
Activities of AVN in the Belgian context of safety assessment of radioactive waste disposal

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Abstract:

In a previous publication [1], the involvement of AVN as a TSO in the safety analysis of radioactive waste disposal was described and the different kind of activities were presented. Since then, the pre-project phase for the disposal of LLW in near-surface facility developed by ONDRAF/NIRAS is approaching an end as ONDRAF/NIRAS is now in a phase of introducing the pre-projects to the government for further decision making.

AVN involvement in the safety analysis of radioactive waste disposal has continued with an increasing effort in the safety assessment of I/HLW in deep geological repositories. Indeed, since 2003, the discussions between FANC, AVN and ONDRAF/NIRAS were extended towards the disposal of Category B (low or medium-level and long-lived) and Category C (high-level short or long-lived) waste (further referenced as Cat. B&C waste). The main themes of discussions between ONDRAF/NIRAS, FANC and AVN are developed in this paper.

Finally, AVN activities concerning the safety of radioactive waste disposal in the international context are also presented.

1 INTRODUCTION

In Belgium, the task of radioactive waste management has been entrusted to a separate agency created in 1980: the Belgian Agency for Management of Radioactive Waste and Enriched Fissile Materials, known by the French/Dutch acronym ONDRAF/NIRAS. More information can be found on the ONDRAF/NIRAS website [2].

A short historical perspective and the present context on the long-term management of short-lived low-level radioactive waste disposal is shortly described hereafter [2, 3].

In 1998, the Belgian federal government opted for a final, or potentially final, solution for the long-term management of short-lived, low-level radioactive waste, a solution that also had to be progressive, flexible, and reversible. At the same time, the government entrusted new missions to ONDRAF/NIRAS - in particular that of developing methods to enable the integration of final repository project proposals at the local level - and restricted the number of potential sites for final disposal to the four nuclear sites already existing in Belgium and, possibly, to non-nuclear but interested local districts.

ONDRAF/NIRAS is now carrying out the necessary studies to help policymakers reach a decision. Technical feasibility, budget and safety are all being thoroughly investigated. Attention is also devoted to local environmental and socio-economical factors, including public acceptance.

As a result of the governmental decision mentioned above, ONDRAF/NIRAS has confined itself for its in situ research to the existing nuclear sites (Doel, Fleurus-Farciennes, Mol-Dessel and Tihange) and to areas where the local authorities are showing an interest. Up to

now, this resulted in setting up Local Partnerships with the communities of Mol, Dessel and Fleurus-Farciennes (see § 2.3).

This paper is mainly focused on the involvement of the Association Vinçotte Nuclear (AVN, see web site [4]) as a TSO in the safety assessment of radioactive waste disposal in Belgium. An overview of its involvement in the safety assessment of radioactive waste disposal for Cat. A and its increasing involvement in the safety assessment of radioactive waste disposal for Cat. B&C waste is given. Finally, some AVN activities on the international scene in the field of the safety of radioactive waste disposal are also provided.

2 AVN ACTIVITIES IN THE FIELD OF THE FINAL DISPOSAL OF LLW IN NEAR-SURFACE FACILITIES

In its 1998 decision, the Belgian federal government also encouraged ONDRAF/NIRAS to involve the nuclear safety authorities in its activities of safety evaluation of site-specific waste disposal options (deep or surface disposal) for the short-lived low-level waste. A working group was created in which ONDRAF/NIRAS, FANC (the Federal Agency for Nuclear Control) and AVN discuss different aspects of the ONDRAF/NIRAS program concerning the long term management of short-lived low-level radioactive waste disposal. It was agreed to work around four main themes, being: development of the regulatory framework, implementation of the regulatory framework, the table of content of a safety analysis report, and the review of safety assessments [1].

The activities above were already addressed in a previous publication [1]. In the first sub-section below, the previous achievements are recalled and their present state-of-progress are given. In the second sub-section, the technical issues raised recently in the framework of the FANC, AVN and ONDRAF/NIRAS working group are presented. Finally, the third sub-section presents AVN experience from its interaction with local partnerships in the framework of the societal process committed in Belgium about the disposal of Cat. A waste.

2.1 Previous achievements

In relation to the regulatory framework discussions were started on the licensing procedure for a waste disposal facility. The starting point was the licensing procedure as presently stipulated in the R.D. of 20 July 2001. A critical analysis of the steps to be foreseen in the licensing of a waste disposal facility was conducted. Based on an AVN proposal for a licensing procedure, an agreement on the technical level has been reached amongst FANC, AVN and ONDRAF/NIRAS. The introduction of such a licensing procedure remains to be embedded in a legally binding framework. Consultations between FANC, AVN and ONDRAF/NIRAS on this framework are planned for the near future.

