Radioactive Waste storage facilities – Involvement of AVN in inspection and safety assessment

R.Simenon and O. Smidts

Association Vinçotte Nuclear (AVN) – Walcourtstraat 148, B1070 Brussels

Abstract:
The legislative and regulatory framework in Belgium for the licensing and the operation of radioactive waste storage buildings are defined by the Royal Decree of 20 July 2001 (hereby providing the general regulations regarding to the protection of the population, the workers and the environment against the dangers of ionising radiation). This RD introduces in the Belgian law the radiological protection and ALARA-policy concepts.
The licence of each nuclear facility takes the form of a Royal Decree of Authorization. It stipulates that the plant has to be in conformity with its Safety Analysis Report. This report is however not a public document but is legally binding. Up to now, the safety assessment for radioactive waste storage facilities, which is implemented in this Safety Analysis Report, has been judged on a case-by-case basis.

AVN is an authorized inspection organisation to carry out the surveillance of the Belgian nuclear installations and performs hereby nuclear safety assessments. AVN has a role in the nuclear safety and radiation protection during all the phases of a nuclear facility: issuance of licenses, during design and construction phase, operation (including reviewing and formal approval of modifications) and finally the decommissioning.
Permanent inspections are performed on a regular basis by AVN, this by a dedicated site inspector, who is responsible for a site of an operator with nuclear facilities.
Besides the day-to-day inspections during operation there are also the periodic safety reviews. AVN assesses the methodological approaches for the analyses, reviews and approves the final studies and results.

The conditioned waste in Belgium is stored on the Belgoprocess' sites (region Mol-Dessel) for an intermediate period (about 80 years). In the meantime, a well-defined inspection programme is being implemented to ensure that the conditioned waste continues to be stored safely during this temporary storage period. This programme was draw up by Belgoprocess[1]-NIRAS/ONDRAF[2].
An extensive investigation programme started in 2003, this in consultation with AVN, due to some problems with non-conform drums in the storage facilities for the low-active conditioned waste.

[1] Belgoprocess : the subsidiary of NIRAS/ONDRAF which ensures the processing and storage of radioactive waste as well as the decommissioning of nuclear facilities
[2] NIRAS/ONDRAF : the Belgian Agency for the Radioactive Waste and Enriched Fissile Materials

1 LEGISLATIVE AND LEGAL SYSTEM IN BELGIUM

The legislative and regulatory framework has been put progressively in place since 1955. The law of 15 April 1994, replacing the law of 29 March 1958, very generally outlines the protection of the population and the workers against the dangers of ionising radiation. The detailed stipulations are given in the Royal Decree (R.D.) of 20 July 2001, replacing the R.D. of 28 February 1963, "providing the General Regulations regarding protection of the population, workers, and environment against the dangers of ionising radiation". The legislative framework thus comprises:

- a set of laws and regulations, concerning the licensing of nuclear installations, the measures to protect the health of personnel and the public, nuclear civil liability, safeguards, nuclear materials transport, waste management, emergency plans, etc.
- a nuclear installation licensing system forbidding to operate an installation without a licence (cf. R.D. of 20.07.2001 and, among other, its Articles 5, 6, 15, 16, 79 as well as all the Articles detailing the technical stipulations),
- a regulatory inspection and evaluation system of the nuclear installations, for verifying compliance with the regulations and conditions set in the licence (cf. R.D. of 20.07.2001, among other its Articles 6, 12, 13, 15, 16, 23),
- measures intended to enforce compliance with the relevant regulations and the conditions set in the licence, including the suspension, amendment or withdrawal of licence (cf. R.D. of 20.07.2001, among other its Articles 5, 12, 13, 16).

The licence of each nuclear facility takes the form of a Royal Decree of Authorization. It stipulates that the plant has to be in conformity with its Safety Analysis Report (SAR), and that only minor modifications are allowed without a formal licensing process (minor modifications are defined as those having either no impact on the safety, or that are safety improvements). This means that the SAR (which however is not a public document) is legally binding, that no exemptions are allowed, but that the SAR can be modified if the modification is minor and if it is approved by the authorised inspection organisation (for example AVN). Important modifications must go through the whole licensing process. No time limit is mentioned in the licence, but a periodic safety reassessment is required every ten years.
The law of 15 April 1994 has created the Federal Agency for Nuclear Control (FANC) and defines the missions entrusted to this agency, regrouping most of the activities previously held by the relevant Ministries. The various Articles of that law were gradually brought into force as needed, and the FANC became completely operational on 1 September 2001. According to the law of 15 April 1994, the FANC appoints the Authorised Inspection Organisations (AIO) in charge of the regulatory inspections of nuclear installations.

2 STORAGE FACILITIES OF CONDITIONED RADIOACTIVE WASTE

Belgoprocess, the subsidiary of NIRAS/ONDRAF (national agency for the radioactive waste and enriched fuel), ensures the processing and storage of radioactive waste as well as the decommissioning of nuclear facilities (e.g. Eurochemic, the former reprocessing facility of spent fuel).
All the conditioned waste that is produced in Belgium will be stored on the site of Belgoprocess (region Mol-Dessel), till it is transferred to the final disposal facility (yet to be created).

No specific regulation is available for the management of long lived radioactive waste the disposal solutions of which are yet to be defined. Today it is only based on the regulations for the storage buildings with a temporary function for the long-lived radioactive waste.
The solutions for the disposal are under study by NIRAS/ONDRAF. It is responsible for the long-term management of all the radioactive waste. The acceptance criteria for disposal (waste package, storage design criteria) have to be established by NIRAS/ONDRAF. The Federal Agency of Nuclear Control (FANC) has the duty to check whether they comply with the general rules approved by the regulatory authority.

Important to mention is at the end of 2001 the publication of SAFIR 2, providng the Belgian status concerning R&D for long lived radioactive waste disposal.

Overview of the storage facilities for conditioned radioactive waste at the site of Belgoprocess and the storage facilities for spent fuel:

2.1 Storage of conditioned low radioactive waste

About 13000 m^3 of low-active conditioned radioactive waste is stored in two buildings (150 and 151) on site 1 of Belgoprocess. Building 155 entered into operation at the start of 2005. This storage building was designed for the interim storage of radium containing and other alpha-contaminated conditioned waste with geological disposal as the final goal. In 2005, about 100 m^3 was stored on an interim basis in building 155.

2.2 Storage of medium-radioactive conditioned waste

About 4000 m^3 of medium-active conditioned waste is stored in the bunkers of building 127 (Eurostorage building on site 1 of Belgoprocess).

2.3 Storage of high-active conditioned waste

The volume of about 253 m^3 vitrified high level waste from reprocessing of Belgian spent fuel at Eurochemic (B) and Cogema (F) is stored in two storage buildings (buildings 129 and 136 on site 1 of Belgoprocess).
The twelfth transport of vitrified waste from COGEMA in La Hague, France, was received in the building 136 in September 2006.
This High-active conditioned waste accounts for over 98% of all radioactivity in storage at Belgoprocess and just 1.4% of its volume.

2.4 Spent Fuel storage

Irradiated fuel storage facilities in Belgium involve:

- pool storage of fuel elements at the NPP (Tihange),
- dry storage of intact fuel elements at the NPP (Doel) and at Belgoprocess (storage of the fuel of the BR3-reactor in Castor casks).

At the present time, the reprocessing of spent fuel (e.g. at Cogema) has been suspended by the Belgian government. The installations of the Eurochemic plant are in a status of dismantling.

3 SAFETY ASPECTS FOR A STORAGE BUILDING

Chapter III "General Protection" of the R.D. of 20.07.2001 introduces in the Belgian law the radiological protection and ALARA-policy concepts. Article 20 of this Royal Decree sets among others the basic radiological protection principles: justification of the practice, optimisation of protection and individual dose limits.
Article 23 of this Royal Decree describes the key role of the Health Physics Department (HPD). This department is, in a general way and amongst other duties, responsible for the organisation and the supervision of the necessary means for operational radiation protection.

3.1 Design of a storage building

Up to now, the safety of spent fuel or waste storage facilities has been judged on a case-by-case basis. Each storage facility has a safety report (which however is not a public document), operation rules and an emergency plan, and the safety demonstration is assessed based on these documents.

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

- general description of the site, buildings and installations
- fundamental design criteria and specifications (systems, components, casks, etc…)
- applied safety related concepts
    - multiple barriers components and systems (confinement of radioactive materials, ventilation, etc..)
    - criticality safety
    - shielding and radiation protection
    - long term behaviour (internal and external influences) at storage
    - thermal analyses for storage conditions (heat removal)
    - fire protection
    - industrial safety
- detailed description of the building and the installations (e.g. ventilation, electricity, etc…)
- secondary waste produced during operation
- radiation protection programme (organisation, equipment, monitoring, procedures)
- normal operating conditions (atmospheric and liquid 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
    - start-up (unitary-, functional- and global tests)
    - exploitation (equipments maintenance, periodic tests, etc…)
    - alarm (process, fire, radiation, security)
- operating conditions and limits
- dismantling
- quality assurance

The application for authorization is accompanied with an environmental impact assessment (which is a public document) where besides the radiological impact, non-radiological aspects have to be evaluated for the construction and the operation.

3.2 ALARA policy during operation

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 acceptance, 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 acceptance, transfer and storage operations the workers are equipped with individual neutron (if required; by using bubble type detectors and/or electronic dose meters) 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…).

3.3 Follow-up at the field

3.3.1 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[3]. In practice the measured dose rate values are far below these limits. The dose rate limits guarantees that the doses received by the workers by the storage activities are low. The areas that can be accessed by the public are distant by several hundreds of meters from the storage buildings. For the design of these buildings it is also implemented that the impact for the public (including sky shine effects) is only a small fraction of 1 mSv/year (for a recent new storage building of Belgoprocess an occupation factor of 1 has been chosen for this impact evaluation).
Various measures have been taken over the years during operation to reduce further the 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 an important amount due to dismantling projects). For the period 2002-2005, about the same values have been recorded (compared with 2001).
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 authorization 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 half of the dose limit (20 mSv for 12 consecutive months, in accordance with the R.D. of 20.07.2001; the mentioned doses are the total doses (sum of internal and external doses)).

[3] outside the older buildings, there is a limit of 25 µSv/h because it was related with the former dose limit of 50 mSv/year (instead of the actual limit of 20 mSv/year)

3.3.2 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 in the storage area for conditioned waste has always to be below about 4 and 0.4 Bq/cm^2 for respectively beta-gamma and alpha contamination.

3.3.3 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, the AIO and the FANC. The results of the continuous monitoring of the atmospheric releases and the liquid discharges (routine releases) are periodically sent to the AIO and the FANC for an additional check.
The Euratom 96/29 Directive has been implemented in the Belgian legislation and as allowed by Article 81.2 of the R.D. of 20.07.2001 there is a request 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 meet at least the maximum annual dose to the public of 1 mSv. These evaluations implement a lower dose constraint to take into account for 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 ?Sv/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, Belgoprocess) and the storage of vitrified high level waste (at Belgoprocess).
For the dry storage of spent fuel, a continuous monitoring of the leak tightness of the casks is provided.
Environmental monitoring programmes (e.g. at SCK-CEN and Belgoprocess: emission, immission, dose rate, contamination, etc...) are established in agreement with the AIO and the FANC in order to monitor the impact on the environment. These results are periodically evaluated by the HPD and the AIO.

4 MISSIONS OF AVN

AVN is an Authorised Inspection Organisation (AIO) for nuclear safety and radiation protection. The organisation is licensed by and is the technical support of the Federal Agency for Nuclear Control (FANC) to carry out the surveillance of the Belgian nuclear installations within the frame of the Belgian laws and regulations. AVN performs hereby nuclear safety assessments (Safety Evaluation Reports), is checking the conformity of new plants or modifications, proposes license conditions and is performing inspections (with written reports) on the nuclear sites.

