Underwater NDE Systems in the JHR
Towards integration issues

Underwater NDE Systems in the JHR:

Required Systems

Two Imaging Systems *(IS)* in the reactor pool:

1 *GXIS*: Gamma & X Imaging System

Spectrometry passive γ and Transmission High Energy X rays

⇒ *Mechanical bench + collimator with a complex and accurate instrumentation architecture*

Note: CEA and VTT (Finland) develop a collaboration to design and supply this GXIS system

1 *NIS*: Neutron Imaging System

=> Using high neutron flux coming from the core

=> Mechanical bench + underwater neutron collimation and instrumentation

JHR experimental programme objectives:

Assessment of irradiation nuclear fuel experiments

Emission and Transmission Nuclear Measurements + Tomography γ and n

Interest:

*Both systems may deliver E**xperimental** results **Images** up to **3D***
(scanning, localised, tomography)

Complementarity between **n and *γ*** *assessments*

Underwater NDE Systems in the JHR:
Systems characteristics

Technical Objectives:

Higher accurate goals than present possibilities ***(OSIRIS, etc…)***

Taking « realist to day state of art » :

Expected resolution of (100µm)^3

=> to day ~(500 µm)^3

Global Engineering Difficulties & Goals: Constraint interfaces *(objective of this presentation)*

Integration of accurate mechanical benches in the pool,

Design of the collimator plug penetration ***(feedthoughs with vessel liner and concrete frame, …)***

Main accurate exigences for the 3 axis & rotation positions:

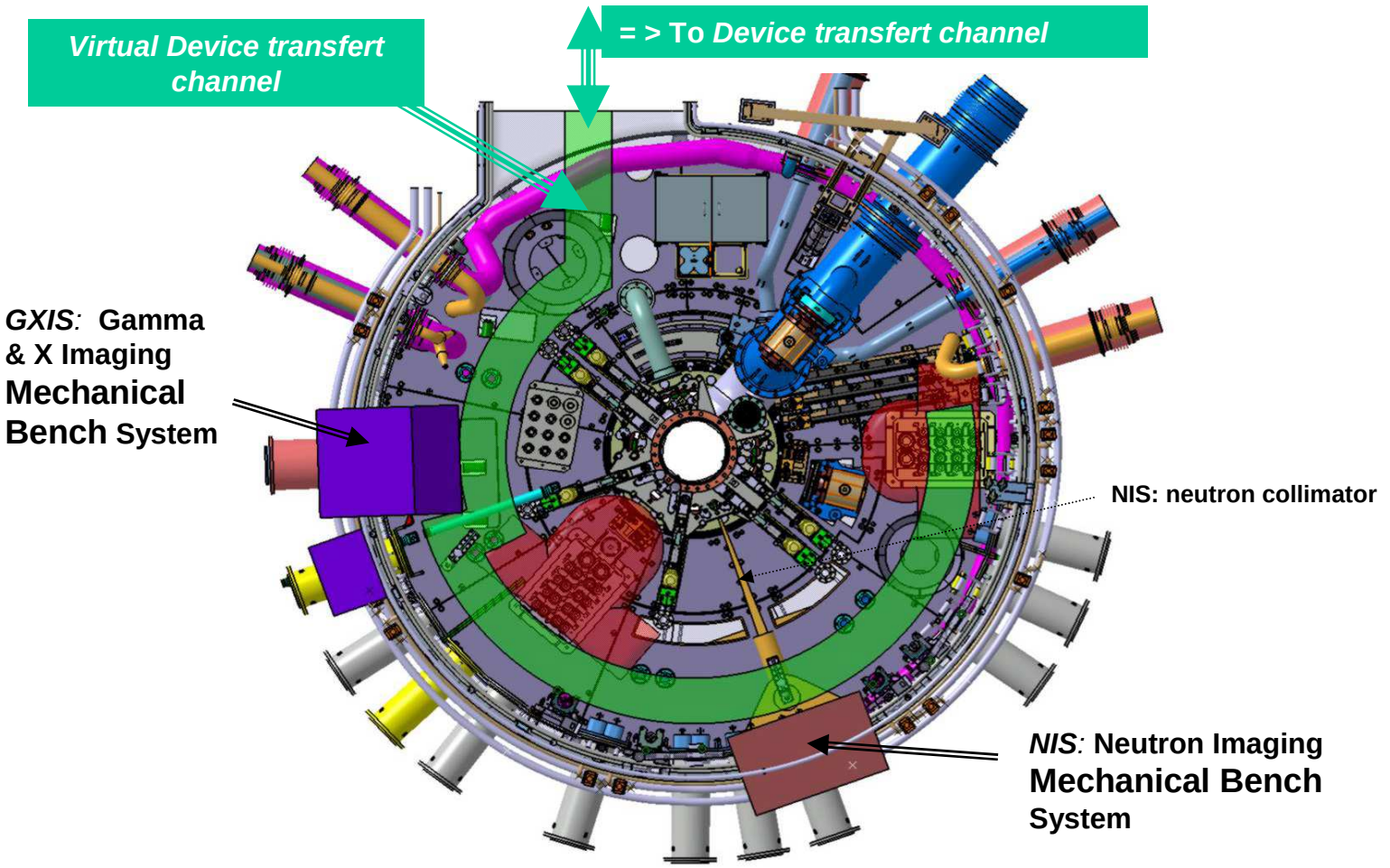
X, Y, Z: +/- 0,1 mm

θ: +/- 0,05°

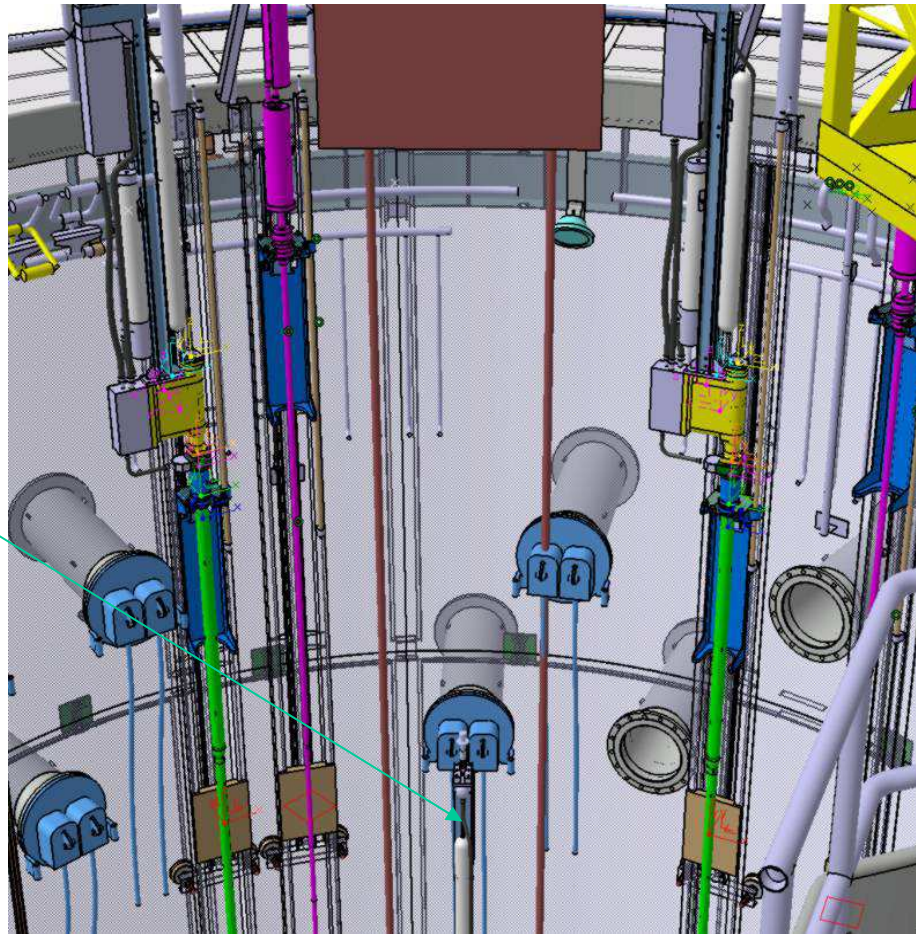
Specific assessment files: Safety, transfert exigencies, etc…

