The shared goals in AVN

1. To be at the service of the population and the workers.
2. To fulfill its missions in full independence, coherence and impartiality.
3. To maintain its competence in nuclear safety and radiation protection.
4. To continuously optimize the dynamics of a multidisciplinary team.
5. To prioritize the good relationships and the mutual respect with each of its partners.
A new service-oriented spirit !
Un nouvel esprit orienté service !
Een nieuwe servicegerichte spirit !
Hello, I’m NucKey.

My father, Carl Stoiber (USA), created me on request of AVN Management to become the AVN mascot, especially to accompany the internet surfers through the FAQ* of the AVN website.

* FAQ : Frequently Asked Questions

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# TABLE OF CONTENTS

## 2006

### A new service-oriented spirit !  
5

### Un nouvel esprit orienté service !  
6

### Een nieuwe servicegerichte spirit !  
7

<table>
<thead>
<tr>
<th>Chapter 1 : General management</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. Structure .......................... 11</td>
<td></td>
</tr>
<tr>
<td>1.2. Human resources .................. 12</td>
<td></td>
</tr>
<tr>
<td>1.3. Workload ........................... 15</td>
<td></td>
</tr>
<tr>
<td>1.4. External communication ............ 16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 2 : Regulatory activities in belgium</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1. General assessment of nuclear installations .......... 19</td>
<td></td>
</tr>
<tr>
<td>2.2. Overview of inspections in NPPs .................. 20</td>
<td></td>
</tr>
<tr>
<td>2.3. Overview of inspections in other nuclear facilities .... 23</td>
<td></td>
</tr>
<tr>
<td>2.4. Emergency preparedness and response ............. 25</td>
<td></td>
</tr>
<tr>
<td>2.5. Medical radio-physics .......................... 26</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 3 : Safety assessments and national projects</th>
<th>27</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Safety improvements Doel 1/2 ........................ 29</td>
<td></td>
</tr>
<tr>
<td>3.2. Thermal-hydraulic studies at reduced flow at Tihange 3... 29</td>
<td></td>
</tr>
<tr>
<td>3.3. Probabilistic safety assessment ..................... 29</td>
<td></td>
</tr>
<tr>
<td>3.4. Periodic safety reassessments (PSR) .................. 31</td>
<td></td>
</tr>
<tr>
<td>3.5. Generic studies (common to all nuclear power plants) .... 33</td>
<td></td>
</tr>
<tr>
<td>3.6. NPPs safety computer-based systems .................. 33</td>
<td></td>
</tr>
<tr>
<td>3.7. Structural integrity of reactor pressure vessels ........ 33</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 4 : International activities</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. EC activities .......................... 37</td>
<td></td>
</tr>
<tr>
<td>4.2. OECD activities .......................... 37</td>
<td></td>
</tr>
<tr>
<td>4.3. IAEA activities .......................... 38</td>
<td></td>
</tr>
<tr>
<td>4.4. Cooperation with western safety authorities .......... 38</td>
<td></td>
</tr>
</tbody>
</table>
| 4.5. Assistance project to the nuclear regulators  
in central and eastern europe ...................... 41 |
| 4.6. Cooperation with other foreign organizations .......... 43 |
In 2006 AVN strove to change its organisation and spirit to improve its regulatory and service roles in nuclear and radiological safety.

**Nuclear and radiological safety**

In the framework of the surveillance of the nuclear power plants and following their letters and audits of 2004, AVN, in close cooperation with the Federal Agency for Nuclear Control (FANC), monitored the implementation of the action plans of Electrabel. A significant attention was devoted to the operator’s preparation of the OSART (Operational Safety Review Team) mission due May 2007. With respect to the containment sump clogging issue on the other hand, pressure was put on the operator to significantly accelerate the implementation of robust solutions.

The important irradiation accident at the Sterigenics plant (sterilisation activities) clearly showed the need, for some installations presenting radiological risks for people, to extend the inspections based on radiation protection (as basically foreseen in the regulation) to more preventive actions, which are more oriented to technical nuclear safety and promoting more involvement of the operator in this area. Extended inspection and verification actions were performed in close collaboration with FANC. A special AVN reflection group concluded that there was a necessity to clarify the responsibilities of AVN in this type of installations, to improve AVN’s contractual agreements with the operators and to propose to the FANC necessary upgrading of the safety requirements to be imposed on installations with direct significant irradiation risk for people.

AVN pursues its strategic policy to develop an integrated set of activities covering the protection of workers, patients and general public. This implies in particular a continued development of the Medical Radio-physics activities.

**European Technical Safety Organisation Network (ETSON)**

In 2006, AVN signed, together with the French and German TSO’s (Technical Safety Organization) GRS and IRSN, a convention creating the European Technical Safety Organisation Network (ETSON), open to further membership of other TSOs in Europe.

The aim of this network is to promote and develop European scientific and technical co-operation between the TSOs in the field of nuclear safety. This will be achieved in particular by systematically exchanging R&D results and experience in connection with the operation of nuclear facilities and safety assessments, by promoting harmonization of nuclear safety assessment practices in Europe, and by encouraging initiatives to define and implement European research programmes.

**The legal context in Belgium**

The practical collaboration between the FANC (Federal Agency for Nuclear Control) and AVN continues to be developed, among others for specific inspection activities and for the implementation of the WENRA (Western European Nuclear Regulators Association) harmonised reference levels. A formal functional & long-term arrangement between the FANC and the authorised inspection organisations is still to be defined.

The results of the new reflections started in 2005 with the objective to preserve the existing expertise of these authorised inspection organisations and to take advantage of the complementary roles, competences and skills of all concerned actors, did not come to a practical solution. A new proposal was made by the end of 2006 by FANC to the Ministry of Internal Affairs.

**AVN Integrated Change Plan (ICP)**

In 2006 AVN launched a systematic Integrated Change Plan with the aim to improve the organisation to better integrate all its safety activities, to boost the organisation toward a stronger customer orientation, to better formalise its technical multidisciplinary referential, to improve the priorities, time and budget management and to improve people development. The assessment of AVN’s way of working has led to the implementation of a management based on the existing quality-system processes (Process Management) and of a middle management level. The new organisation is effective as from 2007.

Jean-Jacques Van Binnebeek
Director General of AVN

Abbreviations: see appendix 2

L’accident d’irradiation survenu sur le site de Sterigenics (sterilisation) montre le besoin, pour certaines installations présentant des risques radiologiques pour les personnes, d’étendre les inspections basées sur la radioprotection (comme prévu par la législation) vers des actions plus préventives orientées vers la sûreté nucléaire technique et promouvant plus d’implication des exploitants dans ce domaine. Des actions d’inspections et de contrôle étendues ont été exécutées en collaboration avec l’AFCN. Un groupe de réflexion d’AVN a conclu qu’il était nécessaire de clarifier les responsabilités d’AVN dans ce type d’installations, d’améliorer les accords contractuels d’AVN avec les exploitants et de proposer à l’AFCN une amélioration nécessaire des normes de sécurité à imposer aux installations présentant un risque significatif d’irradiation direct pour les personnes.

AVN a poursuivi sa politique stratégique de développement d’un ensemble intégré d’activités couvrant la protection des travailleurs, des patients et du grand public. Ceci implique en particulier un développement continu des activités de radio-physique médicale.

En 2006, AVN a signé un accord, avec l’IRSN français et le GRS allemand, créant l’European Technical Safety Organisation Network (ETSON) ouvert à d’autres TSO européens.

Le but de ce réseau est de promouvoir et de développer une coopération européenne technique et scientifique entre les TSO dans le domaine de la sûreté nucléaire. Ceci sera réalisé en particulier en échangeant systématiquement les résultats et l’expérience en R&D à propos des évaluations du fonctionnement des installations nucléaires et de la sûreté, en promouvant l’harmonisation des pratiques d’évaluation de la sûreté nucléaire en Europe et en encourageant des initiatives pour définir et mettre en œuvre des programmes européens de recherche.

La collaboration pratique entre l’AFCN et AVN continue à être développée entre autres par des inspections spécifiques et par l’implémentation des niveaux de référence harmonisés de WENRA. Un accord formel de fonctionnement à long-terme entre l’AFCN et les organismes de contrôles agréés doit encore être conclu.


En 2006, AVN a lancé un plan de changement intégré avec pour objectif d’améliorer l’organisation de manière à mieux intégrer toutes les activités liées à la sûreté, à pousser l’organisation vers une plus forte orientation client, à mieux formaliser son référentiel technique multidisciplinaire, à améliorer la gestion des priorités, du temps et des budgets, ainsi que le développement des personnes. L’évaluation du mode de travail d’AVN a conduit à implanter une gestion basée sur les processus-qualité existants (Process Management) et à introduire un niveau de mid-management. La nouvelle organisation sera effective à partir de 2007.

Jean-Jacques Van Binnebeek
Directeur General AVN

Abbreviations : see appendix 2
In het kader van het toezicht op de kerncentrales en ingevolge de brieven en audits in 2004 heeft AVN, in nauwe samenwerking met het Federaal Agentschap voor Nucleaire Controle (FANC), de implementatie van de actieplannen van Electrabel opgevolgd. Er werd vooral veel aandacht besteed aan de voorbereiding door de uitbater van de OSART-opdracht (Operational Safety Review Team), voorzien in mei 2007. Wat betreft het probleem van mogelijke verstopping van de recirculatieputten in het reactorgebouw, heeft AVN er bij de uitbater sterk op aangedrongen dat de implementatie van degelijke oplossingen aanzienlijk zou bespoedigd worden.

Door het belangrijke bestralingseengeval in de installaties van Sterigenics (activiteit: sterilisatie) kwam duidelijk de noodzaak aan het licht om – in de installaties met verhoogd radiologisch risico voor personen – de inspecties inzake stralingsbescherming (zoals reglementair voorzien) uit te breiden naar meer preventieve acties. Deze zouden meer gericht moeten zijn op technische nucleaire veiligheid en ook meer betrokkenheid vanwege de uitbater moeten aanmoedigen. In nauwe samenwerking met het FANC werden uitgebreide inspecties en controleacties uitgevoerd. Een speciale AVN-overleggroep kwam tot het besluit dat het nodig is de verantwoordelijkheden van AVN aangaande dit soort installaties te verduidelijken, de contractuele overeenkomsten van AVN met de uitbaters te verbeteren en aan het FANC voorstellen te doen voor de noodzakelijke versterking van de veiligheidsseisen die moeten worden opgelegd aan installaties met verhoogd bestralingssaldo voor personen.

AVN zet haar strategisch beleid verder voor het ontwikkelen van activiteiten inzake bescherming van de werknemers, de patiënten en het publiek. Dit omvat in het bijzonder ook een verdere ontwikkeling van de activiteiten in het domein van de medische stralingsfysica.

In 2006 ondertekende AVN, samen met de Franse en Duitse TSO’s (Technical Safety Organizations) GRS en IRSN, een overeenkomst voor het oprichten van het “European Technical Safety Organisation Network” (ETSON), dat openstaat voor toetreding van andere Europese TSO’s.

De praktische samenwerking tussen het FANC en AVN wordt verder ontwikkeld, onder andere voor specifieke inspectieactiviteiten en voor de implementatie van de geharmoniseerde referentieven van WENRA (Western European Nuclear Regulators Association). Een formele en functionele regeling op lange termijn tussen het FANC en de erkende inspectie-instellingen dient nog te worden bepaald.

De resultaten van de nieuwe beschouwingen startten in 2005, met het doel de bestaande deskundigheid van de erkende instellingen te behouden en voordeel te halen uit de elkaar aanvullende rollen, bevoegdheden en deskundigheden van alle betrokken deelnemers; een praktische oplossing is nog niet uit de bus gekomen. Eind 2006 heeft het FANC een nieuw voorstel ingediend bij het Ministerie van Binnenlandse Zaken.

In 2006 lanceerde AVN een systematisch Integrated Change Plan, met het oog op een verbetering van de organisatie. Dit heeft tot doel alle veiligheidsactiviteiten beter te integreren, de dienstverlening van de organisatie te stimuleren, het technisch en multidisciplinair referentiekader beter te formaliseren, de prioriteiten, alsook het tijds- en budgetbeheer én het personeelsbeheer te verbeteren. De evaluatie van AVN’s marier van werken heeft geleid tot de implementatie van een managementstructuur, gebaseerd op de bestaande processen van het kwaliteitsstelsel (Process Management) en de invoering van een mid-management niveau. De nieuwe organisatie is van kracht vanaf 2007.

Jean-Jacques Van Binnebeek
Directeur-generaal van AVN

Abbreviations : see appendix 2
CHAPTER 1 – GENERAL MANAGEMENT

Legal context
Since the organization of the nuclear control in Belgium, according to the intention of the 1994 Law, is rather complicated to implement, no concrete solution has come up in 2006. Hence, the transition period has once again been extended by one year, till 31/08/2007. The new working group put in place in 2006 has formulated a series of recommendations, with the help of a mediator. End 2006, the Federal Agency for Nuclear Control has submitted a new proposal to the Ministry of Home Affairs.

Activities
In 2006, AVN has been very busy implementing an Integrated Change Plan, which will result early 2007 in a new organisation that is in line with the existing quality system processes and introduces a "mid-management" level to improve AVN's human resources management. In addition, the "customer" relations and the technical quality management have been strengthened respectively by the implementation of a "CRP" (Customer Relationship Process) and a real "Technical Quality Management Process".

The quality system has been further developed (new procedures, performance indicators,…). New tools will be developed to better judge the quality aspects of AVN's technical work.

Human resources
With a workforce of 63 persons, AVN has dedicated 7.625 hours to training activities this year, which represents a 26% increase compared to 2005. The increase is due to training of newly recruited personnel and trainings in the frame of the ICP (communication, management,…).

Abbreviations : see appendix 2
CHAPTER 1

GENERAL MANAGEMENT

1.1. STRUCTURE

Legal requirements

The application of the new Belgian legal context (Law of 15/04/1994 applicable as of 01/09/2001) requires that the execution of the inspection and assessment activities can be delegated to organisations authorised by the FANC on the basis of specifications and of a public tendering process. Further reflections were still ongoing in 2006 to avoid drawbacks of the planned process, especially concerning the risk of losing the expertise presently available in the Belgian Authorised Inspection Organisations (AIO), among which AVN.

Since the quest for a solution is rather complex, the legally foreseen transition period is still ongoing and the present practice for appointing the AIOs is still based on the previous regulation.

AVN organisation in 2006

In 2006 the overall organisation structure of AVN is basically unchanged, but AVN is engaged in an integrated change plan (ICP) preparing a new organisation oriented towards the customer relationship (as in the ISO 9000 philosophy), aligned on AVN processes (process-management), including a new mid-management level, and promoting multidisciplinary approaches.

