

BEL ✓

ANNUAL REPORT / 2014

CONTENTS

Message from the Chairman	3
Preface	4
Board of Directors	4
Editorial	5
1 Regulatory activities in Belgium	6
1.1 General assessment of nuclear facilities	6
1.2 Overview of inspections at nuclear power plants	8
1.3 Overview of inspections in other nuclear facilities	12
1.4 Emergency preparedness and response	16
2 Safety assessments and national projects	18
2.1 Probabilistic Safety Assessment (PSA)	18
2.2 Periodic Safety Reviews (PSR)	19
2.3 Long-Term Operation (LTO) – Tihange 1	20
2.4 Shutdown program Doel 1/2	21
2.5 BEST project: Belgian stress tests	22
2.6 Spent fuel and radioactive waste management	23
2.7 MYRRHA (SCK•CEN)	24
2.8 Reactor vessel flaws	25
2.9 Reactor pressure vessel head replacement – Tihange 3 and Doel 4	27
3 International activities and projects	28
3.1 OECD and IAEA activities	28
3.2 Cooperation with safety authorities	30
3.3 Cooperation with technical safety organisations	32
3.4 Assistance projects of the European Commission	34
4 Expertise management	38
4.1 Domestic experience feedback	38
4.2 Foreign operating experience feedback	39
4.3 Knowledge management	40
4.4 Research and development	41
4.5 Training	46
Financial report	48
Balance sheet as at 31 December 2014	48
Profit and loss account as at 31 December 2014	50
Profit and loss account: notes	51
List of abbreviations	52

MESSAGE FROM THE CHAIRMAN

Bel V is a private law foundation created as a subsidiary of the Federal Agency for Nuclear Control (FANC), which delegates activities in the area of nuclear safety and radiation protection to Bel V. Drawing on almost 50 years of experience Bel V contributes to the protection of people and the environment against the danger of ionising radiation.

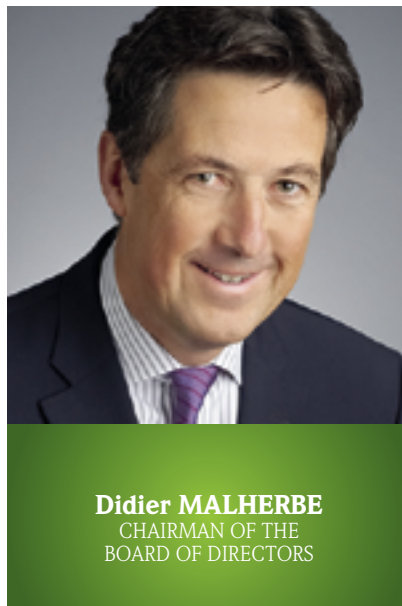
2014 has been a year of continued development for Bel V. In one year, the workforce grew from 75 to 79 employees. Recruitment and training therefore remained key priorities in order to continue to work as a multidisciplinary team of high-level experts.

A new Board of Directors was appointed and after 6 years as President of the Board, Michel Jurisse retired from the post, while retaining a seat on the Board.

At the request of Belgium the International Atomic Energy Agency (IAEA) had scheduled an Integrated Regulatory Review Service (IRRS), which took place in late 2013. The results (available on the website of the FANC) are very positive. In particular, they confirm the role of Bel V as a technical support to the FANC, and forming an integral part of the Belgian regulatory body. The auditors made a number of proposals for improvement, which have been translated into an action plan, whose implementation began in 2014.

Bel V's mission of monitoring the safety of Belgian nuclear facilities is part of the overall inspection and control strategy developed in close collaboration with the FANC. In 2014, special attention was paid to radioactive waste management

at the various nuclear installations. The annual safety evaluation of the various facilities was carried out according to the standards of our quality system. This evaluation is presented by Bel V to each operator and discussed with its management in the presence of the FANC. The results of the annual evaluation are used for drawing up the control program for the following year.



Didier MALHERBE
CHAIRMAN OF THE
BOARD OF DIRECTORS

Given the financial resources available to Bel V, the Board of Directors decided to intensify Bel V's research and development activities. Initiatives were taken to provide financial support to the work of researchers at Belgian universities in areas of interest to nuclear safety, to participate actively in international research programmes and to enhance Bel V's computing means that make it possible to model the accidental behaviour of nuclear facilities. These actions have now reached cruising speed and are set out in more detail later in this report.

Finally, with the future of nuclear energy increasingly drawing political and media attention, on behalf of the Board of Directors, I would like to congratulate and thank the management team and the entire workforce for the results they have achieved and for the professionalism with which they carry out their tasks.

Didier MALHERBE

Chairman of the Board of Directors

PREFACE

Bel V, an incorporated foundation, was established on 7 September 2007 by the Federal Agency for Nuclear Control (FANC).

It is governed by the Belgian Act of 27 June 1921 on non-profit associations, international non-profit associations and foundations, and by its own Articles of Association as filed at the registry of the Brussels Court of First Instance.

Not intended for any pursuit of profit, it aims to contribute technically and scientifically to the protection of the population and the environment against the dangers of ionizing radiation.



BOARD OF DIRECTORS

At year-end 2014, the Board of Directors of Bel V was composed of:

- D. Malherbe** – Chairman
- Ph. De Sadeleer** – Chairman of the Board of the FANC
- J. Bens, Ir** – General Manager of the FANC
- J. Hens** – member of the Board of the FANC
- J. Gemis** – member of the Board of the FANC
- S. Vaneycken** – member of the Board of the FANC
- M. Jurisse, Ir** – former Chairman of the Board of the FANC



TEAM



EDITORIAL

2012 had been marked by the detection of flaw indications in the steel material of the reactor pressure vessels at Doel 3 and Tihange 2. In May 2013 the two units were authorised to restart, provided an action plan was implemented in view of the refuelling outage planned for 2014. One of these actions was to conduct a series of tests designed to assess how radiation affects the mechanical properties of hydrogen-flaked steel. For these tests, test pieces of hydrogen-flaked steel were submitted to irradiation in the BR2 reactor of the Nuclear Research Centre in Mol.

Preliminary test results showed that fracture toughness was more affected than predicted by theoretical models. The licensee decided to preemptively shut down both units and to initiate a new series of tests in order to explain these unexpected results. The results of these new tests will not be available until 2015.

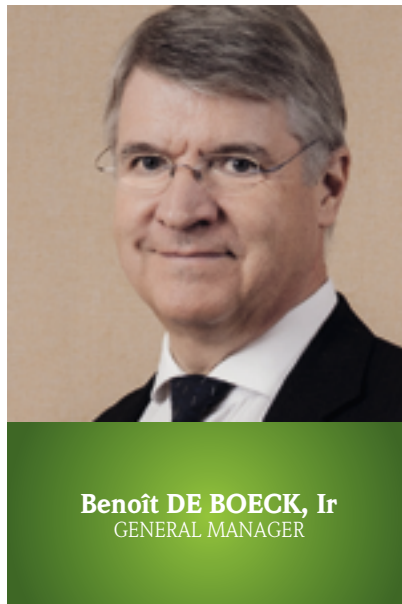
While Electrabel had been preparing for almost 3 years for the final shut-down of Doel 1/2 in 2015, the new government decided to change the nuclear power phase-out law and to extend the operating lifetime of Doel 1/2 by 10 years. This will require the establishment of a Long-Term Operation (LTO) project for Doel 1/2, which will be a real challenge given the limited timeframe. We'll have to make up for lost time, reopen BEST and ten-year review files, and go through all the decisions taken in the context of reduced operating time. This will have a significant impact on the workload of Bel V in 2015 and most likely beyond.

In August, a loss of oil lubrication to the main turbine caused an automatic shutdown of Doel 4. The inertia of the turbine is such that in the event of a shut-down signal it still continues to run for about twenty minutes before complete shut-down. Given the loss of lubrication, the turbine damage was significant and Doel 4 was shut down for repairs for four months. Analysis showed that the cause of the problem was most likely sabotage. This led to a strengthening of security measures at both the Doel and Tihange sites. In particular it was no longer authorised to go into sensitive areas alone, which has caused organisational difficulties, both for the licensee and for Bel V.

In early 2013 ONDRAF/NIRAS submitted its formal licence application concerning the future facility for the disposal of category A waste (low and intermediate level short-lived radioactive waste) in Dessel. Since then Bel V has been deeply involved, in collaboration with the FANC, in analysing the facility's safety analysis report. A first analysis was completed

during the first half of 2014 and led to many questions being submitted to ONDRAF/NIRAS. The answers to these questions are still being examined. At the same time, we continued our long-term safety assessments using digital models.

In summary, Bel V continues to face many challenges. With our dynamic and multidisciplinary team, we are ready to take on these challenges and to prepare for the future serenely.



Benoît DE BOECK, Ir
GENERAL MANAGER

Benoît DE BOECK, Ir
General Manager



REGULATORY ACTIVITIES IN BELGIUM

1.1 General assessment of nuclear facilities

1.1.1 Nuclear power plants

In May 2013, approval was given for the restart of the Doel 3 and Tihange 2 nuclear reactors. This decision was based on an analysis by the Regulatory Body – i.e. the Federal Agency for Nuclear Control (FANC) and Bel V – of the safety case report submitted by the licensee and on advice from a large team of independent international experts and experts of the Belgian Regulatory Body.

In connection with the approval, a list of 16 requirements was drawn up, with 11 requirements to be met before a possible restart in May 2013, and 5 requirements to be met in the course of the first reactor cycle.

One of the requirements set out in connection with the restart of both reactors consisted of a series of tests designed to assess how radiation affects the mechanical properties of hydrogen-flaked steel. For these tests, a test piece of hydrogen-flaked material similar to that of the Doel 3 and Tihange 2 reactor pressure vessels was submitted to intense irradiation in one of the research reactors of the Belgian Nuclear Research Centre (SCK•CEN) for several weeks. As the preliminary test results showed that one of the material's mechanical properties (i.e. fracture toughness) was more affected by radiation than predicted by theoretical models, the licensee decided on 26 March 2014 to bring forward the planned outages of Doel 3 and Tihange 2. In order to explain these unexpected results, the licensee has performed several series of tests.

For the new safety case report that will have to be issued by the licensee, the Regulatory Body set out a two-step review process. The Regulatory Body will first review the relevance of the methodology proposed by the licensee. Depending on the conclusions of this first review, the Regulatory Body will then communicate to the licensee whether its safety case report (for the restart of the Doel 3 and Tihange 2 units) is eligible for review.

At the beginning of August Doel 4 shut down automatically after the oil lubrication for the steam turbine system had been lost. As the damage to the turbine system was quite extensive, the power plant could only be restarted towards the end of 2014. As a result of this event thought to be caused by sabotage, additional security measures were implemented such as the four-eyes principle. The global impact on safety of this principle presented a challenge.

The Long-Term Operation (LTO) project is still ongoing for Tihange 1, in view of the decision to authorise operation for another 10-year period, i.e. until 2025. An action plan was drawn up for the improvement of Tihange 1, based on the safety evaluation report established by the licensee and reviewed by the Regulatory Body. Specific inspections were carried out in the context of the follow-up of this action plan.

