* (FANC) *consider acceptable for substances permitted to be used or released unsupervised"*. These values are published in the GRR-2001 (see further section 5.3.1.2).

The possibility to manage in Belgium waste from foreign countries, under the supervision of ONDRAF/NIRAS, was not excluded in principle by the legislator, but was made subject to the prior consent of the responsible minister. The Belgian government has exceptionally, and due to the small quantities, accepted to treat the radioactive waste coming from the Grand Duchy of Luxemburg and from Spain. The political authorities are reluctant to the treatment of foreign waste in Belgian installations, although the degree of utilised capacity of certain installations is particularly low.

Radioactive waste, just as other categories of waste, are by definition substances for which no further use is foreseen. The assessment of the possibility to re-use certain materials or not, should normally be made by the owner/producer.

Both ONDRAF/NIRAS and the FANC regulations oblige the waste producer (or owner) to establish inventories and prospects concerning the generation of radioactive waste, the quantities of waste in storage and to be disposed of. The gathered information must be available for ONDRAF/NIRAS. These declarations are essential in order to enable ONDRAF/NIRAS to fulfil its missions. As long as a substance has not been declared as radioactive waste by the owner/producer, the ONDRAF/NIRAS regulations do not apply to it. However, the possible accumulation of radioactive waste on a particular site, as a consequence of a non-declaration, can be prevented by the Safety Authorities. For this purpose, the inventory mission of ONDRAF/NIRAS (see section 5.2.1.5) is also an important complementary instrument to inform the responsible minister about potential unwanted accumulations of radioactive substances.

According to the ONDRAF/NIRAS regulations, spent fuel is not regarded as radioactive waste. Consequently its management is not automatically subject to the competence of ONDRAF/NIRAS, as long as it is not declared as in excess by the owner/producer. This aspect will be treated in section 5.2.1.4. The exceptions to this are ONDRAF/NIRAS' tasks related to the inventory of nuclear liabilities and to the R&D programmes on the long-term management of spent fuel. The latter task is based on the Parliamentary Resolution of December 1993 as endorsed by the Federal Government.

5.2.1.3.2 The central mission of ONDRAF/NIRAS: the disposal of radioactive waste and excess fissile materials

The creation of ONDRAF/NIRAS has to be seen in relation with the moral obligation for every country to establish within its borders a safe long term solution for the radioactive waste and excess fissile materials generated by the installations operating under its jurisdiction (cf. point xi of the preamble of the Convention). This approach will normally lead to the construction, on the national territory, of one or more repositories, dedicated to the disposal of radioactive waste or fissile materials without the intention of retrieving the waste in the future. The national legislator decided that the final disposal of radioactive waste should be entrusted to a public institution, given the long term commitment that will be necessary for the development, the design and the construction of a repository, as well as for its operational phase and for the institutional control after its closure. The intervention of a public organisation was considered as a guarantee for the present and future generations that this kind of waste would be managed with the utmost care and in optimal conditions.

Seen from this perspective, the legislator has granted to ONDRAF/NIRAS a "monopoly" for the disposal of all radioactive waste on the Belgian territory. ONDRAF/NIRAS is entrusted with all the radioactive waste (or all the fissile material) that needs to be disposed of in the future, in exchange of full financial guarantees from the waste producers with the aim to cover the costs of its future management (cf. the Long Term Fund, see below). The waste producers have to bear the complete cost of the long-term management. By this formula, the waste producers obtain a guaranteed discharge of their waste, but also after the transfer of the waste to ONDRAF/NIRAS they remain accountable for the total cost of the long-term management. This is guaranteed by a contractual tariff system that is re-evaluated every ten years in order to determine the remaining cost of the long-term management and by a clause of hidden defects, for which the waste producers remain accountable for 50 years. With this system the population gets the guarantee that the management of the public interest will prevail over private interest.

ONDRAF/NIRAS is endowed with an extensive autonomy with regard to the technological choices and solutions it wants to use to implement its nuclear waste management. The legislation does not impose any obligations on ONDRAF/NIRAS, neither with regard to how the waste or fissile materials should be disposed of, nor with regard to the applied conditions (surface disposal, disposal in deep geological formations, reprocessed or non-reprocessed, …). In fact, these issues are or will be subject of policy decisions and, in a later phase, of the license application.

As a Party to the *"Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter"*, generally known as the London Dumping Convention of 1972, Belgium has abandoned the dumping of radioactive waste into the sea as a disposal route for some waste categories, first temporarily (since 1983) and afterwards permanently (since 1993). Consequently, ONDRAF/NIRAS has to resort to a solution on land.

ONDRAF/NIRAS focuses its efforts on the development of proper national systems. Besides that international developments with respect to a disposal system on a broader regional scale are followed, i.e. in the frame of EU research programmes (SAPPIER project).

The final solutions considered will - at the proper time - be submitted for approval to the political and the safety authorities. The governmental decision of 16 January 1998 on the long-term management of short-lived waste forms an excellent illustration of such a decision. It limited the corresponding ONDRAF/NIRAS programme for this waste to surface or deep disposal on the existing nuclear sites.

Regarding the dimensioning of the disposal and storage infrastructures and considering the estimate of the necessary financial means, ONDRAF/NIRAS departs from a reference programme based on the following elements:

- operating of nuclear power plants for 40 years, in agreement with the law on the phase-out of nuclear energy;
- complete or partial reprocessing of spent fuel discharged from the nuclear power plants, in agreement with the parliamentary resolution of December 1993 on the use of MOX and the reprocessing of spent fuel.

ONDRAF/NIRAS uses a classification system for the radioactive waste; this is in first instance based on a potential final destination, also called reference final destination. This classification system (see section B) is in agreement with the international recommendations, such as the

Recommendation of the European Commission, dated 15 September 1999 and the IAEA Safety Guide nr. 111-G-1.1 'Classification of Radioactive Waste' (1994).

The research and development activities within the framework of the disposal is for the greater part subcontracted to the SCK•CEN, university teams and industrial study centres. An important instrument in this respect is the underground laboratory in Mol, run by ESV EURIDICE, an economic interest grouping of ONDRAF/NIRAS and the SCK•CEN.

5.2.1.3.3 Missions of ONDRAF/NIRAS with regard to operations prior to the disposal

As explained in section 5.2.1.3.2, an important mission of ONDRAF/NIRAS is the disposal of the radioactive waste. Its legal missions are, however, not limited to the final disposal, but extend to the complete chain of operations preceding the disposal, such as the waste inventory, the collection, the transport, the processing and the storage of radioactive waste. ONDRAF/NIRAS has to have the guarantee that the radioactive waste has been processed according to techniques that are compatible with the future disposal. The legislator has therefore endowed ONDRAF/NIRAS with the competence of issuing *acceptance criteria*, which have to be met by the conditioned waste to be accepted. Given the fact that the characteristics of the real disposal site are not yet known, ONDRAF/NIRAS uses a reference final destination while elaborating these acceptance criteria. These criteria are elaborated based on *general rules* that have been approved by the Safety Authority. The general rules provide a regular follow-up of the conduct of the packages in the storage facilities through time in order to detect possible deficiencies and in order to regularly verify the conformity with the reference final destination of the waste.

Some waste producers either have their own installation for processing and temporary storage of their waste or they have their waste processed in national or foreign installations. The legislator has endowed ONDRAF/NIRAS with the competence of assessing the suitability of these installations, i.e. to verify whether these installations are capable of producing waste packages that comply with the acceptance criteria. This assessment is formally finalised with the qualification issued for a limited period. This qualification procedure is described in the Royal Decree of 18 November 2002. The processing and storage of radioactive waste in non-qualified installations should be regarded as forbidden by the ONDRAF/NIRAS regulations, because it might generate waste packages which are by definition not in conformity with the waste acceptance criteria. Contracts concluded with foreign processors of radioactive waste have to be submitted for approval to ONDRAF/NIRAS in order to enable it to have an involvement analogous to that regarding the processing in domestic facilities.

Waste producers not disposing of equipment considered appropriate by ONDRAF/NIRAS, may entrust the processing of their waste to ONDRAF/NIRAS. The processing of radioactive waste on behalf of producers which do not dispose of adequate (qualified) equipment is a legal task (mission) of ONDRAF/NIRAS. This waste is entrusted to ONDRAF/NIRAS in raw or unconditioned form, on the basis of the waste *acceptance criteria* for unconditioned waste. In order to fulfil its legal task, ONDRAF/NIRAS has its own installations for processing and storage of radioactive waste; these are operated by its industrial subsidiary Belgoprocess. ONDRAF/NIRAS may also have resort to external processors (a.o. IRE). The collection of this type of waste at the producers' place, as well as the transport of the waste, is part of the monopoly of ONDRAF/NIRAS. This task is subcontracted to specialised transport companies.

And, finally, ONDRAF/NIRAS is competent for the collection and assessment of all information necessary to carry out its missions, including the quantities and characteristics of the waste to be processed, stored or disposed of.

The involvement of ONDRAF/NIRAS in the different waste operations is clearly part of its waste disposal task. The qualification of waste processing equipments and the establishment of acceptance criteria for conditioned and non-conditioned waste aim at making the processing in conformity with unequivocal norms to obtain thus a quality guarantee of the waste management up to the disposal stage (see article 23 of the Convention).

ONDRAF/NIRAS is a service provider for the waste producers. An integrated waste management exceeds indeed the possibilities of the individual waste producers. In order to obtain a technological and financial implementation of the waste management, a solitary approach of all of the waste producers is required; achieving this is "pre-eminently" the role of a public body. All the costs linked to the activities of the Agency are at the expense of the waste producers, according to distribution keys based on objective criteria.

5.2.1.4 **Management of fissile materials**

The management of irradiated or non-irradiated fissile materials is subject to a legislation similar to that of the management of radioactive waste, insofar these fissile materials are declared in excess by the owner/producer. As long as these fissile materials are not declared in excess, its management remains the exclusive responsibility of the owner/producer. This situation is completely comparable to that of radioactive materials that are not - or not yet - declared waste by the owner/producer. The ONDRAF/NIRAS legislation makes an explicit distinction between its missions with regard to radioactive waste on the one hand, and to excess amounts of non-irradiated and irradiated fissile material on the other. The aim of the legislator was to endow ONDRAF/NIRAS with specific missions regarding the management of irradiated fissile material but not with the complete management responsibility; this remains the responsibility of the owner/producer.

a. Irradiated fissile material from *power reactors*

The most important owner/producer of irradiated fissile materials is plc Synatom. This private company is the owner of the fissile materials loaded and unloaded in the Belgian nuclear power plants. The Belgian State has recognised the exclusivity of this company with regard to the management of the nuclear fuel cycle including the management of the irradiated fissile materials (Protocol B.K.B./B.C.N. of 24 August 1981). The fact that, simultaneously with the establishment of ONDRAF/NIRAS, Synatom was transformed into a mixed society (50% State and 50% electricity producers), is a historic explanation of the repartition of the competences between Synatom and ONDRAF/NIRAS in the field of the management of irradiated fissile materials. When in 1994 the participation of the Belgian State was reduced to a ‘golden share’ to which specific rights were linked, the exclusivity rights of Synatom with regard to the management of fissile materials from nuclear power plants remained unchanged. Up to the present, the irradiated fissile materials subject to the management of Synatom have not been declared in excess, and consequently cannot be considered to be entrusted to ONDRAF/NIRAS with the accompanying transfer of financial means. The law of 11 April 2003 has introduced (more) specific rules for the management of the provisions created by Synatom and dedicated to ensure the financing of the future management of the irradiated fissile materials, particularly in the context of the liberalisation of the European electricity market. For more information see also section 6.2.2.2. This law also determines the management of provisions by Synatom for the decommissioning of the nuclear power plants (see section 5.2.1.5).

Due to the gradual *phasing-out of nuclear energy*, after 40 year of operation of the nuclear power plants, the amount of irradiated fissile material to be managed in the future, is estimated to 4 300 t_{HM} produced by the existing nuclear power plants (after subtraction of the 670 t_{HM} which was already reprocessed). The management of these fissile materials, either through reprocessing and disposal of the waste produced, or through conditioning and disposal of the non-reprocessed fissile materials, has been the subject of a Parliamentary debate which has led in December 1993 to the acceptance of a resolution, underwritten by the government. Since then there is a factual moratorium on the reprocessing of spent fuel, in anticipation of a new parliamentary assessment. Until then, both management scenarios - with or without reprocessing – will have to be developed in parallel.

b. Irradiated fissile materials from research reactors

The fissile material resulting from the operation of research reactors (BR1, BR2, Venus and BR3 of SCK•CEN and of the Thetis reactor of the University of Ghent) continue to be managed by the scientific institutes operating these installations or by their supervisory entities, and this until they are declared in excess. Up to the present, only the irradiated fissile material of reactor BR3 has been declared as waste and has been transferred to a storage facility at the BP1 site (building 156). The irradiated fissile material of reactor BR2 has been transported for reprocessing purposes, partly to Dounreay (UK) and partly to the AREVA NC reprocessing facilities of La Hague. The moratorium on reprocessing does not apply to the fissile material unloaded from the research reactors, so that in future the BR2 fissile material will continue to be shipped to La Hague.

5.2.1.5 **Management of the decommissioning and dismantling of nuclear facilities**

Every owner or operator of a nuclear installation is responsible for the future dismantling of his installations, once they are definitely decommissioned. ONDRAF/NIRAS verifies that the owner/operator takes timely the necessary steps in order to carry out the dismantling programme; the owner/operator has to submit his decommissioning programme to ONDRAF/NIRAS for approval. The radioactive waste resulting from the dismantling is subject to the management of ONDRAF/NIRAS according to the same principles as the waste from another origin. Furthermore, it is part of the missions of ONDRAF/NIRAS to follow up the evolution of the methodologies and technologies concerning dismantling.

From the regulatory point of view, the FANC requires early guarantees that appropriate measures are taken for proper management of waste. Indeed, the operation license application must include an estimate of the waste quantities that will be produced during the dismantling of the installations. It also requests information on the management of that waste before being transferred to ONDRAF/NIRAS.
At the time the installation is to cease its activities and is to be dismantled, the full procedure (described in 5.3.1.4) to obtain the required licenses is applicable.

If the owner/operator chooses to renounce the dismantling he can ask ONDRAF/NIRAS to perform these works for his account. To this end, ONDRAF/NIRAS legislation has been adapted in 1991. At present, ONDRAF/NIRAS is commissioned by the Belgian State with the dismantling of some important installations, such as the former reprocessing plant Eurochemic (known as "BP1 liability"), the former waste treatment installations of SCK•CEN ("BP2 liability"), some decommissioned installations of SCK•CEN, such as the research reactor BR3 (technical SCK•CEN liability) and some of the IRE buildings ("IRE liability"). The dismantling operations on the BP1 and BP2 sites have been entrusted by ONDRAF/NIRAS to its industrial subsidiary Belgoprocess.

The financing of these activities was guaranteed till the end of the year 2000 by the Belgian State and the electricity sector. The Law of 24 March 2003 creates the legal framework for a structural financing mechanism of these dismantling activities on the BP1 and BP2 sites until their completion by a levy on the kWh. For each period of five years, ONDRAF/NIRAS has to present a financing plan to its supervising minister.

ONDRAF/NIRAS sees to it that the owners/operators create the necessary provisions for the financing of the future dismantling programme. In 1985, the nuclear electricity producers (now unified in Electrabel) have concluded a convention with the Belgian State introducing a special arrangement for the creation of provisions for dismantling 7 nuclear power plants. With the liberation of the electricity market these arrangements had to be and were strengthened. The Law of 11 April 2003 has introduced a new management system for the dismantling provisions, controlled by a follow up committee, composed of experts appointed by law. For the conclusions of the follow-up committee with respect to the sufficiency of financial provisions a unanimous advice of ONDRAF/NIRAS is needed. Synatom, a 100% subsidiary of Electrabel, has been transformed into a society managing all the provisions for the nuclear liabilities: the dismantling of the nuclear power plants and the management of the spent fuel (see section 6.2.2.2.2 for more details).

In 1997, the legal missions of ONDRAF/NIRAS were extended to the creation of an inventory of all nuclear installations and sites where radioactive substances are present. The purpose of this inventory is the mapping of all potential nuclear liabilities with the aim to detect the creation of such liabilities in time and – if possible – to prevent them. The first inventory, created in January 2003, contained 951 operators of nuclear installations, spread over 1064 sites and regulated by 3510 licenses. This inventory will, in future, be updated every 5 years.

5.3 Regulations regarding the management of radioactive waste and spent fuel

5.3.1 The regulations applying to the facilities dedicated to the production, processing, storage or disposal of radioactive waste or spent fuel

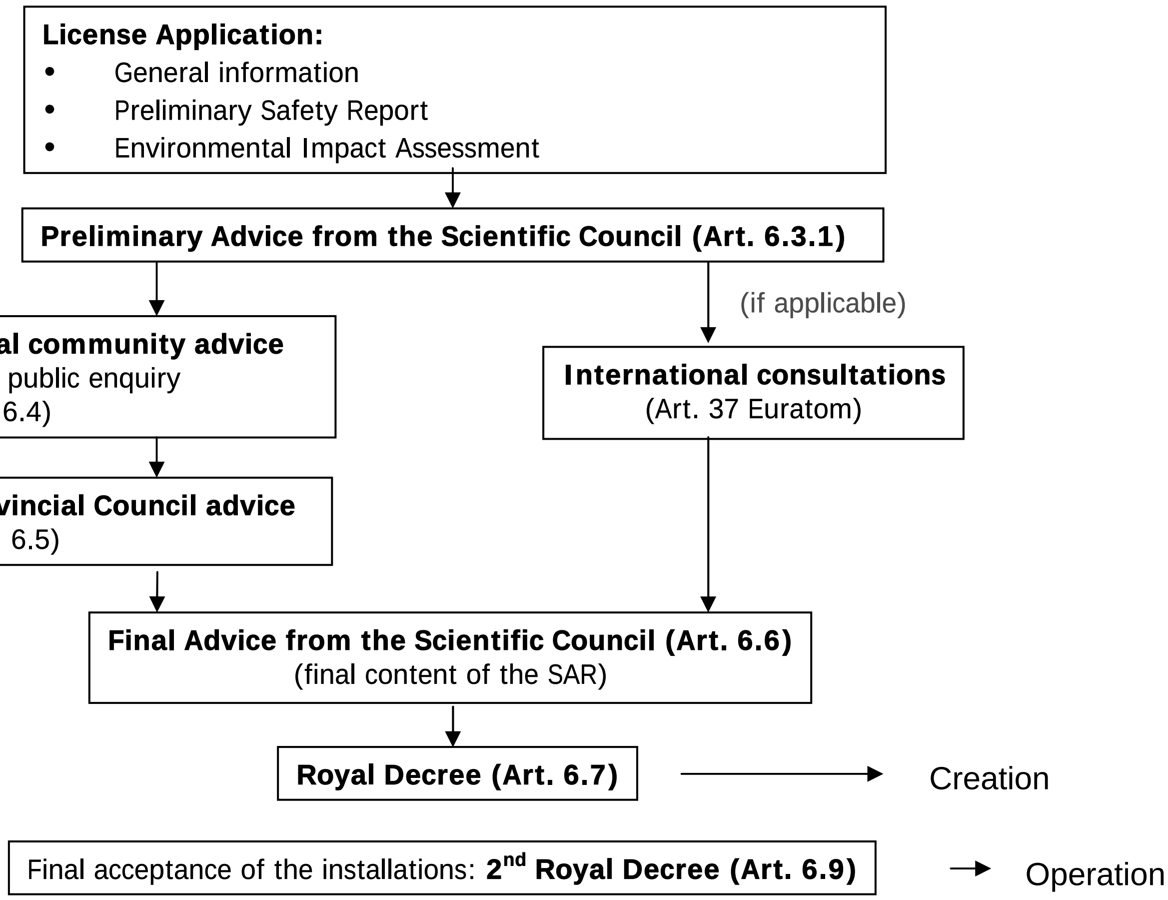
5.3.1.1 **The licensing system for the creation and operation of nuclear facilities.**

Every facility in which an action is performed, that involves the use of radioactive substances or ionising radiation, is subject to a prior creation and operation license issued by the Safety Authority. The licensing procedure to be followed, is described in the GRR-2001 and varies with the class of the facility, ranging from I tot IV. Facilities holding radioactive substances in quantities or concentrations, which do not exceed the exemption levels set in GRR-2001, are class IV facilities. Class IV facilities are exempted from notification and authorisation.

The license application is submitted to and investigated by the Federal Agency for Nuclear Control. Depending on the class, it is forwarded for advice to certain authorities, such as the local authorities, the Scientific Council of the Federal Agency for Nuclear Control and the European Commission. Bel V performs a safety review of the license application which is submitted to the FANC. The creation and operation license is issued by the Federal Agency for Nuclear Control, with the exception of class I facilities. Those are licensed by Royal Decree. The procedure to be followed is described in detail on the following page.

The license application for class I facilities has to be accompanied by an environmental impact assessment, drawn up in agreement with the European Directive 1985/337/EEG (as modified) and the Recommendation of the European Commission 1999/829/Euratom concerning the application of article 37 of the Euratom Treaty.

The license stipulates - among other things – that the safety of class I facilities must be re-assessed with an interval of ten years (see section G, article 5).
The facility can only be put into operation following the verification of the conformity with the license granted. This verification may be performed by a recognized organisation for health physics control for class II-III facilities or by Bel V for class I facilities. With regard to the Class I facilities, the positive result of this verification is validated by Royal Decree, called “confirmation decree”.



Licensing Procedure for Class 1 facilities.

From the point of view of radioactive waste management, a distinction can be made between several types of facilities:

A. Facilities dedicated to processing, storage and disposal of radioactive waste

Facilities for radioactive waste disposal and facilities for radioactive waste processing or storage, provided these activities are the main activities of the company, are categorized as class I facilities. In case the waste processing or storage installation is part of a nuclear facility, it is subject to the licensing procedure for this type of facility.

The most important waste processing and storage facility is that of Belgoprocess, with two sites BP1 en BP2, respectively in Dessel and Mol. Repositories for radioactive waste are still in a conceptual phase. The licensing procedure for repositories actually is the same as for other class I facilities, but work is going on to make the procedure more facility-specific.

B. Facilities dedicated to production, storage, treatment of irradiated fissile material or to the conditioning or disposal of excess fissile material

All facilities producing, treating or storing irradiated fissile material are classified into the highest risk class (class I); these are: nuclear reactors, facilities where the amount of fissile material used or stored is higher than half of the minimal critical mass, facilities for reprocessing of enriched or non-enriched irradiated fissile material.

The most important operational facilities of this type are:

- The nuclear power reactors of Electrabel;
- The nuclear research reactors of SCK•CEN;
- The storage pools for fissile materials on the nuclear power plant sites;
- The facilities for interim storage of irradiated fissile materials on the sites of nuclear power plants (wet and dry storage);
- The facilities for the processing of irradiated fissile materials (hot cells of SCK•CEN, IRE, ex-Eurochemic).

C. Facilities generating radioactive waste

With the exception of facilities using exclusively X-ray devices, all nuclear facilities that are legally subject to a license, and categorized into class I, II or III according to the GRR-2001, are considered potential producers of radioactive waste.

For class I and II facilities, the license application has to comprise information on the expected generation of radioactive waste (gaseous, liquid and solid), including the waste generated by the future decommissioning and dismantling of the installations. The license application also includes information on the treatment techniques applied and the temporary storage before discharge into the environment or transfer to ONDRAF/NIRAS.

The application of a creation and operation license for any facility considered as a potential waste producer, has to comprise a written declaration in which the future operator commits himself to register with ONDRAF/NIRAS and to conclude an agreement with this Agency concerning the management of the radioactive waste.

ONDRAF/NIRAS receives systematically a copy of every license issued. This way, ONDRAF/NIRAS is informed of the identity of the potential waste producers.

If the FANC grants a license exemption for the use of type approved devices containing small quantities of radioactive material but exceeding the exemption levels determined, it will determine the conditions for the removal of these devices. The intention is to prevent that these devices contaminate the non-radioactive waste streams.

5.3.1.2 **Operating conditions for nuclear facilities**

The discharge of radioactively contaminated waste into the environment, be it in the form of gaseous or liquid effluents or in the form of solid material to be treated in future as non-radioactive waste (incineration, dumping) or to be re-used, is subject to very strict conditions and limitations (GRR-2001). Waste that cannot be discharged as such has to be collected and treated as radioactive waste and is subject to the management of ONDRAF/NIRAS.

The radioactive material thus discharged into the environment, has to be kept as low as reasonably achievable.

The concentration of radionuclides present in the discharges of gaseous effluents into the atmosphere and of liquid waste into the surface waters and the sewerage, is limited in a generic manner at their discharge point:

- up to one thousand of the limit (calculated according to the method prescribed in the GRR-2001) of the annual intake through ingestion by an adult belonging to the public in liquid radioactive discharge;
- up to the derived limit (calculated according to the method prescribed in the GRR-2001) of the concentration in the air for persons belonging to the public, in gaseous radioactive waste.

For most radionuclides, the corresponding limit values are published in the GRR-2001 (in Bq/l for liquid waste and in Bq/m³ for gaseous effluents).

The licenses for class I and II nuclear facilities can deviate from these generically determined values. In those cases the discharge limits for the facilities are determined by means of exposure scenarios, taking into account a dose constraint (a fraction of 1 mSv/year, the dose limit for members of the public). According to Article 81.2 of the GRR-2001, the 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.
The results are given in the following table:

Site or Facility	Calculation of the annual exposure to the most exposed individual resulting from the <u>authorized releases</u>			Calculation of the annual exposure to the most exposed individual resulting from the <u>average actual releases between 1991-2000</u>		
	Gaseous	Liquid	Total (maximum) (*)	Gaseous	Liquid	Total (maximum) (*)
SCK•CEN	0.1 mSv	-	0.1mSv	60 nSv	-	60 nSv
FBFC	10 µSv	-	10 µSv	5 nSv	-	5 nSv
Belgonucleaire	5 µSv	-	5 µSv	10 nSv	-	10 nSv
Belgoprocess	0.3 mSv	0.2 mSv	0.5mSv	60 nSv	625 nSv	685 nSv
IRMM	5 µSv	-	5 µSv	70 nSv	-	70 nSv
total MOL - Dessel site	*0.42 mSv*	*0.2 mSv*	*0.62 mSv*			
IRE (**)	0.45 mSv	<10 µSv	0.45 mSv	80 µSv (**)	<10 µSv	80µSv (**)
Tihange Site (3 NPPs)	0.19 mSv	0.08 mSv	0.21 mSv	47 µSv	2.5 µSv	49 µSv
Doel Site (4 NPPs)	0.18 mSv	0.23 mSv	0.37 mSv	18 µSv	2.3 µSv	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 individuals by each type of release are not in the same age category.

(**) The authorized values for IRE are presently being reviewed, because IRE is in a license renewal process. The actual average value is given for the years 2000-2005

The evacuation of solid radioactive waste originating from a licensed facility of class I, II and III with the aim to its recycling or re-use or its management as non-radioactive waste (incineration, landfill disposal) is permitted if it complies with the generically determined clearance levels and conditions stipulated in the GRR-2001. These clearance levels are expressed in kBq/kg. Deviations from these generic clearance levels may be granted by the FANC, provided the operator demonstrates that the radiological protection criteria are met, namely an individual dose of 10 µSv/year and either a collective dose of 1man.Sv per year or optimised protection. These specific clearance levels shall not exceed the exemption levels.

