Ageing Management and Long Term Operation of Nuclear Power Plants

Senior Regulators’ Meeting
17 September 2015

Jan BENS
AGENDA

- Belgian Nuclear Reactor Sites
- LTO Legal Framework
- LTO Regulatory Framework
- FANC Strategic Note on LTO
- SALTO mission at TIHANGE-1
- LTO for DOEL-1 and DOEL-2
- New development: SALTO for Research Reactors
Belgian Nuclear Reactor Sites

THE NETHERLANDS

FRANCE

DOEL
MOL

TIHANGE

GHENT
(Decommissioned)

<table>
<thead>
<tr>
<th>NUCLEAR POWER PLANT</th>
<th>POWER OUTPUT (MWe)</th>
<th>Date of first commercial operation</th>
<th>Date of last commercial operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOEL-1</td>
<td>433</td>
<td>15/02/1975</td>
<td>15/02/2015</td>
</tr>
<tr>
<td>DOEL-2</td>
<td>433</td>
<td>01/12/1975</td>
<td>01/12/2015</td>
</tr>
<tr>
<td>DOEL-3</td>
<td>1006</td>
<td>01/10/1982</td>
<td>01/10/2022</td>
</tr>
<tr>
<td>DOEL-4</td>
<td>1039</td>
<td>01/07/1985</td>
<td>01/07/2025</td>
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<tr>
<td>TIHANGE-1</td>
<td>962</td>
<td>01/10/1975</td>
<td>01/10/2015</td>
</tr>
<tr>
<td>TIHANGE-2</td>
<td>1008</td>
<td>01/02/1983</td>
<td>01/02/2023</td>
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<tr>
<td>TIHANGE-3</td>
<td>1046</td>
<td>01/09/1985</td>
<td>01/09/2025</td>
</tr>
</tbody>
</table>

= NUCLEAR POWER PLANT

= RESEARCH REACTOR
LTO Legal Framework

- **2003** “Law on gradual phase-out of nuclear power”
  - Art. 4: Existing NPPs must cease operating after 40 years (2015-2025)
  - Art. 9: If electricity supply is threatened, the appropriate measures can be taken

- **2009**: New Government announced intention to change phase out law (protocol agreement with GDF-Suez)
  - DOEL-1, DOEL-2 and TIHANGE-1 could operate until 2025 (50 years)

- **2013**: Phase Out Law was changed:
  - DOEL-1 and DOEL-2 definitively stopped in 2015
  - LTO for TIHANGE-1: could operate until 2025 (50 years)
LTO Legal Framework (2)

- **2014**: New Government announced intention to change phase out law once more
  - DOEL-1 and DOEL-2: could operate until 2025 (50 years)
- **2015**: **Confirmation by Law** of Government decisions:
  - LTO for DOEL-1 and DOEL-2: could operate until 2025 (50 years)

⚠️ DOEL-1 was already shut down when law was approved!
LTO Regulatory Framework (1)

- NPP License conditions in Belgium
  - No time limit in license
  - PSR: Periodic Safety Review (every 10 years)
    - Confirm plant is as safe as originally intended
    - Justify current safety levels by comparing with new standards, codes and identify areas for improvement
    - DOEL-1, DOEL-2, TIHANGE-1: 4th PSR (after 40 years) scheduled in 2015
2008 - 2009
Development of LTO-policy by FANC-Bel V
- Analysis of relevant international requirements (IAEA, US NRC,...)
- Meetings with other safety authorities (NRC, ASN,...)

Final result:
FANC- Bel V (2009)
« Strategic Note on LTO for Belgian NPP TIHANGE-1 and DOEL-1 and DOEL-2 »

Eventual forthcoming LTO’s for Belgian NPPs DOEL-3, DOEL-4, TIHANGE-2 and TIHANGE-3 are not concerned by this strategic note.
Strategic Note on LTO

SCOPE

- LTO feasibility depends on many factors (safety, socio-economic, financial, ...)
- Scope of strategic note limited to safety aspects (no security or environmental issues)
- Installations: DOEL-1, DOEL-2 and TIHANGE-1
Strategic Note on LTO (2)

GENERAL FRAMEWORK

- **LTO** will be evaluated as part of 4\textsuperscript{th} Periodic Safety Review for DOEL-1 and DOEL-2 and TIHANGE-1
  - « New » PSR methodology: IAEA NS-G-2.10
  - Global safety evaluation with 14 Safety Factors

- With specific attention to « LTO-aspects »
  - Safety factor Ageing $\Rightarrow$ Ageing Management Program based on American regulations
  - Safety factor Design $\Rightarrow$ Proposal for safety improvements (« Agreed Design Upgrade »)
  - Preconditions for LTO
  - Knowledge and competence management, behaviour
Strategic Note on LTO (3)

AGEING MANAGEMENT

• **References:**
  - IAEA: Safe LTO of NPPs (SRS 57)
  - NRC: 10 CFR 54 + Standard Review Plan (NUREG 1800)

• **Methodology**
  - Scoping & screening of systems, structures & components (passive + active)
  - Assessment & evaluation of ageing of SSC
  - Review and confirmation of « Time Limited Ageing Analysis »

• **Result:** Ageing Management Program for SSC’s of NPP
Licensee must:

1. develop a methodology to identify areas for possible improvements
   - “Comparison with most recent Belgian units”
   - “Comparison with recent PWR-design evolutions” (Generation III)

2. prepare a technical improvement proposal to approach the level of safety of the most recent units”
   - “Compensatory measure if not technically achievable”
   - “Based on deterministic as well as probabilistic considerations”

Result: proposal for «design upgrade » with implementation schedule

NEW REQUIREMENT: Integrate Fukushima- Stress Test conclusions for DOEL-1, DOEL-2 & TIHANGE-1 in proposal for safety improvements
SALTO mission at TIHANGE-1

• Lessons Learned from SALTO mission performed in January 2015:
  – Ensure that during the complete long term operation period of TIHANGE-1 a continuous monitoring and ageing management programme for all components is organized
  – Ensure that the implementation of the developed processes will be completed
LTO for DOEL-1 and DOEL-2

2014-2015: FANC Policy Note
LTO after preparation for decommissioning

Strategic note is still applicable

BUT: with a slight shift in time schedule for the implementation of actions

INTEGRATED ACTION PLAN:
Also take into account the specific actions for DOEL-1 and DOEL-2 from past projects: BEST, 4th PSR, Site action plans, Reactor Vessel inspections, ...
LTO for DOEL-1 and DOEL-2 (2)

• Since 2012:
  – DOEL-1 and DOEL-2 organization was oriented towards decommissioning and prepared a safe transition period
  – 4\textsuperscript{th} PSR that was submitted in 2015 only considered decommissioning
  – A new 4\textsuperscript{th} PSR will be introduced at the end of 2015 to take into account the switch to LTO

• Expert mission in 2016 (⇔ Pre-SALTO)
• SALTO mission in 2017
New development: SALTO for Research Reactors

- BR-2: first operation in 1962
- Timeline
  - Pre-SALTO mission (1 or 2 days):
    - Methodology, agenda, scope, timing, team line-up
  - SALTO mission (5 days):
    - 3 to 6 months after pre-SALTO
    - Review documentation, walk-throughs, interviews
    - Report (good practices, recommendations, suggestions)
  - Follow-up mission
Questions?