Kingdom of Belgium

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

November 2003

National Report

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 via the Law of 2 August 2002. The ratification was obtained on 5 September 2002. The Convention became effective on 4 December 2002, or 90 days after the Ratification Act had been deposited.
Belgium belongs to the group of Contracting Parties having at least one operational nuclear generating unit 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. 5 700 MWe. 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 Research Committee in the field of the Nuclear Safety) between 1988-1990. Through its approval - in October 1990 - of the undermentioned recommendation, the Senate has clearly expressed the wish to pursue these continuous 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 Research Committee on the Opportunity of the Reprocessing of Irradiated Fissile Materials 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 I.A.E.A. and N.E.A. Its representatives take an active part in the activities regarding the 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 of the report

This national report is elaborated pursuant article 32 of the Convention which foresees that each contracting party presents such a report at the meeting of the contracting parties. The principal nuclear Belgian actors have participated to its edition:

- ONDRAF/NIRAS as 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 safety authority working with the Authorised Inspection organisation AVN (Association Vinçotte Nuclear).
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- Electrabel as the operator of the seven nuclear power plants and responsible for the interim storage on site of the spent fuel
- Synatom as the owner of the nuclear fuel from its fabrication to its transfer to ONDRAF/NIRAS when declared as radioactive waste.
- SCK•CEN the Belgian Research Centre operating research reactors and dismantling a former PWR.

Together the above mentioned organisms gather the legal and practical competencies necessary to collect and structure the information required to elaborate the national report.

The report is structured according to the guidelines adopted at the preparatory meeting of the contracting parties held from 10 to 12 December 2001, INFCIRC/604.

Although not required by the Convention, the report is available on different Belgian Web sites as www.fanc.fgov.be, www.nirond.be, www.avn.be.

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 5.7 GWe and approximately to 5 000 tHM 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 tU of the spent uranium-oxide fuel type by COGEMA at La Hague.

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 prolonged 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 at Mol) and at the University of Gent. 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.

2.2 Spent fuel management practices

The reprocessing of 670 tU spent fuel was executed in accordance with four contracts concluded by Synatom (Belgium) and COGEMA (France) during the period 1976-1978. These foresaw the gradual sending back of the resulting waste to Belgium. The sending back of the following quantities of different waste types is presently foreseen:

- 420 canisters of vitrified high level waste;
- 820 canisters of compacted technological and structural (hulls and end pieces) waste;
- 480 drums of bituminised residues.

By December 2002, five nuclear transports between France and Belgium have been undertaken, sending already 140 canisters of vitrified high-level waste back. 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. 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 for 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 licence in May 1997 and the very 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. Four sections are presently equipped with racks. Two additional sections will start being equipped with racks in the next few months. 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).

Concerning the BR2 fuel, a reduced number of elements was sent to Dounreay (U.K.) for reprocessing. After processing, the fuel is recovered, re-used as H.E.U (~ 72 % enrichment) or blend down to < 20 % enrichment. Cemented waste will be returned to Belgium, and will be stored for several decades in a dedicated building on the Belgoprocess site and finally disposed of underground. A part of the BR2 fuel is also reprocessed without recovery of nuclear material for further use as HEU or LEU. After processing, the recovered uranium is diluted to 1 % enrichment. 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.
A contract has been concluded in this sense with COGEMA, covering the whole remaining life of the BR2 reactor, without a limit in time and in quantities.

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) on 8 August 1980 was 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 modalities of operation of ONDRAF/NIRAS were laid down in the Royal Decree of 30 March 1981 and supplemented in the Royal Decree of 16 October 1991.

- In the law 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, are set down in a recent Royal Decree of 18 November 2002.
- Another mission of ONDRAF/NIRAS laid down in the law 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 appointed authority. The set of General Rules was established by ONDRAF/NIRAS, approved by its Board and by the competent minister, 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 law of 16 October 1991. These concerned the collection and evaluation of decommissioning data in order to establish programs 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.

In general terms, ONDRAF/NIRAS is responsible for the management of all radioactive waste on the Belgian territory, generated by nuclear power plants, industrial applications using ionising radiation, medical activities, or research. The task laid down for it by law is to outline a policy for the coherent and safe management of radioactive covering the following aspects:

1. Compiling an inventory of radioactive materials (and enriched fissile materials), and assessing the decommissioning and remediation costs of all sites containing radioactive materials;
2. Collection and transport of the waste to the site of Belgoprocess for a centralised management;
3. Processing and conditioning in the Belgoprocess facilities (some waste producers have their own processing and conditioning facilities and they transfer conditioned waste to ONDRAF/NIRAS and Belgoprocess);
4. Interim storage of all conditioned waste at the Belgoprocess site;
5. Long-term management (disposal as the option under investigation);
6. Tasks relating to the management of enriched fissile materials.

Concerning the policy of long-term management of low and intermediate level short-lived radioactive waste, the decision of the Council of Ministers of 16 January 1998 gave ONDRAF/NIRAS the following mission, which consists of five points:

- Limiting the siting activities to nuclear or non-nuclear volunteering sites;
- Finalising the design studies of surface disposal;
- Finalising the feasibility studies for deep disposal;
- Developing methods of interaction with different local stakeholders;

- Collaboration with the federal safety authorities (FANC) for safety aspects as well as for environmental impact.

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

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 is being negotiated at this moment.

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 four-level hierarchical classification system for conditioned radioactive waste. This 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 **groups** of conditioned radioactive waste, two in total, are defined as a function of the possible disposal solutions for the waste in question.

The *geological* group includes the conditioned radioactive waste of which the radiological characteristics (i.e. the activity concentrations of the radionuclides it contains and their half-life) make it imperative that it is permanently isolated from the biosphere. Permanent isolation, which is thus the sole conceivable solution for the long-term management of the waste, is currently judged to be achievable by its disposal into deep and stable geological layers.

The *open* group contains the conditioned radioactive waste of which the radiological characteristics are such that alternative solutions to geological isolation can be considered, since its activity will decrease to a sufficiently low level by radioactive decay over a period of time compatible with the period over which control can be exercised, i.e. a maximum of 200 to 300 years.

The three main **categories** (Table 1) of conditioned radioactive waste are defined by a radiological criterion and by a thermal power criterion. Category A belongs to the open group, and categories B and C to the geological group.

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, i.e., a maximum of 400 to 4 000 Bq/g of alpha activity according to the generic recommendations of the IAEA and the European Union.

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. It must, therefore, cool down during a period of interim storage, and its residual thermal power at the time of the disposal requires either limiting the number of packages per linear metre of disposal gallery, or increasing the distance between the galleries, or increasing the time during which such wastes are allowed to cool down in aboveground purpose-built facilities.

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

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

	Low-level	**Medium-level**	**High-level**
Short half-life (mainly 30 years or less)	A	A	C
Long half-life (over 30 years)	B	B	C

2.4.2 Practices

1. From the year 1997 onwards, the compiling of an inventory by ONDRAF/NIRAS of all nuclear installations and sites on the Belgian territory and their content of radioactive material, as well as the assessment of their decommissioning and remediation costs are required every 5 years. The first inventory was established at the end of 2002 and was presented to the supervising authority (the Secretary of State for Energy and Sustainable Development) on 27 January 2003.
2. ONDRAF/NIRAS is also responsible for the transports of conditioned and unconditioned radioactive waste, mainly towards the centralised conditioning and intermediate storage facilities on the Belgoprocess site (Dessel). These transports need to be licensed by the Federal Agency for Nuclear Control (FANC), as stipulated in the GRR-2001 (General Radioprotection Regulation for the protection of the workers, the population and the environment, issued in 2001 by Royal Decree of 20 July 2001). These transports are subcontracted by ONDRAF/NIRAS to specialised transport companies.
3. The processing and conditioning 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 and conditioning 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 at Doel and Tihange. Interim storage of radioactive waste is done in surface storage buildings at the Belgoprocess site. Currently there are six storage buildings in operation, two buildings for low-level radioactive waste, one for intermediate-level waste and three for high-level waste (see also section H). A new building for contaminated alpha-waste and radium-bearing waste is currently in its licensing phase.
5. For the long-term management, a distinction is made between the category A (short-lived waste) programme on one hand, and the category B (long-lived waste) and C (high-level waste) programmes on the other. The category A programme is currently in a pre-project phase; sites have been chosen for studying site specific disposal designs with the active participation of the local municipalities (Dessel, Mol, Fleurus/Farciennes) via local partnerships between the

municipalities and ONDRAF/NIRAS. In this pre-project phase for category A waste the two technical options 'surface disposal' and 'deep disposal' are looked at in parallel.

For the waste from categories B&C, the programme is still in a methodological research and development phase, preceding the pre-project phase. Methodological research and development prime aim is to establish if it is, both technically and financially feasible, to design and build on 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. Recently, on 15 July 2002, the SAFIR-2 report – Safety Assessment and Feasibility Interim Report 2 –, presenting the research and development work during the period 1990-2000 was submitted and presented to the supervising authority (Secretary of State for Energy and Sustainable Development). During the second half of the year 2002 the report was submitted to a Peer Review by NEA/OECD on demand of the Belgian Government. The final report of the NEA/OECD Peer Review will be available in April 2003.

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.

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. They were /are also partly financed by the European Commission, which contributed for example to the construction of the underground research infrastructure in the Boom Clay in Mol (SCK•CEN site) and to various experiments and studies.

    b. Short-term management of radioactive waste is financed by two kinds of five-year-long contracts for waste processing and conditioning 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 exploitation 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.

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 production.

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) 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 danger of the radiations emitted by naturally occurring radioactive materials (NORM) is regulated by several laws and regulations. Currently, these materials are considered as radioactive waste only if they are used for their radioactive characteristics in a professional activity. In this case, these materials are regulated by the waste management rules, as described in this report. The scope of the professional activities which imply radioactive materials was broadened by the GRR-2001. It also entrusted the competent authorities with the task of adapting the conditions required for activities using NORM (see section E 5.2.1.3.1 and E 5.3.3).

The armed forces have no nuclear fuel, either fresh or spent. The radioactive waste produced by the armed forces is managed according to the laws and regulations 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} spent fuel. The reprocessing contracts stipulate that conditioned vitrified waste is repatriated to Belgium (as well as hulls and end pieces, technological waste, and bituminised waste). On 31 December 2002, 140 canisters containing on the average 150 litre glass – amounting to an average mass of 492kg per canister and a total volume of 25 m³ vitrified high-level waste (fission products are immobilised in a borosilicate glass matrix) - had been returned to Belgium (five transports of 28 canisters each were organised).
The average activity of the canisters produced in the COGEMA plant in La Hague, determined at the time of the glass casting, varies between 1.5 and 1.7 10^{16} Bq for beta-gamma emitters and amounts to 3 10^{14} Bq for alpha emitters. Radioactive materials (mainly fission products 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 were 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 280 units, what represents a volume of 50 m³.

4.1.2 Non-reprocessed irradiated fuel

The irradiated fuel which is not concerned by the reprocessing 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 31 December 2002) 41 containers in which 1154 fuel assemblies are stored, i.e. about a quarter of the current storage capacity.
The wet storage building at Tihange contained (on 31 December 2002) 995 fuel assemblies, i.e. about a quarter 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) Reactors BR1 (natural uranium) and VENUS (enriched UO_2 and MOX) still working with their initial fuel load, this report does not consider these reactors.
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.

c) As the BR3 reactor (PWR type) is currently under decommissioning, 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 Gent. Both options (dry storage or reprocessing) are still open and are under investigation.

4.3 Radioactive waste: management facilities and inventories.

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

- Belgoprocess Sites 1 and 2 in Mol and Dessel
- 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 respectively in Dessel and Mol

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

These processing and conditioning 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 waste water.

2. **BRE**, started up in 1980, on site 2 of Belgoprocess, does the same for high and intermediate level waste effluents

3. **MUMMIE** (site 2) does the same for low-level waste effluents only. It was constructed in the late 60's.

4. **CILVA** (site 1) is the infrastructure for the processing and conditioning 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-processing unit (waste sorting, cutting, and pre-compaction).

- The supercompaction unit with a 2,000 ton press to compact the 200 litre steel drums containing the unconditioned radioactive waste into 15 to 40 cm³ thick compaction disks (compaction capacity: 8 000 drums/year).

- The incineration unit that incinerates each year up to 250 ton solid waste and 75 m³ organic liquid 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, in the vitrification plant, the 860 m³ liquid high-level waste coming from the Eurochemic reprocessing plant. Afterwards, the PAMELA cementation plant 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 rehabilitation of the BR2 reactor and the dismantling of the BR3 reactor.

7. **Building 123 cell 18** (site 1) for the cementation of solid intermediate-level waste.

8. **290X** (site 2) for the cementation of supercompacted disks of solid waste and incineration ashes.

9. **ALPHA-KAMER** (site 2) for the cementation and bituminisation of alpha contaminated solid waste.

10. **HRA-Solarium** (Building 280x, site 2), not operational at the time being (edition of this report, April 2003) for the processing and conditioning of alpha and beta-gamma waste and radiferous 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.

11. **A3X** (Building 110x, site 1), not operational at the time being (edition of this report, April 2003) for the processing and conditioning of alpha contaminated solid low-level waste coming mainly from the nuclear fuel fabrication (mainly Belgonucleaire, in Dessel).

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 (category A). It is now filled with packages of different volumes (400, 500, 1000, 1200, 1500, 1600, and 2200 litre). It is constructed with 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, resin …) 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. However, its capacity is larger (14 000 m³).

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

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

5. **Building 136**, modular 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).