Electrabel developed an action plan for the end of operation and future dismantling of Doel 1/2 since – from a legal point of view – both the Doel 1 and Doel 2 nuclear power plants will reach the end of their lives in 2015. Discussions about this subject continued in 2014 between Electrabel and the FANC / Bel V. However, as during the fall of 2014 a specific situation in Belgium resulted in three nuclear power plants not being available, discussions were held as to whether the lifetime of the two power plants should not be prolonged.

In mid-2013 a gel-like substance was discovered in a number of drums containing conditioned waste, both at Belgoprocess and at the Doel site. As a result of this discovery, a close collaboration was initiated and is still ongoing by the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS), the FANC and Bel V to thoroughly investigate and remediate this problem.

In the wake of the Fukushima accident, the licensees were asked to conduct stress tests and develop action plans that were reviewed by the Regulatory Body. Various modifications were made to the facilities or are in the process of implementation. In 2014, specific inspections were performed at Doel and Tihange to monitor the implementation of these modifications.

1.1.2 Other nuclear facilities

Following the Fukushima accident, stress tests were conducted for all Class I nuclear facilities in operation. Safety evaluation reports and action plans were drawn up by the operators and reviewed by the Regulatory Body. The implementation phase of each plan is closely monitored by Bel V.

Various projects are ongoing at BR2 with a view to continuing operation after 2016.

Dismantling activities are ongoing at Belgonucléaire, without any significant contamination incidents being reported.

The challenges for the management of the National Institute for Radioelements (IRE) remain numerous. A number of different projects are under study: conversion from highly enriched uranium (HEU) to low-enriched uranium (LEU) for the targets, design study of a new facility, etc. Various action plans are being implemented, including for the disposal of historic waste.

In 2014 old degraded sources of Sterigenics which were stored in the pool could be evacuated to Belgoprocess.

Dismantling of the Thetis research reactor continued in 2014.

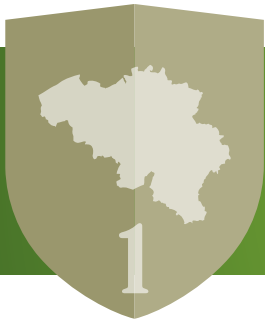
Dismantling of the Franco-Belgian Fuel Fabrication (FBFC) facilities started in 2014.

1.1.3 Integrated strategy for control

The integrated strategy for inspection (by the FANC) and control (by Bel V) was applied in 2014.

The control program for 2014 was sent to the facilities at the end of the previous year. Performance indicators are used to monitor the execution of the program.

More attention is being paid to human factors and human performance, safety management and the development of a safety culture. In particular, the use of 'safety culture observation sheets' was continued and improved in 2014.



REGULATORY ACTIVITIES IN BELGIUM

1.2 Overview of inspections at nuclear power plants

The regulations require permanent inspections during operation of the seven Belgian nuclear units. The aim of these inspections is to verify compliance with the licence, and to assess the licensee's safety management and safety culture.

About 320 inspections were performed at the seven Belgian nuclear units in 2014.

An overview of the main inspection activities performed by Bel V inspectors is given hereafter for each unit.

1.2.1 Doel 1/2

From 3 to 22 January, there was a planned outage of Doel 1 for refuelling.

On the morning of 13 February, Doel 1 scrammed following the drop of a control rod. On 14 February, the unit was operating at nominal power again.

Doel 2 was shut down for refuelling between 13 June and 3 July.

The common annual outage for the safety injection and diesel sequence tests took place from 20 June to 25 June.

On 18 October, there was an automatic power reduction to 86% for Doel 1 as a result of the breaking off of a gaugeglass from a renewal tank in the secondary part of the unit. After 17 hours, Doel 1 was operating at nominal power again.

Over the weekend of 25 and 26 October, Doel 2 was shut down for the repair of leaking safety valves on a safety injection accumulator.

1.2.2 Doel 3

In June 2013, Doel 3 was brought back into service after a favourable opinion from the safety authorities with regard to the justification by Electrabel of the mechanical integrity of the reactor pressure vessel.

However, at the end of March 2014 Doel 3 was shut down again by Electrabel due to unexpected results of mechanical tests at SCK•CEN for the vessels. More specifically, it was observed that the mechanical properties of the material were more affected by radiation than had initially been supposed. While awaiting justification, the unit is in a state of extended outage.

A valve had been torn off a vent pipe of the tank of the chemical and volume control system. The cause seems to have been fatigue as a result of vibrations. This incident did not result in any serious consequences.

1.2.3 Doel 4

The reactor was at nominal power throughout the year, except for:

- a planned outage (33 days, from 14 March to 15 April) for refuelling and maintenance;
- an unplanned outage (from 5 August to 20 December) for repair of the steam turbines that had suffered damage as a result of sabotage.

1.2.4 WAB-SCG

WAB: The upgrade of the WAB installation as a result of the historic corrosion problem is ongoing. A first ground water evaporator has been replaced and the replacement of the second is coming to an end. The extension of storage capacity for concentrates is also ongoing. A limited buffer for storage of concentrates has always been present, but it will be considerably extended in early 2015 (1 storage tank and 2 emergency storage tanks available). The operation of the WAB installation has so far not been jeopardised, with the exception of a breach in the fire compartmentalization.

As reported in 2013, drums originating from KCD were found at Belgoprocess with gel leaking out. This resulted in a thorough investigation into this phenomenon, the origin of which is likely an alkali-silica reaction (ASR) in the drums containing conditioned waste. This concerns thousands of drums produced over the last decade. The production campaigns of the conditioning lines for concentrates and ion-exchange resins were stopped. New conditioning methods are currently being developed. This development is taking some time, meaning that the need for additional storage has become clear. Projects have been initiated with a view to further increasing the buffer for the storage of ion-exchange resins and concentrates (the ion-exchange resin storage in particular is restrictive). Due to the postponement of a conditioning campaign according to method WB03 (conditioning with hematite, the only remaining conditioning method that is accepted by ONDRAF/NIRAS), attributable to the ageing of the concreting installation, the buffer storage of waste to be conditioned is limited. The renovation of this installation is in progress.

SCG: The development of a solution for the storage of leaking fuel rods is under way in collaboration with AREVA. Discussions are also ongoing on the treatment modalities between Electrabel and Bel V/FANC. In addition, a modification file is also being drafted for the introduction of a new type of storage container (HOLTEC).

In preparing the loading of a container at Doel 3 (TN24SH24), particles of foreign origin were detected. Research is currently under way into the cause and definition of corrective measures.



REGULATORY ACTIVITIES IN BELGIUM

1.2.5 Doel site

The Bel V control program at the site was further implemented as follows:

- Meetings were held with the heads of various departments (Maintenance, Operations, Care, Engineering) and services, in order to evaluate their organisation and the management of different processes related to nuclear safety or radiation protection.
- More attention is being paid to human factors and human performance, housekeeping, resolving minor deficiencies, etc., having in mind the importance for improvement actions to be permanent.

Bel V provided support to the FANC within the framework of its inspections, especially the management inspection, the inspection of the management systems and the inspection relating to 'waste'. In addition, Bel V also provided support to the FANC in the area of physical protection.

Bel V is also still closely involved in the BEST (Belgian Stress Tests) project, which resulted in various changes to facilities and procedures.

It is worth mentioning as well the follow-up on the action plan resulting from the common periodic safety review, which was completed at the end of 2011 and resulted in changes to facilities, procedures and the safety analysis report.

1.2.6 Tihange 1

The unit operated at nominal power throughout the year, except for:

- a reactor trip on 19 March, due to a failed transfer of electrical power to some pumps;
- the refuelling outage from 30 August until 20 October. Due to possible electricity shortages as from autumn 2014, Electrabel announced a shortening of the 2014 outage and the deferral of part of the work planned to an extra outage in 2015.

1.2.7 Tihange 2

- A reactor trip occurred on 8 January due to an incorrect operation during a test. The unit was restarted as soon as the diagnosis and required operations had been carried out.
- After obtaining unexpected and unfavourable mechanical test results (related to one of the 'long-term' actions set out in the context of the reactor pressure vessel issue), Electrabel decided on 25 March 2014 to shut down Tihange 2 and Doel 3. The unit has since remained offline.

1.2.8 Tihange 3

The unit operated at nominal power throughout the year, except for:

- 2 August, to correct an oil leak on a normal feedwater isolation valve;
- 23 August, to correct a nitrogen leak on a normal feedwater isolation valve;
- 30 November, following an explosion (followed by fire) at a current transformer located at the high-voltage substation;
- from 25 to 31 December, for reasons of fuel economy.

1.2.9 Tihange site

The Bel V control program at the site was further implemented as follows:

- Meetings were held with the management and the heads of various departments (Maintenance, Operations, Care, Engineering) and services in order to evaluate their organisation and the management of various processes relating to nuclear safety or radiation protection.
- Attention was paid to human factors and human performance, housekeeping, resolving minor deficiencies, etc., in the light of the importance of continuous improvement.
- Specific inspections were carried out to address topics that apply to several units (risks and countermeasures associated with a possible blackout etc.).

Bel V provided support to the FANC within the framework of its inspections, particularly those relating to management, the management system and radioactive waste management. Bel V has also provided support to the FANC in the context of physical protection.

Bel V was again closely involved in the BEST project, which resulted in changes to facilities and procedures and the construction of new buildings.

It is worth mentioning as well the follow-up on the action plan resulting from the periodic safety review, which was completed at the end of 2011 and also resulted in changes to facilities, procedures and the safety analysis report.



REGULATORY ACTIVITIES IN BELGIUM

1.3 Overview of inspections in other nuclear facilities

1.3.1 Nuclear Research Centre (SCK•CEN)

The operating regime of the BR2 reactor in 2014 consisted of 3 cycles of 3 weeks and 3 cycles of 4 weeks.

On 18 July, a transformer break-down resulted in a scram of the BR2 reactor. Upon further investigation, it was observed that the transformers' pressure relief valves had been set up incorrectly. These transformers were replaced a few months later.

The replacement of the beryllium matrix of the BR2 reactor is scheduled for 2015. At the end of February 2015, the BR2 reactor will be shut down for a period of 16 months. The refurbishment of the BR2 reactor will take place during this period.

The Guinevere fuel assemblies were converted from 'type 9' to 'type 13'. Authorisation for the loading of the reactor core with 'type 13' assemblies was approved based on a new core certificate by the Health Physics Department and Bel V.

As a consequence of the Fukushima accident, a stress test of the facilities was carried out by SCK•CEN. This analysis led to the preparation of an action plan that was approved by the FANC. Bel V has observed sufficient progress in the implementation of this action plan.

1.3.2 Belgoprocess

In 2014, two smouldering fires occurred. On 22 October a cavity fire broke out during dismantling works on the roof of building 235A. As a result of the use of a grinding disc for the removal of reinforcements, a spark entered the cavity with glowing combustion as a result. The internal fire department extinguished the fire using water and foam. On 11 November it was observed that a smouldering fire had occurred in the pressure relief filter of the cutting unit in building 102X. The filter was fully burned out internally, but no fire occurred outside the pressure relief installation. The cause of the smouldering fire was probably a spark that fell on the filter medium during grinding work on the pressure relief filter.

As a result of the safety audit carried out in October 2010, Belgoprocess initiated the Strategic Safety Program (SSP). This action plan is periodically monitored by Bel V and the FANC.

