



28th Exchange Meeting:
Belgian R&D programme on Spent Fuel

sck cen

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	Time	Presented by
1. Context	13.40 – 14.50	*Where we stand*
Belgian context for the management of spent fuel		Sophie Pedoux (NIRAS-ONDRAF)
Spent nuclear fuel: Why should we know more … today?		Kevin Govers (NIRAS-ONDRAF)
Knowledge management, the spent fuel platform		Valentin Kerleguer (FANC)
The global work programme of the spent fuel platform explained		Tomas Vandoorne (NIRAS-ONDRAF)
Q&A		
Coffee break	*14.50 – 15.20*	
2. Practical aspects	15.20 – 16.00	*From reactor to research*
Rod extraction at Doel-3		Jonas Stichelbout (Engie)
Loading of the container, transport to SCK CEN		Xavier Bairiot (SCK CEN)
Q&A		
3. R&D programme details	16.00 – 16.50	*Gaining insights*
The experimental spent fuel R&D program		Marc Verwerft (SCK CEN)
Characterizing of spent nuclear fuel through modeling & calculations		Augusto Hernandez Solis (NIRAS-ONDRAF) Gert Van den Eynde (SCK CEN)
Q&A		
Way forward	16.50 – 17.00	Didier Leonard (SCK CEN)
Drink	*17.00 – 18.00*	



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Belgian R&D programme
on Spent Fuel

Belgian programme
on radioactive waste management

Practical aspects

from reactor to research

24-11-2026

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Rod Extraction at Doel-3

Jonas Stichelbout

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ENGIE Electrabel

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Project introduction

Project objective, approach and partners

PROJECT OBJECTIVE

Transport rods from Doel 3 to SCK CEN and perform measurements on fuel assemblies

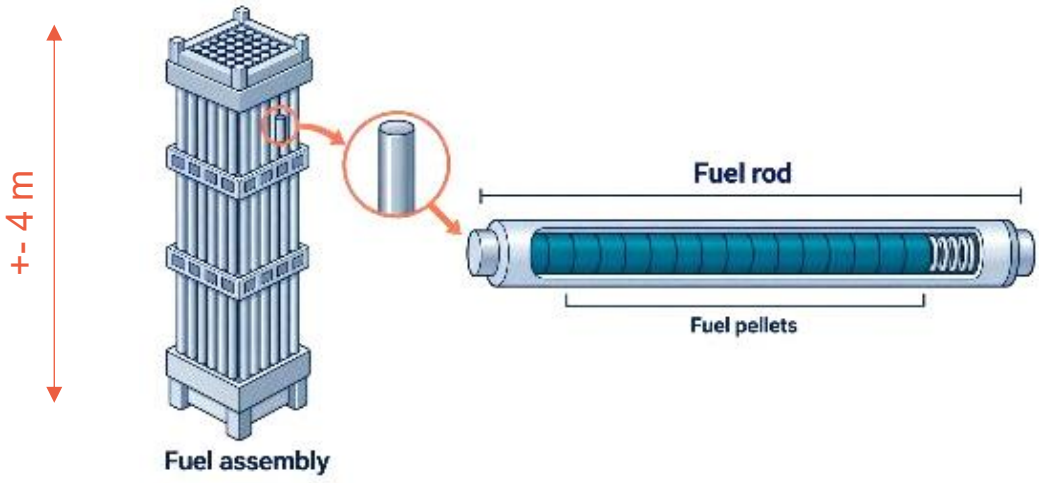




Image from Nuclear Energy Agency

A JOINT EFFORT OF
One team, three organisations

ENGIE | **NIRAS** | **SCK CEN**

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Project scope: campaign overview

Three campaigns in sequence, plus one additional campaign

01 COMPLETED October 2026

R72 dry run

Test the R72 transport container and rehearse the handling operations.

02 PLANNED January–February 2027

Rod extraction

Extract the rods from the fuel assemblies and place them in a storage canister.

03 PLANNED March 2027

Loading & transport

Load the canister containing the rods into the R72 and transport it to SCK CEN.