Special attention was devoted to technical quality by compiling a lot of existing AVN positions or practices and trying to develop guidance for the mid-management to assess safety significance and apply priorities.

People development received a specific attention as people recruitment was increased in 2006. Therefore more active integration and training plans are being developed, and a new career plan is in preparation for 2007.

In the framework of the ICP, tools were developed to follow-up the workload of people in all the activities. The tools are not yet automated, but provide a useful approximate simulation of the forecasted activities of the people.

The implementation of the plan is due in 2007.

Regarding the habitual framework of AVN, regular meetings went on as usual:

The Surveillance Commission met every three months, as planned.

The Scientific and Technical Committee (STC) met on 09/05/2006 and issued encouragements for monitoring the safety culture in the Belgian NPPs, for the preparation of long-term operations of the NPPs, including external communication on the subject, for the preparation to play a key role in the safety assessment of waste disposal installations, and for continuing the efforts to reach a long-term collaboration with the FANC.

AVN activities

The operation of the ISO quality management system introduces some managerial tools to evaluate the performance of the processes. Process operation indicators were developed with that purpose. By the end of November 2006 AVN was successfully submitted to a re-certification audit.

In 2006, AVN pursued its structured development programme in radiation protection inspection (Health Physics of workers as well as in medical radiophysics, aimed at protecting the patients who receive radiological examination or treatment in hospitals). Investments in new expertise, presence in the field and measurement capability were made. Besides more visibility and better description of AVN’s activities, services and legal context is now provided to interested professionals. The professionals, especially the hospitals, continue to favourably welcome this initiative.
Internal communication

The internal communication policy was pursued through official communications and messages, as well as through the periodical informal information sessions, called “sandwich-debates”. This allowed in particular very regular information on the ICP and a training of the personnel on recurrent questions on welfare at work, relations with FANC, ISO quality management system, Electronic Documentation Management system development, projects, external communication. Improvement of the effectiveness of this internal communication is to be considered in the future.

In addition, a specific communication cell – the Active Communication Cell (ACC) composed of 4 AVN personnel members – was launched at the end of 2006. Its aim is to promote company spirit and information exchange by timely neutral communication allowing feedback both top-down and bottom-up.

1.2. HUMAN RESOURCES

The total number of staff on the AVN pay roll is 63 on 31/12/2006. Some shifting occurred in 2006: 9 recruitments and 4 departures. These movements are mainly concerning the technical staff.

The following figure summarizes the characteristics of AVN's personnel.

The majority (83%) of AVN’s staff is “technical”, with high qualification; 86% have academic or superior degrees. The average age is 46 and average seniority is 14 years.

The personnel is more or less evenly distributed among the 4 divisions (see below), knowing that the main characteristic of AVN is that each person usually has different “roles” within the organisation and participates in matrix-structured projects and centres of competencies. This is one of the reasons for AVN's great flexibility and its readiness to very quickly innovate in new projects or activities, making full use of the in-house competencies.

An active training policy is another efficient tool for maintaining and developing the expertise of individuals within AVN. Through the years, depending on the number of staff members and of newly recruited people, the number of hours dedicated to training (external and internal, technical and non technical, formal and non formal) fluctuates between 5,000 and 7,000.

For the year 2006, about 7600 hours have been dedicated to training. As usual, the training organized in 2006 has been mainly technical. However, the 26% hour increase in 2006 is principally due to the training of newly recruited persons and the development of training sessions on new topics, such as communication, management and CRP (Customer Relationship Process).
With respect to the support personnel, AVN has pursued its policy of hiring high quality staff, having the right service attitude in order to simplify the work of the technical staff. A permanent attention is also given to the search of possible productivity improvement in the execution of the administrative tasks in order to be ready to accept new tasks and to avoid monotony.

One of the major non-technical activities in 2006 has been the implementation of the ICP (Integrated Change Plan) which consists of 4 pillars:

1. Technical Quality Management Process
2. Customer Relationship Process
3. People Development Plan
4. AVN Management Process

This integrated change plan should bring AVN to a better way of working in all technical and non-technical domains.

As the assessment of the present functioning of the divisions has shown the necessity for a better sharing of people management as well as for being more in line with the existing processes, the decision was taken in September to implement as from 01/01/2007 a new organization based on a “Process Management” with support from a well-trained Middle Management team.

As to the technical quality management issue, working groups have been created in order to better define the technical policy in AVN and to improve the quality of all technical output.

Another very important pillar of the ICP is the PDP (People Development Process) which includes the implementation of new evaluation and remuneration systems, of a real programme to optimise training and technical integration of people, of “career evolution paths”, all of these tools aimed at helping people in their self-development in a new dynamic way.

Furthermore, the development of a CRP (Customer Relationship Process) will help AVN to improve its present and potential external relationships and to better control all necessary steps in the execution of the customers’ orders.

Abbreviations: see appendix 2
Number of staff members in each Division
Situation end of December 2006

- 2 in GMT (General Management Team)
- 19 in NII (Nuclear Installations Inspections)
- 16 in PEM (Projects & Experience Management)
- 15 in SRD (Studies, Research & Development)
- 11 in HRS (Human Resources & Support)

Abbreviations: see appendix 2
1.3. WORKLOAD

An overview of the workload of AVN technical people is given in the table hereafter in man.hrs for the various types of activities. The total workload amounts to 96360 man.hrs or 58.4 man.year compared to 57.7 in 2005 and 54.3 in 2004.

To be noted are:

- a relative stability in the core business activities of AVN (inspections, PSR, projects): 45757 hrs in 2006 versus 45748 hrs in 2005, although the distribution between the activities has been drastically modified: there is a significant decrease (860 hrs) in inspections of nuclear power plants and also on large operational projects (less than 1000 hrs remain), while there is an increase (1200 hrs) in inspection activities of other than nuclear power plants and in periodic safety reassessments (more than 2000 hrs).

- an increase of 1750 hrs for the activities connected with both Eastern and Western international projects (in particular the assistance in the frame of PHARE and TACIS projects of the European Commission); the level of 5400 hrs will be difficult to increase in the future because PHARE will come to an end as no more projects for the new Member States of the European Union like Bulgaria and Romania will be contracted.

- an increase by 1582 hrs (from 6043 to 7625) of the training activities, mainly due to the recruitment of several new engineers in 2005 and 2006, for which an extensive programme of initial training has been implemented in 2006 and will continue through 2007 and beyond.

- a transfer of scientific non chargeable activities (promotion, working groups in international organisations) towards management activities; the reason is of course the development in 2006 of a new organisation under the impulse of an external consultant, for which a lot of discussions, meetings and training activities have taken place.

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<th>Type of activity</th>
<th>man-hrs.</th>
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<tr>
<td>Inspection during operation and assessment of minor modifications</td>
<td>18.623</td>
</tr>
<tr>
<td>Inspection of installations other than PWR</td>
<td>10.361</td>
</tr>
<tr>
<td>Periodic Safety Reassessments (PSR)</td>
<td>9.261</td>
</tr>
<tr>
<td>Large Operational Projects</td>
<td>975</td>
</tr>
<tr>
<td>Generic Projects</td>
<td>7.397</td>
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<tr>
<td>External Operating Feedback</td>
<td>767</td>
</tr>
<tr>
<td>International projects</td>
<td>5.403</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4.365</td>
</tr>
<tr>
<td>Training</td>
<td>7.625</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>3.565</td>
</tr>
<tr>
<td>Working Groups (IAEA; OECD, EC...)</td>
<td>5.448</td>
</tr>
<tr>
<td>Promotion</td>
<td>1.333</td>
</tr>
<tr>
<td>Management (including some associated training)</td>
<td>22.097</td>
</tr>
<tr>
<td>TOTAL</td>
<td>96.360</td>
</tr>
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Abbreviations: see appendix 2
1.4. EXTERNAL COMMUNICATION

In 2006, AVN continued its action to make its activities transparent to the outside world, among other things by promoting contacts with the media, the political world and other stakeholders.

In this context, the media that appreciate its clear and neutral style of communication, continued to call upon AVN regularly. In particular AVN was interviewed at the occasion of the 20th anniversary of the Chernobyl accident.

In relation with the large scale emergency exercise (see section 2.4), AVN participated in the communication activities organised by the Federal and Local Authorities (press conference, …).
CHAPTER 2 – REGULATORY ACTIVITIES IN BELGIUM

Safety management issue at the Belgian Nuclear power Plants

The new organisation (called NUC21+) of the Utility was put into place. This new organisation reallocated responsibilities among the different departments of the NPPs. All departments on the sites were put under the direct responsibility of the site manager, and the operations department came at the center of the process.

Overview of inspections performed in the Belgian nuclear installations

AVN unit inspectors carry out consistent inspections during operation of the Belgian nuclear facilities as required by the regulations. In 2006, more than 600 inspections were carried out. The goal of the inspections is to verify compliance with the operating licence, as well as the licensee’s safety organisation and culture.

In 2006, eighteen events that occurred in the NPPs and four events in the other nuclear facilities have been rated as level 1 (anomaly) on the INES. One event, which is taking place at the unit 1/2 of Doel, has been rated as level 2 on the INES. The major event in 2006 was the overexposure of an employee at the Sterigenics irradiation facility, which has been rated as level 4 on the INES.

Emergency preparedness & response

The close collaboration with the French counterparts (IRSN) in the Emergency & Response area has been continued by regular contacts and exchanges between experts from the two organizations. In addition to the Belgian exercises, AVN participated at the French Chooz NPP exercise.

Medical radio-physics

AVN continued the Quality control activities of use of ionizing radiation in the areas of radiology services and nuclear medicine. An annual independent check of the system’s performances introduces some safety insurance for the patients.

CHAPITRE 2 – ACTIVITES REGLEMENTAIRES EN BELGIQUE

Gestion de la sûreté dans les centrales nucléaires belges

La nouvelle organisation (appelée NUC21+) d’Electrabel a été mise en place. Cette nouvelle organisation redistribue les responsabilités parmi les différents départements des centrales nucléaires. Tous les départements des sites ont été mis sous la responsabilité directe du directeur de site, et le département « Operations » a été placé au cœur du processus.

Bilan des inspections exécutées dans les installations nucléaires belges

Conformément à la réglementation, les inspecteurs d’AVN effectuent des inspections régulières durant le fonctionnement des installations nucléaires belges. En 2006, plus de 600 inspections ont été effectuées. L’objectif de ces inspections est de vérifier la conformité l’autorisation d’exploitation, ainsi que l’organisation et la culture de sûreté de l’exploitant.

Planification d’urgence et organisation de crise

La collaboration étroite avec les homologues français (IRSN) dans le domaine de la planification d’urgence et de l’organisation de crise a été poursuivie par des contacts et des échanges réguliers entre les experts des deux organisations. En plus des exercices belges, AVN a participé à l’exercice de la centrale nucléaire française de Chooz.

Radio-physique médicale

AVN a poursuivi les activités de contrôle de la qualité de l’utilisation des rayonnements ionisants dans les domaines de la radiologie et de la médecine nucléaire. Un contrôle annuel indépendant des performances des systèmes procure une certaine garantie de sécurité au patient.

HOOFDSTUK 2 – REGLEMENTAIRE ACTIVITEITEN IN BELGIË

Veiligheidsbeheer in de Belgische kerncentrales

De nieuwe organisatie (NUC21+ genaamd) van Electrabel werd geïmplementeerd. Verantwoordelijkheden werden hervorderd over de verschillende afdelingen van de kerncentrales. Alle afdelingen op de sites worden onder de rechtstreekse verantwoordelijkheid van de site manager geplaatst, en de afdeling “Operations” neemt nu een centrale plaats in het proces in.

Overzicht van de uitgevoerde inspecties in de Belgische nucleaire installaties

Overeenkomstig de reglementering voeren de inspecteurs van AVN reguliere inspecties uit tijdens de werking van de Belgische nucleaire installaties. In 2006 werden meer dan 600 inspecties uitgevoerd. Het is de bedoeling van dergelijke inspecties om na te gaan of de werking stroomt met de uitbatingsvergunning, alsook de organisatie en de veiligheidscultuur van de exploitant te verifiëren. In 2006 werden acht contacten in kerncentrales en vier in andere nucleaire installaties op niveau 1 (anomalie) van de INES geklasseerd. Een gebeurtenis, die plaatsvond in eenheid 1/2 van Doel werd op niveau 2 van de INES geklasseerd. De belangrijkste gebeurtenis in 2006 was echter de overmatige blootstelling van een werknemer in de betalinginstallatie Sterigenics; deze werd op niveau 4 van de INES geklasseerd.

Noodplanning en crisisorganisatie

De nieuwe samenwerking met de Franse tegenhanger (IRSN) op het vlak van noodplanning werd verder gezet via regelmatige contacten en uitwisseling tussen deskundigen van beide organisaties. Bovendien de Belgische oefeningen nam AVN ook deel van de Franse oefening in de kerncentrale van Chooz.

Medische stralingsfysica

AVN heeft haar activiteiten verder gezet inzake controle op het gebruik van ioniserende stralingen in de radiologie en de nucleaire geneeskunde. Een jaarlijkse onafhankelijke controle op de werking van de systemen biedt een zekere veiligheidsgarantie voor de patiënt.

Abbreviations : see appendix 2
What is the International Nuclear Event Scale (INES) ?

The principle of the INES scale is identical to the principle of scales for measuring the seriousness of some natural phenomena (earthquakes, winds…). It aims at making easier the perception of the significance of incidents or accidents in nuclear installations.

Only events having an impact, even potential, on the nuclear safety of the installations are considered in this scale. Events are rated on a scale at seven levels, from 1 (anomaly) to 7 (major accident), according to their importance.

Events, which have no nuclear safety significance are termed “deviations” and are rated below scale, or level “0”. Events, which have no nuclear safety relevance are termed “out-of-scale”.

What is the goal of the inspections performed by AVN ?

As authorized inspection organisation, AVN performs permanent inspections during operation of the seven Belgian nuclear power plants. These inspections are required by the Belgian regulations.

The main goal of these inspections is to verify compliance with the license, as well as to assess the licensee’s safety management.
CHAPTER 2
REGULATORY ACTIVITIES IN BELGIUM

2.1. GENERAL ASSESSMENT OF NUCLEAR INSTALLATIONS

Nuclear Power Plants

As mentioned last year, Electrabel proposed to improve the existing organisation. The changes essentially intended to clarify the relationships between the sites and the supporting department belonging to the headquarters, and to reorganise the activities of operation, maintenance and assets. The new organisation (called NUC 21+) reallocated responsibilities among the different departments. An Engineering support department was created and the Assets cluster was suppressed. All departments on the sites were put under the direct responsibility of the site manager. The new proposed organisation was thoroughly discussed with AVN and, after some adjustments and clarifications were made, this organisation was approved by the end of April. The essential administrative procedures were available at the implementation stage. The additional set of important administrative procedures was produced by the end of June as agreed with Electrabel.