The operator of a nuclear facility has to establish and keep an updated inventory of the gaseous and liquid radioactive discharges and of the solid radioactive waste stored on the site and of the cleared materials. This inventory is at the disposition of the Safety Authority and of ONDRAF/NIRAS.

The cooperation agreement of 17 October 2002 between the federal State and the regions obliges the FANC to inform the regional authorities responsible for the non-radioactive waste management, of the clearances granted and of the cleared quantities. To this end the operators are obliged to transfer this information to the FANC every year.

5.3.1.3 **Relations between the waste producers and ONDRAF/NIRAS**

According to the ONDRAF/NIRAS legislation, every person possessing radioactive waste, operating installations producing radioactive waste or any person who has the intention of building such installations has to submit to ONDRAF/NIRAS all the information required for the execution of its missions. ONDRAF/NIRAS concludes agreements with the most important waste producers concerning the general radioactive waste management programme and the collection of the waste with a view to its transport, processing, storage and disposal.

These obligations are also stipulated in the GRR-2001 with regard to every operator of a licensed facility who is also a potential producer of radioactive waste. The operator has to register with ONDRAF/NIRAS and has to conclude an agreement with ONDRAF/NIRAS with regard to the management of all the radioactive waste. The commitment of the future operator to register with ONDRAF/NIRAS is an element of the license application file. Even though the regulations of FANC and ONDRAF/NIRAS are complementary, there are differences. While the GRR-2001 only applies to operators of a licensed nuclear facility, the ONDRAF/NIRAS regulation also applies to the legal owners of radioactive waste (e.g. Synatom). Finally, the GRR-2001 provides for sanctions in case of non compliance (see also section 5.4.1.).

The relations between ONDRAF/NIRAS and the most important waste producers have been conceived by the legislator as being of a contractual nature. The agreements between the ONDRAF/NIRAS and the producers are written down in long-term conventions guaranteeing a certain continuity and price stability (open-ended conventions, valid until decommissioning of producer's facilities has been completed). Attachments to these conventions are dealing with actual tariffs.
With regard to the processing of non-conditioned waste, the related attachments are concluded for a 5-year period.
With regard to the storage of conditioned waste and later disposal, the related attachments are concluded for a 10-year period. The waste producers or waste owners remain accountable for the costs of the waste management activities, also after transfer of the waste to ONDRAF/ NIRAS. This is guaranteed by this contractual tariff system that is re-evaluated every ten years in order to determine the remaining cost of the long-term management to be financed by the then existing waste producers, and also by a clause of hidden defects, for which the waste producers remain accountable during 50 years..

5.3.1.4 **Decommissioning and dismantling of a nuclear facility**

According to the ONDRAF/NIRAS legislation, the operators/owners have to submit their programmes for the future decommissioning of their radioactively contaminated installations to ONDRAF/NIRAS for approval. The decommissioning of important licensed facilities (class I and some of class II) is subject to a prior license granted by the FANC and requiring in certain cases also an environmental impact assessment. The license application has to be accompanied by the advice of ONDRAF/NIRAS. For less important facilities a notification to the FANC is sufficient.

Special attention needs to be paid to the management of the waste and of re-usable materials generated during decommissioning. ONDRAF/NIRAS is charged with the gathering and assessment of all the information enabling it to manage the waste generated during decommissioning. The application for a creation and operation license for a class I or class II facility has to contain information about the expected amount of decommissioning waste.

The clearance of materials originating from the decommissioning of class I facilities and of certain class II facilities is, considering the important volumes at issue, always subject to a license issued by the FANC, regardless of the possible residual contamination level. The licensing procedure to be followed is described in the GRR-2001.

5.3.2 Regulations for the transport, import, transit and export of radioactive waste and spent fuel

The transport and transboundary movement of radioactive waste and spent fuel is performed according to the European and international regulations concerning the transport of dangerous goods by road, rail, ship, and airplane.

The provisions that apply to the transport of radioactive substances in general and of radioactive waste and spent fuel in particular, are laid down in chapter VII of the GRR-2001. This chapter requires that every shipment must be licensed in advance. This license is only granted if it can be demonstrated that the provisions of the relevant international conventions and agreements [4] are observed.

With regard to the transboundary shipments of radioactive waste and spent fuel, the provisions of chapter IV of the GRR-2001 are applicable. This chapter transposes the European Council Directive 92/3/Euratom of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community. The procedure prescribes that the advice of ONDRAF/NIRAS with regard to the import and export of radioactive waste has to be obtained. It must be noted that the European Directive 92/3/Euratom has been replaced by directive 2006/117/Euratom, which must be transposed before the 25th of December 2008. The transposition of this Directive, which extends the scope to spent fuel needs a revision of chapter IV of GRR-2001; the revised regulations are planned to enter into force on the 25th of December 2008.

5.3.3 Regulations applicable to the activities involving exposure to natural radiation sources

In accordance with the current European directives in force, the GRR-2001 also covers activities using natural radiation sources. Activities implying a risk of exposure of persons above the dose limit for members of the public have to be notified to the FANC. Because of enrichment of the radionuclides during processing of raw materials, residues or waste generated may need, from the point of view of radiological protection, special attention. The FANC can decide that such activities be subject to specific provisions and the generated waste to the management principles of ONDRAF/NIRAS.

5.4 Article 20: Regulatory Body

[4] ADR: European agreement concerning the international carriage of dangerous goods by road.
RID: Regulation concerning the International Carriage of Dangerous Goods by Rail, appendix C to the Convention concerning International Carriage by Rail (COTIF).
ICAO: Technical Instructions for the Safe Transport of Dangerous Goods by air, of the International Civil Aviation Organisation.
IMDG: The International Maritime Dangerous Goods Code of the International Maritime Organisation (IMO).
ADNR: Regulation concerning the Carriage of Dangerous Goods on the Rhine.

As enunciated in the National Report elaborated within the framework of the Convention on Nuclear Safety, the surveillance of the nuclear activities in Belgium is structured in 3 consecutive levels: the operator, an independent health physics control organisation recognised by the FANC or Bel V and, finally, the FANC itself.

The criteria and obligations that have to be observed by the health physics control organisations in order to obtain and keep their qualification are mentioned in art. 74 of the GRR-2001. Furthermore, the inspections in nuclear installations have to be entrusted by the health physics control organisations to health physics control experts recognized by the FANC, on the basis of art. 73 of the GRR-2001. Bel V (formerly Association Vinçotte Nuclear) is the only organisation which is recognised by the FANC to perform inspections in the nuclear power reactors and in the waste processing installations (Belgoprocess and IRE).

Hereunder, the statute of the FANC, Bel V and ONDRAF/NIRAS are specified in more detail. The mutual relationships between these organisations and their relations with the most important companies (such as Electrabel, Synatom, Belgoprocess,…) are represented on an organizational schema (see chart on page 56).

5.4.1 The statute of the FANC

The Federal Agency for Nuclear Control (FANC) is an autonomous government agency with corporate personality. The Agency is directed by a 14-headed Board; 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 high level experts within the field of nuclear energy and nuclear safety.

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 granting, refusal, modification, suspension and withdrawal of licenses, recognitions or approvals. It organises inspections to verify the compliance with the conditions stipulated in these licenses, 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.
According to article 9 of the law of 15 April 1994, the nuclear inspectors are nominated by the King and they are considered as judiciary police officers, auxiliaries of the King's Attorney. They search for non-compliances with 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.

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

The above-mentioned statute attributes to the Agency the independence to enable it to impartially exercise its responsibilities as a regulator of the nuclear activities - as required by art. 20, paragraph 1 of the Joint Convention.

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

5.4.2 The statute of Bel V and its relations with the FANC

Bel V (its recognized experts in health physics control coming from Association Vinçotte Nuclear) is a 100% FANC subsidiary body. Only recognized experts perform surveillance activities (Article 73 of the GRR-2001);

Bel V's General Management reports to a Board of directors, appointed by the Board of the FANC.

Bel V's technical personnel comprises some 35 university graduates (engineers and physicists), and recruitment is consistent with the foreseeable workload. The workload relating to inspection of installations is more or less constant; more variable is the time load regarding the progress of the applicants' projects and the number of studies to be reviewed, and also regarding the assessment of incidents or specific safety problems in the installations.

The relations between the FANC and Bel V are actually being reshaped, in accordance with the legal obligations.

Bel V being a non-profit organization, its financial resources are used to pay for its personnel (including training), to participate in national or international working groups, for research and development activities, for keeping technical and regulatory documentation.

More information on Bel V, the organisation and its duties is available on its web site: http://www.belv.be.

5.4.3 Relations between ONDRAF/NIRAS and the FANC

The Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) is a public body governed by a board of directors, whose members are appointed by the federal government. ONDRAF/NIRAS is supervised by the federal Minister who is responsible for the energy policy; he is represented at the board by a Commissioner. The Federal Minister for Internal Affairs also has a Commissioner in the Board of Directors of the ONDRAF/NIRAS. ONDRAF/NIRAS submits annually an activity report to Parliament.

With regard to the management of radioactive waste, the FANC and ONDRAF/NIRAS have been entrusted by the legislator with a legal objective, that is mostly identical, namely the protection of the public and the environment against the hazards of ionizing radiation, in particularly resulting from the presence of radioactive waste. However, the instruments used by those agencies in order to achieve this objective, are different.

The role of ONDRAF/NIRAS should not be confused with that of the FANC. Both Agencies have a complementary role to play. The FANC is the regulator, who sets the operation conditions in the licenses, issued formally by the political Authorities. ONDRAF/NIRAS as a waste management agency qualifies the waste storage and processing facilities, only from a perspective of the quality of the conditioned waste in view of its safe long-term management.

ONDRAF/NIRAS is the owner of large amounts of radioactive waste. Through its 100% subsidiary NV Belgoprocess SA, who is the operator of two nuclear sites, ONDRAF/NIRAS is also involved in the processing and storage of radioactive waste. It is responsible for the construction of new installations on these sites, which needs to be licensed by the FANC. ONDRAF/NIRAS is responsible for the decommissioning of installations on these sites, which ceased their activities. It is charged with the development of repositories for the waste. Even though ONDRAF/NIRAS is currently neither an operator of nuclear installations, nor a holder of nuclear licenses, the missions subcontracted by this Agency are performed by the operators (e.g. Belgoprocess) under its responsibility and supervision. None of the missions exercised by ONDRAF/NIRAS can be regarded as missions belonging to the regulator (in conformity with art. 20, paragraph 2, of the Convention).

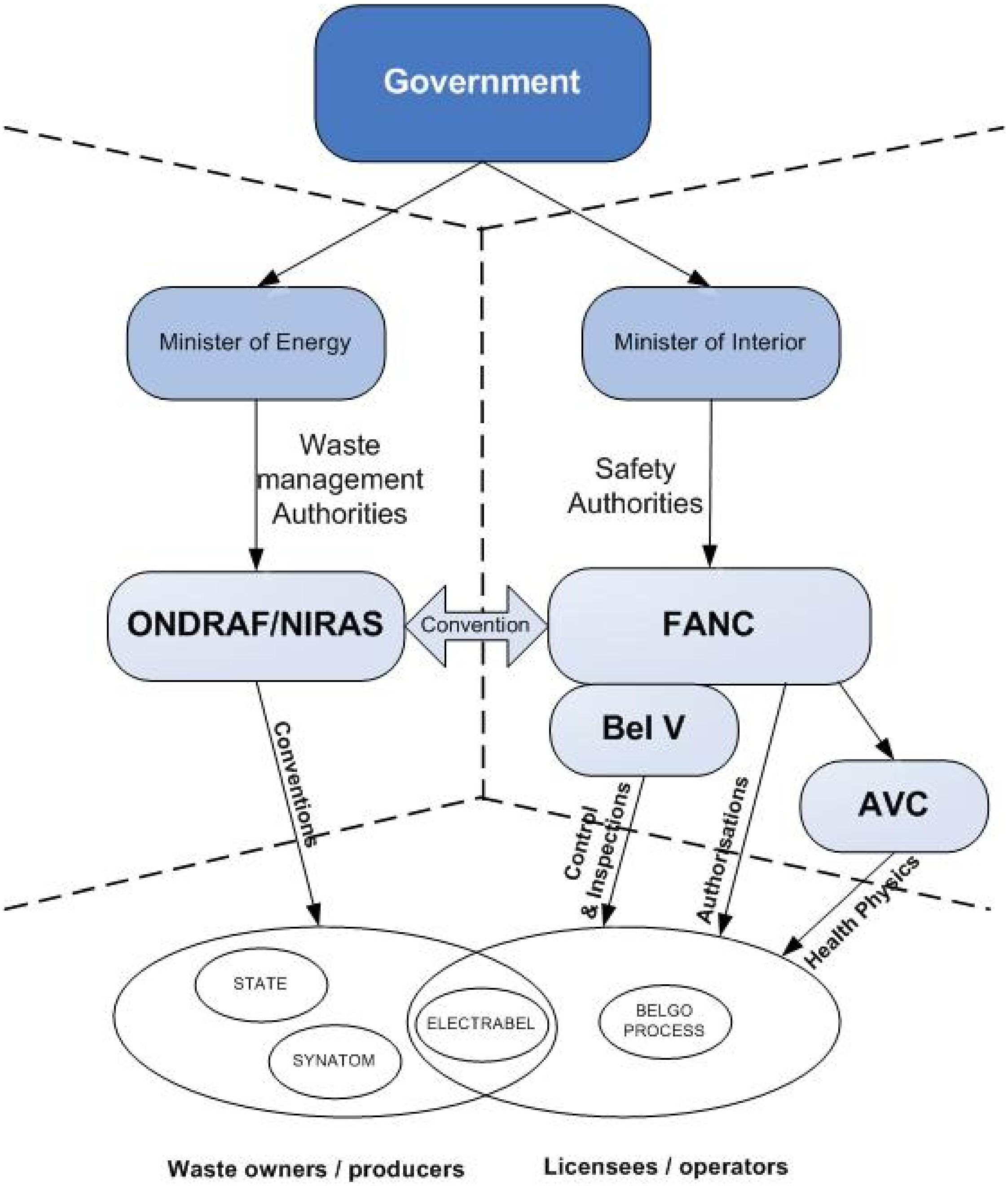
The distinction between the competences and responsibilities of the FANC and ONDRAF/NIRAS are formalized, because the supervision and political responsibility of these public institutions is exercised by different members of the federal government. This does not prevent both public institutions from concluding privileged relations with one another. In implementation of the GRR-2001, both institutions have concluded an agreement in view of the mutual exchange of information and mutual consultation concerning the aspects of radioactive waste management. For more information: www.nirond.be

As the responsible agency for radioactive waste management, ONDRAF/NIRAS works for all matters related to the safety of waste management and the protection of the environment in close cooperation with the federal safety authorities (FANC), which is the licensing authority for nuclear installations (see also section E). A formal agreement organising all the legal interfaces between the two agencies has been signed in 2003. The interactions between the two agencies are organised by and structured in three-yearly programmes of work, defining the thematic priorities, objectives, deliverables and planning of work. The current programme of work covers the period 2008 – 2010. A Commission with members of both organisations and with a rotating chair was created; this Commission coordinates all activities and interactions that are covered by the agreement.

Belgoprocess is a company of which all the shares are held by ONDRAF/NIRAS. The members of the Board of Belgoprocess are appointed by the Board of ONDRAF/NIRAS. A government Commissioner, appointed by the federal Minister responsible for the energy policy, attends the meetings of the Board.

Belgoprocess is the industrial arm of ONDRAF/NIRAS. The ONDRAF/NIRAS installations for processing and storage of radioactive waste are operated by Belgoprocess; these are located on two sites, BP1 and BP2. Belgoprocess is holder of the operating licenses. The agreements between ONDRAF/NIRAS and Belgoprocess are laid down in long-term agreements. For more information: www.belgoprocess.be

Organisational Structure of the Relationships between the Waste management Authorities an the Safety Authorities



Belgoprocess is the daughter company of ONDRAF/NIRAS.

6 Section F: other general safety provisions

6.1 Article 21: Responsibility of the licensee

Radioactive materials can not be brought into or processed in a class I facility until it has been licensed by Royal Decree. For class II and III facilities, the licenses are issued by the FANC.

The Royal Decree of 20 July 2001 (GRR-2001) stipulates (art. 5.2) that the operators of the facilities are to comply with the conditions set in the licenses.

For class I facilities, one of the licensing conditions is the conformity with the 'safety analysis report' handed in with the application and regularly updated.

The license also requires that the installation is in conformity with the general data to be provided by virtue of article 37 of the Euratom Treaty (if applicable). This article 37 requires that each Member State is to provide the European Commission with general data relating to any plan for the disposal of radioactive waste in whatever form in order to make it possible to determine whether the implementation of this plan is likely to result in the radioactive contamination of the water, soil or airspace of another Member State.

Note that the Commission recommendation of 6 December 1999 stipulates that the 'disposal of radioactive waste' covers any planned disposal or accidental release of radioactive substances in gaseous, liquid or solid form, associated with the operation of nuclear reactors, fuel reprocessing, mining, fuel fabrication, fuel storage, waste processing and storage, dismantling, the emplacement above or under the ground of radioactive wastes, etc.

The licensee has to organise a Health Physics Department. In accordance with article 23 of the GRR-2001, this department is entrusted with the task of organising "health physics control" activities, which include amongst others:

1) delimitating and signalling the controlled areas

2) investigating and inspecting the existing protection means

3) suggesting extra protection means and appropriate procedures in order to optimise protection

4) verifying the operation and the correct use of measuring devices

5) investigating the proposals for the transport of radioactive materials inside or outside the facility

6) supervising the conditioning, loading and unloading of radioactive materials inside the facility

7) the measurement of dose rate and of radioactive contamination

8) updating the inventory of liquid and gaseous discharges, as well as the inventory and movements of solid waste

9) review and approval of proposals for clearance

and the verification of compliance with the other provisions of the GRR-2001 and the operation license.

The Head of the Health Physics Department is an expert recognized by the Agency. Article 73 of the GRR-2001 regulates the recognition of the experts. There are two classes of experts. Class 1 experts must be physical engineer, engineer in nuclear sciences or must have another education complemented by a specialisation in nuclear science; their application for recognition is also reviewed by the Scientific Council of the Agency. Class 2 experts must have an education that is appropriate for their task (engineer, physicist…). All must have successfully followed a dedicated course in radiological protection (120 hours).

In class I facilities, the head of the Health Physics Department must be a class 1 expert and is also head of the Safety and Health department.

In class II and class III facilities, the head of the Health Physics Department must be a class 1 or a class 2 expert. If there is no in-house expert, the health physics control activities are entrusted to the Agency, which can delegate these tasks to a recognized organisation for health physics control (AVC).

The operator has also to subscribe an insurance policy covering his civil liability resulting from his nuclear activities. The Law of 22 July 1985, which integrates the Paris Convention and the follow-up Convention of Brussels and their additional protocols, and the Law of 11 July 2000 set the maximum amount of the operator’s civil liability for damages caused by a nuclear accident to about 300 million euros (per accident and per site).

Some operators have obtained a derogation that limits their civil liability to about 75 million euros. Belgoprocess obtained this derogation on 30 January 2001.

The GRR-2001 sets other obligations for the operator. He is required to inform the workers likely to be exposed to ionising radiation before they are affected to a work station (article 25) and he has to keep the individual and collective doses as low as reasonably achievable and below appropriate limits (article 20).

In the license applications, the operator must commit himself to registering with ONDRAF/NIRAS and to concluding with this organisation an agreement on radioactive waste management.

As far as the clearance of solid waste is concerned, the Health Physics Department of the operator must approve the proposals for clearance and the measuring procedures and techniques to verify that the clearance levels are complied with. The recognized organisation for health physics control or Bel V is to confirm this approval if such a clearance for the same materials and according to the same procedures has not been approved previously.

6.2 Article 22: Human and financial resources

6.2.1 Human resources

6.2.1.1 **ONDRAF/NIRAS – Belgoprocess**

As of 31 December 2007, ONDRAF/NIRAS had 67 permanent full-time employees.
The permanent workforce was made up of 44 employees with a university degree, 13 with a higher-education degree and 10 educated to secondary school standard.

The temporary workforce comprised 8 employees.

Belgoprocess, which is in charge of the industrial management of the processing and storage of radioactive waste, whereas ONDRAF/NIRAS is responsible for the overall and administrative management and research, employs 248 people (as of end of 2007).

ONDRAF/NIRAS stimulates its workforce to match or to go beyond the required level by attending regular training in specific technical fields (radiological protection, waste conditioning techniques, disposal of radioactive waste,…) as well as in general fields (languages, quality management, information technology,…). About 4 percent of the working hours and of the “personnel” budget is dedicated to this training
Belgoprocess organises the legal training required by the relevant Royal Decrees as a minimum.

ONDRAF/NIRAS and Belgoprocess are also largely involved in working groups set up by international organisations (IAEA, NEA, European Commission, …) in the field of radioactive waste management.

6.2.1.2 **About NPP’s - Electrabel**

The Doel and Tihange nuclear power stations are operated by the “Société Anonyme ELECTRABEL” which itself is part of the GDF SUEZ group. ELECTRABEL generates about 80% of the electric energy consumed in Belgium; this utility also distributes heat (via cogeneration units), gas and television signals (cable television). It is the owner of the units 1 and 2 of Doel, of 96% of the units 3 and 4 of Doel, of the units 2 and 3 of Tihange (4% being held by the “Société Publique d’Electricité”), and of 50% of Tihange 1 (France’s EdF 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 60% of the electricity consumed in Belgium.

About 1800 people are devoted to nuclear power station operation among the 3100 personnel working for electricity generation as a whole, of ELECTRABEL’s total Belgian workforce of 7700 (full time equivalent). The GDF SUEZ group, of which ELECTRABEL is a part, also has an Engineering division (Tractebel Engineering (TE)) which is the Architect-Engineer of the Belgian nuclear power stations (and of most of the fossil fuel fired plants) and which houses the know-how of over forty years of nuclear technology, which started with the construction of the research reactors at the Mol Research Centre.

6.2.1.2.1 Organisation - training

The Safety Analysis Report (chapter 13) of a NPP deals particularly with personnel qualification, training and re-training. Qualification of the personnel 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, demonstration of qualification of all the operating personnel is available to Bel V and the FANC.

The training programmes are defined in the Safety Analysis Report, which includes a “function-programme” correlation chart. Chapter 13 of the Safety Analysis Report exhaustively lists all posts for which a license is required. This license is granted on the basis of the positive opinion expressed by an Assessment Committee - Bel V being member of this Committee, with veto power - which assesses the operator’s knowledge. This qualification is reviewed every two years or, if an operator has ceased during four months or more performing the function for which he was qualified. It is renewed conditionally to, amongst others, a favourable advice of the Assessment Committee on the basis of the individual's training and activity file.

A knowledge re-training programme for all qualified personnel is set up in function of the occupied position. The content of this programme is discussed with Bel V, is essentially operation-focused and includes, amongst others, 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 (department "Maintenance", see next section).

For all the personnel of the plant, there are training and retraining programmes which are adapted according to the duties of the personnel. Note that the Royal Decree of 20 July 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 who give the training are qualified for the particular subjects that they teach, and possess a formal instructor certification.

Subcontractors are responsible for the training of their own personnel; moreover training in 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 place.

Since 2007, all the personnel and subcontractors operating in the plant have to follow a new basic training in nuclear safety.

In addition to the individual training, 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 are an important part of the knowledge.

ELECTRABEL is member of the World Association of Nuclear Operators (WANO) whose objective is to reach higher standards for the safety and reliability of the operating nuclear units through permanent information exchange, peer reviews, good practice programmes, mutual assistance,… ELECTRABEL is also member of the Institute of Nuclear Power Operations (INPO) whose mission is to promote the highest levels of safety and reliability – to promote excellence – in the operation of nuclear electric generating plants through plant evaluations, training, events analysis and information exchange,…

6.2.1.2.2 NUC21+ organisation

At the end of 2000, Electrabel, which operates the two Belgian nuclear sites, decided a re-engineering as a matrix structure more in conformity with the main professions and the collaborative relationship between the different actors in the operation and the management of a nuclear power plant. This project was called "NUC21".

In 2006, after a few years within the new organisation, was it useful to make some simplifications with some minor modifications and improvements to the NUC21 system. This new organisation is called "NUC21+".

This organisational change has the following targets:
- strengthening of the responsibility of the nuclear site;
- well-defined activities to bring more clarity in the responsibilities’ distribution;
- decrease of the multiple interfaces by developing partnerships in place of customer/supplier relations;
- more attention to strengthen nuclear safety.

In this organisation, the different departments at plant's level are: “Operations”, “Maintenance”, “Engineering support”, and “Care”. The site is also supported by a local (depending of the site) representation of the “Fuel” central department, of the “PPM” central department, and of the “purchasing” central department.

The profession of the “Operations” department is the operation of the installations. The one of “Maintenance” is the maintenance of equipments and installations. "Engineering support" is in charge of: the site projects' and modifications' portfolio management, the main multi-skills projects, and the role of design authority. “Care” is in charge of all controls (including delegation of Health Physics), measurements, protection of the workers (classical safety including fire protection) and safety of the installations (including the setting up and the management of the emergency plans). The “Fuel” department is in charge of all the fuel handling operations, as well as the follow-up of the cycles, while Synatom remains in charge of all aspects concerning procurement of new fuel and the back-end of the cycle. The "PPM" department, Process Performance Management, is in charge of activities related to: quality assurance, continuous improvement, internal and external operating experience, human performance management, and business oversight.

The NUC21+ plan has organised a new central department: ECNSD, the Electrabel Corporate Nuclear Safety Department. This department depends on the head of Health Physics of Electrabel (in the sense of the GRR 2001) who delegates the Health Physics' mission to:
- the direction "Care" at corporate level (health&safety, nuclear safety);
- the "Care" departments at local level;
- the ECNSD department.

ECSND assumes the following missions:
- nuclear safety strategy and coordination
- reporting
- expert advise
- independent controlling
- operational support

Chapter 13 of the Safety Analysis Report describes the structure of that organisation which has been approved by the Belgian Safety Authorities.

6.2.2 Financial resources

6.2.2.1 General information

The mission and competences of ONDRAF/NIRAS are defined by the Royal Decree of 30 March 1981, as amended.

This Royal Decree defines the mission and competences of ONDRAF/NIRAS states with respect to waste management financing:

- All the costs related to the activities of ONDRAF/NIRAS will be charged to those who benefit from the performed services ("polluter pays principle")
- Those charges, evaluated at cost price, will be distributed among the beneficiaries of the services in accordance with objective criteria set by the Board of ONDRAF /NIRAS.
- ONDRAF/NIRAS may, following agreement by the Minister of Economic Affairs, manage a fund in order to finance long term duties, in particular the disposal of the waste. This fund is fed by contributions from the waste producers, according to rules approved by the Minister of Economic Affairs.
- A special fund has been built to cover any contingent costs associated with failed producers. This fund is fed by an additional charge on all the waste producers. The use of this fund is submitted for regular auditing by a special surveillance committee.
- For the financing of the decommissioning activities of facilities other than the nuclear power plants, ONDRAF/NIRAS will establish and/or qualify, in agreement with the producers concerned, the arrangements aiming at guaranteeing the financing of those operations.
- The financial arrangements, for the waste management, for the "regular" waste producers will be fixed in an agreement to be concluded between ONDRAF/NIRAS and the producer.
- The contribution to waste management costs for "occasional" producers is decided upon by the Board of ONDRAF/NIRAS.
- The tasks of ONDRAF/NIRAS set by the law of 12 December 1997, extending the agency's mission to drawing up an inventory of nuclear liabilities include the following:

    1. Drawing up a register specifying the location and condition of all nuclear facilities and all sites containing radioactive substances on Belgian territory
    2. Estimating the cost of decommissioning and cleaning up of these facilities and sites;
    3. Evaluation of the availability of sufficient funds to carry out these future or ongoing operations;
    4. Updating the inventory every five years.