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

7. **Building 270**, is a "buffer" building containing packages which have to be transferred to building 155 immediately of after having been reconditioned. The packages in this building are mainly filled with radiferous 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: quantitative list and activities per storage building

Buildings	**Waste categories**	**Number packages (#) / volume (m³)**	**Capacity (#) / filling rate (%)**	**Activity [1](Bq)**	
				Alpha	**Beta-gamma**
127	A	15935 / 3907	18393 / 87 %	$4\ 10^{14}$	$4\ 10^{16}$
129	C	2335 / 215	2572 / 91 %	$1\ 10^{15}$	$3\ 10^{17}$
136	C	140[2] / 21	590 / 24 % (vitrified) ≈ 820 / 0 % (hulls and end pieces/technological waste) ≈ 2000 / 0 % (bituminised)	$3\ 10^{16}$	$1.5\ 10^{18}$
150	A + B	3316 / 1873	3424 / 97 %	$2\ 10^{12}$	$1\ 10^{14}$
151	A + B	25341 / 10039	35422 / 72 %	$5\ 10^{13}$	$3\ 10^{14}$
155	B	0 / 0	0 %	/	/
156	C	7 castors	8 / 88 %	$2\ 10^{15}$	$1\ 10^{17}$
270	A + B + R	1330 / 527	4899 / 27 %	$5\ 10^{12}$	$2\ 10^{13}$

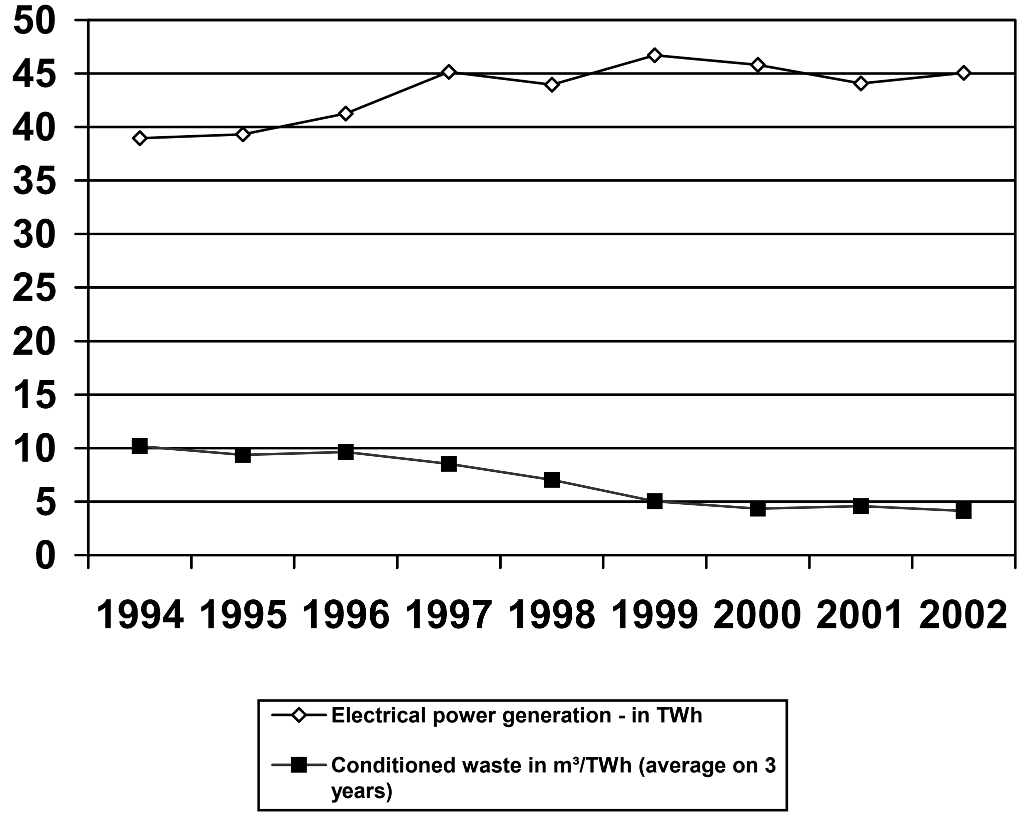
[1] On date of 30 September 2001
[2] Up to now, it contains only canisters filled with vitrified waste.

4.3.2 The sites of the Doel and Tihange nuclear power plants

The Tihange and Doel nuclear power plants have their own processing and conditioning facilities qualified by ONDRAF/NIRAS. The waste processed and conditioned 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 the CILVA installation and then stored in buildings 151 or 127.

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

Power generation of the Belgian nuclear power plants



4.3.3 The Umicore site in Olen

The Umicore facility in Olen has a covered storage area for radium sources, contaminated materials and soils. This storage area 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.

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) possess their own buildings to temporarily store their non-conditioned waste. When practicable, waste is stored until its radioactivity decays under the clearance level and is discharged 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 63 500 sealed sources on 1 January 2000 on the Belgian territory, of which about 40 000 ionising smoke detectors, according ONDRAF/NIRAS inventory. ONDRAF/NIRAS and the FANC are studying the most efficient way to collect these sealed sources once they become unused.

4.4 Nuclear facilities in the process of being decommissioned.

Three main facilities are concerned:

- the reactor BR3 of SCK•CEN is under decommissioning (the end is planned for 2003, the reactor and its building should be completely dismantled in 2009) and serves as a pilot project for this activity ;
- the spent fuel reprocessing pilot plant, EUROCHEMIC, should be dismantled in 2007;
- the dismantling of the former SCK•CEN Waste department (site 2 of Belgoprocess) started in 1998 and should end up in 2020.

Moreover, some buildings of the SCK•CEN, namely those transferred to VITO (Vlaams Instituut voor Technologisch Onderzoek) due to the splitting in 1991, were decontaminated and decommissioned.

5 Section E: Legislative and Regulatory System

5.1 Article 18: implementing measures

On 8 December 1997 Belgium has signed the Joint Convention. The Belgian legislator has expressed its consent with the obligations resulting from the Convention via the Law of 2 August 2002. The ratification was obtained on 5 September 2002. The Convention became effective on 4 December 2002, or 90 days after the Ratification Act had been deposited.

The national legislator decided that the existing legislative and regulatory framework was sufficient to ratify the Convention, without adaptations or completions were deemed necessary. This does not alter the fact that the efficiency and efficacy of the regulations are permanently evaluated by the public bodies involved and that they will be altered if necessary, in order to take into account the scientific, technological and social evolutions or in compliance with obligations resulting from other international or supranational conventions. Since the signing of the Convention on 8 December 1997, the nuclear laws and regulations have undergone important modifications, among other things as a consequence of the operational start up of the Federal Agency for Nuclear Control (see art. 19, point 5.2.1.2), the adoption of the Law of 31 January 2003 concerning the phasing-out of nuclear power and the management of fissile materials irradiated in these nuclear power plants.

5.2 Article 19: legislative and regulatory framework

Belgium is 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 1st and 2nd Review Conferences, organised respectively in April 1999 and in April 2002. Below, attention is paid exclusively to those regulatory aspects relevant to the management of radioactive waste and irradiated nuclear fuel.

5.2.1 Identification and location of the competent authorities

5.2.1.1 The federal nature of the competent authorities

Belgium has a federal state structure, which means certain competences are exercised on a central (federal) policy level, while other competences are partially or completely designed on the decentralised (regional) policy level, constituted by the Flemish and Walloon Regions and the Brussels-Capital Region. Since the State Reform of 1980 (completed with those of 1988 and 1993) the competences in the field of the Protection of the Environment are exercised by the Regions, including the surveillance of operational activities which, in general, may be harmful to man and environment (a.o. by issuing environment protection licences) and the waste management policy. The regulation of the nuclear operational activities is actually an exception to this regional competence. The protection of the population and of the environment against the danger of ionising radiation has indeed remained exclusively a federal matter. Furthermore, the management of radioactive waste, of whatever origin, is also a federal competence (see Special Law of 8 August 1980 on Institutional Reforms).

The Regions are also involved in some of the aspects of the energy policy and in the management of the energy infrastructure. However, the management of the nuclear fuel cycle, of the activities upstream as well as downstream of the nuclear power plants explicitly remained a federal matter (see special law of 8 August 1980 on Institutional Reforms). It follows from this that the management of irradiated and non-irradiated nuclear fuel is an exclusively federal policy matter. The federal competence with regard to the management of radioactive waste generated in the nuclear fuel cycle follows from the repartition of competences within the field of the environment policy as well as of the energy policy.

The involvement of the regional authorities in the regulation of nuclear activities remains limited to the deliberation and information exchange with the aim to ensure a coordinated treatment of the nuclear and non-nuclear environmental aspects. To this end, the regions are involved in the operation of the federally competent public bodies (via representation in the Scientific Council of the FANC and in the administrative bodies of ONDRAF/NIRAS, see points 5.2.1.2 and 5.2.1.3.). Another method in order to realise this coordination is the conclusion of cooperation conventions.

5.2.1.2 Safety Authorities

Belgium is a member of the European Union and of the European Atomic Energy Community (EURATOM), and this since the foundation of these supranational instances in 1957. The Belgian rules and regulations mainly within the field of radiation protection have been developed in implementation of and in accordance with the European Treaty and directives concerned. Also the development of the Euratom Treaty has triggered, in parallel with the development of nuclear national programmes, 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 surveillance of nuclear activities is performed by the ***Federal Agency for Nuclear Control (FANC)***. For the execution of certain tasks, the Agency may call upon the assistance of specialised control organisations such as **A.V.N**. and **A.V.C**., a.o. for routine inspections in nuclear facilities. It is through the association of the FANC on one side, and the control organisations on the other that the function of regulator as stipulated in article 20, 1st paragraph, of the Convention, is ensured. With the creation of the FANC, the legislator aimed to redefine the mutual relations between the nuclear operators, the specialised control organisations and the nuclear regulator. This part of the reform is not yet finalised. During the transition period, the former regulations continue to be applied; according to these, the control organisations receive their missions directly from the operators. For further information, reference is made to article 20 of the present Report and to the reporting in the subsequent National Report.

As a result of the operational start up of the FANC on 1 September 2001, the regulations concerning the nuclear safety and radiation 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 Radioprotection Regulation for the Protection of the Workers, the Population and the Environment (GRR-1963). These regulatory texts have been abolished since 1 September 2001 and respectively 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 1 September 2001)	**New regulation (since 1 September 2001)**
Law	Law of 29 March 1958	Law of 15 April 1994
General Radioprotection Regulation	RD of 28 February 1963 (GRR-1963)	RD of 20 July 2001 (GRR-2001)

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

The GRR-2001 bundles the licence procedures for diverse actions and professional activities implying the use of radioactive substances or ionising radiations, it specifies the protective measures to be taken into account and organises control operations. This regulation regulates the transposition of the ruling European Conventions, Directives and Regulations into Belgian Law, such as the Basic Safety Standards Directive 1996/29/Euratom, the modified Directive 1985/337/EEC on the environmental impact assessment of projects, 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 contains general provisions with regard to the radioactive waste management in the licensed facilities, including the characteristics of gaseous, liquid and solid radioactive substances which, for reasons of radiation protection, cannot be released or evacuated in an uncontrolled way into the environment, and which thus respond to the definition of radioactive waste. A description of the stipulations concerned is given further in this report (see article 19, point 5.3). The General Regulation is modified regularly according to the scientific, technical and social evolution. New modifications, such as the classification of waste into categories, the licence procedures regarding the layout of storage sites and the thereupon applicable conceptual preconditions, etc….are now under study.

Nuclear 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 Direction Civil Security - Algemene Directie Civiele Veiligheid and General Direction Crisis Centre- Algemene Directie Crisiscentrum). The organisation of the crisis management and the role of the intervening instances is, on the whole, described in the Royal Decree of 27 September 1991. For each of the nuclear sites, these directives 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, besides by the FANC, by a threesome of organisations having concluded conventions to that end with the competent Minister (SCK•CEN , AVN and IRE). 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 developed in 1986. For further information we refer to the reports published according to article 25 of the present report.

5.2.1.3 The Public Agency entrusted with the Radioactive Waste Management (ONDRAF/NIRAS)

Next to the safety regulations mentioned above, the management of radioactive waste and of excess fissile materials in Belgium is subject to specific legal framework, specifying the competences and interventions of the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS). ONDRAF/NIRAS was created to fulfil a task of general interest and general utility reconciling the interests of the community with those of the waste producers. The regulation was established at the end of the seventies and has since been adapted and completed a few times, in particular in the beginning of the nineties. In the table below, the legal framework are summarised.

	Legal texts
ONDRAF/NIRAS-law	art. 179, §2 and §3 of the law of 8 August 1980 on budgetary propositions 1979-1980, as modified and completed by: - The law of 11 January 1991 - art. 9 of the Law of 12 December 1997
ONDRAF/NIRAS – Royal Decrees	Royal Decree of 30 March 1981, on the missions and functioning of ONDRAF/NIRAS, as modified by the Royal Decree of 16 October 1991
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 equipments for the storage, processing and radioactive.

The ONDRAF/NIRAS legal framework imposes obligations on the producers (generators) of radioactive waste and excess fissile materials. It defines the relations between ONDRAF/NIRAS and these producers and between ONDRAF/NIRAS and the Safety Authorities. The legal missions of ONDRAF/NIRAS are illustrated below, starting with an overview of the nature of the radioactive substances subject to its management (point 5.2.1.3.1), followed by a description of the interventions of this Agency with regard to the management of radioactive waste and excess fissile materials, starting with the disposal of these materials (point 5.2.1.3.2) and followed by the activities preceding this disposal (point 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

ONDRAF/NIRAS has been charged by the legislator with the management of all the radioactive waste "of whatever origin*”*. Consequently, ONDRAF/NIRAS is not only competent in the field of the management of waste generated in the nuclear fuel cycle (nuclear power plants, production of fissile materials), but also within that of the waste produced by the medical and industrial sector and by the scientific research sector. The waste originating from professional activities using natural radiation sources is part of the competences of the Agency (the materials indicated with the acronyms NORM and TENORM), if the FANC classifies them as radioactive waste.

According to the ONDRAF/NIRAS legal framework, radioactive waste is only determined as such if the contamination level exceeds a determined limit, 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 reproduced in the GRR-2001 (see further point 5.3.1.2).

The management, by the Agency (ONDRAF/NIRAS), of foreign waste (from abroad) was not excluded on beforehand by the legislator, but was made subject to the prior consent of the supervising authority. With this stipulation, the aim of the legislator was to make the potential charging of the Agency with foreign waste, subject to an assessment by the supervising government. This way, the Belgian government has exceptionally, and due to the small quantities, accepted to treat the waste coming from the Grand Duchy of Luxemburg, in Belgium. The political authorities are reluctant to the treatment of foreign waste in Belgian installations, even if the degree of utilised capacity of certain nuclear facilities is particularly low.

Waste in general, and radioactive waste more particularly, are per definition substances for which no use whatsoever is intended. Assessing if certain materials might be re-used efficiently, should normally be done by the owner/producer.
ONDRAF/NIRAS and the FANC regulations oblige the producer to establish inventories and prospects concerning the production of radioactive substances, the waste stored and the waste to be evacuated and to have them 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 radioactive waste by the owner/producer, the ONDRAF/NIRAS regulation does not apply to it. The undesirable accumulation of materials on the site, as a consequence of a non-declaration, can formally only be prevented by the Safety Authorities. For this purpose, the inventory mission of ONDRAF/NIRAS (see further point 5.2.1.5) is an important complementary instrument in order to prevent suchlike unwanted accumulations from taking place.
According to the ONDRAF/NIRAS regulations, irradiated fissile materials are not automatically regarded as radioactive waste and consequently their management is not automatically subject to competence. This aspect will be treated in point 5.2.1.4.

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

The establishment of the Agency has to be seen within the framework of the approach obliging - in principle - every country with the individual implementation of a solution concerning the safe management of 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 layout, on national territory, of one or more repositories, dedicated to the disposal of radioactive waste or fissile materials "without the intention of retrieving the waste". The national legislator deemed that the final disposal of conditioned nuclear waste should best be entrusted to a public institution, given the long terms that usually go hand in hand with the development, conception and construction of a repository, its operational start up and the institutional control after its closure. The intervention of a public organisation was considered essential to guarantee to the – present and future – population that these waste products would be managed with the utmost care and in optimal conditions.

Seen from this angle, the legislator has - as it were - granted a "monopoly" to ONDRAF/NIRAS in the field of the disposal of nuclear waste on the Belgian territory. This Agency is – in the name of the community – entrusted with all the nuclear waste that needs to be disposed of (or the fissile materials to be disposed of) on a later date, in exchange of financial guarantees from the waste producers with the aim to cover the costs of its future management (cf. the Long Term Fund, see further). Via this formula, all the waste producers obtain a guaranteed discharge of their waste, while the population has the guarantee that this waste management will make the public interest prevail over the private interest.

The Agency is endowed with an extensive autonomy with regard to the technological choices and solutions it wants to employ in order to implement the management of nuclear waste. The existing regulations which apply to ONDRAF/NIRAS do not impose any obligations on the Agency, neither with regard to how the waste or fissile materials should be disposed of, on a later date, nor with regard to the condition (surface disposal, disposal in deep geological formations, reprocessed or non-reprocessed, …). As a Contracting Party to the "*Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDC)",* 1972, generally known as the "London Convention."

Belgian has first, temporarily (since 1983) and afterwards permanently (since 1993) abandoned the dumping of radioactive waste into the sea as a means of disposal and, consequently, has to resort to a solution on land. The Agency pursues, with the approbation of its Supervising Authority, a two-track policy: next to the development of a proper national disposal concept, participation to the development of a disposal concept on a broader regional scale is considered. The political authorities chose to make the international approach subordinate to the realisation of an undeniable capital gain within the field of safety. With a view to the development of a regional disposal site, ONDRAF/NIRAS is one of the founding members of Arius (Association for Regional and International Underground Storage), having its official office in Switzerland. The final solutions considered will - at the proper time - be submitted for approval to the political and safety authorities (cf. government decision of 16 January 1998 concerning the disposal of Category A waste).

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 hypotheses: operating of nuclear power plants for 40 years, complete or partial reprocessing of spent fuel unloaded from the nuclear power plants, surface or deep disposal of low-level and short-lived waste, deep disposal in geological formations of high-level or long-lived waste.

The Agency employs 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 conformity with the international recommendations, such as the European Recommendation of 15 September 1999 and the I.A.E.A. Safety Guide nr. 111-G-1.1 'Classification of Radioactive Waste' 1994.

Given the fact that there is not yet a disposal site operational nor in construction, an issue is not which legal body (entity) will be charged with the operation of the disposal installations. ONDRAF/NIRAS could either perform the operation itself, or consign the operation to a subsidiary (cf. the operation by Belgoprocess of the processing, conditioning and storage installations). The research and development activities within the framework of the disposal is for the greater part contracted out to the SCK•CEN, university teams and industrial study centres. An important instrument in this respect is the underground laboratory in Mol, run by E.S.V. EURIDICE, a joint subsidiary 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 point 5.2.1.3.2, an important mission of ONDRAF/NIRAS is in the first place the subsequent disposal of the radioactive waste. The legal missions of the Agency are 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, the conditioning and the storage of nuclear waste. The Agency has to have the guarantee that the nuclear waste has been processed and conditioned 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 accepted by the Agency. 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 on beforehand by the Safety Authorities. 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.

Some waste producers either have their own installation for processing, conditioning and temporary storage of their waste or they have their waste processed in national or foreign installations. The regulator has endowed ONDRAF/NIRAS with the competence of assessing the suitability of these installations, i.e. to verify if these installations are capable of producing waste packages, that respond to the acceptance criteria determined. This assessment is formally finalised with the delivery of a qualification issued for a limited period. This qualification procedure is described in the Royal Decree of 18 November 2002. The processing, conditioning and storage of radioactive waste in non-qualified installations should be regarded as forbidden by the ONDRAF/NIRAS regulations, because it might give cause to waste packages which are per 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 the Agency to have an involvement analogous to that regarding the processing in national installations.

Waste producers not disposing of equipment considered appropriate by ONDRAF/NIRAS, may entrust the processing of their waste to ONDRAF/NIRAS. The processing or conditioning of radioactive waste in behalf of producers which do not dispose of adequate (which means qualified) equipment, is a legal task (mission) of ONDRAF/NIRAS. This waste is entrusted to ONDRAF/NIRAS in raw or unconditioned form, again on the basis of the waste *acceptance criteria*, this time for unconditioned waste. In order to fulfil its legal task, ONDRAF/NIRAS has its own installations for processing, conditioning and storage of radioactive waste; these are operated by its industrial subsidiary Belgoprocess. The Agency may also 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 contracted out 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, conditioned, stored or disposed.

The involvement of ONDRAF/NIRAS in the different waste operations is clearly part of the waste disposal task of the Agency. The qualification of waste processing equipments and the establishment of acceptance criteria for conditioned and non-conditioned waste aims at making the processing and conditioning in conformity with unequivocal norms to obtain thus a quality guarantee (safeguard) 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 solidary approach of all of the waste producers is required; achieving this is "pre-eminently" the role of a public body (government body). All the costs linked to the activities of the Agency are at the expense of the waste producers, according to the distribution key 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 the mission of the Agency with regard to nuclear waste on the one hand, and in excess amounts of non-irradiated and irradiated fissile materials on the other. The aim of the legislator was to endow ONDRAF/NIRAS with "particular" missions concerning the management of irradiated fissile materials but not with the complete management responsibility; this remains the responsibility of the owner/producer.

a. Irradiated fissile materials 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 R.D. 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 government has submitted to the Parliament a project of law with the aim to submit to (more) specific rules the management of the provisions created by Synatom and dedicated to the financing of the future management of fissile materials. The aim is to safeguard more efficiently the availability of these provisions in the context of a free European electricity market.

Due to the gradual *phasing-out of nuclear energy*, after 40 year of operation, the amount of irradiated fissile materials 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 text, 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 materials resulting from the operation of research reactors (BR1, BR2, Venus and BR3 of SCK•CEN and of the Thetis reactor of the University of Gent) 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 materials of reactor BR3 have been declared in excess and have, consequently, been transferred to ONDRAF/NIRAS. The irradiated fissile materials of reactor BR2 have been transported for reprocessing purposes, partly to Dounreay (UK) and partly to the COGEMA reprocessing installation of La Hague. The moratorium on the reprocessing process is not applicable to the fissile materials unloaded of the research reactors, so that in future the BR2 fissile materials will continue to be transported to La Hague, as stipulated in the contract.

5.2.1.5 Management of the dismantling and clearance of nuclear passive

Every owner or operator of a nuclear power plant is in principle responsible for the future dismantling of his installations, once they are definitely decommissioned. ONDRAF/NIRAS as well as the FANC see to it, each one of them within the field of their own competences, that the owner/operator takes the necessary initiatives in time in order to carry out the dismantling programme. The radioactive waste resulting from the dismantling is subject to the management of ONDRAF/NIRAS according to the same principles as the waste due to another origin. Furthermore, it is part of the missions of ONDRAF/NIRAS to follow up the evolution of the methodologies and technologies concerning the dismantling.

If the owner/operator chooses to renounce the dismantling he can ask ONDRAF/NIRAS to perform these works for his account. To this end, the ONDRAF/NIRAS regulations have been adapted in 1991. At present, the Agency is commissioned by the Belgian State with the dismantling of some important decommissioned sites, such as the former reprocessing plant Eurochemic (better known as “passive BP1”), the former waste treatment installation of SCK•CEN (“passive BP2”), some decommissioned installations of SCK•CEN, such as the research reactor BR3 (technical passive SCK•CEN) and some of the IRE buildings (“passive IRE”). 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. New financing mechanisms, better adapted to the free electricity sector, have to guarantee the future activities till they are completed.

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 have concluded a convention with the Belgian State introducing a special arrangement for the creation of provisions for dismantling 7 nuclear power plants. The government has submitted a project of law to the Parliament with the aim to further regulate the management of these dismantling provisions, providing an intervention of an independent follow up committee, composed of financial experts of the government. Synatom will be transformed into a society managing the dismantling provisions as well as the fissile material provisions.

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 passives with the aim to detect the development of such passives 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 3 510 licences. This inventory will, in future, be updated every 5 years.

5.3 Regulations regarding the management of radioactive waste and irradiated fissile materials

5.3.1 The regulations applying to the facilities dedicated to the production, processing, conditioning, storage or disposal of radioactive waste or irradiated fissile materials

5.3.1.1 The licensing system concerning the creation and operation of the respective nuclear facilities

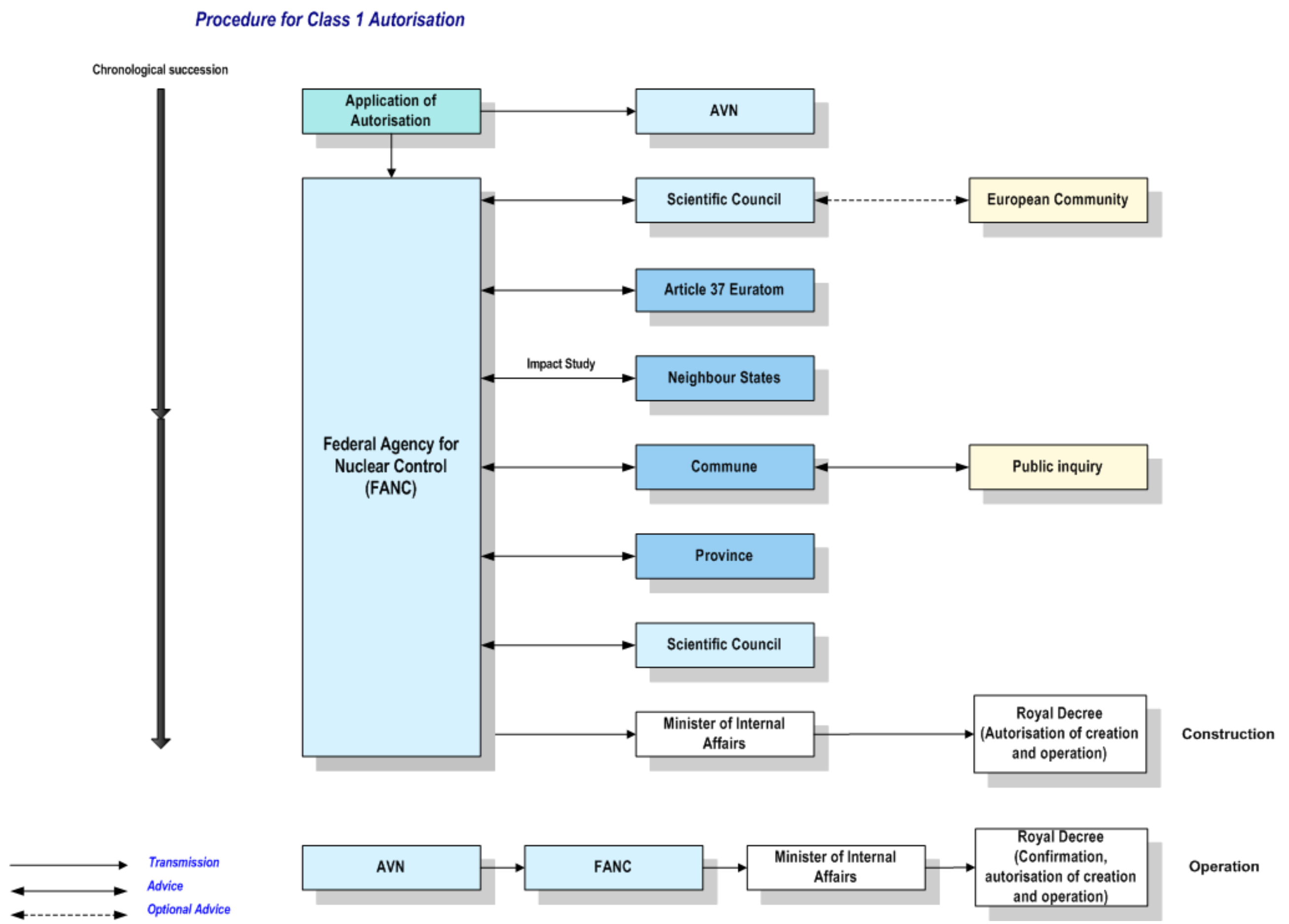
Every facility in which an action is performed, implying the use of radioactive substances or ionising radiation, is subject to a preliminary creation and operation licence (authorisation) issued by the Safety Authorities. The licence obligation is part of the responsibility of the operator of the facility. The licence procedure to be followed, is described in the GRR-2001 and depends on the class of the facility, ranging from I tot IV. Class IV facilities are exempt from any declaration and licence obligation. Installations holding radioactive substances in quantities or concentrations that do not exceed certain determined exemption levels, are classified into class IV.

The licence application is submitted to and investigated by the Federal Agency for Nuclear Control. If desired, it is submitted for advise to certain authorities, such as, dependent on the class, the local authorities, the Scientific Council of the Federal Agency for Nuclear Control and the European Commission. AVN performs a safety review of the licence applications. The safety evaluation report of this safety review is submitted to the FANC. The creation and operation licence (authorisation) is issued by the Federal Agency for Nuclear Control, with the exception of class I facilities. The licence of these last mentioned facilities is issued by Royal Decrees. The procedure to be followed is described in detail on the following page.

With regard to the facilities classified in the highest class, the licence application has to be accompanied by an environmental impact assessment, drawn up in conformity with the (meanwhile modified) European Directive 1985/337/EEG and the Recommendations of the European Commission 1999/829/Euratom concerning the application of article 37 of the Euratom Treaty.

The licence stipulates - among other things - the regulations concerning the periodical safety assessments of the installations; this means a ten-year's revision for Class I facilities (see section G, article 5).
The facility can only become operational after - in a favourable completion report - the conformity with the licence granted has been confirmed. This may be performed by AVN when delegated by the FANC. With regard to the Class I facilities, the completion is finalised by means of a 2nd Royal Decree, called "license decree". The other facilities have their completion report established by the Agency.

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



Procedure for Class 1 Autorisation
Chronological succession
Application of Autorisation
AVN
Federal Agency for Nuclear Control (FANC)
Scientific Council
European Community
Article 37 Euratom
Impact Study
Neighbour States
Commune
Public inquiry
Province
Scientific Council
Minister of Internal Affairs
Royal Decree (Autorisation of creation and operation)
Construction
AVN
FANC
Minister of Internal Affairs
Royal Decree (Confirmation, autorisation of creation and operation)
Operation
Transmission
Advice
Optional Advice

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

Disposal sites for radioactive waste are classified into class I, being the highest risk class. The same goes for facilities where radioactive substances are assembled, processed, conditioned or stored, i.e. if these facilities are the main activity of the company. In case the waste processing installation is part of a nuclear site, it is subject to the licence procedure for this type of installation.

The most important waste processing site is that of Belgoprocess, with its two processing sites BP1 en BP2, respectively at Dessel and Mol. Repositories for radioactive waste, are still in a conceptual phase. The licensing procedure to be followed will be evaluated more in detail.

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

Facilities producing, treating or storing irradiated fissile materials, are all of them classified into the highest risk class, being class I; these are: nuclear reactors, facilities where the amounts of fissile materials used or stored are larger than half of their minimal critical mass, facilities for reprocessing of enriched or non-enriched irradiated fissile materials.

The most important operational installations responding to these criteria are:

- The nuclear electricity production reactors of Electrabel;
- The nuclear reactors dedicated to the scientific research of SCK•CEN;
- The 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 reprocessing of irradiated fissile materials (hot cells of SCK•CEN, IRE, ex-Eurochemic).

C. Facilities producing/generating radioactive waste

With the exception of the facilities using exclusively X-rays apparatus, all of the nuclear facilities that are legally subject to a licence (authorisation), and classified into class I, II or III according to the GRR-2001, are considered potential producers of radioactive waste.

For these facilities, classified into classes I and II, in his licence application, the applicant has to give detailed information about the expected production of radioactive waste, including the waste generated by the future decommissioning and dismantling of the installations. This information includes the production of gaseous, as liquid and solid waste. They include the treatment techniques applied and the temporary storage in anticipation of their removal, either by discharge into the environment or by transfer to ONDRAF/NIRAS.

The applicant of a creation and operation licence for a class I, II or III facility considered as a potential waste producer, has to join to his application file a written declaration in which he engages himself to register with ONDRAF/NIRAS and to conclude an agreement with this Agency concerning the management of the totality of radioactive waste.