As regards the problem of formation of gel in drums from KCD, gel leakage was observed from a couple of additional drums during operations in building 151X. As a result of this, Belgoprocess has drawn up a new action plan. In the short term, a specific zone in building 151X will be freed up for the separation of the gel drums. In addition, the gel was scraped off and collected for the most problematic drums. Lastly, three projects have been started up: (i) a feasibility study for the use of an RX scanner with a view to the detection of gel in the campaigns concerned, (ii) a feasibility study for the removal of gel into an intervention container and (iii) a concept study for a new building for storage of the gel drums.

Within the framework of the UF6 project, the installation for washing and certification of cylinders and the installation for the reconversion of washing liquid have been commissioned.

On the Sterigenics (Fleurus) site, six damaged cobalt radiation sources were stored. These had to be evacuated to Belgoprocess for further treatment and storage. In view of the period for the availability of the transport container, the scenario of direct treatment of the radiation sources in a timely manner was no longer feasible. The decision was therefore taken to temporarily store the cobalt radiation sources in a unit of the Pamela building (131X) until the tools required for the treatment scenario became available.

The operations for the temporary storage of the cobalt radiation sources took place on 27 June 2014 and the actual treatment took place on 20 and 21 August 2014. These operations went well in general. The cemented drum with the cobalt radiation sources was evacuated to building 136X on 10 September 2014.

With regard to the dismantling works, building 101A has been fully demolished. In addition, the Scientific Council has issued a provisional favourable opinion concerning the extension of the license for the dismantling of site 2.

As a consequence of the Fukushima accident, a stress test of the facilities was carried out by Belgoprocess. This analysis led to the preparation of an action plan that was approved by the FANC. The progress of the stress test action plan is being monitored by Bel V. Many actions have been delayed due to lack of resources. Additional resources will be assigned in order to attempt to make up for time lost.

Within the framework of the licence application for the monolith production installation (IPM), the Scientific Council has issued a definitive favourable opinion.

1.3.3 Belgonucleaire

In 2014 the dismantling activities were focused on the dismantling and release of building H, which was emptied in accordance with defined waste flows (radioactive waste and industrial waste after release) based on a detailed radiological characterisation. At the end of 2014, the building was released and isolated from building A.

Dismantling of building H is scheduled for early 2015.

At the same time, the dismantling works progressed in building A. The dismantling of the glove boxes continued. Room A18 has been renovated so as to be able to remove the boxes from room A7. The dismantling of the boxes turned out to be a space- and time-consuming operation.

All the historic waste that was found at Belgoprocess returned to Belgonucléaire and was evacuated as A3X waste.

No incidents occurred and the safety culture remains at a high level despite the challenging and changing work environment.



REGULATORY ACTIVITIES IN BELGIUM

1.3.4 National Institute for Radioelements (IRE)

The controls carried out by Bel V in 2014 confirmed the following trends:

- The supervision and control of the production process of the IRE have been continuously reinforced.
- The challenging IRE program to eliminate historic waste accumulating on site is being pursued.
- The IRE is involved in the development of new production capacity using low-enriched uranium (LEU) instead of highly enriched uranium (HEU).
- The dossier submitted by the IRE to the FANC to increase production capacity is still pending.
- An international audit was carried out with the help of the Autorité de Sûreté Nucléaire (ASN) regarding the performance of the maintenance department of the IRE.

The stress test program, the periodic safety review and the checks performed by the Regulatory Body have highlighted margin for conceptual improvement for a facility that was designed in the 70s'-80's.

1.3.5 Thetis

In 2014, no incidents of note occurred.

Phase 4, i.e. the removal of the asbestos still present, was carried out between February 2014 and April 2014.

In collaboration with SCK•CEN, in 2014 the procedures and methodology were elaborated for the removal of the activated liner (phase 5). These works were carried out in May 2014.

In June 2014, the concrete wall and floor plate were characterised using the ISOCS system. The total activity of the floor plate amounts to 2.48 MBq Eu-152.

In September 2014, the FANC and Bel V informed the operator that they can agree to the future downgrading of the installation to Class III or the inclusion of the reactor vessel in the existing Class II licence for the INW site.

The final dismantling file, the documents for the mapping of the reactor vessel concrete and the final mapping of the Thetis building have still to be approved by the FANC and Bel V in 2015.

1.3.6 Institute for Reference Materials and Measurements (IRMM)

In 2014, no incidents of note occurred.

The operation of the LINAC, the Van de Graaff installation, the mass spectrometry department, the main building and the waste building took place in a correct manner.

The commissioning of three X-ray devices for experimental research was carried out in December 2014.

1.3.7 Franco-Belgian Fuel Fabrication (FBFC)

The dismantling of buildings 1, 2, 3 and 5 is proceeding on schedule.

Building 1 (lab) was almost fully dismantled in 2014, except for a few pipes. The dismantling works in this building are scheduled to be completed for the end of March 2015.

In building 2 (GADO), in 2014 a large proportion of the installations were already demolished. By mid-2015, all dismantling works should be complete.

The dismantling of building 3 ended in 2014.

In building 5, the dismantling of the installations began in 2014.

The approval of the methodology and release files for buildings 1, 2, 3, 5 and 5M and the FBFC site is scheduled for 2015.

The latest MOX campaign in building 5M was started in September 2014.

In 2014, no incidents of note occurred.

1.3.8 Other (Class II and III) facilities

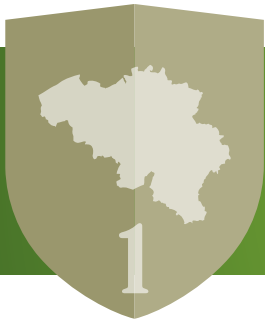
Bel V managed about 150 inspections in Class IIa, II and III facilities.

No accidents were recorded in 2014.

Sterigenics successfully removed the damaged Cobalt-60 sources which had been lying in the pool since the 90's.

Evacuation and accumulation of radioactive waste sometimes stored in public institutions such as universities remained a point of attention for Bel V.

Despite the fact that there are a number of accelerators in Belgium that have not been used for years, none of them have officially declared to have ceased activity. This state of 'quasi-permanent' postponement of the dismantling operations of these facilities has been another point of attention for Bel V.



REGULATORY ACTIVITIES IN BELGIUM

1.4 Emergency preparedness and response

1.4.1 Emergency response exercises

In 2014, four emergency preparedness and response exercises were held under the supervision of the Directorate-General Crisis Centre of the Federal Public Service Interior (DG Crisis Centre):

- in May for the Tihange nuclear power plant: partial exercise limited to the interaction between the emergency crisis cell of the licensee (on-site) and the evaluation cell CELEVAL (off-site);
- in September for the Chooz nuclear power plant (France) with focus on cross-border interaction between the two countries;
- in October for the Doel nuclear power plant: partial exercise limited to the interaction between the emergency crisis cell of the licensee (on-site) and the evaluation cell CELEVAL (off-site);
- in December for the IRE nuclear facility: partial exercise with participation of local authorities and emergency services in addition to federal units and committees (coordination committee, evaluation/information/measurement units). A support team assisted the participating bodies at all stages of the exercise (development, preparation, execution and evaluation).

All these exercises were prepared, conducted and evaluated according to a new Belgian methodology for the preparation, execution and evaluation of emergency preparedness and response exercises. Bel V was heavily involved in these exercises, as a stakeholder but also as 'controller' and 'evaluator' for the IRE nuclear facility exercise (a Bel V representative was appointed as 'local exercise coordinator' and member of the exercise management team). A Bel V representative was also involved in the workshop for first responders and the information session that were held in the context of this exercise.

In addition to the exercises mentioned above, Bel V participated, in a limited way, in an exercise concerning transport of radioactive material jointly organised in April 2014 by the Institut de Radioprotection et de Sécurité Nucléaire (IRSN) (France) and the FANC. Finally, Bel V and FANC observed two internal exercises at the Tihange site in October, which focussed on improvements that were implemented in the context of the Belgian stress test program (BEST).

1.4.2 Other related activities

Bel V participated in the continuation of projects that have been initiated in previous years (such as the implementation, within the various Emergency Planning Zones concerned, of the principles and guidelines as defined in 2009-2010 or the development of improvements regarding the protection of first responders in case of a radiological emergency).

Bel V, together with the FANC, has been involved by the DG Crisis Centre in the process of reviewing the Royal Decree on the nuclear and radiological emergency plan for the Belgian territory. It is expected to publish a consolidated proposal for a revised version of this plan by late 2015 or early 2016 after due consultation of the stakeholders.

1.4.3 Improvement of Bel V's role

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

- Bel V staff participated in the Belgian emergency preparedness and response exercises, which, besides the response activities, required a lot of preparation, observation and evaluation of the response by the Bel V crisis team, by the licensee and by other parties involved (evaluation cell of the DG Crisis Centre).
- In addition to the Bel V participants, Bel V representatives participated as observers in three Emergency preparedness and response exercises (Tihange, Chooz and Doel).
- Two Bel V representatives participated as Trainers in a training module on emergency preparedness and response provided by the European Nuclear Safety Training and Tutoring Institute (ENSTTI) at the ENSTTI offices in December 2014 (Fontenay-Aux-Roses, 1-5 December 2014).
- Bel V participated in R&D activities in the domain of emergency preparedness and response, in the context of a research program with the Vrije Universiteit Brussel (VUB) in view of developing cognitive radio for nuclear power plants (4-year program connected with a Doctorate).
- Bel V was involved in a proposal coordinated by IRSN within the Horizon 2020 Framework Programme for Research and Innovation (FASTNET project: FAST Nuclear Emergency Tools).

1.4.4 International collaboration

Bel V took part, partly in support of the Belgian competent authorities (nuclear safety authorities – TSOs), in the following working groups:

- WG Emergencies of HERCA (Heads of European Radiological Protection Competent Authorities) and AtHLET (HERCA-WENRA Ad-hoc High Level Task Force on Emergencies);
- Exchange meeting between IRSN, the FANC and Bel V on emergency preparedness and response (Fontenay-Aux-Roses, March 2014);
- Exchange meeting between German and Belgian authorities (Brussels, October 2014).



SAFETY ASSESSMENTS AND NATIONAL PROJECTS

2.1 Probabilistic Safety Assessment (PSA)

In the context of the implementation of the WENRA Reference Levels for all existing nuclear power plants (as required by the Royal Decree of 30 November 2011) Electrabel and Tractebel Engineering continued their efforts to develop an Internal Fire PSA and an Internal Flooding PSA for the Belgian nuclear power plants. These PSA models include a plant-specific PSA Level 1 for each of the units (except Doel 1/2, for which the permanent shut-down was originally scheduled for 2015) and a PSA Level 2 for a representative unit (Doel 3). All plant operating states will be covered. In 2014, Bel V reviewed the development of the Flooding PSA study for Doel 3. For the Internal Fire PSA, focus was mainly on the first tasks of the projects (initiating event and human error selection, definition of fire compartments). In particular, a method enabling the assessment of the impact of smoke was discussed. The follow-up of the collection of all required data and the cable routing for each unit also continued. For the Fire and Flooding PSA level 2, Bel V reviewed the preliminary tasks achieved by Tractebel Engineering before obtaining the input from the level 1 studies.

Bel V also monitors the on-site implementation of PSA recommendations (i.e. plant modifications, procedural changes, etc.) made in 2011 after a global upgrade of the PSA models for internal events, which took place during the previous Periodic Safety Reviews (PSR). In addition, these plant-specific PSA models were further updated in 2012/2013 by taking into account all plant modifications up to 2010. Future updates of these PSA models are planned to take into account the Belgian Operational Experience Feedback since previous updates. In 2014, Bel V examined the methodology proposed by Electrabel.

The next upgrade of the PSA models (taking into account a revised scope and methodology) for internal events was started in 2014. The main inputs of this upgrade are the recommendations of an external peer review of the Doel 3 PSA against the American Society of Mechanical Engineers (ASME) Standard for PSA. In 2014, Bel V attended the project kick-off meeting and discussed the scope of the recommendations retained with Electrabel.

Through meetings with the PSA Standing Committee of Electrabel and Tractebel Engineering, Bel V monitors the gradually increasing use of the PSA models by Electrabel for various PSA applications. In particular, Bel V monitors compliance with the requirements of the Royal Decree of 30 November 2011 in terms of PSA applications (e.g. the use of PSA for verifying the adequacy of procedures and plant modifications and for evaluating the significance of operational events).

Bel V's international and R&D activities on PSA methodology and PSA applications are presented in Section 4.4 on research and development.



2.2 Periodic Safety Reviews (PSR)

A Periodic Safety Review consists in an evaluation by the licensee of 14 'safety factors' as defined in the IAEA Safety Guide NS-G-2.10 (recently replaced by SSG-25), the use of which is required by the FANC for all Class I nuclear facilities.

- Nuclear power plants – 2nd Common PSRs

Scope and methodology documents according to the guidelines of the FANC were issued for all the units. All assessment reports for Doel 3 and Tihange 2 (one per safety factor and one for the overall safety evaluation) were reviewed by Bel V. The conclusions of these assessments were discussed by the safety authorities and the licensee. A final version of the resulting action plan was reviewed by Bel V and approved by the FANC.

The scope and methodology documents for the PSR of Tihange 1 & 3, Doel 1/2 and Doel 4 were reviewed by Bel V and conditionally approved by the FANC.

A number of presentations, for some safety factors, of the work to be performed by the licensee for those units in order to perform the PSR evaluation took place in 2014.

- SCK•CEN

SCK•CEN deliverables supporting the safety factor assessment reports were further analysed by Bel V in 2014. The 'living' methodology document was updated on the basis of the analyses and results.

- First periodic safety review of the IRE

The periodic safety review of the IRE consisted of 17 subjects, distributed over 154 tasks. Early 2014, two subjects were still open, but almost completed. By mid 2014 all the subjects were completed. At the end of June the IRE sent a report summarising the output of this first PSR to the FANC. This last action completed the PSR.

- Periodic safety review at Belgoprocess

Scope and methodology documents were issued, presented and approved for all installations of site 2 of Belgoprocess. The first deliverables in support of the assessment reports will be provided to Bel V in the first half of 2015.



SAFETY ASSESSMENTS AND NATIONAL PROJECTS

2.3 Long-Term Operation (LTO) – Tihange 1

The implementation at Tihange 1 of the detailed action plan resulting from the final and approved summary LTO reports (June 2012) continued in 2014 for each area covered by the ‘FANC and Bel V Strategy Note on Long-Term Operation’:

- the development of an Ageing Management Program;
- a re-evaluation of the design (Agreed Design Upgrade);
- pre-conditions to be fulfilled before the start of the life extension period (2015);
- issues related to knowledge and skills management.

Given the risk of power shortages and blackouts in late 2014, it was decided to shorten the 2014 review for Tihange 1 from 10 to 7 weeks and to defer the majority of the LTO-related activities and modification files to an additional scheduled outage in the summer of 2015 (in order to meet the LTO commitments and schedule).

The licensee justified to Bel V and the FANC the postponement of the activities and modification files originally scheduled for 2014 and the possible execution of LTO projects scheduled for 2016 during the 2015 outage.

In November 2014 the licensee presented to Bel V and the FANC its self-assessment of the level of maturity and realisation achieved for LTO program commitments relating to prerequisites and knowledge and skills management. This assessment shows adequate progress, meaning that the deadline for both LTO areas (September 2015) is not under threat.

A preparatory meeting of the SALTO Mission (Safe LTO) scheduled for January 2015 in Tihange 1 was held in late August with the Head of Mission of the International Atomic Energy Agency (IAEA) to identify the expectations of the authorities (the FANC and Bel V) in this matter and to make practical arrangements.



2.4 Shutdown program Doel 1/2

2.4.1 Final shutdown of Doel 1/2

Since the government decision on the final closure of Doel 1/2 was announced, Bel V has been closely involved in the 'final shutdown' project in preparation for the decommissioning and dismantling of the units. It should be noted in this regard that during the various phases of the final shutdown, the same standards for nuclear safety and radiation protection will be adhered to as during operation.

Aspects which were analysed during the considered period or for which analysis is still ongoing:

- finalisation of the questions/answers as regards reducing the scope of the ongoing projects and modifications;
- proposals for organisational changes for the period in which all nuclear fuel elements are located in the nuclear fuel docks of the nuclear support services building (GNH);
- proposals for changes to the technical specifications in order to render them more appropriate for the period in which all fuel elements are located in the fuel docks of the GNH;
- discussions regarding the preparations for the chemical decontamination of the primary loop;
- discussion of changes for the final decommissioning of loops;
- discussion of the appendices to the safety analysis report that describe the status of the unit for the phase whereby all nuclear fuel elements are located in the nuclear fuel docks of the GNH and the phase between the removal of the last nuclear fuel element from the docks of the GNH and the start of dismantling.

2.4.2 Waste Management Facility (WMF) and Dismantling Licence Doel 1/2 (DL)

Electrabel is planning the construction of a waste management facility (WMF) as a supporting building for the dismantling and decontamination activities for the final shutdown of Doel 1/2. This building will also be used during the final dismantling of the other units on the site.

Electrabel has initiated the pre-licensing process for this waste management facility. Based on the FANC Strategy Note, Electrabel has drafted a 'Design Options and Provisions file' and submitted it to Bel V and the FANC for approval.

Given the government decision at the end of December on Long-Term Operation for Doel 1/2 instead of the definitive shut-down of these units, the timing for this waste management facility and the dismantling licence application will be reconsidered.



SAFETY ASSESSMENTS AND NATIONAL PROJECTS

2.5 BEST project: Belgian stress tests

2.5.1 Nuclear power plants

In the wake of the accident that occurred on 11 March 2011 at the Japanese Fukushima-Daiichi nuclear power plant, a wide-scale targeted safety reassessment program was set up among the Member States of the European Union that operate nuclear power plants on their soil. This 'stress test' program was designed to re-evaluate the safety margins of the European nuclear power plants when faced with extreme natural events, and to take relevant action wherever needed.

The stress tests of the Belgian nuclear power plants included the following main steps:

1. reports of Electrabel (2011);
2. national report of the safety authority (2011);
3. peer review, country visit and final ENSREG overall report, in accordance with the ENSREG methodology (2012);
4. action plan of Electrabel based on findings from the previous steps, and approval by the safety authority (2012).

Bel V was involved in steps 2 to 4.

Bel V is now in charge of the technical and organisational follow-up of the implementation of the actions by Electrabel. This follow-up includes the assessment of studies and implementations, regular follow-up meetings and on-site inspections, sometimes with the contribution of the FANC.

In 2014, as in 2013, Electrabel indicated to Bel V and the FANC reasons to postpone or modify certain actions, including the complexity of studies and implementations, additional actions resulting from conclusions of studies, delays due to difficulties resulting from equipment qualification by providers or organisation of the activities during the outages. Analysis of the causes of the delays resulted in modifications to the action plan.

2.5.2 Other nuclear facilities

Following the Fukushima accident, stress tests were also conducted at all other Class I nuclear facilities in operation (BESTA project). Safety evaluation reports were drawn up by the operators and reviewed by the FANC / Bel V. On 16 April 2013 the FANC published the national report of these stress tests on its website. The required action plans for the respective licensees were finalised by 1 July 2013, after which the implementation phase started.

The technical and organisational follow-up of the implementation of the actions by the different licensees is the responsibility of the operational control of each facility (Bel V inspector). As is also the case for the BEST project, this follow-up includes the assessment of studies and implementations, regular follow-up meetings and on-site inspections, sometimes with the contribution of the FANC.



Progress on action plans is generally satisfactory. However, Bel V has noted that some licensees (Belgoprocess, IRE) are having difficulties meeting the deadlines. The delays are caused mainly by a lack of resources. Additional resources have been allocated by these licensees in an attempt to clear the backlog.

2.6 Spent fuel and radioactive waste management

In collaboration with the FANC, Bel V was deeply involved in the licensing discussions (since the license application by ONDRAF/NIRAS on 31 January 2013) concerning the future facility for the disposal of low and intermediate level short-lived radioactive waste (category A waste) in Dessel.

In the first half of 2014 the FANC and Bel V completed the detailed analysis of the safety case and more than 200 questions were submitted to ONDRAF/NIRAS. ONDRAF/NIRAS started answering these questions in June 2014. Bel V is deeply involved in the analysis of the ONDRAF/NIRAS answers in collaboration with the FANC. Furthermore, within the framework of the long-term safety evaluations, Bel V continued its activities (using its own modeling capacity) of independent safety verification (already started in February 2012).

In 2014, the FANC and Bel V initiated a collaboration in the Belgian program for the disposal of B & C waste in deep geological formations. This collaboration relates to the R&D program of the regulatory body (the FANC and Bel V), the analysis of records as part of the implementation of the Act of 3 June 2014 transposing European Directive 2011/70/Euratom and the communication of the regulatory body with the various stakeholders. In this context, Bel V has contributed in particular to the development of the position of the FANC on the interpretation of the Act of 3 June 2014. The draft integrated guide on geological disposal of the FANC was also reviewed.

In 2013 a gel-like substance was discovered in a number of waste drums from the Doel nuclear power plant stored at Belgoprocess. Further investigations revealed that thousands of drums stored at Belgoprocess were potentially concerned by this gel formation issue. Since the discovery of this issue, Bel V has verified that Belgoprocess is taking the necessary actions to ensure the safety of their storage buildings. In addition, Bel V has verified that the Doel nuclear power plant develops new and safe conditioning processes for the waste streams concerned by the gel formation issue and that the temporary on-site storage of unconditioned radioactive waste remains safe. In the context of this gel formation issue, in 2014 Bel V participated in a new working group allowing the FANC, Bel V and ONDRAF/NIRAS to consult each other about the measures to be taken to manage this issue and to avoid such a problem in the future. Finally, in 2014 Bel V drafted a report describing this gel formation issue and submitted it to the IAEA FINAS working group (Fuel Incident Notification and Analysis System). This will allow other FINAS members to benefit from the lessons learned in Belgium with regard to this issue.



SAFETY ASSESSMENTS AND NATIONAL PROJECTS

2.7 MYRRHA (SCK•CEN)

MYRRHA is a multi-purpose irradiation facility coupling a 600 MeV proton accelerator with a fast spectrum reactor of 100 MWth cooled with Lead-Bismuth eutectic, through spallation reactions. The pre-licensing phase of the MYRRHA project, initiated in 2011 in order to analyse the 'licensibility' of the facility, continued in 2014. This pre-licensing phase is expected to run until late 2016.