Another main achievement was the elaboration of a table of content for a safety analysis report (SAR) for a near surface disposal facility of short-lived low-level radioactive waste. Starting from existing references (mainly NUREG-1199 [5]) and taking into account some specificities of the Belgian concepts, AVN developed a proposal for the table of content by amending and completing the table of content as proposed in NUREG-1199. This was then extensively discussed amongst FANC, AVN and ONDRAF/NIRAS. This has also led to a technical agreement on a table of content that could be endorsed more officially in a later stage (e.g. if the development of a waste disposal facility enters the project phase).

Finally, AVN committed an important effort in the review of safety assessment analyses performed by ONDRAF/NIRAS and its contractors:

- Some of the reviewed documents deal with methodological aspects of the safety assessment of a waste disposal facility, as for example the definition of parameters and the elaboration of parameter values needed in the long term safety assessment, the definition of scenarios for the safety assessment (based on the FEP (Features, Events and Processes) approach), the hydrogeological model and the near-field simulations.
- Other documents deal with the generic concept of a disposal facility as developed by ONDRAF/NIRAS as well for a near surface facility as for a deep geological facility. Also some characteristics of specific designs for the potential sites under investigation were discussed.
- Finally technical analyses on specific issues such as the impact on safety of the gas production in a deep geological disposal facility and the safety assessment methodology and acceptance criteria for aircraft crash were analysed and discussed.

2.2 Present activities

In the last two years (2004 – 2005), four main issues were addressed during the discussions between FANC, AVN and ONDRAF/NIRAS on near-surface radioactive waste disposal facilities: the issue of human intrusion, the Fleurus-Farciennes disposal concept, the determination of a reference seismic horizontal acceleration and other seismic aspects, and finally the biosphere modelling to be addressed in safety assessments. The AVN activities concerning these three issues are summarized below.

In preparation of the development of a regulatory position on how to deal with the issue of human intrusion in the safety assessment of a waste disposal facility, AVN hosted in June 2004 a workshop with representatives of regulatory organisations of other countries to discuss regulatory aspects related to human intrusion, the impact of the post-closure period on human intrusion considerations and the scenarios to be considered for human intrusion. The insights gained from this workshop were published [6].

As well for FANC and AVN as for ONDRAF/NIRAS, the treatment of human intrusion for near-surface disposal facilities is being recognized as an important issue for Cat. A waste that should be addressed preferably before the project phase.

ONDRAF/NIRAS presented to the safety authorities the Fleurus-Farciennes disposal concept. AVN made a preliminary analysis on documents and/or ONDRAF/NIRAS presentations describing the specific Fleurus-Farciennes concept and the hydrogeological models. AVN decided to put the priority of its analysis mainly on the specificities of the design and the siting of the repository system before examining near-field calculations and impact assessments. AVN analysis of the Fleurus-Farciennes disposal concept focused on three main themes: the identification of the safety role of the different components of the design, the surrounding area of the disposal system and a functional safety analysis. The results of this analysis was discussed with FANC and presented to ONDRAF/NIRAS.

Questions were asked by ONDRAF/NIRAS to FANC and AVN about the determination of a reference seismic horizontal acceleration for the design of a near-surface disposal facility on the potential sites in Belgium. As near-surface disposal facilities in the post-closure phase are essentially passive installations with a particularly long-term post-closure period to be considered in the safety assessments, AVN suggested to take into account the return period for a given earthquake and to adapt the design.

Meetings between FANC, AVN and ONDRAF/NIRAS about the modelling of the biosphere for the safety assessment of near-surface disposal facilities were the opportunity to raise the

question of the role of the biosphere in the long-term safety assessments and to put in evidence the international developments (BIOMASS initiated by the IAEA and BioMoSa initiated by the EC) on this topic. The specific biosphere models developed for the Mol-Dessel and the Fleurus-Farciennes regions were presented and discussed. A common “biosphere working group” including FANC, AVN and ONDRAF/NIRAS was created in order to define a reference biosphere in Belgium.

2.3 AVN experience from its interaction with Local Partnerships

In the framework of the societal process committed in Belgium about the disposal of Cat. A waste, three local partnerships have been formed, bringing together local representative interested parties (including individual citizens of the local community on a voluntary base) and members of ONDRAF/NIRAS. Chronologically, the first of these, is known as STOLA-Dessel (Studie- en Overleggroep Laagactief Afval - study and consultation group on low-level waste), the second is known as MONA (Mols Overleg Nucleair Afval Categorie A - consultative group on type A radioactive waste) and the third is known as PaLoFF (Partenariat Local Fleurus-Farciennes - local partnership Fleurus-Farciennes). More information on these 3 partnerships can be found on their websites [7, 8, 9].