ONDRAF/NIRAS receives automatically a copy of every authorisation or licence issued for a class I facility as well as for class II and III facilities. This way, ONDRAF/NIRAS is informed of the identity of the potential waste producers.

If the FANC grants a licence exemption for individual apparatus on the basis of a delivered “approval of the type” even though the apparatus do not respect the exemption criteria (this means they contain radioactive materials in quantities or concentrations exceeding the exemption levels determined), the FANC will determine the conditions for the removal of these apparatus. Thus is prevented that these apparatus would pollute the non-radioactive waste stream.

5.3.1.2 Operating conditions with regard to nuclear facilities

The discharge of radioactively contaminated waste into the environment, be it in the form of gaseous effluents or 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 by the GRR-2001. Waste that cannot be discharged as such, has to be assembled and treated as radioactive waste and is subject to the management of ONDRAF/NIRAS.

The activities thus discharged into the environment, have to be kept as low as reasonably achievable (see GRR-2001, art. 20.1 in general and art. 34.5 with regard to liquid discharge, art. 36.3 for gaseous effluents and art. 18.3 for solid waste).

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

- 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 waste water and Bq/m³ discharged air).

The licences for class I and II nuclear facilities can deviate from these generically determined limit values. In those cases the discharge limits for the facilities are determined by means of exposition scenarios, taking into account the observance of the dose limits for members of the public (population) up to a fraction of the maximum effective dose authorised of 1mSv/year. The operators of the licensed facilities of Class I and II had until 1 September 2002 – or one year after the publication of the new GRR-2001 - the time to propose a modification of the discharge limits imposed upon the facilities with the aim to harmonize them with the new dose limits for the public, being 1 mSv/year. These applications are nowadays being studied by the FANC.

The unconditional clearance 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, dumping) is only permitted if it responds to the generically determined clearance levels or conditions stipulated in the GRR-2001. These clearance levels limit the activity concentration in the cleared materials and are expressed in kBq/kg. From these generically determined clearance levels may be deviated by means of a licence application submitted to the FANC and issued by this same Agency. The clearance levels determined in the licence have to be based on impact studies clearly confirming that two radiation protection criteria are observed, namely the individual dose of maximum 10 µSv/year and the collective dose rate of 1man.Sv/year. The levels are kept as low as reasonably achievable and can never exceed the so-called clearance levels.

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

The "s*amenwerkingsakkoord van 17 oktober* 2002 *tussen de federale Staat en de gewesten met betrekking tot het beheer van vrijgegeven afvalstoffen"* (cooperation convention of 17 October 2002) obliges the FANC to inform the regional authorities responsible for the non-radioactive waste management, of the clearance licences issued 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 regulation, 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 the Agency all the information required for the execution of its missions. The Agency concludes conventions with the most important waste producers concerning the general radioactive waste management programme and the collection of the waste with a view to its transportation, conditioning, storage and disposal.

These obligations are stipulated in the GRR-2001 with regard to every operator of a licensed facility who is also a potential producer of radioactive waste. Suchlike operator has to register with ONDRAF/NIRAS by virtue of the GRR-2001 and, as the occasion arises, has to conclude a convention with this Agency with regard to the management of the totality of the radioactive waste. This obligation is manifested in the composition of the file that has to be elaborated on the occasion of every new licence application; to this application a commitment of the future operator to register with ONDRAF/NIRAS has to be joined. 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 is a more enforceable regulation compared to that of ONDRAF/NIRAS, given the fact that this last one does not provide sanctions.

5.3.1.4 Decommissioning and dismantling of a nuclear facility

According to the ONDRAF/NIRAS regulations, the operators/owners have to submit their programmes for the future decommissioning of their radioactively contaminated installations to the Agency for approval. The decommissioning of important licensed facilities (class I and some of class II) is subject to a prior licence granted by the Safety Authorities and requiring in certain cases also the establishment of an environmental impact assessment. The less important facilities can suffice with a notification to the FANC.
Special attention needs to be paid to the management of the waste and of re-usable materials generated by the decommissioning. ONDRAF/NIRAS is charged with the gathering and assessment of all the information enabling it to manage the waste generated by the decommissioning. The application for a creation and operation licence 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 an obligatory licence issued by the FANC, regardless of the possible residual contamination level. The licence procedure to be followed is described in the GRR-2001.

5.3.2 Regulations that apply to the transport; import and export of radioactive waste and irradiated fissile materials

The transport and transboundary movement of radioactive waste and irradiated fissile materials is performed according to the ruling European and international regulations concerning the international carriage of dangerous goods by road, ship, and airplane.

The stipulations which apply to the transport of radioactive substances in general and of irradiated fissile materials in particular, are laid down in chapter VII of the GRR-2001. This chapter determines that every transport requires a preliminary licence. This licence is only granted if it can be proven that the stipulations of the international conventions and agreements with regard to the transport of dangerous goods [3] are observed.

With regard to the transboundary transports of radioactive waste and irradiated fissile materials, the stipulations of chapter IV of the GRR-2001 are applicable. This chapter regulates the transposition of the 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 the advice of ONDRAF/NIRAS with regard to the import and export of radioactive waste has to be obtained.

5.3.3 Regulation applicable to the professional activities implying exposures to natural radiation sources

In accordance with the European Directives in force, the range of application of the GRR-2001 was extended to professional activities using natural radiation sources. Activities implying a risk of the exposition of persons above the dose level determined for the public, have to be reported to the FANC. Through process enrichment of the radionuclides present in the processed raw materials, some of these operations can generate residues or waste, that, from the point of view of radiation protection, need special care. The FANC can make similar activities subject to a licence and can entrust the waste thus produced to the management of ONDRAF/NIRAS.

5.4 Article 20: Regulatory Body

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

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[3] ADR : European agreement on the transport of dangerous goods by road.
RID: the European Agreement concerning the International Carriage of Dangerous Goods by Rail, appendix I to the Convention concerning the International Carriage of Dangerous Goods by Rail (COTIF).
ICAO: Technical Instructions for the Safe Transport of Dangerous Goods, of the International Air Transport Organisation.
IMDG: The International Maritime Dangerous Goods Code of the International Maritime Organisation (IMO).
ADNR: European Regulation concerning the Carriage of Dangerous Goods on the Rhine.

levels: the operator, an independent control organisation recognised by the FANC and, finally, the FANC itself.

The criteria and obligations that have to be observed by the 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 control organisations to experts having obtained an individual qualification from the FANC, on the basis of art. 73 of the GRR-2001. The control organisation recognised by the FANC with regard to the performing of inspections in nuclear reactors or in waste processing installations, is AVN (Association Vinçotte Nuclear).

Hereunder, the statute of the FANC is specified. Next to that, the statute of AVN, ONDRAF/NIRAS and of other important intervening entities is described in order to exemplify their position with regard to the FANC.

5.4.1 The statute of the FANC

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

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

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

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

The above-mentioned statute attributes to the Agency the indispensable independence to enable it to impartially exercise its responsibilities as a regulator of the nuclear activities - as prescribed in art. 20, 1st paragraph of the Joint Convention and in art. 8 of the Convention on Nuclear Safety.

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

5.4.2 The statute of AVN and its relations with the FANC

Being an authorised inspection organisation, AVN (Association Vinçotte Nuclear) meets the requirements of Article 74 of the GRR-2001. These requirements include, among others that:

- It has the status of a non-profit organisation possessing legal personality according to the law of 27 June 1921;
- It submits quarterly report of its activities to a “Surveillance Commission” (i.e. a watchdog) chaired by a representative of the FANC and composed of representatives of the employers’ organisations and of the workers’ organisations (trade unions);
- to perform its missions, it uses only authorized experts (Article 73 of the GRR-2001);
- it is covered by civil liability for all the objects that do not fall within the application field of the law of 18 July 1966 on nuclear civil liability.

AVN’s General Management reports to a Board, mainly composed of Belgian University professors, independent from the licensees controlled by AVN. Furthermore, AVN took the initiative to establish a “Scientific and Technical Committee” composed of representatives of most of the Nuclear Safety Authorities of the European countries and International Organisations (IAEA, OECD/NEA, CEC), as well as of Belgian University professors active in the nuclear field. An annual activity report is prepared for this Committee, where it is discussed at its annual meeting. The Committee assesses AVN’s work and formulates recommendations. It exists since 1991 and is an application of the peer-review principle.

AVN’s technical personnel is composed of some 50 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 examined, and also regarding the assessment of incidents or specific safety problems in the installations.

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

Due to AVN being a non-profit organization, its financial resources are used to pay for its personnel and the costs involved, to participate in national or international working groups, to pay for personnel training, for research and development activities, for keeping technical and regulatory documentation.

More information on AVN, the organisation and its duties is available on its web site: http://www.avn.be.

5.4.3 Relations between ONDRAF/NIRAS and the FANC

The Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) is - exactly as the FANC - a public institution governed by a Board; its members are appointed by the Federal Government. The ONDRAF/NIRAS is supervised by the Federal Minister responsible for the Energy policy via a Government Commissioner. The Federal Minister for Internal Affairs also has a Government Commissioner in the Board of Directors of the Agency, by virtue of his competence as supervisory minister of the FANC. The FANC submits an annual activity report to the Parliament.

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. With regard to the processing of non-conditioned waste, the contracts are concluded for a 5-year period. With regard to the storage of conditioned waste into the storage installations and later into the repositories, the contracts are concluded for a 10-year period; the already existing contracts will expire in 2005.

The financing of the activities of ONDRAF/NIRAS is largely based on a consensus between the parties involved. The ONDRAF/NIRAS Law provides indeed the possibility to regulate the financing of the Agency by Royal Decree, but this alternative financing is only foreseen in case no agreement can be reached with the waste producers. This possibility has yet never been used.

With regard to the management of radioactive waste, FANC and ONDRAF/NIRAS have been entrusted by the legislator with a largely parallel social objective, namely that of supervising if the population (public) and the environment are efficaciously protected against the dangers of ionising radiation emanating from the radioactive waste present. However, the means and instruments that both Agencies dispose of in order to achieve these objectives, are very different.
The role of ONDRAF/NIRAS should not be confused with that of the Safety Authorities. ONDRAF/NIRAS does not dispose of the instrument of one-sided administrative legal acts in order to defend the public interest, this implies that it has to rely on the consent of the waste producers.
Infractions with regard to the decisions of ONDRAF/NIRAS cannot be sanctioned the same way as those of the FANC. Disputes concerning the observance of the contractual conventions have to be settled by the commercial court.

ONDRAF/NIRAS is the legal owner of important amounts of radioactive waste. It acts as operator of two nuclear sites holding processing, conditioning and storage facilities. It is the builder of new installations on these sites, which are the object of licenses issued through the FANC. On these same sites, ONDRAF/NIRAS is responsible for the decommissioning of installations retired from service. It is charged with the development of repositories. Even though, ONDRAF/NIRAS is neither an operator of nuclear installations, nor a holder of nuclear licences, the missions contracted out 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, 2nd article, of the Convention).

The distinction between the competences and responsibilities of FANC and ONDRAF/NIRAS are formalized, because the supervision on both 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 will conclude 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

Belgoprocess is a company of which all the shares are in the possession of 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 the processing, conditioning and storage of radioactive waste are operated by Belgoprocess; these are located on two sites, BP1 and BP2. Belgoprocess is holder of the establishment and operating licenses. The agreements between ONDRAF/NIRAS and Belgoprocess are laid down in long-term agreements. For more information: www.belgoprocess.be

6 Section F: other general safety provisions

6.1 Article 21: Responsibility of the licensee

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 described in their licences.

Radioactive materials can not be brought or operated into a class 1 facility until a Royal Decree confirming the licensing of this facility has been published.

One of the licensing conditions is the conformity with the ‘safety report’ handed in with the application and regularly updated.

For the nuclear power plants, the licensing Royal Decrees also request that it is conform to the document set out in accordance with article 37 of the Euratom Treaty. This article requires that each Member State is to provide the 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 substance associated with the operations listed below, in gaseous, liquid or solid form. It also enumerates activities such as: 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 operator is to organise an internal Health Physics Department. In accordance with article 23 of the GRR-2001, this department is entrusted with the task of organising and controlling “health physics”, that includes i.e.:

1) delimitating and signalling the controlled areas

2) investigating and controlling the existing protection means and plans

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

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

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

6) controlling the conditioning, loading and unloading of radioactive or fissile materials inside the facility

7) the measurements of the radiation intensity, of the dose and of the contaminations

8) updating the inventory

9) investigating release projects

and the other provisions of the GRR-2001 and the FANC decisions on industrial hygiene and safety and on environmental safety and health.

The operator is to entrust the external controls to the Agency, which can delegate this mission to an authorised inspection organisation. In class 1 facilities, these controls have to be carried out by recognised experts that have followed an appropriate training. Article 73 of the GRR-2001 regulates the authorisation of the experts delivered by the Agency. Class 1 experts must be engineer in physics, engineer in nuclear sciences or must have followed another education plus a complementary specialisation considered suitable by the Scientific Council of the Agency.

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 bring the maximum amount of the operator's civil liability for damages caused by a nuclear accident to about 300 millions 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 in charge of the information for the workers likely to be exposed to ionising radiations before they are affected to a work station (article 25) and he has to limit the individual and collective doses (article 20).

In the licence applications, the operator must commit himself to registering at ONDRAF/NIRAS and to concluding with this organisation a convention on radioactive waste management.

As far as the release of solid waste is concerned, the Health Physics Department of the operator must agree each release individually and the release must be performed according to the written procedures worked out by this department. The authorised inspection organisation is to confirm this agreement if such a clearance for the same materials and according to the same procedures has not been agreed previously, in accordance with the GRR-2001.

6.2 Article 22: Human and financial resources

6.2.1 Human resources

6.2.1.1 ONDRAF/NIRAS – Belgoprocess

As of 31 December 2002, ONDRAF/NIRAS had 61 permanent full-time employees.
The permanent workforce was made up of 37 employees with a university degree, 11 with a higher-education diploma and 13 educated to secondary school standard.
The temporary workforce comprised 12 employees with a fixed-term contract, 5 on secondment and 7 with a fixed fee contract.

Belgoprocess, which is in charge of the industrial management of the processing/conditioning and storage of radioactive waste whereas ONDRAF/NIRAS is responsible for the administrative management and research, has 253 people - 240 permanent workers, 3 on secondment and 10 temporary workers.

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

ONDRAF/NIRAS and Belgoprocess are also largely involved in the work groups created by together the international organisation (IAEA, NEA, European Commission, …) in the field of the safety 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 TRACTEBEL group (SUEZ). ELECTRABEL generates some 85% of all 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 all electricity consumed in Belgium.

About 1 600 people are devoted to nuclear power station operation among the 3 100 personnel working for electricity generation as a whole, of ELECTRABEL’s total Belgian workforce of 12 000. The TRACTEBEL group, of which ELECTRABEL is a part, also has an Engineering division which is the Architect-Engineer of the Belgian nuclear power stations (and of most of the fossil fired plants) and which houses the know-how of over forty years of nuclear technology, which started with the construction of the first research reactors at the Mol Research Centre.