In the context of this pre-licensing, Bel V has been evaluating the SCK•CEN deliverables in response to focus points (technical issues that are new or not yet mature enough, that are specific to MYRRHA and that have an impact on the safety of the facility) identified by the Regulatory Body (the FANC and Bel V). At the end of 2014, more than a quarter of the deliverables had been provided by SCK•CEN. Technical meetings took place to discuss focus points with SCK•CEN. As the MYRRHA design still evolves, most of the deliverables are anticipated in 2015 and 2016.

Bel V was also involved in discussions concerning volume 2 'Approach to nuclear safety' of the Design Options and Provisions File, a document prepared by the designer detailing, in a top-down approach, the safety goals and objectives, the safety options, the safety design and operational specifications, as well as the safety provisions. The other volumes of the Design Options and Provisions File will be provided and analysed in 2015.



2.8 Reactor vessel flaws

In June 2012, in addition to the inspection of the Doel 3 reactor pressure vessel welds as required by the regulatory program for inspection in operation for the end of the third inspection interval, an ultrasonic inspection of base metal of the shell forgings of the reactor pressure vessel was carried out. This inspection was part of the inspection program decided for all the Belgian units in the framework of the operational feedback from Tricastin 1, where underclad defects (planar defects perpendicular to the internal wall of the reactor pressure vessel) were identified. No underclad defects were detected, but several thousands of quasi-laminar flaw indications were identified in the upper and lower core shell forgings. Similar inspections were then carried out in September 2012 at Tihange 2, which has a reactor pressure vessel of identical design and construction. Similar quasi-laminar flaw indications were also detected, but to a lesser extent.

The licensee decided to keep both Doel 3 and Tihange 2 in cold shutdown state with the core unloaded and initiated analyses in support of a request for restart of operation.

The safety demonstration by the licensee was documented in two safety cases, one for each unit, as submitted to the FANC and Bel V in December 2012. The safety cases, backed by a number of technical documents, allowed the licensee to conclude that the safe operation of both units was guaranteed and that the units could be restarted immediately.

Taking into account the views of different groups of Belgian and foreign experts and conclusions of both Bel V and AIB-Vinçotte assessments, the FANC issued a provisional evaluation report in January 2013. This report concluded that some issues remained open that impaired the level of confidence in the safe operation of the units, but also that these open issues, in the current state of knowledge and given the available data, did not represent conditions that required final shutdown of Doel 3 and Tihange 2. As a consequence, the FANC decided that, in the current state of events, Doel 3 and Tihange 2 could only restart once the requirements listed in its provisional evaluation report had been met by the licensee. These requirements include short-term and medium-term actions. In response, the licensee developed an action plan to meet these requirements.

Once the licensee had completed its short-term action plan, the FANC evaluated whether all the safety concerns at the origin of these requirements had been resolved and whether the related reservations could be lifted. On this basis, on 17 May 2013, the FANC considered that Doel 3 and Tihange 2 could be restarted safely. Consequently Doel 3 and Tihange 2 resumed operation in June 2013.

Since then the licensee has continued to implement its action plan by carrying out the medium-term actions. Some of the main medium-term actions include those relating to the specific qualification of the ultrasonic inspection method, and experimental confirmation of the margin of conservatism considered in safety cases to reflect the additional influence of defects due to hydrogen on irradiation embrittlement of the steel in reactor pressure vessels. For these two actions in particular, the licensee was able to use an existing forged part affected by defects due to hydrogen. This part is a recently scrapped steam generator shell manufactured by AREVA.



SAFETY ASSESSMENTS AND NATIONAL PROJECTS

First, the aim of the inspection method qualification is to confirm the ability to detect defects due to hydrogen using ultrasound inspection, and to locate and characterise them to the required confidence level. The qualification of the inspection method by the licensee has essentially been monitored by AIB-Vinçotte, and resulted in an adjustment of the inspection procedure, consisting essentially of an improved dimensioning method and a lowering of the notation threshold. On the basis thereof, the number of defects detected in the Tihange 2 and Doel 3 shells was revised up considerably. The zone affected by the phenomenon being unchanged, this has led to the need to consider a higher defect density in the calculations for the justification of the structural behaviour of the reactor pressure vessels.

The experimental verification of the effect of radiation on the mechanical properties of a material affected by defects due to hydrogen, and in particular fracture toughness, is to ensure that irradiation embrittlement of such material conforms to what is expected of a healthy material, but taking into account the higher content of embrittling factors in localised segregations in which defects due to hydrogen are present. Samples from the affected AREVA shell were irradiated in the BR2 reactor of SCK•GEN before undergoing a series of various mechanical tests. These tests have demonstrated unexpected behaviour, indicating a greater effect of the irradiation than expected on the toughness of the material. The existence of this phenomenon of embrittlement was confirmed through repeated trials. A research program was developed by the licensee in order to gain more insight into this phenomenon, and to check whether it is specific to the AREVA shell material, or typical to all materials affected by defects due to hydrogen, in particular the material of the Tihange 2 and Doel 3 reactor pressure vessels. Note that following the discovery of this phenomenon, the FANC has created a group of international experts that is responsible for contributing to the evaluation of the issue on behalf of the safety authority. Their analysis is ongoing and should be completed in 2015.

In response to new challenges, the licensee has changed its calculation methods to prepare its new justification for the structural behaviour of the reactor pressure vessels. In particular, a greater use is made of three-dimensional analyses of indications. Thus the procedure for combining indications uses new local rules developed from three-dimensional analyses of pairs of indications, which reduces the conservatism of the previous rules based on two-dimensional calculations. The reported penalising defect groups have also been the subject of three-dimensional calculations to estimate the harmfulness of each individual defect. The use of three-dimensional analyses has also confirmed, with more accurate quantification than previously, that the defects due to hydrogen, by their relatively favourable orientation, are only slightly loaded, thereby limiting their propagation risk. These results are currently being analysed by Bel V.

Finally, the new inspections on the Tihange 2 and Doel 3 reactor pressure vessels in 2014, at the request of the authorities, have shown that in comparison with the results of inspections conducted in 2012, the size of the defects remained unchanged, thus demonstrating the non-propagation of these defects.



2.9 Reactor pressure vessel head replacement – Tihange 3 and Doel 4

Preventive replacement (in the framework of international experience feedback) of the Tihange 3 and Doel 4 reactor vessel heads represents a 'significant modification' in the sense of Article 12 of the Royal Decree of 20 July 2001 on general regulations for the protection of the population, workers and the environment against the danger of ionizing radiation.

Bel V has reviewed the licence applications introduced with the FANC in October 2013 by Electrabel for both sites and the documents submitted later in support of these requests.

- The preliminary assessment by Bel V was presented to the Scientific Council of the FANC, which, in its meeting of 28 February 2014, issued a provisional favourable opinion for the continuation of these projects through the implementation of complementary actions. These include the supply to Bel V of regulatory documents required by the ASME construction code, taking account of Belgian and international experience feedback on the replacement of reactor pressure vessel heads and aspects related to radiation protection (estimate of the collective dose associated with the replacement work and induced dose rates in buildings used for storing used heads at each site and surroundings thereof).
- The final evaluation report prepared by the FANC and Bel V on each of these projects was presented to the Scientific Council on 12 December 2014. It issued a favourable reasoned opinion on the licence applications of the licensee. This review is subject to conditions to be met before the reactor pressure vessels equipped with their new heads can be put under pressure. These conditions will be included in the Royal Decree on authorization to be obtained to ramp up each unit to nominal power.

Alongside the technical evaluations, Bel V monitored the manufacture of the new AREVA heads. A visit ('Quality' audit) at the plant in Jeumont (France) was carried out in late April 2014 to attend the cluster mechanisms tests for the new heads.

Following delays, the manufacture of the Tihange 3 head is continuing at AREVA's Chalon-sur-Saône plant (which was originally scheduled for delivery to the Tihange site at the end of 2014). Given the imminence of the next outage (end of March 2015), during which the head will be fitted, the licensee decided to finalise the construction of the head on-site. This approach will significantly reduce the transport time of the new head. Irrespective of regulatory controls performed by the AIA (Authorized Inspection Agency) as part of the transposition into Belgian law of the ASME code, Bel V will provide special monitoring of the end of production of the head, given its relocation to the Tihange site.

Installation of the new Doel 4 reactor pressure vessel head is currently scheduled during the next outage of this unit (in October 2015).



INTERNATIONAL ACTIVITIES AND PROJECTS

3.1 OECD and IAEA activities

Bel V participated in the activities of the following committees, working groups and meetings of the Organisation for Economic Co-operation and Development (OECD):

- the Committee on Nuclear Regulatory Activities (CNRA);
- 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);
- the CSNI Working Group on Fuel Cycle Safety (WGFCFS);
- the CSNI Working Group on Risk Assessment (WGRISK);
- the CSNI Working Group on Analysis and Management of Accidents (WGAMA);
- 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 Organizational Factors (WGHOE);
- the CSNI Working Group on Fuel Safety Margins (WGFSM);
- the Senior Level Task Group on Safety Culture of the Regulatory Body;
- the RWMC Integration Group for the Safety Case (IGSC);
- various OECD projects (see also Section 4.4 on R&D);
- the Incident Reporting System Coordinators' activities (IRS, IRSRR, FINAS).

The General Manager of Bel V is a member of the International Nuclear Safety Group (INSAG) of the International Atomic Energy Agency (IAEA), and attended two meetings in 2014.

Bel V participated in the Nuclear Safety Standards Committee (NUSSC) of the International Atomic Energy Agency (IAEA).



Bel V experts participated in several IAEA conferences, workshops and technical committee meetings (14 events in total), mainly on the following subjects:

- post-Fukushima issues;
- emergency preparedness;
- computer security for Instrumentation & Control;
- maintenance optimisation;
- human resource management for regulatory bodies;
- operational experience feedback;
- safety of radioactive waste disposal and spent fuel management;
- decommissioning safety.

The General Manager of Bel V participated in two meetings of the Steering Committee of the Technical and Scientific Support Organizations Forum (TSOF) of IAEA, and in two meetings of the Programme Committee of the TSO Conference.

At this IAEA International Conference on Challenges Faced by Technical and Scientific Support Organizations (TSOs) in Enhancing Nuclear Safety and Security (Beijing, October 2014), the General Manager of Bel V fulfilled the role of President of the Conference. Bel V contributed further with an invited lecture on 'Bridging required capabilities and training'.

A Bel V representative is member of the Steering Committee on Competence of Human Resources for Regulatory Bodies (coordinated by the IAEA), and attended the sixth meeting of this committee.

At the request of the IAEA, a Bel V representative participated in a two-week Integrated Regulatory Review Service (IRRS) mission at the French safety authority ASN. The Bel V representative was involved in the area of waste management, decommissioning and fuel cycle facilities.

Bel V contributed to the update of the Belgian report to be prepared for the fifth review meeting (in 2015) of the contracting parties to the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. This report is available on the Bel V website.



INTERNATIONAL ACTIVITIES AND PROJECTS

3.2 Cooperation with safety authorities

3.2.1 Franco-Belgian Working Group on nuclear safety

This working group is composed of the regulatory organisations of France and Belgium (ASN, IRSN, the FANC, Bel V). Two meetings are held each year, one in Paris and the other in Brussels (the latter chaired by Bel V). The working group covers a large range of topics on nuclear safety.