In line with the above, ONDRAF/NIRAS works at cost price, with complete financial transparency with respect to the producer. For that purpose, it has established a financing mechanism based on fees per volume unit of waste delivered, in order to ensure complete financing of all the operations to be performed. The acceptance of the waste and the transfer of property implies also the transfer of financial means from the waste producer to ONDRAF/NIRAS for the short and long term management of the waste (storage and disposal). Good assessment of the waste management system is therefore required to determine accurate fees which limit the risk of insufficient financing becoming a burden for the community in the future.

For storage and disposal operations the fees are paid into the "long-term fund", which is interest bearing. ONDRAF/NIRAS has the responsibility for managing the fund. Each accounting year the financial performance of the fund is reassessed.

According to the Royal Decree of 4 April 2003 the Agency's funds available in the medium and the long term must be invested in financial instruments issued by the Federal State. As a result, the board of ONDRAF/NIRAS has decided to invest the assets of the "Long-term fund" into Belgian governmental bonds which will be passively managed.

In 1996 the financial mechanism was changed. Before that date, there were no guarantees with regard to fixed costs, and tariffs were based on simple net present value calculations. A new mechanism was put in place in 1996 by ONDRAF/NIRAS which aims to reduce risk while satisfying the fundamental principles of financing. The new financing approach uses two part tariffs, specific to each waste category, which are charged to the waste producer for waste delivered to ONDRAF/NIRAS.

The tariffs are based on the following principles:

- A distinction is made between "fixed costs", independent (within certain limits) of the quantities emplaced, and "variable costs", proportional to the quantities expected to be emplaced in the future.
- The fixed costs are charged to producers according to committed volumes. In the case of storage and disposal payments, producers receive in return "reservations of capacity". Each producer makes a binding minimum commitment to cover its share, regardless of the future fluctuations of its programme. This commitment takes the form of an irrevocable guarantee on behalf of the producer.
- Variable costs are charged to producers according to volumes delivered and accepted.

The aim of the calculation of these fees is to ensure that costs are covered to a confidence level of at least 90%. To help to achieve this, a global uncertainty factor, assigned to the fixed and variable costs of each operation, is derived by the combination of basic uncertainties.

The contractual relationships which underpin this new mechanism are fundamentally different in timing and in scope from the traditional relationship. The contract stipulates in detail the precise requirements of the producer regarding waste management, such as waste types, quantities and operations to be performed. In exchange, ONDRAF/NIRAS quotes a price valid for a minimum time period of 10 years (or 5 years for treatment and conditioning).

To take into account the time value of money and the opportunity cost of capital, the fees escalate each year, beyond inflation, by a constant risk-free interest rate of 2% (real terms).

The parts of the payments which relate to fixed costs are offset against the guaranteed sum and hence the size of the producer's guarantee reduces with time. Should the producer exceed the originally planned volume, the guaranteed sum is increased accordingly (and other producers' guarantees are correspondingly decreased), taking account of interest at 2%. At the end of the contractually agreed period, the waste producer may decide to renew or to terminate the relationship with ONDRAF/NIRAS. Under the latter option, the waste producer then pays in full its outstanding share of the fixed costs, i.e. that part of the guaranteed sum which remains unpaid.

From the above the following conclusions can be drawn about the new approach: the fees are stabilised; waste programme uncertainties are reduced; cost uncertainties and different scenarios are taken into account in the fee calculation; the fixed costs of the full capacity are completely accounted for; and the financial returns decrease the risk carried by the waste management organisation.

The quoted fees are paid by the producers whenever the property of wastes is transferred to ONDRAF/NIRAS. The tariffs to be applied are fixed by contractual arrangements; they are specific for each waste category and the fees paid are proportional to the volume of the wastes transferred to ONDRAF/NIRAS. The amount of the fees to be paid is then deducted of the producer's provisions and transferred to the so-called "long-term fund" managed by ONDRAF/NIRAS.

Financial provisions for decommissioning are not treated within this article but under article 26.

6.2.2.2 **About NPP's**

6.2.2.2.1 Belgian legal context

Since 1985, the nuclear electric power generators have set up provisions for the dismantling and decontamination of the Doel and Tihange nuclear power stations (including the installations for waste and spent fuel management).

The new legal basis regulating the responsibility for the dismantling of the nuclear power plants and the back-end of the nuclear fuel cycle is the law of 11 April 2003. This law stipulates that Synatom is responsible for establishing nuclear provisions on behalf of Electrabel and SPE (Public Electricity Society). The law addresses, among others, the following topics:

- the installation of a Follow-up Committee and its responsibilities;
- the development of a new methodology for the calculation of nuclear provisions;
- the transfer of existing provisions from Electrabel/SPE to Synatom;
- the percentage of the provisions that can be lent to Electrabel and SPE
- the management of the funds.

Electrabel and SPE remain liable for all costs regarding the future dismantling of the nuclear power plants, including cost overruns.

6.2.2.2.2 Dismantling provisions

The main characteristics of the applied methodology are the following:

- the provision must be accrued over the life expectancy of the nuclear power plants (as defined by the law of 31 January 2003, i.e. 40 calendar years), the current scenario is a dismantling approach based on the dismantling of each unit separately, but in series, and the decommissioning of the common facilities well after the decommissioning of the last unit on each site.
- the initial provision is equal to the net present value of all future decommissioning expenses (based on a study performed by an independent engineering company and the engineering office Tractebel).

The new law stipulates a three-year review and a formal approval by the Follow-up Committee of any changes in methodology, funding or investment policy. For the conclusions of the follow-up committee with respect to the sufficiency of financial provisions a unanimous advice of ONDRAF/NIRAS is needed.

6.2.2.2.3 Provisions for the management of spent fuel

The applied methodology ensures that appropriate provisions are made to cover the costs associated with the management of used nuclear fuel and its nuclear waste, up to and including their final disposal.

The estimate has been based on the future costs for all spent nuclear fuel during the total lifetime of the 7 nuclear power plants in Belgium as from 1986 onwards (the spent fuel used before 1986 has been reprocessed and the corresponding future costs have also been provisioned). Those costs cover, but are not limited to the intermediate spent fuel storage until a solution for its treatment is defined (reprocessing or conditioning in view of direct disposal), spent fuel reprocessing or spent fuel conditioning, waste storage and final disposal.

In order to limit the risks associated with the future availability of sufficient financial means, several technical scenarios for reprocessing or direct disposal have been identified and their related cost duly evaluated following the same methodology. The amount of the provisions is determined by the most expensive identified scenario i.e. deferred reprocessing of spent nuclear fuels without recycling of the recovered fissile materials.

6.3 ARTICLE 23: QUALITY ASSURANCE

The qualification of the waste treatment and conditioning (including radiological characterization), as well as storage facilities are imposed at national level by the Royal Decree of 18 November 2002, which is an important element of the quality system of the Belgian waste management regime.

6.3.1 Provisions for the qualification of storage and processing installations for radioactive waste.

Every Belgian installation for the storage or processing of (Belgian) radioactive waste (conditioned and unconditioned waste), including its radiological characterisation equipment, has to be qualified by ONDRAF/NIRAS.

In the technical conditions required for obtaining a qualification, it is stipulated that the equipment has to enable the conformity control of the waste compared to the applicable acceptance criteria and that the radiological characterisation, including the uncertainty margin, has to be sufficiently reproducible. In view of this, the operator needs to dispose of a clear and efficient quality system, containing, among other things, an appropriate description of 1) the applicable acceptance criteria; 2) the organisation chart, including the responsibilities and competences; 3) the procedures and techniques with regard to the conformity control; 4) the research, samplings and tests on raw materials, intermediary and final products; 5) the means used in order to control the accomplishment of the conformity and the effectiveness of the quality system.

ONDRAF/NIRAS exercises on-the-spot inspections on a regular or occasional basis in order to verify whether the qualification requirements have been met.

Before issuing a qualification, the supervising authority of ONDRAF/NIRAS (Minister or State Secretary competent for Energy) can request that the conditioning equipment offers the possibility to take an active sample.
A qualification issued according to the arrangements stipulated by ONDRAF/NIRAS and, among other things, based on a qualification file, together with the commitments required, is limited to a

maximum period of 5 years; the qualification can not be granted on trial and is not transferable. A qualification can be prolonged. An appeal procedure is foreseen.

If the installation is modified, and with that the information linked thereto, and if the applicable waste acceptance criteria are changed, the qualification needs to be re-evaluated.

Foreign operators are submitted to distinct processing and storage procedures.

6.3.2 Acceptance procedure for conditioned radioactive waste packages

Conditioned radioactive waste packages are accepted according to the sequence outlined below. A procedure APG – 4 DC ‘General Procedure for the Acceptance of Conditioned Radioactive Waste’ has been drafted in accordance with ISO 9001, 2000 edition.

1. Production of the packages during a ‘campaign’ according to a process qualified by ONDRAF/NIRAS.
2. Submission to ONDRAF/NIRAS of the production documentation including a request for acceptance, supported by radiological data for each individual package as determined following a physical inspection by the producer or by Bel V or by a recognized organisation for health physics control and using a radiological characterisation method approved by ONDRAF/NIRAS. The request for acceptance must be supported by a declaration of conformity with the acceptance criteria ruling at the time of production.
3. ONDRAF/NIRAS examines the production documentation and the acceptance request: this is the administrative check. ONDRAF/NIRAS then writes a letter to the producer with any comments resulting from the administrative check.
4. ONDRAF/NIRAS carries out a physical examination of the packages that form part of an ‘effective request for physical transfer’. These packages may have been produced during several conditioning campaigns whose production documentation has previously undergone administrative inspection.
5. For each batch to be transported ONDRAF/NIRAS issues a ‘clearance for removal report’ setting out the results of the physical inspection and any administrative or technical reservations. This clearance report is signed before removal by the producer who returns it to ONDRAF/NIRAS.
6. ONDRAF/NIRAS finalises the inspection memo related to the production documentation files, including comments made during the physical inspection; these will serve as a technical reference for the final acceptance report.
7. Planning of the transport of the primary packages of conditioned radioactive waste in one or more campaigns of which the production documentation has been successfully examined by ONDRAF/NIRAS.
8. Simultaneous issuance of an acceptance report and of a transfer report for the packages to be transferred; these two reports are first signed by the producer and then by ONDRAF/NIRAS. The producer receives a copy of the reports signed by ONDRAF/NIRAS not later than the date of removal.
9. The packages of conditioned waste are physically removed from the producer’s site and taken to a facility for storage designated by ONDRAF/NIRAS.
10. On arrival at the facility, the transferred conditioned radioactive waste packages are physically inspected for storage and a storage report is issued.

11. According to article 17 of the General Rules for the acceptance of conditioned radioactive waste, and as part of the producer's liability for hidden defects for a period of 50 years, the packages of conditioned waste will be regularly checked for conformity with the relevant acceptance criteria and for their compatibility with their disposal. The results of the physical inspections are recorded in reports that are issued by ONDRAF/NIRAS and signed jointly by the producer and ONDRAF/NIRAS.

This procedure is illustrated below for the vitrified waste from the reprocessing of Belgian spent fuel in the COGEMA facilities at the La Hague facility (Plant UP3).
An important first step in the waste acceptance procedure is the approval of the processes and installations involved. This element is explained below.
The COGEMA vitrification process and the facility (R7/T7 glass) were officially approved by ONDRAF/NIRAS in February 2001, following the favourable evaluation of the following conditional provisions:

1. Ability of the process to meet the acceptance criteria set by ONDRAF/NIRAS

   ONDRAF/NIRAS has been able to verify - on the basis of the data and information put down in the technical file of the vitrification process - that COGEMA has the technical and administrative means at its disposal to meet each of the acceptance criteria during the approval stage of the process and, subject to verification of the conformity of the residues produced, during the waste package production stage.

2. Favourable evaluation of the quality system introduced by COGEMA in its vitrification facilities

   The technical and administrative provisions applied by COGEMA in the vitrification facilities, are subject to periodical audits conducted by BUREAU VERITAS. The audit reports testify to the ability of the quality system to ensure that the residues are produced in accordance with the applicable technical reference frame.

3. Compliance with the residue acceptance criterion, relating to the qualification of the vitrification process and facility

   This criterion consists in checking the equivalence between, on the one hand, the conditions defined in Belgium by ONDRAF/NIRAS for the qualification (approval) of the conditioning processes and facilities and, on the other hand, the procedure adopted by the French authorities and applied to the COGEMA processes and facilities.
   This equivalence is ensured by:

   - the drawing up, by COGEMA, of a technical file for the process, following the instructions defined by ONDRAF/NIRAS,
   - the commitment of ANDRA to co-operate with ONDRAF/NIRAS, especially regarding the follow-up of the modifications of the R7/T7 process and facilities, the transmission of the results of the audits conducted in the vitrification facilities by ANDRA, and the accessibility of information on the quality of the residues.
     This commitment of ANDRA has been formalised by a draft agreement containing the provisions defined above. So far, this agreement has been scrupulously observed.

The next steps in this specific waste acceptance procedure are as follows.

Upon SYNATOM's request for acceptance of a batch of maximum 28 canisters and 3 spare canisters, ONDRAF/NIRAS performs an administrative verification of the documentation and provides assistance during the physical inspection of the canisters.
The inspection modes are described in an inspection manual. Before ONDRAF/NIRAS can accept the batch of vitrified waste, each canister must meet the applicable acceptance criteria.
During the whole acceptance procedure, ONDRAF/NIRAS draws up the necessary reports. Each step must be satisfactorily concluded before the next verification or inspection can be performed. Non-conformities may lead to the non-acceptance of the canisters submitted.
Before performing the administrative verification of the documents, the inspection of these documents and the physical inspection of the canisters, the validity of the approval granted by ONDRAF/NIRAS is verified.

<u>Administrative verification of the delivery documents</u>
First, ONDRAF/NIRAS checks the coherence and comprehensiveness of the individual quality documents of the canisters, prepared by COGEMA. BUREAU VERITAS issues a certificate of conformity for each canister and ONDRAF/NIRAS checks the compliance of the acceptance criteria.

<u>Administrative verification of the production documents at COGEMA</u>

The production documents contain the documents that are common to the vitrified waste. This verification is performed to check whether the documents are coherent and complete and the raw materials used are in accordance with the specifications.

<u>Administrative verification of the documentation at BUREAU VERITAS</u>

After a positive evaluation of the verification of the correct application of the quality system of COGEMA, BUREAU VERITAS draws up certificates. ONDRAF/NIRAS checks the traceability of the documents and the satisfactory character of the evaluation, in order to ensure the validity of the certificates.

<u>Physical inspection of the canisters at COGEMA</u>

ONDRAF/NIRAS assists in the physical inspections performed by COGEMA in order to check the integrity of the canisters, the surface contamination and the dose rate.

<u>Administrative verification of the COGEMA documentation after taking the canisters from stock</u>

After taking the canisters from stock, COGEMA draws up the necessary documents with the parameters obtained from the physical inspection. ONDRAF/NIRAS checks the coherence and comprehensiveness of these documents.

<u>Administrative verification of the BUREAU VERITAS documentation after taking the canisters from stock</u>

BUREAU VERITAS issues a certificate after taking the canisters from stock. ONDRAF/NIRAS checks the traceability of the documents and the satisfactory character of the evaluation, in order to ensure the validity of the certificates.

<u>Administrative verification of the complete documentation file</u>

Before transporting the batch of 28 canisters, ONDRAF/NIRAS checks the coherence and comprehensiveness of the complete documentation file.

Physical inspection of the canisters at BELGOPROCESS

On receipt of the canisters, ONDRAF/NIRAS attends the physical inspections performed by BELGOPROCESS before storing the canisters in building 136.

Administrative verification of the BELGOPROCESS documentation

After verifying the documentation on receipt of the canisters at BELGOPROCESS, ONDRAF/NIRAS can proceed to the acceptance of the canisters.

Drawing up of the Reception, Acceptance and Transfer reports

The receipt of the 28 canisters is formalised by drawing up a Reception report.
ONDRAF/NIRAS also issues an Acceptance and a Transfer report to indicate its acceptance of the batch of 28 canisters. ONDRAF/NIRAS thus certifies that the transferred vitrified waste is in accordance with the applicable acceptance criteria. The finally accepted documentation file contains all documents and reports resulting from the verifications and/or inspections described above.

6.3.3 Quality Management certification of ONDRAF/NIRAS and Belgoprocess

ONDRAF/NIRAS installed a Quality Management System after many years of experience in the field of Quality. From the very beginning, the agents have followed a “Quality Control” logic (very close to the products that it managed). This logic evolved towards “Quality assurance”, which guarantees also the control of the service performed. Recently, the Quality Management System aims at improving the management of the operations. Lastly, ONDRA/NIRAS is considering to integrate the Quality Management System in a Management Systems (Quality, Safety, Environment) platform, with the risk management as a lead wire.

The “Acceptance system” of ONDRAF/NIRAS obtained the ISO 9001:2000 certificate in June 2002. The Acceptance System constitutes the central point around which most activities of ONDRAF/NIRAS revolve. This is of course the main reason why it has been certified first.

The Quality management System has been extended to the ‘upstream’ and ‘downstream’ processes (i.e. entities of the ONDRAF/NIRAS organisation). Only the paragraphs 7.5.4 “Customer Property” and 7.6 “Control of Measuring and Monitoring devices” were kept out of the certification scope. The whole ONDRAF/NIRAS organisation has been ISO 9001:2000 certified in September 2006. The 2000 aim has been reached within the due delays.

The efforts to further extend the Management System will follow two directions:

- ONDRAF/NIRAS ISO 9001 Quality Management System will be harmonized with Belgoprocess ISO 9001, ISO 14001 (Environmental Management), OHSAS 18001 (Safety Management) systems.

- The three (Quality, Safety, Environment) systems can be considered as contributors to a common risk management philosophy that can include even more aspects (Finances, Corporate Social Responsibility,…). ONDRAF/NIRAS will use the ISO norms to gradually install a risk management philosophy into every level of the organisation. .

ONDRAF/NIRAS subsidiary Belgoprocess, responsible for the management of the radioactive waste on its industrial site (including waste treatment and conditioning, waste storage, decommissioning and site restoration) has implemented a quality management system which complies with the ISO-9001 standard, and with the IAEA code (Safety Series 50-C/SG-Q). Belgoprocess received the ISO-9001 certificate in 1995 for radioactive waste treatment and conditioning in the CILVA installation, and early 1996 for decommissioning and decontamination. These certificates were successfully prolonged in December 1998, 2001 and 2003 and are since early 2007 applicable for all Belgoprocess activities.

Since safety and environmental protection are imperious conditions for nuclear activities, Belgoprocess works continuously towards a total integration of quality, safety and environmental protection issues into one management system. The global certification ISO-9001, ISO-14001 and OHSAS-18001 has been obtained in the beginning of the year 2007.

6.3.4 Quality Management system of ELECTRABEL / SYNATOM

As the US safety rules were applied for the 4 most recent Belgian nuclear units as early as at their design stage, the 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 guides (including 50-SG-QA5) developed in the scope of the IAEA's NUSS programme.

At the time of putting into service the Doel 1 and 2 and Tihange 1 units, in 1974-1975, that level of quality-assurance formalism was not yet required. However, during the first ten-yearly safety reviews of these units, it was requested to apply to them the same quality assurance rules as to the more recent units. Accordingly, any new installation, modification, repair and replacement at the earlier units were made consistent with the formal QA requirements from 1985 on.

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 the commissioning tests.

The QA programme is described in chapter 17 of the Safety Analysis Report which deals with the design and construction phases (first part), followed by the operation period (second part). Since 2006, this second part is now common for all nuclear power plants of ELECTRABEL. All requirements are compiled within a common management system for nuclear safety, following the IAEA GS-R-3. This management system is supported by two documents: an "Internal code" (processes' definition) and a "References for nuclear safety" (corresponding quality requirements).

As there is no unit under construction at present in Belgium, emphasis is put on how the quality assurance programme is applied during operation; this point is illustrated below.

6.3.4.1 **Organisation and responsibilities**

This chapter describes the Electrabel organisation concerned by the nuclear safety. It defines also all the delegation's rules, hierarchical and functional relations.
The objectives of the quality assurance programme remain fully applicable in case of delegation or subcontracting.

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6.3.4.2 **Operational processes: equipment and activities concerned**

The quality assurance programme applies to any safety-related equipment and components as well as to any activities that may affect their Quality. It also applies to the safety-related activities, e.g.:

- risk management;
- legal review;
- ten-yearly review;
- "life cycle management";
- design authority management;
- modifications' management;
- safety and not-safety related computer systems;
- industrial site and installation security;
- education and training;
- communication;
- knowledge management;
- planning, coordination and execution of safety related activities;
- operational management;
- delegation and interfaces;
- subcontractors' qualification and evaluation;
- purchasing;
- emergency situations and interventions;
- quality control;
- deviation, non-conformity, and incident management;
- quality assurance;
- documentation management;
- fire detection and protection;
- radiological protection and environmental monitoring;
- radioactive waste management;
- nuclear fuel management;
- transportation and storing of radioactive substances.

These equipment, components and activities are known as Quality Monitored (Q.M.)

6.3.4.3 **Quality assurance programme**

The quality assurance programme is based on a multi level system of provisions, consisting in:

- . a description of the quality assurance programme:
    - i.e. chapter 17 of the Safety Analysis Report,
    - + the "Code",
    - + the "References"),
- written instructions.

The description of the quality assurance programme establishes the conformity of that programme to the requirements of the reference code (10 CFR 50 Appendix B of USNRC and 50-C-QA of IAEA).

Chapter 17.2 of the Safety Analysis Report describes the key-principles of the quality assurance programme during the operational phase. On this base, the "References" defines the requirements regarding establishment and implementation of the quality assurance programme.

The "Code" specify for each kind of activity the policy and objectives that are defined in the quality assurance programme description.

This "Code" details the functions, the authority and the responsibilities of the departments and individuals within each unit. For the individuals, this is done through job descriptions, and for the departments through internal organisation procedures.

This defines the responsibilities and the internal and external interfaces in each unit and in each department per activity domain, e.g. the management of modifications, or the feedback of operational experience.

It specifies in which way or by what means the regulatory or contractual requirements will be implemented, and they determine the quality level of the Quality Monitored items.

The written instructions constitute a considerable number of documents established by the departments of the units; if necessary these are standardised or harmonised at site level, especially as regards nuclear safety, classical safety, radiological protection and protection of the environment. These documents set in detail the duties or tasks of individual agents or agents groups.

6.3.4.4 **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 in the various services perform quality-related activities. This training is maintained and updated regularly.

6.3.4.5 **Periodic evaluation and improvements**

The Safety Evaluation Committee and the Site Operation Committee perform a half-yearly assessment of the quality assurance effectiveness, the way it is implemented, the possible improvements to be brought to the programme,.…. The written report of this assessment is presented to the Site Director for comments and possible approval of the recommended improvements, etc.

As far as the regulatory control activities are concerned, Bel V examined in the frame of the licensing process of each unit the quality assurance programme to be implemented during the design, construction and operational phases (chapter 17 of the Safety Analysis Report, quality assurance manuals,...) and verified the practical implementation of the various regulations (10 CFR50 Appendix B, ASME code,...) throughout these phases.

As regards pressure vessels for which the ASME code or the conventional Belgian regulations (RGPT) are in force, an independent inspection by a recognised inspection agency is required.

During the operational phase of the power station, Bel V performs systematic inspections, including some dedicated to the assessment of quality assurance programmes during the operation. The quality assurance aspects are also reviewed during investigation of modifications to the installations, incident reports, etc.

There are many other ways foreseen to evaluate and improve the management system for nuclear safety:

- by follow-up of the action plans;
- by supervision and measurement of activities by means of quality controls, prestations' indicators, self evaluations, internal audits, external audits and international benchmarking, evaluation and reporting of the nuclear safety level;
- by management review of the nuclear safety;
- by yearly evaluation and modification of the reference system.

6.4 Article 24: Operational Radiation Protection

6.4.1 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 basic radiological protection principles: justification of the practice, optimisation of protection and individual dose limits.
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. The head of the HPD for the installations in the scope of the Joint Convention has to be a qualified expert of class 1, to be recognized as such by the FANC. The specifications and the conditions for recognition are specified in Article 73 of GRR-2001.

6.4.2 Design

The safety analysis reports for the recently designed buildings or installations for the storage of radioactive waste include the following topics:

- general safety philosophy
- fundamental design criteria and specifications for structures, systems, components, casks, etc…, being subject to quality requirements during design, construction and operation
- multiple barriers concept (confinement of radioactive materials, ventilation (depression cascade, rate of air renewal, etc..)); ventilation during normal conditions and emergencies
- criticality safety
- shielding and radiological protection
- long term behaviour (internal and external influences) of storage
- thermal analyses for storage conditions (heat removal)
- fire protection
- industrial safety
- radiation protection programme (organisation, equipment, monitoring, procedures)
- normal operating conditions (atmospheric releases, radiological impact of workers and members of the public, etc..)
- abnormal operating conditions and design basis accidents (detection, consequences, corrective actions, interventions, etc..)

- procedures during start-up (components tests, functional and global tests), operation (equipment maintenance, periodic tests, etc…) and alarms (process, fire, radiation, security)
- specifications of operating conditions and limits (source limitation (activity, dose rate), fissile materials, radionuclides, surface contamination, radon concentration, etc....), with a programme for the surveillance and control of these limits and the corrective actions.

The license application is accompanied with an environmental impact assessment where, besides the radiological impact, non-radiological aspects have to be evaluated for the construction and the operation.

6.4.3 Operation

6.4.3.1 ALARA policy

Different means are used for the ALARA-evaluation (related dose and cost evaluations): implementation of a good working plan; optimisation of working methodology during the receipt, transfer and storage operations; use of software tools (e.g. 3 D-models) for the visualisation of the up-to-date state of storage and for the evaluation of the individual and collective doses, before the operations are performed.

There is an initial dosimetric estimate by the work supervisor and the radiological protection agent in order to jointly agree on the protective means to be used, a new dosimetric estimate that takes into account the decided protective means, a dosimetric monitoring of the work, with check points or hold points of the estimated dosimetry, and a feedback of operating experience.

During the receipt, transfer and storage operations the workers are equipped with individual neutron (bubble type detectors and/or electronic dose meters) and gamma dose rate meters for a strict follow-up of the dose.

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

If really required and also where possible, the operations are performed remotely (use of manipulators or use of automatic sequences, etc…).

6.4.4 Follow-up in situ

6.4.4.1 Dose

During the design, radiation zones are defined with the limitation of the dose rate in function of the exposure time.