6.2.1.2.1 Organisation - training

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

The training programmes are defined in the Safety Analysis Report, which includes a “function-programme” correlation chart. Chapter 13 of the Safety Analysis Report lists exhaustively all posts for which a licence is required. This licence is granted on the basis of the positive opinion expressed by an Assessment Committee - AVN being member of this Committee, with veto power - which examines 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 conditional to, among other, 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 defined in function of the occupied position. The content of this programme discussed with AVN, is essentially operation-focused and includes, among other, a refresher course regarding the theoretical and practical knowledge (two weeks per year), training on the full-scope simulator (two weeks every two years) and, in teams, a review of the descriptions of the different systems (two weeks per year).

Similar attention is given to the maintenance personnel (cluster "Servicing", see next section).

For all the personnel of the plant, there are training and retraining plans which are adapted according to the missions of the personnel. Note that the 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 that 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; more over a training on radiological protection is legally required and is made specific to the site where they will work. They must pass an examination at the site before they are allowed to the work site.

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

The design bases of the plants, i.e. the knowledge of the design of the plants and the reasons of the choices made 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 …

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 with the collaboration relationship existing between the different actors in the operation and the management of a nuclear power plant.

This new organisation is of the matrix type: vertical per plant and horizontal per profession (that horizontal structure is called "cluster").

The different clusters are: "Operations", "Servicing", "Fuel", "Care" and "Assets".

The profession of the "Operations" cluster is the conduct of the installations, the operation. The one of "Servicing" is the maintenance of equipments and installations. The "Fuel" cluster is in charge on the sites 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. "Care" is in charge of all controls (including Health Physics in the sense of the GRR-2001), measurements, protection of the workers (classical security including fire protection) and safety of the installations (including the setting up and the management of the emergency plans). “Assets” manages the production installations and all the goods attached (as “owner” of the installations).

Each of the last three clusters (Fuel, Care and Assets) has a local organisation per nuclear site (Doel and Tihange) and a centralised organisation for both sites.

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, further extended and adapted by the Royal Decree of 18 October 1991.

The Royal Decree defining 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 between the beneficiaries of the services in accordance with objective criteria fixed by the Board of ONDRAF /NIRAS.
- ONDRAF/NIRAS may, after agreement by the Minister of Economic Affairs, manage a fund in order to finance long term duties, in particular the final disposal of the waste. This fund will be fed by contributions from the relevant waste producers, according to rules to be approved by the Minister of Economic Affairs.
- A special fund must be 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, ONDRAF/NIRAS will establish and/or qualify, in agreement with the concerned producers, the modalities aiming at guaranteeing the financing of those operations.
- The financing modalities, 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 by the Board of ONDRAF/NIRAS.

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 the charging of fees on each 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 modelling 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 disposal operations the fees are paid into a fund -the so-called "long-term fund" -which is interest bearing. ONDRAF/NIRAS has the responsibility for managing the fund, using external money managers. Each accounting year the financial performance of the fund is reassessed.

Funds administered by ONDRAF/NIRAS are under the supervision of a board of representatives from the State and the main waste generators involved, the so-called Supervisory Committee, which monitors cash flow and the portfolio of investments.

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 actual 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.

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.

Financial decommissioning provisions not treated within this article are dealt with under article 26.

6.2.2.2 About NPP's

6.2.2.2.1 Dismantling provisions

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

The basic principles for calculating these provisions are the subject of an agreement between the Belgian State and ELECTRABEL. It has been agreed to periodically reassess the question (every five years) to see whether the provisions that are being set up need to be revised considering the most recent information that has become available. The setting up of these provisions has been phased in time according to the principle of capitalisation: on the one hand, annuities are deposited and, on the other hand, capitalisation interests are generated by the cumulated amounts as at the end of the previous year.

Moreover the licensee must submit his initial decommissioning plans to ONDRAF/NIRAS which must approve them in the frame of its legal missions. These decommissioning plans are reviewed and approved every five years. The total amounts intended to finance these decommissioning must be available 30 years after the beginning of commercial operation.

6.2.2.2.2 Provisions for the management of irradiated fissile materials

Provisions for the later financing of the back-end activities are set up at SYNATOM. In absence of alternative assessments of the cost (a non-reprocessing scenario is currently under construction), the provisions are still set up according to a scenario for the integral reprocessing of fissile materials. The main part of those provisions is lent to ELECTRABEL by means of a long-term receivable. The setting up of provisions for the management of irradiated fissile materials is controlled by the Control Committee. Since SYNATOM was privatised in 1994, the Belgian State has retained a golden share that grants it some specific rights (veto power over any decision that it deems contrary to the goals of the Belgian energy policy).

Note: government bill

The current government is considering modifying the financial provisions as follow, in a law limiting the operation of the nuclear power stations to 40 years:

- The operators remain responsible for applying the nuclear power plants decommissioning plan, for managing the irradiated fissile materials and for managing the waste arising from these activities.
- The nuclear operators set up provisions for financing those activities within the structure of their company. They can continue to use these provisions, provided that they accept the terms of the State control on the setting up, the justification, the adequacy and the availability of the provisions.

- The provisions are centralised at SYNATOM - which will be transformed into a 100% subsidiary of ELECTRABEL – what enables this control. The Belgian State owns a golden share that grants it some specific rights such as to veto some decisions.
- SYNATOM can lend maximum 75% of the provisions set up to Electrabel on normal conditions and at the rate applied for industrial credits, as far as the consolidated group ELECTRABEL is solvent enough.
- The dismantling provisions will be fully set up for each nuclear power plant at the latest for the shutdown planned for the plant, i.e. 40 years after their commissioning *(instead of 30 years initially planned)*. The provisions for the management of the irradiated fissile materials will be yearly set up proportionally to the amount of generated fissile materials.
- SYNATOM will report to a Committee composed of governmental representatives (taking over the mission of the Electricity and Gas Control Committee ([4])*)*, on the forecasting for the setting up of provisions, on the investment of the provisions and on the agreements with ELECTRABEL for the attention of the Parliament.

6.3 ARTICLE 23: QUALITY ASSURANCE

The qualification of the waste treatment and conditioning (including radiological waste characterization), as well as storage facilities are imposed at national level by the Royal Decree of 18 November 2002. This constitutes the central element of the quality assurance system in Belgium.

6.3.1 Description of the provisions of the Royal Decree of 18 November 2002 on the qualification of storage, processing and conditioning installations for radioactive waste.

Every Belgian installation used for the storage, processing or conditioning of (Belgian) radioactive waste (conditioned and non-conditioned 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 applied 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 efficacy of the quality system.

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

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

[4] The general administrator of the Treasury or his delegate, the president of the CREG executive committee or his delegate, the executive manager of the Office de Contrôle des assurances or his delegate, the executive manager of the budget administration or his delegate, two people appointed by the Banque Nationale de Belgique or their delegate.

maximum period of 5 years; the qualification can not be delivered 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, conditioning and storage procedures.

6.3.2 Acceptance procedure for conditioned radioactive waste packages

Conditioned radioactive waste packages are accepted in the sequence outlined below. During the course of the year 2000 a procedure APG – 4 DC 'General Procedure for the Acceptance of Conditioned Radioactive Waste' has been drafted in accordance with ISO 9001, version 2000.

1. Production of the packages during a 'campaign' according to an ONDRAF/NIRAS approved (qualified) process.
2. Submission to ONDRAF/NIRAS of the production documentation including a request for removal, supported by radiological data for each individual package as determined following a physical inspection by the producer or an authorised inspection organisation and using a radiological characterisation method approved by ONDRAF/NIRAS. The request for removal 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 Form C (attached to the removal request): this is the administrative check. ONDRAF/NIRAS then writes a letter to the producer with any comments resulting from the administrative check. ONDRAF/NIRAS also issues an inspection memo listing the comments it has made in its letter to the producer, together with any information relevant to the waste management, e.g. relating to databases, and any significant items that must be checked during the physical examination by the ONDRAF/NIRAS representative appointed to accept the packages prior to their removal.
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 interim storage designated by ONDRAF/NIRAS.
10. On arrival at the facility, the transferred conditioned radioactive waste packages are physically inspected for interim storage and an acceptance report for their temporary storage is issued.
11. According to article 17 of the General Rules for 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; the case of vitrified waste from the reprocessing of Belgian spent fuel in the COGEMA facilities at the La Hague facility (Plant UP3) is described.
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 undermentioned conditional provisions:

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

ONDRAF/NIRAS has been able to verify - on the basis of the data and information put down in the technical approval 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 approval file for the process, following the instructions defined by ONDRAF/NIRAS,
- the commitment of ANDRA to develop a cooperation 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.

Administrative verification of the delivery documents
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.

Administrative verification of the production documents at COGEMA

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.

Administrative verification of the documentation at BUREAU VERITAS

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.

Physical inspection of the canisters at COGEMA

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.

Administrative verification of the COGEMA documentation after taking the canisters from stock

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.

Administrative verification of the BUREAU VERITAS documentation after taking the canisters from stock

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.

Administrative verification of the complete documentation file

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 and Belgoprocess

The “Acceptance system” of ONDRAF/NIRAS obtained the ISO 9001:2000 certificate in June 2002.
Only the paragraphs 7.3 “Design and Development” and 7.6 “Control of Measuring and Monitoring devices” were kept out of the certification field.

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 certificated first.

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 the control of the service performed. Lastly, the Quality Management System aims at improving the management of the operations.

The efforts to extend the Quality Management System follow the same path:

- The ISO ‘logic’ is progressively applied for the ‘upstream’ and ‘downstream’ processes (i.e. entities of the ONDRAF/NIRAS organisation) of the Acceptance System (suppliers and internal customers).
- Two other processes will normally be certified in 2003.
- Most of the ONDRAF/NIRAS processes will be integrated in the application field of the ISO 9001 certificate. This field will progressively extend to form a coherent whole which will bring the whole organisation together.

The Quality Management System will be completed by an Environment Management System, drafted according to the standard ISO 14001. A first assessment of the impact on the organisation will take place in 2003.

ONDRAF/NIRAS subsidiary company 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 is conform to the ISO-9001 standard, and to the code IAEA 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 on 3 December 1998 and are now applicable for the following activities:

- The reception, the determination of the radioactivity content in the NDA-IPAN/GEA installation and the treatment and conditioning in the CILVA-installation of radioactive waste.
- The decommissioning of nuclear facilities and the decontamination of contaminated materials.

Since safety and environmental protection are an imperious condition for nuclear activities, Belgoprocess is working continuously towards a total integration of quality, safety and environmental protection issues into one management system.

6.3.4 Quality Management system 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 guidelines (including 50-SG-QA5) developed in the scope of th IAEA's NUSS safety rules programme.

At the time of putting into service the Doel 1 and 2 and Tihange 1 units, i.e. 1974-1975, that level of quality-assurance formalism was not yet required. However, during the first ten-yearly safety reviews of these units, the request was formulated 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, followed by the operation period. As there is no unit under construction at present in Belgium, emphasis is put on how the quality assurance programme is applied during operation; the Tihange site is considered below to illustrate this point, but the organisation is nearly identical at the Doel site.

6.3.4.1 Concerned equipment and activities

The quality assurance programme must apply to any safety-related equipment and components as well as to any activities that may affect their Quality. It must also apply to the safety-related activities, e.g. radiological protection, radioactive waste management, fire detection and protection, environmental monitoring, nuclear fuel management and emergency intervention. These equipment, components and activities are known as Quality Monitored (Q.M.)

Quality Monitored items are identified in the Safety Analysis Report of each unit.

6.3.4.2 Quality Assurance programme

The quality assurance programme is based on a three-level system of stipulations, consisting in:

- a description of the quality assurance programme (i.e. chapter 17 of the Safety Analysis Report + the Manual),
- administrative procedures,
- 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 Manual defines the requirements regarding establishment and implementation of the quality assurance programme.

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

These administrative procedures detail 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.

These define 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.

They specify 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 safety, classical security, radiological protection and environment. These documents define in detail the duties or tasks of individual agents or agents groups.

6.3.4.3 Delegation and subcontracting

The quality assurance programme objectives remain fully applicable in case of delegation or subcontracting.

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 with time.

6.3.4.5 Periodic evaluation

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, AVN examined in the frame of the licensing process of each unit the quality assurance programme to be implemented during the design, construction and operation 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, the intervention of an Authorised Inspection Agency is required as an independent inspection.

During the operational phase of the power station, AVN 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.

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 general principles for justifying and keeping the exposures as low as reasonably achievable, and the requirements to comply with the 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.

6.4.2 Design

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

- general safety philosophy
- fundamental design criteria and specifications (systems, components, casks, etc…), with a quality concern during design, construction and operation
- multiple barriers concept (confinement of radioactive materials, ventilation (depression cascade, renewal rate of air, etc..)); ventilation during normal conditions and emergencies
- criticality safety
- shielding and radiation protection
- long term behaviour (internal and external influences) of storage
- thermal analyses for storage conditions (heat removal)
- fire protection
- industrial safety
- radiation protection program (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 program for the surveillance and control of these limits and the corrective actions.

The licence application is accompanied with an environmental impact assessment where beside 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, in consultation between the work supervisor and the radiological protection agent in order for them to jointly agree about the protective means to be used, a new dosimetric estimate that takes into account the decided protective means, 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 gamma dose rate meters for a strict follow-up of the committed 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 and where possible, the operations are performed remotely (use of manipulators or use of automatic sequences, etc…).

6.4.4 Follow-up at the field

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 fixed at 7.5 µSv/h. In practice the measured dose rate values are far below these limits.

Various measures have been taken over the years during operation to reduce further the collective annual 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 (including a important amount due to dismantling projects).

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 is denied to certain locations without 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 max. individual dose. In practice for all the nuclear installations, this is about the half of the dose limit (20 mSv for 12 consecutive months, in accordance with the GRR-2001).

6.4.4.2 Contaminations

The contaminations are limited or excluded by the multiple barriers (confinement of radioactive materials, ventilation (depression cascade, renewal rate of air, 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), related with a scheme to notify the operators, the HPD, AVN, and the FANC.

The Euratom 96/29 Directive has been implemented in the Belgian legislation and as allowed by Article 81.2 of the GRR-2001 there is a demand for a re-evaluation of the present authorised discharge limits (gaseous and liquid releases). These limits, or new imposed limits based on this evaluation, have to respect at least the annual dose to the public of 1 mSv. These evaluations implement a lower dose constraint to take in account ALARA and the contribution of other sources of exposure.

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 person of the public is a few nSv/year (based on a conservative approach for the dose calculations).

Irradiated fuel storage facilities in Belgium involve pool storage and dry storage of intact fuel elements (at the NPPs, the SCK•CEN, and 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 AVN and the FANC in order to follow the impact on the environment. These results are periodically evaluated by the HPD and AVN.

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 OECD Nuclear Energy Agency (NEA).

Belgian representatives participate in the WENRA working group on waste. The main goal of this working group is the harmonisation of safety approaches for waste management. 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, by the NEA, by UNSCEAR and by the IAEA.

Finally, bilateral contacts are held with neighbouring countries.

6.5 Article 25: Emergency preparedness

6.5.1 Regulatory framework

The emergency preparedness is the prime responsibility of the Minister in charge of internal affairs. The law of 31 December 1963 defines the notion of Civil Protection, and the Royal Decree of 23 June 1971 organises the civil protection missions and the co-ordination of operations during calamities, catastrophes or disasters. The provisions to be applied in case of radiological accidents are described in the Royal decree of 27 September 1991 defining the national emergency plan (see note at the end of this article).

This national emergency plan defines the tasks of each of the involved parties. The relevant infrastructure is being provided accordingly.

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

This document will 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.