In 2014, exceptionally only one meeting was held (the second one being postponed until early 2015). At the 2014 meeting the main topics were: new initiatives on regulations, status of the Chooz and Gravelines nuclear power plants, cross-inspections, feedback on emergency response exercises, dismantling of reactor vessels, and the status of the findings and ongoing actions related to the flaw indications in the reactor pressure vessels of Doel 3 and Tihange 2.

3.2.2 Western European Nuclear Regulators Association (WENRA)

Bel V representatives participated, in support of the FANC representatives, in the spring and autumn meetings of WENRA. At these meetings, the work progress of the subgroups (see below) was discussed. Interfaces with other international forums (especially ENSREG and HERCA) were also discussed at these meetings. In 2014, special attention was devoted to the future role of WENRA, the flaw indications observed in the reactor pressure vessels of Doel 3 and Tihange 2, and the HERCA-WENRA approach for a better cross-border coordination of protective actions during the early phase of a nuclear accident.

Reactor Harmonization Working Group (RHWG)

Bel V participated in the three RHWG meetings held in 2014. The main achievement of the RHWG in 2014 was the publication of the updated Reference Levels for existing nuclear power plants, which are available on the WENRA website. In this effort, Bel V coordinated the subgroup 'Containment in severe accidents'. The RHWG has initiated discussions on the benchmarking procedure for the implementation of these revised Reference Levels in regulations and in the nuclear power plants. A number of new technical subgroups were created to discuss specific issues, such as 'practical elimination' and passive systems. A number of guidance documents are also under development.

Working Group on Waste and Decommissioning (WGWD)

In 2014, the progress made on the action plans of the Belgian licensees (Electrabel and Belgoprocess) with respect to the implementation of the WENRA Reference Levels for the facilities to store radioactive waste and spent nuclear fuel was



further monitored by Bel V, in collaboration with the FANC.

3.2.3 Task Force on Safety Critical Software (TFSCS)

The main objective of this international task force of experts from regulators and technical safety organisations is to maintain and update a consensus document on the basis of emerging experience, expertise and practice, so as to provide a public record of agreed regulatory expectations on the validation of safety critical software implemented in nuclear facilities. Exchange of information and sharing licensing know-how on digital instrumentation in operating plants and new builds is an additional benefit. Bel V has taken a prominent and active part in this activity since its inception twenty years ago.

In 2014, two new members joined: AECL (Canada) and KAERI (South Korea), which takes the total number of members to eight. Two plenary meetings took place. A full revision of the Common Position report on licensing practices was completed and approved. Contributions were also made to a NUREG/IA report, which includes the Common Position report together with feedback from the Nuclear Regulatory Commission (NRC) to assist NRC staff in using this information within the framework of their licensing review and regulatory activities. Both reports should be ready for publishing and release to the general public in early 2015.

Meanwhile, work was continued on new licensing issues raised by cybersecurity problems, new build and platform qualifications, third party certification and software implications of new programmable memory devices (FPGA). The past and current activities of the task force were presented by ONR (UK) and Bel V at the USNRC Regulatory Information Conference (Washington, March 2014) and at the Halden Workshop on the safety demonstration of software-based systems, organised by the Institutt for Energiteknikk (IFE) of the OECD Halden Reactor Project.



INTERNATIONAL ACTIVITIES AND PROJECTS

3.3 Cooperation with technical safety organisations

3.3.1 EUROS SAFE

The EUROS SAFE Programme Committee met in Paris (January and June), Munich (March) and Brussels (October). Exceptionally, no EUROS SAFE Forum was held in 2014, because of the overlap in dates with the IAEA TSO Conference in Beijing (see § 3.1). The October meeting of the Committee started with the organisation of the EUROS SAFE Forum 2015, which will be co-organised by Bel V and IRSN in Brussels.

The EUROS SAFE Tribune 25 on 'Radioactive waste: standing the test of time' (available at <http://www.eurosafe-forum.org/#tribune>) provides an overview on a number of key issues related to waste management, reflecting views expressed at the EUROS SAFE Forum 2013.

In the EUROS SAFE Tribune 26 on 'Thriving ETSON: A contribution to the IAEA TSO Conference 2014 hosted by the government of China' (available at <http://www.eurosafe-forum.org/#tribune>) Bel V contributed with the views of its General Manager on 'Becoming a capable TSO: an ETSON view'.

3.3.2 European Technical Safety Organisations Network (ETSON)

ETSON contributes substantially to all activities within the framework of the EUROS SAFE approach (i.e. the Forum, Tribune and the public website), as well as to the work of strengthening the scientific and technical partnership. This work area applies to general or specific issues directly linked to the convergence of scientific and technical safety practices in Europe.

The ETSON General Assembly and/or Board met in Cadarache (July) and Beijing (October, at the occasion of the IAEA TSO Conference; see § 3.1).

In 2014 the extension of the network was further explored and potential memberships are being examined.

A Bel V representative continued chairing the ETSON Technical Board for Reactor Safety (TBRS) to oversee the technical activities of ETSON, such as the functioning of the ETSON Expert Groups and the publication of Technical Safety Assessment Guides (available at <http://www.etsn.eu/InformationCenter/Pages/Reports-Publications.aspx>).

Bel V representatives took active part in the ETSON Expert Groups, aimed at sharing views and experiences with colleagues of other technical safety organisations. Bel V is chairing the Expert Group on Ageing management.

From 25 August until 29 August, several junior Bel V members of staff participated actively in the seventh ETSON Summer Workshop in Espoo (Finland). The workshop was devoted to 'Fuel management'. Bel V representatives participated by giving presentations and by coordinating work sessions.



3.3.3 European Nuclear Safety Training and Tutoring Institute (ENSTTI)

ENSTTI is an initiative of the European Technical Safety Organisations Network (ETSON). ENSTTI provides vocational training and tutoring in methods and practices required to perform assessments in nuclear safety, nuclear security and radiation protection. ENSTTI calls on European TSO expertise to maximise the transfer of knowledge and proficiency based on practical experience and culture.

Bel V is a member of this network. The General Manager of Bel V was President of ENSTTI until the end of 2014.

In 2014 Bel V made a substantial contribution to the courses organised by ENSTTI. A course on 'Management System and Safety Management Principles in the Execution of the Regulatory Function' was hosted by Bel V in April. Several Bel V members of staff lectured in this course. Bel V staff also lectured in the courses on 'Final disposal safety' (June) and 'Emergency preparedness and response' (December).

3.3.4 Collaboration with IRSN

Under the terms of the Cooperation Agreement between IRSN and Bel V, activities were continued, in particular in relation to the use of computer codes developed by IRSN, such as the Cathare code for thermal hydraulic analyses.

The collaboration with IRSN in the field of radioactive waste management was pursued in 2014. Three PhDs co-funded by Bel V and IRSN were followed: a first PhD devoted to the study of radionuclide diffusion in concrete and in clay-concrete interfaces, taking into account the effects of 'high' temperature (up to 70°C); a second PhD aiming at modeling the transport of chemical species in simple porous materials (sand, ...) undergoing porosity clogging or porosity opening phenomena; and a third PhD devoted to the development of a new feedback law for modeling the impact of a porosity change caused by cement degradation phenomena on the cement transport properties (based on a detailed experimental programme performed at IRSN). Finally, in 2014 Bel V started using the HYTEC code, obtained in the context of the Pôle Géochimie Transport (PGT) in which among others Bel V and IRSN participate, for the modeling of cement degradation phenomena.

3.3.5 Collaboration with MSEZI (South Africa)

In 2014, contacts were established between Bel V and MSEZI, the technical safety organisation of the South-African safety authority NNR. MSEZI is interested in some expertise available at Bel V, for instance on steam generator replacement of pressurised water reactors. In preparation of a future collaboration, a Memorandum of Agreement was drafted in 2014 and signed in January 2015.



INTERNATIONAL ACTIVITIES AND PROJECTS

3.4 Assistance projects of the European Commission

After the PHARE and TACIS programmes, the European Union has launched a new cooperation programme financed by the Instrument for Nuclear Safety Cooperation (INSC). The main objective is to promote a high level of nuclear safety, radiation protection and the application of efficient and effective safeguards of nuclear materials in third countries.

The first phase of this programme started in 2007. The second phase will cover the period 2014-2020.

3.4.1 Armenia

Bel V has cooperated with the Armenian Nuclear Regulatory Agency (ANRA) for many years through TACIS/INSC-financed projects. At present, Bel V is participating in the project AR/TS/07: 'Enhancement of the safety assessment capabilities of ANRA for licensing of Medzamor 2 safety improvements and decommissioning activities' (follow-up of the AR/TS/06 project). The project started in July 2013 and the inception meeting took place in September 2014. Bel V is participating to the task 5 of this project: 'Pilot decommissioning project and licensing related documentation'.

3.4.2 Jordan

Bel V is involved in the first and second cooperation projects between the European Union and Jordan. Both projects are aimed at providing support to the Jordan Nuclear Regulatory Commission (JNRC) in order to enhance its skills and effectiveness as a regulator.

This first cooperation project (JO/RA/01) ended in April 2012 and the second project (JO/RA/02) ended in July 2014. Bel V participated in Tasks 1 and 6 of the JO/RA/02 project:

- Task 1: Update of the Strategy Plan, the Action Plan and the Cooperation Plan in the field of capacity building for the enhancement of the National Regulatory Authority including an overview of the present situation;
- Task 6: Radiation Protection, occupational exposure (guidelines, instructions, enforcement, and inspection).



3.4.3 Morocco

Bel V was participating as Technical Project Leader and also in tasks 1 and 3 of the first INSC project (MO/RA/01) with Morocco, which started in April 2011.

During the first progress meeting in Rabat in January 2012, it was decided to freeze the activities due to the delay in the promulgation of the law creating the new regulatory authority. Therefore there were no activities in 2012 and 2013. The project will restart in January 2014 with a new Technical Project Leader, due to the retirement of the Bel V Technical Project Leader.

Bel V participates in tasks 1 and 3 of the project:

- Task 1: Update of the Strategy Plan, the Action Plan and the Cooperation Plan in the field of capacity building for the enhancement of the National Regulatory Authority including an overview of the present situation;
- Task 3: Assistance in the field of regulatory framework.

3.4.4 Mexico

Bel V participated in the first INSC project in Mexico (MX/RA/01) aiming to enhance and strengthen certain aspects of the regulatory regime for nuclear safety in Mexico in accordance with international obligations and internationally accepted criteria and practices.

Bel V participated in Tasks 1 and 2 of this project:

- Task 1: Establishment/development of an action plan for cooperation in the field of capacity building for the enhancement of the CNSNS, including an overview of the present situation;
- Task 2: Development and implementation of quality management at CNSNS, aimed at the external certification of the regulatory authority by the end of the project.

This project ended in October 2014.



INTERNATIONAL ACTIVITIES AND PROJECTS

3.4.5 Vietnam

Bel V is participating in the first cooperation project between the European Commission and Vietnam. This project was initiated in July 2012. The general purpose is to develop and strengthen the legal framework as well as the managerial and technical capabilities of the Vietnam Agency for Radiation and Nuclear Safety (VARANS) and the local technical safety organisation.

Bel V is involved in Task 2 of the project, i.e. the development of a quality assurance system for assessment and verification of safety and regulatory oversight (internal regulatory guides and procedures).