ADDITIONAL CAMPAIGN

Radiological measurements

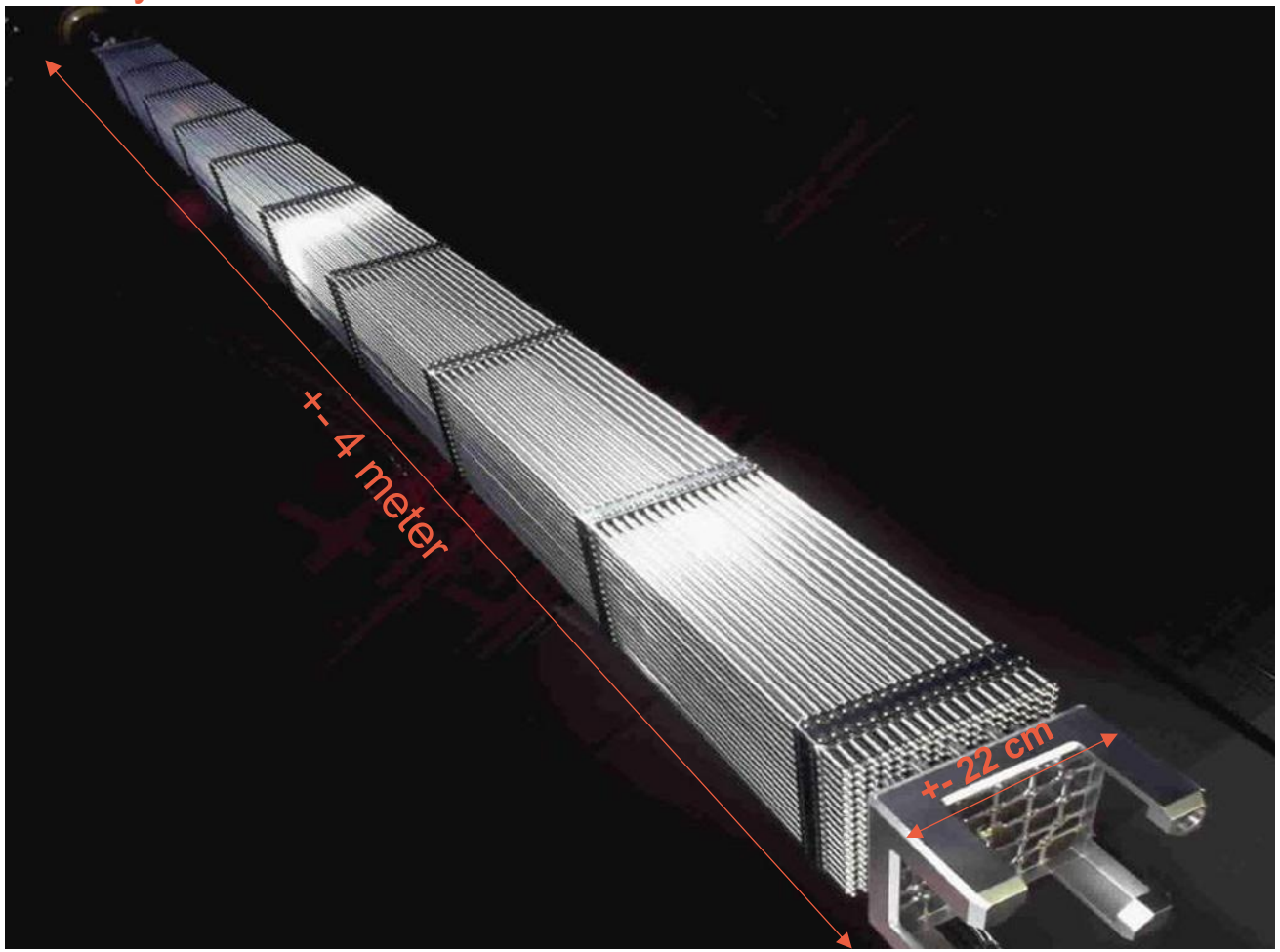
COMPLETED 2025

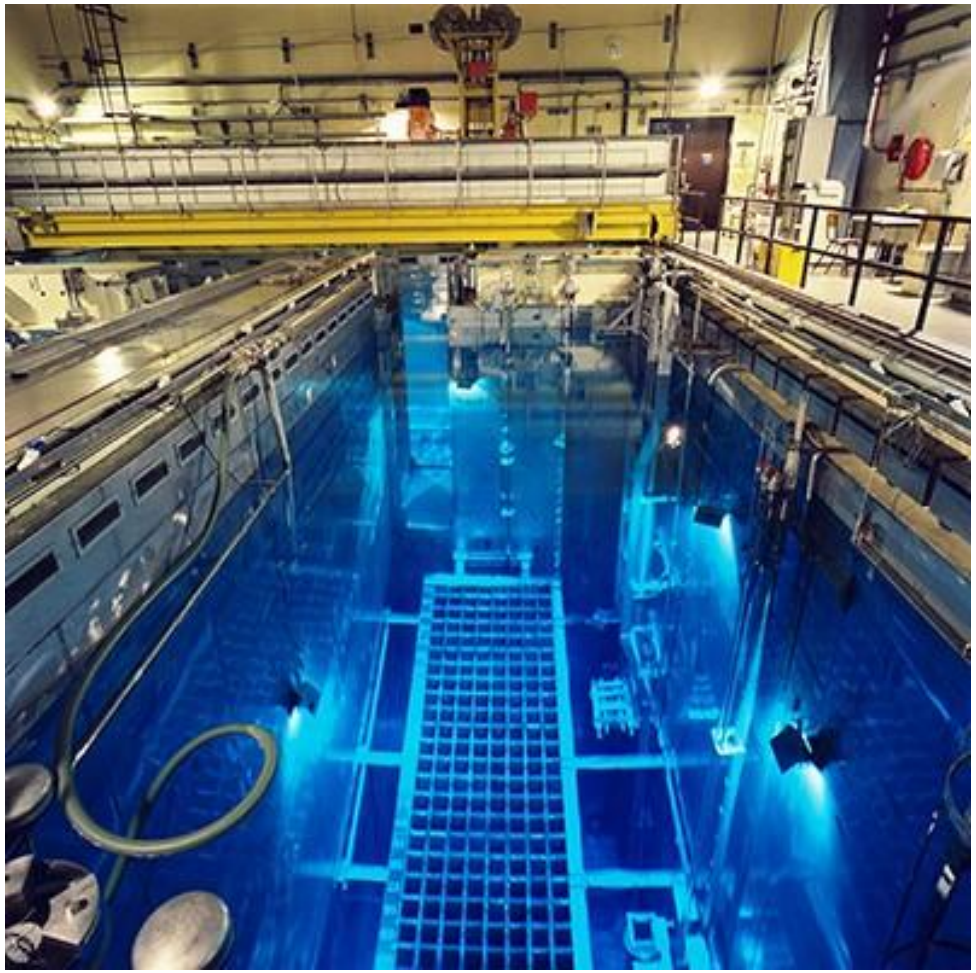
Measure the radiological characteristics of fuel assemblies in the Doel 3 spent fuel pools.

Extraction

Extraction

February 2027





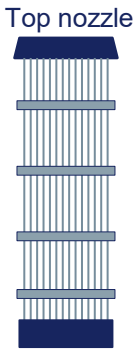
www.synatom.be – Spent Fuel Pool of Doel 3

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Rod Extraction

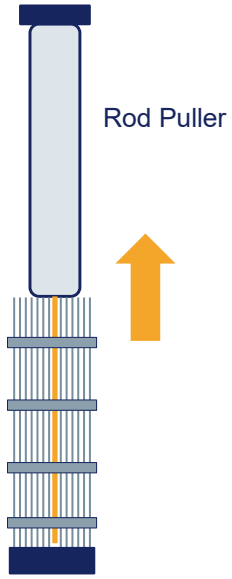
Three images show the core of the campaign: opening, controlled removal and safe temporary storage.

1. Remove top nozzle



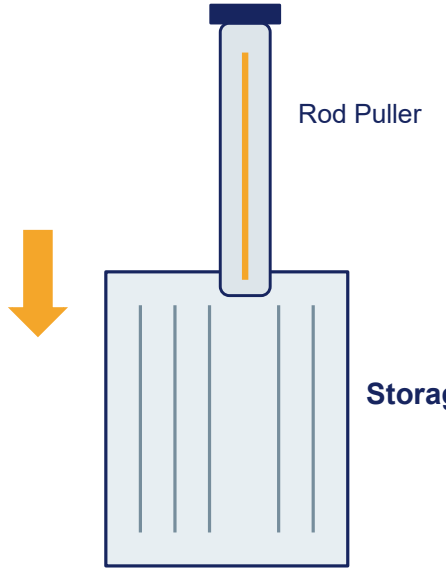
The top nozzle is detached and placed on a separate support.