In the framework of their activities with ONDRAF/NIRAS, the Local Partnerships MONA and STOLA expressed the wish to have contacts with the Belgian safety authorities. These interactions have already been described in a previous publication [1].

More recently, the third Local Partnership PaLoFF also expressed its wish to have contacts with the Belgian safety authorities. As for the Local Partnerships MONA and STOLA, the Local Partnership PaLoFF wanted to be better informed about the independent assessment made by the regulatory organisations on the safety assessments of the disposal options.

As for MONA and STOLA, AVN explained its role in the Belgian regulatory context. Special attention was drawn on the fact that at this stage of the NIRAS-project on radioactive waste disposal, AVN has not yet a legally binding regulatory assessment role. Indeed, the project is still in a pre-project phase and no formal licensing is on going.

AVN also presented to the Local Partnership PaLoFF the main results of the review of the safety analyses developed by ONDRAF/NIRAS.

In this way, communicating with local stakeholders is for AVN a rather recent experience. However, the interest and the motivation encountered at those local stakeholders are an incentive to pursue and develop further this strategy of being as open and transparent as possible.

3 AVN ACTIVITIES IN THE FIELD OF THE FINAL DISPOSAL OF I/HLW IN DEEP GEOLOGICAL REPOSITORIES

In 2001 ONDRAF/NIRAS published the Safety and Feasibility Interim Report 2 (SAFIR2) [10] focused on the final disposal of Cat. B&C in potential clay host rocks. This report was taken as a starting point to involve the Safety Authorities in discussions on the future development of the Cat. B&C programme. Discussions between ONDRAF/NIRAS, FANC and AVN focused on the following four general aspects: general context of licensing a disposal facility, strategy of the Belgian R&D programme, review of ONDRAF/NIRAS documents in view of the development of a Safety and Feasibility Case (SFC) and exchanges of information and views concerning implementation aspects and technical issues.

3.1 Context of licensing a geological repository (short, medium and long-term activities)

Question has been raised by ONDRAF/NIRAS to the Belgian safety authorities concerning the general context of licensing a geological repository in Belgium. The question addresses as well the stakeholders to be involved in the process as the licensing process itself.

The opportunity of having a Strategic Environmental Assessment (SEA) and the role it could play in the Belgian context were the subject of preliminary discussions between FANC, AVN and ONDRAF/NIRAS. Subject to the adaptation of the European Directive 2001/42/EEC in the Belgian legislation, it is therefore envisaged to develop in Belgium a process inspired by the SEA principles. ONDRAF/NIRAS foresees that the SEA report should be submitted to an official approval by 2008 – 2009. The extent, the content, the intervening actors, the implementation schedule and the possible periodicity of this SEA process in Belgium are still however to be defined. In the regulatory context, one of the tasks identified is the interaction of this SEA process with other European Directives, Belgian laws and regulation (regional and/or federal). Concerning the SEA content, one of the subjects identified is the level of details in which a SEA should describe the different options (long-term surface storage, P&T, final geological disposal, ...) for the long-term management of radioactive waste.

Since a project for deep geological disposal could lead to a multi-phase process, the implications of long time intervals between these different phases for the safety and the licensing process have been identified by FANC, AVN and ONDRAF/NIRAS as an important issue for which further developments are necessary. It was suggested firstly to inform about the possible experience gained by regulators in other countries. It appeared that contacts about potential subjects of common interest with SKI/SSI, the Swedish safety authorities, could be very fruitful due to their experiences with the SFR repository. AVN had a first meeting with SKI, end of August 2005, about the topic “flexibility and multi-phases approach versus licensing process“. The insights gained will be useful for further discussions on this issue amongst FANC, AVN and ONDRAF/NIRAS.

3.2 Strategy of the Belgian R&D programme

In 2003 ONDRAF/NIRAS presented to the safety authorities FANC and AVN its view on the short, medium and long-term planning of activities for the geological disposal of Cat. B&C waste in Belgium. Discussions between FANC and AVN on the ONDRAF/NIRAS proposition of planning were the opportunity of first exchanges of views concerning, among others, the licensing process, the successions and definition of the different disposal phases, the regrouping of waste streams, the siting criteria, the role, schedule and content of PSAR and SAR. Responding to a FANC request, the impact of the NEA peer-review of SAFIR 2 on the Belgian R&D programme was also presented by ONDRAF/NIRAS and discussed.