=> Especially: need of seismic mechanical design

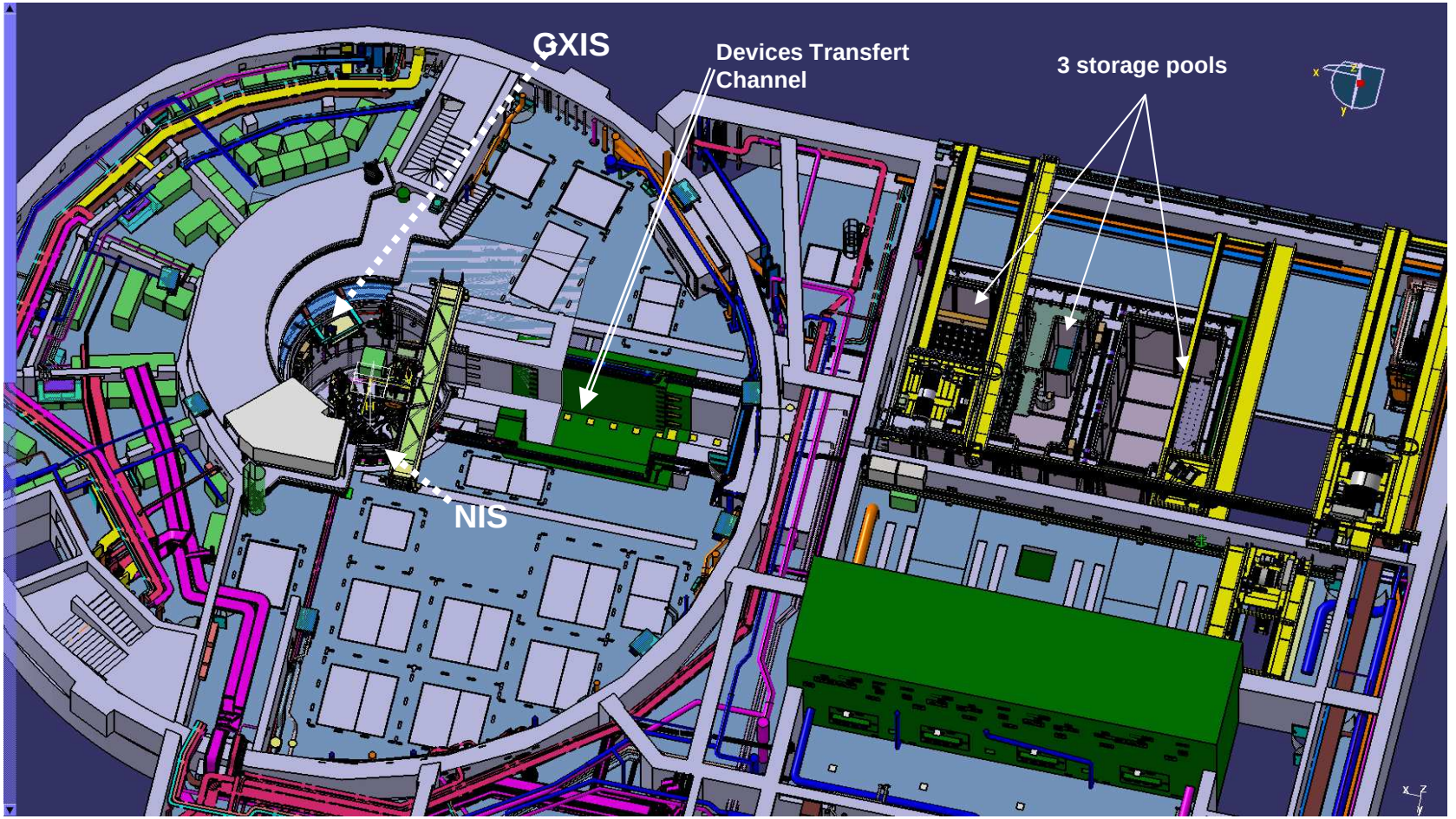
Reactor Pool General Horizontal View: GXIS and NIS positions