For the waste storage buildings at Belgoprocess the dose rate outside the recent buildings (in contact with the walls) is limited to 10 µSv/h. For the storage building of the used steam generators of the Tihange plant, this limit is set at 7.5 µSv/h. In practice the measured dose rate values are far below these limits. These dose rate limits guarantee that the doses received by the workers from the storage activities are minor. The areas which can be accessed by the public are several hundreds of meters from the storage buildings. The design of these buildings is such that the impact for the public (including sky shine effects) is only a small fraction of 1 mSv/year (for a recent new storage building of Belgoprocess an occupation factor of 1 has been chosen for this impact evaluation).

Various measures have been taken over the years during operation to reduce further the annual collective dose. For example at Belgoprocess: the value has been reduced by a factor of about 2.4 during the 1997-2001 period, with a collective dose of about 112 man.mSv (an important part being due to dismantling projects).For the period 2002-2006, about the same values (105-150 man.mSv) have been recorded

Shielding is systematically installed at various locations during operations. Specific shields are also installed when dictated by the size of the work (e.g. detecting hot spots). Signals indicating the hot spots and the ambient dose rates informs the workers about the ambient radiological conditions in which they will carry out the work; access to certain locations is only allowed with specific authorisation of the Health Physics Department; specific ALARA signals forbid to the worker to remain stationary; signals indicate to the worker where the very low dose rate areas ("green" area) are, and may be used as falling-back station. On a voluntary basis there is implementation of a dose constraint for the individual dose. In practice for all the nuclear installations, this is about the half of the dose limit (20 mSv per 12 consecutive months, in accordance with the GRR-2001); the mentioned doses are the total doses (sum of external dose and committed dose)).

Conform Article 23.2 of GRR-2001, the assessments and stipulations of the Health Physics Department must be recorded, including the dose registration. The individual doses, including doses due to the internal contaminations and accidents are reported to the medical service. Each year the licensee has to send a copy to the Ministry of Labour and the FANC. The registers of the licensee are stored for 30 years.

The intervals of the medical surveillance of the exposed workers are fixed by the medical officer, and depend on the risks at the installations. The medical control (routine) is at least once a year and each 6 months for the most exposed workers.

6.4.4.2 Contaminations

The contaminations are limited or excluded by the multiple barriers (confinement of radioactive materials, ventilation (depression cascade, rate of air renewal, etc..)).

Systematic measurements are performed periodically for the surface and air contamination (continuous air monitoring is also foreseen if required) in representative locations. Immediate action is taken should a problem be detected (decontamination of the surfaces).

The degree of the contamination has to be below about 4 and 0.4 Bq/cm^2 for respectively beta-gamma and alpha contamination during dry storage of spent fuel.

6.4.4.3 Discharges

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), linked with a scheme to notify the operators, the HPD, Bel V, and the FANC. The results of the continuous monitoring of the atmospheric releases and the liquid discharges (routine releases) are periodically sent to Bel V and the FANC for an additional check.

The Euratom 96/29 Directive has been implemented in the Belgian legislation and as required by Article 81.2 of the GRR-2001 the present authorised discharge limits (gaseous and liquid releases) have been revised. (see section 5.3.1.2).

For the storage of spent fuel, and of non-conditioned and conditioned radioactive waste, the atmospheric releases at the stack are a very small fraction of the authorised limits, and the impact for the critical exposed member of the public is a few nSv/year (based on a conservative approach for the dose calculations).

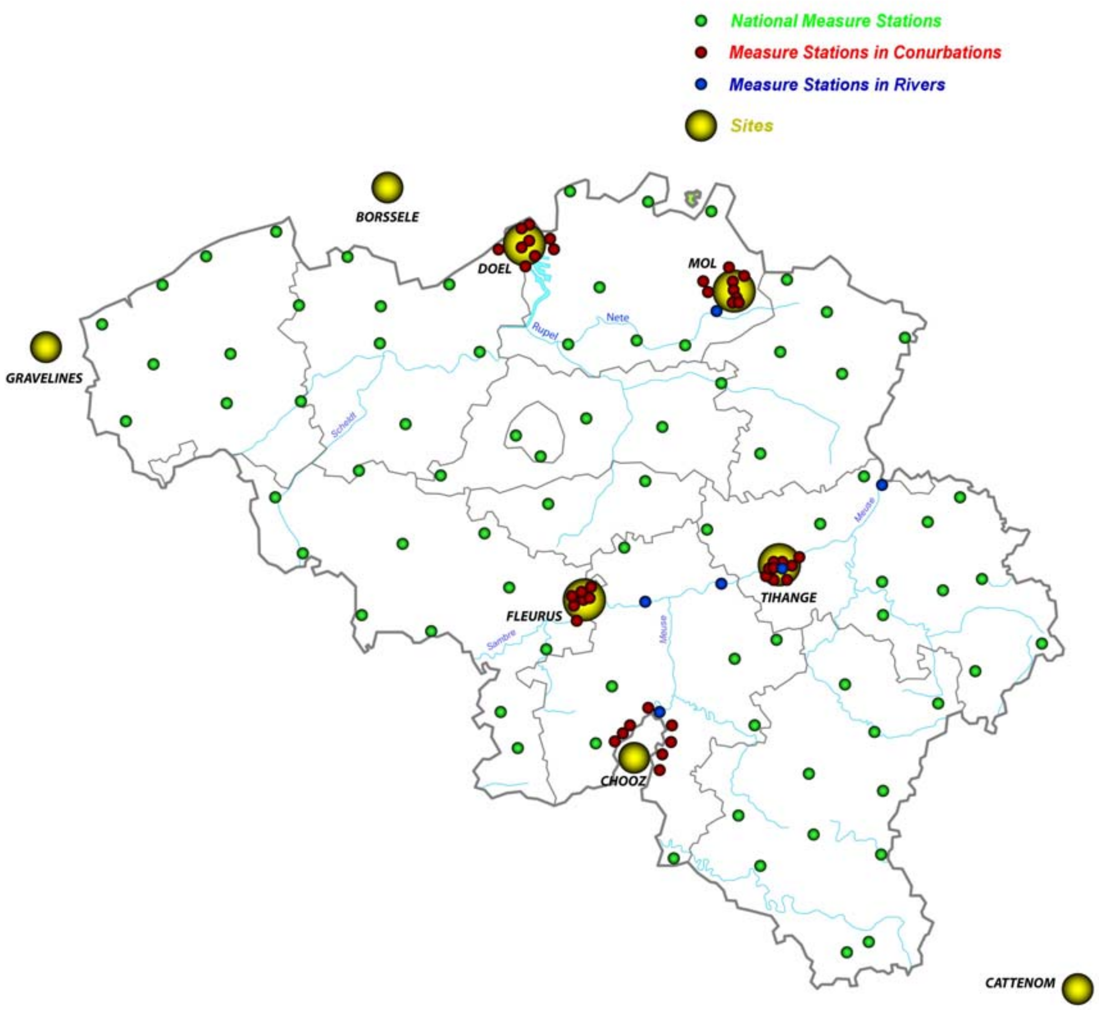
Storage facilities in Belgium involve pool storage and dry storage of intact fuel elements (at the NPPs, the SCK•CEN, Belgoprocess) and the storage of vitrified high level waste (at Belgoprocess).

For the dry storage of spent fuel there is a continuous monitoring of the leak tightness of the casks.

At the NPPs and at Belgoprocess, the liquid effluents are released via a single pipe which is continuously monitored and isolated in case an instantaneous limit is exceeded.

Environmental monitoring programmes (e.g. at SCK•CEN and Belgoprocess: emission, immission, dose rate, contamination, etc...) are established in agreement with the Bel V and the FANC in order to follow the impact on the environment. These results are periodically evaluated by the HPD and Bel V.

The data received through Belgium's Telerad automatic radiological monitoring network can also be used. Telerad is a network with principal aim to measure routinely the immissions and make measurements in case of an accident occurring in a Belgian nuclear site or abroad : in total, measurements from 192 detectors, of ambient radioactivity in air (186) and water (6) are collected, treated and sent to the computer server located at the FANC



TELERAD network: location of the measuring stations

6.4.5 International exchanges

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

Belgian representatives participate in the WENRA working group on Waste & Decommissioning. The main goal of this working group is the harmonisation of safety approaches for waste management and decommissioning. Several topics are dealt with, e.g.:

- management of very low level waste
- sharing experiences during cross inspections (exchange of practices)
- decommissioning policies

Belgium also participates in the relevant working groups set up by the European Commission, the NEA, UNSCEAR and the IAEA.

Finally, bilateral contacts have been established with neighbouring countries.

6.5 Article 25: Emergency preparedness

6.5.1 Regulatory framework

The emergency preparedness is primarily the responsibility of the Minister in charge of internal affairs. 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. The relevant infrastructure is being provided accordingly .

This emergency plan for addressing nuclear risks on the Belgian territory aims at co-ordinating the measures to protect the population and the environment in the event of a nuclear accident or any other radiological emergency situation in which radioactive substances could be released and dispersed outside the nuclear installation.

This document is to serve as a guide for the protective measures to be implemented in the event of a necessity. It establishes the tasks that the various departments and organisations would have to accomplish if the case arises, each within their legal and regulatory competence.

The provisions of the emergency plan apply in the cases where the risk exists that the population could be exposed to significant radiological doses 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.

This plan has been designed essentially for:

- nuclear accidents or any other radiological emergency situations arising at the Belgian nuclear power plants of Doel or Tihange or in the other main Belgian nuclear installations such as the Nuclear Research Centre (SCK•CEN) in Mol, the “Institut des Radioéléments” (IRE) in Fleurus, Belgoprocess and Belgonucléaire in Dessel;
- cases of detection of abnormal radioactivity on the Belgian territory ;

- nuclear accidents or any other radiological emergency situations arising in other countries, especially in those installations located close to the border (Chooz and Cattenom in France, Borssele in The Netherlands).

It therefore covers all installations managing spent fuel or radioactive waste.

This plan can also be activated in radiological emergency situations arising form accidents during transport of nuclear fuel, isotopes or radioactive waste, following re-entry of spacecraft containing radioactive material, following accidents or situations involving military equipment or in military facilities, or during accidents at Belgian nuclear installations other than those referred to above (Thetis reactor in Ghent, FBFC in Dessel, IRMM in Geel,...). It also applies to terrorist actions using radiological dispersion devices.

The off-site operations are directed by the "Governmental Co-ordination and Crisis 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 conducted by the Governor of the Province concerned.
In addition to the duties defined in the Royal Decree of 17 October 2003, the Federal Agency for Nuclear Control (FANC) is a main actor within this emergency plan. Its role is defined in articles 15, 21 and 22 of the law of 15 April 1994, creating the FANC, and in articles 70, 71 and 72 of the GRR-2001. These articles stipulate that the FANC is responsible to survey, to control and to monitor the radioactivity on the territory and to deliver technical assistance to set up the emergency plan. It is also in charge of participating and/or organising operational cells (i.e. evaluation cell and measurements cell).

6.5.2 Implementation of emergency response organisation

6.5.2.1 Classification of emergencies

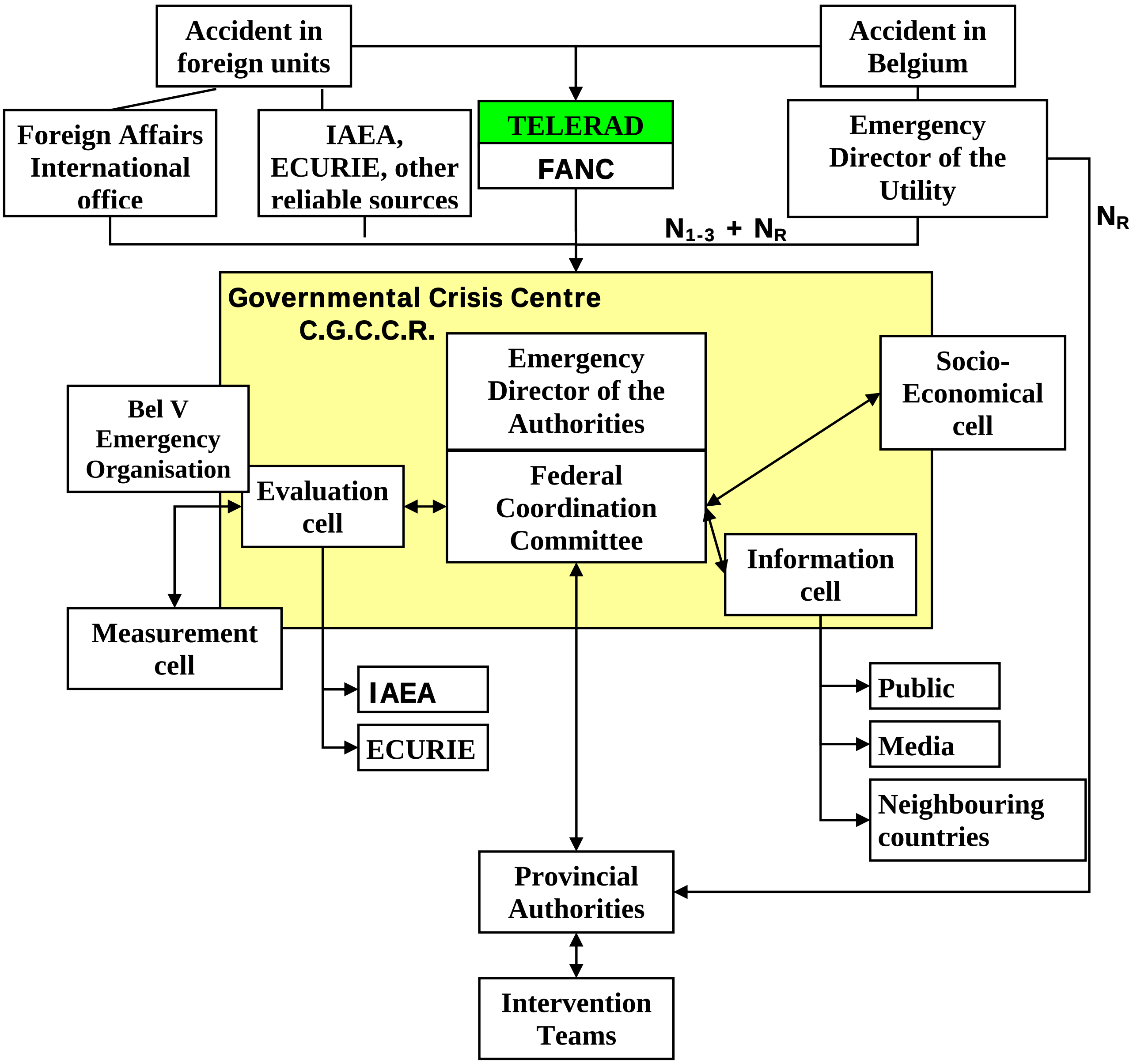
The Royal Decree of 17 October 2003 defines three levels for the notification of emergencies, which are in ascending order of seriousness N_1 to N_3, which the operator must use when warning the “Centre Gouvernemental de Coordination et de Crise - CGCCR” (i.e. the Governmental Centre for Co-ordination 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 kinetic. 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 an intervention level, immediate protective measures for the off-site population – without any further assessment – are taken by the local authorities (Governor of the Province), waiting for the full activation of the emergency cells. The criteria leading the operator to launch this 'reflex' phase have been defined in advance, based on the potential source terms of rapid scenarios and in agreement with the competent authorities. 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. 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 surrounding area of the site. Radioactive releases are still small and there is thus no danger for the surrounding area of the site (no action required to protect the population, the food chain or drinking water). Actions to protect workers and visitors on site might be necessary." In addition, for each nuclear installation, a set of particular types of events is established for each of the notification levels.

Each of these 4 notification levels (N_1 to N_3 + N_R) activates the federal emergency response 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 response plan.
All emergencies (N_1 to N_3 + N_R) have to be notified to the Governmental Centre for Co-ordination and Emergencies (CGCCR). This centre is permanently manned, alerts the cells involved in the crisis management at the federal level (Emergency and Co-ordinating Committee, evaluation cell, measurement cell, information cell, economico-social cell) and houses these cells during the crisis situation as well. The staffing of the crisis management cells is supposed to be operational at the CGCCR at least within two hours after the initial notification. The implementation of protective measures at the provincial level is expected to be performed within approximately three hours.
The "Emergency Director" of the Authorities (EDA) 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 governor of the province hosting the nuclear site immediately and automatically transforms the notification level into an U_R alarm level.

6.5.2.2 General overview of the organisation in the event of nuclear or radiological emergencies

The "Governmental Co-ordination and Crisis Centre" (CGCCR) is composed of the "Co-ordination and crisis Committee" chaired by the Emergency Director of the Authorities, the "Evaluation cell", the "Measurement cell" chaired by the FANC and the "Information cell" and the "Socio-economical cell" chaired by a person nominated by the EDA according to the situation, 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 ECURIE) or other reliable sources. The General Directorate of Civil Security 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 in 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 automatic radiological monitoring network managed by the FANC can also trigger a nuclear or radiological emergency. Telerad is a network with principal aim to measure routinely the emissions and make measurements in case of an accident occurring in a Belgian nuclear site or abroad: ambient radioactivity in air and water are collected from a total of 192 measurements sites (6 water dose rate counters, 179 air dose rate counters, 7 stations measuring α and β activity and iodine in aerosols, 13 meteorological masts). The

monitoring of the Belgian territory consists in a measurement network having a 20 km mesh. Besides, 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, there are measurements along the Belgian border, particularly in the vicinity of foreign nuclear power plants (Chooz, Gravelines, Borssele).

The Federal Coordination Committee immediately meets when a notification level N_R is declared or as soon as the Emergency Director decides a U_2 (or higher) alarm level. Based on the information and recommendations provided by the evaluation cell the Committee decides whether protection measures for the population and/or the food chain or drinking water supply are necessary. Their decisions are sent to the Provincial Emergency Centre for implementation by the different intervention teams (fire brigade, police, emergency medical services …).

The evaluation cell is composed of representatives of the relevant organizations, in particular FANC (chair), 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 national des Radioéléments" (IRE), and of Bel V, as well as of a representative of the operator of the installation. This cell has to evaluate the situation in radiological terms and advise the Emergency and Co-ordination Committee about 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 "Ecurie" Directive and "Early Notification of Accidents Convention".
The measurement cell coordinates all the activities aimed at collecting the radiological information, based on ambient radiological measurements depending on the various exposure modes. It rapidly transmits the collected and validated information to the evaluation cell.

The "Information cell" is the CGCCR's communication channel with the public, the media, the international organisations (European Commission, IAEA), and the neighbouring countries.

The "Economico-social cell" advises the Federal Co-ordination Committee on the feasibility and economico-social consequences of their decisions; it informs the Federal Coordination Committee about the follow-up and ensures 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, Economico-social Cell and Information Cell) participate in exercises of the emergency plans at the relevant installations.

The Royal Decree of 24 November 2003 sets the emergency planning zones relative to the direct measures to protect the population (evacuation, sheltering, and iodine prophylaxis). These evacuation and sheltering zones vary from 0 to 10 km radius depending on the nuclear plant concerned; the stable iodine tablets pre-distribution zones extend from 10 up to 20 km around the nuclear plants.

The National Emergency Plan is under continuous improvement as concerns the organisation and the infrastructures: stable iodine tablets distributed around the nuclear sites (last campaign 04/2002), the working procedures developed, investment made at local level, Telerad put into service, sirens installed around the nuclear installations, etc. The web site address of Telerad is : www.telerad.fgov.be .

6.5.2.3 Internal and external emergency plans for nuclear installations, training and exercises, international agreements

Each licensee of a nuclear installation has to establish an on-site emergency response plan to be approved by the regulatory body. This on-site emergency plan details the responsibilities, the roles and functions of all actors and the dedicated infrastructure, such as the On Site Technical Centre or the Emergency Operations Facility. This on-site emergency plan is regularly tested, as required by the Royal Decree of 17 October 2003.

The General Directorate of the Civil Security of the Ministry of Internal Affairs organises once a year for each nuclear power plants site and each second year for other sites an emergency response exercise. According to the intended objectives aimed at, the Ministry includes different topics in these annual exercises (fire rescue, health care, police services, field measurements teams ...). The operator is then put in charge of building an appropriate scenario.

During the exercises, the information corresponding to the scenario is gradually forwarded to the 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 Governmental Co-ordination and Crisis Centre (CGCCR), which is the "national contact point" for both the "Nuclear Accident Early Notification Convention" (IAEA) and for the similar European Union system (ECURIE).
Agreements also exist at local and provincial level between homolog's on both sides of the States border. 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 stations of Roosendaal (The Netherlands) and Antwerp, informing it as soon as the alert level U_2 notification is decided. This direct line is also used when certain accidents occur in the chemical industry (installations subject to the European post-Seveso Directive). A direct information exchange can also take place between the alarm stations of Vlissingen (The Netherlands) and Ghent should an accident occur at the Borssele nuclear power plant. For the Chooz and Tihange nuclear power plants, 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 Government of France and the Government of Belgium 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 power plants at Tihange, Chooz or Gravelines. This alarm takes place between the CGCCR on the Belgian side and the "COGIC", ("Centre opérationnel de gestion interministérielle des crises") on the French side.

During the exercises of Chooz (June 2000, May 2003) and of Gravelines (May 2001) that trans-border collaboration was actually tested at the local and national levels. In addition a direct exchange of technical and radiological information took place between the organisations in charge of the expertise (IRSN on the French side, Bel V on the Belgian side) and of the advice (Nuclear Safety Authority in France, Evaluation Cell of CGCCR in Belgium) and was quite successful.
As regards independent evaluation in the event of an emergency, Bel V which oversees the affected installation sends a representative to that site, a representative to the evaluation cell of the CGCCR, and activates its own headquarters emergency centre. This emergency centre has its own infrastructure (dedicated telephone and facsimile lines, computer means …). Based on the technical

information supplied directly by its representatives and all the information about the affected installation available at its head office, Bel V proceeds with a technical analysis of the situation and evaluates the radiological consequences from the expected releases. These evaluations of the consequences to the environment are performed with specific tools available in the Bel V emergency centre.

6.5.2.4 **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 Directive 89/618/Euratom. 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, etc.).

6.6 Article 26: Decommissioning

6.6.1 Legal framework related to decommissioning and liability management.

Legal assignments regarding the *management* of decommissioning and related liabilities have been entrusted since 1991 by Royal Decree to ONDRAF/NIRAS. The responsibilities involve:

- the approval of decommissioning plans,
- the elaboration of mechanisms for building up financial provisions for the execution of programmes, in agreement with the operator or the owner of the facilities,
- the execution of decommissioning programmes as requested by the owner or in case of failure.

These legal assignments have been extended by law in December 1997 to all nuclear installations and sites containing radioactive substances. ONDRAF/NIRAS is in charge of elaborating and reviewing every five years a national inventory comprising a database of all nuclear installations and sites concerned, and of assessing their decommissioning and remediation costs. ONDRAF/NIRAS is also responsible for verifying the existence of sufficient financial provisions to cover the execution of the programmes. A report on the situation must be submitted to its supervising Minister which may constrain the responsible body to take the necessary actions to avoid further uncovered "nuclear liabilities".

The results of the first national inventory exercise were submitted to the State Secretary for Energy and Sustainable Development in January 2003. The second national inventory was submitted in March 2008 to the Minister for Energy.

6.6.2 Implementation of the legal requirements

6.6.2.1 **Decommissioning planning**

To fulfil its legal assignments related to the collection and evaluation of decommissioning programmes of nuclear plants in Belgium, ONDRAF/NIRAS defined and implemented the structure of the *decommissioning plans*, based on the recommendations of the IAEA.

An initial decommissioning plan is set up by the licensees for new facilities and facilities in operation for which the ending of activities is not planned in the short term. This plan needs to be reviewed every five years or more frequently in the case of major modifications to the nuclear facility. The final decommissioning plan is submitted to ONDRAF/NIRAS three years before the foreseen final shutdown of the facility or part of the facility.

In 2004, ONDRAF/NIRAS has communicated to Belgonucléaire the approval of the final decommissioning plan of the Belgonucléaire production facility: this plan had been submitted to ONDRAF/NIRAS in 2003.

6.6.2.2 **Decommissioning programmes**

The operator or the owner of a nuclear facility can call upon ONDRAF/NIRAS for the execution of his decommissioning programme. In this case, ONDRAF/NIRAS has to conclude a convention with the operator or owner covering the technical and financial aspects of the decommissioning.

Up to now, the Belgian government has entrusted ONDRAF/NIRAS by conventions with the management of the nuclear liability funds SCK•CEN, Belgoprocess 1 (BP1), Belgoprocess 2 (BP2) and IRE.

6.6.2.2.1 Liability fund SCK•CEN

The SCK•CEN nuclear liability fund was raised in 1990 and aims at financing the decommissioning of all nuclear facilities existing before 1989 on the Nuclear Research Centre SCK•CEN site in Mol, as well as the management of all the historical waste present on the site. These facilities cover:

- the BR1 complex with a graphite moderated research reactor and the VENUS zero-power reactor. Both reactors are still in operation;
- the BR2 complex, a material testing reactor which was restarted in 1997 after two years of refurbishment;
- the BR3 reactor, a pilot PWR shut down in 1987 and currently being decommissioned;
- the laboratory buildings containing mainly hot-cells and glove boxes,
- a farm and pastures.

Beside the nuclear installations, the fund also covers the management of spent fuel from these reactors as well as the management of other “exotic” fissile materials and specific special waste which are still stored on the site.

The decommissioning activities are executed mainly by the SCK•CEN staff following annual programmes and budgets which have to be approved by ONDRAF/NIRAS. These activities are in line with the decommissioning plans which were elaborated by SCK•CEN and approved by ONDRAF/NIRAS.

6.6.2.2.2 Liability funds BP1 & BP2

The BP1 & BP2 liability funds were raised in 1989 to finance the decommissioning and the remediation of respectively the former EUROCHEMIC reprocessing plant and its associated activities in Dessel (site BP1), and the former waste processing sites of the Nuclear Research Centre SCK•CEN in Mol (site BP2). All these facilities are located on the two BELGOPROCESS nuclear sites in Mol and Dessel.

The former EUROCHEMIC facilities cover:

- the reprocessing plant which is being decommissioned since 1986;
- the vitrification plant PAMELA. As the last vitrification operation took place in September 1991, this installation has been adapted for the treatment and conditioning of alpha bearing waste and medium active waste.
- the bituminisation plant EUROBITUMEN which is in operational stand-by;
- waste storage buildings containing medium- and high-level waste conditioned during and after the reprocessing activities.

The former waste processing installations of the BP2 site cover:

- waste processing installations;
- waste storage and processing facilities containing special waste.

The decommissioning activities are executed by the BELGOPROCESS staff following annual programmes and budgets which have to be approved by ONDRAF/NIRAS.

6.6.2.2.3 Liability fund IRE

The IRE liability fund was raised in 1997 to finance the management of waste and irradiated uranium respectively produced and used during the operation of the *Institut National des Radioéléments* (IRE), a nuclear facility producing mainly radioisotopes for nuclear medicine.

6.6.3 The financing of decommissioning programmes

Financial provisions not treated in this article are dealt with under article 22.

6.6.3.1 Programmes without financial provisioning during operation

For the moment, the clearly identified nuclear facilities in Belgium for which no financial provisions were raised, are owned or were owned in the past directly or indirectly (via the public sector) by the Belgian State. For these facilities, decommissioning and site remediation or, in one specific case, waste and spent fuel management, are financed by a levy mechanism on the distributed kWh, as determined in the law of 24 March 2003. This Law guarantees the financing of the BP1 and BP1 passives till the completion of the corresponding dismantling and waste conditioning activities.

