Decommissioning Session
The Belgian experience : main achievements and future challenges

International Seminar

Nuclear decommissioning: an opportunity for global and sustainable development

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ONDRAF/NIRAS

Legal framework ONDRAF/NIRAS

- **ONDRAF/NIRAS is a public body in charge of the management of all radioactive waste on Belgian territory (transport, processing & conditioning, storage & disposal)**
- **Specific mission ONDRAF :**
  - Approval of decommissioning plans
  - Management of nuclear liabilities
- **Belgoprocess since 1986, subsidiary company of ONDRAF/NIRAS**
  - Operating, under the control and responsibility of ONDRAF/NIRAS, the agency's facilities for
    - Processing and conditioning
    - Interim storage on the central management site of Dessel/Mol

ONDRAF/NIRAS

Approval of dismantling plans

- **Nuclear operators submit a decommissioning plan of their facilities for approval to ONDRAF/NIRAS**
- **Decommissioning plans have to be reviewed every five years (by agreement between ONDRAF/NIRAS and nuclear operator)**
- **Final decommissioning plan has to be submitted three years at latest before ending operation**
- **Follow up of decommissioning activities with focus on 'cost to complete'**

- **Remark : FANC issues decommissioning licence (radiological safety and environmental impact)**

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Remediation and Decommissioning : Nuclear Liabilities

ONDRAF/NIRAS entrusted by the Belgian State with managing three main nuclear liabilities in application of one of the competencies of ONDRAF defined by the Royal Decree of March 30, 1981

- **BP1 (ex-Eurochemic and related facilities) in 1986 and BP2 (ex-Waste department of SCK·CEN) in 1989**
- **SCK·CEN in 1991**
- **IRE (Fleurus) in 1998**

=>Operational activities entrusted by ONDRAF/NIRAS to
Belgoprocess: for nuclear liabilities BP1/BP2
SCK·CEN: for nuclear liability SCK·CEN
IRE: for nuclear liability IRE

- **ONDRAF/NIRAS recently (August 2012) charged with the management of a new nuclear liability: remediation and decommissioning of nuclear facilities of Best Medical Belgium S.A. in Fleurus (through bankruptcy)**

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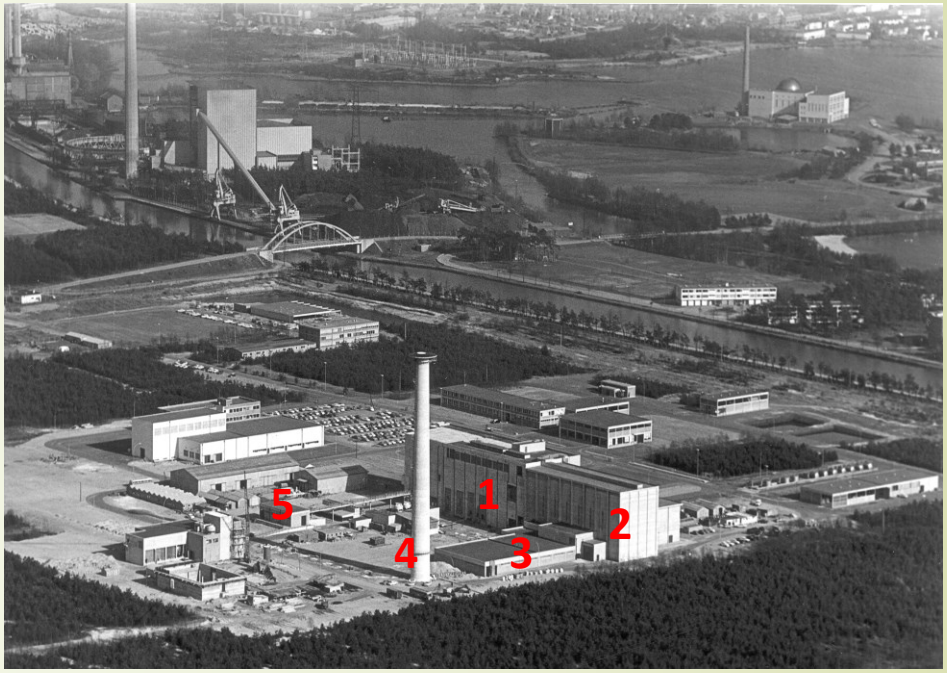
Decommissioning former reprocessing plant Eurochemic (site BP1)

- pilot reprocessing plant - consortium of 13 OECD countries
- operated from 1966 to 1974
- reprocessing of 180 tons natural and low-enriched uranium fuel, and 30 tons HE fuel
- start of decommissioning 1989



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Decommissioning former reprocessing plant Eurochemic (site BP1)

- **Relevant data :**
  - Length 90 m, width 27 and heigth 27 m
  - Volume: 56.000 m³
  - Concrete volume : 12.500 m³
  - Concrete surface : 55.000 m²
  - Metal: 1.500 ton
  - 7 floors, 40 large cells
- **Strategy developed to minimize radioactive waste production by appropriate D&D techniques**
- **Methodology and installations for clearance, depending on the material and its history (potential contamination): recycling > 90%**