3.4.6 China

Bel V is participating in the first INSC project between the European Commission and China (CH3.01/11), i.e. 'Enhancing the capacity and regulatory capabilities of the Chinese national nuclear safety authority and its technical support organisation'.

The agreement with the European Commission was signed in early December 2013. The project will last for three years. The main task for Bel V in 2014 was the development of the project manual (organisation and methodology) along with its consortium partners.

Bel V is involved in three tasks:

- Task 2.3: Independent evaluation, validation and verification of the safety of digital instrument and control systems used in nuclear power plants;
- Task 3: Safety culture and safety management (Bel V is acting as task leader);
- Task 5: Assessment of flood hazards.



3.4.7 Philippines

Bel V is participating in the first INSC project between the European and the Philippines (PH3.01.09), i.e. ‘Technical assistance for improving the legal framework for nuclear and strengthening the capabilities of the Regulatory Authorities of the Philippines (PNRI) and its technical support organisation’.

The agreement with the European Commission was signed in November 2013. The project will last for three years. Bel V is involved in subtask 1.2, supporting PNRI in the development of safety regulations.

3.4.8 Egypt

Bel V is participating in the second INSC project between the European Commission and Egypt (EG.01.10), i.e. ‘Provision of assistance related to developing and strengthening the capabilities of the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA)’. This project has been frozen for two years because of the political turmoil in Egypt.

The kick-off meeting of the project took place in November 2013. The project will last for three years. Bel V is involved in training the new Egyptian authorities to review the Preliminary Safety Analysis Report (PSAR) and the Environmental Impact Assessment Report (EIAR) of a nuclear power plant.

3.4.9 Training and tutoring

In the context of the INSC and as a member of ENSTTI, Bel V is involved in the second training and tutoring project and organised a training course on management systems on its premises in April 2014.



EXPERTISE MANAGEMENT

4.1 Domestic experience feedback

Each year, Bel V performs a systematic screening of events at all Belgian nuclear facilities, as well as an in-depth analysis of a number of events with emphasis on root causes, corrective actions and lessons learned. In 2014 more than 50 events were registered into the domestic experience feedback database.

For a number of events a more detailed event analysis was performed with a view to identifying lessons learned which are potentially applicable to a wider range of nuclear facilities. These analyses resulted in 1 IRS report, 1 IRSRR report and 1 FINAS report.

2014 was marked by the following events which were analysed in depth by Bel V and for which appropriate analysis, regulatory inspection and follow-up of corrective actions was carried out:

- rupture of an underground glass reinforced epoxy pipe of the fire protection system at Tihange 2;
- rupture of a weld due to fatigue in a vent pipe near the tank of the chemical and volume control system during cold shutdown at Doel 3;
- error in the minimum boron curves for shutdown conditions at Doel 4 and Tihange 3;
- recurrent emergency diesel generator start failures due to substandard components of Bendix drive at several units at Doel and Tihange;
- fire event in an electrical cabinet at Tihange 3;
- reactor and turbine trip due to loss of lubricating oil to turbine at Doel 4;
- loading of sources in irradiator without availability of all required safety features at Sterigenics;
- reactor trip following a fire on current transformer at high voltage switchyard at Tihange 3.

4.2 Foreign operating experience feedback

In addition to screening domestic events, Bel V also performs a screening of events at foreign nuclear facilities as well as potential generic issues that are safety significant, require technical resolution by licensees or require generic communication to the licensees.

In this context, the Bel V Operating Experience Feedback coordination committee selects events resulting in either formalised Operating Experience Examination Request Letters (OEERL), Operating Experience Information Letters (OEIL) or follow-up inspections.

In 2014, no such letters were issued but a follow-up of former OEERLs occurred:

- ‘Seismic considerations – issues involving tanks’, initiated in 2013 for the nuclear power plants, was handled and closed with some Bel V recommendations.
- ‘Non-compliance of component cooling systems in France’, also initiated in 2013, progressed with reponses being received from Electrabel, which are now under review.
- ‘Design vulnerability in electric power systems’, initiated in 2012, required a technical meeting to discuss the action plan of the licensee.



EXPERTISE MANAGEMENT

4.3 Knowledge management

For several reasons (one of them being that in the next 5 to 10 years several experienced Bel V staff members will retire), Bel V is attaching great importance to knowledge management. Various tools are used in order to generate, capture, transfer, use and store knowledge.

The Technical Responsibility Centres (TRC) continue to play a key role in knowledge management within Bel V. There are about 20 Technical Responsibility Centres, acting as 'centres of competence' for all important fields of expertise of Bel V. In line with developments in nuclear issues, new Technical Responsibility Centres are regularly set up (i.e. concerning decommissioning issues). Moreover, TRC management and operation is fully embedded in Bel V's Quality System.

In 2014, several new engineers were recruited. This requires an important effort on the part of the more experienced engineers to ensure an adequate transfer of knowledge. A coach is assigned to every newly recruited person, to facilitate their integration. This knowledge transfer approach is combined with, among other things, on-the-job training and cross-functional activities. The recruitment of a high number of new people also requires customised training (see Section 4.5). Mention should also be made of the Bel V focus on knowledge transfer from retiring experts to younger staff. A Knowledge Transfer Form is used for this purpose. In addition, we also use a Knowledge Critical Grid that aims to identify and reduce the risk of knowledge loss.

Knowledge management is also closely linked to the R&D program aimed at generating new skills, better ideas or more efficient processes (see Section 4.4).

The continuous implementation of the Bel V adapted Electronic Documentation Management software (KOLIBRI, based on Hummingbird DM) is an important step towards an efficient retrieval of information, good knowledge sharing and easier integration of new members of staff. To this end, a specific committee known as the DOCumentation USers group (DOCUS) focuses on user needs analysis and on improvements.

4.4 Research and development

4.4.1 Management activities

The involvement in research and development (R&D) activities remains an important pillar for the continuous development and sustainability of Bel V's expertise. In 2014, special attention was again paid to the possibility of encouraging new R&D projects. In particular, a new sponsorship agreement was signed with Ghent University, and several Horizon 2020 projects were proposed.

4.4.2 R&D on nuclear installation safety

Thermal hydraulic phenomena

An important effort was devoted to our participation in the experimental thermal-hydraulic PKL-3 project (OECD/NEA). Bel V submitted a proposal within the PKL-3 project related to the assessment of the 3D mixing impact on the natural circulation interruption phenomenon. The proposal was approved and carried out successfully in the ROCOM test facility. A CATHARE model for the ROCOM facility was used to reproduce the ROCOM tests.

Within the OECD/NEA ATLAS project, Bel V submitted a proposal aimed at assessing the natural circulation interruption phenomenon under the special geometrical scaling of the ATLAS test facility.

In the OECD/NEA PREMIUM project, Bel V participated in phase IV of the project. This subject concerned the envelope calculations using the PERICLES-2D reflooding experiment data. The calculations were carried out using CATHARE and URANIE (CEA's uncertainty analysis platform).

The activities related to the MYRRHA project were focused on the use of a RELAP5-3D model to carry out pre-licensing activities related to the simulation of long-term loss of AC power, heat removal by combined convection and thermal radiation from the outer surface of the reactor vessel, and blockage of forced flow in a fuel assembly.

Other applications using CATHARE and RELAP5-3D for pressurised water reactors were carried out. For this purpose a CATHARE input deck for a 3-loop nuclear power plant was built and assessed under steady and transient operating conditions. A RELAP5-3D input deck of a 3-loop pressurised water reactor is under construction.



EXPERTISE MANAGEMENT

Severe accidents

In 2014, considerable progress was made in developing MELCOR simulation capabilities at Bel V. The main goal was to develop an input deck of a 3-loop Belgian pressurised water reactor, representing the entire reactor coolant system including each of the three reactor coolant loops, steam generators, and reactor coolant pumps, the steam lines out to the isolation valves and associated safety and relief valves, as well as the pressuriser and associated safety and relief valves, and the pressuriser relief tank.

An annual meeting of the steering committee to supervise the Belgian participation in the United States Nuclear Regulatory Commission (USNRC) program on severe accident research was organised by Bel V, who holds the implementing agreement with the USNRC.

Bel V was one of the contributors to the NEA/CSNI 'Status Report on Filtered Containment Venting' and 'Status Report on Hydrogen Management and Related Computer Codes', and was one of the lead authors of the NEA/CSNI 'Status Report on Spent Fuel Pools under Loss-of-Cooling and Loss-of-Coolant Accident Conditions'.

PSA methodology and its applications

In 2014, Bel V restarted its PSA-based Event Analysis activities. A screening of events that occurred in 2013 in the various Belgian nuclear power plants was performed in order to identify the most interesting cases for further examination using PSA Event Analysis. Two study cases were eventually selected and further analysed.

Bel V attended the 17th Technical Meeting on Experiences with Risk-based Precursor Analysis (Brussels, 5-6 November 2014). PSA-based Event Analyses performed by Electrabel for Belgian nuclear power plants and by foreign organisations (utilities, TSOs) for nuclear power plants abroad were discussed.

With respect to PSA for external natural and man-made hazards, Bel V participated in the first End User Workshop (Uppsala, May 2014) of the ASAMPSEA_E project. The objective of this 7th Framework Program project is to develop guidance for Level 1 and Level 2 PSA for internal and external hazards. The workshop offered the opportunity to discuss the results of a survey on PSA End User needs and to identify End User recommendations for PSA guidance for external hazards.

Fire protection

The involvement of Bel V in the OECD/NEA PRISME2 project continued in 2014. The participation in this project is considered extremely important in acquiring proper knowledge on fire behaviour in nuclear facilities such as smoke and hot gases propagation through horizontal openings, fire spreading on real fire source such as cable trays and electrical cabinet and fire propagation from one fire source to another, and fire extinguishing. Based on experimental results, code guidelines to simulate complex fires, such as cable trays or electrical cabinets, are another important objective as there is a lack of knowledge on these types of fire sources and, following the assumptions of simulation, there is a considerable discrepancy in the results.

For the first fire simulation benchmark of the OECD PRISME2-project, Ghent University and Bel V carried out simulations concerning the PRISME integral tests 4 and 6 using the Fire Dynamics Simulator software.

The work performed in the context of the recently terminated post-doctoral research grant has deeply strengthened the ties of Bel V and Ghent University with other organisations and institutions such as the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) and the Laboratoire de l'Incendie et des Explosions (IEL) in France.

4.4.3 R&D on waste and decommissioning

Waste disposal

In 2014 Bel V pursued its R&D activities aimed at strengthening its expertise in near-field models supporting the long-term safety assessment of a near-surface disposal facility. Among others, important efforts were made to develop 2D unsaturated models representing possible evolution scenarios of the near-surface repository.

In the context of its participation in the Pôle Géochimie Transport (PGT IV), Bel V developed expertise in the understanding and modeling of the reactive transport of radionuclides in porous media. For instance, preliminary models coupling radionuclide migration in cement and cement physicochemical degradations were developed with HYTEC.

Three PhD theses co-funded by Bel V were also followed up. These PhDs provide Bel V with results and information relevant for its own R&D activities (e.g. modeling of transport and reactive transport of radionuclide migration) and, more generally, for the long-term safety of waste disposal. Moreover, these PhDs allow Bel V to strengthen its collaborations with other technical safety organisations (e.g. IRSN) and R&D actors (e.g. CEA).