6.6.3.1.1 Liability fund SCK•CEN

Annual endowments for decommissioning all nuclear facilities existing on the SCK•CEN site in Mol before 1989 are spread over the period 1989 - 2019.

6.6.3.1.2 Liability funds BP1 & BP2

The BP1 & BP2 liability funds were raised in 1989 to finance respectively the former EUROCHEMIC reprocessing facilities in Dessel (BP1) and the former waste processing activities of the Nuclear Research Centre SCK•CEN in Mol (BP2). Structural financing of these activities via a special levy on the electricity consumption limited to a total annual amount, until the year 2008 is guaranteed by a Royal Decree. For the upcoming period of 2009-2013, the same mechanism of financing is in progress.

6.6.3.1.3 Liability fund IRE

The liability fund was raised in 1997 and will last until the activities covered by the fund are over, namely the management of waste and irradiated uranium respectively produced and used during the operation of the *Institut National des Radioéléments* (IRE). The cost of the decommissioning activities will be covered by a separate agreement with the Belgian State through an additional fund, which is currently still in negotiation.

6.6.3.2 **Settlement of provisions during plant operation**

One of the main tasks of ONDRAF/NIRAS is to avoid lack of financial means for the execution of future decommissioning programmes (article 9 of the Programme Law of 12 December 1997). Therefore, ONDRAF/NIRAS has to control the existence and the sufficiency of provisions to be set up by the operator or the owner of nuclear facilities and sites contaminated by radioisotopes. Nevertheless, the legal responsibility for building up sufficient provisions remains with the operator or the owner.

Decommissioning and remediation costs as well as the annual financial provisions are re-evaluated periodically.

The annual provisions are calculated on the basis of the best estimates of the decommissioning and remediation costs for the year of the evaluation. The final objective is to constitute the total amount of financial means at the final shutdown of the facility. This way, the provisions are raised during the operational lifetime while the facility is still providing benefits.

7 Section G: Safety of Spent fuel Management

7.1 Article 4: General safety provisions

7.1.1 Sites at Doel and Tihange

The installations are described in appendix 1.

The residual heat generated during the spent fuel management is removed, depending on the storage mode. Three storage modes are used:

- in fuel-cooling pools in the units;
- in containers in building SCG (Doel);
- in pools in building DE (Tihange).

7.1.1.1 **Fuel-cooling pools in the units.**

The fuel-cooling pools are located in the buildings “GNH” (Doel 1/2), “SPG” (Doel 3/4), “BAN” (Tihange 1) and “D” (Tihange 2/3).
The residual heat is removed by the fuel pool purification system of each unit (PL at Doel and CTP at Tihange); these systems are designed to remove the residual power generated by the spent fuel assemblies, even if the external power supply is down.

Calculation codes recognised by the safety authorities were used to verify that the K_{eff} (neutron multiplication rate) does not exceed the criteria in normal and accidental conditions. The calculations have not taken into account a potential presence of boric acid in the system (what is conservative). Burn-up credit is involved in the criticality analyses, with the approval of the Safety Authorities, on a case-by-case basis.

7.1.1.2 **Containers in building SCG (Doel)**

<u>Containers:</u>

The storage containers are designed in such a way that the residual decay heat is removed passively by convection and radiation. The thermal power removed by the container is determined to reduce as much as possible the maximum temperature of the fuel can in normal storage conditions (300 to 400°C depending on the container model), in order to guarantee in the long term the fuel integrity. The data used for the design of these containers are penalising with regard to the power history of fuel assemblies and their cooling time before being loaded in containers.

It has been verified that the containers meet the IAEA requirements for the analysis of the sub-criticality. In particular, a K_{eff} lower than 0.95 is obtained by taking penalising hypotheses as regards the size and the nuclear characteristics of the fuel assemblies plunged into pure water.

Building SCG:

The spent fuel storage building (SCG) has been designed to remove through natural circulation the calories produced by all the storage containers stored in the building.

The dose rates due to neutron and gamma-radiation have been calculated inside and outside the storage building when it is completely filled with the number of containers planned during the design phase. In order to make a conservative calculation of the dose rate, it was supposed that each container emits the accepted dose rate limit at 2 meters and that the containers were all stored at the same time.
In these extremely penalising conditions, it was demonstrated that the dose rate at the site limit remains far below the accepted maximum dose.

7.1.1.3 **Pool building DE (Tihange).**

The heat generated by the spent fuel assemblies is removed by three systems operating in cascade. These systems – which are physically separated – are permanently operating in the normal operational conditions of the installations.
The first system, named 'STP', is composed of a heat exchanger that transfers the heat emitted in the pool water to the second system.
This second system, called 'intermediary cooling system' (SRI), is part of the intermediate cooling system (CRI) of the Tihange 3 nuclear facilities. Via an exchanger, this CRI system transfers the heat extracted from the STP system to the third circuit.
This last, named 'raw water system' (CEB), cools down the heat in the CRI system with water pumped from the river Meuse. After having flowed through the exchangers between the CRI and CEB systems, this water is released in the river Meuse.
The CEB system constitutes the normal cold source in building DE.
If the raw water supply is unavailable (in accidental conditions), the groundwater of the Tihange nuclear power plant site is used as an alternative cold source.
Calculation codes recognised by the regulatory body were used to verify that the K_{eff} (neutron multiplication rate) does not exceed the criteria in normal and accidental conditions. The calculations have not taken into account a potential presence of boric acid in the system (what is conservative).

The fuel management has been designed to minimise the number of fuel assemblies used in the reactor core and to comply with the limitations regarding the discharged fuel radiation rate. This management policy keeps intrinsically the production of radioactive waste at the lowest level possible.
The mechanical features of the fuel cans, especially corrosion resistance, have been improved by using new alloys.

The coherence of the measurements described in the previous paragraphs has been verified at every step of the spent fuel management.

7.1.1.4 **Specificity of the Tihange site**

7.1.1.4.1 Intermediary storage in buildings «BAN» (Tihange 1) and «D» (Tihange 2/3)

The intermediary storage buildings as well as the installations and systems integrated in these buildings have been designed and built according to the safety principles, the general design criteria, the building standards in force at the time when the nuclear power generating units were designed and built.
These safety principles and general criteria, approved by the Belgian Safety Authorities, are mainly those in force in the American regulation accepted on international level.
The design of these buildings complies with the provisions set out in the GRR-1963, now replaced by the GRR-2001.

7.1.1.4.2 Intermediary storage building DE

The design requirements for the safety of building DE are the same as for building D of unit 3. They are mentioned in the Safety Analysis Report of this unit:

- Building DE is designed to resist earthquakes and other natural phenomena like violent wind, tornado and flood.
- The building is also designed to cope with external accidents such as an airplane crash, an explosion accompanied by a shock wave and projectiles and to avoid the seepage of explosive gas inside the installations.
- The entrance is controlled.
- The mechanical and electrical systems and the instrumentation are qualified for their specific use.
- The shields and other measures (pipe arrangement, pool water purification) make it possible to meet the requirements of the regulations on radiological protection.
- The design also includes considering the particular recommendations set out in the American and international regulations for this kind of installations.
- This building is located within the perimeter of the Tihange 3 site, and is therefore an integral part of the Tihange 3 installations.
- The different services of the Tihange nuclear power plant cover, each for its own field, all the activities related to this building. More specifically:
    - Radiological surveillance activities and surveillance of the installations;
    - Fuel handling;
    - Fuel transport from buildings BAN to building DE.

7.1.1.5 **Specificity of the Doel site**

7.1.1.5.1 Intermediary storage in the buildings “GNH” (Doel 1/2) and “SPG” (Doel 3/4)

The intermediate storage buildings as well as the installations and systems that are integrated in these buildings have been designed and constructed according to the safety principles, the general design criteria, the building standards in force at the time when the nuclear power generating units were designed and built.
These safety principles and general criteria, approved by the Belgian Safety Authorities, are mainly those in force in the American regulations.
The design of these buildings complies with the provisions of GRR-2001.

7.1.1.5.2 Intermediate storage building SCG

At Doel, the intermediate storage safety functions are fulfilled mainly by the storage containers. The storage container models are approved by the FANC for transport, and comply therefore with the IAEA transport regulations.
The storage configuration of the containers is a bit different from the transport configuration and the regulation in force on the site is applied.
The design of the intermediary storage – i.e. the containers configured for the storage and the storage building – complies with the provisions of GRR-1963 which was replaced later by GRR-2001.

In general, the design requirements for the intermediate storage are the same as those in force for the generating units on the site:

- The containers must resist seismic loads and the consequences of other natural phenomena like violent wind and tornado.
- The containers have been designed to cope with external accidents such as an airplane crash, an explosion accompanied by a shock wave and projectiles.
- The access to the building is controlled.
- The shields of the containers and of the storage building make it possible to meet the requirements set out in the regulations on radiological protection.
- This building is located within the perimeter of the Doel nuclear power plant. It is independent from the generating units. The management of this building is connected with the management of the waste processing installations (WAB).
- The different services of the Doel nuclear power plant cover, each for its own field, all the activities related to this building. More specifically:
    - Radiological surveillance activities
    - Surveillance of the installations;
    - Fuel handling;
    - Control of the tightness;
    - Accountancy of the assemblies and controls in the framework of the Non-Proliferation Treaty.

The general safety provisions consider the biological, chemical and other risks resulting from the management of the spent fuel.

During the operation and in the frame of the ten-yearly reviews, the operator takes the appropriate measures to comply with the regulations in force, including recommendations by the International Commission on Radiological Protection and the International Atomic Energy Agency. From now on, financial provisions are accumulated for the future execution of the spent fuel management programme.

7.1.2 SCK•CEN site: BR2

Additional information may be found in appendix 4

7.1.2.1 Spent fuel storage

The spent fuel and radioactive materials stored under water in Side-pools are cooled by the pool water circuit.

BR2 standard fuel elements are stored under water, mainly for shielding reasons. Storing this kind of fuel is foreseen in the containment building and in the storage canal in the machine hall. The transfer of BR2 fuel elements can only take place 100 days after their last irradiation considering the ^{131}I content and the residual power.

Irradiated standard fuel elements are manipulated in the reactor pool or in the storage canal either single or in a transfer basket, which can contain up to 9 standard fuel elements in an annular configuration. In case the fuel elements have the most reactive state, they cannot reach the criticality level, even if they fall out of the basket. The fuel elements are locked in their baskets during handling operations.

A single fuel element could approach a storage rack with other standard fuel elements. The distance between axes, however, is still larger than 120 mm (> 44.5 mm between surfaces), corresponding to a k_{eff} value of 0.9 for an infinite array in square lattice of this distance. As regards the wet-sipping rack, the minimum distance may be 121.5mm between axes, but the other fuel elements are more distant from each other, and a critical assembly cannot be formed in this way.

As far as the racks for 200 mm type fuel elements are concerned, these fuel elements are neutronically nearly uncoupled. The distance between surfaces (75mm) is sufficient to avoid criticality, taking into account that the 200 mm type fuel element contains a cadmium screen. The tight tubes used for the transfer are stored with a protective cover.

7.1.2.2 **Criticality considerations**

A maximum admissible limit of 0.90 for k_{eff} has been fixed for every storage place.
The different types of standard fuel element (alloy A, cermet C, G or E) did not have to be considered individually, as the experimental evidence shows that the most reactive state of any BR2 standard fuel element is the state of a fresh alloy fuel element. Criticality calculations of standard BR2 fuel assemblies are therefore conservative, if they concern fresh alloy fuel elements of the type VIn A 244 g^{235}U.

Generic studies were carried out on the storage of several kinds of fuel and to find simple rules that encompass some cases of fuel arrangements. Other fuel elements or experimental fuel rods have to comply with the preceding criteria.

7.1.2.3 **Cooling**

The pool water circuit transfers the heat produced in the reactor pool (870 m³) and the side-pools to the secondary cooling circuit through two heat exchangers having a total capacity of 2.9 MW.
This circuit consists of the following loops:

- cooling,
- purification,
- auxiliary.

The circulation in the cooling line of the reactor pool is maintained by 2 pumps, each with a flow of 420 m³/h (one in service and the other in standby). A third one of 90 m³/h is used when the reactor is stopped. The flow in the side-pools is ensured by 2 pumps of 85 m³/h (one in service and the other in standby).

Before entering the reactor pool, the cooling water flows through the reactor shroud to ensure the cooling of the outside wall of the reactor vessel and of the beam-tube walls in the vicinity of the vessel.

Part of the flow of this line also cools down the beam-ports in the pool wall in order to evacuate the heat generated by the gamma heating.

When the pumps stop, the shutdown pump with a flow of 90 m^3/h starts automatically to evacuate the residual heat.

In case of loss of integrity of the dam, the water in the side-pools is kept at a minimum level of 2.2 m, enough to keep the fuel elements under water.

The *main secondary water circuit* evacuates into the air the heat removed from the reactor by the primary circuit and the pool circuit; afterwards, it cools down the gas condenser of the primary degasifier. This circuit consists of the following loops:

- cooling,
- purification,
- auxiliaries.

The circulation in the cooling loop is maintained by 4 pumps each with a flow of 39.2 m^3/min and a pressure head of 4 kg/cm^2. Each pump is driven in direct coupling by an electric motor of 500 HP.

When the reactor is operating, there are 2 or 3 pumps in service, depending on the power of the reactor, and one pump in stand-by.
The fourth pump in stand-by is equipped with a progressive opening which is used when restarting the secondary circuit. This avoids shocks in the piping.

7.2 Article 5: Existing Installations

7.2.1 Sites in Doel and Tihange

The installations are described in appendix 1.

The measures to investigate and improve the safety of the spent fuel management installations are addressed below.

7.2.1.1 **Ten-yearly safety reviews**

The License of each Belgian nuclear power plant makes it mandatory to conduct ten-yearly safety reviews starting from the inspection acceptance (granted during the first operation at full power).
As a result, the operator and Bel V compare together, 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.

A joint report is established highlighting the differences found, the necessity and possibility of remedial actions and, as the case may be, the improvements that can be made and the time schedule for their implementation. The report is transmitted to the FANC.

The objectives of a ten-yearly review have been defined as follows:

- show that the unit has at least the same level of safety as it had when the license was granted to operate 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.

Following a FANC recommendation issued in July 2007, the next Periodic Safety Reviews (around 2015) will be performed in accordance with the IAEA Safety Guide NS-G-2.10.

7.2.1.2 Safety assessments

During the operation of the installations, experience feedback leads the operator to consider some modifications to the installations.

The proposals for modifications to the installations are examined by the Health Physics Department of the operator, and Bel V is informed. The procedure is described in article 14 of the National Report established for the second meeting of the Contracting Parties in the framework of the Nuclear Safety Convention. In short, the proposal is classified into one of the three following categories:

- major modifications changing the basic characteristics of the unit. These modifications are subject to a license according to the provisions of Article 12 of the GRR-2001. The safety analysis performed by Bel V is presented to the FANC, and an amendment to the License Decree (Royal Decree) will be established. The implementation of that modification will be authorised by the unit's HPD and by Bel V.
- minor modifications having a potential impact on safety. The modification file is established by the requesting department, possibly with outside help, such as Tractebel Engineering, is presented for approval to the Unit or Site Operation Committee and is examined by the Health Physics Department. After this, it is examined by Bel V, which may result in amendments being ordered to the modification file. When Bel V is of the opinion that the file is acceptable, it approves the modification application, and the implementation may start. Commissioning the completed modification is subject to a positive acceptance report, issued after validation of the modification and requalification of the portion of the installation that was modified and the updating of the operation documents. Bel V issues a final acceptance report (operating license) when all the files, procedures and the Safety Analysis Report have been adequately updated. This process is followed up by the FANC, which may intervene if deemed necessary.
- modifications without impact on safety, that usually do not imply modification of the Safety Analysis Report and which comply with all the safety rules applicable to the installation. These modifications have to be approved only by the Health Physics Department of the unit, without formal involvement of Bel V.

Based on operational feedback, a number of modifications have been made, such as (not exhaustive):

  - modifications of the overhead handling cranes;

- modifications to the access doors;
- replacement of certain neutron-absorbing materials (boraflex) by steel sheets containing boron;
- modifications to the handling and transfer systems of spent fuel shipping containers.

7.2.1.3 Surveillance programmes

The technical specifications (chapter 16 of the Safety Analysis Report) prescribe 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 controls and tests to be performed and their frequency.

Specific programmes are established, in particular for:

- inspections and controls
- tests

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 (based on IEEE 323 and the Arrhénius law) or experience feedback of similar equipment, defining the qualified life of the equipment. The qualified life determines the frequency of replacement of that equipment, which can be re-assessed depending on the real operational conditions and location of that equipment.

7.2.2 SCK•CEN site: BR2

Additional information may be found in appendix 4

The steps to investigate and improve the safety of the spent fuel management installations are dealt with below.

7.2.2.1 Ten-yearly reviews

The Royal Decree granting the license N.0024 of 30 June 1986 for the operation of SCK•CEN makes it mandatory to conduct ten-yearly safety reviews starting from the inspection acceptance (granted during the first operation at full power). This general delay is reduced to five years for the BR2.
As a result, the licensee 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.

Like for nuclear power plants, a joint report is established with Bel V highlighting the differences found, 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 report is transmitted to the FANC.

The objectives of a ten-yearly review have been defined as follows:

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

7.2.2.2 **Safety assessments**

Operational experience might bring the operator to consider performing certain modifications to the installations.

In order to guarantee a safe and reliable operation of BR2, it is necessary to observe specific prescriptions with regard to the modifications of materials and/or installations. The aim is:

- To guarantee that the quality of the systems and components is not lost due to the modifications;
- To guarantee the compliance with the description in the license documents;
- To guarantee a safe and reliable operation.

A standard application and modification form with regard to the installations is presented.

Overview

Committee on the Modification of Installations (CWI/CMI):

After receipt of the application, a review and assessment are performed by the Committee. It is only after its advice is obtained, that the application will be submitted to the Internal Service for Prevention and Protection at Work (IDPBW/SIPPT) and the HPD.
The modifications need to be:

- Either sufficiently small (GRR-2001 art. 12);
- Or having no negative effect on the safety in case they are considerable; (RD N°0024 art. 2.2, 2.3 and 2.4).

A preliminary investigation of this modification is also necessary in order to verify whether it fits within the framework of the special license conditions, implying that no additional license is needed.

Modifications having an important impact on safety and on the reactor need to be approved by the "Committee COP-CEE", in addition to the approval by Bel V.
The final approval has to be given by the Reactor Manager BR2.

7.2.2.3 **Surveillance programmes**

A surveillance programme is established in order to guarantee the quality of all safety-related activities in the company, in case of a shutdown, as well as during maintenance works.

The general surveillance programme is applicable to all BR2 systems and is based on the legal provisions, standards, the internal safety and quality programme and the procedures and instructions of the manufacturer.

The periodicity of the checks needs to be guaranteed, depending on the safety, the possibility of failure and the above-mentioned documents. In the absence of these documents, reference is made to the constructor's or own experience. A decrease of the frequency is only permitted if regulations or license conditions allow so.

7.2.2.3.1 Types of inspection

Periodical inspections

Almost all of the inspections belong to this category. Nevertheless, the definition of periodicity can take on many forms, e.g. time interval, number of effective working hours, as a result of an incident, at the start of a new cycle...etc.

These inspections consist mainly of the following activities:

Inspection of structures, systems and components;

Operational checking (quality);

Calibrations (quantity).

OVERVIEW OF PERIODICAL INSPECTIONS		
Safety	CLASSICAL/NUCLEAR	
Frequency	≥ 3 months followed by an internal supervision programme	-< 3 months -Cyclic -Daily...
Legal	RGPT / AREI / R.D. N.0024........	
Voluntary	Risk reducing / Q.A. manuals / Standards / IAEA Safety Standards	

Occasional inspections

Non-periodical inspections are also possible, e.g. on demand of Bel V or FANC, or on the initiative of the HPD.

Inspections before operation

The company ensures that the products, machines, devices, installations, equipments, etc.. supplied, are not being used or processed before it is verified that they meet the safety requirements prescribed.

The entrance inspection can range from an ordinary identity control of the product supplied, based on the accompanying delivery note or order form to an extensive inspection of the observance of the safety requirements prescribed.

7.3 Article 6: Siting of proposed facilities

The installations are described in appendix 1.

The current spent fuel management installations have been sited after evaluation and consideration of the relevant factors related to the sites.

7.3.1 Sites of Doel and Tihange

7.3.1.1 Siting

Characteristics taken into account for the selection of the sites

The Doel and Tihange nuclear power plant 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 surrounding area were specifically investigated in order to identify the soil characteristics and the earthquake spectrums that must be considered when designing the structures and systems.
- The hydrological characteristics of the rivers Meuse and Scheldt were investigated, 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 made it possible to define the atmospheric diffusion and dispersion models to be used when assessing the short-term and long-term environmental impacts of atmospheric releases considering the local characteristics. These studies were complemented with demographic surveys in the vicinity of these sites.
- Concerning the population density around the sites, no specific criterion was set 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 most important.

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 that the local industrial activities may have on the power stations, specific requirements were adopted: protection against external accidents such as civil or military airplane crash, gas explosion, toxic gas cloud, major fire.

Periodic reassessment of the sites characteristics

These reassessments are systematically performed in the frame of the ten-yearly safety reviews of each unit.
For the Tihange site, the safe shutdown earthquake considered originally (early seventies) for Tihange 1 was of 0.1 g acceleration. 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 following the analysis of the earthquake that occurred in Liège in 1983.
The seismic reassessment of Tihange 1 was performed during its first ten-yearly 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).
During the ten-yearly safety reviews of each unit, studies are performed and, where necessary, measures are implemented to ensure that the residual risk following external accidents remains

acceptable considering the surrounding area of the site with respect to the risks resulting from transport, aircraft or industrial activities.

International agreements

Informing neighbouring countries when planning a nuclear installation is required by Article 37 of the Euratom Treaty, and as a consequence is mandatory in Belgium (cf. the GRR-2001). The reports drawn up to meet this requirement have been submitted to the European Commission as part of the licensing procedure for the Belgian power stations. Having consulted the “Article 37” group of 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 Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2003/35/EC.

7.3.1.2 **Measures**

The appropriate measures to ensure that such facilities have not unacceptable effects on other Contracting Parties are listed in article 4 (see above).

7.3.2 SCK•CEN Site: BR2

Additional information may be found in appendix 4.

7.3.2.1 **Siting**

The SCK•CEN installations were sited in 1953. The selection had to comply with the regulations in force at that time for the construction and operation of the installations.

7.3.2.1.1 Periodic review of the sites characteristics

Seismic analysis

During the design and construction of BR2, seismic loads were not taken into account, although the risk of earthquakes was considered, as the original safety report[i] indicates:

11.2.7 Earthquakes

The seismic index for Belgium is 0.2. This means that the average number of earthquakes per year and per 100,000 km^2 is 0.2. The last appreciable earthquake occurred in 1938 and was of class 7, which means that the acceleration was approximately of 100 cm/sec^2.

11.4.7.2 Earthquakes

Information received from Belgian sources indicates that earthquakes are not taken into account in building design. The last appreciable earthquake (see Section 11) occurred in 1938 and was of Class 7, which is defined as producing an acceleration of 100 cm/sec^2. No special provisions have to be taken for earthquakes in the reactor building or control design.

[i] Belgian Engineering Test Reactor BR2 - Safety and Design - Final Report - Report CEN - Blg 59 - R.1996 - May 1, 1961.

The earthquake mentioned occurred on 11 June 1938, in the massif of Brabant. The epicentre was located in Zulzeke-Nukerke (geographical co-ordinates: Lat 50.783N; Lon 3.58E). The magnitude was 5.9 and the depth of the hypocenter 24 km. The intensity at the epicentre was VII (MSK) with a macro seismic region of 340 km^2. In the region of Mol, an intensity of IV was observed.

In the operating license, issued after the safety review of 1986, a study of the protection against earthquakes was requested. The definition of the reference earthquake had to be done according to the procedures of 10 CFR 100, Appendix A, though with the exception that the horizontal acceleration could be lower than 0.1 g.

For the restart of BR2 in 1997, following the replacement of the beryllium matrix, a seismic qualification was asked by the authorities. A dynamic calculation of the main structures of the reactor building was made.

The study concluded that the fuel storage canal would provide adequate resistance to the reference 0.1g seismic event with a minimum safety factor of 1.4.

Other External events

All barriers can be damaged due to external events. The effect of an aeroplane impact, explosions, etc. is discussed in a report by Belgatom dated January 1988 “Réévalutation de la sûreté des installations du SCK•CEN - Etude des agressions d’origine externe”.

7.4 Article 7: Design and construction of facilities

7.4.1 Doel and Tihange Installations

The design of the facilities is described in Appendix 1

7.4.1.1 **Appropriate measures to reduce the radiological effects**

7.4.1.1.1 Fuel cooling pools in buildings “GNH” (Doel 1/2), “SPG” (Doel 3/4), “BAN” (Tihange 1) and “DE” (Tihange 2/3)

On each site, the spent fuel assemblies discharged from the reactors are stored in the cooling ponds of the units for radioactive decay.
The intermediate storage capacity of spent fuel assemblies had to be substantially improved to cope with the stopping of the transfer of spent fuel to the reprocessing plants. A storage building was constructed on each site. These buildings are designed to receive and store discharged spent fuel coming from the units under water (building DE-Tihange; see section 7.4.1.1.2. below) or in shielded containers (‘dry storage’ -building SCG-Doel; see section 7.4.1.1.3 below).
The function of biological protection of the personnel handling the assemblies and operating the pools is guaranteed in the different operation modes.
During the storage, the biological protection consists of an 8 meter-thick layer of water above the plane of the subassembly heads stored in the racks.
During the transfer operations between the pools and the transit operations in the transfer canal, the layer of water above the assembly heads is at least 3-meter thick.
To avoid emptying the pools and uncovering the spent fuel elements, all penetrations through the pool surface occur 3 meter above the upper level of the racks.
A small hole in the pipes going down to the bottom of the pools avoids creating a siphon effect in case of rupture of these pipes outside the pools.

The ALARA principle, which consists in keeping the exposure of the workers as low as reasonably achievable, is applied.
The GRR-2001 requirements are complied with.
As already mentioned, this regulation imposes the following limits:

- the annual dose of occupationally exposed workers must not exceed 20 mSv;
- the annual dose of members of the public must not exceed 1mSv;

The following measures have been taken during the design of the buildings to meet these requirements:

- use of materials avoiding the accumulation of activation and fission products.
- reduction of the length of the pipes carrying radioactive fluids in the frequently accessed areas;
- use of remote-controlled valves and fittings;
- installation of removable or fixed biological shields;
- limitation of the surface and air contamination in the areas;
- accessibility to the equipments that must be regularly inspected in order to reduce the exposure time.

The spent fuel storage ponds are designed in such a way that the fuel is only handled under water so that the shielding is sufficient to limit the dose rate at the level of the working desk.
The external wall of the building is designed to protect the external staff and the public against the radiation of the sources present in the building in normal as well as in accidental conditions.