AVN plays a role in the nuclear safety and radiation protection during all the phases of a nuclear facility:

- during the design and construction phase (license for construction and operation; SAR);
- proposing license conditions and follow-up in the commissioning phase (conformity tests and issuance of partial approbations);

- operation phase, with permanent routine inspections (including periodic safety reviews)
- decommissioning (license and SAR for decommissioning)
- etc….

The assessment of methodological approach and, the review and approval of the final studies and results is performed by AVN.

4.1 Routine inspections by AVN during operation phase

The permanent inspections, with routine systematic visits (e.g. local visit at the storage building) and specific visits (e.g. follow-up of legal aspects, follow-up of dosimetry results, modifications, incidents etc…), are performed by a dedicated site inspector of AVN, who is responsible for a site of an operator with nuclear facilities (e.g. Belgoprocess, Belgonucléaire, the Nuclear Research Centre (SCK-CEN), etc...). The inspector needs to be licensed as an expert in nuclear safety and radiation protection by the FANC to perform these inspections.

The routine inspections are performed by periodic inspections, and each type of installation or storage building is hereby inspected at least every 3 months. For a nuclear site like Belgoprocess (central waste processing company in Belgium), about 1 to 5 different installations (depending on the size of the installations) are grouped for a half or a whole day visit on the site. In practice this means that for the nuclear fuel cycle facilities, there is at least a routine inspection on the site every two weeks. In combination with the specific inspections, there is an average of one inspection on the site every week.
During 2005, about 20 systematic and 17 specific inspections have been performed by AVN on the Belgoprocess sites. An example for planning routine inspections by AVN for the storage buildings is given in Appendix 1 of this paper.

During a routine inspection for a storage building, the following points are in particular checked or done (the list below is however not an exhaustive list):

- conformity of the installations with the R.D. of 20.07.2001, the SAR and the Authorization(s) (conformity check with the license conditions for operation);
- state of the waste packages in the storage buildings (e.g. by an "at random" visual inspection of the stored drums in a storage building of low level radioactive waste[4]);
- radiation monitoring on the field by AVN:
  - dose-rate measurements : gamma and neutron (if required)
  - surface contamination measurements: alpha, beta-gamma measurements (e.g. "at random" or selective wipe tests from the drums or from the surfaces in the storage building).
- approval of modifications (evaluation and approval by AVN, acceptance if required; See also §4.2 "Plant Modification: legal basis") and check of these modifications on the field during an inspection;
- incident analyses : reporting by the licensee, INES classification (approval of AVN required), operational feed-back, evaluation of internal contaminations;
- check of safety functions:
  - monitoring being done by the operator (air-monitoring, surface contamination-monitoring, dose - and dose rate monitoring, authorised radioactive releases (stack monitoring))
  - ventilation (under pressure cascade, ventilation regime, etc…)

[4] dose received by an inspector during this kind of inspection is kept low (only some microSv's)

  - adequate radiation shielding
  - etc….
- follow-up of dosimetry results (internal and external exposure, operational dosimetry (X-gamma , beta and neutron, etc…).

4.2 Plant Modification: legal basis

The Royal Decree of Authorization prescribes that a nuclear installation has to remain in conformity with its license, and in particular with respect to the Safety Analysis Report. Modifications are however allowed if they do not degrade the safety. By modification is understood a change, an addition, or an extension of the installation which, for a new installation, would normally be described in the licensing documentation. A modification may be classified as “important”, or as “non-important”. The classification is proposed by the licensee, endorsed by AVN and, if necessary, submitted to the approval of the competent Authorities.

An “important” modification is one which necessitates an authorization to be delivered in the same manner as an authorization for a new installation. Such a modification implies in-depth studies, followed by specific inspections and test programme during its implementation; in some cases, it requires some rewriting of the Decree of Authorization.

On the other side, each modification which is not considered as “important” is classified as “non important”. Such a modification is proposed by the licensee and discussed with the AIO, which approves its realization, on basis of a project file; then it is followed during its implementation and is the object of a provisional “acceptance”. It is definitely accepted by the AIO after modification of the technical documentation including the Safety Analysis Report, if necessary.