This plan has been essentially designed for:

- nuclear accidents or any other radiological emergency situation 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) at Mol, the "Institut des Radioéléments" (IRE) at Fleurus, Belgoprocess and Belgonucléaire at Dessel;
- the cases of detection of abnormal radioactivity on the Belgian territory or outside it.

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

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 products, 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 at Gent, FBFC at Dessel, IRMM at Geel,...).

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 under the leadership of the Governor of the Province concerned.
In addition to the duties defined in the Royal Decree of 27 September, the Federal Agency for Nuclear Control (FANC) is 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 article 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 of the emergency plan.

6.5.2 Implementation of emergency organisation in the event of an emergency

6.5.2.1 Classification of emergencies

The Royal Decree of 27 September 1991 defines four levels for notification of emergencies, which are in ascending order of seriousness N1 to N4, which the operator must use when warning the "Centre Gouvernemental de Coordination et de Crise - CGCCR " (i.e. the Governmental Co-ordination and Crisis Centre) which is composed of several units, called "cells", under the authority of the Minister of Internal Affairs.
For each of these 4 notification levels (N1 to N4) the notification criteria are defined in the Royal Decree of 27 September 1991. In addition, for each concerned nuclear installation, a set of particular types of events is established for each of the notification levels.

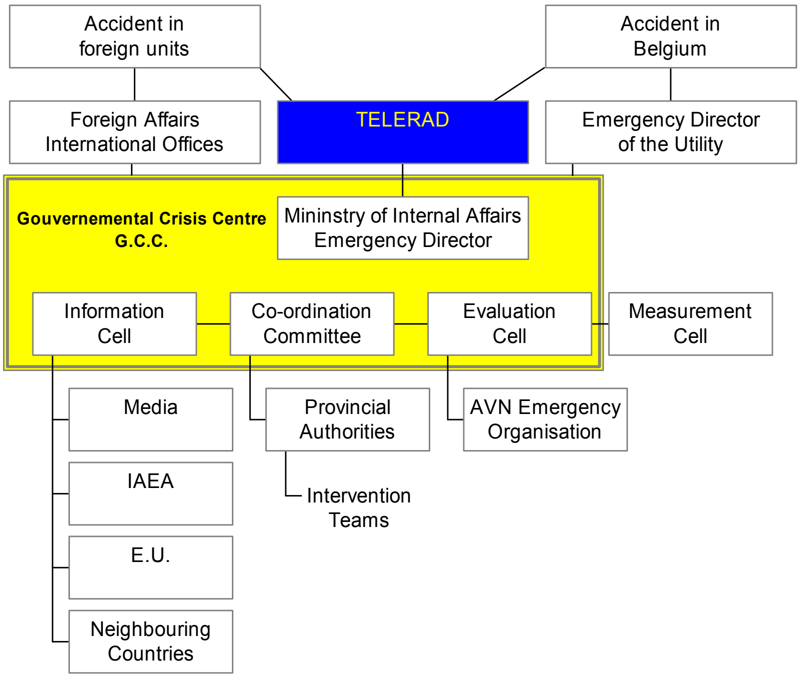
For example, the criterion associated with the N1 level is defined as follows: "Event which implies a potential or real degradation of the safety level of the installation and which could further degenerate with important radiological consequences for the environment of the site. Radioactive releases are still small and there is thus no danger for the environment of the site. The on-site emergency plan is put into action."

In addition to these four levels, a "N0" level is defined for notifying the Authorities in case of an operational anomaly. This level does not activate the off-site emergency plan.

The "Emergency Director" of the Authorities transforms the notification level into an alarm level (U1 to U4), putting into action the corresponding organisation of the off-site Emergency Plan.

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 several units : 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", as indicated in the figure below.



In case of an accident abroad, the information is channelled to the Ministry of Foreign Affairs which informs the CGCCR. In addition, the quick exchange of information systems in case of a nuclear accident developed by the IAEA and by the European Union (Ecurie) is another source of information for the CGCCR.

In case of an emergency in a Belgian nuclear installation, the licensee's "Emergency Director" should inform the CGCCR and supply all the information that becomes known to him as the situation evolves.

The data received through Belgium's Telerad automatic radiological monitoring network can also be used by the CGCCR. 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, 183 measurements, from 183 detectors, of ambient radioactivity in air and water

are collected, treated and sent to the computer server located at the FANC. The monitoring of the general territory consists in a measurement network having a 20 km mesh (76 air dose rate counters, 7 initiating alarms stations measuring activity α and β and iodine in aerosols, 9 meteorological masts). Besides, around the Belgian nuclear sites, the network consists 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, in the vicinity of foreign nuclear power plants (Chooz, Gravelines, Borssele).

The "Evaluation cell", chaired by the FANC, is composed of representatives or experts from relevant ministerial departments, state organisations, AVN or other technical organisations (nuclear research centre SCK•CEN, the "Institut de Radioéléments" IRE, …) and a representative of the licensee. The evaluation cell has to evaluate the situation on the radiological point of view, based on the information coming from the affected site, from the measurement cell and from organisations represented within the cell, in order to advise the Co-ordination and Crisis Committee over the protective measures for the population and the environment. The recommendations about the measures to be taken to protect the population and the environment are elaborated on the basis of pre-established intervention guidance levels. These guidance levels are given in the text of the Royal Decree of 27 September 1991.

The "Measurement cell", also chaired by the FANC, co-ordinates all the activities aimed at collecting the radiological information, based on various radiological measurements in function of the various exposure modes (external radiation, deposits, samples measurements, …). 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 (EU Commission, IAEA), and the neighbouring countries.

The "Co-ordination and Crisis Committee" immediately meets as soon as the Emergency Director of the Authorities decides a U2 (or higher) alarm level. Based on the advices from the evaluation cell the Committee decides about the necessity (and their extents) of protection measures for the population and/or the food chain or drinking water supply, and manages the (federal and provincial) Authorities intervention during the accident. The decisions are then transmitted to the Provincial Crisis Centre to be implemented by the different emergency services (fire brigade, police, emergency medical services,…).

The Royal Decree of 27 September 1991 defines the emergency planning zones relative to the direct measures to protect the population (evacuation, sheltering, stable iodine intake).

The size of the emergency planning zones varies from 4 to 10 km radius in function of the concerned nuclear installation.
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, investments 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 should issue an on-site emergency 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 in the Royal Decree of 27 September 1991.

The General Directorate of the Civil Protection of the Ministry of Internal Affairs organises once a year and for each nuclear site concerned 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 a scenario adequate to these objectives.

During the exercises, the information corresponding to the scenario is gradually forwarded to the various participants; the Training Centre simulator may in certain cases also be used as a source of information.

Information exchange at international level is performed through the Governmental Co-ordination and Crisis Centre (CGCCR), which has contacts with the competent Authorities of the neighbouring countries, and which is the "national contact point" for Nuclear Accident Early Notification Convention (IAEA) for the similar European Union system (ECURIE).
Agreements also exist at local and provincial level. The protocol Agreement between the province of "Noord Brabant" (The Netherlands)) and the province of Antwerp (Belgium) provides for a direct line between the alarm station of Roosendaal (The Netherlands) and that of Antwerp, informing it as soon as the alert level U2 notification is decided. This direct line is also used when certain accidents occur in the chemical industry (installations subjected to the European post-Seveso Directive). A direct information exchange can also take place between the alarm station of Vlissingen (The Netherlands) and that of Ghent should an accident occur at the Borssele nuclear power plant. For the Chooz 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 French Republic Government and the Kingdom of Belgium Government about the Chooz nuclear power plant and the exchange of information during incidents or accidents, a mutual alarm is foreseen between the two countries in case of an accident occurring in the nuclear power plants at Tihange, Chooz or Gravelines. This alarm takes place between the CGCCR on the Belgian side and the CODISC ("Centre opérationnel de la Direction de la sécurité civile" which has now become the "COGIC","Centre opérationnel de gestion interministérielle des crises") on the French side. A specific memorandum of application of the above mentioned French-Belgian agreement will, in the future, fix a full communication path and procedures between the competent authorities in case of radiological emergencies. It take due account of experience gained from bilateral exercises.

During the exercises of Chooz (June 2000) and of Gravelines (May 2001) that transborder 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, AVN on the Belgian one) 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, AVN which oversees the affected installation sends a representative to that site, a representative to the evaluation cell of the CGCCR,

and activates its own 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, AVN 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 AVN 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 Euratom 89/618 Directive. During the accident itself, information is supplied to the media by the information cell of the CGCCR. At local level the provincial emergency plan includes the ways to inform the population (sirens, police equipped with megaphones, radio and television) and following-up the instructions given to the population (iodine tablets, sheltering, evacuation, etc.).

Note
The Royal Decree of 27 September 1991 is under revision. The major changes proposed by an expert group during the revision process are the following:

- setting up within the CGCCR of a socio-economical cell in charge of advising the co-ordination and crisis committee about the socio-economical repercussions of the taken or to be taken decisions;
- removal of the notification/alert level N4/U4 replaced by a new NR/UR level. This “reflex” level aims for setting up of automatic protective measures in a pre-defined zone in the case of event with quick evolution awaiting the setting up of the crisis cells and committees;
- general evaluation report to be issued yearly from experience gained from exercises. This general report should include a derived action plan.

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 agreement of decommissioning programmes,
- 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 the State Secretary for Energy and Sustainable Development 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.

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 no final shutdown is 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 final shutdown of the facility or part of the facility.

6.6.2.2 Decommissioning programmes execution

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, Belgoprocess1 (BP1), Belgoprocess2 (BP2) and IRE.

A management structure defining the responsibilities of the different parties involved has been set up for each of the liability funds within the conventions.

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. 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 under decommissioning;
- 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 the management structure as defined by the convention. These activities are in line with the decommissioning plans which were elaborated by SCK•CEN for these installations and were 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 installations are located on the two BELGOPROCESS nuclear sites in Mol and Dessel.

The former EUROCHEMIC facilities cover:

- the reprocessing plant which is under decommissioning since 1986;
- the vitrification plant PAMELA. As the last vitrification operation took place in September 1991, this installation is now used for the cementation of medium-level metallic waste arising from the dismantling of the BR3 reactor internals and vessel.
- the bituminisation plant EUROBITUMEN which is still in operation;
- 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 programs and budgets which have to be approved by the management structure as defined by the convention.

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 in 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 by the Belgian State. For these facilities, decommissioning and site remediation or, in one specific case, waste and spent fuel management, are financed by means of annual endowments received and managed by ONDRAF/NIRAS. The amounts of the annual endowments are based on preliminary cost assessments and are each guaranteed by a convention signed between the Belgian State, the utilities and ONDRAF/NIRAS.

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). Financing of these activities are covered by annual endowments until the year 2000. The mechanisms of financing and the annual endowments after the year 2000 are still not completely solved.

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).

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. 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).

7.1.1.2 Containers in building SCG (Doel)

Containers:

The storage containers are designed in such a way that the residual decay heat can be 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 sort of container), in order to guarantee in the long term the fuel integrity. The data used for the sizing 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, we obtain a K_{eff} lower than 0.95 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 sized to remove through natural circulation the calories produced by all the storage containers stored in the building.

The equivalent dose rates due to neutron and gamma-radiation have been calculated inside and outside the storage building when it is fully filled with the number of containers planned during the design phase. In order to calculate a level higher than the dose rate, it was supposed that each container did not go lower or higher than 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 proved 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 intermediary 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 system.
This last, named 'raw water system' (CEB), cools down the heat in the CRI system with water pumped in 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 licensed 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 norms and 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 seismic designed and must resist 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 admission is controlled.
- The mechanical and electrical systems and the instrumentation are qualified for their specific use.
- The shields and other measures (i.e. 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 regulation 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 intermediary 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 norms and 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.

7.1.1.5.2 Intermediary storage building SCG

At Doel, the intermediary storage safety functions are fulfilled for the most part by the storage containers. The storage containers are licensed for highway transport and comply therefore with the IAEA regulation, standards and criteria.
Each container is accompanied by a multilateral certificate proving the conformity with the IAEA regulation. The certificates are confirmed by the regulatory body.

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 intermediary storage safety 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 admission inside 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 necessary measures to comply with the regulations in force, including the recommendations formulated by the International Radiological Protection Commission and by the International Agency of Atomic Energy. From now on, financial means are set up for the future execution of the spent fuel management plan.

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.

Radioactive 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 nearly uncoupled neutronically. The distance between surfaces (75mm) is sufficient to avoid forming a critical mass, 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 $k_{eff} < 0.90$ 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.

A fractional 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 a loss of integrity of the dam, there is still minimum 2.2m water into the side-pools: 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 appropriate to investigate and improve the safety level of the spent fuel management installations are:

7.2.1.1 Ten-yearly safety reviews

The Licence Decree of each Belgian nuclear power plant makes it mandatory to conduct ten-yearly safety reviews starting from the inspection acceptance (delivered during the first operation at full power).
As a result, the operator and AVN 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 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:

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

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 AVN 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 licence application under the provisions of Article 12 of the GRR-2001. The safety analysis performed by AVN is presented to the FANC, and a rider will be established to the Licence Decree (Royal Decree). The implementation of that modification will be authorised by the unit's HPD and by AVN.
- the 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 for example, 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 an AVN's inspector, and if necessary by AVN's Technical Responsibility Centres (TRC), which may result in amendments being ordered to the modification file. When AVN deems that the file is acceptable, it approves the modification application, and the implementation may begin. 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, plus updating of the operation documents. AVN delivers a final acceptance report (operating licence) 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 it deems it necessary.
- modifications without impact on safety, that usually do not imply modification of the Safety Analysis Report and which are conform to all the safety rules of the installation. These modifications have to be approved only by the Health Physics Department of the unit, without formal involvement of AVN.

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 periodicity.

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 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 in function of the real operation conditions and location of that equipment.

7.2.2 SCK•CEN site: BR2

Additional information may be found in appendix 4

The appropriate steps to investigate and improve the safety level of the spent fuel management installations are:

7.2.2.1 Ten-yearly reviews

The Royal Decree granting the licence 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 (delivered 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 installations, a joint report is established with AVN 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:

- demonstrate that the installation i.e. spent fuel management installations, has at least the same level of safety as it had when the licence was delivered to operate it;
- 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;
- 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

During the operation of the installations, the 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 conformity with the description on the licence documents;
- To guarantee a safe and reliable operation.

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

Overview

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

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

- Either sufficiently small (GRR-2001 art. 12);
- Or having no decreasing 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 if it fits within the framework of the special licence conditions, implying thus that no new or supplementary licences are needed.

Modifications having a potential impact on the safety level and on the reactor need to obtain the approval of the “Committee COP-RVC” next to the approval of the recognized organisation .
The final approval has to be given by the Department Head BR2.

7.2.2.3 Surveillance programmes

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

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

The periodicity needs to be guaranteed in function of 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 lessening of the frequency is only admitted if no regulations or licence requirements are thereto opposed.

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 PERIODICAL INSPECTIONS		
Safety	CLASSICAL/NUCLEAR	
Periodicity	>=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 / Norms / IAEA Safety Standards	

Occasional inspections

Non-periodical inspections are also possible, e.g. on demand of a thereto AVN or FANC, or on the own initiative of the HPD.