7.4.1.1.2 Building DE (Tihange)

7.4.1.1.2.1 Protection against radiation

Functionally, building DE is an extension of the spent fuel storage building in unit 3 (building D). It is located within the technical perimeter of unit 3.
It is designed to handle and store under water irradiated fuel assemblies coming from units 1, 2 and 3.
The fuel is transferred from the three units to building DE by means of transfer containers complying with the international regulations for the transport of radioactive material.
The function of biological protection of the staff handling the assemblies and operating the pools of building DE is the same as in the above-mentioned section 7.4.1.1.1.
The design of building DE also meets the requirements of the European Directive 96/29/EURATOM of 13 May 1996 laying down the basic safety standards for health protection of the workers and the general public against the dangers arising from ionising radiation.

7.4.1.1.2.2 Radiation control in the areas

Inside building DE, the activity in the pool hall is permanently controlled by a gas chain and an ambient radiation monitoring.
The objective of both chains is to:

- monitor the radiation level around the storage pools and check indirectly if the layer of water separating the radioactive fuel from the handling areas is thick enough ;

- monitor the radioactive noble gas concentration in the air of the pool hall and, therefore, control indirectly the integrity of the fuel rods; moreover, it is possible to take manually a gas sample in order to measure the aerosols and, if necessary, the radioactive iodine.

These functions (except the sampling) are performed continuously. If the limits established are exceeded, the alarms are set off, but there is no automatic action.

7.4.1.1.2.3 Ventilating building DE

The VDE ventilation system is composed of 6 different circuits and is designed to fulfil in the first place the safety functions during the operation of the spent fuel storage installations. The tasks include:

- Keeping building DE under a slightly negative air pressure with respect to the outside air;
- Releasing the air extracted in building DE trough the chimney of unit 3;
- Evacuate the heat generated by the pump for water flow in the pools

The other classical functions fulfilled by the VDE system allow to:

- Keep the ambient temperature and the humidity in building DE at a level allowing good operation of the material and permanent accessibility to the personnel;
- Limit the radioactive gas or aerosols concentration in the air of building DE in order to permit access to the personnel ;
- Prevent the potential contamination limited to a room from spreading to other non-contaminated or low contaminated areas.

In normal operational conditions, the ventilation system of building DE allows the flow of air from potentially low contaminated zones to potentially more contaminated zones.
As a result, all the areas are ventilated.
"Normal operational conditions" relates to the situation when the radioactive contamination rate of building DE is not too high and when the normal operation of the building is not disturbed by an internal or external event.

7.4.1.1.2.4 Release of effluents in the environment

Radioactive release in the air in normal operational conditions

In normal operational conditions, ^{3}H - that occurs at trace levels in the humidity of the air extracted from the pool hall - is the only isotope that can be released in the air through the ventilation system of building DE. This air is filtered continuously by packed bed filters before it is released in the air through the chimney of the Tihange unit 3. The gaseous effluents of building DE are monitored by the existing control chains in unit 3.

Release of radioactive liquid effluents in normal operational conditions

Fuel handling operations generate no liquid effluents.
The feedback of operational experience of fuel cooling pools shows that these installations generate very few effluents. The liquid effluents generated by the operation of building DE are first transferred to unit 3 to be controlled a first time and to be temporarily stored. Afterwards, they are transferred to unit 2 to be treated by evaporation.

The pool water of building DE is mainly contaminated by activation products (^{54}Mn, ^{58}Co and ^{60}Co) that can be set free from the external surface of the cans during the handling of the assemblies under water. This contamination is (a factor of 10) lower than the water contamination of the fuel-cooling pools of the three units in Tihange. Indeed, the assemblies must be stored at least 2 years before being transferred to building DE. This results in a substantial reduction of the activity of the residual deposits arising from the activation products (almost complete radiological decay for ^{54}Mn and ^{58}Co) on the cans. Moreover, the permanent purification of the water in the pools of building DE keeps the contamination at a very low level.

Storage of solid radioactive waste

The solid waste that is produced during the operation of the building DE spent fuel storage ponds are:

- Spent filters and spent ion exchange resins arising from the pools water treatment systems
- Low contaminated dry active waste produced by the DE installations and systems maintenance and by the replacement of the pre-filters and HEPA filters from the building DE exhaust ventilation system.

The operation of the intermediate storage building does not create other categories of radioactive waste than these that have already been treated in the context of the operation of the energy generating units.

7.4.1.1.2.5 Incidental releases of radioactive effluents

Incidental releases of radioactive effluents in the environment results mainly from accidental situations that can occur during the operation.
The accidents considered during the design of nuclear installations can be divided in two categories:

1° **The accidents of external origin** (AEO), can be classified in two subgroups:

- the AEO resulting from natural phenomena: earthquake, violent wind and tornado, including the projectiles and flood.
- the AEO resulting from human activities: airplane crash, explosions and toxic gas.

2° **The accidents of internal origin** (AIO) are considered as particular operational situations. These situations are grouped per category according to their probability of occurrence:

- Loss of electric power
- Loss of the pool cooling
- Loss of pool water
- Fire in building DE
- Criticality accident
- Accidental drop of a container

- Drop of a spent fuel assembly; in the American regulations, this accident is considered as a design accident. Indeed, the nuclear experience shows that the probability is very low for such an accident to occur. This conclusion also prevails for the accident of a spent fuel assembly falling in building DE due to the many controls and the mechanical and physical safety measures imposed on the handling operations.

However, the safety assessment considers the drop of a fuel assembly being handled, leading to the rupture of every fuel rod.

This accident leads to a release of the gaseous and volatile fission products contained in the space pellet–can. A part of these fission products is absorbed by the pool water. The activity that is not absorbed by the water passes through the air of building DE and arrives in the Tihange unit 3 chimney through the ventilating system.

The accident of a falling spent fuel assembly constitutes the reference accident, which is the most serious foreseeable accident for building DE.

Considering the different kinds of fuel that can be stored in building DE, the radiological consequences of the fuel handling accident have been assessed for MOX and UO_2 fuels having the highest burn-up fraction and the shortest pool residence time before being transferred to building DE (2 years).

Given the above-mentioned residence time, ^{85}Kr and ^{129}I are the only volatile isotopes remaining in the pellet-can space that can be released during the accident.

The radiological consequences of the fuel handling accident remain for the most exposed population groups far below the routine discharge limits.

7.4.1.1.3 Building SCG (Doel)

7.4.1.1.3.1 Protection against radiation

Building SCG is an isolated building used only for intermediate storage. It consists of a dry storage in containers qualified for transport. The containers are filled with spent fuel assemblies and are conditioned and tested in the fuel building of the units before being transferred. There is no operation leading to discharge performed in building SCG. The potential incidents do not lead to radioactive release either. Therefore the design of the building does not take account of the occurrence of discharge.
Building SCG is composed of a preparation hall and a storage hall. The latter is divided in two parts and has a total capacity of 165 storage casks. The majority of the operations are performed in the preparation hall in order to limit the exposure of the workers. After it has been prepared, the container is transferred to its storage place in the storage hall by means of a remotely controlled bridge.
The design of the containers ensures the appropriate biological protection of the staff. The containers comply with the dose rate limits set in the international transport regulation (IAEA TS-R-1), i.e. 2 mSv/h at the external surface, 0.1 mSv/h at 2 meter.

A redundant barrier has been designed in the primary lid of the container in order to prevent leaks. The leak tightness of this barrier is continuously monitored. As regards exposure of the personnel and the population, only external radiation must be taken into account since there are no discharges. The ALARA principle is implemented.

Building SCG is part of the WAB controlled area; the requirements set out in the GRR-2001 are followed.
As already mentioned, this regulation imposes the following annual limits:

- 20 mSv for occupationally exposed workers;
- 1 mSv for members of the public.

The following measures have been taken during the design of the buildings to meet these requirements:

- Use of a remotely controlled bridge in the storage hall.
- Use of concrete shielding
- Control of the contamination on the external faces of the containers before transfer
- Accessibility of the container to reduce the residence time during the inspections.

The external walls of the building are designed in such a way as to protect the external personnel and the general public against the radiation of the sources held in the building in normal operational conditions.
The design of building SCG also meets the requirements of the EU Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation, fully transposed in the GRR-2001.

7.4.1.1.3.2 Radioactive discharges in the air

Normal operation
Every container is equipped with two metal seals. The overpressure between the seals is monitored.

Incident/Accident
The accidents of internal or external origin are grouped per category following the probability of occurrence.
For an accident of category 1 or 2, it is checked whether the monitoring system of the container is working correctly. There is no discharge.
Category 3 includes the following accidents:

- Loss of electric power during a long period
- impact of a projectile on the container
- fall of the container during the (un)loading on (from) the trailer
- drop of a container on another container.

Category 4 includes the following accidents:

- airplane crash on building SCG
- fire resulting from the transport
- fire resulting from an airplane crash
- wreckage of the building on the container.

In any case, the metal seals integrity is intact and the discharge is minor. Radiological consequences of accidents have been assessed. The criteria set in the national and international regulations dealing with the protection of the population are largely met.

7.4.1.2 Decommissioning

Regarding the decommissioning aspects of the spent fuel management installations, it must be noted that the decommissioning phase should not raise any particular technical problem given the preliminary decommissioning plans already examined and the experience feedback (cf. art 9, section 7.6.1.7);

7.4.1.3 Technologies used

The technologies used for the design and construction of the spent fuel management installations are based on the experience, the tests and the investigations. See appendix 1.

7.4.2 Installations of SCK•CEN: BR2

Additional information may be found in appendix 4

7.4.2.1 Discharge of liquid waste into the environment

The water of the secondary circuit is checked in order to detect possible contamination through leaks in the heat exchangers. Also the secondary water, after the heat exchanger, is checked. Different measuring chains are installed on different locations, monitoring the ^{16}N activity and the γ-activity.

Samples of the secondary water are regularly taken to be analysed by means of spectrometry.

<u>Pools</u>
Two measuring chains are installed to monitor the activity of the water in the storage canal.
The water of the pools in the reactor building is monitored by these chains (γ-activity measurement).
Samples of the water in the pools are regularly taken to be analysed by means of spectrometry.

7.5 Article 8: Assessment of safety of facilities

7.5.1 Doel and Tihange installations

The installations are described in appendix 1.

The construction and the commissioning of any installation, and in particular a spent fuel management installation, are subject to a licensing process that includes a systematic safety assessment and an environmental assessment. These assessments cover its lifetime.
The applicant supplies the information required by the GRR-2001 and by article 18 of the National Report established for the second meeting of the Contracting Parties in the framework of the Nuclear Safety Convention.
These documents, together with the numerous technical supporting documents are reviewed by the Regulatory Body and give rise to an intense exchange of questions and answers. The resulting information and data are used to update the Safety Analysis Report until it eventually becomes the "Final Safety Analysis Report" (FSAR).

It is planned to:

- have the possibility to modify the installations if those have no adverse impact on safety,
- update the FSAR, which throughout the life of the installation has to exactly reflect its actual situation,
- perform ten-yearly safety reviews,
- follow up all the recommendations made in the "Safety Evaluation Report" established by Bel V and which gives a synthesis of the performed safety analysis. Bel V is responsible for assessing the satisfactory nature of the responses given by the operator to those recommendations.

The conformity investigation and the commissioning tests are conducted under the acceptance inspection procedures of the installations by the Regulatory Body.

7.5.2 Installations of SCK•CEN: BR2

See articles 4 to 7

7.6 Article 9: Operation of facilities

7.6.1 Doel and Tihange installations

The installations are described in Appendix 1.

7.6.1.1 **Initial license and commissioning**

The licensing process and the related safety analysis have been described in Article 7 of the National Report established for the second meeting of the Contracting Parties in the framework of the Nuclear Safety Convention. The license is signed by the King after it has been investigated in detail by the Regulatory Body and its Scientific Council.
The commissioning test programme is discussed and approved by Bel V, which follows-up the tests, evaluates the test results, verifies the conformity to the design and issues the successive operating licenses that allows to proceed with the next step of the test programme. The FANC is informed and can intervene if it deems it necessary.
This process is complete when the final acceptance report is delivered by Bel V and sanctioned by a Royal Decree granting an operation license (cf. Section E, art. 19, section 5.3.1.1).

7.6.1.2 **Operational limits and conditions**

As described above, the Technical Specifications are approved in the license (chapter 16 of the Safety Analysis Report). They specify the operational limits and conditions, the requirements with respect to the availability of the systems, the test and control conditions, and the actions to be taken if the acceptance criteria are not met.
This applies to any status of the installation.
There are procedures related to the compliance with 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 monitor the requirements of the Technical Specifications.
Each modification that may have an impact on the safety must be approved by the regulatory body before it can be implemented. In this respect, modifications to procedures, to the Technical Specifications and to the Safety Analysis Report are identified and discussed.

7.6.1.3 **Operation in accordance with the approved procedures**

A general description of the procedures in force in the power plant is given in section 13.5 of the Safety Analysis Report.
The completeness (form and contents) of the procedures has been investigated on the basis of the USNRC Regulatory Guide 1.33 which lists the subjects for which procedures must be established. This investigation was conducted as part of the licensing process and the acceptance of the installations by Bel V. During the commissioning tests, the relevant procedures that were used by the operators were verified for adequacy.

7.6.1.4 **Engineering and technology support**

The organisation and know-how of the operator, dealt with in chapter 13 of the Safety Analysis Report, must be maintained throughout the useful life of the power plant, and even after its definitive shutdown as long as this new status is not covered by a new license.
From an engineering point of view, the licensee gets the help of Tractebel Engineering (TE) by means of a specific partnership program for a limited list of critical activities. TE has indeed an excellent knowledge of the installations as it was the Architect-Engineer during their construction. Moreover TE has been in charge of the investigations and their implementation during the ten-yearly safety reviews, of the steam generators replacement projects and of a large part of minor modifications projects, which allowed keeping up the competence and knowledge of the installations. TE is also consulted by the licensee when the latter wants to proceed to 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 competence in conformity to the state of the art. In order to reach these goals, TE is involved in many international research projects and is a member of various networks (or competence centres).
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.
The operator - with the support of the Architect-Engineer - has developed a complete set of procedures to be able to cope with incidents (‘I’ procedures) or accidents (‘A’ procedures). These procedures are simulated, validated and used for the operators’ training.

7.6.1.5 **Notification of significant incidents**

Section 16.6 of the Safety Analysis Report lists the events that must be notified to Bel V and/or the FANC, indicating for each notification the delay within which it must be notified.
The same section also specifies the cases where incident reports must be supplied to the Regulatory Body, and within which delay.
For each incident, a classification with reference to the INES international scale is proposed by the operator, discussed with Bel V, and decided by the FANC.

The IRS reports are established by Bel V for the incidents that this body deems interesting and transferred for commentary to the operator and to the FANC before it is distributed abroad.

7.6.1.6 Operational experience feedback

Operational experience feedback has always been considered essential to plant safety, both by the operators and the regulatory body.
The licenses impose that experience feedback from the Belgian and foreign units are considered. Incident analysis includes an evaluation of the root cause, the lessons learnt and the corrective actions taken.
Databases have been developed, in particular by Bel V, to systematise experience feedback and facilitate the link with the safety analysis.

7.6.1.7 Decommissioning plans

The operator entrusted TE with the follow-up of the decommissioning issue for the spent fuel management installations.
In particular, initial decommissioning plans for generating units have been established, including the spent fuel storage installations; these decommissioning plans are reviewed regularly.
In concrete terms, a set of provisions have been taken to facilitate the dismantling:

- Considering all dismantling aspects when modifying the storage installations, in order to facilitate these operations and to reduce as much as possible the activity level during the dismantling;
- Giving access to the information relating to the storage buildings in order to improve the organisation of the future dismantling operations;
- Implementing an efficient waste management policy throughout the normal operation.

7.6.2 SCK•CEN installations: BR2

A description of the BR2 may be found in appendix 4

7.6.2.1 Initial license and commissioning

see Section E, article 19

7.6.2.2 Operating limits and conditions

As described before, the Technical Specifications are approved in the license. They specify the operational limits and conditions, the requirements with respect to the availability of the systems, the test and control conditions, and the actions to be taken if the acceptance criteria are not met.
This applies to any status of the installation.

7.6.2.3 Operation in accordance with the approved procedures

A general description of the operation procedures is given in the Safety Analysis Report approved by Bel V.

7.6.2.4 **Engineering and technology support**

The organisation and know-how of the operator must be maintained throughout the useful life of the power plant, and even after its definitive shutdown as long as this new status is not covered by a new license.

7.6.2.5 **Notification of significant incidents**

Each reactor cycle is preceded by a note called "start-up" justifying the operational safety on the basis of the observations made during the previous period. In particular, these notes report the operational incidents that occurred and form a first available database.

Since 1994, an analysis is carried out for each operational incident according to a standard format. The new database set up was completed up to 1986 thanks to the data filed in the "start-up" notes.

A « significant event » is in fact an event/incident that, on its own or in correlation with other events/incidents, could put the operational safety of the installations at risk.

During the summer of 1994, the water of the channel became turbid. The hydraulic channel at BR2 is the storage place of set ups for irradiation experiments and irradiated fuel awaiting their decommissioning or evacuation.
The original purification did not seem sufficient. Consequently, after having decontaminated the water, a more intensive purification was decided to prevent any future contamination.
After consideration, it was decided to modernise (automate) the present installation and to increase the rate up to 40 m^3/h (20 m^3/h for pools and 20 m^3/h for the canal) and not to build a new purification installation. The study performed still remains valid. An extra advantage is the fact that the overflow eliminates the floating particles by means of the existing filters of 20 μm (washed down if $\Delta P > 0.9$ kg/cm^2 with air and water).

The number of events in direct or indirect link with human errors increased substantially during these last ten years, but not related to the spent fuel management. For this reason, precise actions were taken to improve qualitatively the operation and its control. These measures can only improve the management of the spent fuel:

- Revision of every operational procedure: every procedure in force has been and is still re-examined periodically. Any modification of the installations requires automatically an adaptation of these procedures.

- Motivation of the personnel to comply strictly with the operational procedures.

- Training of the reactor operators: initial training and permanent training programmes have been set up. During the shutdown for refurbishment, each reactor operator has followed a theoretical and practical retraining. Since the reactor was started up again in 1997, 2X5 days sessions have been organised for every driving agent (level reactor operator). These training sessions include both theoretical and practical aspects, but also general information (e.g. modifications of the installations). Before starting up each cycle, a specific practical training is organised in the reactor - as far as possible – for the learning of some procedures.

- Improvement of the man-machine interface: specific actions have been taken – remote control of the valves – and are still taken – new control panel in the reactor control room, new regulation of the primary temperature, emergency panel in the reactor control room - during the refurbishment.

These measures, together with the maintenance of a stable and uniform operating team for the years to come, constitute the best way to guarantee and optimise a safe operation.

7.6.2.6 **Decommissioning plans**

A fund - financed by the State – has been set up to cover obligations resulting from the denuclearisation of the installations as regards the nuclear activities of the Centre before 31 December 1988. This fund is called "Technical Liability Fund" (Fond du Passif technique). The objective is to obtain the *green field*. Nevertheless, if other installations or parts of the installations should be re-used for purposes other than the initial ones, the decommissioning would be limited to modifying the installations or installation parts so that they can be re-used and to planning the disposal and the future of the existing waste. Decommissioning of BR2 is covered by this fund.

An initial decommissioning plan was worked out for BR2 and approved by ONDRAF/NIRAS and the Technical Passive Fund administrators. See also article 26

7.7 Article 10 :

All issues related to spent fuel disposal are dealt with in section H.

8 Section H: Safety of Radioactive Waste Management

Section H of this report provides comprehensive information on safety objectives and how they are or will be met for the following installations:

- Future disposal facilities for radioactive waste
- Future disposal facilities for spent fuel if considered as waste, at that time,
- Existing facilities for temporary storage of radioactive waste and conditioning of radioactive waste.

As mentioned in section B of this report, Belgium is currently considering two options for the back-end of the fuel cycle, reprocessing and direct disposal of spent fuel.

ONDRAF/NIRAS is studying the technical feasibility and safety of a disposal facility for high-level and long-lived waste and spent fuel in a clay host rock (Boom Clay). A detailed overview of all the results obtained in this R&D programme for the period 1990 - 2000 was published in 2002 (Safety assessment and feasibility interim report 2, SAFIR 2, NIROND 2001-06 E, December 2001). This report was issued on request of the Belgian Government and was submitted to an international Peer Review by NEA/OECD in 2002. The final report of the International Review Team was published in April 2003. In the current planning for disposal of this waste, the construction of a disposal facility will not start before 2025. All high-level and long-lived waste and spent fuel will remain in surface storage facilities until then.

For the low- and intermediate level short-lived waste the national disposal programme, under the responsibility of ONDRAF/NIRAS, is in a project phase, and the construction and operation of a surface disposal facility is planned by 2012.

The gaseous, liquid and solid radioactive waste treatment facilities of the NPP's are shortly described in appendix 2

8.1 Article 11: General safety requirements

8.1.1 Safety objectives[5] applicable for a disposal facility

FANC is currently developing specific regulatory guidance for disposal. In the meantime, international guidance and best practices are used as bases.

A disposal facility for radioactive waste has to ensure a dual safety objective:

1. *First, to concentrate and isolate the waste from Man and his environment for as long as this is necessary, or equivalently, to afford Man and his environment adequate **protection** from the risks which this waste can pose;*

2. *Second, to provide protection which can, over time, become independent of active measures to be taken by future generations, such as maintenance, controls and supervision. This is the concept of **passive isolation and containment** or passive safety.*

[5] IAEA safety standards WS-R-1 and WS-R-4.

The protection of Man has to be assessed for the operational phase and for the period after repository closure by providing all the arguments that the expected radiological impact is lower than the dose constraint imposed by the regulator or lower than other complementary safety indicators the regulator might define or impose (see also section E, Article 19) and that all reasonable efforts have been done to optimise protection (ALARA principle).

ONDRAF/NIRAS has developed and implemented for the different types of waste a system of waste acceptance criteria to ensure that the treatment and conditioning of the waste is coherent with the interim storage facility and with the reference disposal solutions studied. These acceptance criteria - based on the General Rules - set out the minimum requirements (mechanical, physical, radiological, chemical or others) which primary packages of conditioned radioactive waste must meet before they can be accepted by ONDRAF/NIRAS within its terms of reference.

Irrespective of the requirements of Article 14 (which sets procedures for dealing with non-conformities) and Article 15 (exemptions from the acceptance criteria) of the General Rules, each primary package of conditioned radioactive waste which ONDRAF/NIRAS accepts must comply with the relevant statutes and regulations, including the terms of the operating licenses of the nuclear installations concerned (mainly interim storage facilities), the General Rules and ONDRAF/NIRAS's own acceptance criteria. The conformity of the accepted waste packages with the reference disposal solutions being developed is periodically re-assessed, by control and inspection campaigns of the stored waste packages, the first time three years after acceptance and then every ten years. Acceptance criteria for disposal facilities (i.e. post-conditioned waste ready to be disposed of) are currently being developed by ONDRAF/NIRAS.

8.1.2 Existing installations (Belgoprocess)

The storage facilities are described in appendix 3.

A set of measures are taken in order to ensure the highest level of protection of the population, the workers and the environment during those radioactive waste processing and storage operations:

- The category C waste storage buildings are designed and laid out to allow the removal, by natural convection and radiation, of the heat produced by this waste. Moreover, the mass of some critical U and Pu isotopes is kept at values low enough to avoid any criticality risk.

- The processing techniques are implemented to reduce as much as possible the quantity of radioactive waste resulting from those operations.

- The protection and safety methods applied to the construction and operation of the processing and storage installations and any other equipment (containers, etc.) meet the regulations enacted by the competent national authorities (see next articles) in accordance with the international rules and recommendations.

- Compliance with the safety regulations takes into account the radiological, biological, chemical and other risks that can be linked with radioactive waste management.

- Some obligations must be complied with during the operation of the installations so that the future generations will not find themselves faced with too heavy constraints in terms of safety and financial means. That's why, from the operational phase of the installation onwards, provisions are set up to finance the future decommissioning operations.

8.2 Article 12: Existing facilities and past practices

The storage facilities at the Belgoprocess site are described in appendix 3.

8.2.1 Regulatory framework

As the Joint Convention came into force in Belgium on 5 December 2002, every processing and storage installation in operation on the Belgoprocess site is concerned by article 12.
Prior to the construction and the operation of the installations, the operator must first comply with all legal rules to guarantee the safety of the installations. Indeed, in accordance with the regulation[6] in force at that time, the operator had to submit a construction and operating license

[6] Royal Decree of 28 February 1963 (GRR-1963) providing the General Regulations regarding protection of the population and workers against the dangers of ionizing radiation (or one of the modifications). As mentioned in section E, this regulation has been replaced by the Royal Decree of 20 July 2001 (GRR-2001).

application. A safety analysis report[7] describing a set of applicable measures had to be annexed to the license application.
The most important safety-related information that had to be mentioned in this report concerns:

a. The purpose and the nature of the facility,

b. A plan of the installations,

c. A cadastral plan and a topographic survey of the region (500 m around the installations),

d. Demographic, topographic, geologic, seismologic, hydrologic and meteorological characteristics of the region (15 km around the installation) and information on the lay-out of the site,

e. An exhaustive description of the radioactive materials, with special attention to fissile material,

f. A report describing the most important accidents likely to occur in the installations and assessing the probability and the consequences for the population and the workers (accidental scenarios: explosion, fire, airplane crash, failure of the ventilating system, etc.),

g. A description of the systems for the storage, purification and discharge of gaseous and liquid waste; a description of the maximum daily and monthly standards and quantities (in terms of volume and activities) of discharged liquid and gaseous waste, the nature of the discharge, a plan of the areas showing the discharge points, the description of the local sewer system, the flow rate of the rivers where liquid waste are discharged, the temperatures at the chimney outlet for the release of gaseous waste, the monitoring stations to measure the radioactivity levels in air; a description of the volumes and masses of solid waste to store.

h. Protective measures for the personnel working in direct contact with radioactive materials,

i. Staff qualification and competences.

Before the licenses are granted, this safety analysis report is analysed by the competent authorities and by the Scientific Council which may consult national and international experts.

For some waste processing installations and some storage buildings, the operating licenses are granted for a limited period. At the end of this period, a new operating license application must be submitted, in accordance with the regulation in force at that time. A new license is also necessary for any major modification or extension of the installation.

The revision of the regulations in 1994 has obliged the operator, from this date onwards, to add a more detailed environmental impact assessment (in comparison with the assessments mentioned in f and g) to the license application. According to the date of the license application, only building 155 and the HRA-Solarium processing installation were to comply with this obligation to add a detailed environmental impact assessment to the license application.

[7] The building license can be granted on the basis of a Preliminary Safety Analysis Report (PSAR) whereas the operating license is granted on the basis of a Final Safety Analysis Report. However, this report is updated during the operational phase of the installation.

For any modification of an existing installation having an impact on the environment, a new environmental impact assessment must also be added to the new license application.

8.2.2 Regulation enforcement

Bel V performs the acceptance inspection of the installations, including verification if the rules and the cold tests are complied with. According to the acceptance report, the starting-up is authorised or not.

The above-mentioned Royal Decrees set out the obligation of organising an internal Health Physics Department. This department is entrusted with the task of organising the surveillance of the measures necessary to comply with the regulations on workplace safety and health and with the rules on neighbourhood safety and health. It can be assisted in its mission by Bel V. During the operation, Bel V must also verify the compliance with the rules, in accordance with the regulations in force. It can propose any modification to improve the safety of the installations.