Finally, Bel V participated in several IAEA working groups related to the safety of radioactive waste disposal (e.g. PRISMA, DISPONET, MODARIA, HIDRA, GEOSAF II...).



EXPERTISE MANAGEMENT

Decommissioning and dismantling

The aim of the 2014 R&D activities was to gather information from international experience in order to build up knowledge in the field of decommissioning in order to support Bel V's activities related to the decommissioning of nuclear facilities. The IAEA DRiMa project provided important results in view of determining the strategic and operational risks associated with a large decommissioning project to be assessed at the end of the DRiMa project (end of 2015).

4.4.4 R&D on cross-cutting issues

Safety culture assessment

The Safety Culture Observations process has been extended to all Bel V members of staff in order to capture a larger range of Safety Culture Observations. In that respect all experts within Bel V have been trained to provide observations and then contribute to strengthening the Bel V regulatory oversight.

Emergency preparedness

In view of enhancing Bel V's expertise and competence in emergency preparedness and response, various R&D activities were initiated at both national and international level. These initiatives were mainly focused on gaining more insight into software tools to be used for estimating the consequences of an emergency situation occurring at a nuclear facility.

4.4.5 R&D collaboration with other institutes

R&D collaboration with Belgian universities

Vrije Universiteit Brussel (VUB)

A research agreement was signed in October 2012 with the VUB, which will undertake studies in the field of cognitive radio for nuclear power plants. This project will make a contribution to the emergency support plan. The objective is to improve communication links during emergencies that might promote a stronger emergency management.

Bel V has also collaborated with the VUB on the R&D project entitled 'Experimental analysis of flow-induced vibrations and application to the fuel rod bundle of the MYRRHA reactor'.

Université libre de Bruxelles (ULB)

Since November 2012, Bel V has been sponsoring an R&D project at the ULB, in the area of long-term safety assessment of radioactive waste disposal. This project relates to the modeling of the evolution of diffusion coefficients during degradation of cement used for waste disposal.

Ghent University

In April, an International Master of Science in Fire Safety Engineering student submitted his thesis on 'Modeling of water-based fire extinction systems in nuclear facility fire scenarios' supervised by Ghent University and Bel V.

A new collaboration agreement was signed with Ghent University to pursue research on fire safety within the framework of a PhD grant.

Université catholique de Louvain (UCL)

Two new R&D collaboration agreements were signed with the UCL: one to undertake studies on pressurised thermal shocks in pressurised water reactors, and a second agreement on the modeling of the flow phenomena responsible for thermal stripping on the surface of a vessel of a lead-cooled fast reactor.

Von Karman Institute for Fluid Dynamics (VKI)

In cooperation with the von Karman Institute for Fluid Dynamics, an R&D program was completed for a master thesis aimed at modeling a spent fuel assembly channel in the event of complete loss-of-coolant accident conditions using a CFD code.

R&D collaboration with IRSN

Several R&D agreements with IRSN are ongoing, on a number of topics:

- radionuclides migration in waste disposal facilities – this R&D project is carried out together with ARMINES (France);
- development of a quantitative simulation tool taking into account chemistry and hydrodynamic transport to be used within the framework of the assessment of waste disposal facilities – this R&D project is carried out together with ARMINES, AREVA, EDF, LAFARGE and CEA (all France);
- radionuclides diffusion in clay – this R&D project is carried out together with CEA (France).



EXPERTISE MANAGEMENT

4.5 Training

A structured training approach has been adopted on the basis of the IAEA Systematic Approach to Training (SAT). Training programmes are developed for all staff members, and in particular for new hires, on the basis of the job descriptions and the relevant competencies needed. In this respect, Bel V is implementing the IAEA SARCoN model in order to properly assess the competence level of new members of staff and therefore to finetune our competence needs analysis.

The training programmes are implemented using different methods, depending on the availability of training materials and the adequacy of external courses: self-study, internal training sessions, external courses or on-the-job training.

A key element of the initial training of new members of staff is the programme of internal training sessions conducted by the Technical Training Manager with the help of experienced experts (mainly from Bel V) as lecturers. This programme comprises 23 training modules: 11 sessions took place in 2012, 9 in 2013 and 8 in 2014:

- Radiation Protection
- Emergency Plan
- Nuclear Safety Principles
- Regulatory Control & Practices - Construction / Licensing + LTO
- Cyclotron Shielding
- Safety Culture Observation
- Transport
- Human and Organisational Factors

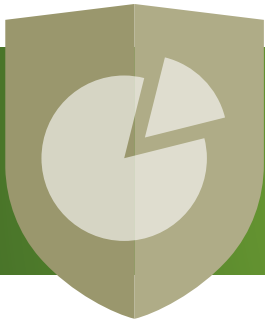
Examples of external training courses with the participation of new members of staff at Bel V in 2014:

- Sûreté des centrales à eau sous pression (Institut national des sciences et techniques nucléaires, 1 week)
- Physique du fonctionnement normal des réacteurs à eau pressurisée (IRSN, 2 weeks)

In addition, Bel V set up so-called 'Internal Technical Sessions' aimed at distributing the R&D results of the Technical Responsibility Centers. In 2014, 4 Internal Technical Sessions were held.

Also worth mentioning is the participation of Bel V staff members in numerous specialised or refresher training activities, and in several international working groups, seminars and conferences.

In total, more than 70 training activities took place in 2014.



FINANCIAL REPORT

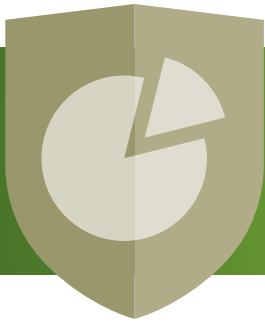
Balance sheet as at 31 December 2014

(amounts in thousands of EUR)

	2013	2014
ASSETS	13,489	13,231
FIXED ASSETS	6,408	6,028
II. Intangible fixed assets	1,143	872
III. Tangible fixed assets	5,263	5,154
A. Land and buildings	5,116	4,953
B. Plant, machinery and equipment	63	139
C. Furniture and vehicles	84	62
Financial fixed assets		2
CURRENT ASSETS	7,081	7,203
VII. Amounts receivable within one year	2,576	2,994
A. Trade receivables	2,519	2,928
B. Other amounts receivable	57	66
IX. Cash at bank and in hand	4,302	4,018
X. Deferred charges and accrued income	203	191



	2013	2014
LIABILITIES	13,489	13,231
EQUITY	8,448	8,817
I. Capital	4,732	4,732
IV. Reserves	2,868	2,868
V. Profit carried forward	848	1,217
DEBTS	5,041	4,441
VII. Amounts payable after more than one year	1,500	1,000
IX. Amounts payable within one year	3,540	3,413
A. Current portion of amounts payable within one year	500	500
C. Trade debts	424	206
D. Advances received on contracts in progress	1,500	1,542
E. Taxes, remuneration and social security	1,116	1,165
F. Other amounts payable		
X. Deferred charges and accrued income	1	1



FINANCIAL REPORT

Profit and loss account as at 31 December 2014

(amounts in thousands of EUR)

	2013	2014
Turnover	10,981	11,608
Other operating income	125	142
TOTAL OPERATING INCOME	11,106	11,750
Services and other goods	2,099	1,986
Wages and social security costs	8,173	8,790
Depreciation	515	512
Write-downs on trade receivables		
Other operating charges	91	98
TOTAL OPERATING CHARGES	10,878	11,386
Operating result	228	364
Financial charges and income	11	5
Profit on ordinary activities	239	369
Profit for the financial year	239	369

Profit and loss account: notes

In 2014, the activity continued apace, yielding a 6% increase in our turnover.

Operating income

Turnover

In 2014, the largest part of the turnover of Bel V (95 %) was again related to the regulatory inspections and safety assessments in Class I facilities, which are invoiced on the basis of a rate which has been agreed with the FANC and which covers the costs of our services. This year was once again marked by activities linked to the stress tests and the implementation of the action plans, by continuing the analysis of the confirmation dossier on the flaw indications in the vessels of two reactors, as well as by the ten-year reviews. Moreover we observed an increase of our activities in the Tihange 1 Long-Term Operation project, the preparations for the final shut-down of Doel 1/2 and the MYRRHA project.

A small part of the turnover (2.9 %) derives from contracts with the European Commission for support to nuclear safety authorities in Eastern European and emerging countries. Regulatory inspections were also carried out in some Class II facilities (the future Class IIA).

Other operating income

Other operating income is not actual revenue, but consists principally of contributions by staff for the private use of company cars and for the provision of meal vouchers.

Operating charges

Services and other goods

Services and other goods represent 17% of the charges. This year, our expenditures in research and development have increased to 5% of our operating charges.

Wages and social security costs

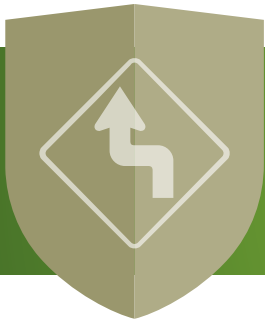
Staff expenses represent 77% of our costs, including training expenses.

Financial charges and income

Financial income comes from cash investments.

Operating result

Operating result for the financial year has been allocated to retained earnings.



LIST OF ABBREVIATIONS

ASN	Autorité de Sûreté Nucléaire (France)
BEST	Belgian Stress Tests
CEA	Commissariat à l'énergie atomique et aux énergies alternatives (France)
CNRA	Committee on Nuclear Regulatory Activities (OECD)
CSNI	Committee on the Safety of Nuclear Installations (OECD)
DG Crisis Centre	Directorate-General Crisis Centre of the Federal Public Service Interior
ENSREG	European Nuclear Safety Regulators Group
ENSTTI	European Nuclear Safety Training and Tutoring Institute (ETSON)
ETSON	European Technical Safety Organisations Network
FANC	Federal Agency for Nuclear Control
FINAS	Fuel Incident Notification and Analysis System
HERCA	Heads of European Radiological Protection Competent Authorities
IAEA	International Atomic Energy Agency
INSC	Instrument for Nuclear Safety Cooperation (European Commission)
IPM	Installation for the production of monoliths
IRE	National Institute for Radioelements
IRRS	Integrated Regulatory Review Service (IAEA)
IRS	Incident Reporting System
IRSN	Institut de Radioprotection et de Sûreté Nucléaire (France)
IRSRR	Incident Reporting System for Research Reactors
LTO	Long-Term Operation
NEA	Nuclear Energy Agency (OECD)
NRC	Nuclear Regulatory Commission (US)
NUSSC	Nuclear Safety Standards Committee (IAEA)
OECD	Organization for Economic Cooperation and Development
ONDRAF/NIRAS	Agency for Radioactive Waste and Enriched Fissile Materials
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
R&D	Research & Development
SCK•CEN	Studie Centrum voor Kernenergie – Centre d'études d'Énergie Nucléaire (Mol)
TBRS	Technical Board for Reactor Safety (ETSON)
TRC	Technical Responsibility Centre (Bel V)
TSO	Technical Safety Organisation
TSOF	Technical and Scientific Support Organization Forum (IAEA)
VKI	von Karman Institute for Fluid Dynamics
WENRA	Western European Nuclear Regulators Association
WMF	Waste Management Facility

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