Inspections before operation

The company sees to it that the products, machines, devices, installations, equipments, etc.. delivered, are not being used or processed before it is assessed that they meet the safety requirements prescribed;

The entrance inspection can range from an ordinary identity control of the delivered product 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 in Doel and Tihange

7.3.1.1 Siting

Characteristics taken into account for the selection of the sites

The Doel and Tihange nuclear power sites were originally evaluated according to the requirements set by the US rules (Chapter 2 of the Safety Analysis Report, Standard Review Plan, 10 CFR 100). These requirements apply to the phenomena of natural origin (earthquakes, floods, extreme temperatures,…) and to the phenomena of human origin (industrial environment, transports,…).
With regard to the natural phenomena:

- The geological and seismic characteristics of the sites and their environment were specifically investigated in order to identify the soil characteristics and the earthquake spectrums that must be considered when sizing the structures and systems.
- The hydrological characteristics of the rivers Meuse and Scheldt were surveyed, not only to quantify the risk of floods and possible loss of the heat sink, but also in order to develop the river flow models in order to evaluate the impact on dilution of released liquid effluent.
- Meteorological and climatic surveys 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 detailed criterion was imposed originally. But the design of the installations made allowance for the existing situation: the "low population zone" of the USNRC rules is in fact within the site. Consequently the radiological consequences of incidents or accidents are calculated for the critical group living at the site border or in any other location outside the site where the calculated consequences are the 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 intensity. This value increased to 0.17 g following the Tihange 2 safety analysis (end of the seventies). As a consequence, the latter value was adopted for the site as a whole; it did not need to be modified when the earthquake that occurred in Liège in 1983 was analysed.
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 taking into account the environment of the site with respect to the risks resulting from transport, aircraft or industrial activities.

International agreements

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

7.3.1.2 Measures

The appropriate measures to ensure that such facilities have not unacceptable effects on other Contracting Parties are enumerated 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.

The earthquake mentioned in the text occurred on 11 June 1938, in the massif of Brabant. The epicentre was located in Zulzich-Nukerke (geographical co-ordinates: Lat 50.783N; Lon 3.58E).

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

The magnitude was 5.9 and the depth of the hypocenter 24 km. The intensity in the epicentre was VII (MSK) with a macro seismic region of 340 km. In the region of Mol, an intensity of IV was observed.

In the new operating licence, issued after the safety review of 1986, a study of the protection against earthquakes was requested. The definition of the reference earthquake has 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 after 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 calculated 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 dating from 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 plunged into the cooling pools of the units for radioactive decay.
The intermediate storage capacity of spent fuel assemblies had to be substantially improved to cope with the stoppage of the transfer of spent fuel to the reprocessing plants. A storage building was erected on each site. These buildings are designed to receive and store under water (building DE-Tihange; see § 7.4.1.1.2. hereafter) or in shielded container ('dry storage' -building SCG-Doel; see § 7.4.1.1.3 hereafter) discharged spent fuel coming from the units.
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 plan 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, every penetration 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 as low as reasonably achievable the exposure of the workers, is applied.
The GRR-2001 requirements are complied with.
As already mentioned, this regulation imposes the following limits:

- workers exposed to radiation must not exceed a radiation dose rate of 20 mSv/year;
- the general public must not exceed a radiation dose rate of 1mSv/year;

The following positive steps 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 pools are laid out 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 general public against the radiation of the sources present in the building and this in normal conditions as well as in accidental conditions.

7.4.1.1.2 Building DE (Tihange)

7.4.1.1.2.1 Protection steps 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 similar to the containers licensed for the transfer outside the site.
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 § 7.4.1.1.1.
The design of building DE also meets the requirements of the EU Directive 96/29/EURATOM of 13 May 1996 laying down 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:

- Control the background 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 ;

- Control 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 slight negative air pressure with respect to the outside air;
- Releasing the air extracted in building DE trough the chimney of unit 3;
- Transferring in the air the heat generated by the motorpump 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 the 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 grant admission 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 any internal or external event.

7.4.1.1.2.4 Release of effluents in the environment

<u>Radioactive release in the air in normal operational conditions</u>

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 release chimney of the Tihange unit 3. The gaseous effluents of building DE are controlled and listed by the existing control chains in unit 3.

<u>Release of radioactive liquid effluents in normal operational conditions</u>

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 undergo a treatment by evaporation.

The pool water of building DE is mainly contaminated by activation products (^{54}Mn, ^{58}Co and ^{60}Co) that can break loose from the external surface of the cans during the handling of the assemblies under water. This contamination is (at 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 buildings DE. This results in a substantial reduction of the activity of the residual deposits arising from the activation products (radiological decay nearly total 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.

Disposal of solid radioactive waste

The solid waste that are being produced by the building DE spent fuel storage pools operation 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 intermediary storage building does not create other categories of radioactive waste than these that have already been treated in the context of the energy generating units operation.

7.4.1.1.2.5 Non-concerted releases of radioactive effluents

Non concerted releases of radioactive effluents in the environment results mainly from incidental or 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 divided in two subgroups:

- the AEO resulting from natural phenomena: earthquake, violent wind and tornado, including the projectiles and flood.
- les 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 following their probability of occurrence:

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

- Accident of a falling spent fuel assembly; in the American regulation, this accident is considered as a designing 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 investigation takes into account the fall of a fuel assembly being handled, leading to the rupture of every fuel rod.

This accident leads in the pool water 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, that is to say 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 corresponding routine discharge limits of 50 µSv/year for the whole body and 150 µSv/year for any organ of the most exposed people.

7.4.1.1.3 Building SCG (Doel)

7.4.1.1.3.1 Protection measures against radiations

Building SCG is an isolated building only used for intermediary storage. It consists of a dry storage in containers qualified for highway 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. For that reason, the design of the building does not take into account the occurrence of discharge.

Building SCG is composed of a preparation hall and a storage hall. The latest 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 remote-controlled bridge.

The design of the containers ensures the appropriate biological protection of the staff. The containers comply with the dose rate criteria settled in the international regulation (IAEA SS-6), i.e. 2 mSv/h contact dose rate, 0.1 mSv/h dose rate at 2 meter.

A redundant barrier has been designed in the primary lid in order to prevent leaks. This barrier is continuously controlled throughout the storage of the container in the storage hall. As regards exposure of the personnel and the population, only the radiation must be taken into account since there is no discharge.

The ALARA principle, which consists in keeping as low as reasonably achievable the exposure of the workers, is applied.
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 limits:

- workers exposed to radiation must not exceed a radiation dose rate of 20 mSv/year;
- the general public must not exceed a radiation dose rate of 1mSv/year;

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

- Use of a remote-controlled bridge in the storage hall.
- Use of a biological shielding (concrete)
- 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 wall of the building is designed in such a way 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 integrated 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 monitoring system ensures an overpressure between both seals in such a way that a leak in the container is not possible.

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 if 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
- tilt of a container by 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 have been checked for the accidents. The criteria set in the IAEA regulation and in the national and international regulations on the protection of the population are largely met.

7.4.1.2 Decommissioning

Regarding the decommissioning aspects of the spent fuel management installations, note that de decommissioning phase should not raise any particular technical problem given the preliminary decommissioning plans already examined and the experience feedback (cf. art 9, § 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 employed 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 adapted to the risk. These assessments cover its lifetime.
The applicant for the licence 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 examined by the Regulatory Body and give rise to an intense exchange of questions and answers. The resulting information and data is 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 the modifications 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 overhauls/safety reviews,
- follow up all the recommendations made in the "Safety Evaluation Report" established by AVN and which gives a synthesis of the performed safety analysis. AVN is responsible for assessing the satisfactory nature of the responses 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 licence 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 licence is signed by the King after it has been investigated in detail by the Regulatory Body and the Scientific Council of the Federal Agency for Nuclear Control.
The commissioning test programme is discussed and approved by AVN, which follows-up the tests, evaluates the test results, verifies the conformity to the design and issues the successive operating licences that allow 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 AVN and sanctioned by a Royal Decree granting an operation licence (cf. Section E, art. 19, § 5.3.1.1).

7.6.1.2 Operational limits and conditions

As described before, the Technical Specifications are approved in the licence (chapter 16 of the Safety Analysis Report). They specify the operational limits and conditions, the availability requirements 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 respect of the Technical Specifications (T.S.) for maintenance activities during plant outage and plant operation. Each maintenance procedure has its own paragraph dedicated to T.S. requirements and limitations. During plant outages, some safety engineers are monitoring the requirements of the Technical Specifications.
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 in the scope of the licensing process and the acceptance of the installations by AVN. 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, defined in chapter 13 of the Safety Analysis Report, must be maintained throughout the useful life of the power station, and even after its definitive shutdown as long as this new status is not covered by a new licence.
From an engineering point of view, the licensee gets the help of Tractebel Engineering (TE). TE has indeed an excellent knowledge of the installations as it was the Architect-Engineer during 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 to keep up the competence and knowledge of the installations. The advice of 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 competency 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 competency 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 AVN and/or the FANC, indicating for each notification within what delay it must be notified.
The same section also specifies the cases where incident reports must be supplied to the Regulatory Body, and within what period of time.

For each incident, a classification with reference to the INES international scale is proposed by the operator discussed with AVN, and decided by the FANC.
The IRS reports are established by AVN for the incidents that this body deems interesting and transferred for commentary to the operator and to the FANC before it is spread 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 licence decrees 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 AVN, to systematise experience feedback and facilitate the link with the safety analysis.
No incident, even a minor one, took place in the spent fuel intermediate storage installations in Belgium.

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 for 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 every 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 licence 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 licence. They specify the operational limits and conditions, the availability requirements 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 AVN.

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 station, and even after its definitive shutdown as long as this new status is not covered by a new licence.

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 notes "start-up".

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

During the summer months of 1994, the water of the channel became turbid. The hydraulic channel at BR2 is the storage place of irradiated tests and irradiated fuel in awaitance of 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 20m^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/cm² 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 operators 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 (i.e.

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 board in the reactor control room, new regulation of the primary temperature, emergency panel in the reactor control room - during the refurbishment.

These measures added to the maintenance of a stable and uniform operating team for the years to come constitute the best way to guarantee and optimise a safe – though decreasing –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 Passive 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 BR2 is covered by this fund.

An initial decommissioning plan was worked out for BR2 and agreed 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 treated 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 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 on request of the Belgian Government submitted to an international Peer Review by NEA/OECD in 2002. The final report of the International Review Team will be 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-level and short-lived waste the national disposal programme, under the responsibility of ONDRAF/NIRAS, is in a pre-project phase, and the construction and operation of a disposal facility (at the surface or in deep geological layers) could be planned around 2015 - 2020, depending on the technical option chosen, i.e. surface or deep disposal.

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

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 containment*** *or passive safety.*

[5] IAEA Safety Series No. 99, Safety principles and technical criteria for the underground disposal of high-level radioactive wastes – Safety Guide, Vienna 1989.

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 (0.1 to 0.3 mSv/year) imposed by the regulator (see also section E, Article 19) and that all reasonable efforts have been done to optimise protection (ALARA principle).

On a more technical level, a series of design requirements have been defined. For a reference disposal system for high-level and long-lived waste and spent fuel in a deep geological clay formation, these design requirements affect different aspects of the disposal solution:

- Design requirements related to long-term radiological safety: providing long-term safety by a multi-barrier concept (with a series of natural and man-made barriers) and by implementing the long-term safety functions of the disposal system, i.e. "physical containment", "delaying and spreading the releases" and "limitation of access".
- Design requirements related to long-term radiological safety assessment: by enhancing the robustness of the disposal system (as a whole or of its components), the ability to assess the long-term safety of the disposal system is also enhanced;
- Design requirements related to safety during the operational phase;
- Design requirements related to minimising the potential for criticality;
- Design requirements related to minimising the non-radiological impact on the environment, including e.g. the chemotoxic and thermal impact on the environment;
- Design requirements related to maintaining the flexibility of the solution, i.e. in the stepwise approach to disposal, technical and managerial decisions can easily be reversed if needed, or new knowledge can be integrated in the solution;
- Design requirements related to other choices which society must or can make, such as retrievability.

These design requirements are an integral part of the safety strategy which, in turn, has a dual aspect:

- The strategy for **ensuring** a safe solution, both during the operational phase and during the period after the repository is closed;
- The strategy for **assessing** the safety of the solution.

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 interim storage facility and 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 set out 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 licences of the nuclear installations concerned (mainly interim storage facilities), the General Rules and ONDRAF/NIRAS's own acceptance criteria.

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 safety level to the population, the workers and the environment during those radioactive waste processing/conditioning 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/conditioning 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/conditioning 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 biological, chemical and other risks that can be linked with radioactive waste management.
- Some obligations must be respected 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/conditioning 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 licence

[6] Royal Decree of 28 February 1963 (GRR-1963) providing the General Regulations regarding protection of the population and workers against the dangers of ionising 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 licence 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 (500m 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 and an evaluation of the critical mass,

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 control stations to measure the radioactivity levels in air; a description of the volumes and masses of solid waste to store.

h. Protection steps for the personnel working in direct contact with radioactive materials,

i. Staff qualification and competencies.

Before the licences are granted, this safety analysis report is analysed by the competent authorities and by the Special Commission (recently renamed ‘Scientific Council’) which can consult national and international experts.

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

The revision of the Royal Decree 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 licence application. According to the date of the licence application, only building 155 and the HRA-Solarium processing and conditioning installation were to comply with this obligation to add a detailed environmental impact assessment to the licence application.

[7] The building licence can be granted on the basis of a Preliminary Safety Analysis Report (PSAR) whereas the operating licence 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 licence application.

8.2.2 Regulation enforcement

AVN performs the acceptance inspection of the installations, including verification if the rules and the cold tests are respected. 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 experts from an authorised inspection organisation. During the operation, an authorised inspection organisation must also control the respect of the rules, in accordance with the regulations in force. It can propose any modification to improve the safety level of the installations.

Belgoprocess is implementing a wide programme to measure the liquid and gaseous discharge in the environment and the water quality of 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. radiation on 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 "milieu-jaarrapport"(annual environmental report).

Moreover, the regulatory body also take some control samples.

In 2001, Belgoprocess discharged nearly 28 000 m³ purified waste water, that is to say 23 % of the authorised volume. The total weighted radioactivity of this discharge amounted to 5.25 GBq (99.9 % of the total activity arose from H^3), that is to say 0.29 % of the authorised value whereas the impact of the dose per inhabitant was assessed to 0.09 µSv/year. The biological indexes show that the discharge has no impact on the biological quality of the river Molse Nete water.

If necessary, installations where radioactive waste is stored or processed and conditioned are kept in underpressure by a ventilating 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 2001 amounted to less than 2% (1.2 MBq alpha emitters and 1.02 MBq beta emitters - ^3H not included) of the authorised limit. For ^3H, the activity of the discharge amounted to 0.2 GBq (0.02 % of the authorised limit). A mathematical model is also used for assessing the exposure of the inhabitants living around the Belgoprocess sites. It represents a value of 0.005 µSv/year for the critical person (fictive person standing 500 meter from the most exposed place of the Belgoprocess site 2).

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 only values lower than the natural radiation level of the region (up to 60 nanosievert/hour for site 1 and 200 nanosievert/hour for site 2). Therefore, the radiation level measured has no impact on the population.

8.2.3 Storage buildings for conditioned waste on the Belgoprocess site

Hereunder, the storage buildings for conditioned waste on site 1 of BELGOPROCESS are briefly described. It concerns the buildings 127, 129, 136, 150, 151 and 155 (further abbreviated as B127, B129, etc.). This illustration focuses on the acceptance criteria for waste.
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 1 describes the applicable conditions (with regard to the radioactivity) for the storage of the packages for the different buildings while **Table 2** is directly taken from the applicable safety reports of the buildings.

