OVERVIEW OF BEL V AND USE MELCOR CODE

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Overview of Bel V

INTRODUCTION

INTRODUCTION

Bel V = Subsidiary of the FANC (Federal Agency for Nuclear Control)

to carry out the surveillance of the Belgian nuclear installations within the frame of the Belgian laws and regulations

In Belgium, FANC and Bel V are considered to constitute together the regulatory body

ORIGIN OF BEL V

- Creation (1969)
  - Nuclear safety department of Vinçotte
- Merger (1989)
  - AIB + Vinçotte + Controlatom
- Split (1990)
  - AV et al. = AIB-Vinçotte (conventional controls)
  - AVN = AV Nuclear (safety of NPP)
  - AVC = AV Controlatom (radiation protection)
- Merger (1996)
  - AVN + CORAPRO
    ($\rightarrow$ NPP + other nuclear installations)
- Split (2008)
  - Bel V – Subsidiary of the FANC (regulatory controls)
  - AVN – Consultancy in nuclear safety

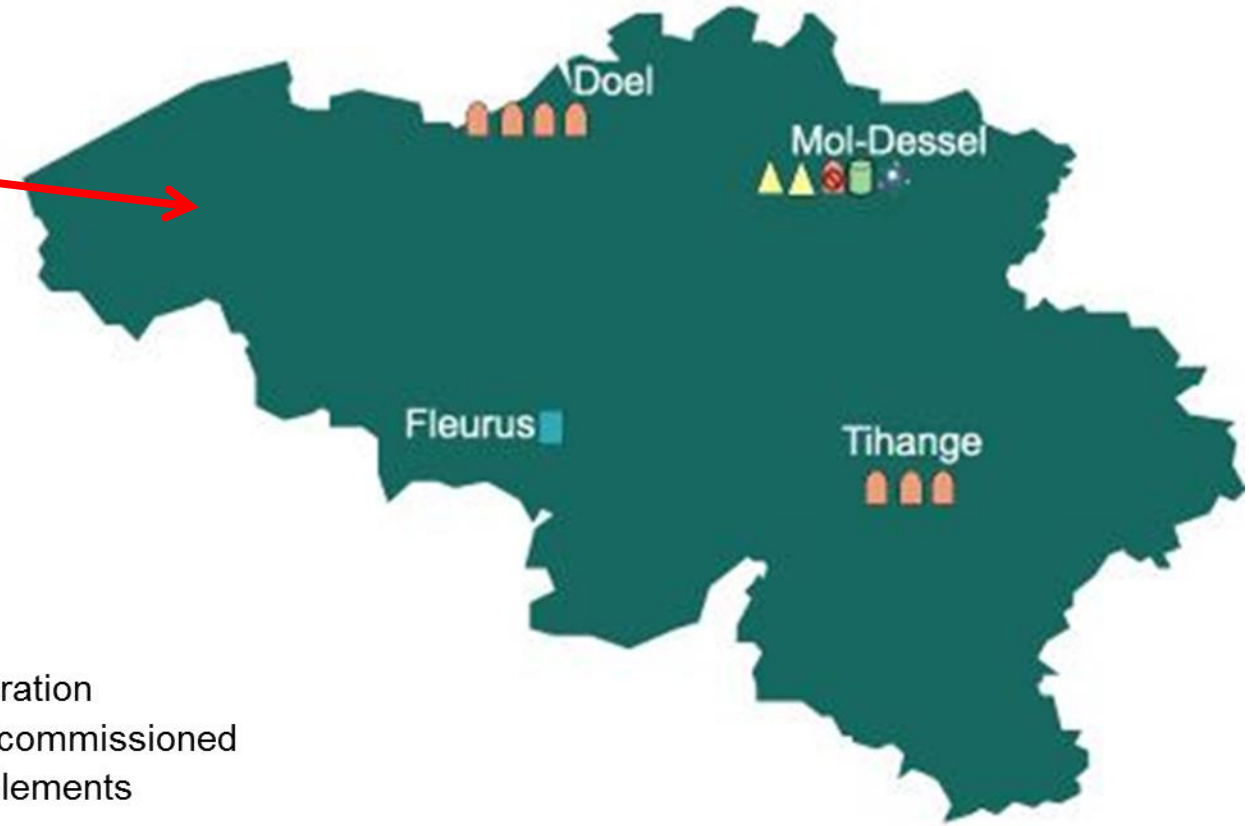
BEL V BASIC ROLE

- Technical Support of the Federal Agency for Nuclear Control
  - Nuclear Safety Assessments: Safety Evaluation Reports
  - Conformity checks of new plants or modifications: issuance of licenses
  - Inspections: written reports