The new organisation included significant amounts of additional staff members, as well as some changes in the management staff.

Although some improvements of the revised organisation for operation were noticed, a significant number of events related to safety were observed. This at least apparent discrepancy is partly due to increased attention paid to the collection of information and to the implementation of enhanced quality control systems.

Other nuclear facilities

The overexposure accident in the irradiation facility at Sterigenics underlines the vital importance of strictly and fully applying the access procedures to the controlled area. Although simple in operation, these installations can present a very high risk to the workers, which, possibly due to routine and habit, can be underestimated by the Licensee.

Although nuclear consequences were not significant, the fall event of fuel elements at the BR 1 reactor has to be considered with increased attention. This kind of event could indicate that the implementation of the procedures is not always performed with the appropriate rigor.

No further degradations of the liquid waste discharge line of Belgoprocess were observed indicating that this issue seems to be solved. The release of some limited contamination into the site shows that the follow-up of decommissioning activities can be improved and that even small changes to foreseen activities should be carefully examined.

The social negotiations resulting from the definitive stop of activities at the Belgonuclear MOX plant caused some social unrest but with no consequences for the nuclear safety.

Several limited contamination incidents and Xe releases occurred at the IRE site during the production of radioactive isotopes. Although these events had no significant consequences, the activities performed on this site deserve sustained follow-up and monitoring.

Abbreviations: see appendix 2
The situation in Class II and III installations with regard to the respect of regulation is still slightly improving. The FANC is pursuing its information campaigns to remind the users of their duties with respect to RD of 2001.

2.2. OVERVIEW OF INSPECTIONS IN NPPs

The regulations require permanent inspections during operation of the 7 Belgian nuclear units. The goal of the inspections is to verify compliance with the license, as well as to assess the licensee’s safety management and safety culture. In 2006, more than 400 inspections have been performed in the 7 Belgian nuclear units.

An overview of the main inspection activities by AVN inspectors is given hereafter for each unit. The major activities performed during the 2006 outages and the most significant events in the NPPs as well as a table containing the characteristics of the current fuel cycles of the 7 reactors are described in Appendix 1.

In 2006, one event has been rated as level 2 on the INES and 18 as level 1.

**Doel 1/2**

One reactor trip occurred at Doel 2 because of an electrical fault in the control rod system.

The following event has been rated as level 2 on the INES:
- non compliance with leaktightness criteria of the motors of the reactor buildings internal ventilation system (for both units).

Three events have been rated as level 1 on the INES:
- late testing of a filter of the annulus ventilation system;
- inadequate withdrawal from service of the filters of the nuclear auxiliary building ventilation system;
- inadequate requalification of a primary containment isolation valve of the ventilation system.

During the annual outage of Doel 2 all baffle bolts of the reactor internals were inspected. Bolts with indications of degradation and some bolts at susceptible places were replaced.

During the annual outage of Doel 1 one steam generator was extensively inspected. The known corrosion phenomena remain stable and no new corrosion was discovered.

During a heat wave this summer the chilled fluid system of the electrical systems building showed under capacity with respect to its design characteristics.

**Doel 3**

The unit was at nominal power during the whole year, except for
- the stretch-out that started on May 12. The power was at 88,1 % of the nominal power at the beginning of the refuelling outage;
- the refuelling outage from June 16 until July 25;
- a loss of 230 MW due to the failure of a transmitter in the turbine speed control on January 21. On January 22 full power was reached again.

Four events have been rated as level 1 on the INES:
- deviation of Technical Specifications due to their incorrect implementation on the minimal pressure of the safety injection accumulators;
- unavailability of the overspeed protection of the single-failure-proof travelling crane above the spent fuel storage pool;
- unavailability of the emergency breaks of the single-failure proof-crane above the spent fuel pools;
- deviation from qualification requirements for the motors of the residual heat removal system and of reactor building internal ventilation system.
**Doel 4**

During the cycle of the unit:
- reactor trip due to control rods’ drop
- increase of the amounts of recuperated condensates in the reactor buildings due to a blown-out packing on an isolation valve of one of the bypasses of the primary circuit legs

Two events have been rated as level 1 on the INES:
- deviation from qualification requirements for the motors of the residual heat removal system and of reactor building internal ventilation system;
- trip of safety diesel generators during a capacity test due to a tagging error on the cooling system.

During the annual outage, the doors with inflatable seals of the main hatch have been replaced by doors with a passive sealing system, improving the reliability of the containment (especially for severe accidents). Also, the ten-yearly leakage test of the primary containment was successfully performed.

This year, the first phase of the reracking of the spent fuel pool has been terminated: one of the two spent fuel pools has been completely reracked. This first phase has been characterised by project management weaknesses in terms of anticipation and oversight. The difficulties that occurred led to an important delay of the end of the first phase. The second phase of the reracking that should have ended before the outage, was not started and postponed until May 2007.

**Doel - Common activities**

**WAB (liquid and solid waste treatment facilities)**

The conditioning of filters, ion exchange resins, evaporator concentrates, metal scrap and activated fuel assembly components has been carried out in conformance with the qualification files and associated procedures approved by the waste agency ONDRAF/NIRAS.

At the beginning of the year, a general overhaul of the facilities took place, during which for instance the instrumentation and control of the concrete conditioning facility and of some evaporators was replaced.

Additional equipment was installed to sort out and pre-condition miscellaneous solid radioactive waste to be conditioned together with evaporator concentrates. This type of waste has in the past been treated by means of a mobile installation.

**SCG (Spent Fuel Dry Interim Storage Building)**

In 2006, 2 type TN24Sh casks were loaded with spent fuel from Doel 1/2 and stored in the interim storage building. These activities were performed without any particular problem.

Maintenance activities consisted in the replacement of the pressure transducers of the pressure monitoring system of 7 casks.

During the summer, a temperature measurement campaign was carried out to verify the respect of the thermal design criteria of the casks.

**GSG (Used Steam Generator Interim Storage Building)**

Nothing particular is to be mentioned.

**Tihange 1**

The unit was at nominal power during the whole year, except for:
- a reactor trip, due to a failure of an electronic component of a non safety related device;
- a reactor trip during a periodic test on main feedwater valves;
- two reactor trips (at low power) due to closure of a main feedwater valve (induced by the failure of a relay);
- a reactor trip, due to the failure of an electrical breaker.

Abbreviations : see appendix 2
Two events have been rated as level 1 on the INES:
- unavailability of the inhibition of non essential protections of the standby diesel generator;
- unavailability of one of the two main pumps of the fire protection circuit.

**Tihange 2**

The unit was at nominal power during the whole year, except for:
- an unplanned hot shutdown from January 5 to 7 in order to replace one phase of the main transformer (24/380 kV), which showed abnormal heat-up.
- an unplanned hot shutdown on February 10 in order to replace the rupture diaphragm of a not safety related steam tank in the turbine hall.
- a reactor trip on January 29, due to a tagging error by an operator on an electric board (115 VDC).
- a reactor trip on February 26, induced by a low steam generator level and water/steam flow rate mismatch due to the loss of a steam flow rate instrumentation channel.
- the refuelling outage, from August 5 to September 23;
- a reactor trip at 15 % of nominal power due to turbine trip, during plant shutdown
- two reactor trips at low power, during power increase after outage, induced by the protection system and due to main turbine control instabilities;
- a reactor trip during power reduction in order to repair a leaking valve on the excess letdown heat exchanger system.

Three events have been rated at level 1 on the INES:
- on February 26, the auxiliary feedwater turbine driven pump tripped again by overspeed as it started automatically after the reactor trip. This occurred already during a hot shutdown in October 2005 and during a previous reactor trip. The availability of this pump since the last outage (April 2005) has been considered as uncertain;
- Inadequate maintenance frequency of two motors of the residual heat removal system;
- Connection error of the fuel feeding pump of the “spare” stand-by diesel generator not identified by requalification tests. Wiring error on a 380 V auxiliary board (replaced during the 2006 outage) of the spare diesel generator (used to replace unavailable safety diesels on the Tihange site).

**Tihange 3**

The unit was at nominal power during the whole year, except for:
- the refuelling outage, from February 28th to April 19th.
- a reactor trip, due to a defect on the electrical supply system of sensors on the main feedwater pumps;
- a planned outage in December in order to fix a steam leak at the temperature sensors on the turbine. A reactor trip occurred during the power decrease.

Another event should be mentioned:
- the cooling tower was bypassed till April 24th, due to interventions on its internal structure. This bypass, combined with the low flow rate of the Meuse river, forced the unit to perform a number of load variations in order to comply with the legal thermal discharges constraints.

Four events have been rated as level 1 on the INES:
- exceeding of the maximum unavailability delays as required by the technical specifications of an auxiliary feedwater valve.
- some fire extinguishers were unavailable since the refuelling outage;
- a valve on the containment spray system was unable to move due to a misalignment of its electrical cell;
- limited release of gaseous effluents, during an intervention on a compressor of the gaseous waste treatment system (far below the annual limit, but beyond the daily limit).

**Tihange – Common activities**

The OSART preparatory meeting took place in February and the site inspector actively participated to the preparations and discussions. The OSART project was further followed up during monthly meetings with the Utility project manager. The results of the efforts made by the plant staff are becoming more and more visible. This has also a positive effect on personal attitudes. People are keener to identify and communicate deviations they notice. The support obviously brought by the general management to the project induces better motivation of plant personnel and willingness to improve safety.

The inspection programme on the site was further implemented as follows:
- follow-up of the activities linked with emergency planning and fire protection on the plant (training programme, organisational aspects, tools, legal exercise,…);
- Several detailed discussions with the site manager were held to follow up the implementation of the action plan to reduce the back-log in activities and to monitor the implementation of the new organisation (NUC 21+);
- Meetings with the managers of the Operation, Care and Maintenance Departments.

### 2.3. OVERVIEW OF INSPECTIONS IN OTHER NUCLEAR FACILITIES

In 2006, about 230 inspections have been performed in the nuclear facilities other than NPPs.

The significant activities and events in those facilities are summarised below. Events are described in more details in Appendix 2: one event has been rated as level 4 on the INES and four as level 1.

**Major event in 2006: Overexposure of employee in irradiation facility (INES level 4)**

On Saturday March 11th, a senior operator was called back because of recurring high-level alarms on the gamma monitors of the Gammir II installation. The door of the irradiation cell was open and the cell was empty; Gammir II was in shutdown at that time. He reset the monitors and verified that the alarms were not reappearing. He then decided to close the door of the irradiator. In that case, safety regulations require that he enters the cell and switches on a contact located in the back of the cell, thus proving that he verified nobody was inside before shutting the door. He remained in the cell for about 20 s to perform this check. He did not notice any anomaly at this time, neither inside the cell nor outside. He reported that the gamma monitor did not actuate again.

Later that day he suffered from nausea and queasiness but did not relate this to his work. Still later he observed massive hair loss; medical examinations showed he had been severely exposed to about 4,6 Gy.

Computer records of the position of the sources show that the "down" limit switch was actuated at several times during the period where the accident took place. It is assumed that during his short presence in the cell, due to a defect of the hydraulic system, the sources have left their safe position and have risen closer to the surface of the water pool. Further investigations identified that some features of the hydraulic system could have caused the sources’ upwards move.
Nuclear Research Centre (SCK•CEN)

- The working regime of BR2 during 2006 consisted of 3 cycles of 3 weeks and 2 cycles of 4 weeks. During the last cycle, BR2 scrammed due to fluctuation on the external power grid. Some automatic actions by the safety systems were found not to have been performed.
- As a result of an increased release of I-131, the fuel was to be removed from four channels in the BR1 reactor to be able to investigate the fuel elements. As a result of a human error 23 fuel elements fell in the ventilation system of the reactor (INES level 1).
- In February, a transport incident took place between the BR2-HC and the LHMA. When closing one of the packages, loaded with irradiated samples, the sliding door was not locked. It opened during the transport. Neither the carrier nor the operator received any abnormal irradiation (INES level 1).
- In March 2006 a loaded BPIII-container fell during transport and was found to be damaged.

Belgoprocess

- In 2006 the PAMELA installation has been modified by the operator in order to prepare this installation for the processing of waste coming from Belgonucleaire. Several demo-tests in the framework of the reception of this modified installation have been realized in the presence of AVN. The reception PV has been approved by AVN in October and on the basis of this PV a Royal Decree has been issued in December for the operation of the modified installation.
- The authorization case for the dismantling of the installations on the site 2 of Belgoprocess was submitted to the Scientific Council in June for a temporary advice; AVN acting as the reporter on this dismantling case to the Scientific Council.
- In October an incident has occurred in the building “Chaud” of the site 2 leading to limited contaminations of three operators and a merely measurable contamination in the environment. This incident was due to the unexpected blocking of filters and the resulting overpressure inside a tank with rests of contaminated residues. The incident has been rated as level 1 on INES. The causes and the lessons learned from this incident were analysed by the operator and discussed with AVN. It was decided that corrective actions to improve the preventive detection of anomalies and the follow-up of procedures during the daily operations were necessary in the future to avoid this kind of incident.
- A new organisation of Belgoprocess for 2007 has been developed in 2006. The result is a.o. a reduced numbers of departments (coming from 6 to 3: operation, safety and administrative departments).

Belgonucleaire

As announced end of 2005 the commercial MOX production was stopped in the course of 2006, more precisely at the end of August. In the following months the remaining fissile material has been transformed into MOX pellets and rods.

In the mean time BN has submitted to the FANC a safety evaluation report in order to obtain the authorization to dismantle the MOX plant. The dismantling file has been reviewed by AVN. The results of this review have been summarized in a report and presented to the Scientific Board of the FANC on June 16th. After further discussion during a second session of the Board on October 6th, a favourable preliminary preceding advice was pronounced. End of December, the file was transmitted to the 5 municipalities impacted by the dismantling project.