Table 3: Acceptance criteria/conditions with regard to radioactivity

B 127
1. The contact dose rate has to remain below the limit of 2 Sv/h. A package with localized contact dose rate exceeding the (maximum) limit value may, in close consultation with the Health Physics Department and possibly with the authorized inspection organisation, be accepted on the condition that the criterion regarding the dose rate on a 1 meter distance is observed (< 0.2 Sv/h). 2. The volume-activity concentration of alpha emitters in the primary package is limited to 50 GBq/m3 and of beta emitters and gamma emitters to 37 TBq/m^3. 3. the removable surface contamination of the primary package needs to be below 0,4 Bq/cm2 for alpha emitters; 4 Bq/cm2 for beta and 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 contact dose rate has to remain below the limit of 5 mSv/h. A package with localised contact dose output exceeding the (maximum) limit value may, in close consultation with the Health Physics Department and possibly with the authorized inspection organisation, 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/cm2; that of beta/gamma surface contamination below 0.4 Bq/cm2. 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 contact radiation (dose rate) has to be below or equal to 5 mSv/h. If the contact radiation exceeds 5 mSv/h, the radiation on a 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/cm2; that of beta/gamma below 0.4 Bq/cm2. 5. ^{226}Ra en ^{232}Th should not exceed their natural concentrations.
B 155 RAGAL
1. The contact radiation needs to be below or equal to 5 mSv/h. If above 5 mSv/h, the radiation at 1 m needs to be below 0.5 mSv/h. 2. The removable alpha surface contamination needs to be below 0.04 Bq/cm2 while the transferable beta/gamma surface contamination needs to be below 0.4 Bq/cm2. 3. The alpha activity concentration needs to be below 4 GBq/t. The maximum alpha Radium concentration needs to 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, dependent on type of waste.				
B 136				
Maximum dose rate on outer walls of building: 20 µSv/h.				
	Vitrified waste	Cemented waste		Bituminized
	High active solutions	Hulls and end pieces	Technological waste	Process
Dose rate (Sv/h) D (contact) D (1 meter)	 1.4 E4 420	 < 75 < 4.6	 < 4 E-2 < 1 E-2	 < 10 0.45
Activity per primary package (TBq) Beta/Gamma Alpha	 2.8 E4 141	 800 < 0.89	 0.74 < 0.74	 19 < 0.15
Removable surface contamination (Bq/cm^2) Beta/Gamma Alpha	 < 4 	 < 4 0.4	 < 4 < 0.4	 < 4 0.4
B 150				
Maximum dose rate in contact with vessel: 5 mSv/h, exceptionally, 10 mSv/h. Per package maximum alpha activity up to 2E9 Bq and maximum beta activity up to 3E12 Bq, dependent on type of waste.				
B 151				
Maximum dose rate in contact with vessel: 5 mSv/h, exceptionally, higher if value at 1 m is below 0,5 mSv/h is. Maximum alpha activity 4GBq/t, except for 160 vessels from historical production,< 75GBq/t. Maximum beta activity up to 3E12 Bq/vessel, dependent on type of waste.				
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 for the processing/conditioning 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 and conditioned in these installations, the following limits apply:

- Maximum dose rate at the surface of the primary package and of the transport package may not exceed 2 mSv/h.
- Level of removable surface contamination of primary package may not exceed 4 Bq/cm² for beta-gamma emitters and weak radiotoxical alpha emitters and 0.4 Bq/cm² for other alpha emitters.
- Regarding solid beta-gamma waste, the activity may not exceed 40 GBq/m^3 (average 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 may not exceed 40 GBq/m^3. The alpha-activity may not exceed 10 GBq/m^3.

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

In the installations, the following activities are performed:

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

8.2.5 General description of the building

The building has a surface of 100 m x 65 m and is built on a foundation plate resting at a level of about 0.75 m depth on compact, mainly sandy ground.
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, dependent on the activity areas, while the higher parts have a variable number (two to five) of levels.
The roof is composed of lightweight concrete arches, covered with isolation materials and a density 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.

8.2.6 Radiological protection

The storage of non-conditioned and of conditioned waste as well as the treatment and processing of this waste in CILVA is performed in shielded areas. Entrance to these areas is strictly limited to the necessary operations, provided that the general and specific radiation protection procedures are observed. Involuntary trespassing of these areas has to be avoided. These areas are defined as "processing areas ".
The areas surrounding these areas are, dependent 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 accommodation not permanently occupied	25
IV	Working accommodation permanently occupied	5

It needs to 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 only represent 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, ...).

8.2.7 Confinement

In order to prevent radioactive substances from dispersing, the ventilation is thus designed so that a pressure gradient provides an air current from the areas with a small contamination risk to those with a large contamination risk.
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 leakproof reservoirs, which, in case of a leak, collect all of the liquids stored;
The transport packages are opened under an exhaust hood aspiring in all of the aerosols and deposing them then onto filters.
The opening of the primary package and the manipulations of the waste are performed either in glove boxes or in adapted areas.
The standard 400 l vessels 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 outward contamination of the vessel. This lock is kept in underpressure by means of a specific ventilation system with a prefilter and an absolute filter.

8.2.8 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.

8.2.9 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, faucet filters of the ventilation, 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 control is performed with indication of the evacuation.

8.2.10 Radiation control devices

In CILVA a radiation control 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 control in the areas;
- air contamination control;
- control of air evacuated through the chimney;
- surface contamination control;
- surveillance on exposition of personnel.

8.2.11 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 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, as a consequence of the direct radiation as well as of the anticipated dose due to the intake of radioactive substances, as low as reasonably achievable and below the regulatory limits.

8.2.12 Fire protection

Around the building a fire strip of more than 15 m has been deforested.
The protection system is thus conceived to detect the start of a fire and to extinguish a fire, or to limit it maximally.

In the safety assessments, the following accidents were considered;

8.2.13 Accidents considered

In the safety assessments, the following accidents were considered.

Accidents of internal origin

- fall of a package;
- current interruption;
- 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

Nearly the whole of the processing/conditioning installations and storage buildings in Belgium are currently located on both 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). Both "installations" were to comply with the regulations in force at that time for their construction and operation. Next to the licence application necessary for the dismantling of these former installations, changing the use of both sites required new licences (see article 12). Beside safety and security requirements (see above), demographic (population density), topographical, geological, seismological, hydrological and meteorological characteristics and environmental impacts, the procedures require that the licence applications are transferred to the municipal authorities in order to inform the population or any other third party concerned (fire brigade, civil protection, …).

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 establish if it is feasible, both technically and financially, to design and build on Belgian territory one deep disposal solution for the considered waste that is safe, while not prejudging 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 future 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 pre-project phase: sites have been chosen for studying site specific disposal designs with active participation of the local municipalities via local partnerships. In this pre-project phase for category A waste, the two technical options 'surface disposal' and 'deep disposal' are studied in parallel. 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[8] and in the IAEA Safety Guide on Siting of Near Surface Disposal Facilities[9]. For geological or deep disposal, the required site characteristics are in line with those in the IAEA Safety Guide on Siting of Geological Disposal Facilities[10]. The different site specific disposal designs and the sites are studied and evaluated in an integrated way in the safety and environmental assessments that are being conducted (see Article 15). In the subsequent project phase (in case of favourable decisions on the local and national level, from 2005 on), the required safety and environmental evaluations for a licence application will be performed.

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 imposed 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 situation 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.

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,

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8 IAEA Safety Standard Series No. WS-R-1, Near Surface Disposal of Radioactive Waste – Safety Requirements, Vienna 1999.

9 IAEA Safety Series No. 111-G-3.1, Siting of Near Surface Disposal Facilities – Safety Guide, Vienna 1994.

10 IAEA Safety Series No. 111-G-4.1, Siting of Geological Disposal Facilities – Safety Guide, Vienna 1994.

- data necessary to identify and assess the main environmental impact of 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 spare a too heavy financial burden to the next 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 » programme,
- 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/conditioning 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 authorisation 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 support basis for their decision to grant an authorisation for the construction.

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.

The disposal programme for low- and intermediate level short-lived waste is also not yet in a licensing phase, but currently there are safety and environmental assessments being undertaken in the pre-project phase in order to assess the safety of the proposed integrated site-specific repository designs for surface and deep disposal. These safety assessments are also used for preparing the safety and environmental assessments that will have to be carried out during the project phase that requires a licence application. These safety and environmental assessments will have to 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[11]).

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 must be annexed to the building and operating licence applications.
AVN 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 is 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 a authorized inspection organisation with regard to compliance with the regulations and the particular operational conditions set in the licence and to verification of the cold tests. The operating licence is granted if the final acceptance report issued by the authorized inspection organisation is positive.

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 a authorized inspection organisation. Following the experience feedback of any other observation, it proposes - if necessary - the appropriate modifications in order to improve the safety and security level.

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[11] IAEA Safety Standard Series No. WS-G-1.1, Safety Assessment for Near Surface Disposal of Radioactive Waste – Safety Guide, Vienna 1999.

In accordance with the regulations in force, the incidents must be notified to the recognised control organisation and classified with reference to the INES international scale after approval of AVN 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 regulation aspects such as the release limits resulting in modifications for the evaluation 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 with the installation’s operator an agreement to set which information related to the dismantling must be provided to the authorities.

8.7 Article 17: Institutional measures after closure

Not applicable yet for disposal facilities since no specific regulatory measures have been imposed so far, and since one 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 stipulations applying to the transboundary movements of irradiated fissile materials and waste are described in chapter VII of the *GRR-2001*. This chapter stipulates that a preliminary licence is required for every transport. This licence is only granted if it can be proven that the stipulations of the international Conventions and agreements with regard to the transport of hazardous substances[12] are observed.
With regard to the transboundary movements of radioactive waste, the stipulations of chapter IV of this same GRR are applicable, this chapter contains the transposition of Directive 92/3/EURATOM of the Council 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 waste is foreseen.

Momentarily, there are very few transboundary transports of irradiated fuel and waste licenses in Belgium. The only existing licenses are:

- Transfer of irradiated fuel from the Dutch nuclear power plant of Borsele to COGEMA La Hague in France;
- Export of the irradiated MTR fuel assemblies of reactor BR2 from Mol to La Hague;
- Import of vitrified high-level radioactive waste from COGEMA La Hague to Belgoprocess Dessel. This waste is the result of the reprocessing of irradiated fuel of the nuclear plants of Doel 1-2 and Tihange 1 which was transferred previously from Belgium to France;
- Sporadically waste, generated either through the decontamination of materials (e.g. pumps) or as a consequence of melting of radioactively contaminated metal, is imported;
- Sporadically used sources are transported as waste from Luxemburg to Belgium within the framework of the existing convention between Luxemburg and Belgium.

[12] ADR : European agreement on the transport of dangerous goods by road.
RID: the European Agreement concerning the International Carriage of Dangerous Goods by Rail, appendix I to the Convention concerning the International Carriage of Dangerous Goods by Rail (COTIF).
ICAO: Technical Instructions for the Safe Transport of Dangerous Goods, of the International Air Transport Organisation.
IMDG: The International Maritime Dangerous Goods Code of the International Maritime Organisation (IMO).
ADNR: European 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 decommissioned sealed sources. The same conditions and licenses are applicable to these decommissioned sealed sources as those regarding new sources: operation licenses, transport licenses for the transporters 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 transport 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 is finalising a directive 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. Up to now, the radiation threshold defining which sources must be taken into account has not been fixed yet. 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 dangers 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 licence for the holder of a sealed source. The licence will only be delivered 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 licence 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.

11 Section K: Planned activities to improve safety

Most of the issues related the safe management of spent fuel and radioactive waste are dealt with at international level in different groups where the relevant experts panels in the fields are gathered. Belgium is active, and will continue to be, in relevant groups like the Waste Safety Standards Committee (WASSC) of the IAEA, the Radioactive Waste Management Committee (RWMC) of the NEA, or European Union activities. Belgium will also continue to support initiatives like the COWAM project (Community WAste Management) which address the decision making process related to the waste disposal or activities taking place within the WENRA association or at bilateral level.

At national level, as presented in this report, Belgium has developed a full framework to cope with the safe management of spent fuel and radioactive waste. It leads to an efficient and safe treatment of the spent fuel and the radioactive waste. However different issues should or are still to be developed, or could be improved in the future. The local partnerships initiated up to now to address the problem of surface or geological disposal delivered good results and should be further developed in the future. In parallel, licensing procedures of waste disposal should be examined. The present applicable procedures for class I installations licensing does not sufficiently cover all the specific aspects related to disposal installations, in particular those aspects related to the decision making process and the consultation of stakeholder.
The organisations in charge of the management of the radioactive waste (ONDRAF/NIRAS) and of the nuclear safety (FANC and AVN) will further develop their cooperation, in particular through specific agreements.
As explained in the report, the SAFIR-2 report is an important step for the demonstration of the feasibility of geological disposal of radioactive waste including high active waste in Boom Clay. The feasibility will be further investigated, focusing on practical implementation and including remaining R&D aspects.
The continuous improvement of safety will also be pursued by regular inspection and safety studies performed in particular within the legal framework like the decennial safety review of installations.

Progress on those issues will be reported in the 2nd national report edited within the scope of the Joint Convention.

12 Section L: Appendixes

Please see attached document

13 List of abbreviations

ANS: American Nuclear Standards.
ANDRA: Agence Nationale pour la gestion des déchets radioactifs (National Agency for the Management of Radioactive Waste).
AVN : Association Vinçotte Nuclear.
SCK•CEN : Centre d'Etudes de l'Energie Nucléaires/Studiecentrum voor Kernenergie, Nuclear Research Centre, situated at Mol, Belgium).
BP1/2: Belgoprocess1/2.
BS: Basic Standards.
CGCCR: Comité Gouvernemental de Coordination et de Crise,(i.e. the Governmental Centre for Co-ordination 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,(i.e. Franco-Belgian Company for Fuel Manufacturing).
GRR-2001: General Radioprotection Regulation for the protection of the workers, the population and the environment, issued in 2001 by Royal Decree of 20 July 2001.
GRR-1963: General Radioprotection Regulation for the protection of the workers, the population and the environment, issued in 1963 by Royal Decree of 28, February, 1963.
HPD: Health Physics Department.
IAEA: International Atomic Energy Agency.
INES: International Nuclear Event Scale (IAEA).
IRE : Institut des Radio-éléments.
IRS : Incident Reporting System (NEA/OECD-IAEA).
KCD : Kerncentrale Doel (i.e. Doel Nuclear Power Station).
MOX : Mixed-oxide $U0_2$-$Pu0_2$.
NDA: Non Destructive Analyse.
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 Radioactive Afval en verrijkte Splijtstoffen (i.e. Belgian Agency for Radioactive Waste and Enriched Fissile Materials).
Q.M. : Quality Monitored.
R.D. : Royal Decree.
RGPT : Règlement Général pour la Protection du Travail (i.e. Belgium's Occupational Health & Safety Regulations).

SAFIR-2:	Safety Assessment and Feasibility Interim Report 2.
USNRC:	United State Nuclear Regulatory Committee.
TE:	Tractebel Engineering.
TENORM:	Technologically-Enhanced Naturally Occurring Radioactive Material.
WASSC:	Waste Safety Standards Committee (AIEA).
WENRA:	Western European Nuclear Regulator's Association.