Belgoprocess is implementing a wide programme to monitor the liquid and gaseous discharge in the environment and the water quality of the river Molse Nete where the discharged liquid waste is released:

a. flow rate and volume of discharged water
b. chemical and radiological control of discharged water before and after being discharged
c. chemical and radiological control of the river water and the river bed sediment, upstream and downstream from the discharge point
d. radioactive contamination of the river banks, on and around the industrial sites
e. radiological control of air and ground water samples from the vicinity
f. radiological control of the chimney emissions

These controls are performed twice a year and are reported each year in the annual environmental report.

Moreover, the regulatory body also takes some control samples.

In 2007, Belgoprocess discharged 24 511 m³ purified waste water, that is about 20 % of the authorised volume. The total weighted radioactivity of this discharge amounted to 0.36 GBq (99.98 % of the total activity arose from ^{3}H), that is 0.24 % of the authorised value whereas the impact of the dose per inhabitant was assessed to be less than 0.1 µSv/year. The biological indexes show that the discharge has no impact on the biological quality of the water of the river Molse Nete.

If necessary, installations where radioactive waste is stored or processed are kept in underpressure by a ventilation system. Ventilation air and industrial gas (smoke gas arising from the burning of solid waste and from the evaporation of liquid waste) are purified. The activity of the Belgoprocess discharge in 2007 amounted to about 3% (1.53 MBq alpha emitters and 0.75 MBq beta emitters - ^{3}H and ^{220}Rn not included) of the authorised limit. For ^{3}H, the activity of the discharge amounted to 0.28 GBq (0.028 % of the authorised limit) and to 11.7 TBq for ^{220}Rn (69 % of the authorised limit). A mathematical model is also used for assessing the exposure of the inhabitants living around the Belgoprocess sites. It leads to a value of 7.8

µSv/year for the most critical individual (due to radon, the contribution of other radionuclides being 15 nSv/year only).

Lastly, since the waste is processed and stored in adapted and shielded buildings, radiation measurements taken at 50 different places around both Belgoprocess sites showed values between 73 and 79 nanosievert/hour for site 1 and between 81 and 188 nanosievert/hour for site 2, with one exception (485 nSv/h). For the latter actions are planned that will result in moving waste to other buildings offering additional shielding and therefore smaller radiation levels). The measured radiation level has no impact on the population.

8.2.3 Storage buildings for conditioned waste on the Belgoprocess site

The storage buildings for conditioned waste on site 1 of BELGOPROCESS are briefly described below. It concerns the buildings 127, 129, 136, 150, 151 and 155 (further abbreviated as B127, B129, etc.). This description focuses on the waste acceptance criteria that are directly relevant for storage..
The current storage conditions are presented in the acceptance criteria mentioned below, in the safety files and in the IPA (Internal Project Application of Belgoprocess).
Table 3 summarizes the conditions (with regard to the radioactivity) applicable for the storage of the packages in the different buildings while **Table 4** is directly taken from the applicable safety reports of the buildings.

In 2003, ONDRAF/NIRAS and Belgoprocess started an inspection programme for all the stored conditioned waste drums. The objective is to classify the stored waste packages, after a visual inspection, based on acceptance criteria. In case of observations of non-conformities with the waste acceptance criteria (e.g. degradation of waste packages due to corrosion phenomena) specific measures are taken:

- regular inspections of the waste packages to closely follow further evolutions;
- specific measures to avoid any release of activity;
- investigation of the mechanisms and phenomena leading to non-conformities, in order to be able to define and implement corrective measures.

This programme runs until 2012. At the end of 2007, 33949 conditioned waste packages were inspected. The gathered information is used in the acceptance process.

Table 3: Acceptance criteria/conditions with regard to radioactivity

B 127
1. The dose rate at the external surface of the package has to remain below the limit of 2 Sv/h. A package with localized surface dose rate exceeding the (maximum) limit value may, in close consultation with the Health Physics Department and possibly with Bel V, be accepted on the condition that the criterion regarding the dose rate at 1 meter is observed (< 0.2 Sv/h). 2. The volume-activity concentration in the primary package is limited to 50 GBq/m3 for alpha emitters and to 37 TBq/m^3 for beta-gamma emitters. 3. the removable surface contamination of the primary package needs to be below 0.4 Bq/cm^2 for alpha emitters; 4 Bq/cm^2 for beta-gamma emitters. 4. ^{226}Ra and ^{232}Th in the primary package are only allowed in mass-activity concentrations which do not exceed the natural radioactivity of these isotopes.
B 129
Storage building already filled.
B 136
Building foreseen for Synatom waste coming from COGEMA. See specific acceptance criteria for more details about the radiological conditions.
B 150
Storage building already filled
B 151
1. the dose rate at the external surface of the package has to remain below the limit of 5 mSv/h. A package with localised surface dose rate exceeding the limit value may, in close consultation with the Health Physics Department and possibly with Bel V, be accepted on the condition that the criterion regarding the dose rate on a 1 meter distance is observed (< 0.5 mSv/h). 2. the mass-activity concentration of alpha emitters in the primary package is limited to 4 GBq per ton. 3. the removable alpha surface contamination has to be below 0.04 Bq/cm^2; that of beta/gamma surface contamination below 0.4 Bq/cm^2. 4. ^{226}Ra and ^{232}Th in the primary package are only allowed in mass-activity concentrations, which do not exceed the natural radioactivity of these isotopes.

B155 LAGAL
1. the dose rate at the external surface of the package has to be below or equal to 5 mSv/h. If the surface dose rate exceeds 5 mSv/h, the radiation at 1 meter distance has to be below 0.5 mSv/h. 2. The ^{241}Pu quantity has to be below 112 g per package. The Pu-239 quantity has to be below 219 g per package. The ^{235}U quantity has to be below 326 g per primary package. The sum of the proportions of the quantities of these 3 radionuclides compared to the maximum quantities of each of these radionuclides has to be below 1. 3. The beta activity concentration, with the exception of that of ^{241}Pu, has to be below 40 GBq per primary package. 4. The removable alpha surface contamination needs to be below 0.04 Bq/cm^2; that of beta/gamma below 0.4 Bq/cm^2. 5. ^{226}Ra en ^{232}Th should not exceed their natural concentrations.
B 155 RAGAL
1. The dose rate at the external surface of the package must be below or equal to 5 mSv/h. If above 5 mSv/h, the radiation at 1 m must be below 0.5 mSv/h. 2. The removable alpha surface contamination must be below 0.04 Bq/cm^2 while the removable beta/gamma surface contamination must be below 0.4 Bq/cm^2. 3. The alpha activity concentration must be below 4 GBq/t. The maximum alpha Radium concentration must be below 740 GBq/package
B 156
4. Storage of BR3 fuel assemblies.

Table 4: Conditions stipulated in the Safety Files

B 127

Maximum dose rate on outer walls of the building. 25 µSv/h. Mean activity <3.7 E10 Bq, mainly beta; alpha activity negligible

B 129

Maximum dose rate on outer walls of building: 25 µSv/h. Per package maximum alpha activity up to 1.37E12 Bq and maximum beta activity up to 3.2E14 Bq, depending on the type of waste.

B 136

Maximum dose rate on outer walls of building: 20 µSv/h.

	Vitrified waste	Cemented waste[8]		Bituminized
	High active solutions	Hulls and end pieces	Technological waste	Process
Dose rate (Sv/h)				
D (contact)	1.4 E4	< 75	< 4 E-2	< 10
D (1 meter)	420	< 4.6	< 1 E-2	0.45
Activity per primary package (TBq)				
Beta/Gamma	2.8 E4	800	0.74	19
Alpha	141	< 0.89	< 0.74	< 0.15
Removable surface contamination (Bq/cm^2)				
Beta/Gamma	< 4	< 4	< 4	< 4
Alpha		0.4	< 0.4	0.4

B 150

Maximum dose rate in contact with package: 5 mSv/h, exceptionally, 10 mSv/h. Per package maximum alpha activity up to 2E9 Bq and maximum beta activity up to 3E12 Bq, depending on the type of waste.

B 151

Maximum dose rate in contact with package: 5 mSv/h, exceptionally, higher if value at 1 m is below 0,5 mSv/h. Maximum alpha activity 4GBq/t, except for 160 vessels from historical production,< 75GBq/t. Maximum beta activity up to 3E12 Bq/ package, dependent on type of waste.

[8] As AREVA NC has changed the processing and conditioning mode for these waste streams, the implications of the new waste form (compacted hulls and end pieces, mixed with technological waste) is being analysed and discussed between the parties involved (AREVA NC, Synatom, ONDRAF/NIRAS, FANC and Belgoprocess).

B 155
Maximum dose rate on outer walls of building: 10 µSv/h. Other conditions as in the acceptance files
B 156
The dose rate limits outside the building are: • surface of the storage building 10 µSv/h • 300 m distance from the storage building 0.1 mSv/y

8.2.4 CILVA: Central Installation for Low-level Solid Waste (site 1 Belgoprocess)

The **CILVA** installation (Central installation for low-level solid waste) is designed for the processing of low-level solid waste, mainly produced in Belgium. This low-level solid waste contains mainly beta-gamma waste, but also very low-level contaminated alpha waste.
With regard to the radiological characteristics of the waste that can be processed in these installations, the following limits apply:

- Maximum dose rate at the surface of the primary package and of the transport package: 2 mSv/h.
- Level of removable surface contamination of primary package must not exceed 4 Bq/cm² for beta-gamma emitters and low-toxic alpha emitters and 0.4 Bq/cm² for other alpha emitters.
- Regarding solid beta-gamma waste, the activity must not exceed 40 GBq/m^3 (averaged over volume of every primary package). No traces of alpha activity may be present up to 40 MBq/m^3.
- Regarding solid waste, the beta-gamma activity must not exceed 40 GBq/m^3. The alpha-activity may not exceed 10 GBq/m^3.

The waste contaminated with pathogenic substances is collected and packed for transportation separately.

In the installations, the following activities are performed:

- Waste reception;
- Pre-treatment of waste (sorting out, pre-compression, reduction);
- Compaction of waste drums;
- Incineration;
- Immobilisation;
- Inspection and transport of the conditioned waste to the storage facilities.

8.2.4.1 **General description of the building**

The building has a surface of 100 m x 65 m and is built on a foundation plate resting on compact, mainly sandy ground, at about 0.75 m depth.
The building is composed of a structure in reinforced concrete.
Its height is about 10 m with the exception of an area of 1000 m² which is 16 m high. The lower part contains areas on one or two levels, depending on the activity, while the higher parts have a variable number (two to five) of levels.
The roof is composed of lightweight concrete arches, covered with isolating materials and a sealing film. The floors are made of full plates of reinforced concrete.
In the areas requiring a biological shield for the roof, the roof is made of a full concrete plate.
The walls are made of reinforced concrete or of stonework, depending on the biological shield required and on the supporting capacity.

8.2.4.2 **Radiological protection**

The storage of unconditioned and conditioned waste as well as the processing of this waste in CILVA is performed in shielded areas. Access to these areas is strictly limited to the necessary operations, provided that the general and specific radiation protection procedures are observed. These areas are defined as “processing areas ".

The areas surrounding these areas are, depending on their protection level according to the regulations which apply to the BELGOPROCESS site, classified as follows:

Radiation area	Description	Maximum dose rate (µSv/h)
I	Adjacent processing premise	250
II	Intervention area	75
III	Working area not permanently occupied	25
IV	Working area permanently occupied	5

It must be noted that these maxima are "project rates" used for the calculation of the protection shields. During the operation, the ALARA principle is applied, implying that the doses for the personnel are only a fraction of those estimated on the basis of the project rates.

Processing areas (Area 0)
The processing areas are areas in which conditioned or non-conditioned waste is stored or in which the waste is not treated or processed manually.
The walls of these areas shield sufficiently to ensure that the radiation conditions in the adjacent areas are observed.

Area I
Between the adjacent processing areas, the necessary shielding is foreseen to ensure that in case of an intervention, the dose rate in the area in which the intervention takes place, will not exceed the conditions with regard to area I. In normal working conditions, there are no areas belonging to area I.

Area II

Area II includes the areas, which, in normal working conditions, are not entered, but are used in the case of interventions in processing areas.

Area III

The areas in which the personnel is not permanently present, but during an important fraction of the working time, belong to this area. These are e.g. the areas where the waste is manually treated, processed and sorted out. Most of the technical areas and passageways are also classified into this area.

Area IV

Areas in which the personnel is normally permanently present, belong to this area (e.g. control rooms, offices, ...).

8.2.4.3 **Confinement**

In order to prevent dispersion of radioactive substances, the ventilation is designed such that a pressure gradient provides an air current from the areas with a small probability of contamination to those with a large probability of contamination.

Radioactive liquids are stored either in 30 l flasks, in storage containers, or in transport containers. All of these recipients are stored in areas equipped with retention tanks or leaktight reservoirs, which, in case of a leak, collect all of the liquids stored;
The transport packages are opened under an exhaust hood to extract the aerosols and depositing them then onto filters.
The opening of the primary package and the manipulations of the waste are performed either in glove boxes or in accommodated areas.
The standard 400 l drums in which the waste is conditioned are, in their super compact unit as well as in their final package, filled through a lock in order to prevent any contamination of the outer surface of the drum. This lock is kept in underpressure by means of a specific ventilation system with a prefilter and an absolute filter.

8.2.4.4 **Decontamination**

The form and the surface finishing of the material in the controlled area are – as far as possible - designed to facilitate decontamination.
The apparatus in the controlled are covered with a protective and easy-to-decontaminate layer (epoxy or equivalent).
The floors, and in some cases also the walls, are covered with an easy-to-decontaminate layer.

8.2.4.5 **Waste produced**

Conditioned solid waste

The conditioned solid waste produced in CILVA as a final product during the normal operation of the installation, is low-level waste comparable to the waste received at the entry of the installation. This waste consists mainly of packages, equipment, ventilation filters, and clothing for the personnel and secondary waste generated by the combustion installation.

Liquid waste

There is no direct discharge of liquid radioactive waste. All the liquid waste produced in the controlled area of the CILVA unit is collected in containers.

Gaseous waste

The gaseous waste produced in the CILVA installations is, after treatment, evacuated through a chimney to the location of BELGOPROCESS where a permanent monitoring is performed.

8.2.4.6 **Radiation monitoring devices**

In CILVA radiation monitoring equipment is installed. This gives the necessary information concerning the radioactivity levels in different parts of the building and in the gaseous effluents in the chimney, enabling the operating personnel to take the necessary measures in order to keep the activity level as low as reasonably achievable.
A distinction can be made between:

- dose rate monitoring in the areas;
- air contamination monitoring;
- monitoring of air evacuated through the chimney;

- surface contamination monitoring;
- monitoring of exposure of personnel.

8.2.4.7 **Workers' dose**

As indicated, the protection shield between the areas was calculated on the basis of the radiation area to which these areas belong and, accordingly, based upon the occupation and the presence of radioactive sources. In this regard it needs to be stipulated that the activity of the waste treated, the dose rate at the surface of the package, as well as the radioactive contamination of the package are limited.

Moreover, appropriate measures are taken in order to keep the workers' dose, resulting from external radiation and the committed dose due to the intake of radioactive substances, as low as reasonably achievable and below the regulatory limits.

8.2.4.8 **Fire protection**

Around the building a fire strip of more than 15 m has been deforested.
The protection system is designed to detect the start of a fire and to extinguish a fire, or to limit it maximally.

8.2.4.9 **Accidents considered**

In the safety assessments, the following accidents were considered:

Accidents of internal origin

- drop of a package;
- interruption of electric power supply;
- explosion;
- fire.

accidents of external origin

- earthquake;
- airplane crash;
- heavy wind;
- flood;
- explosion

8.3 Article 13: Siting of proposed facilities

8.3.1 Existing facilities

Almost all processing installations and storage buildings in Belgium are currently located on the Belgoprocess sites, which were formerly the SCK•CEN WASTE Department (started up in

1956) and the EUROCHEMIC fuel reprocessing pilot plant (started up in 1966). All facilities were to comply with the regulations in force at that time. In addition to the license for the dismantling of these former installations, changing the use of both sites required new licenses as well (see article 12).

8.3.2 Future disposal facilities

The current disposal programme of ONDRAF/NIRAS for high-level and long-lived waste and spent fuel is a programme of *methodological* research and development. Its prime aim is to investigate whether it is feasible, both technically and financially, to design and build on Belgian territory one deep geological disposal facility for the considered waste that is safe, without prejudgment on the site where such a solution would actually be implemented. The actual siting of such a disposal facility will become a central element of the next phase of the disposal programme. Proposed disposal facilities for these kinds of waste are thus in a R&D stage of development, and not yet in siting nor licensing phase.

For low and intermediate level short-lived waste (LILW-SL) – category A in the Belgian waste classification system – the disposal programme is currently in a project phase: the Dessel site has been designated for surface disposal of category A waste, through a process of active participation of the local municipalities in local partnerships that led to the decision of the Council of Ministers of 26 June 2006.

On 16 January 1998, the council of ministers decided to opt for a long-term management solution for category A waste that would be final or could become final. The council of ministers entrusted ONDRAF/NIRAS with missions to allow the government to make a choice between near surface disposal and geological disposal as soon as possible. One of these missions was to develop the methods, including management and consultation structures, making it possible to integrate a project of this kind at local level.

Concretely, the method of consultation with the population, desired by the government, has taken shape through the application of the methodology of local partnerships. This led to the creation of partnerships between ONDRAF/NIRAS and the municipalities of Dessel and Mol.

1. STOLA-Dessel (Studie- en Overleggroep Laagactief Afval [Study and consultation group on low level waste]) was created on 30 September 1999 by the municipality of Dessel and ONDRAF/NIRAS.
2. MONA (Mols Overleg Nuclear Afval Categorie A [Mol's Consultation on Category A Nuclear Waste]) was created on 9 February 2000 by the municipality of Mol and ONDRAF/NIRAS.
3. PaLoFF (Partenariat Local [Local Partnership] Fleurus-Farciennes) was created on 27 February 2003 by the municipalities of Fleurus and Farciennes and ONDRAF/NIRAS

Each partnership was assigned the mission of developing an *integrated preliminary disposal project*, i.e. *a disposal facility coupled with a set of accompanying conditions*. This way, the concerns of the inhabitants of the concerned municipalities regarding safety, environmental protection and health, and the accompanying conditions were given a prominent place in the development of the disposal project. Within the partnerships, it was investigated whether an acceptable proposal of integrated disposal project could be drawn up. The final decision on the acceptance or rejection of the proposal lay with the community council. The partnerships were organized in such a way that they could play their part as representative, transparent, open and independent local discussion and working platforms[9].

In 2006, ONDRAF/NIRAS concluded the missions that the council of ministers had entrusted it with in its decision of 1998. ONDRAF/NIRAS has successively submitted the files relating to the integrated disposal projects of the partnerships to its supervising minister. Each of these files contained three parts:

1. The report of the partnership describing its integrated disposal project, namely a system "disposal site + preliminary design of disposal facility" and a set of conditions that are inextricably bound up with this system.
2. The decision of the municipality council. The municipality councils of Dessel and Mol have agreed to consider the implementation of a preliminary design of disposal facility on their territory, provided that the conditions coupled with this preliminary design are fulfilled. The municipality council of Fleurus decided to terminate the studies. In view of this decision, the municipality council of Farciennes refrained from expressing an opinion on the file.
3. The report of ONDRAF/NIRAS. ONDRAF/NIRAS has formally confirmed that the integrated disposal projects of STOLA-Dessel and MONA are, based on current knowledge and taking into account the applicable legal framework, in agreement with the conditions set in the decision of the Council of Ministers of 16 January 1998, in particular concerning the requirements on safety and feasibility, and has confirmed the existence of a participatory process.

Finally, ONDRAF/NIRAS has also drawn up a concluding report that contains all elements allowing the government to decide on the continuation of the category A disposal programme.

Both remaining partnerships indicate in their final report that they wish to remain involved in the further studies and implementation of the integrated project. The approval, without modification, of the final reports of STOLA-Dessel and MONA by their respective general assemblies and by the municipality councils of Dessel and Mol proves that the integrated disposal projects enjoy broad societal support. In accordance with the demands of STOLA-Dessel and MONA, the municipalities and ONDRAF/NIRAS, the participatory process is continued in the form of partnerships in Dessel and Mol, and further extended to the management of radioactive waste in general. Therefore, in succession of STOLA-Dessel the partnership STORA (Studie- en Overleggroep Radioactief Afval Dessel - Study and Consultation Group on Radioactive Waste Dessel) has been established between the municipality of Dessel and ONDRAF/NIRAS on 27 April 2005. The articles of association of the partnership MONA have been modified on 24 November 2005 and its name has been changed to *Mols Overleg Nucleair Afval – Mols Consultation on Nuclear Waste*.

The preservation of this participatory process and co-design remains an important mission of ONDRAF/NIRAS for the category A disposal programme (see section 2.3).

The relevant site-related factors for surface disposal are in line with the required site characteristics in the IAEA Safety Requirements for Near Surface Disposal of Radioactive Waste[10] and in the IAEA Safety Guide on Siting of Near Surface Disposal Facilities[11]. For

[9] More information on the organization of the partnerships can be found in the publication of the NEA Forum on Stakeholder Confidence (FSC): "Dealing with Interests, Values and Knowledge in Managing Risk", Workshop Proceedings, Brussels, Belgium 18-21 November 2003", ISBN 9789264007314, NEA 2004.

[10] IAEA Safety Standard Series No. WS-R-1, Near Surface Disposal of Radioactive Waste – Safety Requirements, Vienna 1999.

[11] IAEA Safety Series No. 111-G-3.1, Siting of Near Surface Disposal Facilities – Safety Guide, Vienna 1994.

geological or deep disposal, the required site characteristics are in line with those in the IAEA Safety Guide on Siting of Geological Disposal Facilities[12]. The site specific disposal design and the site are studied and evaluated in an integrated way in the safety and environmental assessments (see further section 8.5.1).

Since 2000, France and Belgium have developed a specific cooperation in the field of the safety approach to geological disposal. A working group was set up and the French and Belgian authorities had issued in 2004 a document entitled “Geological disposal of radioactive waste: Elements of a safety approach”. This document was discussed in a broader group of experts in 2005-2005. It was decided in 2005 not to lose the momentum created by the Franco-Belgian initiative and therefore a Pilot group was created to undertake a study on the regulatory review of the safety case for the geological disposal of radioactive waste. This group had regular meetings and worked, on one hand, on the regulatory approach and on the integration of safety elements in the safety case, and on the other hand, on a more specific topic concerning the management of uncertainties. In 2007, the European pilot group had produced 2 reports. The first, “*The regulatory review of the safety case for geological disposal of radioactive waste*” addresses the main issues raised by the assessment of a staged safety case for a geological disposal facility, and the second “*Case Study : Uncertainties and their management*” addresses the treatment of uncertainties in such project. The participants to this project proposed to undertake, in a near future, a new programme of work to consider the characteristics of wastes that could be disposed in different types of repository. The objective of the work would be to set down areas of agreed common practice and approach among different countries. Where differences in practice between countries are identified, the reasons for such differences need to be explored and documented.

8.4 Article 14: Design and construction of facilities

The Preliminary Safety Analysis Report describes how the following points have to be implemented:

- protection against potential criticality (very low acceptable U and Pu quantities in the containers),
- protection against contamination (i.e. casks in corrosion-resistant materials),
- protection against irradiation (thickness of the cell walls calculated to remain below the dose rate limits, installation of permanent dosimeters, use of portable dosimeters during a handling or maintenance operation),
- expected levels of radioactivity released in normal and accidental situations and operational limits,
- consideration of accidental scenarios (cask fall, airplane crash, radiolysis, failure of the cooling or electric system, floods, explosion) and their impact on radiological safety,
- Probability Safety Analyses available at the time of the application.

The levels of details of the above-mentioned points, namely the accidental scenarios considered, depend on the type of installations.

12 IAEA Safety Series No. 111-G-4.1, Siting of Geological Disposal Facilities – Safety Guide, Vienna 1994.

The environmental impact is described in a report on the environmental impact assessment of the facility concerned. This study describes the direct and indirect environmental effects in the short, intermediate and long term of the installation. This environmental impact assessment covers at least:

- data similar to the general data as they are set out in the Commission Recommendation of 6 December 1999 on the application of article 37 of the Euratom Treaty,
- data necessary to identify and assess the main environmental impact of the installation,
- a draft of the main alternative solutions investigated and an indication of the main reasons to justify the choice made.

A preliminary decommissioning plan must be established during the design of the installations. The objective of this decommissioning plan is to:

- assess the dismantling strategies which depend on factors such as the protection of the operators, the public and the environment, the planning and the organisation,
- evaluate the dismantling techniques specific to the installations,
- list the waste produced during the dismantling,
- assess the costs generated by those operations,
- analyse the financial provisions that will be available to ensure that the safety conditions are met when those operations are performed and to avoid a too heavy financial burden on future generations.

The decommissioning plan can be established during the operation of the installation. It includes the points described above, but also:

- the description of the installations and their 'history',
- the description of the quality system,
- the description of the safe maintenance,
- the destination of all the waste,
- the available scientific and technical knowledge.

Finally, the techniques considered during the design of the processing and storage installations and used during their construction are based on the industrial experience, on tests and on analyses.

8.5 Article 15: Assessment of safety of facilities

8.5.1 Future disposal facilities

Before a disposal facility can be constructed, an license for construction has to be granted by the FANC. A safety assessment as well as an environmental impact assessment has to be conducted and submitted to the FANC as a basis for its decision to grant this license.

1. Categories B&C programme

As the disposal programme for high-level and long-lived waste is not in a licensing phase yet, it is so far impossible to implement it. However, for the methodological R&D phase (see article 6), preliminary safety and environmental assessments, covering both the *period before and after closure*, are used at a regular basis for reporting and analysing the status of the programme (see e.g. SAFIR 2 report). These preliminary safety and environmental assessments constitute also a preparation for the safety and environmental assessments that will be established during the licensing phase. A first Safety and Feasibility Case for deep disposal of high-level and long-lived waste is currently in preparation and its publication is planned in 2013.

The current scientific and technical achievements regarding geological disposal in Boom Clay can be summarised as follows:

System of geological disposal in Boom Clay

The system of disposal in Boom clay is deemed to be safe and feasible according to the current state of knowledge and evaluation. It is made up of the disposal installation itself and the Boom Clay, for which the installation was developed.
Boom Clay is a rock which has not hardened very much and which is quite impermeable. Its performance as a barrier to the migration of radionuclides has been established experimentally, in particular its homogeneity, its bedding capacity, which reduces the impact of the disturbances induced by the deposit, and its very good ability to delay the migration of radionuclides towards the environment
The considered geological disposal installation consists of a network of horizontal galleries built in Boom Clay. Three wells provide access to a main gallery, which leads to the smaller-diameter disposal galleries. These are divided into three sections, intended to receive heat generating waste (vitrified waste as well as, where applicable, used fuel) on the one hand and on the other, category B waste.
The system of engineered barriers considered for heat generating waste is based on the use of super-containers, with a super-container being the unit formed by an outer wrapper in carbon steel containing vitrified waste or spent fuel and a massive protective layer in concrete called *a buffer*. The super-container is intended to ensure that radionuclides are confined while the thermal gradient through the engineered barriers is high (i.e. during some hundreds to thousands of years) and to provide a permanent radiological shield for workers.
The reference design for category B waste is based on the use of monoliths and each monolith is presented as a solid block of concrete in which several packs of waste have been immobilised. This monolith is mainly used to provide radiological shielding for workers and to facilitate underground handling operations.