Research Reactor of the University of Ghent (Thetis)

Nothing particular is to be mentioned.
Institute of Radionuclides (IRE) and associated facilities

- In the building 6, which is used in common by IRE and NORDION, the 2 operators have been required from the FANC to discriminate the measurement of their own gaseous release due to their production. Presently only IRE is accountable of the gaseous originating from the production of the building 6.
- The Royal Decree concerning the authorization to extend the building B17, to reorganize the waste management, and to dismantle sealed sources in the building has been edited in September 2006.
- IRE introduced a new authorization to increase Mo-99 and I-131 in building 6 as well as a new authorization for new gaseous and liquid releases limits. The Scientific Board of the FANC gave in December the first preliminary positive advice.
- MDS-NORDION: In the first semester, some incidents occurred in the department of sealed sources production. Mostly they have been blamed on non-compliance to the procedures. Training of operators in procedures has been intensively organised. No incidents occurred in the second semester.

The following events took place at the IRE site and associated installations:
- Sterigenics Belgium: see major event above.
- The annual atmospheric release of I-131 due to the production on the site is equal to 12.1 GBq (0.326 Ci). It is somewhat higher than in 2005 but in the same order as previous years.
- A Sr-90 contamination occurred during the transfer of a flask containing 555 GBq (55 Ci) (INES level 1).
- During the months of October and November, three Xenon releases were observed. They remained well below the authorized release limits for the IRE.
- During the handling of a gamma-radiography camera in the Nordion installations, the Ir-192 source was accidentally ejected in the laboratory because of a failure of the locking pin.

Other facilities

In the Biosource installation, while carrying out labelling operations (I-125), a worker received a thyroid contamination (3000 Bq) as well as a contamination on his trousers. A splashing of I-125 during the labelling manipulations under the exhaust hood caused both contaminations.

2.4. EMERGENCY PREPAREDNESS AND RESPONSE

Emergency response exercises

In 2006, three emergency preparedness and response exercises were organized under the supervision of the General Directorate Crisis Centre of the Ministry of Internal Affairs:
- in September for the Doel NPP with the social and economical issue as main subject;
- in October for the IRE nuclear site (large scale exercise - see below);
- in November for the Tihange NPP with the protection of the food chain and relationships with the agricultural world as main subject.

All these three exercises were prepared, conducted and evaluated according to a new Belgian methodology for preparation, execution and evaluation of emergency preparedness and response exercises. AVN was largely implicated in these exercises, as involved organization but also as ‘controller’ and ‘evaluator’.

In addition, AVN participated in the French emergency and response exercise for the Chooz NPP in June 2006. The main objective for this exercise was to test the interaction between the technical assessment teams of IRSN and AVN.

The first large-scale exercise, organized according to the Royal Decree of October 2003, took place in October 2006. This exercise organized for the IRE nuclear site aimed to test the interaction of all involved organizations at the different levels (on-site, local, federal). A lot of preparatory work took place in terms of scenario development but also in terms of information to the responders and to the general population:
- a general information leaflet was produced and distributed to the population in the vicinity of the IRE nuclear site;
- a general information session open to the public was organized before the exercise;
- an information session for the rescuers was also organized before the exercise;
- training sessions were organized for the first responders.

AVN was associated to these activities.

**Improvement of AVN’s role**

In order to improve the Belgian emergency preparedness and response in case of a nuclear emergency and especially the role of AVN herein:

- AVN staff participated in the Belgian emergency preparedness and response exercises, which, besides the response activities, implied a lot of preparation, observation and evaluation of the response by the AVN-crisis team, by the licensee and by other involved parties (evaluation cell of the governmental crisis centre);
- Four unannounced emergency activation tests were organized. These tests allow to check the availability of the roles of duty of AVN in different conditions;
- The AVN’s Emergency Preparedness & Response coordinator participated to the IAEA OSART mission for the Ignalina NPP, as responsible for the emergency planning and preparedness area (2-21 June 2006)

**International collaboration**

The close collaboration with the French counterparts (IRSN) in the Emergency Preparedness & Response area has been continued by regular contacts and exchanges between experts from the two organizations.

**2.5. MEDICAL RADIO-PHYSICS**

AVN realizes quality controls for apparatus owned by nuclear medicine and radiology services. An annual independent check of the systems’ performances introduces some safety insurance for the patients.

Following the spirit of the Royal Decree of 2001, medical physicists also have to:
- set up procedures and quality control programs;
- optimize, in collaboration with the medical team, the dose delivered to the patient;
- optimize the dose generated by the apparatus;
- write, in collaboration with the medical team, the user’s requirements for new systems;
- accept and calibrate the new apparatus.
CHAPTER 3 – SAFETY ASSESSMENTS & NATIONAL PROJECTS

Safety improvements Doel 1/2
- The evaluation of the auxiliary feed water capacity and the effect of stretch-out conditions on reactor protection have been initiated

Probabilistic Safety Assessments
- The evaluation of the level 1 and 2 PSA studies for Tihange 1 has been terminated
- The scope of future PSA updates of all the Belgian NPPs has been defined
- The review of the extended level 1 PSA study of the BR2 research reactor was accomplished
- The analyses of events in NPPs based on PSA (PSAEA) continued

Periodic safety reassessments
AVN continued the assessment of the safety studies performed in the framework of the periodic safety reviews of the 7 Belgian plants. The corresponding safety improvements need to be implemented within a period of maximum 5 years. AVN reviewed the PSRs of the research centre in Mol and the Belgoprocess site N° 2.

Other activities
- The evaluation of the potential sump clogging issue (Barsebäck) induced the construction of enlarged strainers
- The radiological consequences of a steam generator tube rupture were studied further and a series of improvements were proposed by the licensee.
- AVN reviewed software-based components in the new detection system for toxic gases
- AVN follows up the structural integrity of reactor pressure vessels (RPV in service inspection, RPV head penetrations, under clad cracks, dissimilar weld corrosion issue)

Abbreviations : see appendix 2
CHAPTER 3
SAFETY ASSESSMENTS AND NATIONAL PROJECTS

3.1. SAFETY IMPROVEMENTS DOEL 1/2

At the end of the project devoted to the Power Uprating and Steam Generator Replacement at Doel 2, Electrabel decided to treat some safety problems in the short term, with the aim of finding pragmatic solutions:

- **AF/MW “Auxiliary Feedwater System” and “Degassed and Demineralized Water System”** – Assumptions for calculating the required make-up water capacity.
  
  Safety concern: these systems provide the necessary water capacity to the steam generators in order to bring the plant to hot standby conditions under the hardest conditions. The MW circuit supplies water to the AF tank. A re-evaluation of the required capacity based on updated assumptions was felt necessary.

- **Accidents – Saturation of the temperature measurements in the cold leg during stretch-out conditions** – Impact on the OPDT protection.
  
  Safety concern: under some conditions, and particularly in stretch-out operation, the OPDT protection can become ineffective because of a saturation of the related temperature measurements in the cold leg. The purpose of the evaluation is to check whether an adaptation of the protection parameters is necessary as a result of these findings.

Progress was already made on the second subject.

3.2. THERMAL-HYDRAULIC STUDIES AT REDUCED FLOW AT TIHANGE 3

The activity connected to this project, which has started in 2004, has been quite intensive in 2006. The licensing of a new Westinghouse best estimate methodology, “ASTRUM”, for the study of the Loss of Coolant Accident has been performed, as well as the evaluation of two studies performed by TE based on the use of coupled codes. The project will be completed in 2007.

3.3. PROBABILISTIC SAFETY ASSESSMENT

*Development and Review of PSA*

The AVN review of the PSA study (level 1 and level 2-) of Tihange 1 was accomplished in view of a final evaluation report. Besides a global evaluation of the PSA study, this evaluation report also includes specific recommendations for future PSA updates.

In view of the next Periodic Safety Review, efforts were continued in conducting a preparatory study to establish the scope of the future PSA updates. This preparatory study involves Electrabel, Tractebel and AVN. In 2006, considerable progress was made in the specification of the PSA level 2 update. AVN has substantially contributed to this preparatory study with a structured approach and a significant amount of relevant information and expertise that was compiled, assessed and transformed into proposals to be discussed. This input was mainly derived from AVN recommendations established in previous PSA evaluation reports, from the results of the comparison exercise between the Tihange 1 level 1 PSA and the level 1 PSAs of the French 900 MWe-series PWR and the Koebberg PWRs, from insights gained from the PSA-based Event Analysis program of AVN, from its participation in the SARNet research program, from the WENRA reference levels for PSA (established in 2006), from positions of other regulators and international organisations, as well as from workshops, conferences and publications in literature.

The extended level 1 PSA study of the BR2 research reactor (SCK•CEN, Mol), which had earlier been evaluated by AVN, has now been updated.
ANNUAL REPORT

AVN continued its participation in the comparison of the Tihange 1 level 1 PSA with the level 1 PSA of the French 900 MWe-series PWR and the level 1 PSA of the Koeberg plant (South-Africa). A common paper on the tripartite PSA comparison by IRSN-AVN-NNR, entitled “Improving Quality of NPP PSA by International Comparisons”, has been presented at the PSAM8 conference in May.

For more details on this PSA comparison, as well as for the use of PSA for regulatory inspections, we refer to section 6.3 and related annex of this report on Research and Development.

PSA Application: PSAEA

The PSAEA program (PSA-based Event Analysis) continues to be performed by AVN. This activity is a part of the operational experience feedback process that exists within AVN, which supports the regulatory inspection of the licensees who are responsible for maintaining a properly working operational experience feedback process.

The objectives of the AVN precursor program are mainly focused on (1) the determination of the quantitative importance of a few well-selected operational events per year, and – if sufficiently significant – on (2) the subsequent identification of potential safety issues for improvement (based on the real best-estimate case as well as on relevant what-if questions). AVN considers the identification of potential safety issues for improvement to be among the most important outcomes of the study, because they have the potential to lead to real safety improvements.

From the 88 new NPP events recorded in the incident database, generated by the AVN process of experience feedback, four events have been analysed in detail:

1. Trips of the turbine-driven auxiliary feedwater pump due to overspeed (case 6-1ic). This event is a precursor.
2. Adjustment errors in voltage monitoring relays and in overcurrent protection relays of safety grade 380V electrical boards (case 6-2c). This condition event is a precursor.
3. Failure to open of the four commanding valves of the main steam isolation valves during a test (case 6-3c). This condition event is no precursor.
4. Valves in Component Cooling System fail to open (case 6-4c). This condition event is no precursor.

The studies and their results were presented to the utility for further consideration and follow-up.

The following graph shows a summary of the results of all PSAEA studies performed by AVN in 2000-2006. It contains an order of magnitude for the best-estimate Conditional Core Damage Probability (CCDP) in decreasing order. Moreover, it shows the order of magnitude of the CCDP induced by several credible what-if cases (which – in some cases – induce a considerably larger CCDP than the best-estimate calculation, and which therefore should also be considered when discussing the safety issues involved). An event is considered a precursor if its CCDP is equal to or higher than 1.E-6.

Abbreviations : see appendix 2
A status report on these PSAEA activities was presented at the 9th international meeting on probabilistic precursor analysis, organised by AVN in November.

An AVN-paper on PSAEA was presented at the PSAM8 conference in May: “Risk-Based Precursor Analysis in the Nuclear Industry – Experiences on the National and the International Scene”. Another related paper was presented at the EUROSAFE Forum 2006 in November, entitled “Use of PSA for the Analysis of Operational Events in Nuclear Power Plants”.

For R&D activities undertaken in view of (existing or future) PSA applications and for PSA activities undertaken in an international framework (OECD, IAEA), we refer to section 6.3 and related annex of this report on Research and Development.

3.4. PERIODIC SAFETY REASSESSMENTS (PSR)

Current PSRs

The first three units (Doel 1/2 and Tihange 1) are currently submitted to their third periodic safety review while for the other Belgian units the second PSR is ongoing.

The FANC has been informed of the progress of the current PSRs. It will continue to follow the PSRs, mainly the completion of the planning, a.o. through the Contact Commission meetings.

In particular, the ageing management process has been reviewed. AVN has verified that the global approaches chosen in this framework are adequate in order to ensure a safe operation for at least the ten years to come.

Methodological documents, some of which are still under review by AVN, describe for each subject: the safety concern, the situation before PSR, the objective, the way to tackle the concern, the scope of the studies, the inputs and deliverables, and the planning.

The studies of most of the subjects of these joint periodic safety reviews are underway.
The available conclusions of various subjects are summarized hereafter. Generally, these conclusions are still under review by AVN:

- The analysis of the reference regulations is almost complete and ready to be implemented in the Safety Analysis Reports.
- Some minor modifications of the current ISI/IST program based on ASME, section XI, ed. 1992 are proposed.
- The polar crane of Tihange 1 needs some modifications to be defined more precisely.
- The availability of safety related components in case of high external temperature has been enhanced by means of procedural adaptations.
- The protection of the site against flooding is still under review. Nevertheless some measures have already been taken.
- Safety valves discharging water will be further tested on air, using correlation factors.
- It has been confirmed that software systems are adequately protected against smoke.
- The program for an appropriate update of the PSA studies has been defined and is currently under final review by AVN. It covers modifications to the units, human reliability and an refined definition of operation modes.
- The capacity of the ground water supply to the ultimate sink systems has been enhanced by the drilling of new wells.
- The process of writing, verification and updating of accident procedures has been reviewed and completed.
- Procedures to stabilize incidents while manipulating fuel assemblies have been written.
- An evaluation of the available SAMG using representative severe accident scenarios is underway.
- The follow-up of pre-tensioned containment cables has been re-evaluated; some minor procedural modifications have been implemented.
- Ageing degradations on some elastomers supporting safety-related components have been detected. A follow-up program is under discussion.
- A renovation program of fire detection and protection components is underway.
- Some renovation of concrete buildings has been performed.
- The safety related functions of the various ventilation and smoke extraction systems described in the SARs have been re-evaluated.
- Pipe segments coming under internal pressure under LOCA conditions have been re-evaluated.
- The heat exchangers’ capacity has been reviewed and an appropriate program developed.
- The existing personnel training and qualification programs have been updated and extended to all safety related functions within the Owner’s organisation.
- Knowledge management measures have been defined and implemented at corporate level at Electrabel. A pilot project related to the design basis of the bunker of Doel 3 and Tihange 2 has been completed.
- Various ageing affected (sub-)components have been (re)-inspected and/or re-evaluated, and appropriate measures are being defined in order to ensure a safe operation for at least the ten years to come. This includes: RPVs, primary piping subjected to thermal ageing, baffle bolts, control rod support guide pins, radial guiding of RPV internals, piping affected by thermal stratification, other fatigue or corrosion mechanisms.
- An ALARA policy has been defined at the Tihange site.

**Future PSRs**

Meetings with FANC, Electrabel and Tractebel were held in order to re-define the PSR approach in line with the FANC’s expectations; it is to be confirmed by FANC early 2007. These imply a significant change of the current PSR timing and expected results.
3.5. GENERIC STUDIES (common to all nuclear power plants)

Sump Clogging during the Recirculation Phase (Follow-up of the Barsebäck event)

The objective is to evaluate the potential of sump clogging during the re-circulation phase of an accident, and if necessary to define adequate solutions to this issue.