The duties of the site inspector of AVN in the case of a plant modification are the following:

- The site inspector discusses the request for modification before its official issue;
- The site inspector submits the request for modification to the headquarters technical support of AVN;
- The consulted AVN experts involved in the safety analysis of the modification reports in writing to the site inspector;
- The site inspector approves the request before its implementation;
- The site inspector verifies how the modification has been implemented and tested;
- The site inspector keeps the modification file up to date.

4.3 Periodic Safety Reviews (PSR)

Besides the day to day inspections during operation which are mandatory, the nuclear installations are required to reassess the safety of their installations every ten years, by comparing the installation and the procedures which are applied to the rules, standards and practices which are used in Belgium and on an international level (e.g. the European Union), knowing that Belgian nuclear licenses are not limited in time.

The general aims of these ten year reviews are:

- to show that the installation is at least as safe as it was when it was licensed,
- to identify any degradation or wearout process which might limit its operating conditions, so that measures can be taken where necessary to ensure safe operation for the following ten years,
- to justify the safety level of the installation by comparing it to the most recent safety criteria and practices, taking into account the various phenomena and scenarios studied abroad and to propose the improvements which can be made at reasonable cost.

A list of the subjects to be studied is drawn up jointly by the operator, the Health Physics Departement of the licensee and the AIO. A joint report is then submitted to the competent Authorities (FANC). For each subject, this report explains:

- the situation before reasssessment
- the proposed methodology of analysis
- the results expected, including the proposals for modification
- the planning for the studies and/or the realizations.

AVN assesses the methodological approaches for the analyses, reviews and approves the final studies and results.

5 INSPECTION OF THE CONDITIONED RADIOACTIVE WASTE

The final decision for disposal of the radioactive waste has not yet been taken in Belgium. The conditioned waste is stored on Belgoprocess' sites for an intermediate period (about 80 years). In the meantime, a well-defined inspection programme is being implemented to ensure that the conditioned waste continues to be stored safely during this temporary storage period. This programme was draw up by Belgoprocess-NIRAS/ONDRAF and is in general based on an periodic inspection of a limited and fixed number of drums that are representative for the different conditioning processus.

An extensive investigation programme started in 2003, this in consultation with AVN, due to some problems with non-conform drums in the storage facilities for the low-active conditioned waste. The main observations[5] were:

- the swelling of drums and outflow of the non-radioactive bitumen matrix[6] for the bituminized waste,
- the corrosion of the drum walls (corrosion from the inside of the drums to outside) for the cemented waste.

The number of the concerned drums is very limited and the radiological impact is nil.
With this extensive investigation programme, studies and investigations were started to identify the production processus linked with the observed anomalies and to better understand the root causes (by e.g. destructive and non-destructive examinations of the deformed drums). An action plan for remediation was also implemented and countermeasures/corrective actions were performed (e.g. short term actions: use of overpacks to place the leaking drums inside, installing drying installation to control the humidity in the storage areas (was more a preventive action), etc…).

The visual inspection programme involves that each drum of conditioned waste is being taken out of the storage bunker, inspected (in general by remote control, using travelling

[5] in the other storage facilities, e.g. for the medium level bituminized waste (building 127, Eurostorage), these phenomena were however not observed.
[6] see appendix 3 for some pictures

cranes and the installation of a semi-automatic inspection system (turn-table, video camera)[7]) and made the subject of additional documentation, before being returned to storage. If any abnormalities are detected during this inspection, safety measures are immediately taken to prevent the contamination of the storage buildings.

In concrete terms, these measures relate to a small number of drums in which rusting or swelling have been observed. Some of these were previously intended for disposal at sea within a period of two years. Other drums were produced to be stored for 10 to 15 years only while awaiting disposal. This deadline has now long since been passed. Because the intensive inspections have not detected any severe problems, immediate extensive corrective measures were not deemed necessary. However, an investigation is being conducted into the reasons why certain drums show defects after a number of years of temporary storage. This will enable preventive action to be taken on a long term basis to ensure the guaranteed lifespan of newly produced drums of conditioned waste.

An evaluation report presenting the results of the extensive investigation and inspection programme is periodically issued by Belgoprocess-NIRAS/ONDRAF. A copy of this report is among others send to AVN and if necessary discussed with AVN.

Before conditioned waste is cleared by NIRAS/ONDRAF for temporary storage and subsequent disposal, Belgoprocess as the waste processor is required to demonstrate that the content and packaging meet NIRAS/ONDRAF approval criteria. This means that the authorization files for the original waste, for the primary packaging and for the treatment and conditioning process have to be approved, that the waste has to be radiologically and physico-chemically defined on the basis of approved methodologies and isotope vectors, and that evidence has to be provided in the form of conformity documentation to show that the waste really has been conditioned and defined in line with the procedure set out in the authorization files. A long-term plan has been drawn up covering all these activities with regard to each batch of conditioned waste, and is being systematically implemented. The plan has been extended, and will take around ten years to complete. This policy of precisely defining waste with a view to its subsequent safe disposal is another instance of the sustainable policy of both NIRAS/ONDRAF and Belgoprocess. It should be mentioned that more than a third of the preparatory work had already been carried out which is needed to complete all the authorization files, methodologies for radiological characterisation and conformity files.

6 CONCLUSIONS

AVN is an authorised inspection organisation for nuclear safety and radiation protection, having a role during all the phases of a radioactive waste storage facility. AVN performs hereby nuclear safety assessments, is checking the conformity of new storage buildings or modifications, proposes license conditions and is also performing inspections in the storage buildings.

[7] see appendix 2 for some pictures

Appendix 1: Example of Inspection Program by AVN (limited to storage buildings of Belgoprocess only)

Inspection Program Belgoprocess - Storage Buildings	
Installation or building	programmed period of inspection 2005 (month)
Storage building 129, for Eurochemic's vitrified High Level Liquid Wastes	**1 - 4 - 7 – 10**
Storage building 136 - COGEMA's vitrified High Level Liquid Wastes	**1 - 4 - 7 – 10**
Storage building 156 - Spent fuel reactor BR3 (Castor)	**1 - 4 - 7 – 10**
Storage building 150 - NIRAS (Conditioned Low Level Solid Wastes)	**2 - 5 - 8 – 11**
Storage building 151 - Conditioned Low Level Solid Wastes	**2 - 5 - 8 – 11**
Storage building 155 - Radium-containing and other alpha-contaminated conditioned waste	**2 - 5 - 8 – 11**
Eurostorage building 127 - storage facility of conditioned ILLW	**2 - 5 - 8 – 11**

figure 1: Storage building 155 - Radium-containing and other alpha-contaminated conditioned waste

figure 2: Storage building 136 for COGEMA's vitrified High Level Liquid Wastes

Appendix 2: Visual inspection of drums in the storage building of low level radioactive waste