Reactor Pool General Vertical View:
NIS position (upper part)



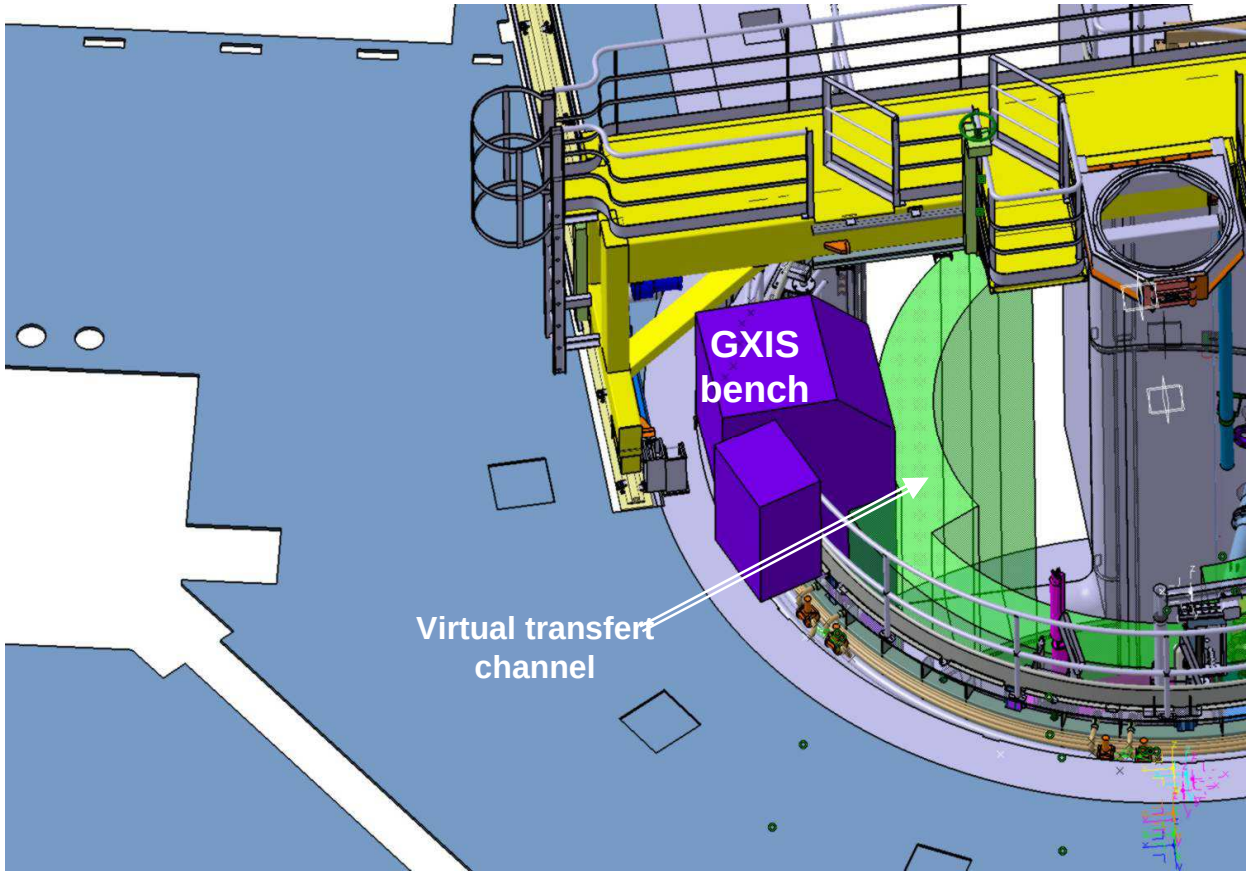
JHR General Horizontal View: Reactor and auxilliary zones



JHR NDE - View over the Reactor Pool

***Handling system tools** (experimental applications)*

Interfaces with GXIS



NDE Systems in the JHR:
GXIS system Development and management
Expected Planning

=> ***CEA and VTT (Finland) develop a collaboration to design and supply this GXIS system***