Based on the NEI-guide, TE and EBL have performed a walkdown during each outage of the Belgian Nuclear Power Plants. A meeting between EBL-TE-AVN was organised after each walkdown to present and discuss the results.

Without waiting for complete sump evaluation guidance, TE/EBL have already started a campaign of strainers enlargements. Six units have already enlarged strainers: Doel 3 will be modified at the next outage.

In parallel, TE and EBL have defined improvements to the procedures after an accident (done for Tihange, in progress for Doel).

The international evolution of this issue is still followed. An approach to assess the re-circulation function remains to be chosen.

Steam generator tube rupture (SGTR; class 3 transient)

The objective of this study is to re-evaluate the radiological consequences after SGTR and to assess the issue of overfilling.

TE has established a synthesis of the work done. A synthesis by AVN is also available. For the scenario leading to tube uncovery, it confirms that the main issues are alleviated thanks to improvements in the hypotheses for the studies and some (proposed) changes in the installations. However a lot of hypotheses have still to be confirmed. The overfilling of the SG is not yet solved, even with the proposed improvements. Specific studies of the installations (if any) should follow in another framework.

3.6. NPPs SAFETY COMPUTER-BASED SYSTEMS

Electrabel decided to install a new system for the detection of toxic gases. This system contains software-based components. AVN reviewed the software qualification report prepared by Tractebel and conducted a software qualification audit at the supplier.

Progress was made in the discussions between EBL/TE and AVN regarding the architecture of (computer-based) I&C systems to replace conventional I&C systems in the years to come.

AVN also performed the safety assessment of a programmable system for the ventilation flow control of a new hot cell at SCK•CEN.

3.7. STRUCTURAL INTEGRITY OF REACTOR PRESSURE VESSELS

In-service inspection program of the reactor pressure vessels (RPV)

As per Section XI of the ASME Code, Edition 1992, the in-service inspection program of the reactor pressure vessels requires that a percentage of the required examination be performed during each inspection period. The 2006 in-service inspection program included the inspection of the reactor vessel of Tihange 2 and 3 and Doel 3.

At Tihange 2, ultrasonic examination (UT) and eddy current testing of the bimetallic butt welds at the inlet and outlet nozzles from the inside diameter (ID) identified crack-like indications at the ID of some welds. Acceptability for continued service up to the forthcoming refuelling outage in September 2007 has been demonstrated by analysis.

Abbreviations : see appendix 2
At Doel 3, inspection of the nozzle shell-to-upper shell weld confirmed the identification of the three indications detected in 2002. In 2002, it was deemed necessary to combine two of those indications as one indication for the flaw acceptance evaluation. During the 2006 inspection, improved UT examination using catch-and-pitch method and simulation thereof using dedicated software allowed characterizing those two indications as two single indications.

**Reactor pressure vessel head penetrations**

In 2006, bare metal visual examination of the RPV upper head surface has been performed at Tihange 3. No evidence of leakage has been identified.

Non-destructive examination of the penetration nozzles of the RPV upper head has been performed at Doel 1 and 4: at Doel 1, no degradation has been evidenced on the penetration nozzles, including the nozzles repaired in 2005, while, at Doel 4, no degradation has been reported.

**Primary Water Stress Corrosion Cracking (PWSCC) of the dissimilar metal (DM) butt welds**

PWSCC of the DM butt welds made of Alloy 182 is a significant safety issue. The discussions with EBL/TE about the augmented in-service inspection program of the DM butt welds were still going on in 2006.

**Underclad cracks in the core shell of the reactor pressure vessels**

EBL/TE have initiated an answer to the conclusions of the evaluation performed by AVN related to the assessment of the structural integrity of the reactor pressure vessels for underclad cracks in the beltline region.
Main activities

- Active participation in international organizations, in particular the committees and working groups of the IAEA, OECD and EC.
- Participation in many projects of assistance to the regulators of Central and Eastern European countries in the frame of Phare and Tacis projects of the EC.
- Performance of safety related activities at the request of the Dutch authority KFD (VROM).
- Cooperation with Western European Safety Authorities:
  - Participation in Working Groups and committees with the French Safety Authorities.
  - Enhanced cooperation with GRS and IRSN, in particular for the joint organization of Eurosafe 2006 in Paris.
  - AVN participated in the definition of the Belgian action plan to eliminate some gaps between the WENRA (Western European Nuclear Regulators Association) reference levels for PWRs and the Belgian situation. AVN participated in the waste storage and decommissioning (WGWD) meetings and assisted the FANC in a self assessment exercise regarding the Belgian legal framework.
- Launching of the European TSO Network with GRS and IRSN.
- The harmonization of licensing practices for nuclear safety critical software, started in the NRWG of the EC, was continued under AVN’s chairmanship; the report will be finished in 2007.

Activités principales

- Participation active dans les instances internationales, en particulier dans les comités et groupes de travail de l’IAEA, l’OCDE et la CE.
- Participation dans plusieurs projets d’assistance aux régulateurs des pays d’Europe Centrale et d’Europe de l’Est, dans le cadre des projets Phare et Tacis de la CE.
- Activités liées à la sûreté, à la demande des autorités des Pays-Bas KFD (VROM).
- Coopération avec les Autorités de Sûreté d’Europe Occidentale :
  - Participation à des Groupes de Travail et comités avec les Autorités de Sûreté françaises
  - AVN a participé à l’élaboration d’un plan d’action belge pour combler les lacunes entre les niveaux de référence WENRA (Western European Nuclear Regulators Association) pour les centrales nucléaires et la situation en Belgique. AVN a également participé aux réunions pour le stockage de déchets et le déclassement (WGWD) et a assisté l’AFCN dans un exercice d’auto-évaluation relatif au cadre légal belge.
  - Lancement du réseau de TSO européen avec GRS et IRSN.
  - L’harmonisation des pratiques d’autorisation pour des logiciels liés à la sûreté nucléaire, laquelle a débuté dans le NRWG de la CE, a été poursuivie sous la présidence d’AVN ; le rapport sera terminé en 2007.

Belangrijkste activiteiten

- Actieve deelname aan internationale organisaties, in het bijzonder de comités en werkgroepen van het IAEA, de OESO en de EC.
- Deelname aan diverse projecten voor bijstand aan Centraal- en Oost-Europese reglementaire instellingen, in het kader van de Phare en Tacis projecten van de EC.
- Uitvoeren van veiligheidsgebonden activiteiten op vraag van de Nederlandse overheid KFD (VROM).
- Samenwerking met West-Europese Veiligheidsoverheden:
  - Deelname aan de Werkgroepen en comités met de Franse Veiligheidsoverheid.
  - Intensievere samenwerking met GRS en IRSN, in het bijzonder voor de gezamenlijke organisatie van Eurosafe 2006 in Parijs.
  - AVN nam deel aan de opstelling van het Belgisch actieplan voor het overbruggen van een aantal hiaten tussen de WENRA (Western European Nuclear Regulators Association) referentieniveaus voor kerncentrales en de situatie in België. AVN nam deel aan de vergaderingen inzake afvalopslag en declassering (WGWD) en stond het FANC bij voor een zelfevaluatie-oefening rond het Belgisch wetelijk kader.
- Lancering van het Europees TSO-netwerk met GRS en IRSN.
- De harmonisering van praktijken voor de vergunning van nucleaire veiligheidsgebonden software, die gestart werd in de NRWG van de EC, werd onder het voorzitterschap van AVN verder gezet; het verslag zal in 2007 worden afgerond.
CHAPTER 4
INTERNATIONAL ACTIVITIES AND PROJECTS

4.1. EC ACTIVITIES

AVN participated in the activities of the Working Party on Nuclear Safety (WPNS); this group started early 2005 the establishment of a report in order to answer the two following questions:

1. What has been accomplished in the international contexts of the Convention on Nuclear Safety, WENRA, the IAEA work on safety standards, the OECD/NEA, and the EC-groups with regard to common approaches, positions or consensus on key nuclear safety and regulatory issues, and how are these common approaches reflected at the national level of the EU Member States?

2. Are there any justifiable reasons to add something to current practices of the mentioned international contexts from the EU point of view?

The report was finalized end of 2006. The Deputy Director General of AVN was in charge of the task examining the impact of the EC-groups.

Other activities in relation with the EC nuclear safety assistance to the Eastern European countries are described in section 4.5.

4.2. OECD ACTIVITIES

AVN participated in the activities of the following Committees, Working Groups or meetings:

- the Committee on Nuclear Regulatory Activities (CNRA) and its bureau;
  At the CNRA International Conference on Improving Nuclear Safety through Operating Experience Feedback (Köln, March 29-31), AVN’s Director-General made a presentation entitled “The Use of Operating Experience by AVN”. Another AVN representative made a presentation entitled “The relationship between risk analysis and event analysis – PSA based Event Analysis”;
- the Committee on the Safety of Nuclear Installations (CSNI);
- the Nuclear Science Committee (NSC);
- the CNRA Working Group on Inspection Practices (WGIP);
- the CNRA Working Group on Operating Experience (WGOE) and the CNRA WGOE Task Group on Improving International Operating Experience Feedback;
- the CNRA Working Group on Public Communication (WGPC);
- the CSNI Working Group on Fuel Cycle Safety (WGFCFS);
- the CSNI Working Group on Risk Assessment (WGRISK) and its Bureau;
- the CSNI Working Group on the Analysis and Management of Accidents (GAMA);
- the CSNI Working Group on the Integrity and Ageing of Components and Structures (IAGE), and its subgroups on the integrity of metal components and structures, and on the ageing of concrete structures;
- the CSNI Working Group on Human and Organisational Factors (WGHOF);
- the CSNI Working Group on Fuel Safety Margins (WGFSM);
- the Radioactive Waste Management Committee (RWMC), to which AVN participated for the first time. AVN also participated to the Workshop on Long Term Safety Criteria;
- various OECD projects;
- the IRS coordinators meetings.
4.3. IAEA ACTIVITIES

AVN participated in the following activities of the IAEA:

- the Committee on nuclear safety standards (NUSSC); The last version of the unified “Safety Fundamentals” was discussed and finally approved for submission to the Commission of Safety Standards; it consists in 10 principles, many of them related to radiological protection aspects. The first drafts of the Requirements and some guides belonging to the thematic area “Safety assessment and verification” were commented. In the fall meeting the proposed new structure for the IAEA standards was presented by the IAEA, and many comments and suggestions were made.


AVN experts also participated in the following meetings:

- the technical meeting to develop a safety guide on “safety assessment for radioactive waste disposal facilities” (March 6-10);

- the 3rd Coordination Meeting of the Coordinated Research Project ASAM (March 27-31);

- the Biennial Technical Meeting of the International Nuclear Event Scale (INES) National Officers

- the Expert Consultancy Meeting on “Implementing and Licensing Digital I&C Systems and Equipments in Nuclear Power Plants” (September 6-8).

4.4. COOPERATION WITH WESTERN SAFETY AUTHORITIES

Franco-Belgian Working Group on nuclear safety

This working group, originally created in the frame of the construction of the Chooz B NPP, is composed of the regulatory organizations (DGSNR, IRSN, FANC, AVN). Two meetings are organized each year, one in Paris and the other in AVN.

The working group covers a large range of subjects on nuclear safety, such as cross-inspections, inspection practices and information exchange related to the NPP operation. The working group can also initiate specific studies like PSA-studies comparison.

The following main topics were discussed during the two 2006 meetings: status of the Chooz NPP, cross-inspections, exchange on the containment sump filters clogging, PSA-studies comparison, activity in the primary circuit & radiological consequences, human factors, use of PSA, thermal fatigue, periodic safety review methods, the Sterigenics accident, the OSART mission foreseen in Tihange.

Franco-Belgian Working Group on radioactive waste management

In connection with the Franco-Belgian Group on nuclear safety, another working group, composed of the same regulatory organizations and of the waste management agencies (ANDRA, ONDRAF/NIRAS), has been active for several years to cover all aspects of radioactive waste management.

In 2006, no meeting of this group on radioactive waste management was held. The working group will be reactivated around mid-2007.

European Seminar on the Safety Approach related to Geological Disposal of Radioactive Waste

After the second European Seminar on the safety approach related to geological disposal of radioactive waste which took place in Brussels in May 2005, regulators from Belgium, Finland, France, Germany, Spain, Sweden, Switzerland, and UK and members of EC and IAEA have decided to launch a pilot project. The main objective of this project is the elaboration of a consensus advisory document on the expectations...
of the regulator on safety related elements of a safety case for geological disposal of radioactive waste at the different levels of development.

Several meetings were organized in 2006 (Madrid, London, Paris and Vienna (2)).

Two documents were elaborated:

- One dedicated to the “Uncertainty Management”.


FANC and AVN respectively participated to the elaboration of the first and second document.

A meeting will be organized in April 2007 in order to present the outcome of the pilot project and decide about the future orientation of the working group on radioactive waste management.

**Other cooperation activities between France and Belgium**

The Groupe Permanent Réacteurs (GPR) discussed in 2006, among other topics:

- The knowledge management for the operating personnel of PWR’s;

- The safety assessment of EPR, summarizing the work done on the PSAR before the issuance of the Creation Authorization Decree of Flamanville 3;

- The radiological consequences of design basis and severe accidents;

- A very interesting presentation of the R&D related to severe accidents;

- Participation in the every four year meeting of the Advisory Committees of France, Germany, Japan and the USA, this time in Washington.

Two AVN representatives, involved in a Franco-Belgian working group on radiological consequences, were offered the possibility to attend a meeting of the GPR concerning the evaluation of radiological consequences of accidents for PWR and EPR.

An AVN representative was offered the possibility to attend a meeting of the Groupe Permanent Déchets (GPD) concerning the revision of the safety analysis report of the “Centre de stockage de l’Aube”.

**Cooperation with IRSN**

Since 2003, an agreement is signed between IRSN and AVN in order to promote the cooperation on nuclear safety and radioprotection between the two organizations. This agreement covers e.g. the exchange of information on a voluntary basis with no payment between the parties, each of them making available its own expertise to the other. In this framework, different areas of cooperation could be defined in a separate document called “specific theme of cooperation”. Four themes are now active and several meetings and information exchanges on these subjects took place in 2006. Some discussions were started in order to further extend the cooperation to other themes such as fire protection.

**Western European Nuclear Regulators Association (WENRA)**

The Federal Agency for Nuclear Control (FANC) and AVN represent Belgium in WENRA.