Safety assessment
The main findings in the area of assessing the long-term safety of the disposal in Boom Clay (in normal conditions) can be summarised as follows:

- Boom Clay makes the biggest contribution to long-term safety;
- the role of waste matrices and engineered barriers is marginal;
- the maximum dose caused by the disposal facility is lower by at least an order of magnitude than the regulatory dose limit, while the main contributors to the dose are fission products that are not trapped by Boom Clay (^{129}I, ^{36}Cl, ^{14}C, etc.), with actinides (U, Pu, etc.) only contributing very weakly to the dose;
- fission products leave the Boom Clay after periods of approximately some tens of thousands of years; the actinides leave the Boom Clay after several hundreds of thousands of years. The quantities are minimal in both cases.

Moreover, ONDRAF-NIRAS has formalised its safety strategy on the basis of the functions that must be provided by the different components of the disposal system. This strategy will make it possible to support all choices in the area of designing the disposal and the RD&D priority.

Feasibility assessment

The main findings in the area of feasibility assessment are the following:

- a demonstration of the possibility of industrially implementing wells and galleries in Boom Clay at a depth of over 200 metres as well as the possibility of creating a junction between two galleries while limiting the geo-mechanical disturbances of the clay;
- possibilities of handling super-containers or monoliths in wells and in galleries in accordance with known industrial methods;
- a demonstration of the possibility of producing a quality bedding for an access well;
- a demonstration of the possibility of filling empty spaces between the cladding of the deposit galleries and the super-containers or monoliths with a cement grout.

Main RD&D activities planned up to 2020

The main RD&D activities currently planned up to 2020 concern the reference solution, i.e. the disposal in Boom Clay. The activities relating to Ypresian Clays are essentially limited to 'transferability' studies. Generally speaking, the RD&D programme is intended to reinforce confidence in geological disposal in not very hardened clay and to establish arguments supporting the different decisions in the decision-making process

2. Category A programme

The disposal programme for low- and intermediate level short-lived waste is in the last phase before the licensing, i.e. the project phase with the detailed design and safety assessment of a surface disposal facility in Dessel aimed at submitting a license application for a surface disposal facility in Dessel by the second half of 2010. Currently safety assessments are ongoing on the basis of:

- International treaties and guidance;
- The established assessment basis during the previous phases of the category A disposal programme.
- The points of attention to the safety of the integrated disposal project in Dessel as identified by the FANC on the basis of the analysis and discussions on the safety and environmental assessments carried out during the preliminary project phase (1998-2006);
- The guidance elements of the FANC that are currently under development. This guidance concern human intrusion, radiation protection criteria, surface disposal, accidents of external origin, seismic hazards, biosphere and hydrogeology.

- Advice of the FANC on intermediate parts of the safety assessments that are being submitted to the FANC by ONDRAF/NIRAS in preparation of the submission of a license application file. These intermediate parts concern:
  1. The general design of the disposal facility
  2. The methodology and tools used for the safety assessments
  3. The qualification files for the conceptual models and the calculation codes for use in the safety assessments

These assessments are being discussed with the nuclear safety authorities (FANC) and with the regional authorities responsible for environmental protection in preparation of the formal license application. They encompass the *period before closure* as well as the *period after closure*. The general approach of the safety assessments is *systematic* and iterative (e.g. the IAEA Safety Guide on Safety Assessment for Near Surface Disposal of Radioactive Waste[13]), and based on the outcome of the ISAM and ASAM IAEA projects. The safety assessments before closure are similar to the existing facilities for processing and intermediate storage of radioactive waste (see section 8.2), although some of the analyses are being updated according to the current state-of-the-art (e.g. the treatment of the seismic hazard).

In parallel to the actual disposal facility, a facility for the production of monoliths is being developed also within the integrated disposal project. Waste will be delivered to the disposal facility in standardised disposal units, i.e. monoliths. Monoliths consist of a concrete container filled with waste and a cementitious backfill material. In the production facility of monoliths, concrete containers will be filled with waste and cementitious backfill material. Safety assessments of this facility are similar to the existing facilities for processing and intermediate storage of radioactive waste.

8.5.2 Existing facilities

For the existing Belgoprocess installations, articles 12, 13 and 14 mention and describe the content of the Preliminary and Final Safety Analysis Reports and of the environmental impact assessment which are elements of the construction and operating license applications.
Bel V analyses the Preliminary Safety Analysis Report and the related technical notes and it expresses comments and remarks, which are taken into account to adapt the Safety Analysis Report and get the final version.
The FANC also follows up the drawing up of the safety analysis report; the final version will be submitted to the Scientific Council of the FANC for approval (see also approval procedures, section E, 5.3.1.1.).

8.6 Article 16: Operation of facilities

When the construction is finished, the installation must be inspected by bel V or by a recognized organisation for health physics control with regard to compliance with the regulations and the specific operational conditions set in the license and to verification of the cold tests. The operating license is granted if the final acceptance report issued by this organisation is positive.

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[13] IAEA Safety Standard Series No. WS-G-1.1, Safety Assessment for Near Surface Disposal of Radioactive Waste – Safety Guide, Vienna 1999.

Throughout the operation, the safety analysis report is updated so that it reflects the real state of the installation.

The operation, maintenance, surveillance, inspection and test conditions are described in the safety analysis report. The internal Health Physics Department is entrusted with the task of implementing the procedures necessary for complying with these conditions. These procedures will then be controlled by Bel V or by a recognized organisation for health physics control. Following the experience feedback of any other observation, it proposes - if necessary - the appropriate modifications in order to improve safety.

In accordance with the regulations in force, the incidents must be notified to the recognized organisation for health physics control and classified with reference to the INES international scale after approval by Bel V and the FANC, which assess if it is useful to establish an IRS report.

The know-how of the different parties involved in the construction or in the modification of the installations must remain available throughout the operational phase of the installations for any safety-related problem.

As mentioned in article 14, the preliminary decommissioning plan established during the design phase is updated throughout the lifetime of the installations. This updating takes into account:

- The evolution of the technologies related to decontamination and dismantling,
- The evolution of the regulatory aspects such as the release limits resulting in modifications for the estimation of waste quantities,
- the destination of the waste,
- the “historical review” of the installation (maintenance, intervention, incidents, accidents, …),
- the modification of the "quality" policy,

In accordance with the Royal Decrees of 16 October 1991 and 12 December 1997, ONDRAF/NIRAS concludes an agreement with the installation’s operator to set which information related to the dismantling must be provided to the authorities.

Following a proposal by the Scientific Council of the FANC in June 2003, all Class 1 facilities had to be subject to Periodic Safety Reviews, every 10 years. As this was not foreseen in the existing operating licenses of Belgoprocess, this was added to these licenses (Royal Decree of 24 october 2004) and implemented in 2 steps.

At first during 2006-2007, the operating license of the site 2 of Belgoprocess was reviewed and a safety re-assessment was made for all the facilities on this site for which no decommissioning activities are foreseen in the near future. An action plan with priorities was defined in agreement with the recognised Organisation for health physics control and the FANC. The same safety re-assessment review has been conducted for the site 1 of Belgoprocess, and the report has been submitted to the FANC by mid 2008.

A detailed overview of the first Periodic Safety Review of the Belgoprocess facilities in given is Annex, Appendix 5.

8.7 Article 17: Institutional measures after closure

This is not yet applicable for disposal facilities, since no specific regulatory measures have been imposed so far, and since the long-term management programme is not yet in a detailed design phase for disposal facilities. These measures for disposal facilities will be developed in due time.

9 Section I: Transboundary movements

9.1 Article 27: Transboundary movements

The provisions related to the transboundary shipments of spent fuel and radioactive waste are set in chapter VII of the *GRR-2001*. This chapter stipulates that a prior license is required for every shipment. This license is only granted if it can be demonstrated that the requirements of the relevant international Conventions and agreements[14] are observed.
With regard to the transboundary shipments of radioactive waste, the provisions of chapter IV of this same GRR are applicable. This chapter contains the transposition of Directive 92/3/Euratom of 3 February 1992 on the supervision and control of the shipments of radioactive waste between Member States and into and out of the Community. In the procedure the advice of ONDRAF/NIRAS in case of import and export of radioactive waste is foreseen. It must be noted that the European Directive 92/3/Euratom has been replaced by directive 2006/117/Euratom, which must be transposed before the 25th of December 2008. The transposition of this Directive, which extends the scope to spent fuel needs a revision of chapter IV of GRR-2001; the revised regulations are planned to enter into force on the 25th of December 2008.

Currently, there are very few transboundary shipments of spent fuel and radioactive waste. Licenses have been granted for:

- Transit of spent fuel from the Dutch nuclear power plant of Borsele to COGEMA (now AREVA NC) La Hague in France;
- Transit of vitrified high-level waste from COGEMA La Hague to the Netherlands;
- Transit of waste, resulting from decontamination of packagings, from France to the Netherlands;
- Export of the irradiated MTR fuel assemblies of reactor BR2 from Mol to La Hague;
- Import of vitrified high-level radioactive waste from COGEMA (now AREVA NC) La Hague to Belgoprocess Dessel. This waste is the result of the reprocessing of spent fuel of the nuclear plants of Doel 1-2 and Tihange 1 which was transferred previously from Belgium to France;
- Import of waste, resulting from either the decontamination of materials (e.g. pumps) or from the melting of radioactively contaminated metal;
- Import of used sources from Luxemburg within the framework of the existing convention between Luxemburg and Belgium.

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[14] ADR : European agreement concerning the international carriage of dangerous goods by road.
RID: Regulation concerning the International Carriage of Dangerous Goods by Rail, appendix C to the Convention concerning International Carriage by Rail (COTIF).
ICAO: Technical Instructions for the Safe Transport of Dangerous Goods by air, of the International Civil Aviation Organisation.
IMDG: The International Maritime Dangerous Goods Code of the International Maritime Organisation (IMO).
ADNR: Regulation concerning the Carriage of Dangerous Goods on the Rhine.

10 Section J: Disused sealed sources

10.1 Article 28: Disused sealed sources

Belgium has no specific regulation with regard to disused sealed sources. The same conditions and licenses are applicable to these sources as those regarding new sources: operation licenses, transport licenses for the carriers and import licenses are required as well as the application of the ruling European regulation 1493/93 on shipments of radioactive substances between Member States.
The user/holder can either transport these sources to ONDRAF/NIRAS as declared radioactive waste or, if it is stipulated in the contract, he can return them to the deliverer/producer.

In case a Belgian producer takes back the sources, they are subject to the same regulatory requirements as those regarding the import of new sources, including the application of the regulation 1493/93. The producer has to take these used sources in "decay storage" or has to transfer them to ONDRAF/NIRAS.

Aware of the risks associated with the use of sealed radioactive sources and, in particular, of "orphan sources", the European Union has promulgated a directive (2003/122/Euratom) on the control of these sources. This initiative finds its justification in the significant number of accidents that happened worldwide during these recent years.

The purpose of this directive is to prevent the public and the workers from being exposed to ionising radiation resulting from an inadequate control of sealed sources. Its provisions will cover all sources emitting, at the time of its production, a dose flow equal or greater than 1 mSv/h at 1 meter, and all orphan sources. This directive completes the Directive 96/29/EURATOM laying down basic safety standards for the health protection of the general public and workers against the hazards of ionising radiation, already integrated in the Belgian Law.

The Directive sets out the obligation for each Member State to set up a system requiring prior license for the holder of a sealed source. The license will only be granted if the competent authorities have taken appropriate measures for the safe use of the source, including when it becomes disused. A financial guarantee will have to be set up for the disposal and storage of the source when it becomes disused, or arrangement to return the source to the supplier or to a recognised storage installation will have to be made.
The license must cover different fields: responsibilities of the holders, staff competencies, information and training requirements for workers and people working in the vicinity of the sources, minimum equipment and packaging performance criteria, procedures to be followed in case of an accident, transfer modalities …

Each source will be identified by a standard record sheet indicating, among others, the name of the holder, the location, the transfers, the nature of the radio-isotopes and the results of regular integrity tests. The packaging and, if possible, the sources will be marked by a unique identification number. The competent authorities receive regularly updated copy of these sheets.

The holder has the obligation to check regularly the location and the good state of the sources in his possession and to warn immediately the competent authority of any disappearance or accidents having led to an exposure. The competent authority can perform any useful control to check that the directive is correctly applied. The holder is also to transfer forthwith every disused source to a recognised installation or to the supplier, according to the arrangements made.

The competent authorities must establish appropriate provisions in order to recover orphan sources and to deal with radiological emergencies resulting from any misuse of these sources. The Member States are encouraged to develop controls aimed at detecting orphan sources in places where orphan sources may be encountered such as metal scrap recycling installations. Campaigns for recovering the orphan sources shall be organised.

A fund financed by guarantees shall be established to cover the costs for recovering the orphan sources when the liabilities can not be identified or when the liable person is insolvent.

This Directive has been transposed in the Belgian regulations by the Royal Decree of 26 May 2006, amending accordingly the GRR-2001.

11 Section K: Planned activities to improve safety

At national level, as presented in this report, Belgium has developed a framework to cope with the safe management of spent fuel and radioactive waste.

Nevertheless, the FANC is going to improve the GRR-2001, and several large projects have been launched in 2007-2008, related to:

- The development of a regulatory framework for the licensing of future facilities for long term storage and disposal of radioactive wastes (surface and geological)
- In addition, two regulatory projects have been launched in 2008, with the objective of the implementation of the WENRA waste & spent fuel storage and decommissioning reference levels in the Belgian regulation.

On the practical field, the following safety improvement measures are planned or ongoing:

- The implementation of safety improvement actions resulting from the PSRs of class I facilities (Belgoprocess, nuclear reactor installations);
- The objective to comply with the WENRA reference levels on the practical field at relatively short term (around 2010).

Most of the issues related to the safe management of spent fuel and radioactive waste are dealt with at international level in different groups where experts are gathered. Belgium is and will continue to be active in international groups, such as the Waste Safety Standards Committee (WASSC) of the IAEA, the Radioactive Waste Management Committee (RWMC) of the NEA, and in European Union initiatives.
In addition, FANC is involved in many bilateral cooperations. FANC has signed specific cooperation agreements with the French Safety Authorities (ASN), with the US-NRC and with the Safety Authorities of the Russian Federation.

Finally within the frame of the High Level Group of European regulators, the FANC has taken commitments to organize a self assessment as well as to plan an IRRS IAEA mission.

Specific actions, on-going or planned by ONDRAF/NIRAS are listed and explained below:

For the long-term management of the short-lived waste (SL-LILW or category A waste) ONDRAF/NIRAS is preparing in interaction with the FANC/AFCN, the licence application file (including the safety report and the environmental impact assessment) for a near surface repository in Dessel. ONDRAF/NIRAS plans to apply for a construction and operation licence for the surface disposal facility, in view of an operational facility by 2016.

In collaboration with its subsidiary company Belgoprocess ONDRAF/NIRAS is preparing the licence application file for the post-conditioning facility for the production of the monoliths (emplacement of conditioned category A waste and, possibly, non-conditioned waste, e.g. decommissioning waste, in a concrete box for surface disposal). Belgoprocess plans to apply for a construction and operation licence for this facility by the end of 2010. Once this post-conditioning facility operational (planned by 2016) the stored category A waste drums in the storage buildings 150 and 151 on the Belgoprocess site, can be post-conditioned for surface disposal and, after acceptance for disposal, transfer to the repository can start.

ONDRAF/NIRAS and Belgoprocess will continue their inspection programme of all the conditioned waste in the different storage buildings in view of a complete inspection of all stored waste by 2012. The analysis and investigations of the degradation mechanisms leading to non – conform waste packages (corrosion of waste packages and swelling of bituminous waste) will be continued in order to define and implement the required corrective measures. The post-conditioning of the category A waste packages in monoliths for surface disposal will be an important step towards the long-term management of non-conform category A waste packages.

In conformity with its legally defined tasks ONDRAF/NIRAS is preparing a national plan for the long-term management of radioactive waste in Belgium (waste plan). ONDRAF/NIRAS is currently preparing the supporting documents, as well as the document describing the general approach to the waste plan. As required by the law of 13 February 2006 ONDRAF/NIRAS is also preparing a Strategic Environmental Assessment (SEA), focussing at the long-term management of the high-level and long-lived waste. The SEA will on the one hand compare various long-term management options for the high-level and long-lived waste and on the other hand assess their environmental impacts. The steps before submission for adoption of a final waste plan are:

- Participative dialogue with the general public and experts – March and April 2009
- Proposal to the advisory committee of scope and level of detail of the SEA by May-June 2009;
- Submission of the draft waste plan and the SEA to the advisory bodies (incl. the general public) as defined by the law of 13 February 2006 – begin 2010
- Drafting of the final waste plan in view of its submission for adoption by mid 2010.

It is ONDRAF/NIRAS' intention to focus its 2010 waste plan, and consequently also the SEA, on the long-term waste management of the high-level and long-lived waste (categories B & C waste), with the aim to obtain a national decision-in-principle on the reference option for this long-term management. Besides this main focus of the waste plan, it will also identify remaining key issues for the long-term management of other waste streams, to be addressed in (a) subsequent waste plan(s).

Considering its impact on the guarantee of conformity of the conditioned radioactive waste packages and on the safety of the storage and disposal facilities, ONDRAF/NIRAS continues to implement the qualification process of the radioactive waste processing, conditioning and storage facilities. It must be borne in mind that ONDRAF/NIRAS only accepts conditioned radioactive waste produced and characterized in facilities qualified by the agency.

Considering its impact on the safety of the disposal site for conditioned radioactive waste packages, the qualification by ONDRAF/NIRAS of the radiological characterization methods for radioactive waste will be extended to the methods applied to determine the uncertainties affecting the waste activity declarations. In view of the importance of this aspect of the radiological characterization of radioactive waste, ONDRAF/NIRAS will issue the necessary rules, principles and directives to maintain the general coherence of the calculation methods applied.

The processing and conditioning of two important waste streams on the site of Belgoprocess will continue:

- the historical alpha contaminated and radium-bearing waste on site Belgoprocess 2 is being processed and conditioned in the HRA-Solarium facility; the conditioned waste is send for storage in the interim storage building 155 on site BP1. The conditioning of this waste and the transfer to site 1 for storage, which will continue the following years, significantly improves the safety on the Belgoprocess site and reduces the dose rates in the immediate surroundings of site 2, without noticeably increasing dose rates around site 1;

- Alpha-contaminated waste from MOX fuel fabrication. This waste is being processed and conditioned in the PAMELA facility and the conditioned waste is stored in building 155 on Belgoprocess site 1.

12 Section L: Appendices

(This section contains security classified information which is therefore not available in this public version of the report)

12.5 APPENDIX 5: Overview of the Periodic Safety Reviews of the Belgoprocess facilities

Belgoprocess operates 2 sites. The first periodic safety reviews have been performed and the corresponding synthesis reports have been submitted to the FANC, respecting the deadlines of 1 July 2006 (Site 2) and 1 July 2008 (Site 1).
This appendix gives an overview of the regulatory requirements, the objectives of the periodic safety reviews, the methodology for evaluation of the present safety status and for the definition of safety improvements

1. Regulatory requirements
The Operating licence of Belgoprocess was amended in 25 October 2004 by Royal Decree by introducing an additional operational condition related to periodic safety reviews.
"At least every ten years it is required that the operator and the Federal Agency of Nuclear Control (or by delegation the appointed recognised body for health physics control) perform a review of the safety of all installations operated by the N.V. Belgoprocess. The following issues need to be addressed: the present status of the installations, the occurred problems, the incidents and the possible evolution of the applicable norms. Such a review can also be required at the request by the competent authorities. For each review a report will be established, including the measures to be implemented and the corresponding time schedule.
In case that the Federal Agency for Nuclear Control delegates the review to a recognised body for health physics control, the report will have to be submitted to the Federal Agency for Nuclear Control. The Scientific Council will be informed about the conclusions of the review.
Those installations which are not operated any longer and for which a decommissioning licence has been granted in accordance with the General Regulations for the protection of workers, the population and the environment against the hazards of ionizing Radiation, are excluded.
The ten-yearly review (and the corresponding report as mentioned in article 1) can be split between site 1 (Dessel) and site 2 (Mol). The first report related to the ten-yearly review of site 2 was to be submitted to the Federal Agency for Nuclear Control at the latest on 1 July 2006. The first report related to the ten-yearly review of site 1 was to be submitted to the Federal Agency for Nuclear Control at the latest on 1 July 2008."

2. The objective of the ten-yearly review
The objective of the ten-yearly review is to verify that the present safety status is at the level which should be reasonably expected at the moment of the review, taking into account the present applicable standards and regulations and the technological developments. Use is made of the acquired experience, the problems which appeared during operation as well as the incidents and necessary actions are defined in order to justify that the safety of the operation during the next 10 years is at a sufficiently high level.

3. Methodology

3.1 Definition of the subjects

A distinction has been made between “general issues”, “installations” and “supply systems”.

The following general safety issues were examined: personnel needed for the operation, emergency planning and preparedness, management system, regulatory requirements, radiological protection, security, liquid and gaseous releases, external risks, decommissioning and decontamination, environment, fire safety and general safety management.

All installations without decommissioning licence have been included in the scope of the periodic safety review.

For Site 1 the installations considered are storage buildings, ventilation building, decontamination facility and waste conditioning installations. These installations are kept in a status of operational standby (as they are not operated continuously), those which are no longer operated are kept in a safe state until their decommissioning.

For Site 2 the review covered temporary storage buildings for solid waste, the area for storage of medium level waste, a conditioning facility for waste with radium content, a building for the conditioning of medium level waste coming from other storage areas, installations for collection, storage and treatment of liquid waste, a pyrolysis unit for alfa-contaminated waste, various installations for support of decommissioning activities, steel grid blasting, treatment of disused maritime containers and a laundry facility for contaminated clothing. The general supply systems include the chimney, electric power, compressed air, steam, water, piping systems and alarm treatment system.

All these subjects have been discussed and agreed beforehand with then AVN (now Bel V).

3.2 Identification of the objectives

The examination of the risks, management system and other issues related to the global site yielded a series of improvements, after consideration of the present regulatory requirements and the technological progress in the field. The actions and their planning were described in the individual safety fiches.

The considered internal risks in each of the installations were the following: fire, internal explosion, loss of confinement due to loss of ventilation, inundation (e.g. due to internal leaks), contamination spread to the environment, drop of material, ageing, environment, other operational risks, chemical risk, criticality, suffocation, general safety management and safety systems. The same approach has been sued for the general supply systems. The needed improvements and their planning were defined in the related fiches.

3.3 Organisation

Different teams of staff, which was most familiar with the safety issues, described their conclusions in the detailed fiches. These were discussed with the health physics control department and with Bel V.

3.4 Content of the detailed fiches

These were established according to a standard structure: safety concern, situation before the evaluation, safety objective, way of work and actions, results and conclusions.

4. Synthesis of the results

The periodic safety review focused on those issues for which an urgent intervention is not necessary and which improves the safety on the longer run. The future use of some of the installations was duly taken into account.

For Site 1, about 36 actions were defined. The planning was established on the basis of the relative urgency of their implementation and on the importance (design, resources, and needed time delay) of the action.

The most urgent actions are related to emergency planning (review of the source term), procedure for transfer of installations to non-operational status and alarm processing. The updating of the safety reports (usually one per installation) continues to be carried out, also in view of the transfer of knowledge to the younger generation. The review of the external risks, like fire and seismic activity is planned as well.

The synthesis report for site 1 was submitted to the FANC before July 1st, 2008.

The review of Site 2 identified a series of issues which needed improvement: emergency planning (the plan and the source term), the review of the operational experience, updating of the safety analysis report, explosion risk , impact analysis of the releases, procedure for transfer to non operational status, additional analysis of the ground layer of the site.

The review also identified about 33 actions, the most important being the procedure for evacuation of stored waste of the Stelcon hall and the further use of the latter, the explosion risk during manipulation of Na and NaK containing waste and the determination of its evacuation towards the conditioning installation, the fire protection and HAZOP analysis of the Mummie-installation, the verification of the present status and of the inspection programme of underground piping.

Finally the review of the supply systems indicated the need for physical separation between boiler and emergency diesel generator, the updating of the electric power distribution schemes, the selectivity of the electric power system, the renovation plan for the alarm system and the alarm processing unit as well as the alarm test programme.

5. Conclusion

The periodic safety review has not identified important safety gaps. Nevertheless a number of safety improvements were identified in order to justify the continued operation during the next 10 years. Many of these actions will be implemented before end 2009 or earlier.

12.6 List of acronyms

ANS: American Nuclear Standards.

ANDRA: Agence Nationale pour la gestion des déchets radioactifs, France (French Agency for the Management of Radioactive Waste).

AVN: Association Vinçotte Nuclear.

SCK•CEN: Studiecentrum voor Kernenergie/Centre d'Etudes de l'Energie Nucléaire/, Nuclear Research Centre, situated at Mol, Belgium.

Bel V Subsidiary of the Federal Agency for Nuclear Control, to which its provides technical expertise

BP1/2: Belgoprocess site 1/2.

BSS: Basic Safety Standards.

CGCCR: Comité Gouvernemental de Coordination et de Crise (the Governmental Centre for Coordination and Emergencies).

CSDC: Conteneur Standard Déchets Compactés (Standard Container for Compacted Waste).

CSDV: Conteneur Standard Déchets Vitrifiés (Standard Container for Vitrified Waste).

EU: European Union.

FANC: Federal Agency for Nuclear Control.

FBFC: Franco-Belge de Fabrication de Combustible (Franco-Belgian Company for Fuel Manufacturing).

GRR-2001: General Regulations for the protection of workers, the population and the environment against the hazards of ionizing Radiation, laid down by Royal Decree of 20 July 2001.

GRR-1963: General Regulations for the protection of the workers, the population and the environment against the hazards of ionizing Radiation, laid down by Royal Decree of 28 February 1963.

HPD: Health Physics Department.

IAEA: International Atomic Energy Agency.

INES: International Nuclear Event Scale (IAEA).

IRE : Institut national des Radio-éléments.

IRS: Incident Reporting System (NEA/OECD-IAEA).

KCD: Kerncentrale Doel (Doel Nuclear Power Station).

MOX: Mixed-oxide $U0_2$-$Pu0_2$.

NDA: Non Destructive Analysis.

NEA (OECD): Nuclear Energy Agency (OECD).

NORM: Naturally Occurring Radioactive Material.

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 Radioactieve Afval en verrijkte Splijtstoffen (Belgian Agency for the management of Radioactive Waste and Enriched Fissile Materials).

RGPT: Règlement Général pour la Protection du Travail (Occupational Health and Safety Regulations).

SAFIR-2: Safety Assessment and Feasibility Interim Report 2.

USNRC: United States Nuclear Regulatory Commission.

TE: Tractebel Engineering.

TENORM: Technologically-Enhanced Naturally Occurring Radioactive Material.

WASSC: Waste Safety Standards Committee (AIEA).
WENRA: Western European Nuclear Regulators' Association.