4 technical phases:

- **Feasibility:** **2008 to ~june 2010**
- **Conception (detail design)** **~june 2010 to ~june 2011**
- **Realization (and supply)** **~june 2011 to end 2012**
- **Installation (and tests on site JHR)** **2013 to ~june 2014**

NDE Systems in the JHR:
GXIS main interfaces difficulties

Close to the end of the feasability phase tree main technical challenges are noted:

1. **Mechanical accurancy: especially bench position**

   goal = 0,1 mm ***(compared to the bench lengh ~10 meters !)***

1. **Feedthrought *(especially the « nose » guide which create a pool penetration)*: => critical interface « Bench / Pool Liner »**

   ⇒ **leak risk to be excluded *(the nose is a 2nd barrier)*: *risk of internal agression to be excluded during working phases; need a deep analysis of seismic behavior***

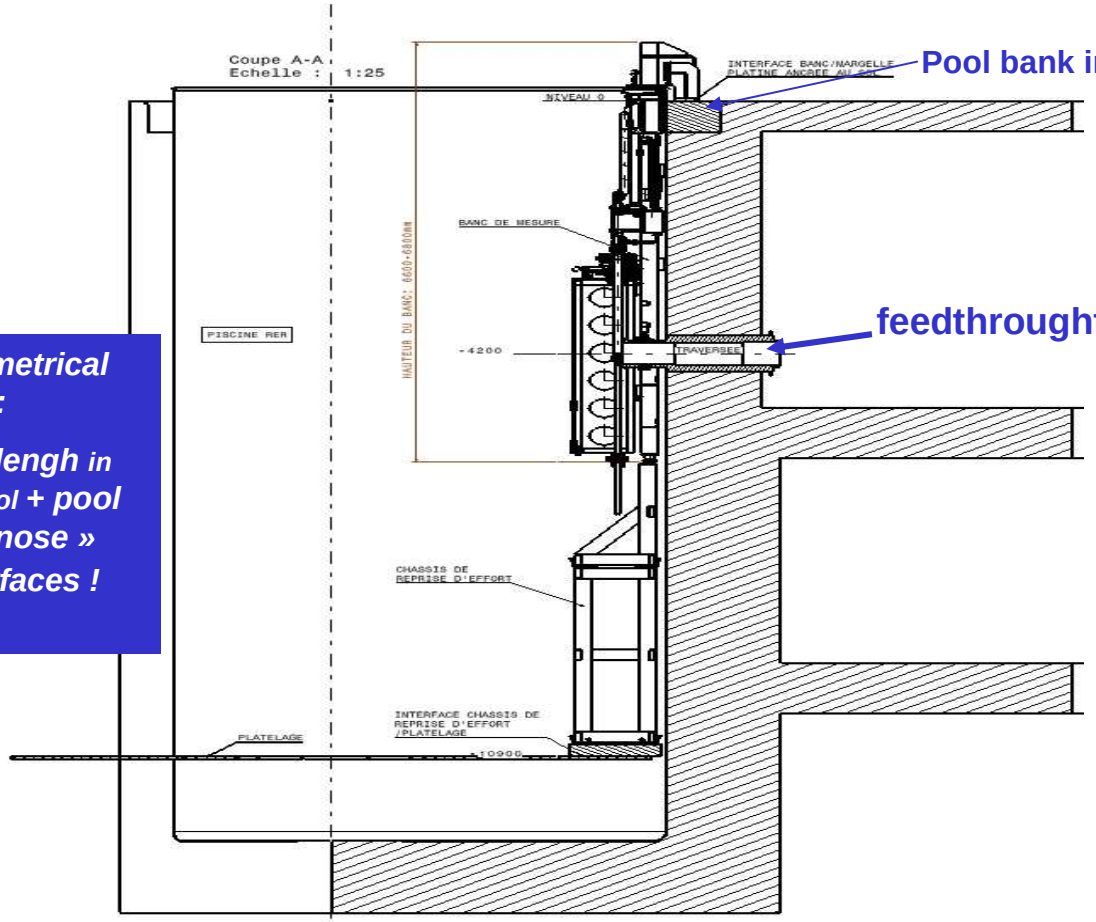
2. **Mechanical behavior of the bench during a seismic scene**