2. Extract the rod



The rod slides axially upwards and remains guided within the tool along its full length.

3. Place rod in storage tube



The extracted rod is placed in its designated storage position in a controlled manner.

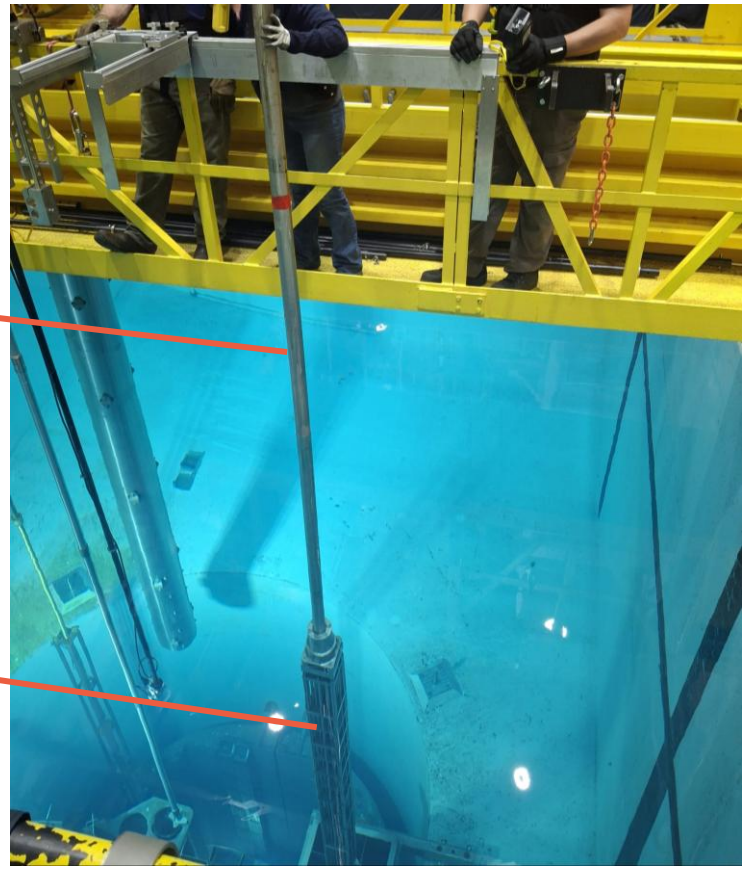
10 RODS | 3 ASSEMBLIES

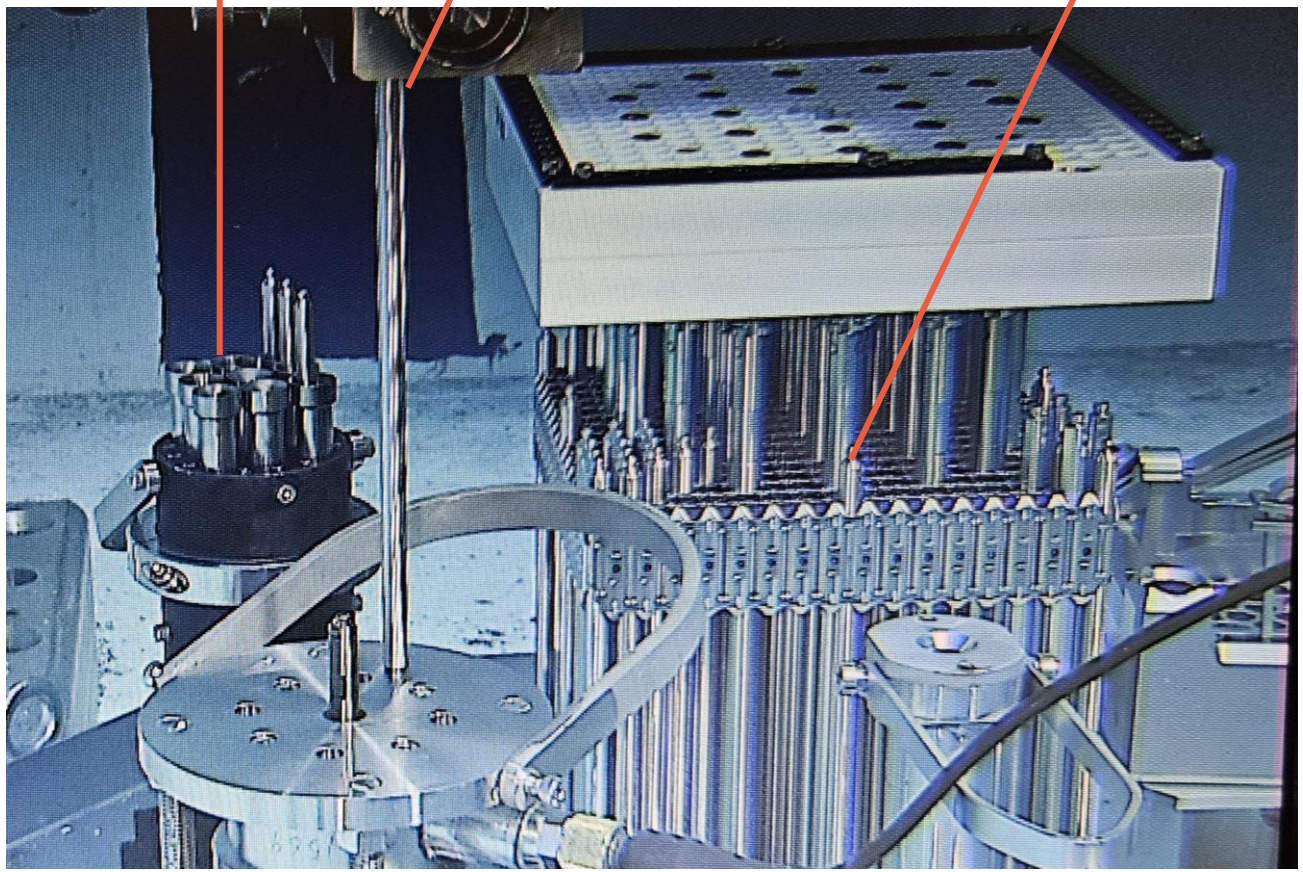
Then: insert an inert replacement rod, refit the top nozzle and return the assembly to storage.