3.3 Development of a Safety and Feasibility Case (SFC)

A guidance about the content of a first Safety and Feasibility Case (SFC) (foreseen by ONDRAF/NIRAS in 2013) was asked by ONDRAF/NIRAS to the safety authorities FANC/AVN. The basis of this guidance was the review by AVN of the “Safety Charter” [11] elaborated by ONDRAF/NIRAS and the review of the chapters of SAFIR2 not impacted by the modifications of the repository design decided by ONDRAF/NIRAS in 2003.

The “Safety Charter” contains two parts, Part 1 dealing with “Safety Objectives and Safety Requirements”, and Part 2 dealing with “Safety Strategy and Safety Demonstration”. A

common position on a first version was achieved previously [1] after discussions amongst FANC, AVN and ONDRAF/NIRAS in the context of the final disposal of Cat. A waste. The option was taken that further development of Part 1 should be taken over by the Safety Authorities, given its close liaison with regulatory aspects. ONDRAF/NIRAS revised Part 2 due to new insights (international discussions about the safety of geological disposal [12], implications of the discussions in the framework of the French-Belgian working group [13]). The review of the “Charter” by AVN was the opportunity of exchanging views on the different disposal phases and their coherence with the steps of the authorization process, the safety strategy, the safety functions and the role of the environment in the safety assessment.

SAFIR2 being a state-of-the art report of the programme for the disposal of Cat. B&C waste in poorly-indurated clays in Belgium in the period 1990 - 2000, it has intentionally not been structured as a safety case by ONDRAF/NIRAS. The detailed analysis undertaken in the SAFIR2 report makes it however possible to give a preliminary indication of the level of confidence in the developed disposal solution. In its review of SAFIR2, AVN decomposed its analysis according to the following types of comments/suggestions:

- *Additional issues to be considered in a first SFC.* Some issues only mentioned or partially treated in the SAFIR2 report, due to the stage of the disposal programme for this report, were identified by AVN as further issues to be developed in a SFC for the new stage of the Belgian programme.
- *Subjects of future investigations already identified in SAFIR2 and for which AVN supports further efforts.* AVN identified several thematic areas already intensively investigated by ONDRAF/NIRAS which drew particularly its attention in the view of a first SFC.
- *Issues judged to be of fundamental importance for the present safety demonstration.* Some issues were identified by AVN as being of main importance in the present stage of development of the Belgian programme for the safety demonstration. It was suggested to ONDRAF/NIRAS, for some of these issues, to discuss them with FANC and AVN and for others to increase the efforts of the demonstration.
- *Issues for which further precisions and/or developments are expected.*

3.4 Implementation aspects and technical issues

In order to develop and maintain its expertise about the main technical issues in the safety assessments of geological disposal facilities, AVN actively participated, with the FANC, to meetings organised by ONDRAF/NIRAS about the implementation and the development of disposal concepts. Exchanges of views about these concepts allowed the safety authorities to draw the attention of ONDRAF/NIRAS on some aspects potentially affecting the licensing process and the safety of the repository system.

Public information meetings open to the different nuclear actors, research centers and universities also allowed AVN to get more easily acquainted with specific technical topics encountered in the ONDRAF/NIRAS R&D programmes. Information about the return of experience following the dismantling of the OPHÉLIE Mock-up (a heat-emitter test above the surface), presentation about the state-of-the-art for the long term behaviour of bituminized waste and the outcomes of the European R&D projects SELFRAC concerning the excavation damaged/disturbed zone of a geological repository are examples of events organised by ONDRAF/NIRAS attended by AVN.

4 AVN ACTIVITIES CONCERNING SAFETY OF RADIOACTIVE WASTE DISPOSAL IN THE INTERNATIONAL CONTEXT

4.1 European Regulators Seminar

In 2000, a franco-belgian working group was established to discuss the methodology for safety evaluation of deep geological disposal of radioactive waste. In this working group, the Safety Authorities (DGSNR and FANC), their Technical Support Organisations (IRSN and AVN) and the waste management agencies (ANDRA and ONDRAF/NIRAS) are participating. The result of this work was integrated in one single common document on “Geological Disposal of Radioactive Waste: Elements of a Safety Approach”, see [13].

Later, this document has been presented to regulators and operators of different European countries (and representatives from IAEA and NEA) being already in a pre-project phase for the disposal of I/HLW in geological repositories (or being in a R&D and methodological phase close to the pre-project phase), during a European Regulators Seminar, organised by DGSNR and FANC in November 2004. Consequently, it has been decided to create a “pilot project” in order to demonstrate the feasibility of a European regulators working group on regulatory issues for the disposal of radioactive waste. The pilot project has just been launched.