**RHWG (Reactor Harmonisation Working Group)**

In January 2006, AVN presented the results of the benchmarking performed by AVN to the Licensees and FANC. This presentation was intended to inform the Licensees on these results, in advance of the International Seminar organised in Brussels on February 9.

In spring, discussion started between FANC and AVN for developing the Belgian Action Plan. In June, these discussions were enlarged towards Electrabel and its architect-engineer Tractebel Engineering.
In accordance with the deadline set by WENRA, the Belgian Action Plan was transmitted to WENRA at the end of October. AVN contributed in an important way when defining the required actions concerning implementation of the Reference Levels in the nuclear power plants.

AVN was also active in the effort related to the consideration of the detailed comments (mainly from ENISS) on the RLs. In July, AVN hosted the meeting of a sub-group of RHWG-members preparing a first proposal for dealing with the comments. Later, AVN also participated in the full RHWG-meeting in September.

**WGWD (Working Group on Waste and Decommissioning)**

AVN participated in the WGWD-meetings, held in April (Rome), July (Bratislava) and October (Stockholm). The outcomes of these meetings were discussed with the FANC.

In the last trimester of 2006, the FANC performed a first self-assessment concerning the “Legal side” on the Reference Levels related to waste management. AVN (taking into account its experience with the RHWG-self-assessments and benchmarking) reviewed this Belgian self-assessment and comments were discussed with FANC.

**WENRA Task Force on Safety Critical Software**

This European task force has pursued its activities on the harmonization of licensing practices for nuclear safety critical software, under the chairmanship of AVN. Other current members are BfS and ISTEc (Germany), CSN (Spain), DGSNR and IRSN (France), NII (UK), SKI (Sweden) and STUK (Finland). At the end of 2005 when the NRWG activities were suspended by the EC, the task force joined the WENRA organisation under the auspices of which the work is being pursued.

Two residential meetings were held in 2006, in AVN and at the Consejo de Seguridad Nuclear, Madrid. Great progress has been made. New topic areas have been addressed - such as the safety demonstration, the reliability and the diversity of software based systems - that are known to be problematic and for which guidance will be extremely beneficial. The use of pre-existing software in safety systems and the evidence that can be obtained from operating experience are other difficult areas that were attended too. A report is in preparation.

**Cooperation between GRS/IRSN/AVN: launching of the European TSO network**

Early 2006 GRS, IRSN and AVN decided to strengthen their collaboration by creating a so-called Eurosafé Association. A Memorandum of Understanding was signed end of May creating this European TSO network and outlining the objectives and associated activities.

The first Assembly meeting was held at AVN in October. Rules of procedures were agreed upon, a definition of the concept of TSO was adopted, to be used as a yardstick for new members, and an action plan for the next two years was drafted.

**Eurosafé Forum**

AVN is represented in the Eurosafé programme committee. The committee met in Paris in February and in Stockholm in June in order to prepare the Forum which took place in Paris in November. AVN presented several papers in the plenary and in the technical sessions of the Forum.

**KFD (The Netherlands)**

AVN continues to co-operate with the Dutch nuclear authority in the area of nuclear safety inspection and periodic safety reviews.
4.5. ASSISTANCE PROJECT TO THE NUCLEAR REGULATORS IN CENTRAL AND EASTERN EUROPE

Armenia

AVN is providing assistance to the Armenian Nuclear Regulatory Agency (ANRA) through several Tacis-financed projects:

- support in regulatory matters, such as emergency plan, pyramid of regulatory documents, inspection practices, training, quality system, radioactive sources and review of the SAR; AVN is the Technical Project Leader for this project (AR/RA/03);
- assessment of design and operational safety aspects of the Medzamor NPP (project AR/TS/04);
- regulatory aspects of decommissioning (project AR/TS/05).

AVN is the country coordinator for Armenia and maintains regular contacts with other donors like USNRC, IAEA, SUJB and the UK in order to have a coherent and non-overlapping approach.

Under the frame of a generic Tacis project (called Tareg), the impact of the Tacis assistance on the regulator (ANRA) and its TSO, the Nuclear Regulatory Support Centre (NRSC), was investigated. The corresponding report has been reviewed and approved by ANRA and the NRSC.

Bulgaria

AVN continued to co-operate with the BNRA in particular in a Phare project contracted by the Centralized and Financial Contracting Unit of the Ministry of Finance for the assessment of severe accident management guidelines for the Kozloduy NPP. The work was completed in 2006.

AVN is participating in another Phare project, addressing regulatory issues related to the decommissioning of the units 1 and 2 of Kozloduy NPP.

Ukraine

Within the Tacis project UK/TS/26 (licensing related safety evaluations of the decommissioning facilities of the Chernobyl NPP) AVN was the task leader for the safety evaluation of the engineered near surface disposal facility. This was carried out in cooperation with NIRAS/ONDRAF, the State Nuclear Regulatory Committee of Ukraine (SNRCU) and its TSO, the Ukrainian SSTC-NRS. This Tacis project was implemented under the project leadership of Riskaudit and the technical management by GRS and IRSN. The SNRCU has used the recommendations made by Riskaudit/SSTC in its licensing process. A revised safety analysis report, which should be the basis for the commissioning of the near surface disposal facility, was submitted and analysed. The results indicate that further improvements of this report are necessary in order to reach an internationally acceptable level.

AVN participated in Tacis-funded activities related to the new NPPs (Khmelnitsky 2 and Rovno 4). These activities covered the analysis of their quality management programmes as well as safety related plant modifications through local inspection visits. AVN is also participating in projects to support the licensing of plant improvements in Zaporozyhe NPP and in the development of commissioning procedures and related inspections.
Further the impact assessment of the regulatory assistance that has taken place since 1994 within the Tacis programme was investigated under the frame of a generic Tacis project (Tareg).

In the Tacis project UK/RA/06, AVN is participating in several activities related to quality management, electronic documentation management, international project management and management of licensing activities. One expert is taking part in the regular oversight of the assistance provided by two western senior experts to the SNRCU management.

**Russian Federation**

Reviews have been made of regulatory documents that are part of the Russian regulatory framework related to the manufacturing of mixed oxide fuel.

AVN is participating in a two-year Tacis project of regulatory assistance to the Nuclear Safety Authority of the Russian Federation Rostechnadzor (project RF/RA/06):
- Senior Advisory Group, with the objective to advise Rostechnadzor on their regulatory strategy, system and practices, to support them in their relations with the Russian Parliament and Government and in the implementation of the obligations of the Nuclear Safety Convention;
- Advise to Rostechnadzor in the application of the new Russian Law “On Technical Regulations”, together with delegated of the G-7 States;
- Support in the emergency planning and preparedness of research reactors;
- Improvement of Russian regulatory requirements to diagnostic (non-destructive test) systems for the major NPP equipment and methods used for diagnostic taking into account ageing of materials;
- Training of Rostechnadzor personnel.

AVN is the western task leader in project RF/TS/46 for the improvement of analysis methods and classification of operational events with respect to their impact on safety. The analysis of safety performance indicators is to be used to optimize the review process and the inspection activities.

**Lithuania**

AVN participated in the two Phare projects to support VATESI and the RPC in the framework of decommissioning of the Ignalina NPP, in cooperation with IRSN, SIP, STUK, SCK•CEN, CEPN, SSI, ITER-Consult, SERCO Assurance. AVN contributed to the assessment of solid waste facility, the repository of low and intermediate short-lived waste and the technical specification for a landfill facility for Short-Lived Very Low Level Waste.

**Belarus, Georgia, Kazakhstan**

AVN is involved in Tacis financed projects for regulatory assistance to the Nuclear Authorities of some “new” countries: Belarus, Georgia and Kazakhstan. These three projects started in 2006 and most of the activities will take place in 2007.

**Poland**

At the request of the Polish Nuclear Authority (NAEA), AVN performed a training of young inspectors in nuclear safety issues related to research reactors. This activity was financed by the Belgian bi-lateral assistance programme, which is managed by the Federal Service for Economic Affairs.
**Regulatory Assistance Management**

For the majority of its Phare and Tacis activities, AVN is participating in projects managed by Riskaudit.

AVN continued its participation in the Regulatory Assistance Management Group (AVN is chairing the Group) and in the Nuclear Safety Experts Group of the European Commission.

### 4.6. COOPERATION WITH OTHER FOREIGN ORGANIZATIONS

**FRAREG**

No activities have been undertaken in 2006. The next meeting is foreseen to be hosted by China (June 2007).

**PSI (Switzerland)**

The Deputy Director General of AVN was nominated in 2003 to become a member of the Scientific Advisory Committee of the Thermal-Hydraulics Laboratory (SAC-LTH) of the Paul Scherrer Institute (PSI) in Villigen. The third meeting was held in July 2006. The primary objective of the meeting was to review and evaluate the LTH research programmes with emphasis on the following issues: response to previous recommendations, scientific quality of research, performance efficiency, relevance and innovativeness of research, and research priorities and future plans.

**CHINA**

The Vice-Chairman of the Chinese Expert Consulting Committee of the Commission of Science, Technology and Industry for National Defence of the People’s Republic of China, Mr. ZHANG Huazhu visited AVN on 31 October 2006. This visit was organised by the Embassy of the People’s Republic of China. He lead a delegation of different experts coming from his Commission as well as from the China Atomic Energy Authority and the Embassy. AVN and a representative of the FANC discussed several issues of interest to this high level delegation: the Belgian nuclear power plants, periodic safety reviews, AVN’s quality management system as well as the activities of the Belgian Nuclear Society, which is chaired by a senior AVN expert.

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*Abbreviations: see appendix 2*
Advisory role in Belgium

On June 23, 2006, the council of ministers decided to dispose of the low and medium active short-lived waste (category A waste) in a surface disposal installation on the territory of the municipality Dessel. This has lead to a new phase in the discussions ONDRAF/NIRAS-FANC-AVN because of the transition from a pre-project phase to a project phase. In this phase, AVN now acts directly as the support organization of the FANC.

The discussions on the disposal of the high level and long lived radioactive waste (category B&C) have been pursued.

Experience feedback

AVN continued its efforts to analyze domestic and foreign events in order to improve the identification and implementation of lessons learned.

Rôle de conseil en Belgique

Le 23 juin 2006, le Conseil des Ministres a décidé de déposer les déchets radioactifs de faible ou moyenne activité et à vie courte (déchets catégorie A) dans une installation de dépôt en surface sur le territoire de la commune de Dessel. Cela a conduit à une nouvelle phase dans les discussions ONDRAF/NIRAS-AFCN-AVN, évoluant d’une phase de pré-projet à une phase de projet. Dans ce stade, AVN intervient directement en tant qu'organisation de support pour l'AFCN.

Les discussions concernant les déchets radioactifs de haute activité et à vie longue (catégorie B&C) ont été poursuivies.

Retour d’expérience

AVN a poursuivi ses efforts d’analyse des événements survenus en Belgique et à l’étranger afin d’améliorer l’identification et la prise en compte des enseignements à en tirer.

Adviserende rol in België


De besprekingen voor de opslag van hoogactief langelevend radioactief afval (categorie B&C) werden verder gezet.

Ervaringsterugkoppeling

AVN leverde verdere inspanningen op het vlak van analyse van binnen- en buitenlandse gebeurtenissen teneinde de identificatie en inachtneming van de eruit getrokken lessen te verbeteren.
CHAPTER 5
OTHER TECHNICAL SUPPORT ACTIVITIES

5.1. ADVISORY ROLE

SCK•CEN
The Deputy Director General of AVN chaired the Department Advisory Committee (DAC) on reactor safety, fuel, and reactor materials (VSR) of the Mol Nuclear Research Center (SCK•CEN) until June 2006. He was also a member of the Scientific Advisory Committee of SCK•CEN until December 2006. Several meetings were held in 2006. Various research programmes in relation with reactor materials and fuel performance were discussed. In particular, the new organization of SCK•CEN was discussed, and the design of the proposed MYRRHA ADS concept was reviewed.

ONDRAF/NIRAS
With regard to radioactive waste disposal, AVN pursued the discussions with FANC and ONDRAF/NIRAS concerning regulatory issues and the analysis of the safety assessments performed by ONDRAF/NIRAS and their subcontractors (in particular SCK•CEN).

On June 23, 2006, the council of ministers decided to dispose of the low and medium active short-lived waste (Category A waste) in a surface disposal installation on the territory of the municipality Dessel. This lead to a new phase in the discussions ONDRAF/NIRAS-FANC-AVN evolving from a pre-project phase to a project phase (although not yet a licensing phase).

In the project phase, AVN now directly acts as the support organisation of the FANC. A project structure was set up by FANC, in which different Working Groups have been created. Each Working Group is lead by a “Pilot” person and for some of the Working Groups the “Pilot” person is an AVN-engineer.

The topics that took most work effort in 2006 were related to: developing guidance for safety evaluations, level of earthquake to be considered for the design, qualification of codes for safety evaluations, the inventory of comments made in the pre-project phase concerning the design of the installation as proposed for the Dessel-site.

A contract between FANC and AVN for financing AVN’s support to the FANC was close to be signed at the end of 2006.

Also the discussions on the disposal of category B&C waste have been pursued. Main points of discussion were related to the long-term safety functions within the disposal programme of ONDRAF/NIRAS and the preparation of the 1st Safety and Feasibility Case (SFC1), foreseen for 2013.

5.2. DOMESTIC EXPERIENCE FEEDBACK

For the year 2006, 75 internal event-reporting forms have been established.

A detailed analysis of lessons learned has been performed for 33 events, which are all related to the NPPs and occurred in the period 2003-2006.

The results of this analysis were taken into consideration on a sample basis during the inspection activities in order to check that the operating experience process of the licensee is performing as expected.

The identified lessons learned can be grouped into plant design, plant operation, plant maintenance, safety-related support processes and emergency planning.

Appendix 3 presents a more detailed overview of the lessons learned.

5.3. FOREIGN EXPERIENCE FEEDBACK

AVN performs a systematic screening of officially published international operational experience documentation, with emphasis on the detection of Lessons Learned for the Belgian PWRs.

Abbreviations: see appendix 2
One Screening Card is written for each incoming document, which was worth an in-depth analysis. Twenty-four Screening Cards were established in 2006.

The AVN Foreign Operational Experience database (ARIANE, an ACCESS relational database) contains 1685 records, which make a synthesis of the 5884 documents registered. The complete history of Nuclear power plants since 1968 is addressed (including all major events, regardless of reactor type). Complex codification allows an easy retrieval of the safety issues described. An attempt is systematically made to regroup and compare within a single record (named RER, for Recurring Events Record) all the past events with strong similarities. Those RERs are converted in Word for incorporation in the AVN electronic Library KOLIBRI.

In order to address a too large number of similar events, the equivalent information is collected more conveniently in separate spreadsheets in KOLIBRI.

AVN establishes quarterly reports on the screening results and applicability of the lessons learned. These reports are transmitted to the licensee Electrabel, the architect engineer Tractebel, and to the VROM (NL) as a service contract.

REXe Forms are maintained for the follow-up of formal letters to the Licensee, requesting action on significant Lessons Learned. Two were created (# 42 and 43) in 2006, addressing the problem of excessive vibration in some French vertical safety related pumps, and the July 25 FORSMARK loss of electrical power event.

Appendix 4 presents an overview of the FORSMARK event, the RERs created or modified in 2006, the spreadsheets and the published USNRC Bulletins and Generic Letters.
CHAPTER 6 – EXPERTISE MANAGEMENT

Knowledge management

Increasing attention is paid to knowledge management due to the ageing of the staff. The technical responsibility centres are playing a key role with respect to this issue. The use of an electronic document management system is an equally important step towards a good sharing of knowledge.

R&D

The studies performed in 2006 are related in particular to the definition of safety reference levels for decommissioning, to international projects in relation with the safety analyses of radioactive waste disposal facilities, to discussions on the scope of the upcoming PSA update, to the studies of thermal-hydraulic phenomena during mid-loop operation as well as to the modelisation of phenomena and consequences of severe accidents, and to Junior Staff Programme projects.

Training

The qualification of the technical personnel remains a priority of AVN. The efforts dedicated to nuclear training increased in 2006 due to the recruitment of six new technical staff members. Improved coaching and training programs were developed.
CHAPTER 6

EXPERTISE MANAGEMENT

6.1. KNOWLEDGE MANAGEMENT

For several reasons (one of them being that in the next 5 to 10 years several experienced AVN staff members will retire) AVN is attaching increasing importance to knowledge management and has therefore continued a series of actions that were started earlier.

The TRCs (Technical Responsibility Centres) are playing a key role for knowledge management within AVN. There are about 20 TRCs, acting as “Centres of competence” for all-important fields of expertise of AVN. The TRC management and operation is now fully embedded in AVN's Quality System. An evaluation of the organisation and the functioning of the TRCs is performed within the process managing the TRCs (amongst others by evaluation of the annual reports of the TRCs). These annual reports also allow identifying areas for which developing or maintaining expertise represents challenges in the upcoming year.

Also the recruitment of some new engineers has to be considered in the scope of knowledge management, allowing the younger engineer to work in parallel with a person that will retire in a few years.

An R&D project proposal “European Upgrading in Research Optimisation and Safety Analysis further enhancement” by the EUROSAFE Consortium, containing a working package on knowledge management, was not accepted within the EC 6th Framework Programme. In mutual agreement, the EUROSAFE partners decided to start the work related to this proposal on own costs, albeit in a somewhat reduced scope. AVN continues to participate in the working package on knowledge management.

An AVN-representative was invited by the IAEA to act as Session Reporter at the IAEA “International Conference on Knowledge Management in Nuclear Facilities”, to be organised at the IAEA on June 18-21, 2007.

6.2. ELECTRONIC DOCUMENT MANAGEMENT

The year 2006 the implementation of the electronic document management tool (KOLIBRI) continued as a routine action, after the training sessions and the transfer of the most important existing documents (Inspection Reports, documents of Internal knowledge, etc...).

The inspection and expertise reports, which contain highly valuable technical information for all AVN staff, are automatically integrated in Kolibri and available for automatic and powerful searches.

Additional developments such as full use of a multilingual thesaurus (keywords and related terms), a Web portal (towards other internal or external resources) or a Publishing Workflow (guided process for step by step publishing) are on hold due to reorganizations on the contractor’s side (LogonSI and Hummingbird).

The current implementation of KOLIBRI is already an important step towards a good sharing of knowledge and a more easy integration of newcomers.

6.3. RESEARCH AND DEVELOPMENT

The total R&D effort in 2006 amounted to 4 % of AVN's technical staff potential. The significant R&D activities performed in 2006 are reported in Appendix 1. Below is an overview of the spin-offs of the R&D on the overall AVN activities.

Decommissioning

Harmonized safety reference levels of WENRA WGWD have been proposed as licensing conditions for the decommissioning operations of two projects driven by Belgoprocess.

Waste Disposal

Its R&D activities provide to AVN the opportunity to develop its expertise in the field of radioactive waste disposal, to be known as competent technical expert organisation and to maintain contact with other organisations involved in the field of radioactive waste. For the first time, in 2006, AVN participates in two R&D projects that are partially financed by the EC.
After the AVN presentation at EUROSAFE, representatives of Riskaudit found the work performed by AVN on "Review guidance for safety assessment of radioactive waste disposal" very interesting and consider that this type of development could be, in the future, integrated to some TACIS or PHARE projects. This demonstrated that AVN waste R&D activities could have significant repercussions as well in term of future work as in term of AVN image of competence.

AVN also participated in the Junior Staff Programme, which held a meeting in parallel with the symposium Eurosaf. This meeting was, among other R&D topics, the opportunity to strengthen the partnership between AVN and the other TSO's.

**SETH / ROSA / PKL / NCI**

The participation to the OECD SETH, ROSA and PKL projects has allowed AVN to gain deep understanding of the phenomena and the simulation problematic related respectively to plumes and jets in multi-compartment geometries, small breaks in the Upper and Lower Head of the Vessel and to Boron dilution in Mid-loop scenarios.

The investigation on Natural Circulation Interruption (NCI) during a FWLB and a LOOP using a 3D model of the vessel using CATHARE v2.5_1 code has confirmed this safety relevant phenomenon occurring at cooldown rates much lower than the upper limits found in the technical specifications.

**EUROSAFE JSP (Junior Staff Programme) Pilot Project “Fracture Mechanics”**

This project leads to a better understanding of the Master Curve approach. With regard to the ageing of the Belgian NPP's reactor vessels, this project will become of major importance in the assessment of the reactor pressure vessel integrity in the future.

**PRISME project : use of the CFAST code**

The know-how in the use of a computer code as CFAST in order to evaluate particular risks or in the achievement of a Fire PSA is of great importance.

**PSA Methodologies**

The active participation in international activities is expected to keep the AVN PSA staff aware of new developments in methodology and applications.

The comparison efforts of the Ti1 PSA with PSAs of similar plants allow getting useful insights on potential improvements of the methodology and models of the Belgian PSAs, in particular for the modelling of the shutdown states.

The present outlook on the capabilities of fire PSA, gained at the OECD/IAEA workshop, is quite encouraging for applications in Belgium. Together with the in 2006 adopted WENRA reference levels on PSA that are to be implemented in the years to come, it leads AVN to include fire and flooding PSA into the scope of its R&D program for probabilistic studies.

The participation in SARNet will give AVN valuable expertise in view of the review of the Belgian PSA level 2 analyses. Indeed, two level 2 analyses and the results of the AVN review have been discussed with TE/EBL, and the discussions on the work program for the update of the level 2 PSA have been started.

**PSA-based Event Analyses (PSAEA)**

The ongoing PSAEA program and the REXi process of AVN already benefits from the precursor studies, as well as from the results of the annual international PSAEA meetings. The information in the meeting minutes is also of particular interest to the REXe process of AVN. It can also facilitate the establishment of Belgian IRS records.

AVN's pilot set of performance indicators includes a risk-based performance indicator based on CCDP (indicator: safety significant events).
6.4. TRAINING

In 2006, the number of hours dedicated to training amounted to 7,625 hours, i.e. 7.9% of the total number of technical man-hours, compared to 6.3% in 2005 and 4% in 2004.

The reasons for such an increase are the following:

- recruitment of six new technical staff members, which required some significant coaching activities by senior people.
- implementation of an improved methodology for coaching; it includes weekly activity reports, continuous discussions with the coach and the supervisor and periodic formalised evaluations.
- development of an extensive programme of initial training for all newcomers recruited in 2005 and 2006; this programme is made of self-study, on-the-job training and some external training courses
- start of the implementation of this training programme in 2006; it will continue through 2007 and beyond.

Examples of external training courses with participation of AVN newcomers in 2006 are:

- Design and Operation of PWR reactors at Areva (3 weeks)
- “Eugene Wigner” course for Reactor Physics experiments (21 days)
- basic training in non destructive examination at Vinçotte (3 days)
- familiarisation course with the ASME Code at Westinghouse (3 days)
- OECD conference on corrosion and long term performance of reinforced concrete in NPPs and waste facilities (4 days)

Also to be mentioned is the organisation of several internal training sessions at the intention of all the technical staff to strengthen the practical knowledge of the IAEA Safety Standards within AVN. Actually, the quality of those Standards has increased significantly in the last 10 years and they are used in particular as a reference in the WENRA harmonization work and for the upcoming OSART mission in Tihange.
A new service-oriented spirit!
Un nouvel esprit orienté service!
Een nieuwe servicegerichte spirit!

APPENDIX 1

AVN RESEARCH & DEVELOPMENT ACTIVITIES 2006

1. INTRODUCTION

2. ACTIVITIES DIRECTED TOWARDS EFFECTIVENESS
   2.1 Regulatory Approaches and Practices
   2.2 Pro-activity

3. ACTIVITIES DIRECTED TOWARDS EFFICIENCY
   3.1 Knowledge Mastery
   3.2 Tools
   3.3 Identification and Ranking of Safety Concerns at Risk
1. Introduction

This report gives a summary of the significant R&D activities performed in 2006. The total R&D effort in 2006 amounted to 4% of AVN's technical staff potential.

2. Activities directed towards Effectiveness

2.1. Regulatory Approaches and Practices

2.1.1. Use of PSA in Regulatory Inspections

In 2005, a small “pilot project” has been launched to investigate whether some “small effort” calculations could already give valuable insights for plant inspectors about the importance of structures, systems and components (SSCs), and to explore whether these insights could also give valuable input to the discussions with regard to PSA applications.

PSA team members and plant inspectors have jointly participated in the “pilot project”, in particular by providing their estimates (judgements) for the risk ranking of SSCs and comparing these risk rankings with RiskSpectrum calculations. A report with the results has been finalised in 2006 and was submitted to the Division of the plant inspectors.

2.2. Pro-activity

2.2.1. Decommissioning

In line with the pursued objective of developing additional expertise in AVN and improving the knowledge in the decommissioning field, harmonized safety reference levels of the WENRA WG on Waste & Decommissioning have been implemented as licensing conditions for the decommissioning operations of two projects conducted by Belgoprocess.

2.2.2. Waste Disposal

Regarding the international conferences and workshops, AVN has been involved:

- in NEA activities through the workshop about “Long-term safety criteria”, the RWMC meeting and through answering to the INTESC (INTernational Experience in developing Safety Cases) and AMIGO (Approaches and Methods for integrating GeOlogical information in the safety cases) questionnaires;
- in the European Seminar (extended Franco-Belgian working group) through five meetings; a paper of the performed work has been presented at the EUROSAFE Forum (Paris, November 2006).

Besides, AVN participated in the TOPSEAL conference as well as in two topical exchange meetings at SCK\textsuperscript{CEN}.

In 2006, two 3-year European R&D programs directed towards waste disposal, and in which AVN contributes, have been launched in the framework of the 6th FP: PAMINA (Performance Assessment Methodologies IN Applications to guide the development of the safety cases) and MICADO (Model uncertainty for the meChAnism of Dissolution Of spent fuel in a nuclear waste repository). The contributions of AVN in these two programs are of 16 and 4 man-months respectively.

Furthermore, AVN has undertaken a significant work in order to develop his own tool for safety assessment review. Three different subtasks have been performed: first an overview of the national and international requirements; second, a generic structure of the review document and, third, two technical review documents have been finalised.
Besides, AVN also participated in the EUROSAFE Junior Staff Programme, which held a meeting in parallel with the EUROSAFE symposium. This meeting was, among other R&D topics, an opportunity to exchange information concerning the Mol and Bure data for the migration simulation.

2.2.3. Accelerator Driven Systems

The main task of this year was related to the OECD report “Accelerator and Spallation Target Technologies for ADS Applications” and to the pre-design file of MYRRHA.

The examination of these two documents allowed drawing conclusions about:

1°) the development of the chosen accelerator technology;
2°) issues resulting from the spallation windowless target design;
3°) the general safety analysis.

3. Activities directed towards Efficiency

3.1. Knowledge Mastery

3.1.1. Instrumentation & Control

AVN participates in a new project of the 6th EC Framework Programme: the Integrated Infrastructure Initiatives Project MTR+I3 (Integrated Infrastructure Initiatives for Material Testing Reactors innovations). The kick-off meeting of this project was held in Paris on 16-17/10/2006.

AVN will participate in the activity JRA4 (Safety Test Instrumentation) for identifying important “safety issues” (RIA, LOCA …) and associated phenomena to be observed, and parameters to be measured in a Material Testing Reactor.

3.1.2. Participation in the Halden Reactor Project

No Enlarged Halden Programme Group Meeting took place in 2006. AVN participated in the annual meeting of the Belgian Halden Consortium in November.

3.1.3. Thermal Hydraulics Phenomena

AVN has continued to participate actively in the OECD SETH, ROSA and PKL projects and lead the PKL Benchmark group. The benchmark has been extended until May 2007.

The investigation on Natural Circulation Interruption (NCI) during a FWLB and a LOOP is currently under investigation using the 3D model of the CATHARE v25_1 code. A specific piece of code has been developed in order to create the 3D model of the vessel and to perform mesh sensitivity analysis. Initial results show this phenomenon to occur at very low cooldown rates.

3.1.4. Mechanical Safety Issues

Collaboration has been set up with IRSN in the framework of the Eurosafe Junior Staff Programme (JSP) in order to share experience in the field of fracture mechanics for nuclear safety analyses. In the framework of the surveillance of the reactor pressure vessel integrity, the Master Curve methodology has been presented as an alternative to the ASME Toughness Curve. The aim of this project is to share a common understanding of the conservatism of this approach. The first phase of this JSP Project is focusing on the statistical evaluation of the fracture toughness data that lead to the Master Curve.

3.1.5. Fire Safety Issues

AVN participates in the OECD PRISME project, notably by taking actively part in the benchmarking exercise. For this purpose, AVN uses presently the CFAST software.