Conceptual visualization for non-technical audiences

Rod Extraction

Images of handling operations in non nuclear test facility





Dry Run R72

Dry run R72

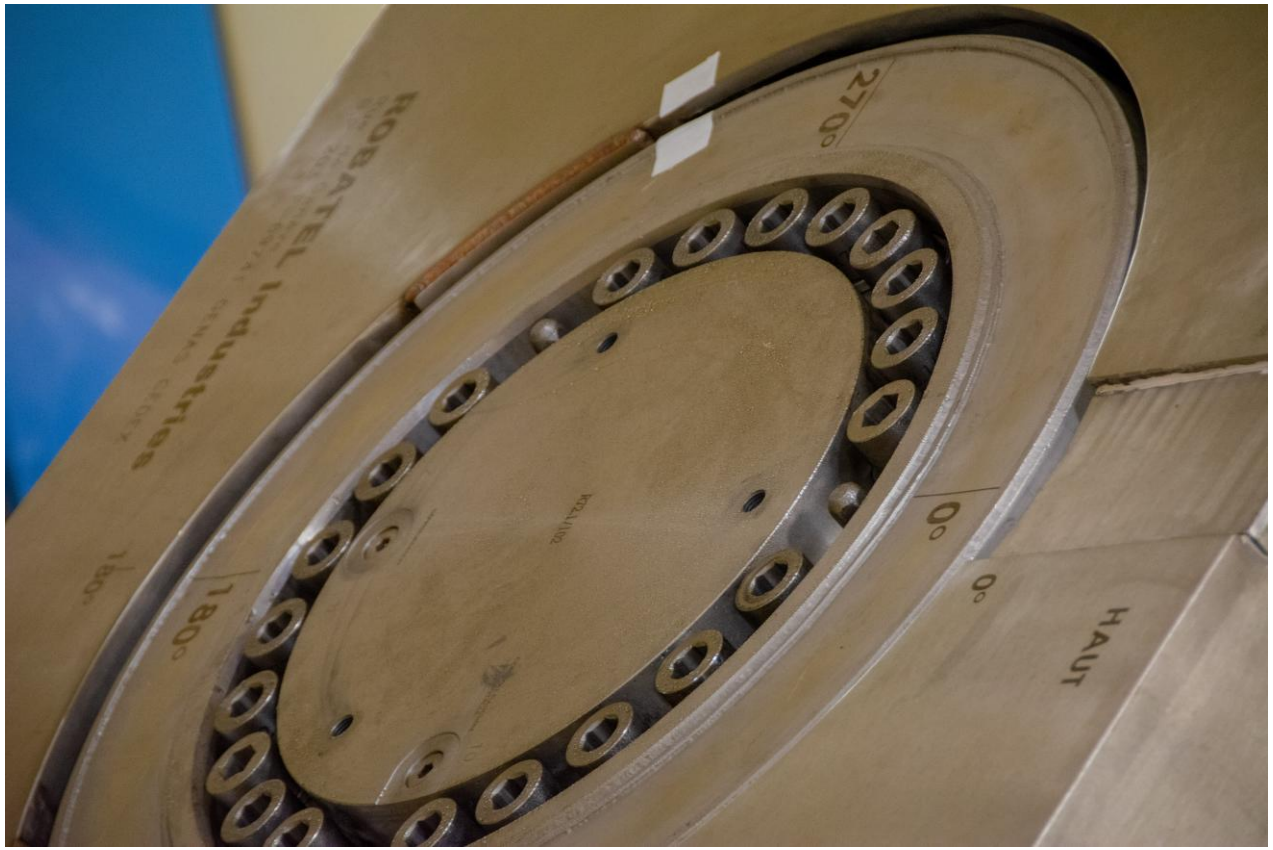
October 2026





Dry run R72

October 2026





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R72 container dry run

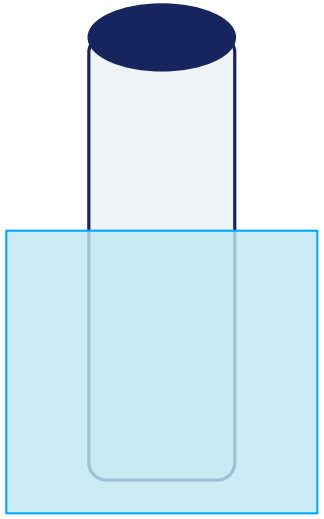
A full rehearsal with empty canister: the same equipment, interfaces and operations, but without fuel rods.

1. Delivery & setup



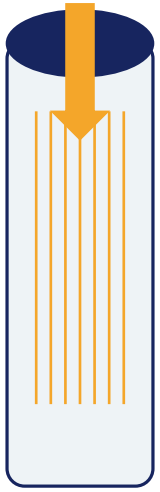
R72 and tools arrive and are set up.

2. Immersion



The container is brought into the spent fuel pools.

3. Empty canister loading



The loading and closing steps are completed with an empty canister.

4. Conditioning & follow-up



Removal, drying, decontamination and repackaging of material.

Drying & leak tests

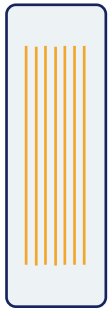
Goal: to test working methods, interfaces, resources and staff deployment in advance before the actual loading campaign.

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R72 loading & transport to SCK CEN

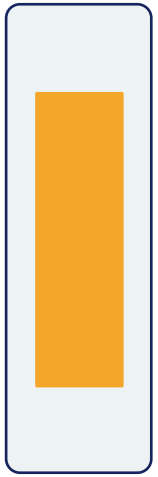
The extracted rods move from temporary storage into the transport package and then to the research facility.

1. Rods in canister



The selected rods are in the designated storage canister.

2. Canister in R72



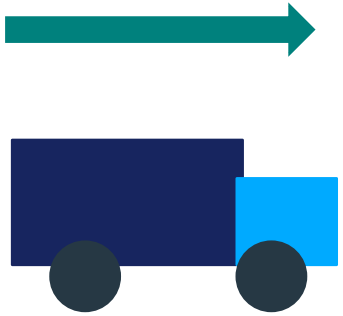
The filled canister is placed in the R72.

3. Close container



The plug/lid is fitted, followed by drying, sealing and checks.

4. Release & transport



The loaded R72 leaves Doel after the required checks.

5. Arrival at SCK CEN



The R72 will be taken to SCK CEN for further treatment and examination.

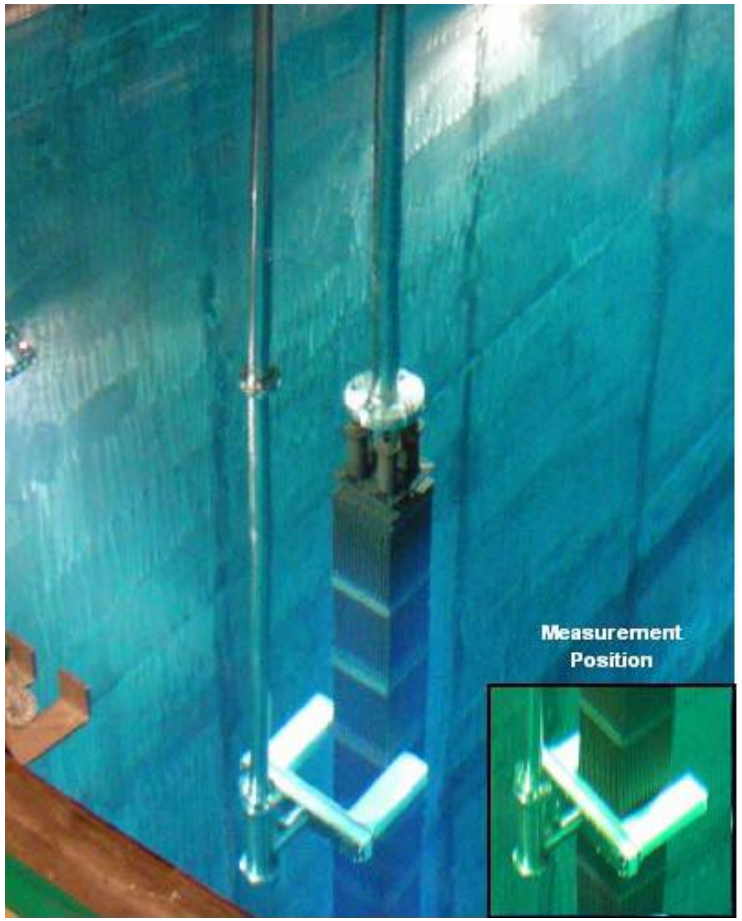
R72 is approved for transport of the radioactive content.

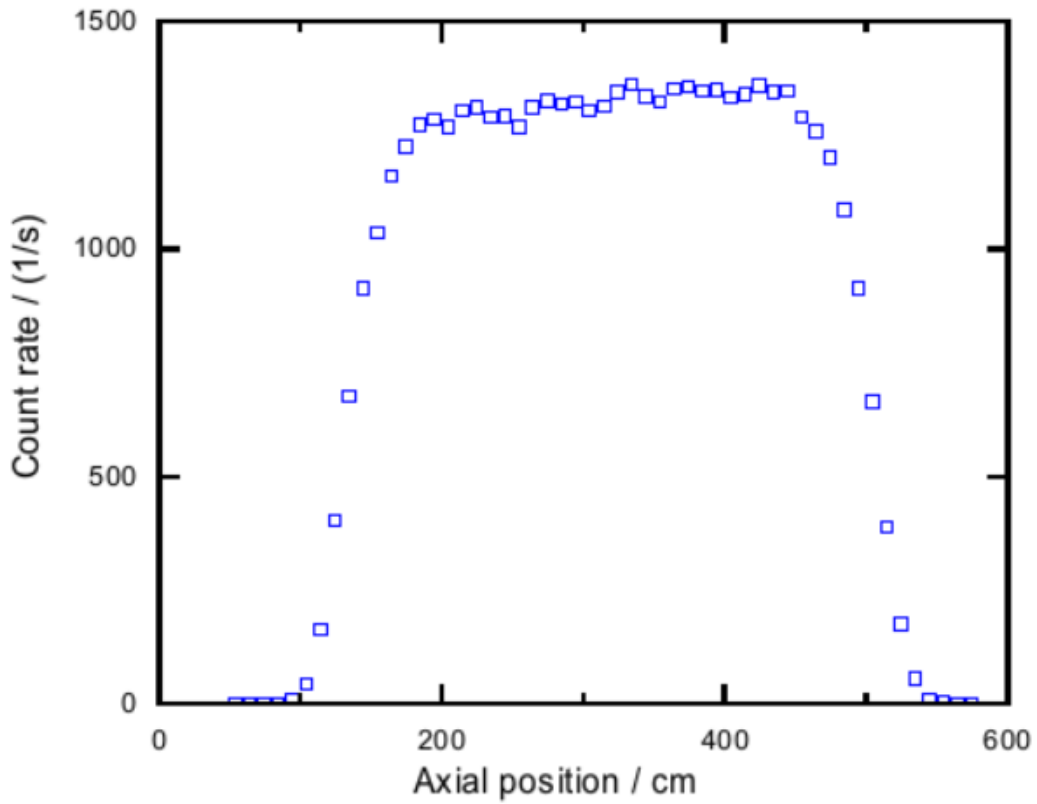
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Ionfork measurements

Ionfork measurement campaign

Fuel assemblies are measured one by one to document their radiological characteristics.

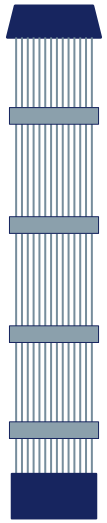




Ionfork measurement campaign

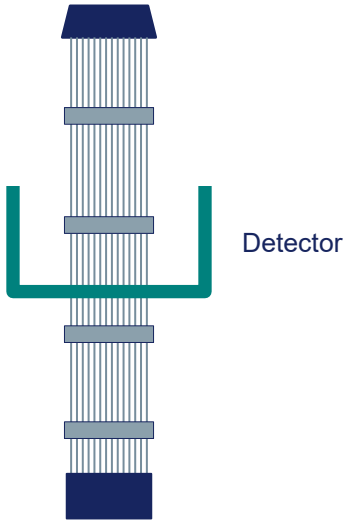
Fuel assemblies are measured one by one to document their radiological characteristics.

1. Position the assembly



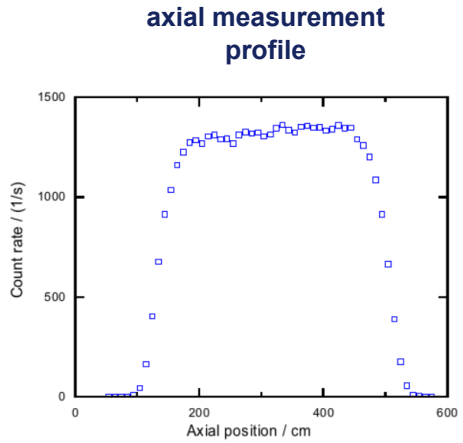
The handling machine brings the assembly to the measurement position.

2. Measuring at multiple heights



The ionfork records signals at different heights; background measurements support interpretation.

3. Record the results



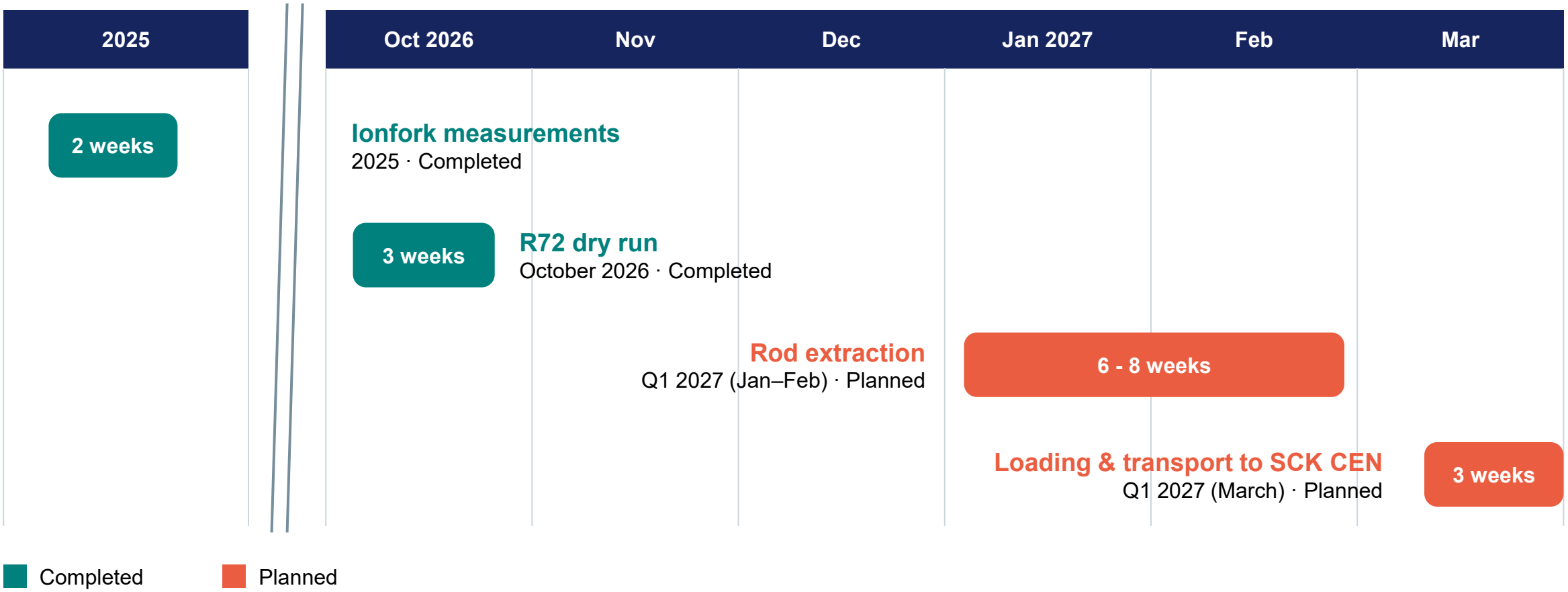
The measurement series is recorded for each assembly and checked for deviations.

Overview

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Campaign timeline

Ionfork measurements in 2025, followed by three campaigns between October 2026 and March 2027.




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Loading of the container Transport to SCK CEN

Xavier Bairiot

24-11-2026

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Way forward to transport

Loading, transport, unloading :

- Description of the fuel rods
  - As basis to find the appropriated packaging
- Approved packaging
  - for the considered content
  - Approved in Belgium
- Technical interfaces for loading and unloading

All steps required attention

Description of the fuel rods

- Why ?
  - Need to compare with the allowed content of available packagings
  - Stay within the design parameters of packagings
- What ?
  - General information (qty, dimensions, …)
  - Detailed information : ->
- Consequence : deep dive early in the project to select the fuel rods

Nombre maximal de crayons	
Burn Up maximal (Gwj/t de métal lourd)	
Burn up moyen assemblage	
Masse de métal lourd avant irradiation kg)	Calculated on fuel pins
	BU < 55 GWj/tML
	BU < 100 GWj/tML
Erichissement maximal en U-235 (% massique)	
Teneur maximale de Pu (% massique)	
Vecteur isotopique Pu	Pu fiss/ U+Pu tot
	Pu fiss / (Pu+Am) tot
	(Pu-241 + Am-241)/ (Pu+Am tot)
	Pu-238/(Pu+Am) tot
	Pu-239/Pu+Am tot
	Pu-240/(Pu+Am)tot
Temps de refroidissement minimum (mois)	
Puissance thermique (W)	Calculated on fuel pins
	Puissance thermique résiduelle linéique maximale au maximum du profil de taux de combustion (W/m) (pour la totalite du chargement)
	Puissance thermique résiduelle
Activité totale maximale TBq)	

Description of the fuel rods

- Mix of UO2 and MOX
- High burnup
- Leaking fuel pins ?
  - selected rods are a priori intact
  - incident during rod extraction cannot be 100% excluded
  - Need to cover the worst case scenario

Approved packaging

- No recurrent activity => need to rely on existing packagings
- 2 existing packagings identified :
  - NCS45, owned by ORANO, Germany
  - R72, owned by Robatel, France (financed by EDF)
- Both packagings were compared for our considered fuel pins :
  - NCS45
    - 2 transports required (limit of heavy metal exceeded)
    - Encapsulation required for UO2 leaking fuel pins
  - R72
    - Allowed content 2 is suitable
    - Leaking fuel rods in the safety file, but not in the approval certificate
  - None of both are approved in Belgium



NCS45



R72

Approved packaging

R72 is the only suitable available packaging subject to :

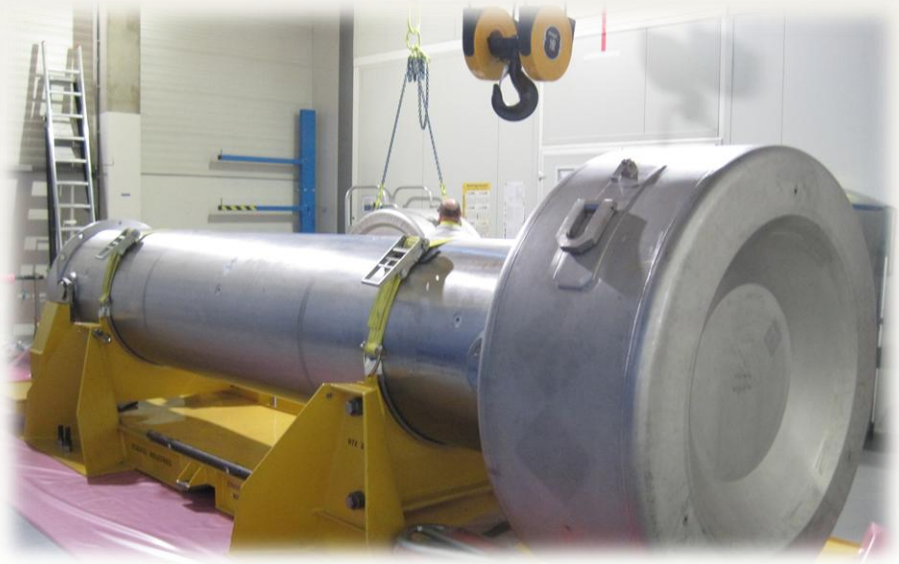
- Approval in Belgium on basis of the existing French approval certificate
- Extension of the allowed content to address possible leaking fuel rods

Approval in Belgium of the existing French approval certificate

- No preparatory work
- Safety file introduced to the FANC
- Belgian approval certificate obtained after 1 year

Extension of the allowed content for leaking fuel rods

- Preparatory work was mandatory (Robatel + SCK CEN)
- Safety file introduced to ASNR (FR) and FANC (BE)
- Belgian approval certificate obtained after 1 year

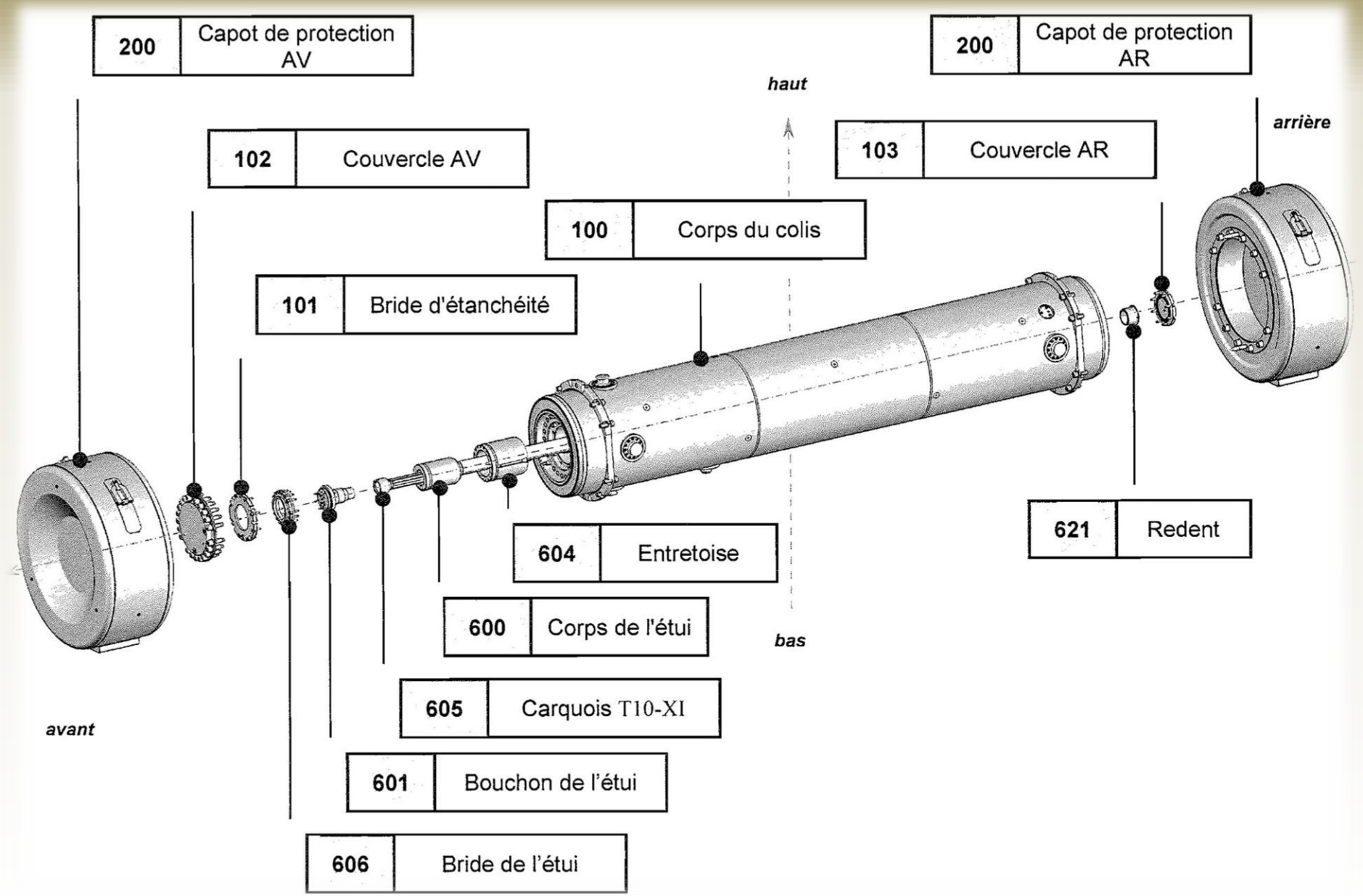


R72 planning

- EDF priority
- Early planning Engie EBL – SCK CEN
- Regular alignment between EDF – SCK CEN – Robatel to consolidate
- Limited but appreciated efforts of EDF to take our planning into consideration



R72 configuration



R72 configuration

2 different internal configurations inside R72 :

- EDF configuration : square head as fuel head
  - Advantage : handling in Doel as fuel assemblies, proven for storage on fuel racks
  - Disadvantage : square head too large to pass hot cell channel
- International configuration : small rounded head
  - Advantage : passes SCK CEN's hot cell channel
  - Disadvantage : not foreseen to handle in pools

Choice : use proven technology for Doel, and address challenge for SCK CEN

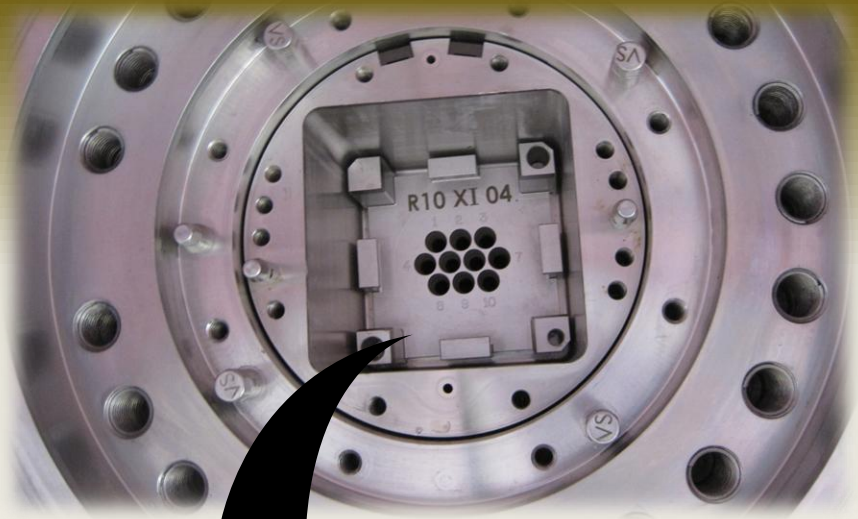


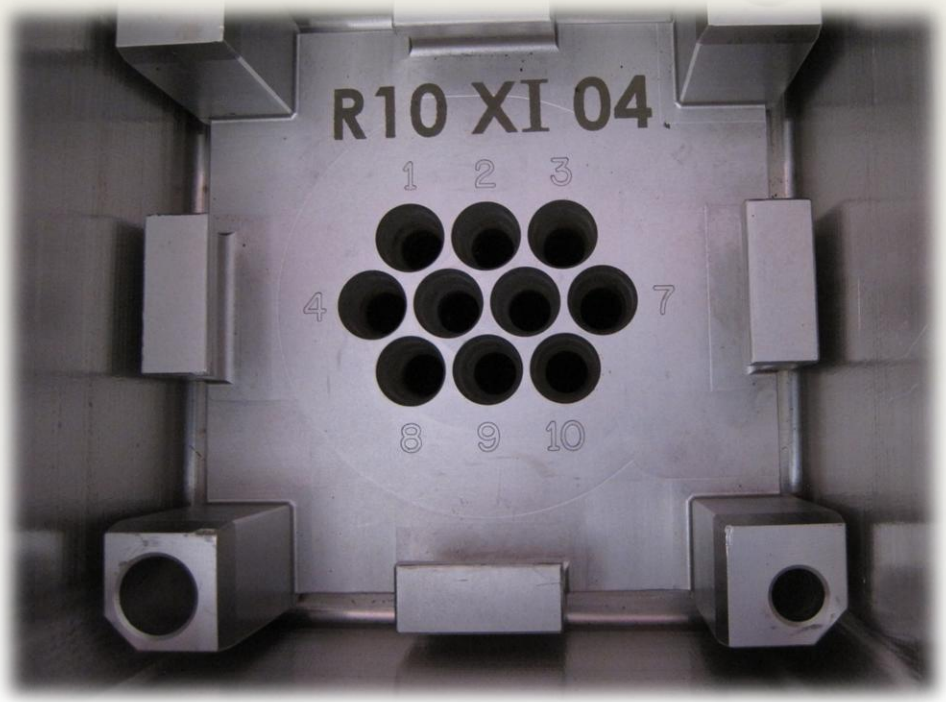


R72 configuration

- EDF not allowing the use of their basket
  - Need to build our own basket
  - Need to configure the R72

- R72 configuration addressed in the MaT building at SCK CEN :
  - Removal of EDF basket
  - Insertion of our own basket in the R72
  - Insertion of dummy fuel rods for LHMA cold tests





Technical interfaces for loading and unloading

- Addressed through a feasibility study :
  - Walkdown in Doel 3 and LHMA
  - Drafting the kinematics
  - Challenging the kinematics
  - Drafting :
    - procedures
    - ALARA plan
    - Safety analysis
    - Degraded operation modes

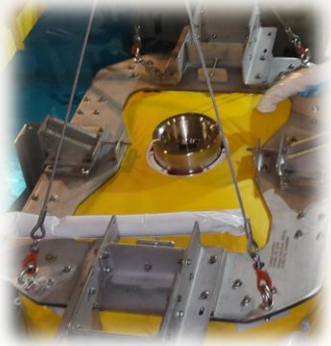
Technical interfaces for loading in Doel

- Extensive use of existing tools of the R72
  - Existing EDF tools to use R72 as heavy spent fuel packages





- Limited need of construction of new specific tools
  - Spreader
  - Plug lifting device





Technical interfaces for unloading @ SCK CEN

- Main challenges :
  - No power manipulator in the hot cell to remove the plug
    - Construction of a plug removal tool



  - Square head of the R72 internals not passing through the LHMA hot cell channel
    - Specific gripping tool operated by manipulators
    - Tested during cold tests with dummy fuel rods





Transport

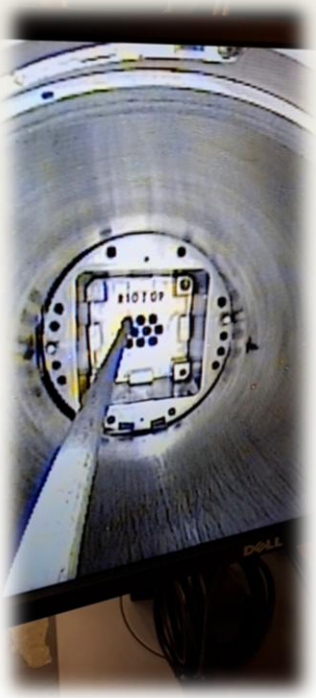
- Entrusted to Transrad
- No issues identified
- Success based on regular alignment



Cold test @ LHMA and Doel 3

- Agreed from the start due to :
  - New type of packaging for KCD and LHMA,
  - Specific tools, build for purpose
- All steps tested
- Kinematics, interfaces and specific tools validated
- No main issue identified
- Practical improvements were identified to ease the effective operations





Lessons learned

- Early stage : detailed fuel rods definition (T_0 – 2 years)
- Timely organization for safety file extension (leaking fuel rods) and approval by authorities (T_0 – 1,5 years)
- Detailed kinematics is key to :
  - Assess the interactions between the packaging, existing equipment and infrastructures
  - Identify specific equipment needs and associated design specs
- Stakeholders' constructive participation and common target



Ready for transferring fuel rods from Doel to SCK CEN early 2027