figure 3: extensive visual inspection programme at the beginning of the project

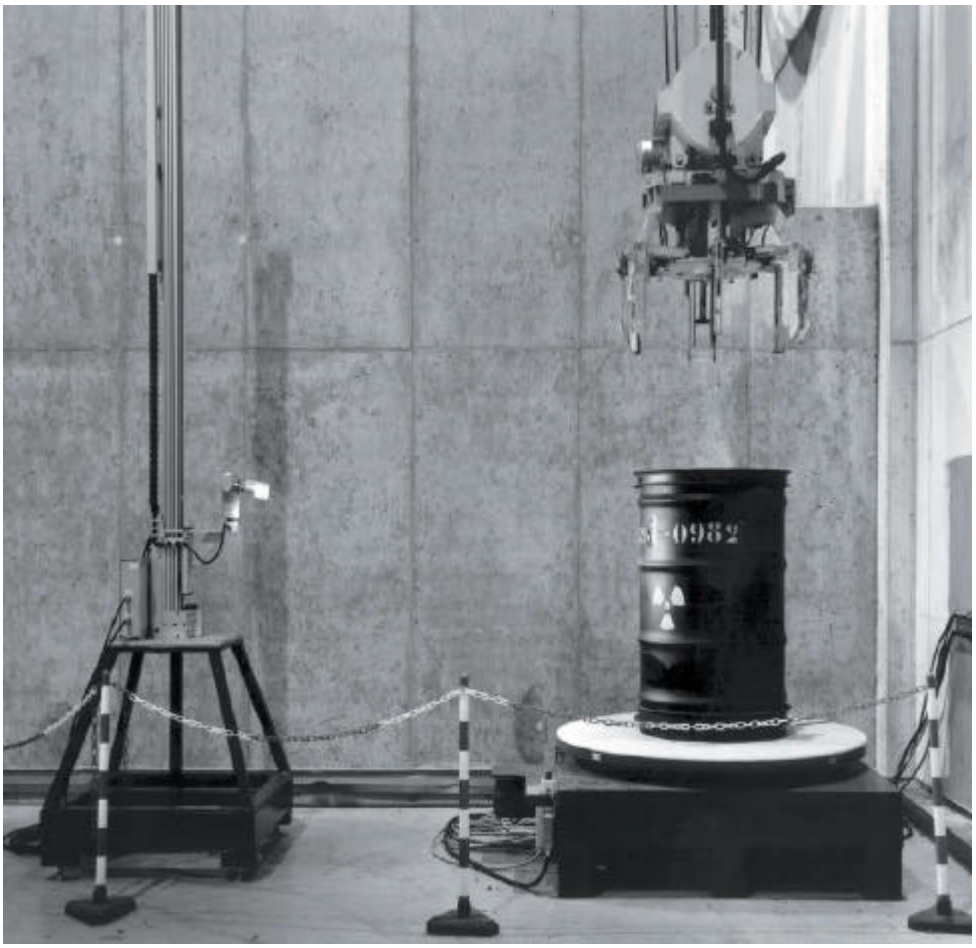

figure 4: the same extensive visual inspection programme, after the installation of camera's and a turn-table

Appendix 3: : Storage building 151 of Belgoprocess with low level conditioned waste

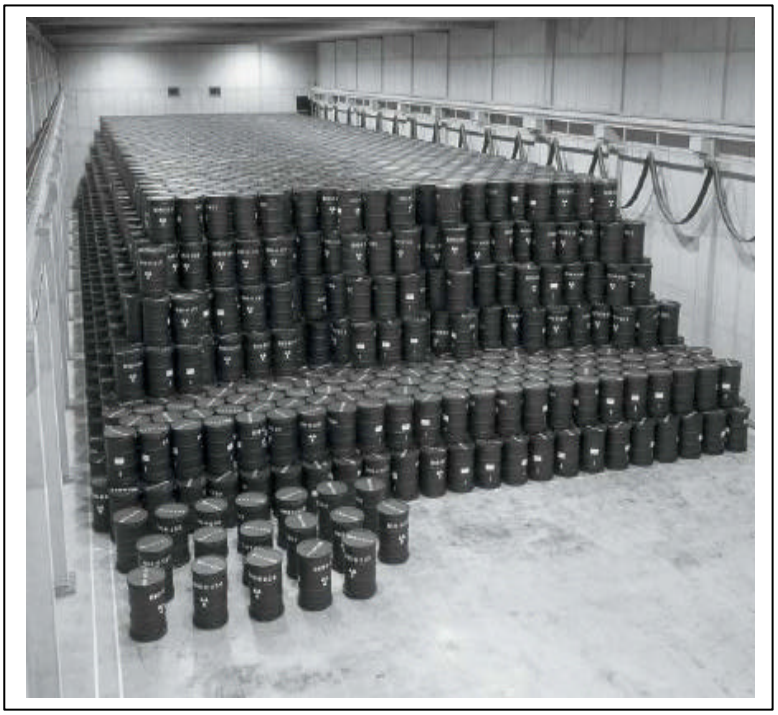

figure 5: a limited number of bitumized waste drums, with outflow of the non-active bitumen matrix, are put a side to perfom a continous follow-up of the state of the drums