4.2 NEA initiative for the handling of timescales

Discussions related to timescales issues and their treatment in repository safety assessment and the safety case were launched at an OECD/NEA workshop held in April 2002 [14].

Since then, the Integration Group for the Safety Case (IGSC) of the OECD/NEA developed in 2004 a questionnaire send to operators and to regulators. AVN answered the questions and discussed some of them with the FANC. The AVN participation in a meeting organized in May 2005 by the NEA was an opportunity to discuss with international experts the responses to this questionnaire. It is foreseen that the outcome of this questionnaire should be discussed in the Belgian framework between FANC, AVN and ONDRAF/NIRAS.

4.3 EC projects

Since more than one decade AVN is intensively involved in activities of transfer of Western European methodology and practices in the field of nuclear safety to Eastern European countries. In these countries, AVN assistance to the Regulatory Authorities and their TSOs is supported by the European Commission (EC) in the framework of TACIS and PHARE projects.

In this context, more than five years ago, the safety issues concerning the final disposal of radioactive waste were an increasingly part of AVN activities. Support to the State Nuclear Regulatory Committee of Ukraine (SNRCU) for the review of safety assessments in the licensing process of a near-surface repository for LLW in the Chernobyl area at the “Vector” site – in the Industrial Complex for Solid Radioactive waste Management (ICSRM), Lot 3 - is a current project where AVN is involved with other Western European TSOs.

Other support activities in the field of spent nuclear fuel (MOX fuel in particular) and radioactive waste management were carried out with the Nuclear Regulatory Authorities of the Russian Federation: AVN has reviewed regulatory documents of RF Gosatomnadzor concerning safety requirements for interim storage facilities and for the disposal of radioactive waste.

A project to support VATESI and Lithuania TSOs in licensing activities related to the decommissioning of the Ignalia NPP has been recently launched. In this project, AVN participates to safety issues concerning the interim storage facility for RBMK spent nuclear fuel assemblies and for a L/ILW repository (review of a safety assessment report).

Finally, a new project to support the Bulgarian safety authorities has been accepted recently by the EC for the safety assessment of disposal facilities. AVN will be involved in training activities and in the review of the table of content of a safety assessment report.

4.4 R&D

Efforts of AVN in the field of R&D related to waste disposal are being undertaken in the framework of the IAEA Co-ordinated Research Programme ASAM, standing for "Application of Safety Assessment Methodologies for Near Surface Waste Disposal Facilities". This programme started in November 2002, as the successor of the Co-ordinated Research Programme ISAM. Within the ASAM CRP, AVN has mainly been active in the "Disused Sealed Sources and Heterogeneous Waste Working Group" and in the "Regulatory Review Working Group". In the latter a lot of attention is being devoted to the definition of a Safety Case for a waste disposal facility and to a procedure for the review of safety assessments and of the Safety Case.

Very recently, AVN has been involved in two proposals submitted to the EC in the framework of the EURATOM 6th FP. The first proposal is an Integrated Project about "Performance Assessment Methodologies in Application to Guide the Development of the Safety Case" (PAMINA) whereas the second proposal is a Coordination Action Project about "Model uncertainty for the mechanism of dissolution of spent fuel in a nuclear waste repository" (MICADO). Both proposals gather research centers, universities, operators, TSOs and regulators (with respectively 25 and 19 participants for PAMINA and MICADO).

Contacts are also maintained with academic institutions, in particular with the ULB (Université Libre de Bruxelles). Some students have been guided in elaborating a thesis.

5 CONCLUSIONS

Since 1999, AVN has undertaken important efforts to develop its competencies in radioactive waste disposal safety assessment.

A major part of these efforts are taking place in the national framework via discussions between FANC, AVN and ONDRAF/NIRAS. In Belgium the pre-project phase of the disposal projects for Cat. A waste is reaching an end and ONDRAF/NIRAS is now in a phase of introducing the pre-projects to the government for further decision making. Several important topics (mainly related to regulatory aspects of the disposal of Cat. A waste) will be discussed between FANC, AVN and ONDRAF/NIRAS, in preparation of the project phase. The present AVN activities on the national scene focus also on the disposal of Cat. B&C waste where the general licensing context, the content of a Safety and Feasibility Case and an exchange of technical views about safety assessments are discussed with FANC, AVN and ONDRAF/NIRAS.

Also the contacts with the Local Partnerships (in particular recently with PaLoFF) allowed to illustrate the involvement of AVN in the safety analysis review of future waste disposal facilities.

To strengthen its capacities, AVN is taking part in international projects, working groups and R&D projects.

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