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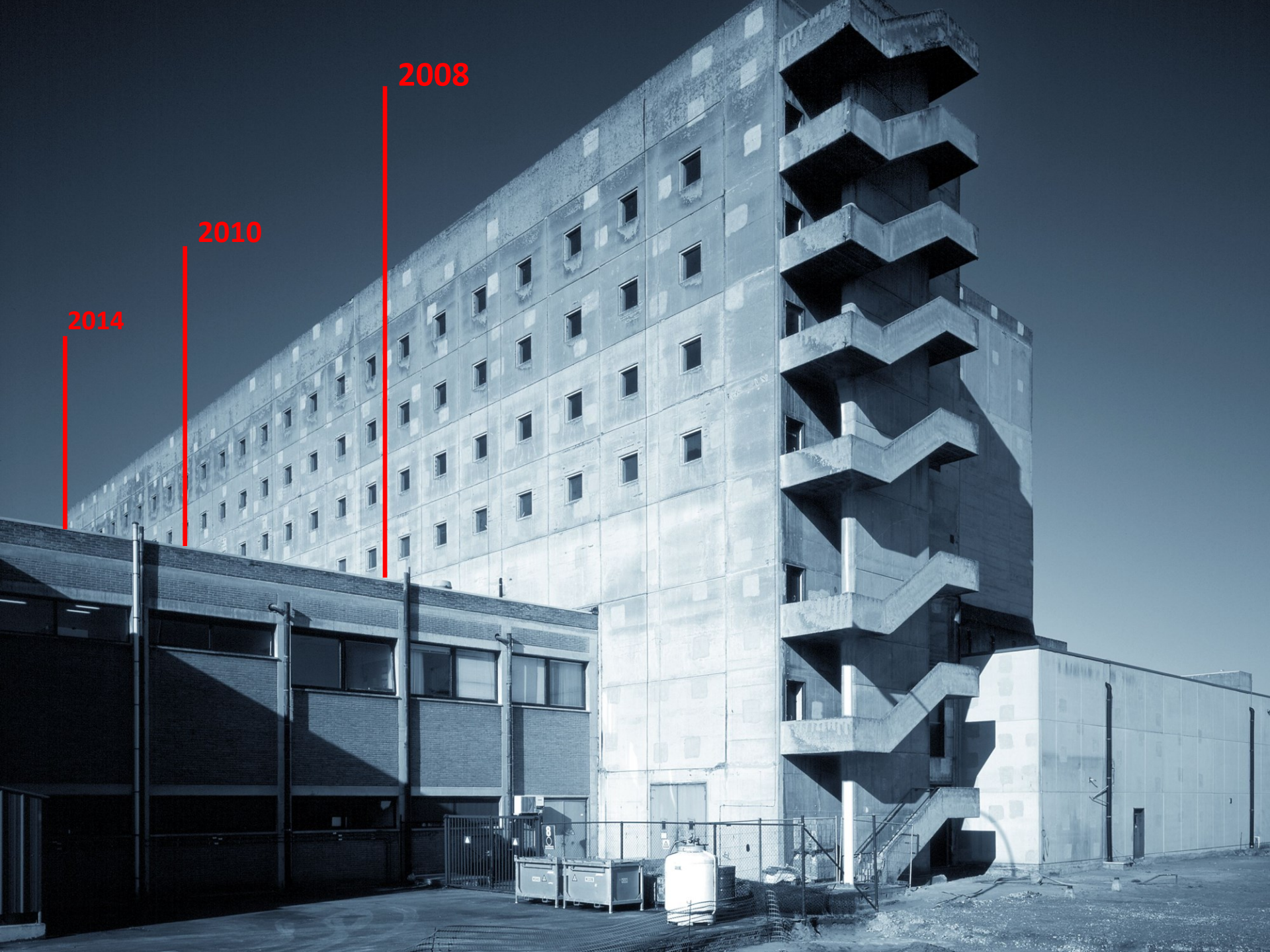
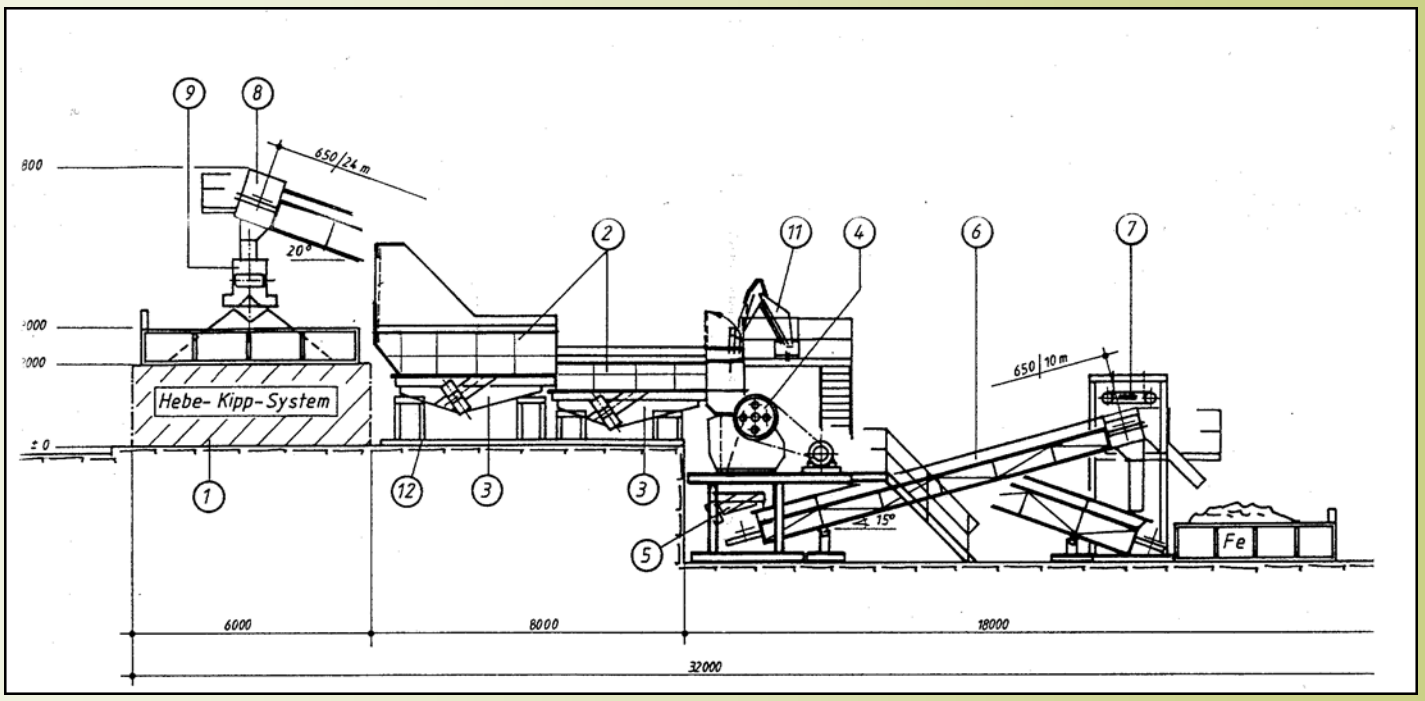
Decommissioning strategy