   ⇒ **Non agression of the liner**

   ⇒ **integrity criteria *(risk of internal agression to be excluded ..)***

   ⇒ **High level of the set of acceleration references *(despite of anti seismic technical dispositions)***

NDE Systems in the JHR
Mechanical reactor bench: vertical view



Pool bank interface

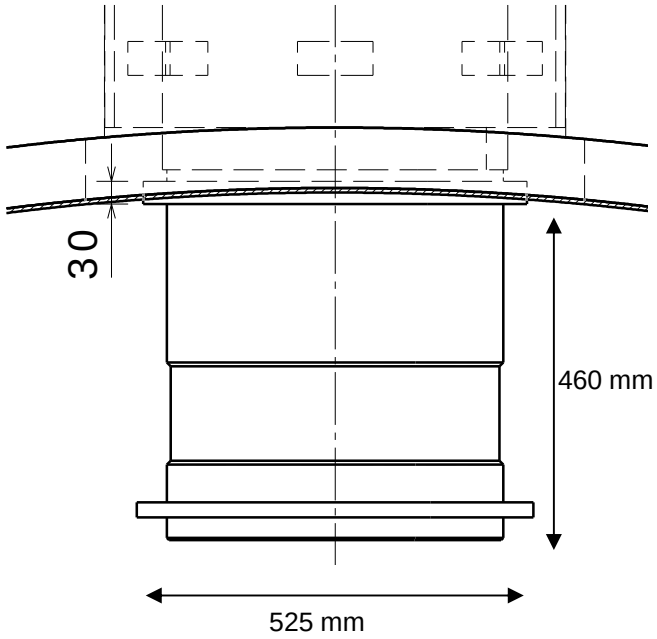
feedthrought

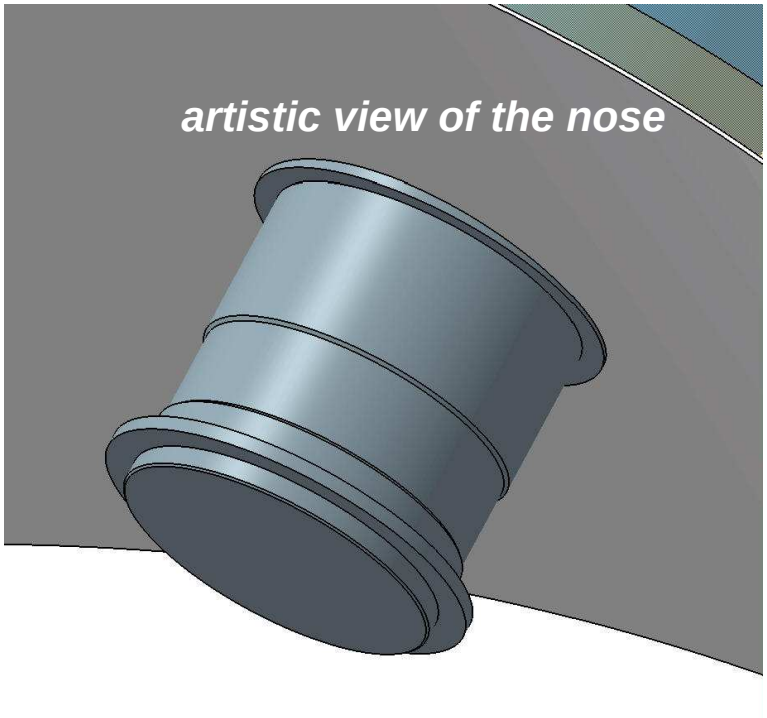
Bench Geometrical dimensions:

~10 meters lengh in the reactor pool + pool bank and « nose » critical interfaces !

