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PARTICIPATION OF THE CZECH REPUBLIC IN BUILDING UP NEW RESEARCH REACTOR THE JHR

Zdarek Jiri, Horak David

Division of Integrity and Technical Engineering, Nuclear Research institute Rez,

250 68 Rez near Prague, Cezch republic

E-mail: zda@ujv.cz; hod@ujv.cz

Abstract

Jules Horowitz Reactor will be the highest-rating research reactor (100 MW) located in Cadarache, France. There has been pan-european interest to renew current testing infrastructure and cover increasing energetic consumption in Europe. This reactor will provide possibilities to demonstrate high safety level of common and new reactors, study new materials and fuel under irradiation, develop and implement new technologies relating to radiopharmaceuticals, experimental devices, life extension of current power plants and designing reactors of new generation.

Nuclear Research Institute is the one of the eight members of consortium responsible for hot cells supply for the Jules Horowitz project.

Key words: *Jules Horowitz, research reactor, high safety, materials, fuel, hot cells*

1. INTRODUCTION

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A. JULES HOROWITZ REACTOR - INTERNATIONAL COLLABORATIVE PROJECT

A1. Project introduction

Nuclear power is a major reliable significant source of energy, which explains why a 'renaissance' of nuclear power has recently been observed all over the world.

In this context, high performance research infrastructures are needed to support nuclear energy in terms of safety, ageing management, innovation capacity, economic performances and training.

A consensus on the need of a new high performance material testing reactor has been progressively reached within the international community.

JHR, as a major research infrastructure to sustain the safe development of nuclear energy, will be a European users-facility opened to international cooperation and will be operated within the JHR Consortium gathering funding partners.

For these reasons it has been decided to launch a new Material Testing Reactor, the Jules Horowitz Reactor (JHR).

A2. Main Project purpose and scope of application

Main project purpose:

- New *high performance material testing reactor* - 100 MW.
- Demonstration of *safety operation* of common reactors
- Brand new possibilities in *studying material and fuel* behaviour under irradiation
- *Experimental capabilities* relevant for different power reactor technologies and generations.
- Development and implementation of new *diagnostic methods using radiopharmaceuticals*

Scope of application

- Fuel - new types, their construction and optimization, safety, influence of opportunity and emergency situations
- Materials - new types, ageing and research of environmental influences
- Lifetime management of power plants
- Radiopharmaceuticals - research of state-of-the-art radiopharmaceuticals
- Water reactors - development and designing (100 years of operation)
- Experimental devices - on operating and emergency conditions
- Chemical economy

A2. General Time Schedule

General Time Schedule - for construction and activation phase:

- Development studies: 2006-2007
- Preliminary safety report: 2006
- Construction permit: 2007 – kick off the construction
- Construction and testing: 2008-2013
- Coming into operation: 2014

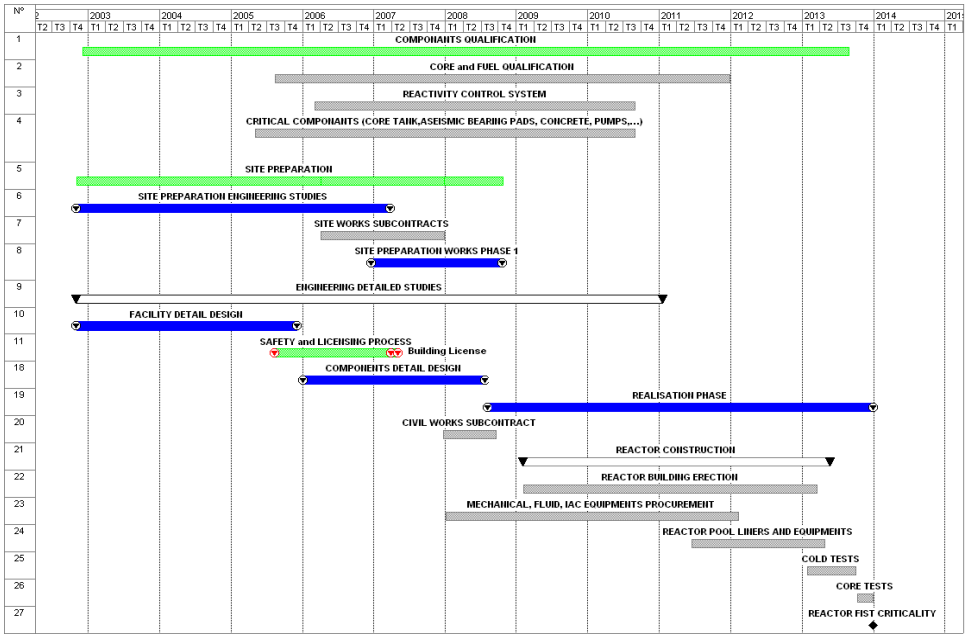


Fig. 1 General Time Schedule - for construction and activation phase - more detailed

A4.Reference Agreements

In the framework of the JHR project, the *reference agreements* are:

- ❑ Bilateral Agreements between CEA and all particular Beneficiaries
  - specify general and financial commitments for research and development and implementation of the JHR Project
  - specify terms of each party contribution
  - are completed by the Consortium Agreement in order to decide the building of the JHR
- ❑ Consortium Agreement signed on the 19/03/07
  - *Consortium* Agreement specifies general commitments of the Parties for implementation of the JHR project
  - *International partnership* in form of Consortium was set up to fund JHR construction and operation
- ❑ Grant Agreement signed on the 03/12/08
  - concluded between Euratom and CEA and other accessing parties in form of *Collaborative Project*
  - full name is "Contribution to the design and construction of new research infrastructure of pan-European interest, the JHR Material Testing Reactor"
  - financial contribution for the implementation of the Project within the framework of the SP5 - Euratom

A5.Beneficiaries and their Shares

Overview of Beneficiaries and their Shares:



CEA (FRANCE) - cca 50%

Commissariat a l'Energie Atomique



EDF (FRANCE) - 20%

Electricite de France



AREVA (FRANCE) - 10%

Societe des Participations du Commissariat a l'Energie Atomique



EURATOM - (EUROPEAN UNION) - 6%

The European Atomic Energy Community



CIEMAT (SPAIN) - 2%

Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas



NRI Rez (CZECH REPUBLIC) - 2%

Nuclear Research Institute Rez, plc



SCK•CEN (BELGIUM) - 2%

Studiecentrum Voor Kernenergie / Centre D'etude De L'energie Nucléaire



VTT (FINLAND) - 2%

Valtion Teknillien Tutkimuskeskus / Technical Research Centre of Finland



VATTENFALL AB (SWEDEN) - 2%



JAEA (JAPAN) - 3%

Japan Atomic Energy Agency

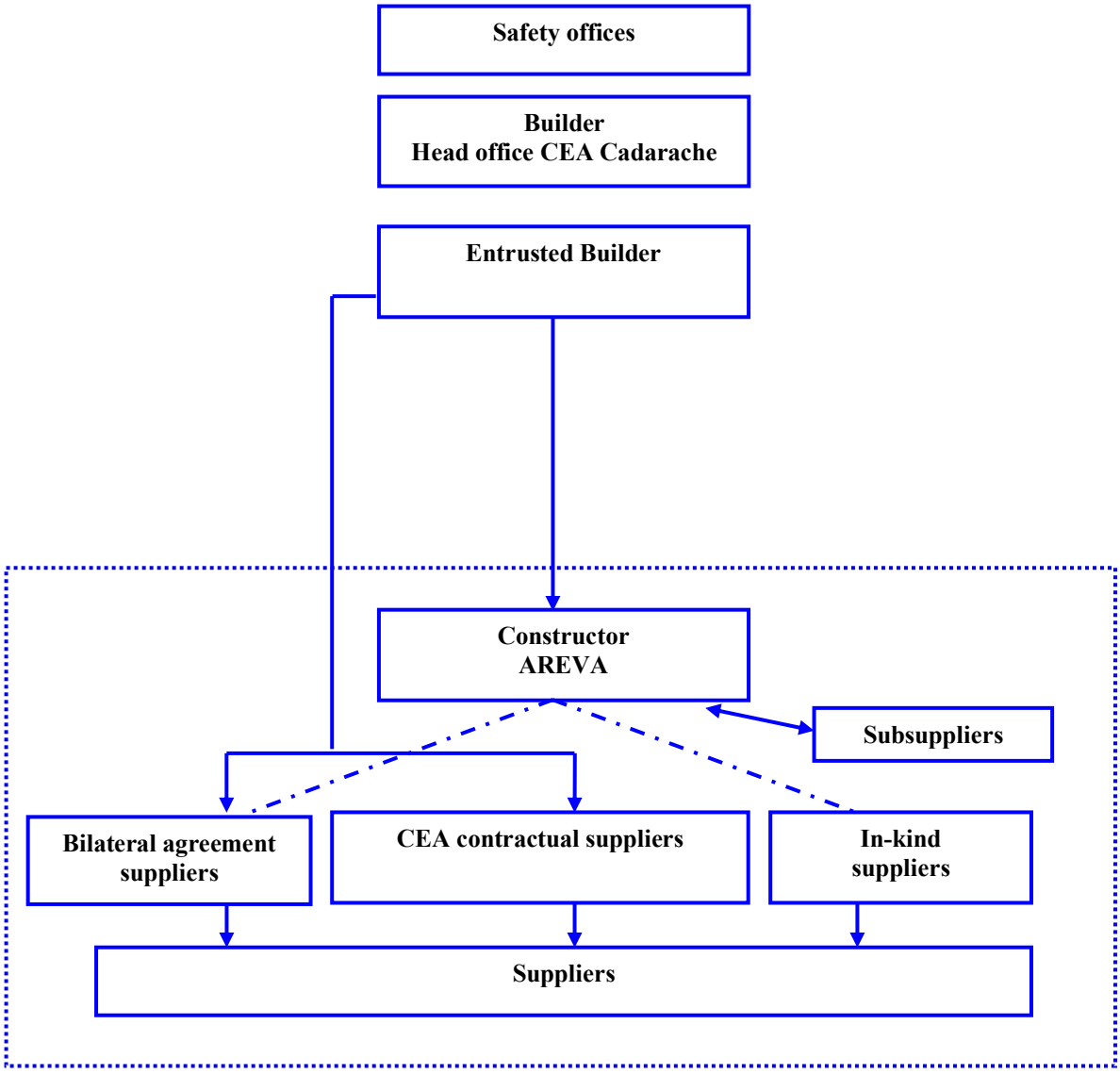


DAE: BARC, IGCAR, IPR (INDIA) - 2%

Department of Atomic Energy

- Shares defined in percentage is the contribution of each Consortium member
- Particular Shares express the *Access Rights* of the members to the future working capacity of the JHR
- CEA is the owner and the nuclear operator of JHR as a nuclear facility
- CEA is responsible for the JHR construction with the support of an Engineering Team gathering the competences of AREVA and EDF

A6.Organization structure



Legend:

Management of the Builder

Contractual relationship

Functional relationship

Fig. 2 General organisation structure of the JHR Project:

A7.Pictures



Fig.1. Position of Cadarache, France

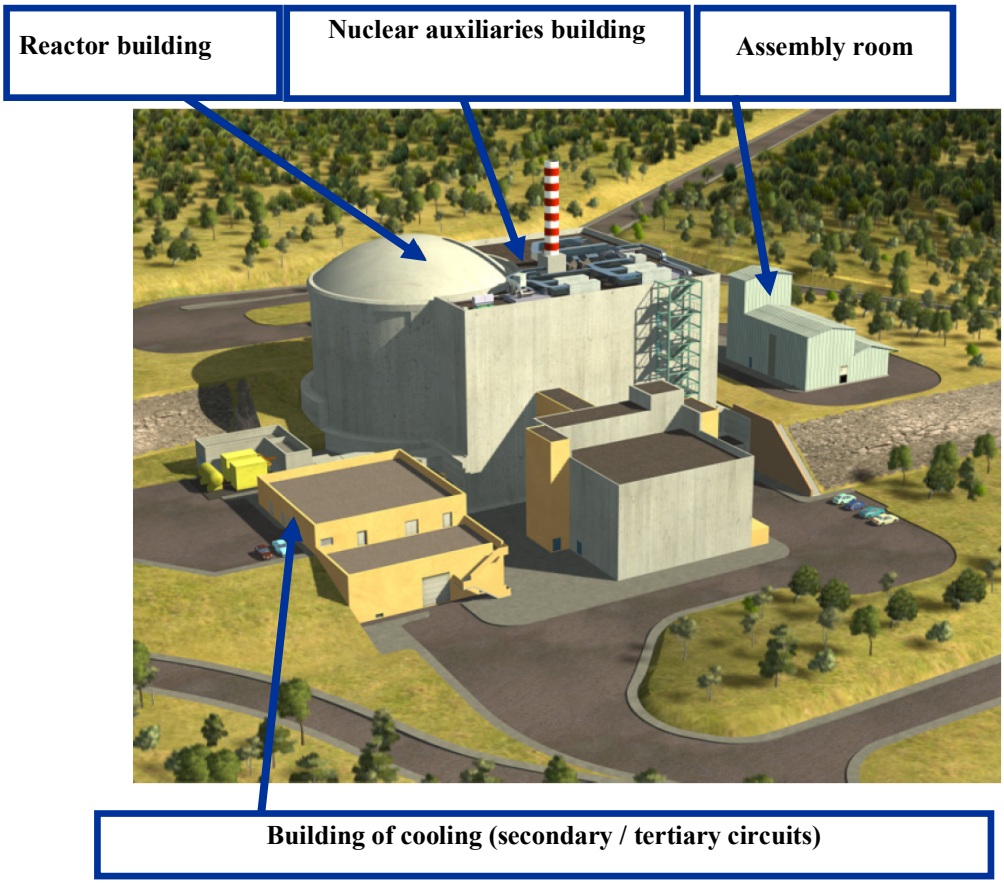
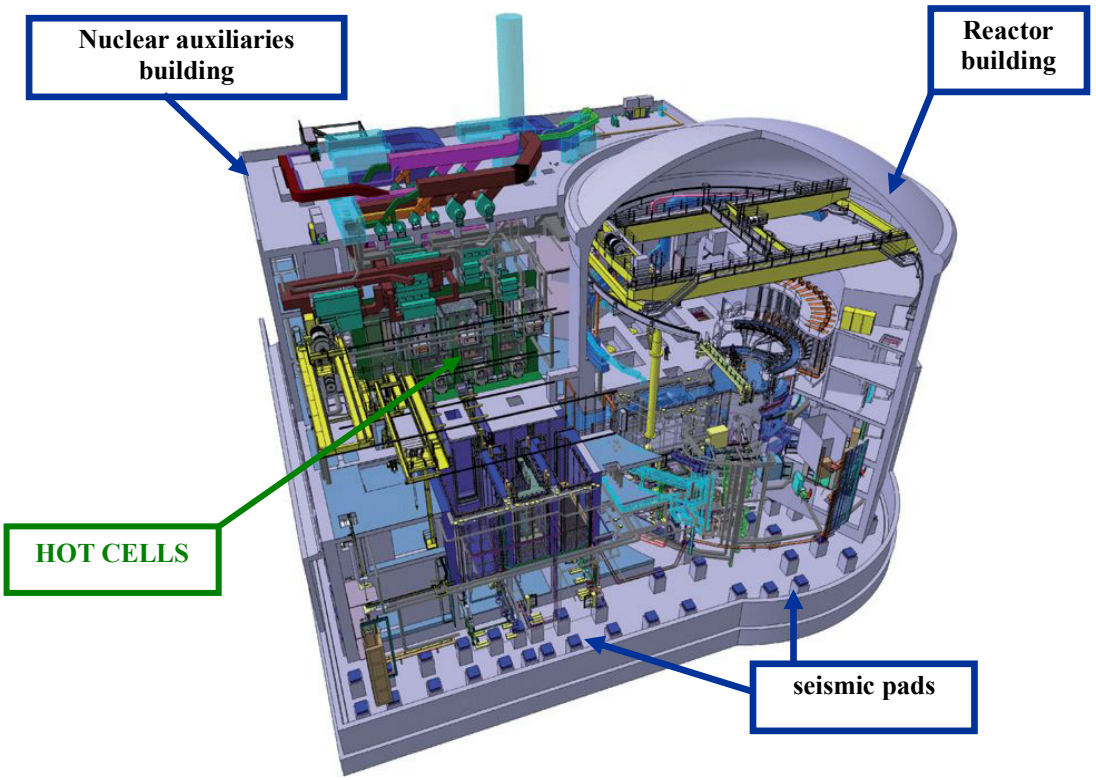


Fig.2. 3D design study of the Jules Horowitz Reactor



Lend:

HOT CELLS - Czech Republic in-kind contribution

Fig.3. 3D design study of Jules Horowitz Reactor - cross section

Fig.4. State of works - year 2007









Fig.5. State of works - year 2008

B. JULES HOROWITZ REACTOR - HOT CELLS SUPPLY (NUCLEAR RESEACH INSTITUTE REZ, CZECH REPUBLIC)

B1.Project introduction

- *Nuclear Research Institute Rez, plc (NRI)* is the Hot Cells supplier for the JHR Project
- Czech *Ministry of Education* is the main financial partner for Czech Republic
- To ensure full usage of irradiation capacity, NRI will establish *Interest grouping* of organizations operating and registered in Czech Republic

B2.Profits for Czech Republic

- ❑ Optimum operation support of power plants
  - high safety level, fuel cycle efficiency, lifetime of components
- ❑ Innovation of current power plants
- ❑ Development of evolution typer of power plants radioactive waste and used spent fuel recycling
- ❑ Development of new radiopharmaceuticals and diagnostic methods in pharmacy

❑ High scientific-technical level thanks to the participation in collaborative projects with

B3.NRI contribution description

NRI technical contribution is consisting of the supplying of the *JHR Hot Cells*, except the civil work part:

- ECC: fuel cell
- ECA: alpha cell
- ECD: material cell
- ECR: conditioning evacuation cell
- ECE: fuels NDE cell
- ECM: material NDE cell
- ECS: alpha NDE cell

NRI contribution involves:

- the pre-design and the design studies, including the interface with the civil work
- the development
- the manufacturing of the components
- the factory tests
- the delivery
- the on-site integration (assembly, installation, performance tests)
- the production of necessary elements to support the licensing by CEA of the supply.

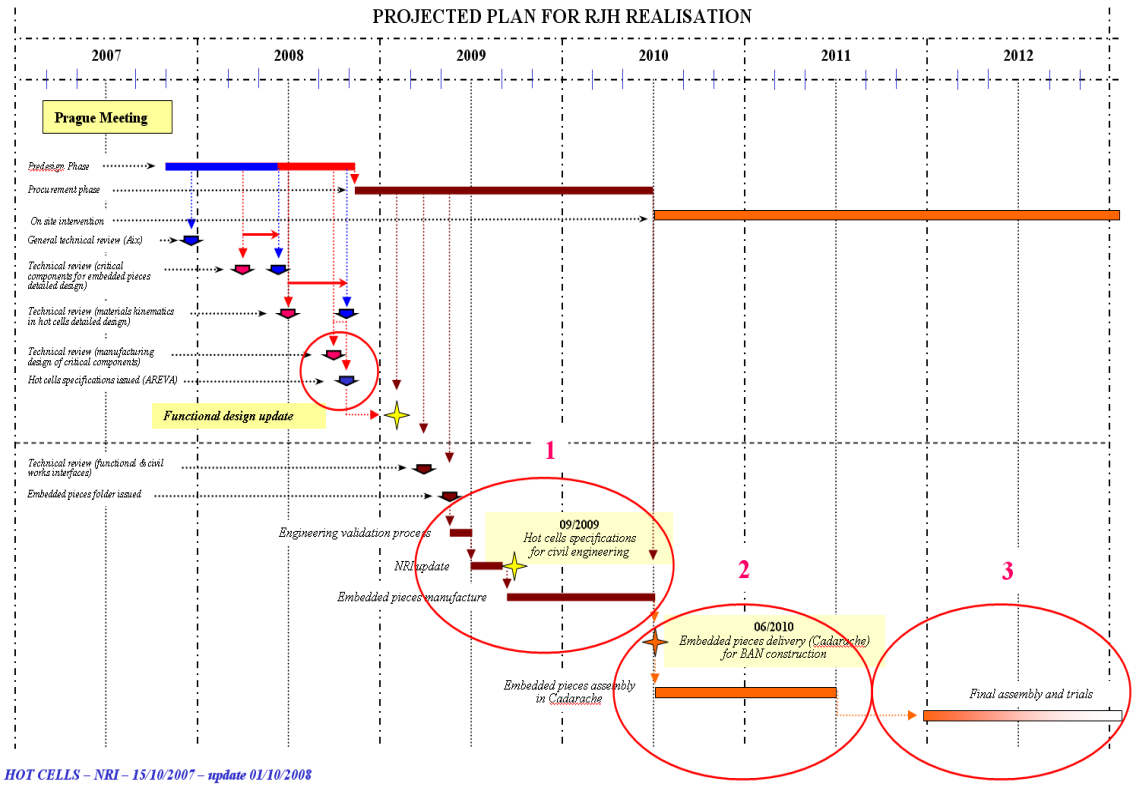
NRI supplies following Hot Cells components:

- steel structures embedded into concrete
- inner stainless liner (coat)
- wall equipments
- internal equipments
- cranes
- manipulators
- small materials
- I&C
- other inside / outside components and systems (ventilation, lighting

B4.NRI implementation of the contribution

Time Schedule of JHR Hot Cells supply:

- Phase 1: preparation and pre-design
- Phase 2: manufacturing



Legend:
1 - Hot cells specifications for civil engineering - 09/2009
2 - Embedded pieces delivery (Cadarache) for BAN constructions - 06/2010
3 - Final assembly and trials - 2012

Time Schedule of JHR Hot Cells supply - more detailed

B5. Funding

Till the end of 2010 ensured through:

- Czech Ministry of Education, Youth and Sport
  - full institutional financial support
  - state budget subsidy for research and development
  - support to the NRI participation in Collaborative Project in research and development

- European Union through Euratom
  - Contribution in form of grant support

After 2010 funding not contractually ensured yet

- negotiation process for will start at the beginning of 2010

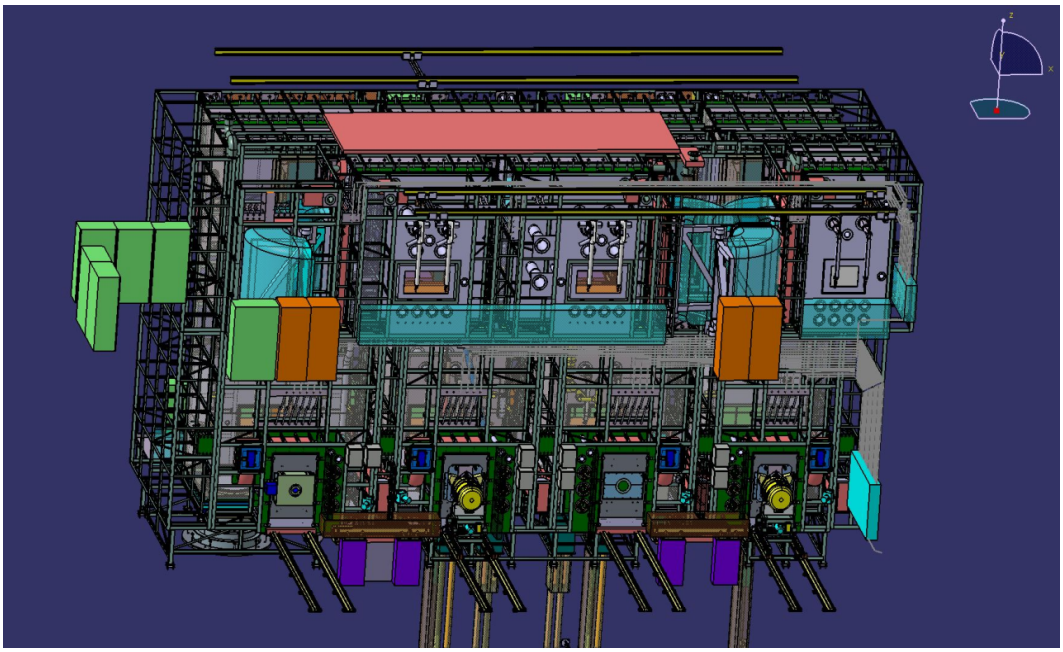


Fig.1. Hot cells - overall view of structures embedded into concrete

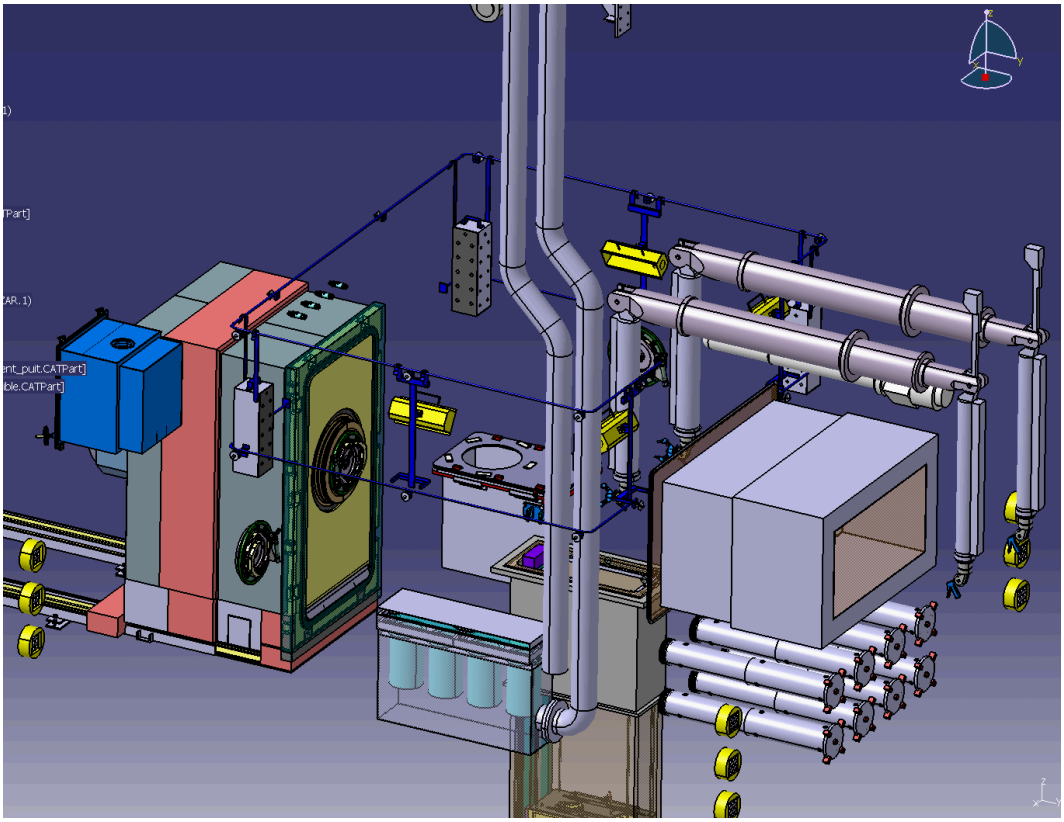


Fig. 2. Hot cell ECA - inside equipment (alpha cell)

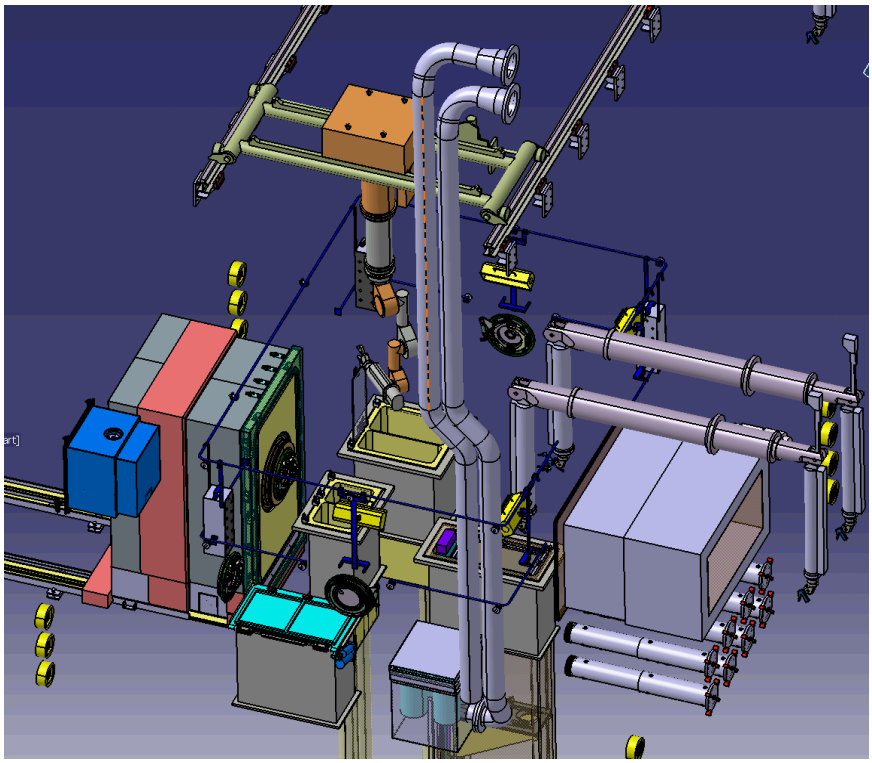


Fig. 3. Hot cell ECC - inside equipment (fuel cell)

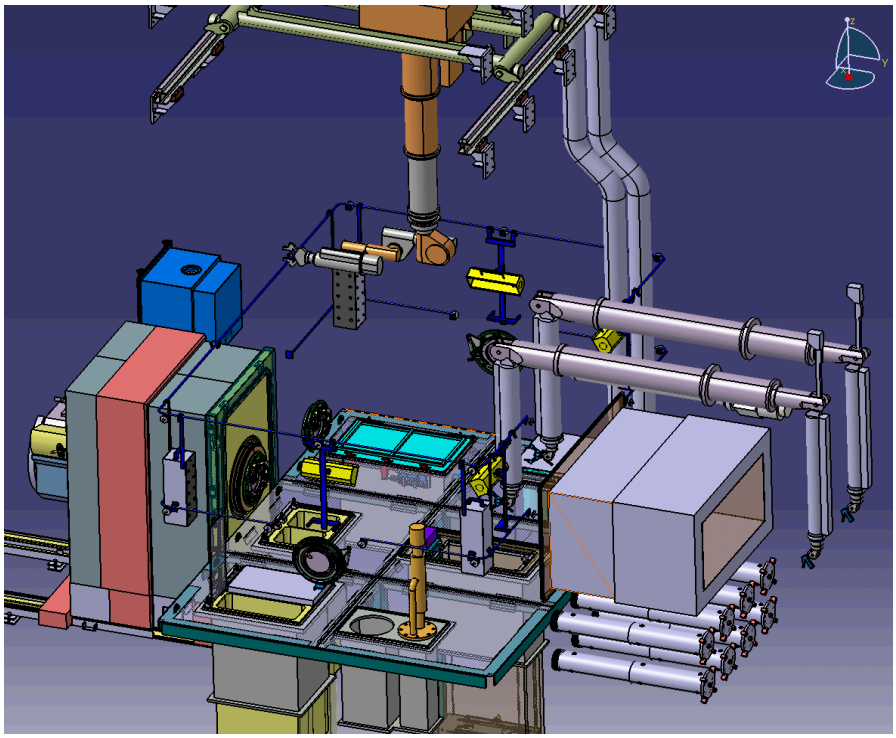


Fig.4. Hot cell ECD - inside equipment (material cell)

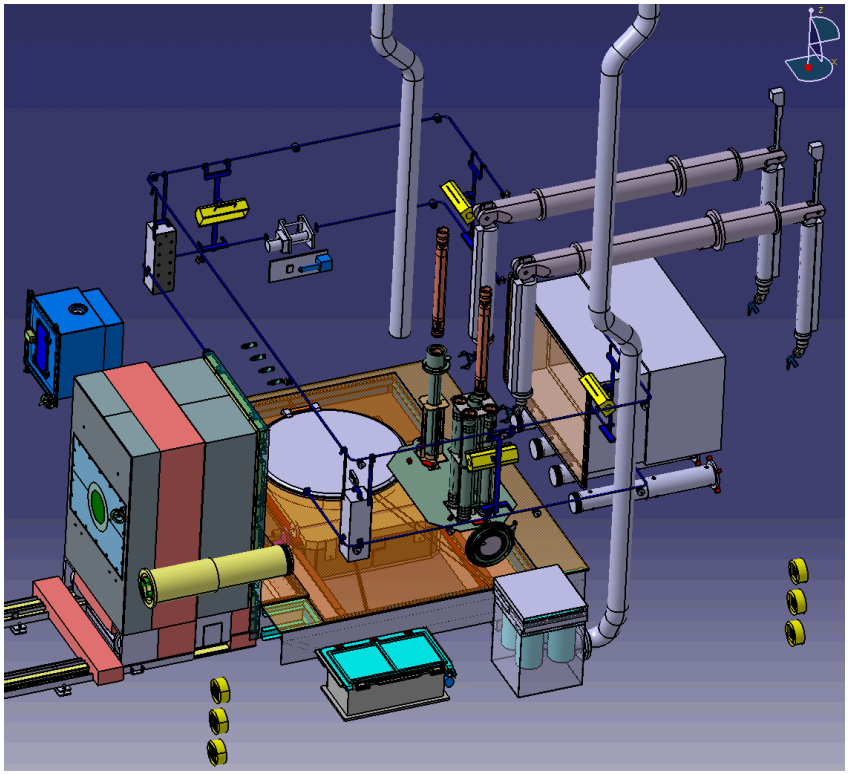


Fig.5. Hot cell ECR - inside equipment (conditioning evacuation cell)

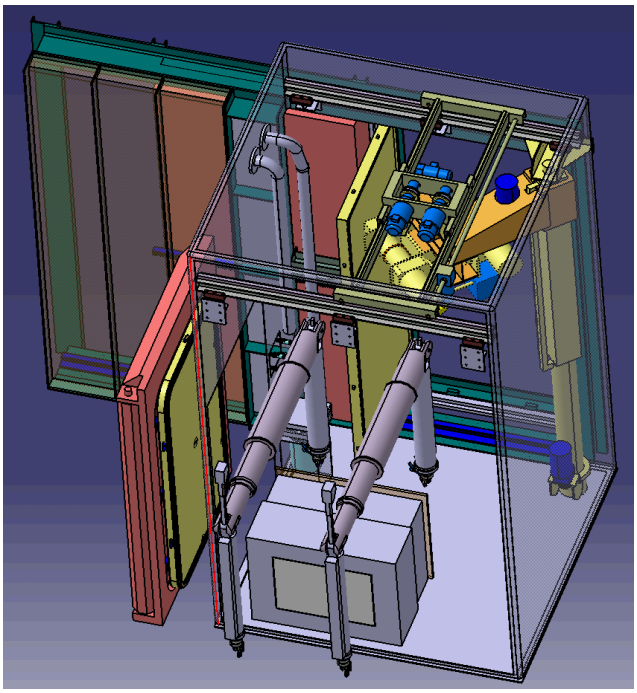


Fig.6. Hot cell ECS - inside equipment (alpha NDE cell)

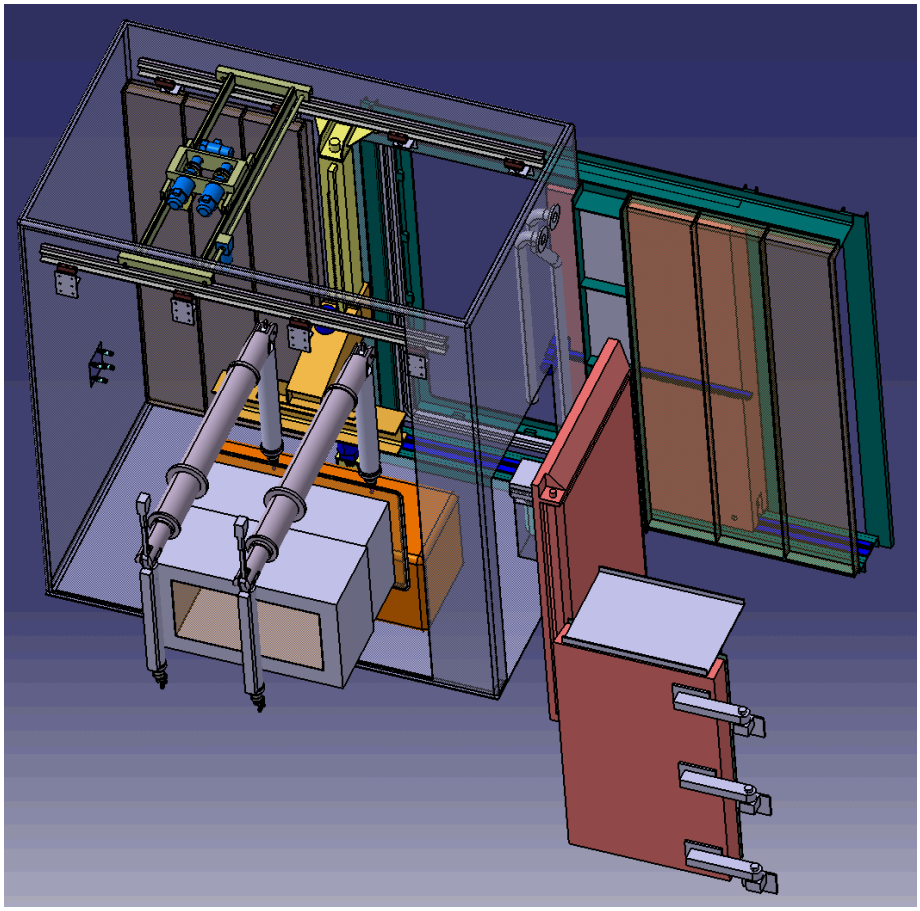


Fig.7. Hot cell ECS - inside equipment (alpha NDE cell)

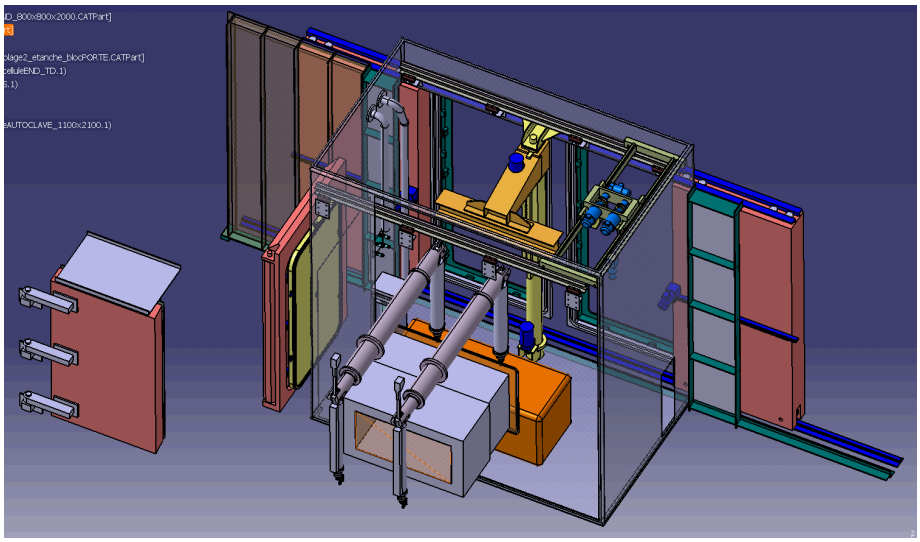


Fig.8. Hot cell ECR - inside equipment (conditioning evacuation cell)