INSTALLATIONS UNDER BEL V SURVEILLANCE

- 7 nuclear power plants (Doel & Tihange)
- Nuclear Research Centre at Mol (SCK•CEN)
- Waste processing facility (Belgoprocess)
- MOX fuel (Belgonucléaire) – (in dismantling)
- Fuel fabrication plant (FBFC)
- Isotope production facility (IRE)
- Research reactor (UGent) – (in dismantling)
- JRC-Institute for Reference Materials and Measurements (IRMM)
- Universities / Hospitals
- Irradiation facilities

NUCLEAR INSTALLATIONS



- Fuel fabrication plant
- Radioactive waste storage
- Nuclear research center
- Nuclear power plant in operation
- Research reactor being decommissioned
- National institute for radioelements

Doel and Tihange NPP's are operated by Electrabel (GDF-Suez group)

OVERALL VIEW OF BEL V ACTIVITIES

- National & international activities
  - Inspection of nuclear installations
  - Advisory role, working groups
- Operating Experience Feedback
  - National & international
- Personnel training
  - In-depth initial training + on the job training
- Research & Development
- Technical documentation

LEGAL DOCUMENTS

- Law 15/04/1994, creating the FANC
  - Regrouping of various activities relating to the nuclear control including health physics and non-proliferation
- Royal Decree 20/07/2001
  - RD on the protection of the population, the workers and the environment against the danger of ionising radiations
- FANC operational : 01/09/2001

SEVERE ACCIDENT REGULATORY FRAMEWORK

- Severe accident issues are dealt with in Belgium within the Periodic Safety Reviews (PSR) since 90's
- After Fukushima Daiichi Accident, additional commitment comes from the Belgian Stress Tests
- Severe accidents are addressed in the Belgian regulation since 2011
  - WENRA RHWG RLs transposed in Belgian regulation

Recent Severe Accident Activities

USE OF MELCOR CODE WITHIN BEL V

CSARP AGREEMENT: USE OF MELCOR CODE

- MELCOR: reference code selected by Bel V for severe accident analysis
- Bel V, as a subsidiary of FANC, signed an agreement with USNRC relating to participation in CSARP in 2012
  - Acquisition of the MELCOR code
  - Management of the distribution of MELCOR code in Belgium
  - Participation to review meetings
  - Development of modeling capabilities
- Organization of the 7th European MELCOR User Group Meeting EMUG

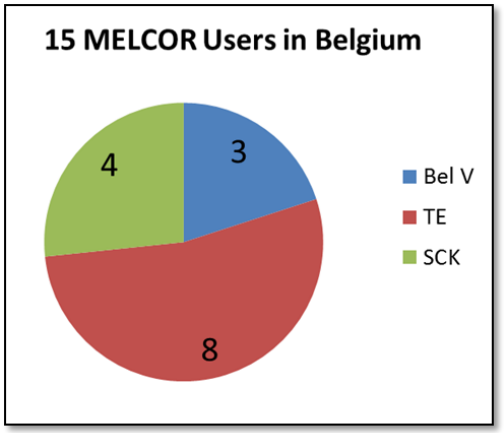
Tractebel Engineering, as FANC's designee, held previously the CSARP agreement

CSARP AGREEMENT: USE OF MELCOR CODE

- Scope of the contribution:
  - improvement, verification and validation of the severe accident codes
  - safety analysis of Belgian nuclear installations by means of MELCOR code (NPP, SFP, RR)
  - sharing the experience in analyzing Belgian nuclear installations and SA management analysis

CSARP AGREEMENT: USE OF MELCOR CODE

- 3 organizations are currently participating to CSARP activities in Belgium:
  - Bel V
  - Tractebel Engineering
  - SCK•CEN
- 15 MELCOR users in Belgium
- Annual meetings of the 3 organizations using MELCOR (i.e. TE, SCK•CEN, Bel V) and FANC



Ref. Bel V, Oct. 2014

MELCOR APPLICATIONS WITHIN BEL V: FRAMEWORK

- MELCOR code mainly used in the framework of Bel V R&D program
- Related know-how for the assessment of proposals or studies of the Licensee and proposed actions related to severe accident analysis and management in the framework of:
  - BEST Action Plan
  - Long Term Operation (LTO)
  - SF5 and SF6 of the ongoing Periodic Safety Review (PSR)
  - follow-up action plan to the WENRA BAP reference levels
  - improvement of capability to evaluate the level 2 PSA models of the Licensee (fire PSA, PSA update & upgrade)