2008
2010
2014

Decommissioning former reprocessing plant Eurochemic (site BP1)

Concrete crushing ,milling and sampling facility



- Length 48 m, width 10 m, height 9 m
- Current nominal capacity set at 240 Mg per week

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Decommissioning former reprocessing plant Eurochemic (site BP1)

Concrete crushing and sampling unit				
	Eurochemic [Mg]	Rest [Mg]	Total [Mg]	
Processed	9 069	4 767	13 837	
Unconditionally released	9 006	4 763	13 769	±100%

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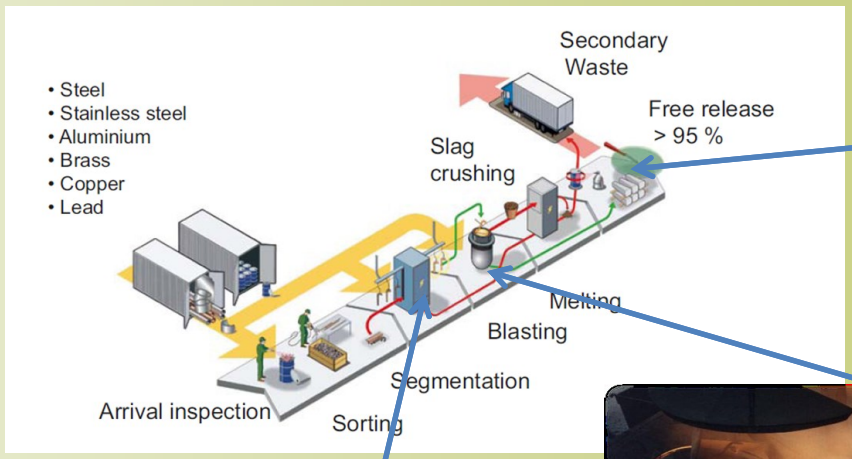
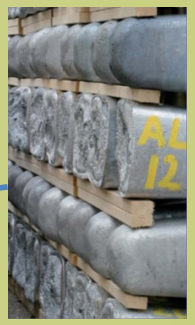
Decontamination for recycling and reuse of metal

	METAL		
	Total [Mg]	Free Release [Mg]	% tot
1989-1994	394	243	62%
1995-1999	554	383	69%
2000-2004	375	261	70%
2005-2009	279	218	78%
2010-2014	160	134	84%
Total	**1762**	**1239**	**70%**





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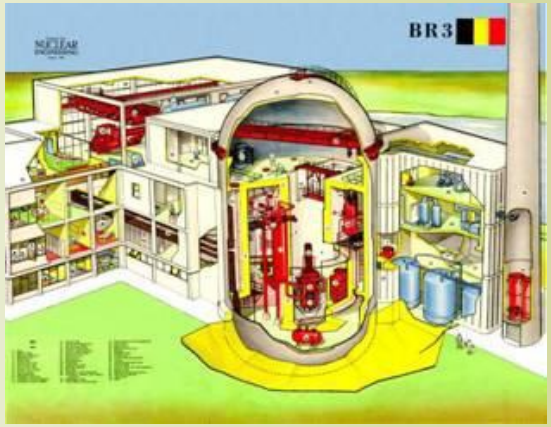
Remediation and decommissioning nuclear liability SCK•CEN

Decommissioning BR3

- BR3 reactor, first pressurized water reactor in Western Europe
- Commissioned in 1962 and ended operation in 1987
- Decommissioning activities on the BR3 reactor started in 1989
- Selected by the European Commission as pilot dismantling project within the framework of the European Union's 5-year research program on the decommissioning of nuclear installations



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Decommissioning BR3: main achievements

- 1989 Start of the BR3 decommissioning project
- 1991 Full System Decontamination of the primary loop
  Dismantling of the Thermal Shield
- 1995 Dismantling of the two sets of internals
  Dismantling of primary and auxiliary loops
- 1999 Commissioning of the MEDOC and ZOE
- 2000 Dismantling of the Reactor Pressure Vessel
- 2002 Dry Storage of the Spent Fuel
  Decontamination of the Steam Generator and the Pressurizer
- 2004 Decontamination of the Fuel Transfer Tank
- 2005 Dismantling the Steam Generator and the Pressurizer
  D&D of cellars in Auxiliary buildings
- 2007-2011 Remote dismantling of the NST
- 2012-2014 Hands on dismantling of the NST

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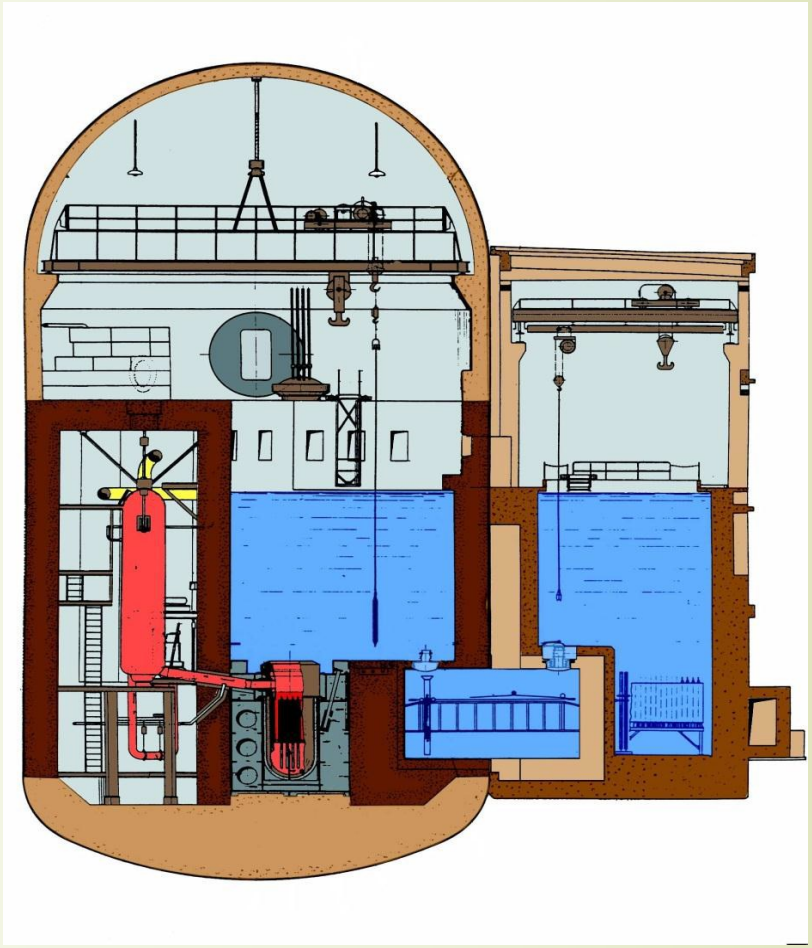
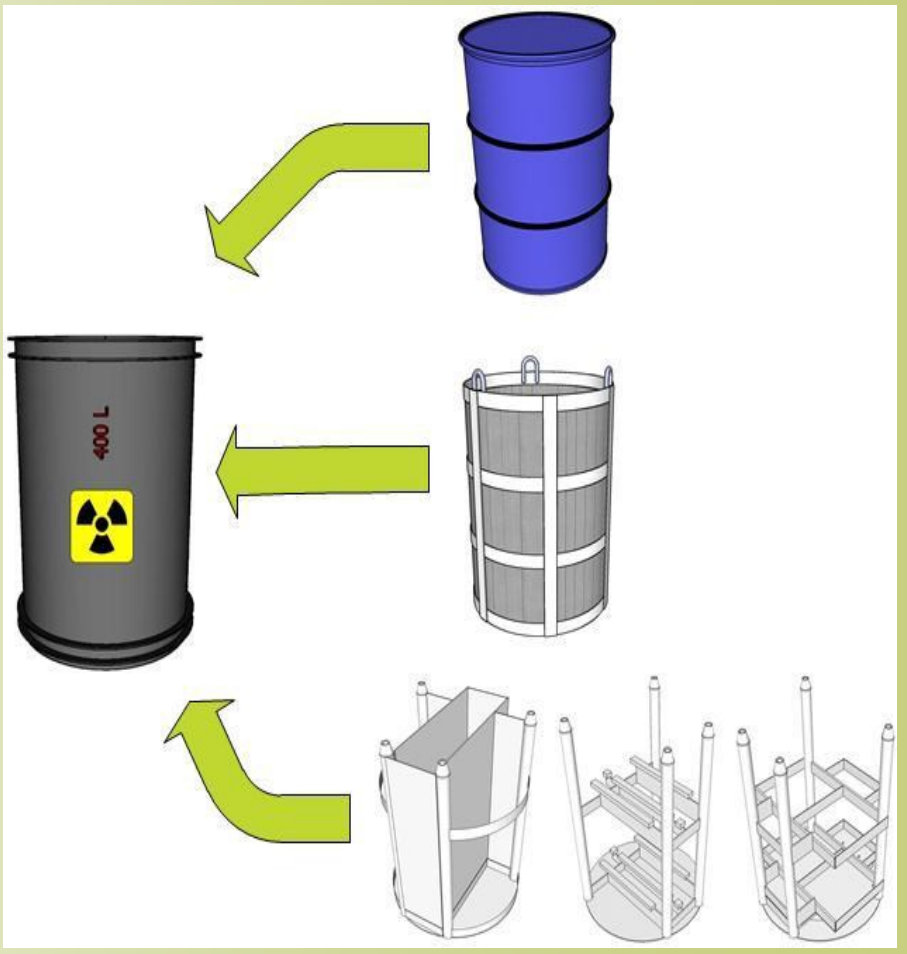
Decommissioning BR3: the strategy is to cut it in-situ -> 400 liter drum





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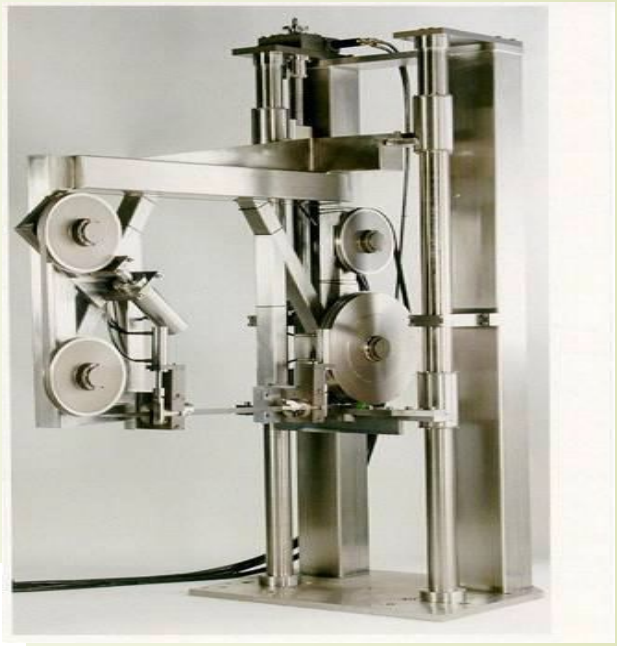
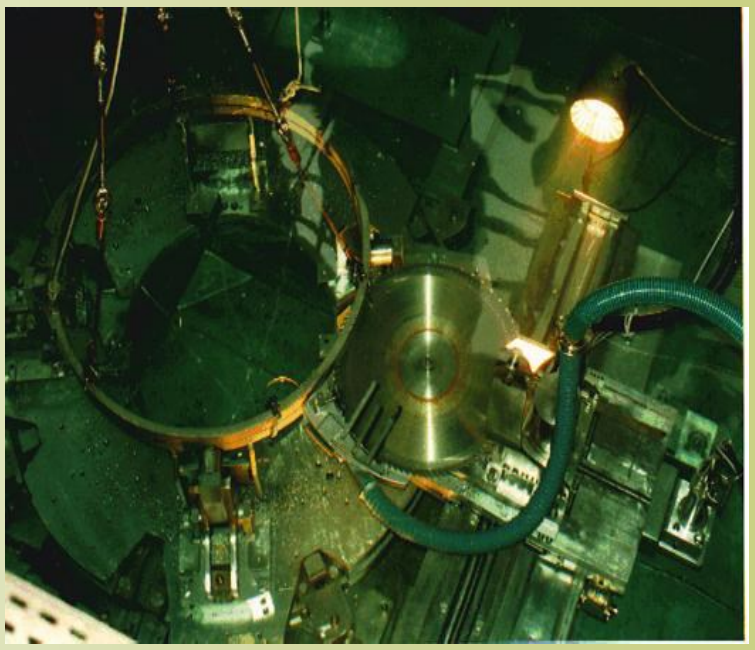
Decommissioning BR3: devolopment of underwater cutting techniques RPV & internals

- Underwater remote EDM cutting, mechanical cutting and plasma arc torch have been compared
- Remote controlled underwater cutting has been extensively used



The Bandsaw



The Milling cutter

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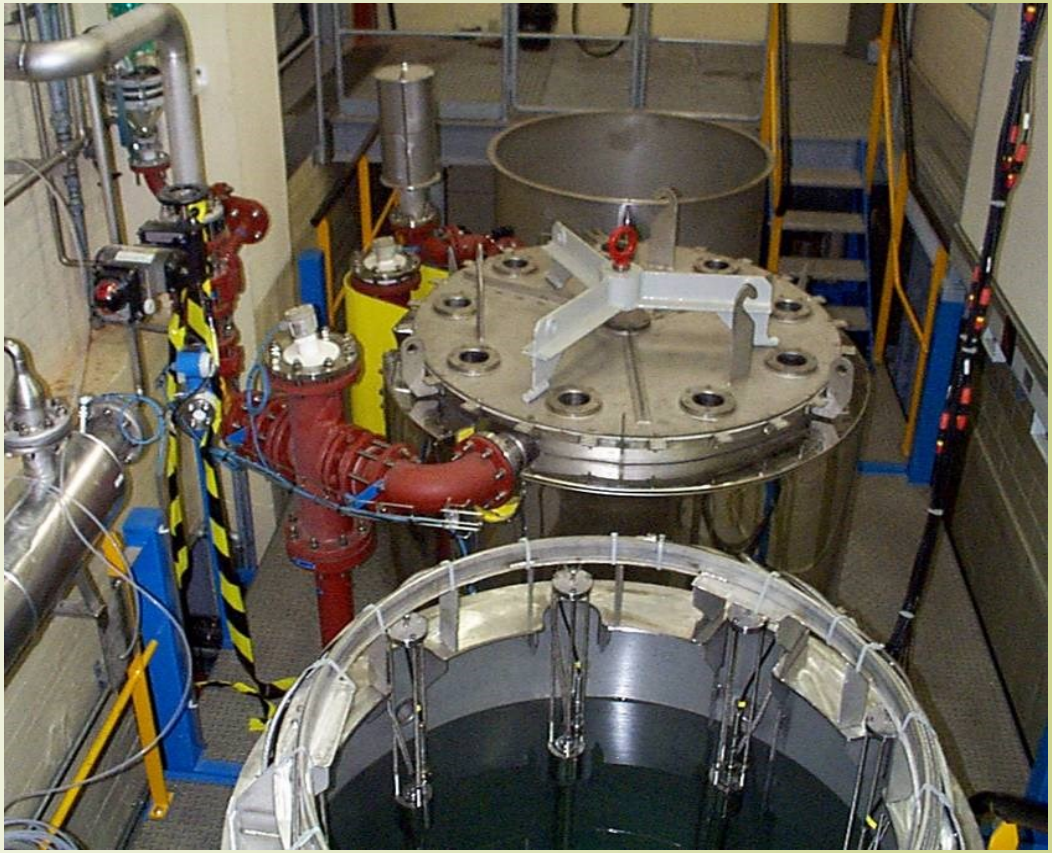
Decommissioning BR3

MEDOC process : chemical wet decontamination of metallic materials on SCK•CEN site



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Dismantling and remediation : nuclear liabilities

Decommissioning Best Medical Belgium

May 14, 2012 : bankruptcy of Best Medical Belgium S.A (Fleurus)

Belgian law provides that ONDRAF/NIRAS is charged with remediation and decommissioning in case of bankruptcy or failure of a nuclear operator

August 1, 2012 : ONDRAF/NIRAS was charged by its supervisory authority to undertake remediation and decommissioning operations of Best Medical Belgium S.A. facilities

September 28, 2012 : ONDRAF/NIRAS submits an operating licence application to the Federal Agency for Nuclear Control (FANC)

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Dismantling and remediation : nuclear liabilities

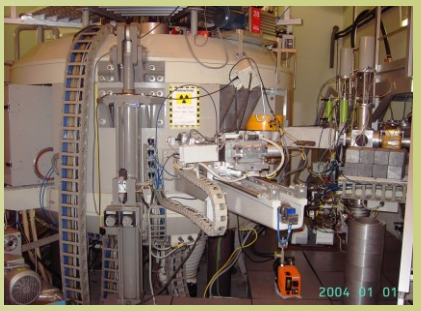
Decommissioning Best Medical Belgium S.A.

October 5, 2012 : licence granted - ONDRAF/NIRAS becomes nuclear operator

Licence covers all activities required to :

- restore the safety standards and maintain proper safety levels
- collect the waste, radioactive sources or materials
- release the materials and the buildings from radiological surveillance

ONDRAF/NIRAS currently prepares dismantling strategy, dismantling plan and licence application for decommissioning



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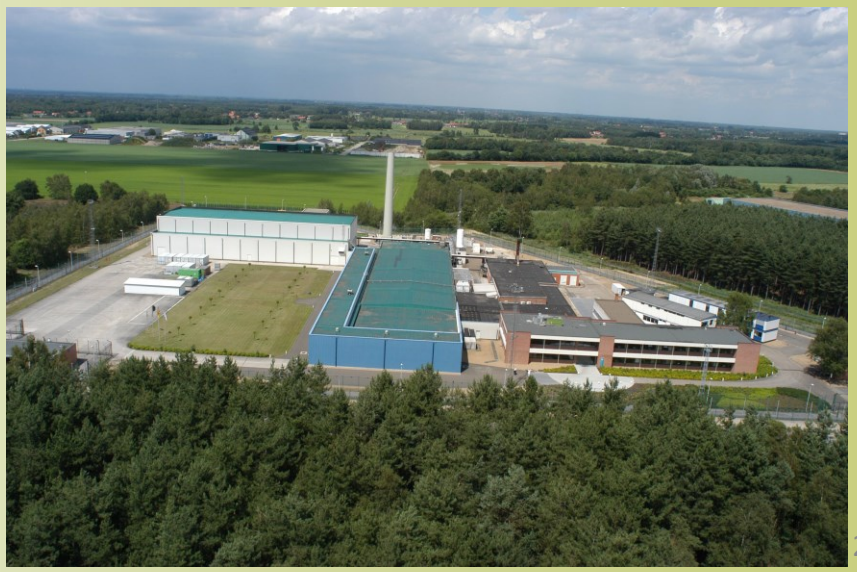
Other decommissioning projects in Belgium

Decommissioning Belgonucleaire (Dessel)

- For more than 20 years, Belgonucleaire (Dessel) produced MOX fuel for nuclear reactors
- 2005: Belgonucleaire decides to close down its facility in Dessel
- Last production campaign ended on August 15, 2006
- 2008 : licence for decommissioning
- 2009 : start decommissioning activities
- 2016 : unconditional release



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Other decommissioning projects in Belgium

Decommissioning Belgonucleaire (Dessel)
Glove boxes : cleaning->removal of internals before GB separation from line-> "in situ" cold cutting in „glove tent"

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Other decommissioning projects in Belgium

Decommissioning FBFC International (Dessel)

- Produced uranium oxide and MOX nuclear fuel elements for nuclear power plants
- December 2010 : licence for decommissioning
- Dismantling started in September 2011
- 2016 : “brown field”

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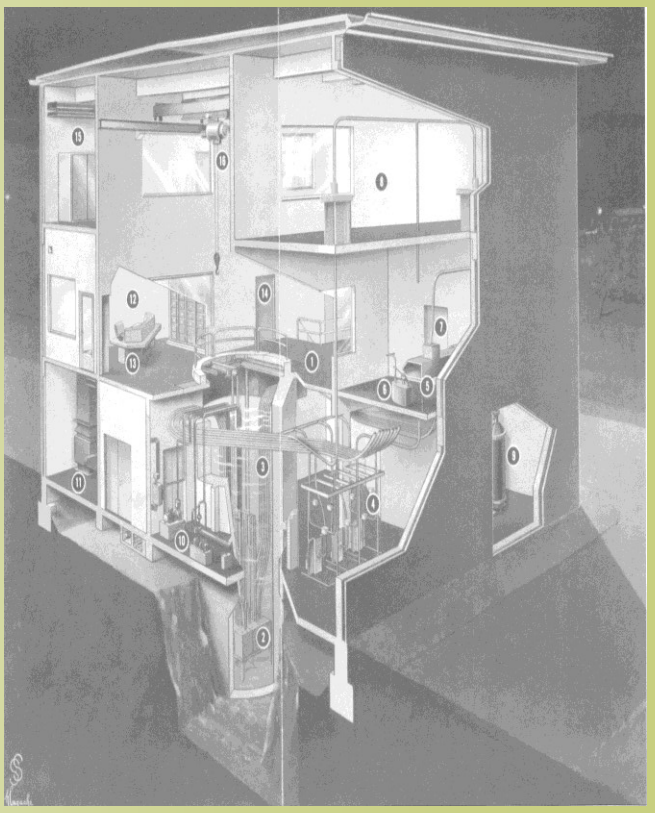
Other decommissioning projects in Belgium

Decommissioning reactor Thetis University of Ghent

- In operation from 1967 until December 2003 (max. 250 kW)
- 2010 : final decommissioning plan, drawn up by SCK•CEN, approved by ONDRAF/NIRAS
- 2010 : fuel elements removed from reactor core and transferred to Belgoprocess (Dessel) for treatment and conditioning in PAMELA facility (cementation of the elements in a 400l drum)
- 2012 : licence for decommissioning granted by the Federal Agency for Nuclear Control (FANC)
- beginning of 2013 : a team of Belgoprocess started the work under supervision of SCK•CEN
- decommissioning activities expected to be completed in 2015 (“brown field”)



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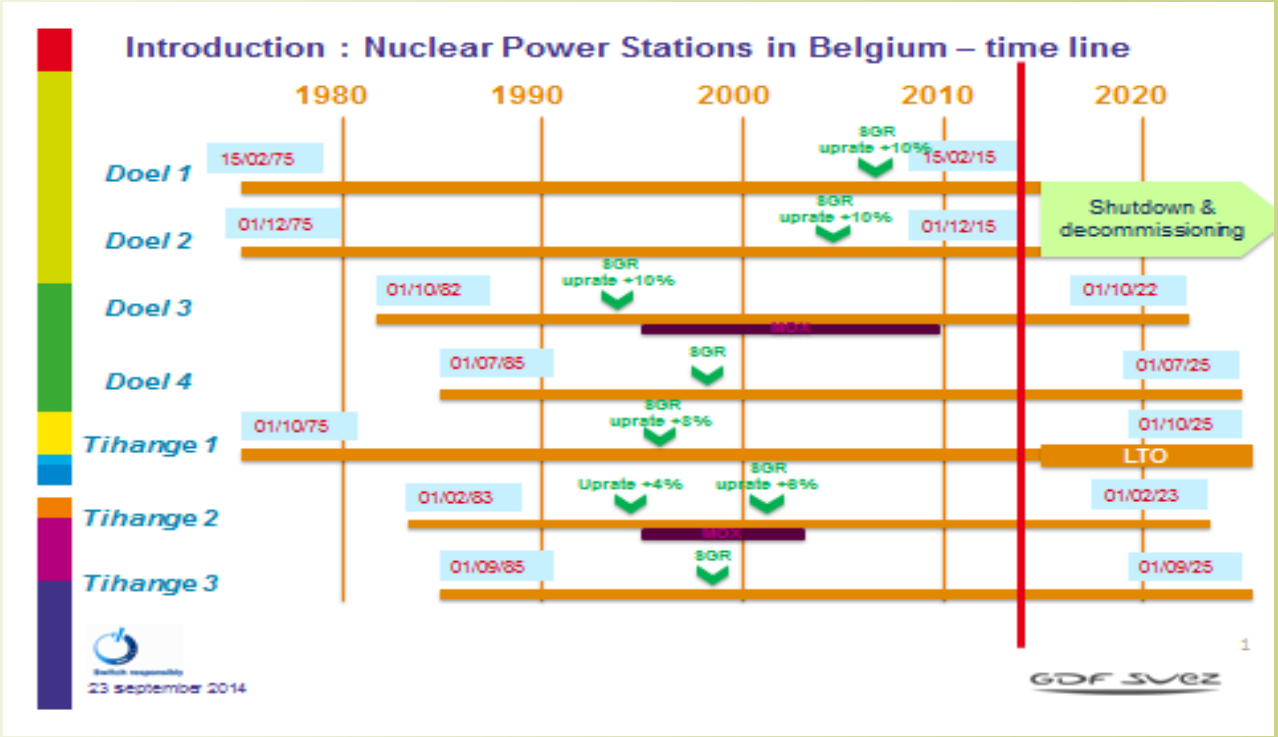
Challenges for the future

Time Frame Shut Down of the 7 Belgian NPP: D1&2 in 2015; D3&4-T1&2&3 2022-2025



Decommissioning power reactors Doel1 and Doel 2

July 2013 : first discussions between nuclear operator (Electrabel) and ONDRAF/NIRAS to determine a dismantling strategy taking into account all logistic aspects from waste generation (dismantling) to disposal

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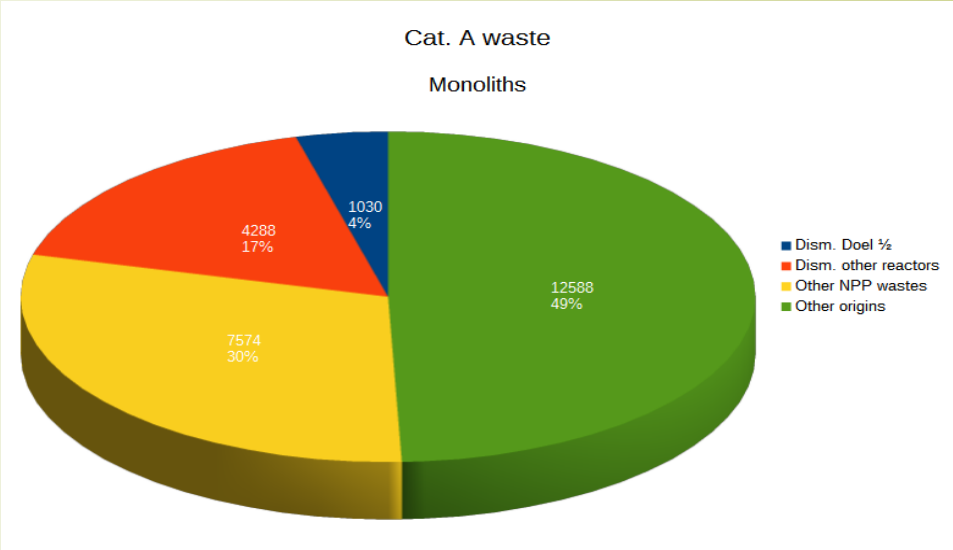
Challenges for the future

Radioactive Waste from Decommissioning of the 7 NPP: quantities and categories

- **Cat A-waste (low and intermediate level short lived waste): 21 % total cat –A waste to be managed by ONDRAF**
- **Cat B- waste (low- and intermediate level long lived waste): 20 % total cat –B waste to be managed by ONDRAF**



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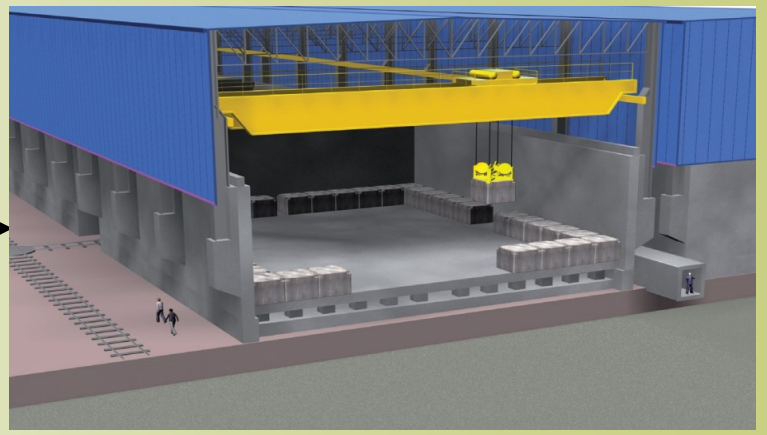
Challenges for the future
cAt Project : Surface Disposal in Dessel

Technical concept



- Planning :
  - License introduced : 2013
  - To obtain license : 2016
  - Construction : 2017-2020
  - Operation: from 2020

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Challenges for the future
Decommissioning D1&2

Following actual planning:

- disposal Cat-A in operation from 2020
- dismanting D1&2 from 2019

⇒ respect of planning major importance

BUT

new Federal Government: intention to approve extension of lifetime for units Doel 1 & 2 with 10 years, but this under investigation

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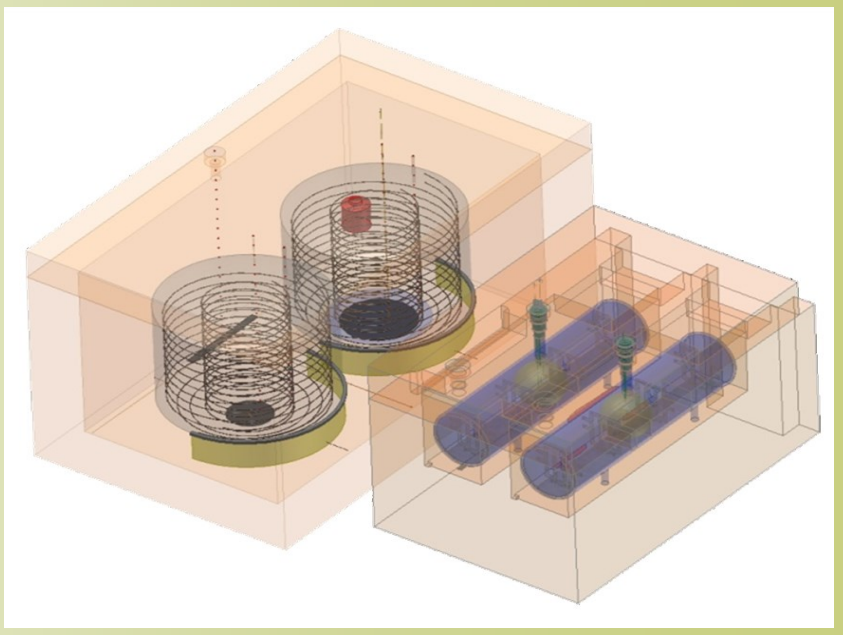
Challenges for the future

Remote decontamination of vessels in building 105X/122X at site BP1



horizontal vessels: former storage 50 m³ HLLW(LEWC); vertical vessels: former storage of 850 m³HLLW (HEWC)

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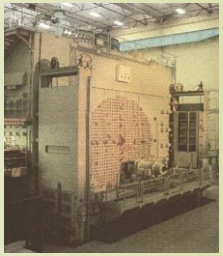
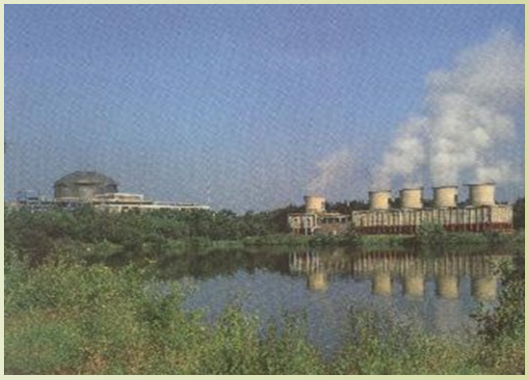
Challenges for the future

- **Nuclear liability SCK·CEN : Decommissioning research reactors BR1 and BR2 > 2025**
  - the BR1 : a uranium/graphite reactor;



  - the materials test reactor BR2 : fuel assemblies with highly enriched uranium placed in a beryllium matrix shaped as an hyperbolic paraboloid, which ensures at the same time a high neutron flux and an easier access to the experiments from the top and the bottom of the reactor;



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Conclusions

- **ONDRAF/NIRAS central role decommissioning activities in Belgium due to:**
  - **management of different nuclear liabilities**
  - **decommissioning plan and follow up during decommissioning**

- **Belgoprocess and SCK•CEN have built up a large industrial experience in decommissioning nuclear facilities (former Eurochemic pilot reprocessing plant, reactor BR3, other installations)**

- **Specific decontamination and dismantling techniques have been developed by Belgoprocess and SCK•CEN and are available for further use**

- **The availability of a disposal site for cat A-waste is crucial for the decommissioning of the 7 NPP**

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