Abbreviations : see appendix 2
3.1.6. Fission Products and Aerosols Behaviour

AVN has attended the first Experts Meeting on the "Behaviour of Iodine Project" (BIP) (27-28/09/2006, NEA, Issy-les-Moulineaux). The BIP project is proposed by AECL and would address some open issues related to iodine behaviour at containment surfaces (cf. Status Paper on Iodine Chemistry, 2005). It includes iodine chemistry experiments at the RTF facility as well as code calculations of some previous RTF experiments. The BIP project would also be complementary to other international experimental programs in the area of iodine behaviour. At the Expert Meeting, many institutes and countries have supported the BIP project. The project has since then been endorsed by the CSNI and AVN will indeed participate.

3.1.7. Evaluation of Radiological Consequences

AVN has presented its contribution to the ARTIST-research program during the fourth PRC meeting (December 2006). In this work, the steam generator section has been modelized and the flow velocity field has been computed using a CFD-code. A first estimation of decontamination factors was also performed by tracking the particles (aerosols and droplets) in the flow.

3.1.8. Severe Accidents Progression

AVN participated in the last MASCA-2 Programme Review Group and Management Board meetings held at GRS, Garching, May 30-31. All the planned experiments have been performed as well as the studies related to measurement of physical properties. The MASCA-2 Application Report and the MASCA-2 Final Report will be issued early 2007.

3.2. Tools

A new Linux server has been installed and two operating systems (32/64 bit) have been tested on it. Version CATHARE2v2.5_1 mod4.1 has also been received, installed and tested.

Initial portability calculations have successfully been performed on both old and new Linux machines on several different types of transients showing the effects of machines and compilers.

An automatic meshing tool to easily develop 3D vessel input decks and to perform sensitivity analyses for CATHARE has been developed in C language.

3.3. Identification and Ranking of Safety Concerns at Risk

3.3.1. PSA Methodologies

The work for the SARNet project (6th FP), where AVN contributes in the PSA Level 2 work package, has been continued. A first meeting discussed the contributions of the partners regarding the treatment of hydrogen and the consequences of vessel breach (i.e. specifically DCH) in the Level 2 PSA. Another meeting in June focused on the treatment of MCCO and iodine releases in the Level 2 PSA.

The comparison of the Tihange 1 PSA with PSAs of similar plants (French 900 MWe PWR, Koeberg PWR) has been continued. For power states, the three detailed reports of the PSA comparison (PSA results, SBLOCA, and LOOP) have been completed and validated by all partners (IRSN, NNR, AVN). In addition, a synthesis report with the major results and insights of the PSA comparison has been written. Publication of all reports is foreseen early 2007.

A common paper (IRSN-AVN-NNR) on the tripartite PSA comparison, entitled "Improving Quality of NPP PSA by International Comparisons", has been presented at the PSAM8 conference in New Orleans, May 2006.

An AVN representative participated to the annual WGRISK meeting (OECD/NEA). This meeting remains an important forum for exchange of information on state-of-the-art of PSA and PSA applications.

Abbreviations : see appendix 2
3.3.2. PSA-based Event Analysis

An AVN-paper on PSAEA was presented at the PSAM8 conference in May: “Risk-Based Precursor Analysis in the Nuclear Industry – Experiences on the National and the International Scene”. The information retrieved at this conference has been useful to several TRCs.

In 2006, the work on probabilistic precursor analysis was continued in the framework of the AVN process of operational feedback (REXi). Four new PSAEA studies have been performed. One of the new PSAEA studies proposed a few recommendations towards the utility, which were discussed at the REXi committee of AVN. The four PSAEA studies were presented to and discussed with the utility for further consideration and follow-up.

An international Technical Meeting on Risk-based Precursor Analysis is organised annually by AVN in order to share experiences in this field with other organisations. Main topics are practical experiences like lessons learned, technical issues of interest and feedback on the applied methodology. Other points of interest are the objectives, challenges and achievements of current precursor analysis programs. The 9th meeting was held on 09-10 November 2006 at the AVN premises in Brussels. It was widely announced towards the practitioners of risk-based precursor studies, as well as towards OECD/NEA/CSNI/WGRISK and IAEA. AVN welcomed delegates from CSN (E), EC JRC-IE (NL), EDF (F), Electrabel (B), GRS (D), IRSN (F), STUK (Fi), Tractebel (B) and US-NRC (USA). The presentations included status reports, case studies, results, overview papers and applications on precursor programs in Belgium, France, Germany, Spain and the USA (regulators as well as utilities). The many case studies cited or discussed in detail at this forum allowed to gain an overview of current practice and to learn from tangible examples. Moreover, a topical discussion was held on the interest and the feasibility of probabilistic precursor studies using PSA level 2, and an exchange of ideas has taken place on the present relationship between deterministic and probabilistic event analysis. The discussions enhanced the understanding of various issues and allowed for a frank exchange of views.

An AVN-paper on PSAEA was presented at the EUROSsafe Forum 2006 in November: “Use of PSA for the Analysis of Operational Events in Nuclear Power Plants”.

Abbreviations : see appendix 2
## APPENDIX 2

### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
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<tr>
<td>AIO</td>
<td>Authorized Inspection Organization</td>
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<td>ALARA</td>
<td>As Low As Reasonably Achievable</td>
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<tr>
<td>ANDRA</td>
<td>Agence Nationale pour la Gestion des Déchets Radioactifs (France)</td>
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<td>ANRA</td>
<td>Nuclear Safety Authority of Armenia</td>
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<tr>
<td>ARIANE</td>
<td>Automatic Retrieval of Information on Abnormal Nuclear Events</td>
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<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>AVC</td>
<td>AIB-Vinçotte Controlatom</td>
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<tr>
<td>AVN</td>
<td>Association Vinçotte Nuclear</td>
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<tr>
<td>BNRA</td>
<td>Bulgarian Nuclear Regulatory Agency</td>
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<tr>
<td>BP</td>
<td>Belgoprocess</td>
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<tr>
<td>CCDP</td>
<td>Conditional Core Damage Probability</td>
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<tr>
<td>CEN/SCK</td>
<td>Centre d’Etude de l’Energie Nucléaire (Mol)</td>
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<tr>
<td>CNRA</td>
<td>Committee on Nuclear Regulatory Activities (OECD)</td>
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<tr>
<td>CNT</td>
<td>Centrale Nucléaire de Tihange</td>
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<tr>
<td>CSN</td>
<td>Consejo de Seguridad Nuclear (Spain)</td>
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<tr>
<td>CSNI</td>
<td>Committee on the Safety of Nuclear Installations (OECD)</td>
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<tr>
<td>DAC</td>
<td>Department Advisory Committee</td>
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<tr>
<td>DG</td>
<td>Director General</td>
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<tr>
<td>DGSNR</td>
<td>Direction Générale de la Sûreté Nucléaire et de la Radioprotection</td>
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<tr>
<td>EBL</td>
<td>Electabel</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>ECCS</td>
<td>Emergency Core Cooling System</td>
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<td>EDF</td>
<td>Electricité de France</td>
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<tr>
<td>FANC</td>
<td>Federal Agency for Nuclear Control</td>
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<tr>
<td>FCS</td>
<td>Fuel Cycle Safety (Subgroup in OECD)</td>
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<tr>
<td>FRAREG</td>
<td>FRAmatome REGulators</td>
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<tr>
<td>GAMA</td>
<td>Working Group on the Analysis &amp; Management of Accidents (OECD)</td>
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<tr>
<td>GMT</td>
<td>General Management Team</td>
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<td>GPR</td>
<td>Groupe Permanent Réacteurs (France)</td>
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<td>GRS</td>
<td>Gesellschaft für Anlagen und Reaktor Sicherheit (Germany)</td>
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<tr>
<td>HELB</td>
<td>High Energy Line Break</td>
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<td>HRS</td>
<td>Human Resources and Support (Division in AVN)</td>
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<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
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<tr>
<td>IAGE</td>
<td>Working Group on the Integrity and Ageing of Components &amp; Structures (OECD)</td>
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<td>I&amp;C</td>
<td>Instrumentation and Control</td>
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<td>INES</td>
<td>International Nuclear Event Scale</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>IRE</td>
<td>Institut des Radio-Elements (Institute of Radionuclides)</td>
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<tr>
<td>IRS</td>
<td>Incident Reporting System</td>
</tr>
<tr>
<td>IRSN</td>
<td>Institut de Radioprotection et de Sûreté Nucléaire (France)</td>
</tr>
<tr>
<td>KCD</td>
<td>Kerncentrale Doel</td>
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<tr>
<td>KFD</td>
<td>Kern Fysische Dienst (The Netherlands)</td>
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<tr>
<td>LOCA</td>
<td>Loss of Coolant Accident</td>
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<tr>
<td>LTH</td>
<td>Thermal Hydraulics Laboratory (Switzerland)</td>
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<tr>
<td>MOX</td>
<td>Mixed Oxide Fuel</td>
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<tr>
<td>NEA</td>
<td>Nuclear Energy Agency (OECD)</td>
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<tr>
<td>NEI</td>
<td>Nuclear Energy Institute</td>
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<tr>
<td>NII</td>
<td>Nuclear Installations Inspections (division in AVN)</td>
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<tr>
<td>NPP</td>
<td>Nuclear Power Plant</td>
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<tr>
<td>NRC</td>
<td>Nuclear Regulatory Commission</td>
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<td>NRWG</td>
<td>Nuclear Regulators Working Group (CEU)</td>
</tr>
<tr>
<td>NSC</td>
<td>Nuclear Science Committee (OECD)</td>
</tr>
<tr>
<td>NUSSC</td>
<td>Nuclear Safety Standards Committee (IAEA)</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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<tr>
<td>ONDRAF/</td>
<td>Belgian Radioactive Waste Agency</td>
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<tr>
<td>NIRAS</td>
<td>Over-Power Delta Temperature</td>
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<td>OPDT</td>
<td>Operational Safety Analysis Review Team (IAEA)</td>
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<td>OSART</td>
<td>Projects &amp; Experience Management (division in AVN)</td>
</tr>
<tr>
<td>PHARE</td>
<td>Poland Hungary Assistance Reconstruction Economy (CEU)</td>
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<tr>
<td>PI</td>
<td>Performance Indicators</td>
</tr>
<tr>
<td>PSA</td>
<td>Probabilistic Safety Analysis</td>
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<tr>
<td>PSAEA</td>
<td>PSA-based Event Analysis</td>
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<tr>
<td>PSI</td>
<td>Paul Scherrer Institute (Switzerland)</td>
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<tr>
<td>PSR</td>
<td>Periodic Safety Reassessment</td>
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<td>PWR</td>
<td>Pressurised Water Reactor</td>
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<tr>
<td>PWSCC</td>
<td>Primary Water Stress Corrosion Cracking</td>
</tr>
<tr>
<td>RCS</td>
<td>Reactor Coolant System</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>RPV</td>
<td>Reactor Pressure Vessel</td>
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<tr>
<td>SAC</td>
<td>Safety Advisory Committee</td>
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<td>SC</td>
<td>Steering Committee of AVN</td>
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<tr>
<td>SCC</td>
<td>Stress Corrosion Cracking</td>
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<td>SCG</td>
<td>Splijtstof Container Gebouw</td>
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<tr>
<td>SCK/CEN</td>
<td>Studie Centrum voor Kernenergie (Mol)</td>
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<tr>
<td>SG</td>
<td>Steam Generator</td>
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<tr>
<td>SGTR</td>
<td>Steam Generator Tube Rupture</td>
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<tr>
<td>SKI</td>
<td>Swedish Nuclear Power Inspectorate</td>
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<tr>
<td>SNRCU</td>
<td>State Nuclear Regulatory Committee of Ukraine</td>
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<tr>
<td>SRD</td>
<td>Studies, Research &amp; Development (division in AVN)</td>
</tr>
<tr>
<td>SSTC</td>
<td>State Scientific &amp; Technical Centre for nuclear and radiation safety (Ukraine)</td>
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<td>STC</td>
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<td>Technical Responsibility Centre (AVN)</td>
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<td>TS</td>
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<td>United States Nuclear Regulatory Commission</td>
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<td>VVER</td>
<td>Russian Pressurised Water Reactor</td>
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<td>WAB</td>
<td>Water- en Afval-Behandelingsgebouw</td>
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<td>WENRA</td>
<td>Western European Nuclear Regulators Association</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<td>WGIP</td>
<td>Working Group on Inspection Practices (OECD)</td>
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<td>WGOE</td>
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<td>WGPC</td>
<td>Working Group on Public Communication (OECD)</td>
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<td>WGRISK</td>
<td>Working Group on Risk Assessment</td>
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<td>WGWD</td>
<td>Working Group on Waste storage and Decommissioning</td>
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The main mission of AVN is to contribute to the prevention of nuclear risks

Acting in the interest of the population, including the patients, the workers and the environment, AVN is responsible for supervising how the licensees manage nuclear safety and radiation protection in their installations and for performing quality controls of use of ionizing radiation in medical applications.

• Legal inspections of nuclear power plants (class 1 installations)

As for the permanent supervision of nuclear power plants, AVN is involved in four phases: licensing, commissioning, operation and decommissioning.

AVN inspections may occur at any time, in any field of activity, with no access restriction.

AVN performs specific visits in case of incidents/accidents, modifications to the installations and licensing of the control room personnel.

AVN participates to the regulatory safety reviews carried out every ten years by the licensees and, in particular, reviews and approves the associated studies and modifications.

• Legal inspections of class 1 installations other than nuclear power plants

AVN performs legal inspections and safety assessments for installations such as the Thetis research reactor at the University of Ghent, the Institute for Radioelements (IRE) in Fleurus, the Nuclear Research Centre (CEN•SCK) in Mol, the Belgonucléaire factory (fabrication of nuclear fuel) and the site of Belgoprocess (conditioning of radioactive wastes).

• Legal inspections of class 2 and 3 installations

AVN performs legal inspections of nuclear medicine centers, medical irradiation facilities, university laboratories, particles accelerators, service centers specialised for nuclear power plants.

The main goal of these inspections is to verify compliance with the license, as well as to assess the licensee’s safety management.

• Medical radio-physics

AVN performs the legal controls in the field of the medical applications of ionizing radiations and protection of patients. The services provided by AVN concern the areas of radiodiagnostics and nuclear medicine.

The main goal of these quality controls is to verify compliance of the medical equipments with respect to the exposure to the patients.
Our services in Nuclear and Radiological fields

Inspection of Nuclear Installations

Radiation Protection

Medical Radiophysics

Safety Analysis

Risk Assessment

Support to Nuclear Waste Management

Support to Decommissioning

Emergency Planning & Crisis Management

Facing risks in other industries?

If your activities belong to an industrial domain in which risk management is a priority, you may wish to turn to a multidisciplinary team of experts, proficient at risk control methodologies.

www.avn.be
For more information: services@avn.be
The control of nuclear safety