NDE Systems in the JHR
Mechanical feedthrought

and « nose » *interface with the bench*



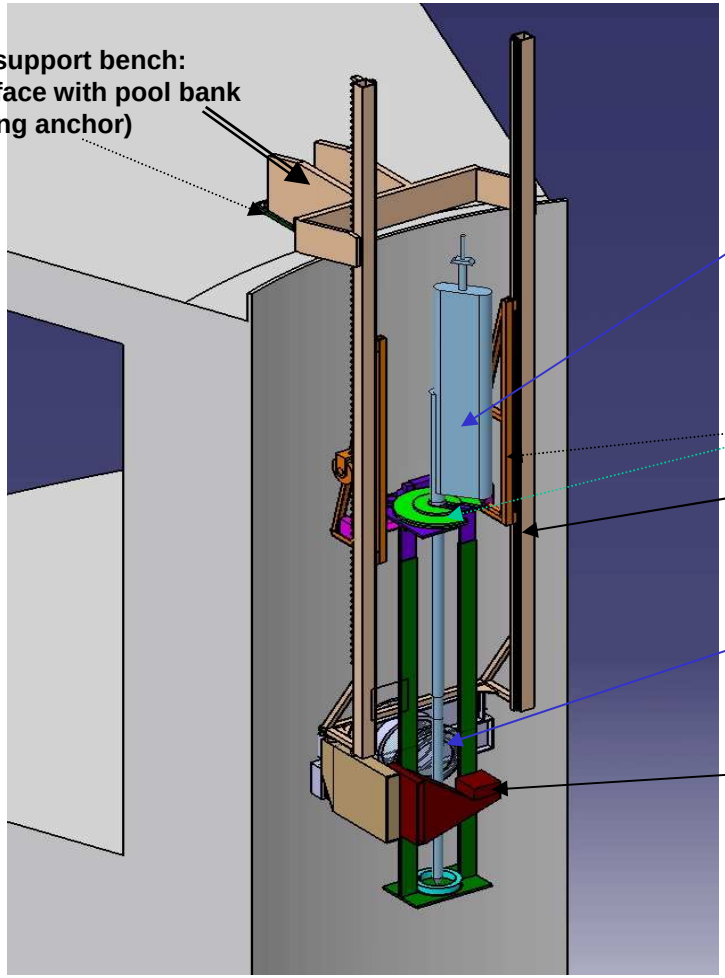


NDE Systems in the JHR: *Gamma & X*

Imaging System

Mechanical Immerged Bench

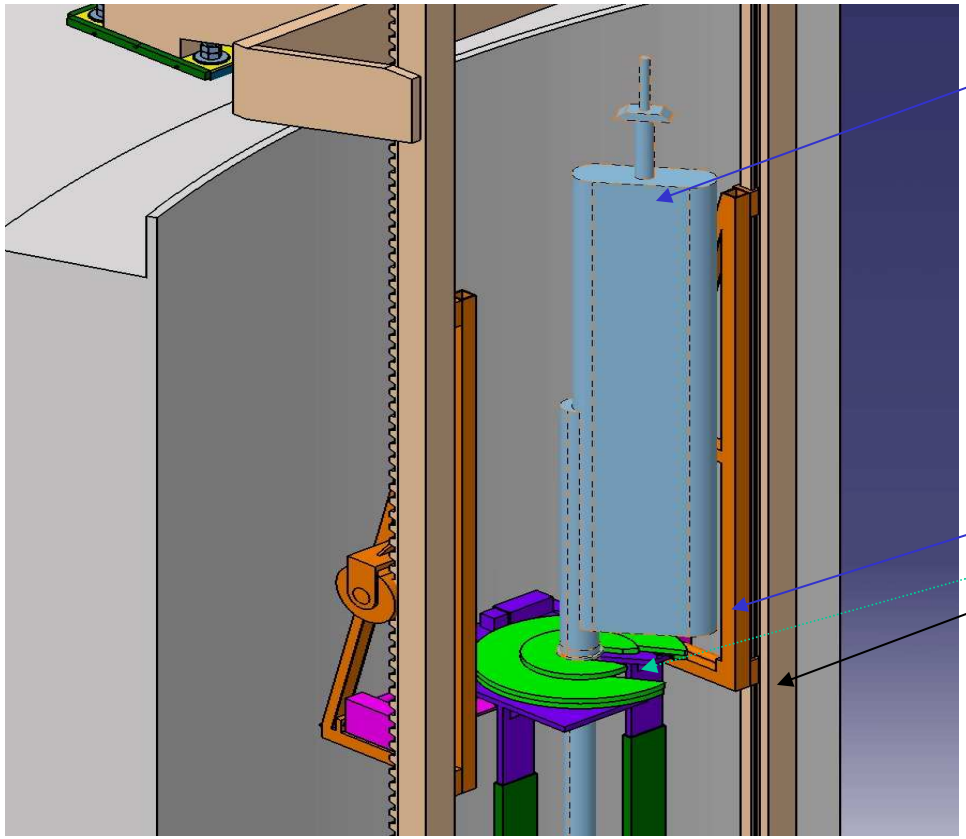
(principles)



NDE Systems in the JHR: *Gamma & X Imaging System*

Mechanical Immerged Bench (principles)

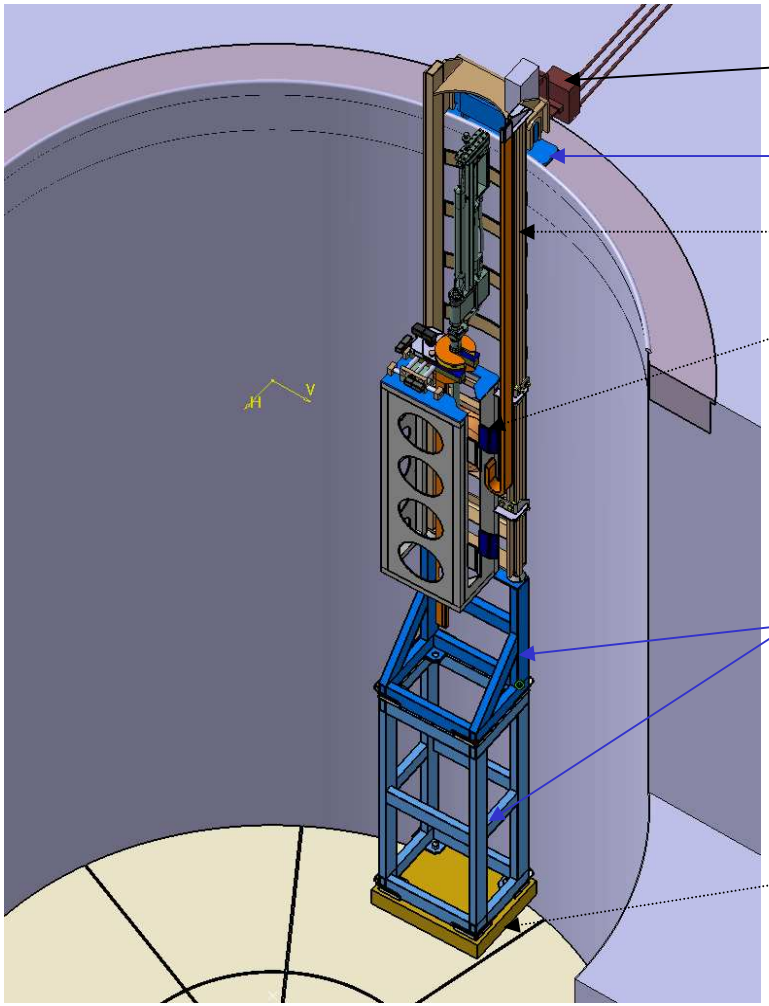
Principle View about « fuel experimental device/Bench mobile part »



NDE Systems in the JHR:

Gamma & X Imaging System

Mechanical Bench Architecture: global assembly (principles)



Electrical cupboard

Plate interface with pool bank

Bench (frame)

Bench (mobile part)

Stool structure

(to be assessed and designed after seismic calculations)

Interface plate anchored in the platform reactor pool

Specific bench modular conception exigences

The reactor bench equipment will be transferred trough a “sas” to its pool bank place (figure): that must determine a modular conception of the bench.