MELCOR APPLICATIONS WITHIN BEL V: ACTIVITIES

- Development of computational capabilities:
  - safety analyses of Belgian nuclear installations
  - confirmatory/audit calculations
  - safety analysis of MYRRHA (planned)
- R&D and international projects and benchmarks
  - cooperation with universities (e.g. VKI, UGent, UCL…)
  - participation to international research projects (planned)
- Follow-up Fukushima Daiichi NPP accident
- Technical contribution to CSARP/MCAP/EMUG (yearly)
- …

DEVELOPMENT OF COMPUTATIONAL CAPABILITIES

- Main goal: development of an input deck of a 3-loops Belgian pressurized water reactor
  - entire reactor coolant system, including each of the three coolant loops, steam generators, and reactor coolant pumps
  - steam lines out to the isolation valves and associated safety and relief valves
  - pressurizer and associated safety and relief valves, and the pressurizer relief tank
  - core components and the lower-head directly below the core

More details and some results: ppt session 4

DEVELOPMENT OF COMPUTATIONAL CAPABILITIES

- Main achievements:
  - stabilization of the plant model at full-power steady-state operating conditions, by using boundary conditions to represent the turbine pressure and feedwater flow
  - comparisons against plant data and code-to-code for steady-state results (when available, mainly with results of CATHARE calculations obtained by Bel V)
- The development of input deck to be continued
- Requested external expertise to GRS, for Bel V very valuable support

Overview of Bel V and use MELCOR code

CONCLUSIVE REMARKS

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- MELCOR: reference code selected by Bel V for severe accident analysis
- CSARP agreement with Bel V from 2012, previously with Tractebel Engineering
- MELCOR applications:
  - Progress in development of computational capabilities
  - R&D and international projects and benchmarks
  - Contribution to CSARP
  - Others

QUESTIONS?

DOEL SITE

1. Doel 1 (440 MWe)
2. Doel 2 (440 MWe)
3. Doel 3 (1030 MWe)
4. Doel 4 (1039 MWe)

Data refers to net electric capacity

DOEL SITE

Table 1: Characteristics of Doel site units

Units	Type	Thermal power (MWth)	Date of first criticality	Containment building characteristics	Steam generator replacement	Fuel storage pool capacity	Designer
Doel 1	PWR (2 loops)	1 312	1974	Double containment (steel and concrete)	2009	664 positions	Westinghouse
Doel 2	PWR (2 loops)	1 312	1975	Double containment (steel and concrete)	2004		Westinghouse
Doel 3	PWR (3 loops)	3 064	1982	Double containment with inner metallic liner	1993	672 positions	Framatome
Doel 4	PWR (3 loops)	3 000	1985	Double containment with inner metallic liner	1997	628 positions	Westinghouse
SCG building	Spent fuel dry storage	-	-	-	-	165 spent fuel containers	Tractebel Engineering

TIHANGE SITE

1. Tihange 1 (960 MWe)
2. Tihange 2 (985 MWe)
3. Tihange 3 (1042 MWe)

Data refers to net electric capacity

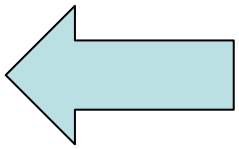
TIHANGE SITE

Table 2: Characteristics of Tihange site units

Units	Type	Thermal power (MWth)	Date of first criticality	Containment building characteristics	Steam generator replacement	Fuel storage pool capacity	Designer
Tihange 1	PWR (3 loops)	2 873	1975	Double containment with inner metallic liner	1995	324 positions + 49 removable positions	Framatome / Westinghouse
Tihange 2	PWR (3 loops)	3 054	1982	Double containment with inner metallic liner	2001	700 positions	Framatome
Tihange 3	PWR (3 loops)	2 988	1985	Double containment with inner metallic liner	1998	820 positions	Westinghouse
DE building	Spent fuel wet storage	-	-	Bunkered building	-	3 720 positions + 30 temporary positions	Tractebel Engineering

RESEARCH REACTORS

Facility Name	Type	Thermal Power (kW)	Status
BR-1	GRAPHITE	4000.0000	OPERATIONAL
BR-2	TANK	100000.0000	OPERATIONAL
VENUS	CRIT ASSEMBLY	0.5000	TEMPORARY SHUTDOWN
MYRRHA	FAST	85000.0000	PLANNED
BR-3	PWR POWER	40900.0000	DECOMMISSIONED
THETIS RR-BN-1	POOL	250.0000	DECOMMISSIONED
BR-02, Mock-up of BR2	POOL	0.5000	DECOMMISSIONED



http://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx