ROBATEL

ROBATEL

COMPANY PRESENTATION

**“From floating mills to steam engines,
then to nuclear power:
A sense of the long term.”**

- MICHEL ROBATEL -

ROBATEL INDUSTRIES

A little bit of history

2010
New ROBATEL INDUSTRIES plant built in Cadarache

2009
New registered ROBATEL Technologies office in the USA

2000
Establishment of ROBATEL INDUSTRIES

1989
Market introduction of the first centrifuge designed for operation in a sterile environment, for pharmaceuticals and fine chemical industry.
New company name: « ROBATEL », which coincides with the trademark in the world.

1954
First shielded package using lead and steel for the transport of radioactive materials

1953
Michel Robatel launches the nuclear activity of the group.

1905
Designing of centrifugal dryers with horizontal axis, with automatic operation, used in fertilizer and synthetic ammonia plants in Europe, Russia, the USA and Japan.

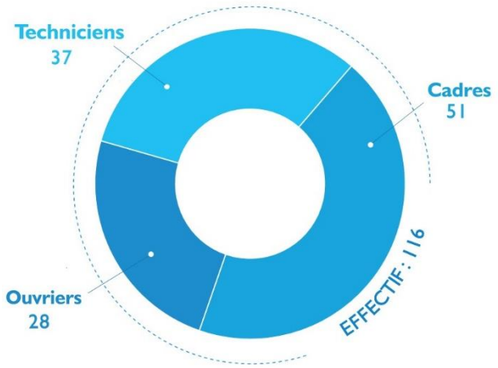
1899
Construction of the “Narval”, a submersible submarine equipped with a periscope and external ballasts which got the favor of the French Navy of that time. It was the first submarine with a combined propulsion: A ROBATEL Steam engine on the surface and an electric motor when diving.

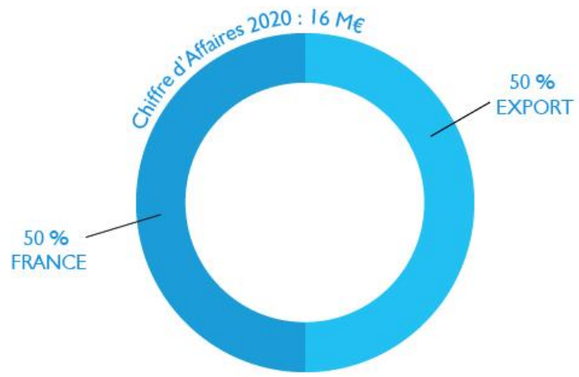
1830
Foundation and construction of floating mills, then steam engine machines, locomotives and mechanical equipment for the textile and food industries.

ROBATEL INDUSTRIES

Key Figures

- French company established in 1830
- Involved in the nuclear field since 1953
- Family owned with a capital of 1,600,000 Euros





Locations

- **Genas (Headquarter)**

  12 rue de Genève CS 80011
  69747 GENAS Cedex

  Tél. 04.72.22.10.10
  commercial@robatel.fr

- **La Hague**

  Z.I. de Digulleville
  CS 703 DIGULLEVILLE
  50440 LA HAGUE

  Tél. 02.33.01.80.00
  Fax 02.33.04.09.57
  lahague@robatel.fr

- **Agence de Cadarache**

  Ecoparc Corbieres - Lieu dit La Gare - 04220 CORBIERES

  Tél. 04.92.70.63.35
  cadarache@robatel.fr

WEB

- www.robatel.fr

ROBATEL TECHNOLOGIES, LLC

Established in 2009

- Subsidiary of ROBATEL SA
- In charge of the group development in the North American market
- Mechanical and nuclear engineering

Location

- **ROBATEL Technologies, LLC**

  5115 Bernard Drive, Suite 304

  Roanoke, VA 24018

  Tel.: 001 540 989 2878

  sales@robateltech.com

WEB

- www.robateltech.com

➢ ROBATEL technologies, LLC

➢ Emballage RT100

ROBATEL INDUSTRIES

Our certifications

- ISO 9001 / 2015
  - Quality Management System for : Design, fabrication, installation, and maintenance of equipment for the nuclear industry and research.
- ISO 14001 / 2015
- CEFRI N° 348 E Personnel working under ionizing radiation management Category A or B
- CAEAR D5.2 for design works (ORANO)
- EDF
  - Certificate of qualification to provide services in the following EDF qualification systems:
    - Activities on nuclear fuel
    - Nuclear logistics maintenance
    - Consulting services and technical assistance
    - Transport
- QA/QC capabilities : NQA-1 & 10 CFR Part 71
- NFEN 1090-1+A1 :2011
  - Steel and Aluminum structures fabrication, Part 1 : Requirements for the conformance evaluation of structural elements Implementation levels: EXC 1 to EXC3

ISO 9001 ISO 14001 CEFRI NQA-1 COMPLIANT

ROBATEL INDUSTRIES

They trust us in France

- CEA (BRUYERES-LE-CHATEL, CADARACHE, FONTENAY-AUX-ROSES, GRENOBLE, MARCOULE, SACLAY, VALDUC)
- EDF (AMI - CNPE - DAC - DCN - DIPDE - DP2D - FRAMATOME - UTO)
- ORANO (CERCA, FBFC, MELOX, ORANO CYCLE, ORANO DS, ORANO MED, ORANO TN)
- ANDRA
- ALSTOM, ARIANE GROUP, BOCCARD, BOUYGUES, CAMECA,CIS BIO (IBA Group),CNIM, DAHER,DGA (General Delegation for Weaponry),ENGIE, IRSN,GROUPE ONET,GANIL, LINAC,NAVAL GROUP, NUVIA, SPIE, SYNCHROTRON SOLEIL, TECHNICATOME, RAZEL-BEC, VINCI …

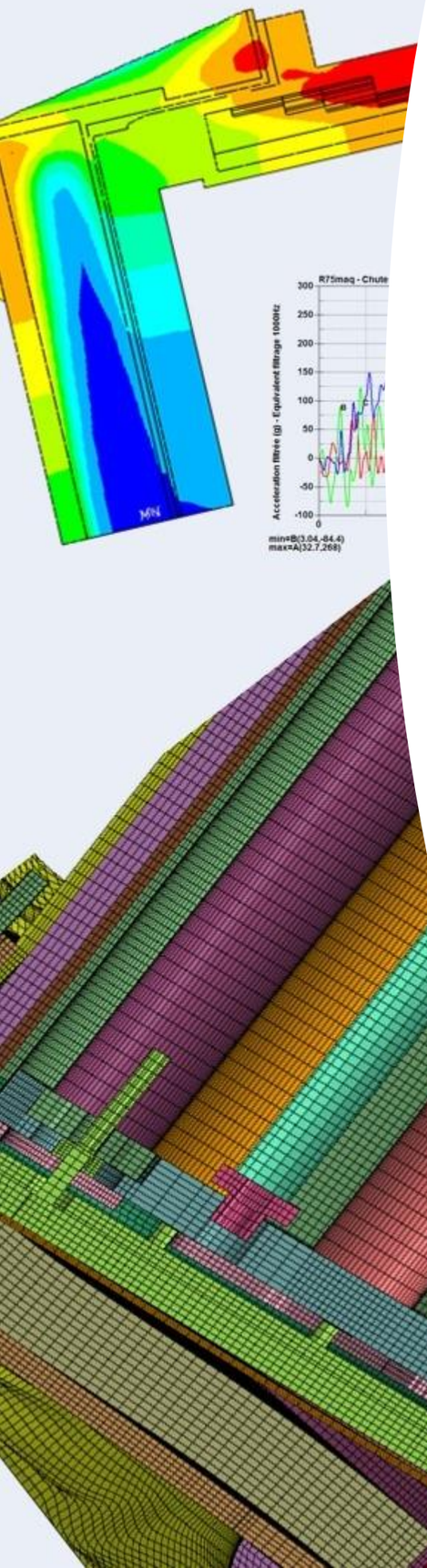
They trust us around the world

- GERMANY
  - Babcock Noell
- ARGENTINA
  - INVAP
- AUSTRALIA
  - ANSTO
- BELGIUM
  - ONDRAF
  - Institut des radioéléments (IRE)
  - SCK CEN / TRANSNUBEL
  - BELGOPROCESS
- BRAZIL
  - CTMSP
- CANADA
  - TRIUMF
- CHINA
  - CGN
  - CNEIC
  - TNPJVC
- SOUTH KERA
  - KAERI
- EGYPT
  - Atomic Energy Establishment
- GREAT BRITAIN
  - DSRL
- ITALY
  - EURATOM, Ispra / CNEN,
- JAPAN
  - Tokai Mura / JNFL
- MOROCCO
  - CNESTEN
- NORWAY
  - ABB Norsk Kabel
  - ALGETA
- NETHERLANDS
  - ECN
  - NRG
- CZECH REPUBLIC
  - Nuclear Research Institute
- RUSSIA
  - ZVEZDOTCHKA (Severodvinsk shipyard)
- SWEDEN
  - SKBF
- SWITZELAND
  - ZWILAG
- UKRAINE
  - UKRATOMINSTRUMENTS
- U.S.A.
  - ORANO US
  - Department of Energy
  - Premier TECHNOLOGY Inc.
  - U.S. ITER Project Office
  - WCS
  - EXELON

ROBATEL

OUR EXPERTISE

“ Engineers and manufacturers since 1830 ”



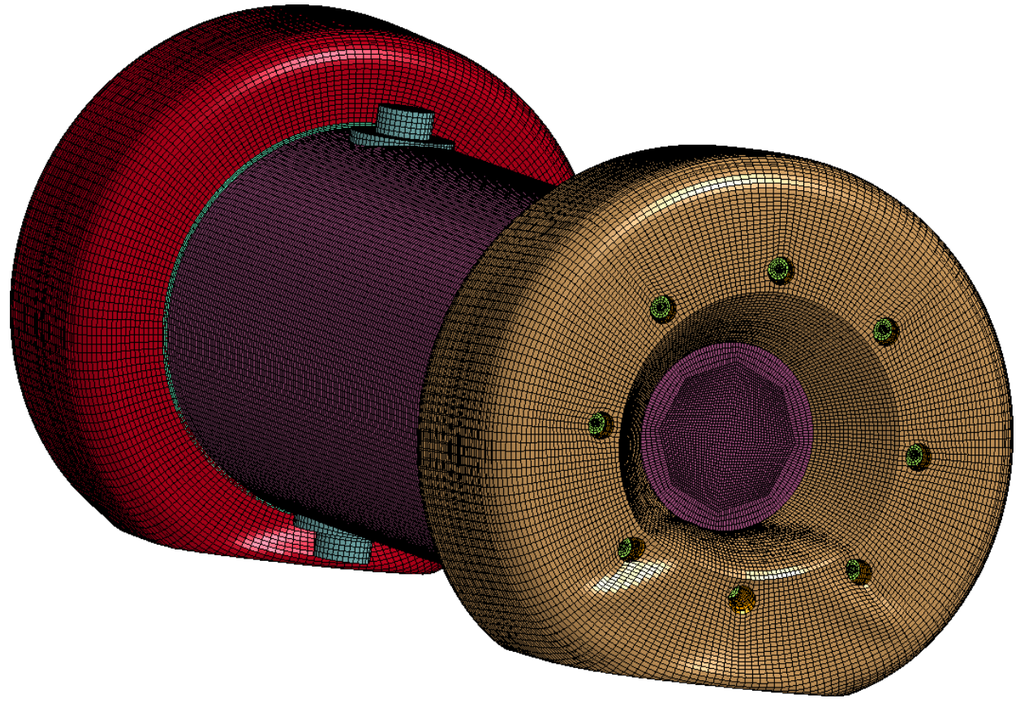
ENGINEERING

Our expertise

- Preliminary studies, detail studies and final designs
- Complete installations system integration studies
- Feasibility/manufacturability studies
- Dismantling scenarios
- Mechanical and dynamic impact calculations
- Containment calculations
- Radiation shielding and criticality calculations
- Seismic calculations
- Thermal calculations

Codes and standards used

- ASME
- CODETI
- CODAP
- DESP / ESPN
- EN 1090-2
- EUROCODE
- FEM
- RCC-M, RCC-MRx



➢ Déformée LS DYNA

Our resources

- CAD: Solidworks, CATIA, Spaceclaim, Autocad,
- Analytical calculations: MATHCAD
- Crash, dynamic impact calculations : LS-DYNA
- Finite element mechanical calculations: ANSYS, Cosmosworks
- Neutron and criticality calculations: TRIPOLI / SCALE
- Radiation shielding calculation : TRIPOLI / SCALE / MICROSHIELD
- Finite element thermal calculations : ANSYS

BOILERMAKING: STAINLESS STEEL AND ALLOYS

Materials

- Austenitic, austenitic-ferritic and super-austenitic stainless steels
- Copper and alloys
- Aluminum and alloys
- Titanium and alloys
- Nickel and alloys

Main welding processes

- TIG
- Arc electrodes
- Semi-automatic flux core
- Semi-automatic MIG and pulsed MIG
- Automatic submerged arc

Welding types

- Homogeneous
- Autogenous
- Heterogeneous
- Mixed

Welding procedure qualifications (WPS)

- Standards : ISO 15614-1, NFEN 288-3, ASME, RCC-M …
- Over 340 Procedure qualification records (PQR) for :
  - Stainless steels: 304L, 316L, U45N, …
  - Noble alloys: UB6, …
  - Carbon steel: S235, S355, S460 (Ø, JR, J2)
  - Copper and alloys
  - Borated stainless steel
  - Nickel and alloys: C22, Inconel, Hastelloy, Monel …

LEAD FOUNDRY AND MACHINING SHOP

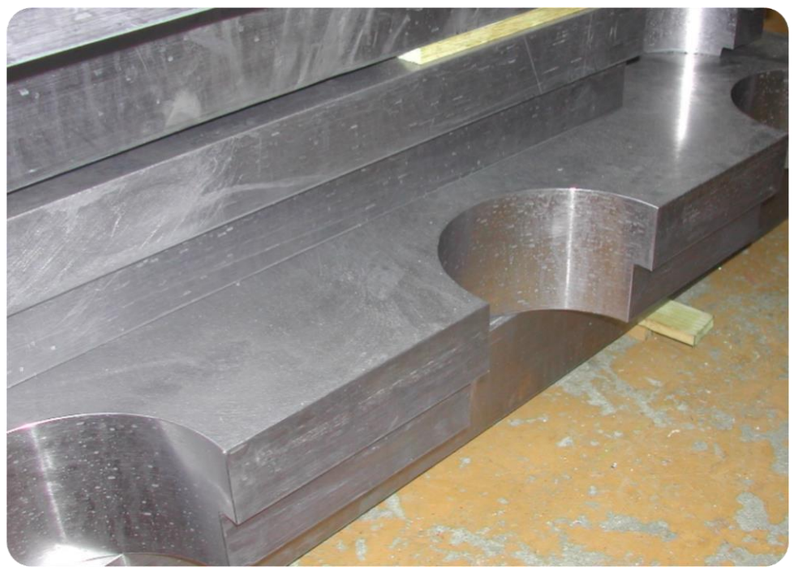
Capacity

- Two sites classified for environment protection (ICPE) for their lead foundry: Genas and La Hague
- One ICPE authorized to recycle lead from the nuclear plants: Genas. Protocol led by the French CEA
- An annual lead pouring and machining capacity of several thousands tons per year
- Part ranging from few kilograms to over 20 tons
- A continuous experience of over 50 years in techniques for lead implementation for the nuclear industry

➢ Lead smelter

➢ Lead milling machine

➢ Piping lead shielding



➢ Machined lead parts

SPECIAL MATERIALS

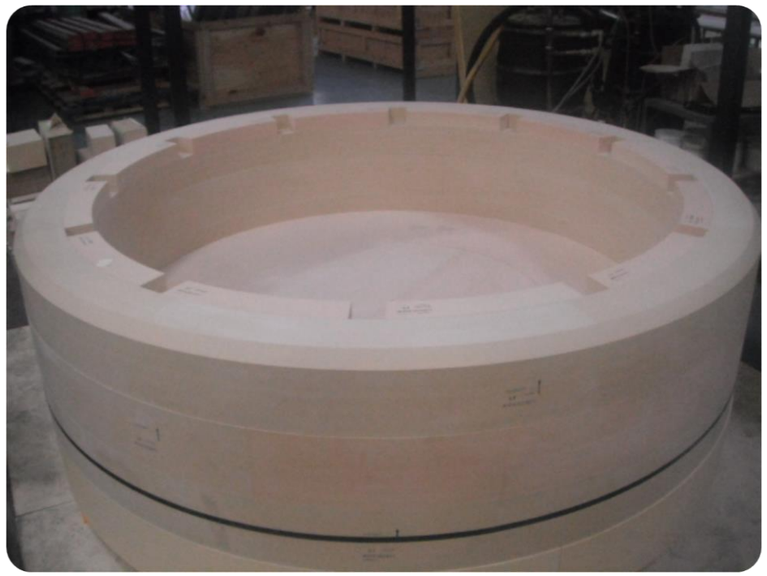
FENOSOL™

- A rigid phenolic foam that meets all ISO 9001 Quality system requirements
- Used in the design of shock absorbers, for mechanical reinforcements, isolation and fire protection of packages for the transportation of sensitive goods for the nuclear and defense industries
- Developed in partnership with the French CEA

Caractéristiques

- Molded and machined or directly injected in the final shock absorbers
- A large range of densities for different mechanical specifications
- A rigid and light material
- Outstanding mechanical properties
- High isolation properties
- Excellent behavior and resistance to fire (classified M1)
- Negligible emission of black and toxic fumes (classified F1)
- Does not contain any CFC or HCFC
- Very low permeation by steam
- Humidity and Moisture resistant

➢ Shock absorber in assembly process



➢ Shock absorber foam

SPECIAL MATERIALS

Compound ROBATEL n° 9™ and n° 10™

- Made with a plaster-based binder, these neutron shielding materials can be used for applications not subjected to specific mechanical or thermal constraints. Must be poured into an encasing.
- No apparent degradation when subjected to irradiation up to $1{,}8.10^{17}$ thermal neutrons /cm²
- Chemical composition : boron, calcium, carbon, hydrogen, oxygen, sulfur, miscellaneous
- Materials approved by : CEA, ORANO, EDF

Compound ROBATEL n° 21™ and n° 22™

- Neutron shielding material based on a polyester resin binder. These materials provide a high mechanical strength with higher operating temperatures. They are generally molded into an encasing built to specified dimensions. It can be machined
- No apparent degradation when subjected to irradiation up to $1{,}4.10^{18}$ thermal neutrons /cm²
- Chemical composition : aluminum, boron, calcium, carbon, chlorine, hydrogen, oxygen, miscellaneous
- Materials approved by : CEA, ORANO, EDF referenced in ISO 14152 standard
- Installation at over 50 NPPs in France, China, Korea, and South Africa

Compound ROBATEL PNT3™ and PNT7™

- Neutron shielding material in the form of a fine mortar, to be used for all applications subject to thermal and mechanical constraints
- Fire classification M0
- Chemical composition : aluminum, boron, calcium, iron, hydrogen, oxygen, miscellaneous
- Materials approved by: CEA, ORANO, EDF, US Department of Energy

➢ Compound 9™ wall

➢ Neutron shielding plug (Compound 21™)

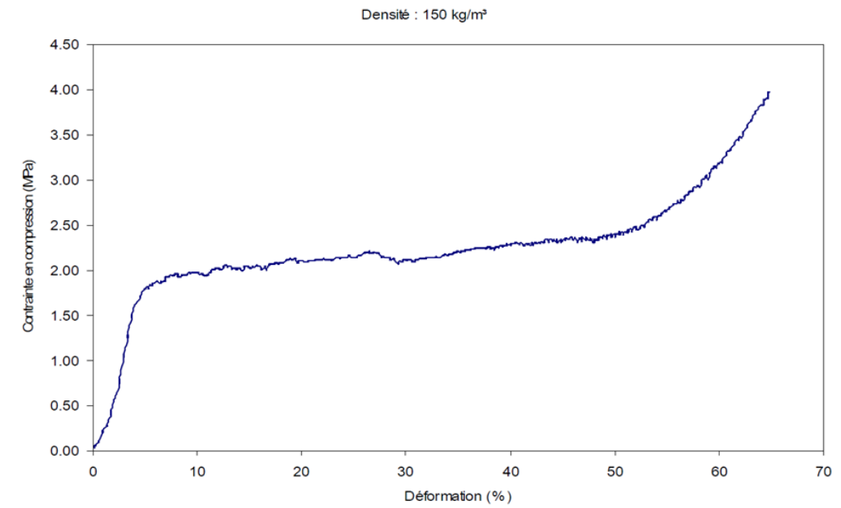
➢ Neutron shielding PNT7™

RESEARCH AND DEVELOPMENT

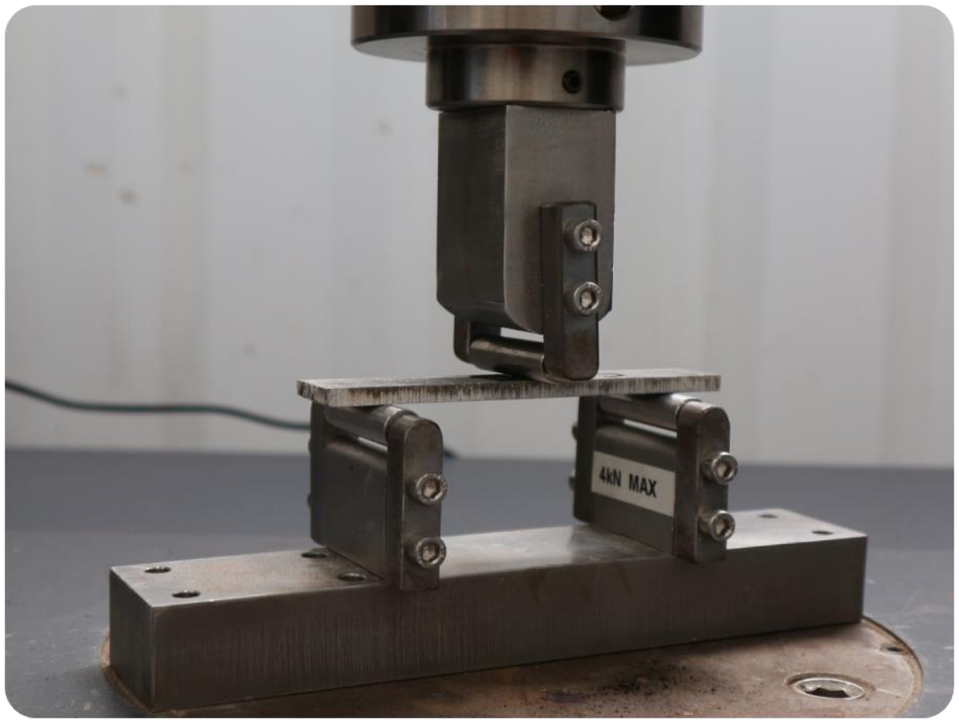
A continuous improvement of our solutions

- Within the framework of our special material activities, our R&D team develops new solutions for:
  - Shock absorbing materials
  - Neutron shielding materials

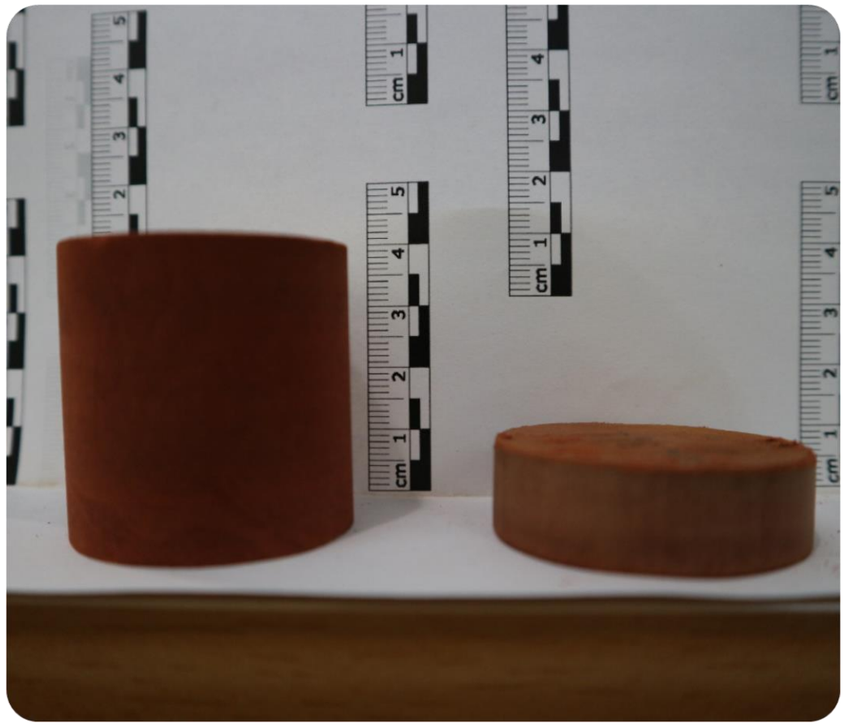
- Our recent developments allow us to offer new materials, having improved performance, and better resistance for accidental conditions (LOCA, fire rating M1):
  - PNT8™
  - Compound 23™ and Compound 24™



➢ Deformation stress strain curve



➢ Mechanical test on compound sample



➢ FENOSOL™ foam samples (before and after densification)

DROP TESTING

Capacity

- ROBATEL Industries maintains its own drop test target approved by the ASN (French nuclear safety authority), having a useful surface of 4000 x 2500 mm
- It allows for drop-testing of an object weighing up to 5 metric tons from a height of 9m (with the option to test heavier masses at lower heights)
- Our team ensures the
  - Drop sensor collected Data post treatment
  - Validation of the computer models (Benchmarking)
  - Drop test programs and reports
- Our main experimentation tools are :
  - High definition high speed camera
  - Accelerometers
  - Strain gauges

➢ Drop demonstrator ANDRA – 14T

➢ RT100 scale model - 9m drop

SITE OPERATIONS

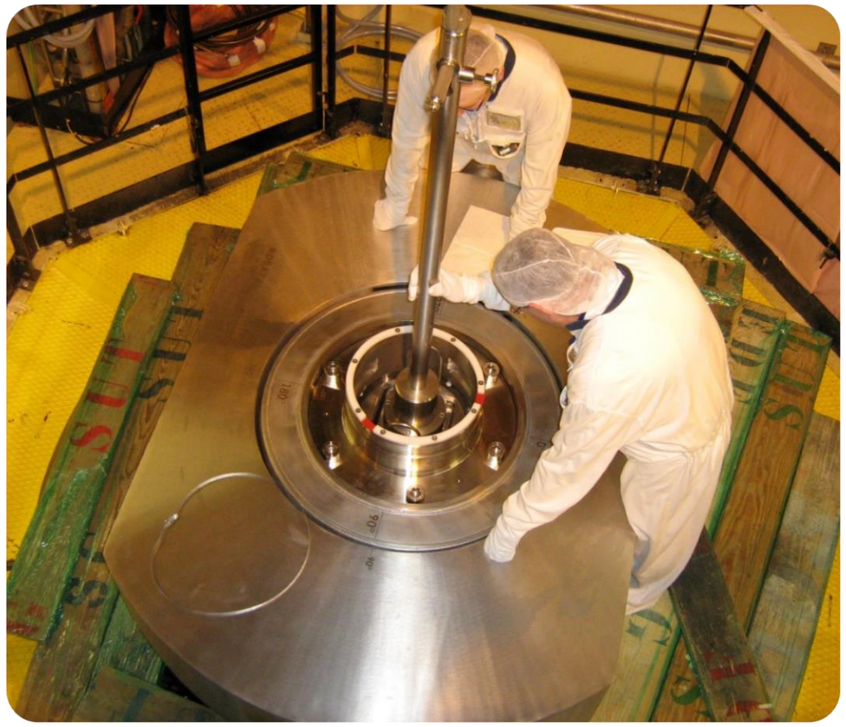
Activities

- ROBATEL Industries has its own dedicated team for site operations
  - Assembly and commissioning of our equipment
  - Operation in restricted areas
  - Equipment and cask maintenance
  - Technical assistance during reactor outage
  - Leak testing (COFREND 2)
  - Dismantling and decommissioning

- ROBATEL Industries team has the following certifications (French standards)
  - DATR
  - SCN1, SCN2
  - PR1 / PR2 (CR/RN)

➢ Site operation in contaminated area

➢ Equipment site assembling



➢ Testing run during reactor refueling shutdown

ROBATEL

NUCLEAR SYSTEM INTEGRATOR

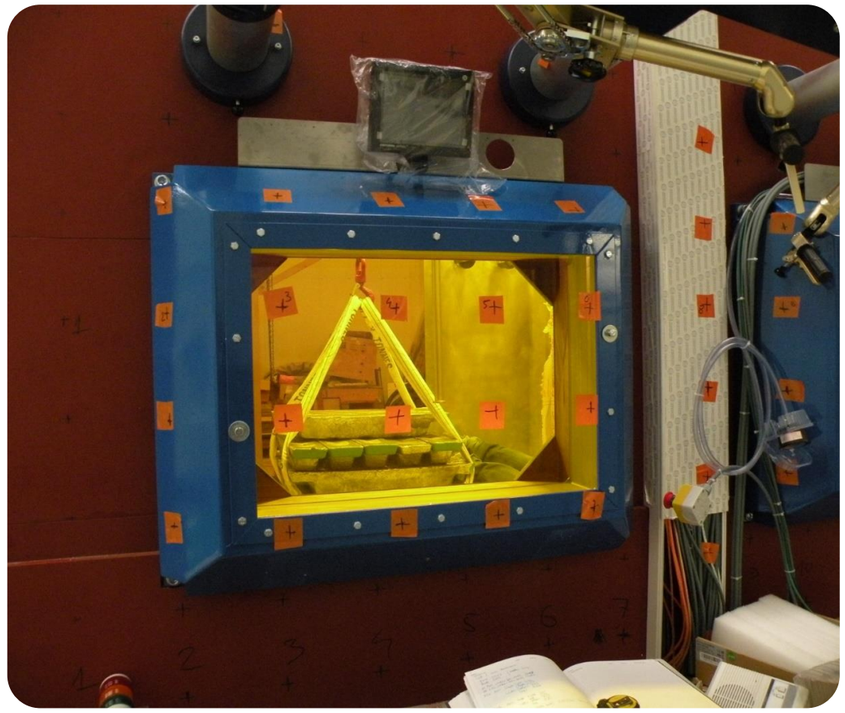
“From the design of a nuclear installation down to its decommissioning, we put the safety of our installations as an absolute priority”

HOT CELLS

Our knowledge

- Designer, manufacturer and responsible for the installation of hot cells since the 1960s

- ROBATEL Industries continuously maintains development and optimization technique activities relative to the design and fabrication of hot cells for the nuclear industry, nuclear research and nuclear medicine
  - Containment boxes and liners
  - Gamma radiation shielding (Lead, steel, concrete)
  - Neutron shielding (proprietary materials)
  - Shielded and leaktight docking systems
  - Access hatches, feedthroughs, penetrations
  - Ergonomics / Human factor studies



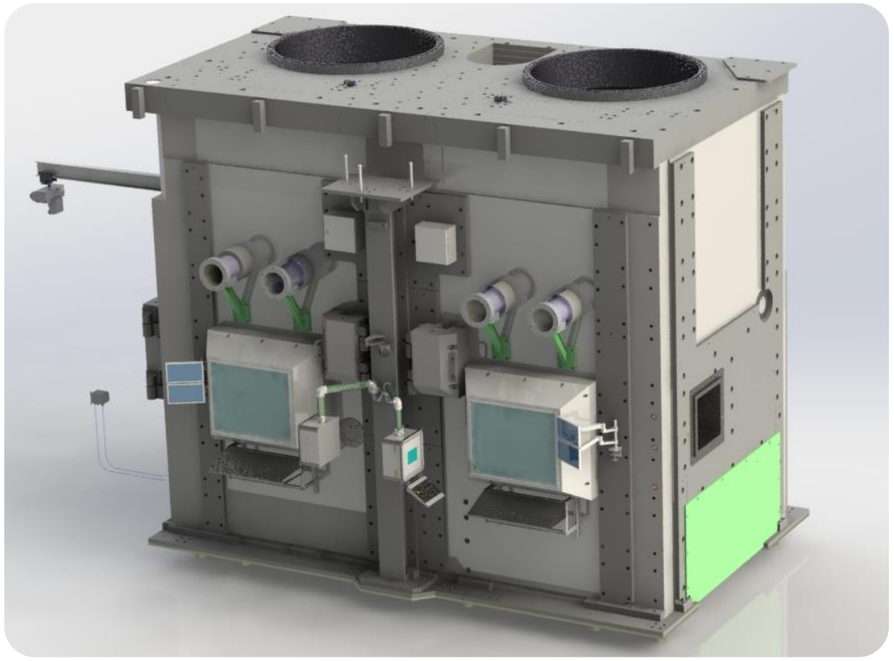
➢ Load testing of in cell lifting fixture

➢ Machined lead panels for a hot cell

➢ Mockup for ergonomics and accessibility testing

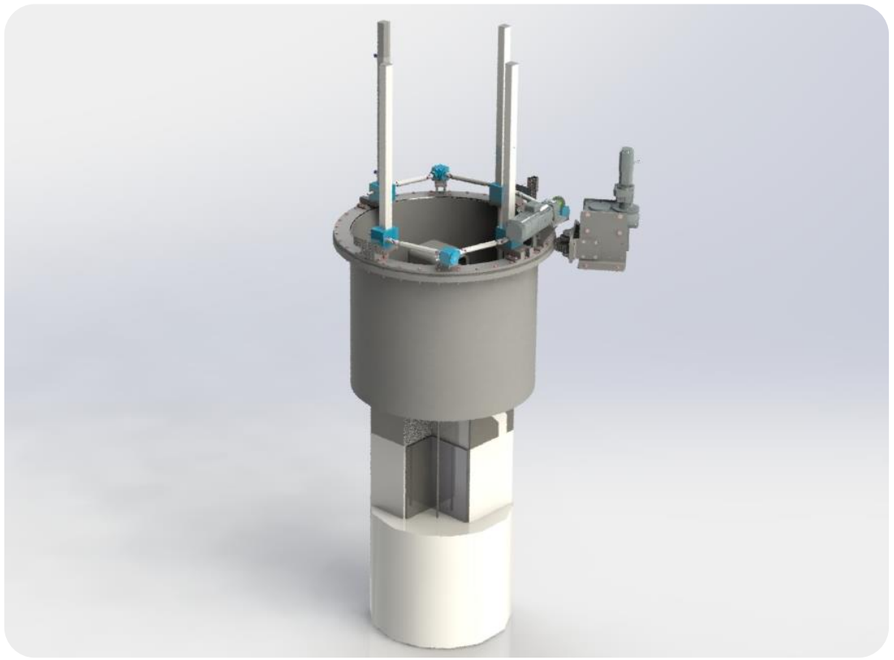
HOT CELLS

TRIUMF CANADA Hot cell



➢ TRIUMF– Canada Hot Cell

➢ Raw slabs



➢ Turntable

➢ TRIUMF machined slabs

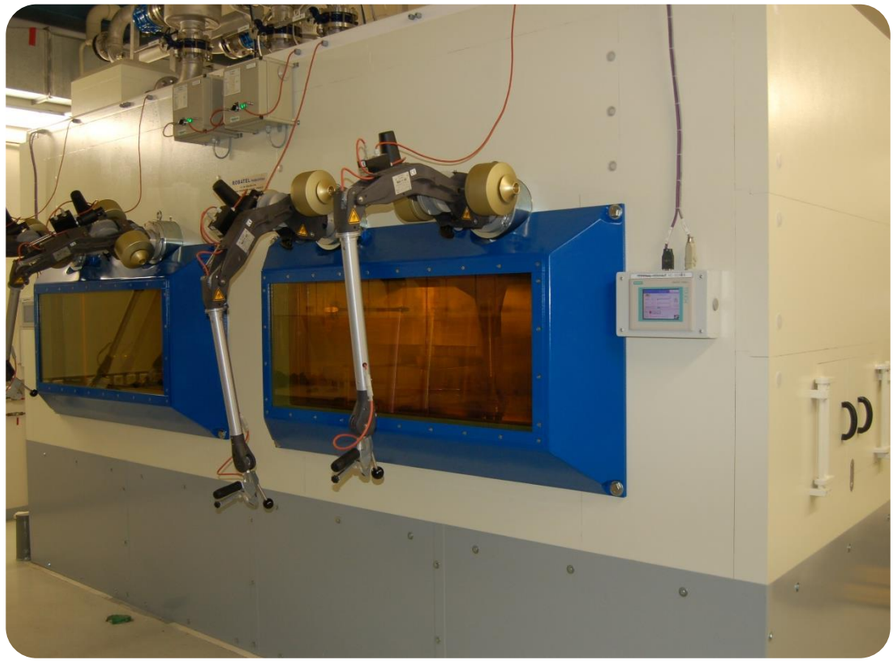
HOT CELLS

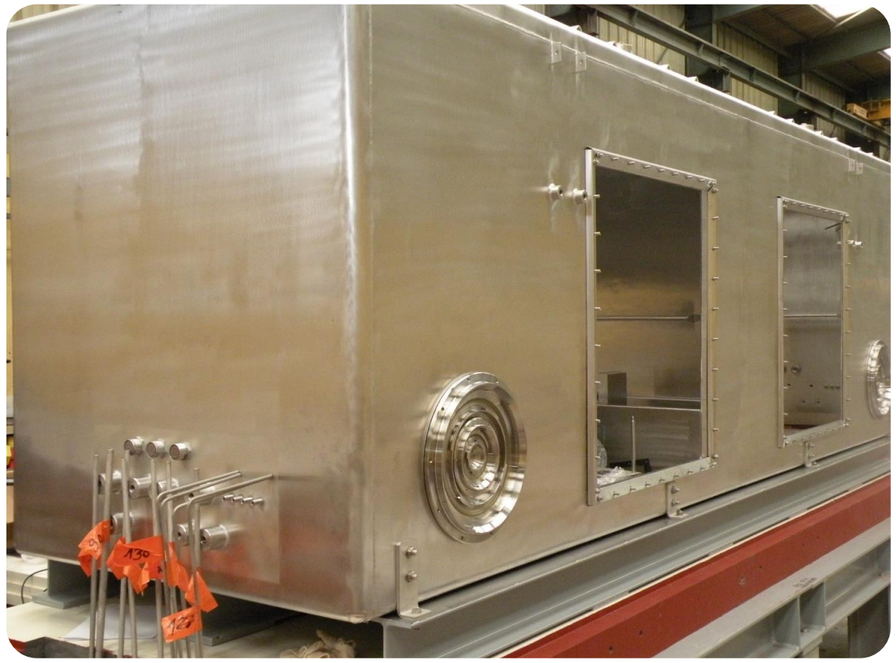
INVAP hot cells - Argentina

SCK CEN N°2-3 Hot Cells

HOT CELLS

ALGETA hot cells - Norvège

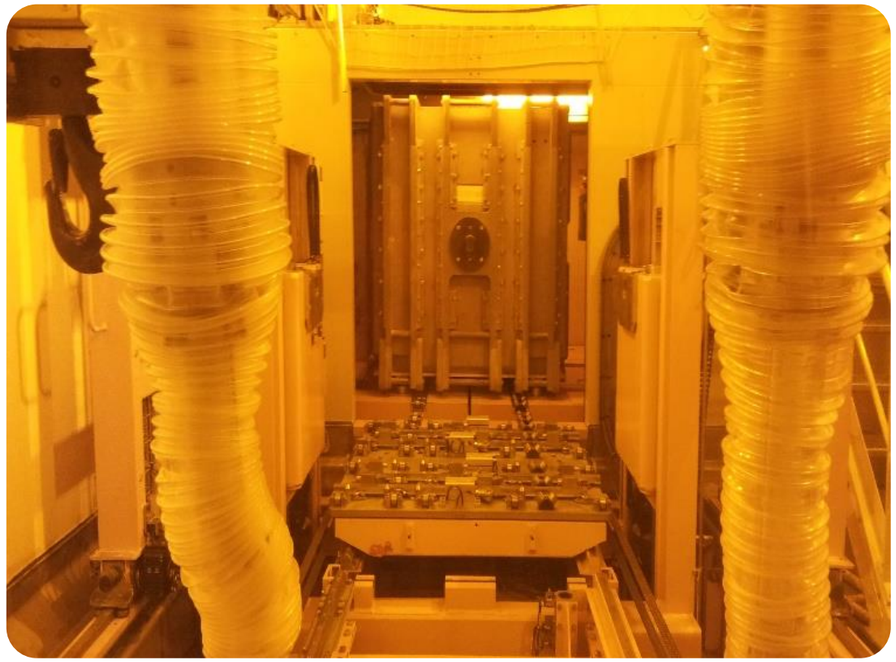




ANSTO hot cells - Australie

HOT CELLS

CADECOL hot cell – CEA Cadarache



VERDON hot cells – CEA Cadarache

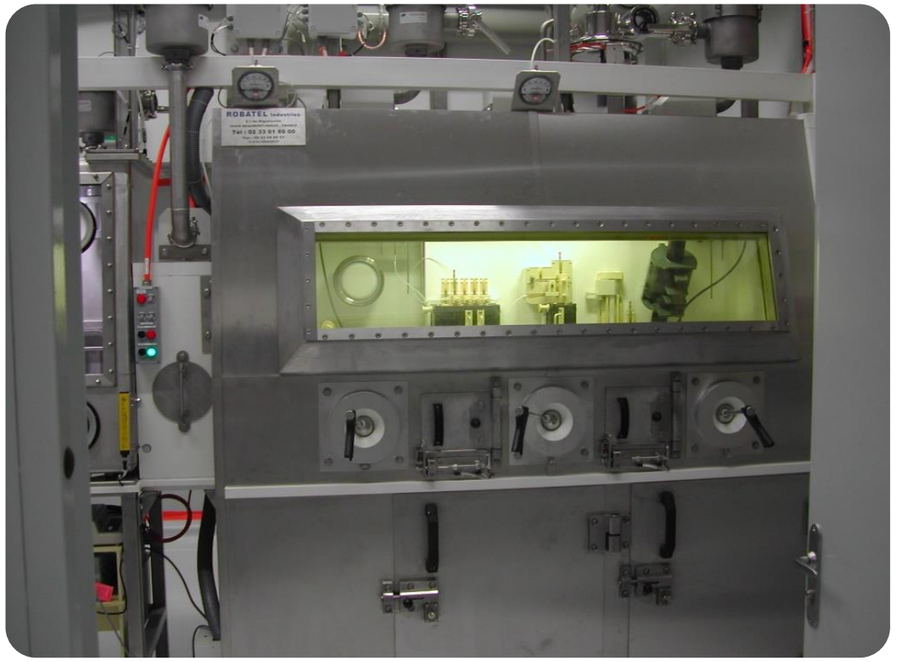
HOT CELLS

Radio-pharmaceutical / nuclear medicine

➢ Hot cell for Cyceron

➢ Hot cell for CNESTEN - Morocco

➢ Hot cell for Cis Bio (IBA)



➢ ORANO MED hot cell

HOT CELLS

Projet DIADEM – Lot 90, CEA

The lot 90 (Control hot cell and equipment) scope included:

- The cell constituent items:
  - The structure, the outer skin and the inner separation walls
  - The in-cell shielded door
  - The smear test cloth transfer hatch
  - The three workstations and their associated equipment
  - In-cell nuclear ventilation equipment
  - The penetrations and feedthroughs necessary for hot cell equipment
- Equipment related to the hot cell access
  - Motorized hatch for the Alpha door
  - The hot cell entry channel
  - The two upper hoppers
  - The personnel accesses to the hot cell from the rear maintenance zone
- Internal cell equipment

➢ Entry channel

➢ Equipment installation before concrete pouring

GLOVEBOX SYSTEMS

Our knowledge

- ROBATEL Industries develops tailored and turnkey glovebox solutions for containment applications
- Complete design and manufacturing of:
  - The containment enclosure (glovebox)
  - The internal applications (mechanical, handling, chemical process equipment, pneumatic transfer)
  - The complete process implementation
  - The docking systems
  - The surrounding equipment (Ventilation, Electricity and controls, automation, fire extinguishing systems)
- Leak tightness Levels from 1 to 4 following ISO 10648-2
- Viewing panels, Omega frames, and machined frames
- Seismic ratings
- Fabrication following EUROCODE, RCC-M, ASME.
- Installation and on-site commissioning

➢ Gloveboxes for PEGASE - CEA

GLOVEBOXES

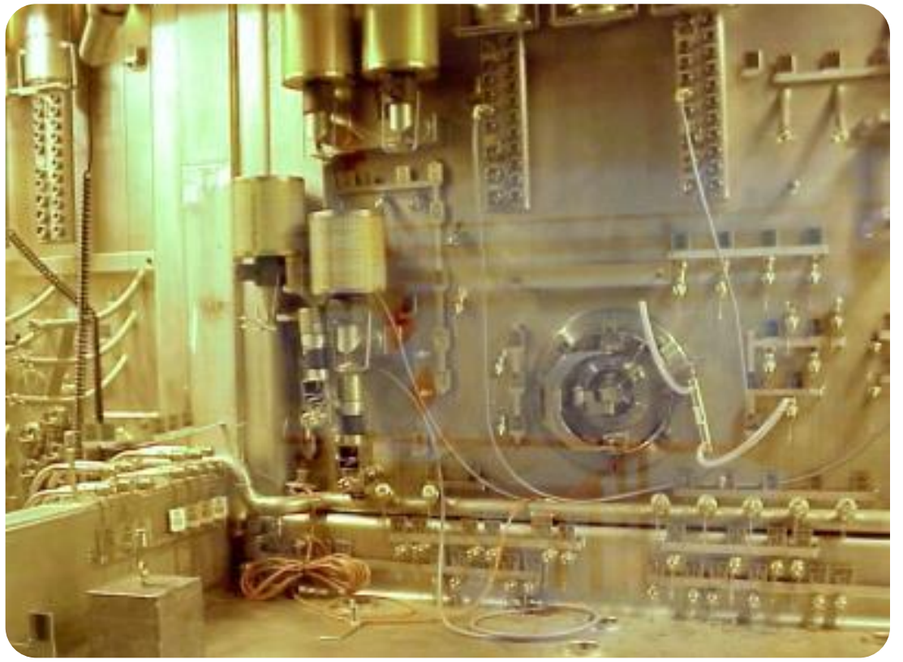
Design, fabrication and assembly

➢ ALL FILL BàG n°1 (GB)

➢ ALL FILL BàG n°2 (GB)

➢ ALL FILL BàG n°3 (GB)

➢ IRSN



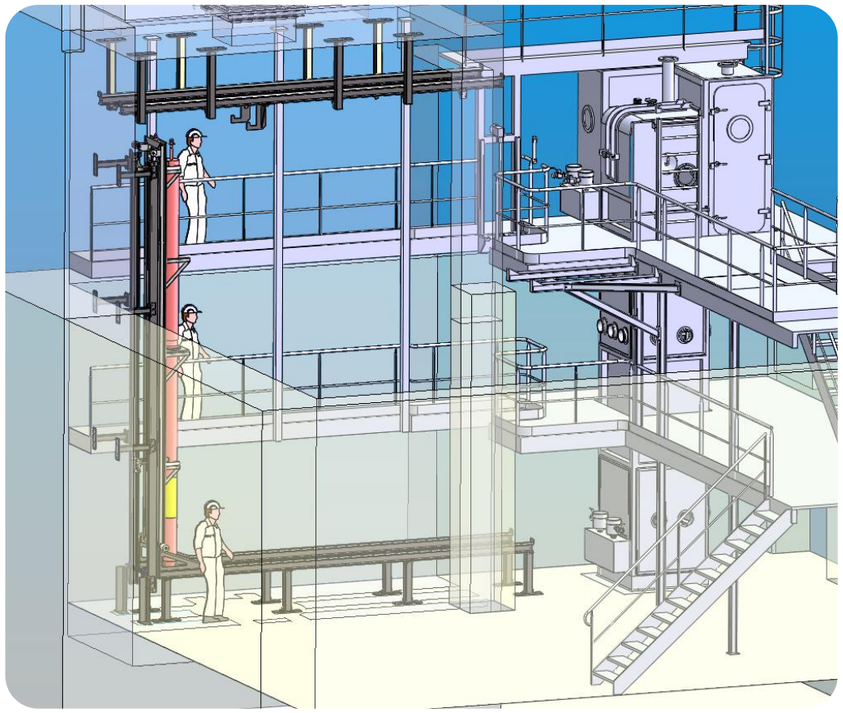
➢ CEA

GLOVEBOXES

C02 – REACTOR JULES HOROWITZ (RJH)

- Item 1 : Laboratory ELD
  - Shielded containment box
  - Fume hood
  - Additional radiation shielding
  - Pneumatic transfer system
- Item 2 : Laboratory ELC and ELR
  - ELC gloveboxes
  - ELC and ELR fume hood
  - ELR source shielded box
- Item 3 : MDS spent resin management premises
  - Gloveboxes
  - hydraulic transfer system and network
- Item 4 : internal equipment for the restricted area workshop (hot) EAC
  - Ventilated airlock
  - Gloveboxes
  - Rotating chassis
  - Transportation chassis
  - Storage racks and telemanipulators
  - Workbench and fume hood
- Item 5 : Lifting and handling equipment
  - Hot workshop lifting crane
  - Ventilated airlock lifting crane
  - Waste storage room lifting crane
  - Spent resin management room lifting crane
- Item 6 : Other equipment
  - Steel structures
  - Spent resin can elevation chassis.
  - Resin drum handling trolley for the spent resin management workshop
- Item 7 : Shield doors, under hot cell shaft

➢ ELC glovebox

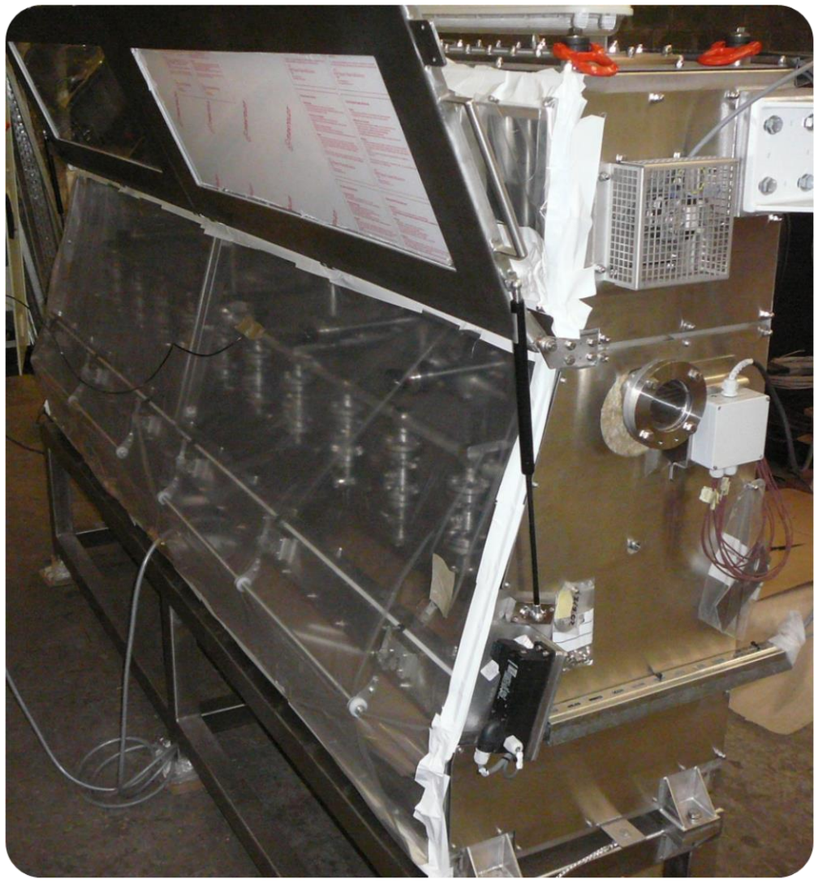


➢ EAC Platform

GLOVEBOXES

COMURHEX - ORANO

- Design and fabrication
  - EF1: Preparation of the loads
  - EF2: Packaging, drum insertion of the M.U.R
  - EF3: Fluorine packaging
  - EF4: UF6 Sampling system
- Installation and on-site testing
- Industrial commissioning



➢ Leak testing on draining containment box – UF6 sampling unit

➢ Sampling glovebox – UF6 sampling

GLOVEBOXES

AGATE, CEA Cadarache

- A glovebox system for liquid effluent sampling including liquid sampling, distribution of sample jugs and pneumatic transfers
- Integration of a part of the global advanced process workshop for treatment of radioactive effluents
- ROBATEL Industries was responsible for the design, fabrication, onsite installation, testing and commissioning of this glovebox system including four gloveboxes (seismic requirements compliant), with automated sampling and pneumatic transfers
- Integration of all automated mechanical equipment and Electricity, instrumentation and command (EC&I)
- Supply and installation of fume hoods

➢ Factory assembly of the chain

➢ Sampling gloveboxes

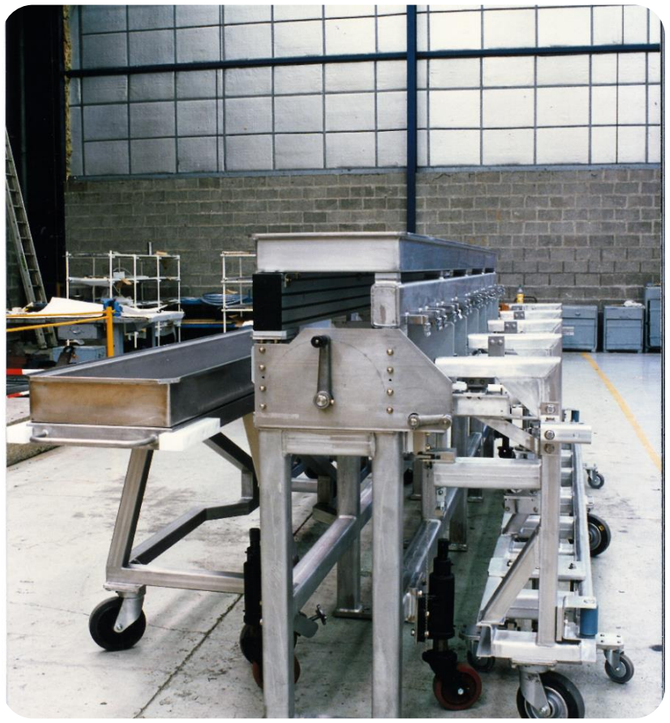
➢ Factory assembly of the chain

GLOVEBOXES

MELOX – Design, fabrication, installation and testing

➢ Storage and handling of powders glovebox system

➢ THE filters pre-clogging glovebox



➢ Fuel pins handling trolleys

➢ Fuel pins decontamination glovebox

➢ Fuel pins decontamination glovebox

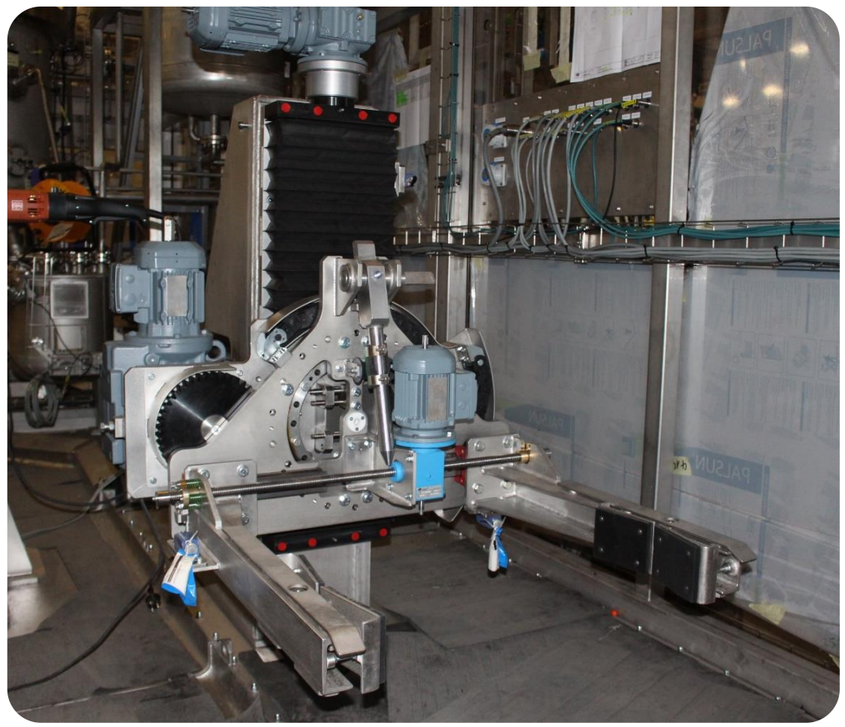
NUCLEAR WASTE MANAGEMENT

Na-NaK project, ONDRAF - Belgium

- The Na-NaK project concerns the modifications brought to an existing cell of the Pamela building on the BELGOPROCESS, DESSEL site in order to treat the Na and NaK radioactive wastes
- Item 1 : Pre-treatment equipment
  - Sorting and inspection workstation, transfer system, waste reconditioning workstation, opening, recovery, cutting, drilling and draining workstations
  - Telemanipulator maintenance lifting crane
  - Reactor basket
  - Reactor screen
  - Effluent measuring system
- Item 2 : Leaktight containment enclosure
- Item 3: In-cell overhead crane

➢ Containment enclosure and in-cell overhead crane

➢ Reactor



➢ Drum automated rotating workstation

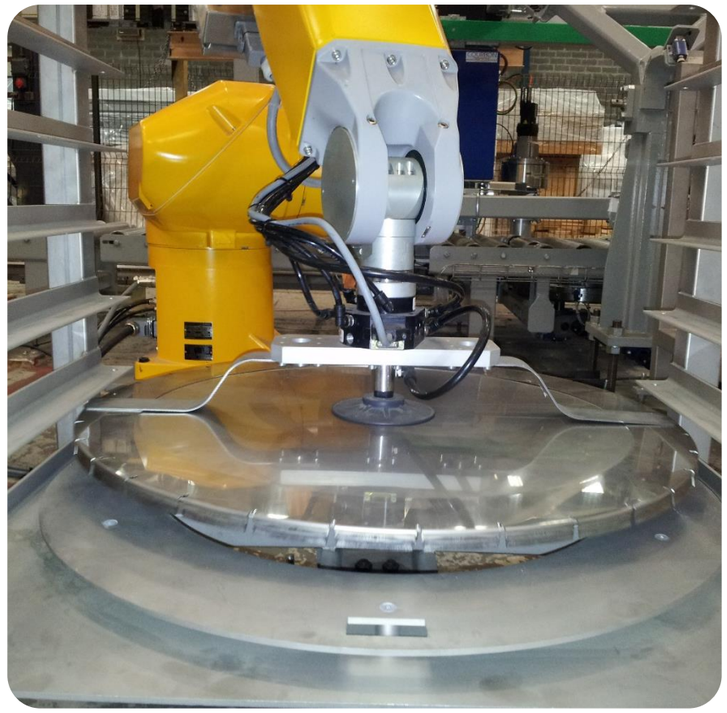
NUCLEAR WASTE MANAGEMENT

STEMA project - CEA

- Drum conveyance (60 mGy/h)
- Pouring prior to mixing (drum docking, tube rinsing, weighing, vibration, and centering of the drum)
- Recovery of rinsing waters
- Drum drying and inspection
- Preparation and pouring of inactive completion mortar
- Drum lid crimping
- Robotized contamination smear testing
- Dose rate control
- Storage carousel
- Transportation cask loading workstation
- Electricity, Control & instrumentation of our supplies

➢ Filling Glovebox

➢ Transfer carousel



➢ Automated robot arm

➢ conveyers

➢ Truck transfer station

NUCLEAR WASTE MANAGEMENT

Waste sorting and conditioning system, EDF/AMI Chinon

- This installation allows the sorting of nuclear legacy wastes thanks to a dedicated alpha tight and leaktight hot cell, equipped with remote handling and lifting features
- These radioactive wastes are sorted according to their activity levels and their physical and chemical characteristics
- They are then reconditioned for later transportation to the ANDRA repository site or others
- The “ETC” is composed of three zones:
  - A waste sorting concrete cell
  - A loading and drum sealing station
  - A final automated contamination survey in a cask loading airlock chamber

➢ Sorting cell inner containment enclosure

➢ Control room

➢ Ventilation register

NUCLEAR WASTE MANAGEMENT

Removal of drums from INB PEGASE (CEA)

- Removal of over 2700 drums thanks to a cask specifically developed for the project
- Leaktight transfer of drums from the cask into the gloveboxes
- Measurement and characterization of radioactive wastes
- Compaction of emptied drums
- Mortar pouring into the 870L waste drums
- Transfer of the drums to the interim storage facility
- Project challenge: 2 year lead time for the design, fabrication, and commissioning. Operation services for 3 years

➢ PEGASE waste management gloveboxes

➢ PEGASE treatment gloveboxes

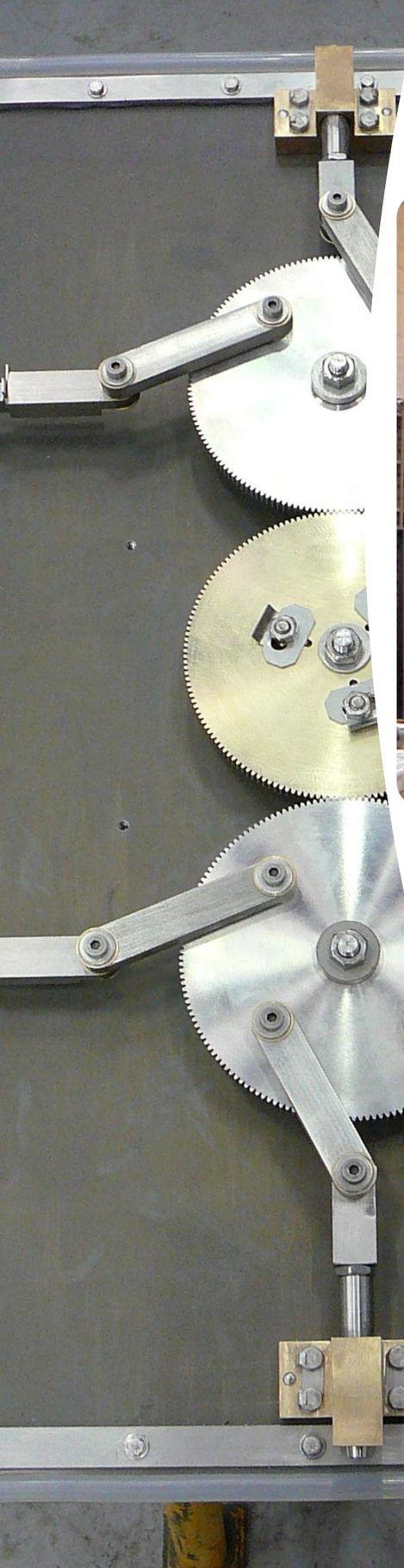
NUCLEAR WASTE MANAGEMENT

Radioactive waste cementation installation, ZWILAG (Switzerland)

- Receipt and storage of concrete components
- Preliminary treatment of certain homogeneous wastes
- Preparation and mixing of the mortar
- Mortar pouring into waste drums, or transfer to other workstations
- Mortar injection system, cleaning, and recovery of rinsing effluents
- Transfer, drying, and inspection of the drums

➢ Gloveboxes

➢ Cementation process



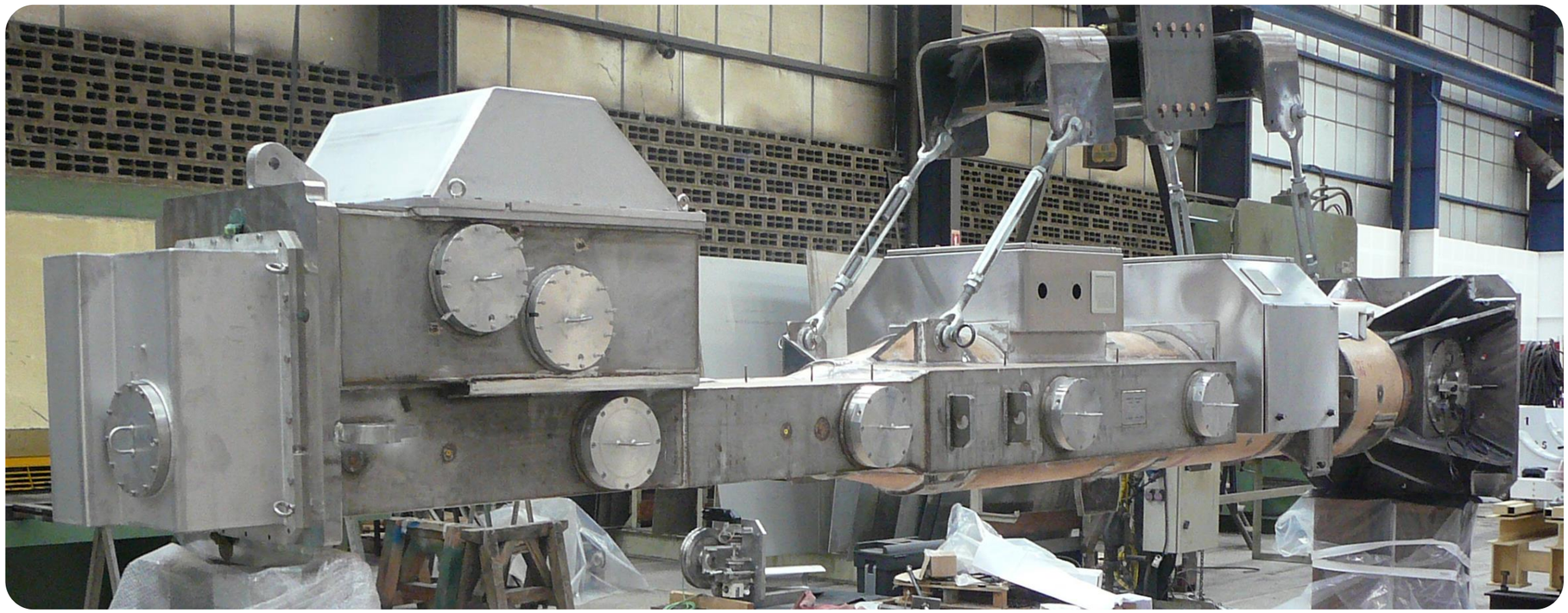
SHIELDED TRANSFER BELL

Leaktight and shielded transfers for radioactive and contaminated items

➢ Transfer cask CEA

➢ Transfer cask 55 Tons - ORANO

➢ Transfer cask 8 Tons LAMA - CEA

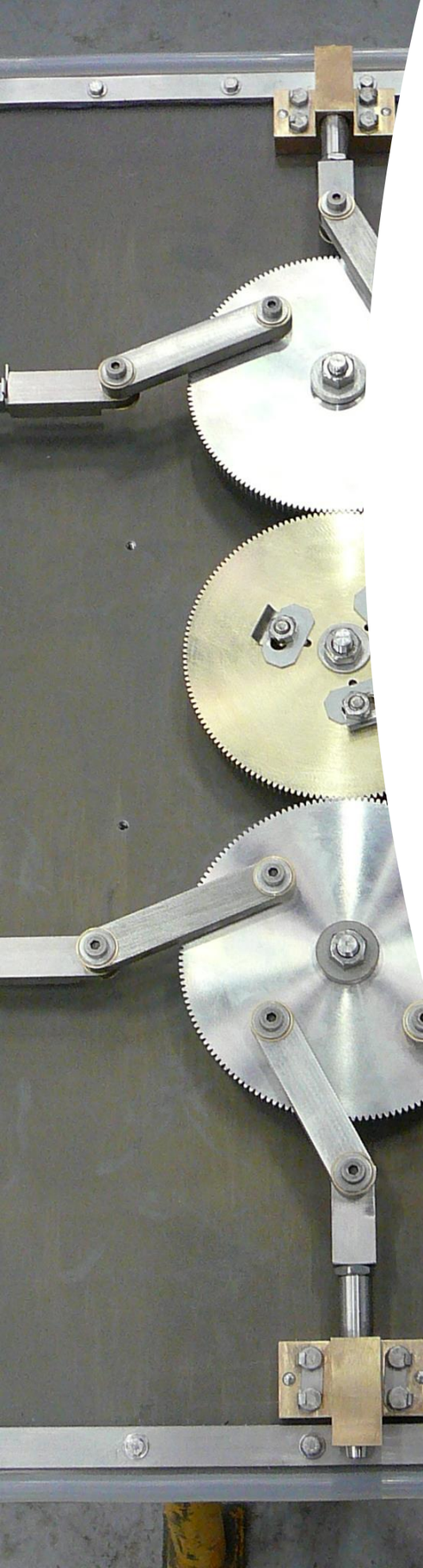


➢ Transfer cask CABRI 20 Tons - IRSN

SHIELDED TRANSFER BELL

➢ Lead shielded shell VVP - 70 Tons

➢ K15 equipment – 70 Tons



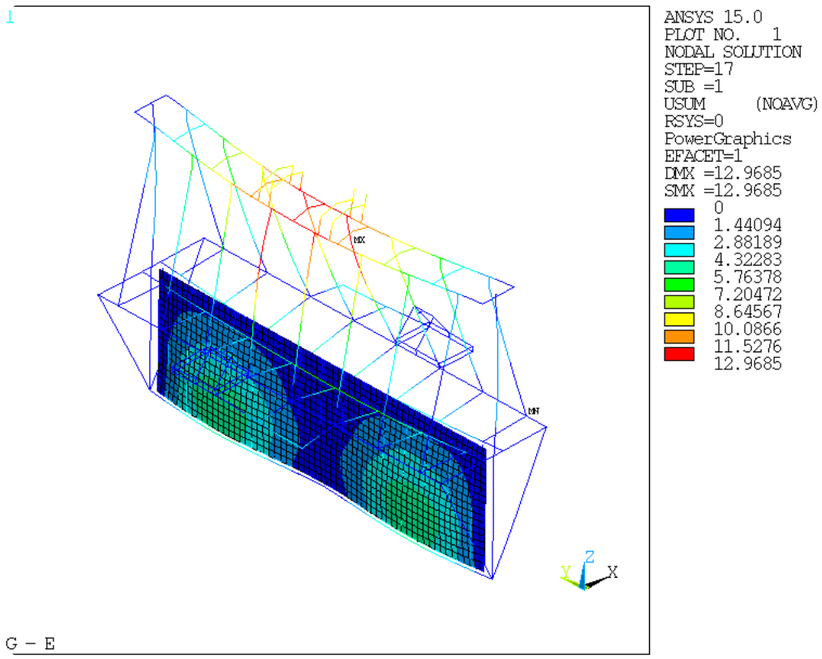
SHIELDED DOORS AND HATCHES

Our skills and key points

- Feasibility and preliminary draft studies
- Design, fabrication, assembly, and testing in our workshop and final assembly onsite
- Maintenance services
- 1 200 tons manufactured since year 2000

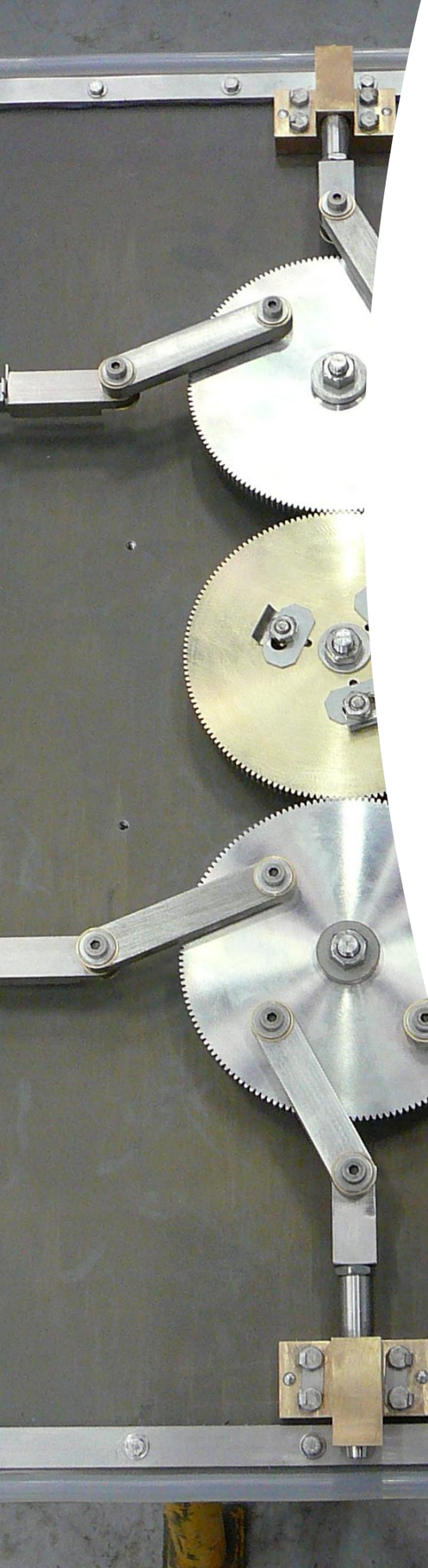
Technologies

- Sliding doors, hinged doors, or plugs
- Static and dynamic containment features
- Gamma and/or neutron radiation shielding
- Manually or remotely operated
- Thermal insulation/ Fire protection
- Designed to withstand seismic events



➢ Seismic preliminary assessment model

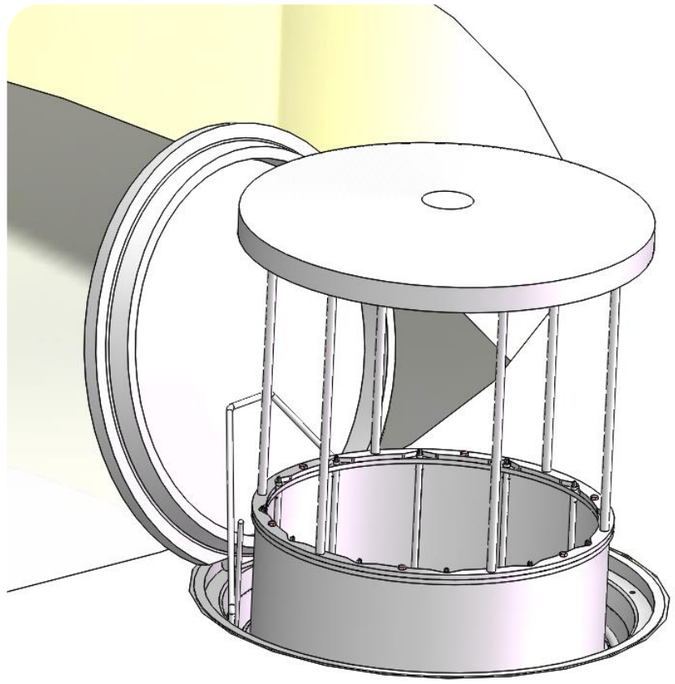
➢ PAMELA shield door- SCK (Belgium)



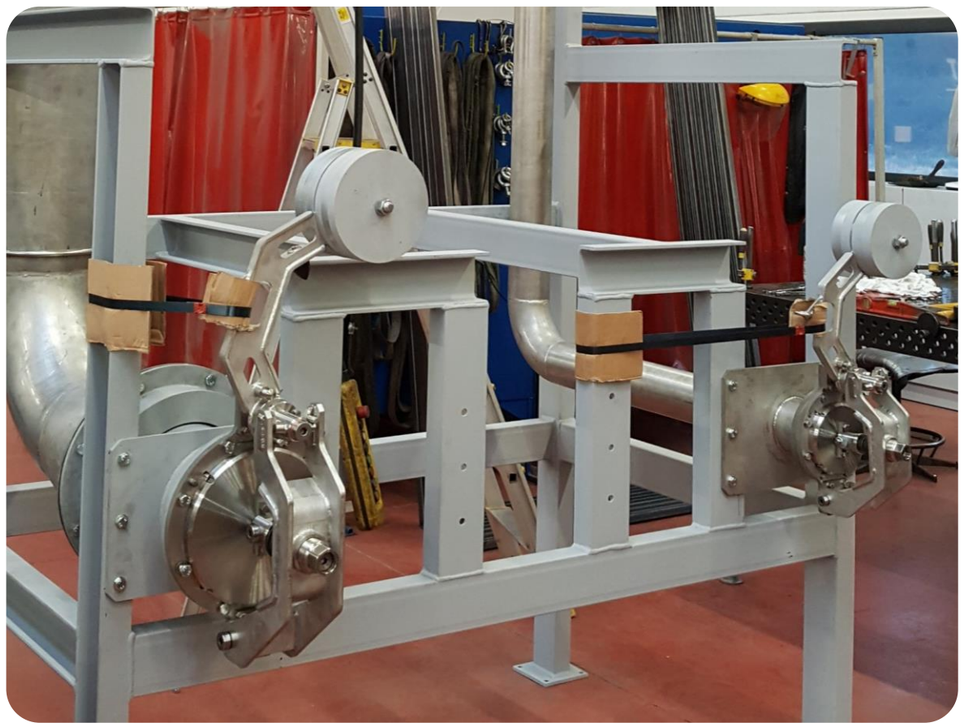
SHIELDED DOORS AND HATCHES

Improvement of the levels CP0, CPY containment concrete apron - EDF

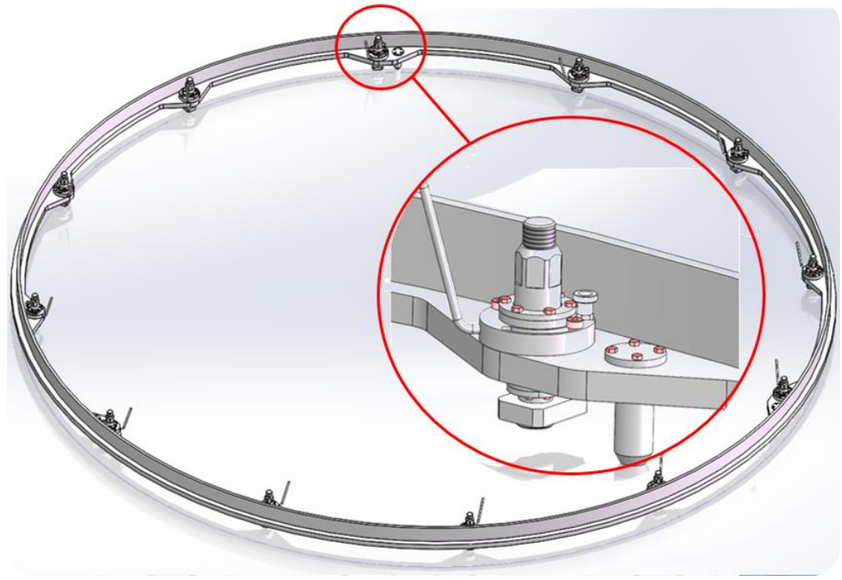
- Within the scope of the re-examination of NPP nuclear safety, EDF plans modifications to reinforce containment of the reactor buildings, in case of a loss of coolant accident with reactor core fusion
- Part of the solution consists of implementing a passively-activated water flushing system by the opening of a leaktight hatch in the reactor vessel pit
- Design and manufacturing of a functional mockup and testing of the system
- Detailed design of:
  - The leak tightness system of the CP0 pool bottom
  - The leak tightness system of the CPY pool bottom



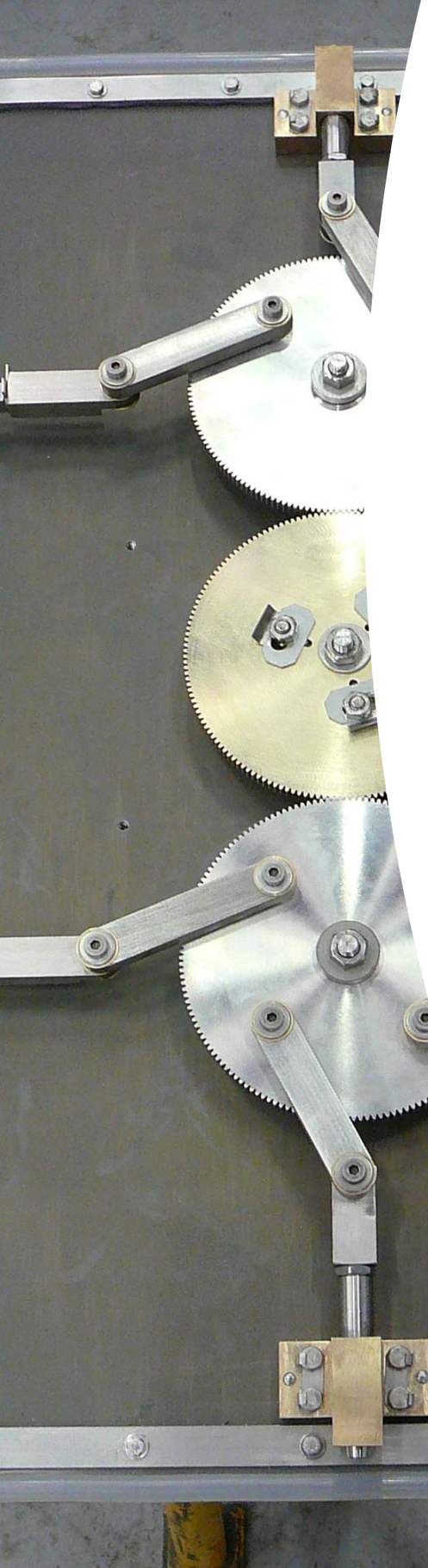
➢ Leak tightness system of the channel CPY



➢ Water flushing system



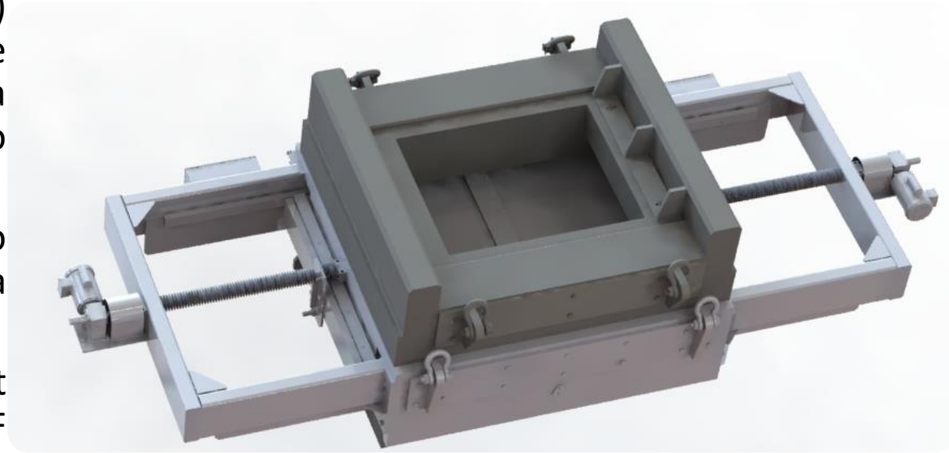
➢ Leak tightness system between the reactor vessel and the pool bottom CP0



SHIELDED DOORS AND HATCHES

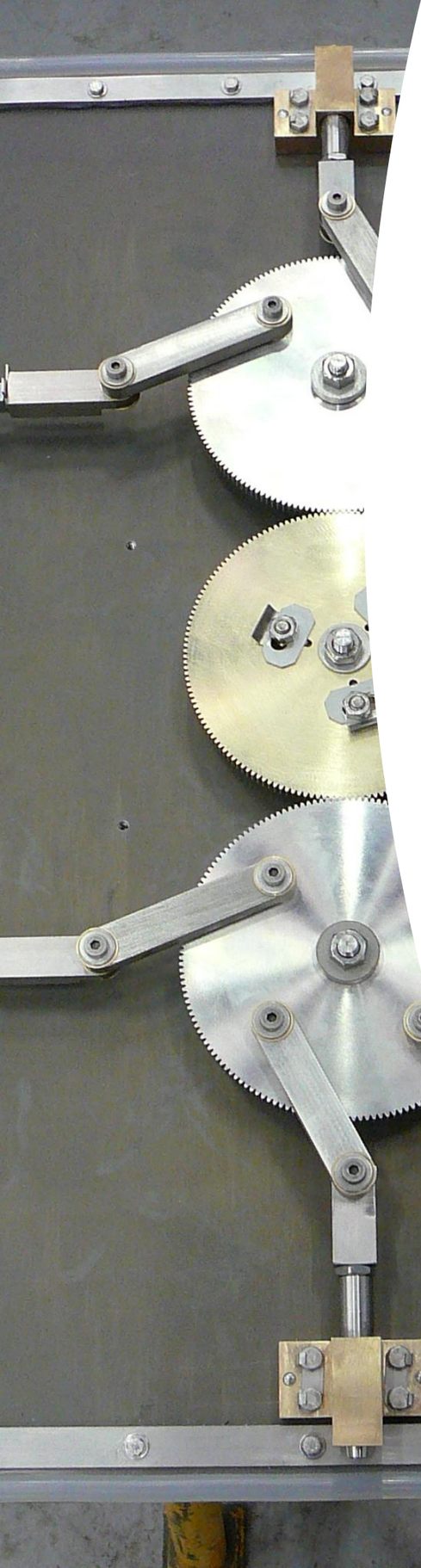
SIM Project - CANADA

- As part of the Whiteshell Laboratories (WL) decommissioning process, Canadian Nuclear Laboratories (CNL) is planning to transfer the inventory of used fuel from the WL Concrete Canister Storage Facility (CCSF) to Chalk River Laboratories (CRL) for long term (50 to 100 year) management. WL fuel baskets will be retrieved from the CCSF using a Basket Transfer Flask (BTF), and loaded into a Used Fuel Transportation Package (UFTP) for transport to CRL.
- Retrieval and loading of the fuel baskets from the UFTP to the concrete fuel canisters at Waste Management Area (WMA) G will be done using another BTF at CRL.
- A Shielded Interface Module (SIM) is required to connect and provide continuous shielding between the UFTP and BTF for loading of the UFTP at WL and unloading at CRL. A SIM is required for both the CRL site at WMA G and the WL site at the CCSF.
- Mass: 25Tons



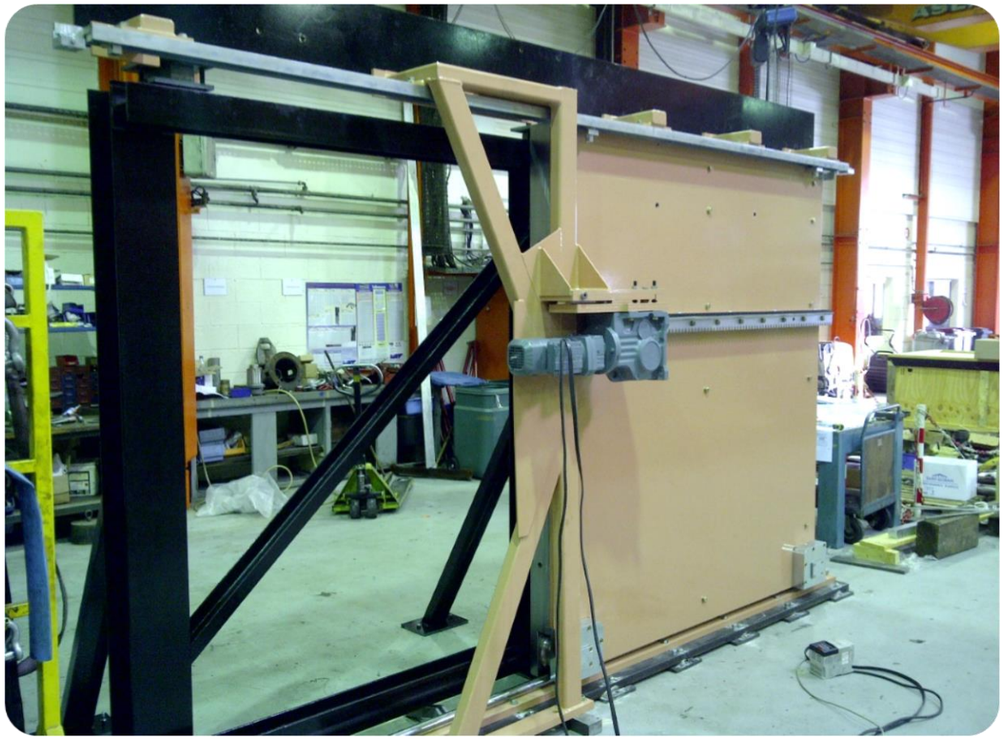
➢ CAD model

➢ Fabricated SIM at ROBATEL's premises



SHIELDED DOORS AND HATCHES

Leaktight shield doors



➢ CADECOL shield door - CEA

➢ Shield door - BELGOPROCESS (Belgium)

➢ Shield door - BELGOPROCESS (Belgium)

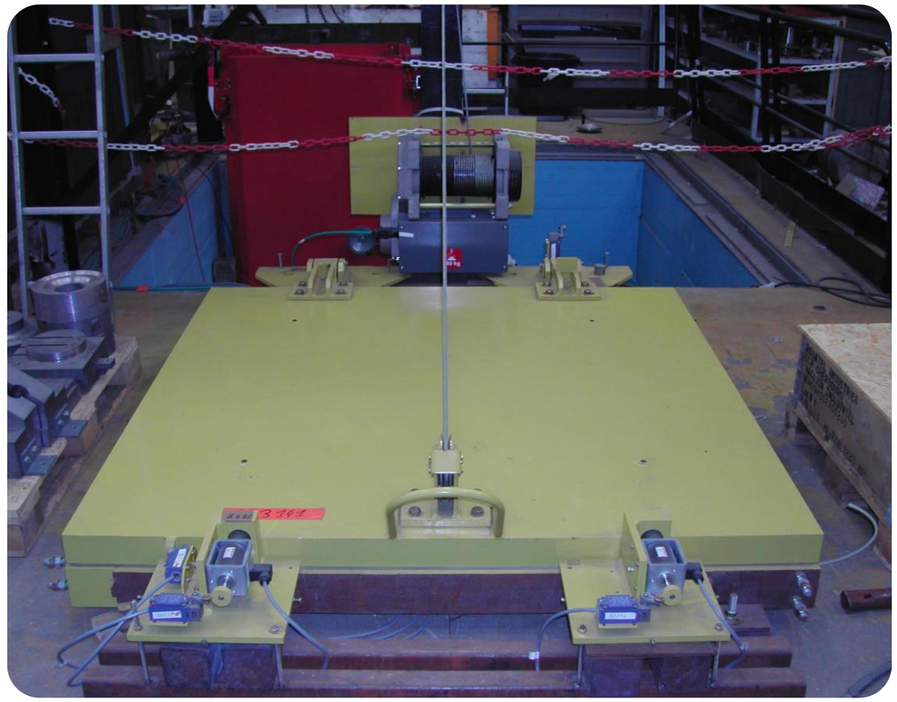
SHIELDED DOORS AND HATCHES

➢ ETC shield door - EDF

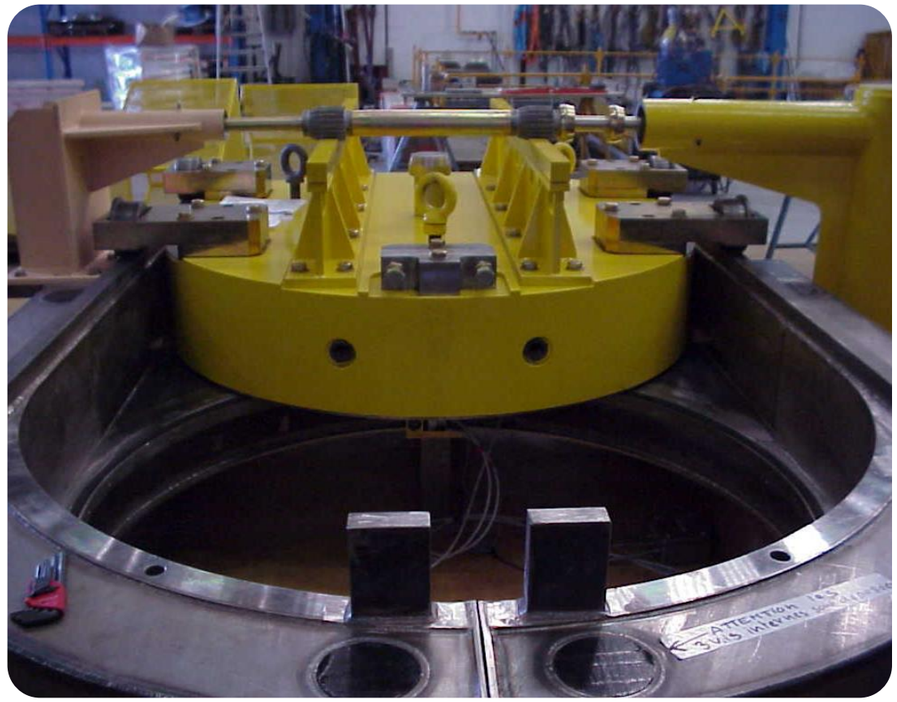
➢ Shield door for Léon Bérard institute

➢ STELLA shield door - CEA

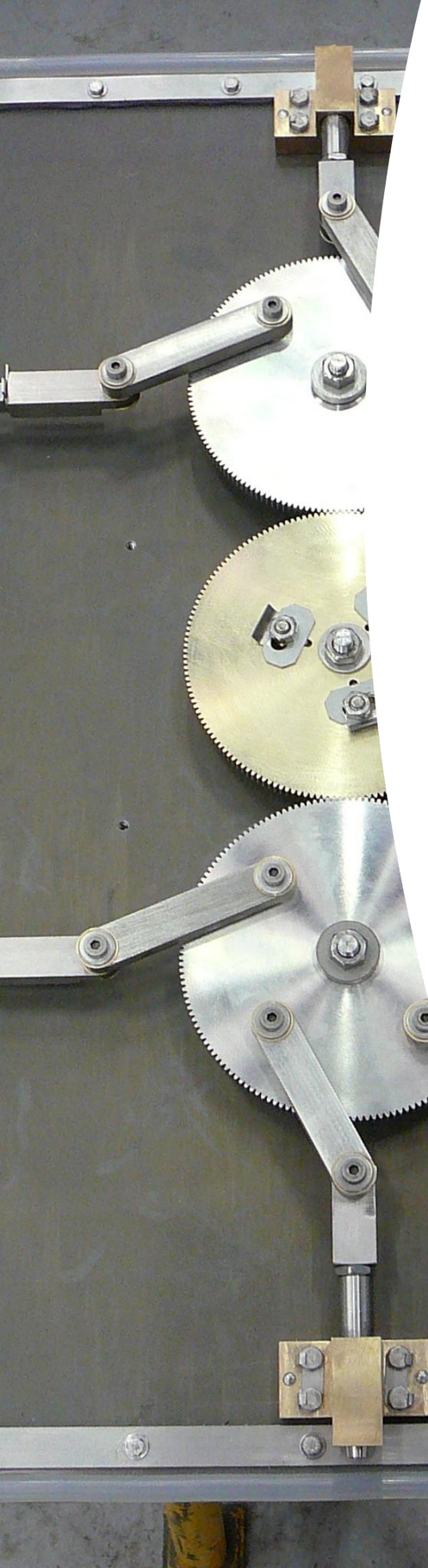
➢ Shield door for PEGASE - CEA



➢ Shield hatch for STELLA - CEA

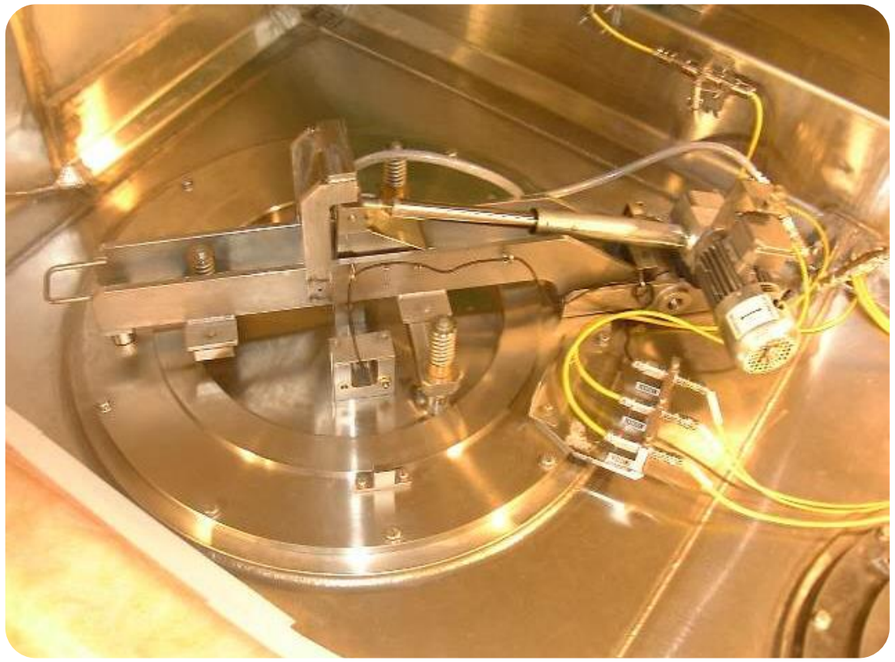


➢ Horizontal sliding shield hatch for Chernobyl

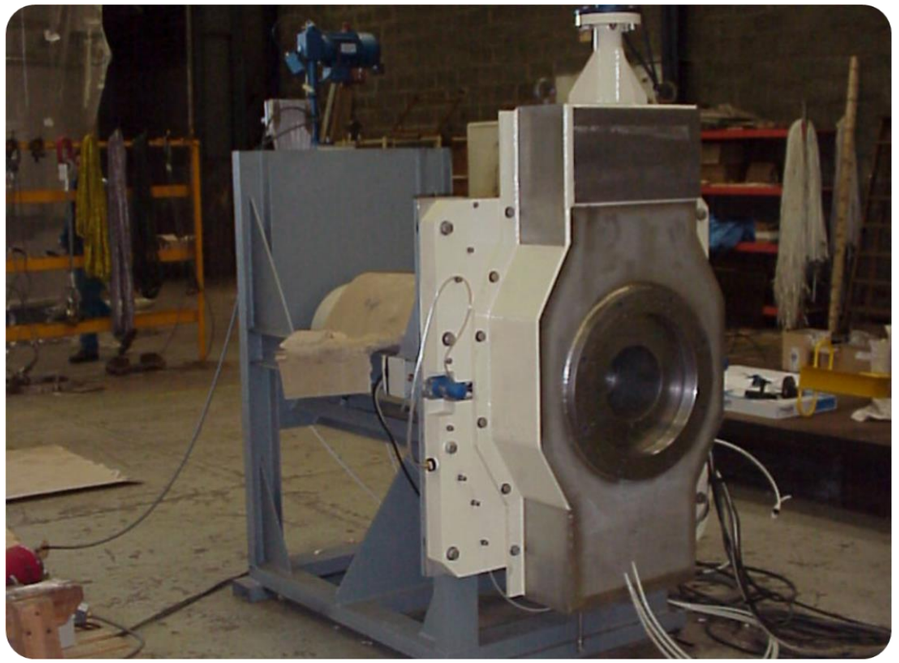


DOCKING SYSTEMS

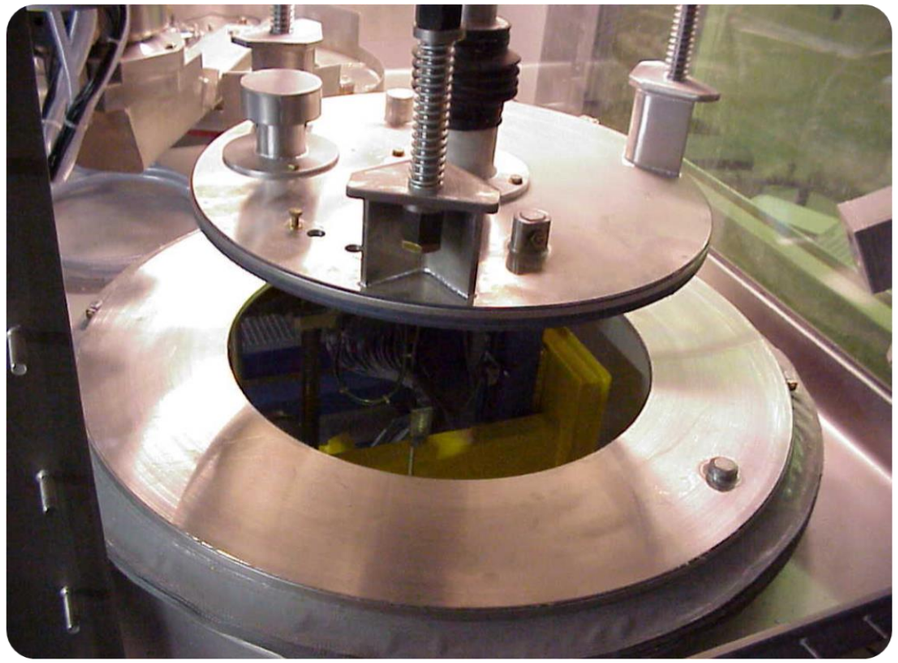
Shielded and leaktight docking systems for transfer into hot cells / gloveboxes



➢ Drum docking system

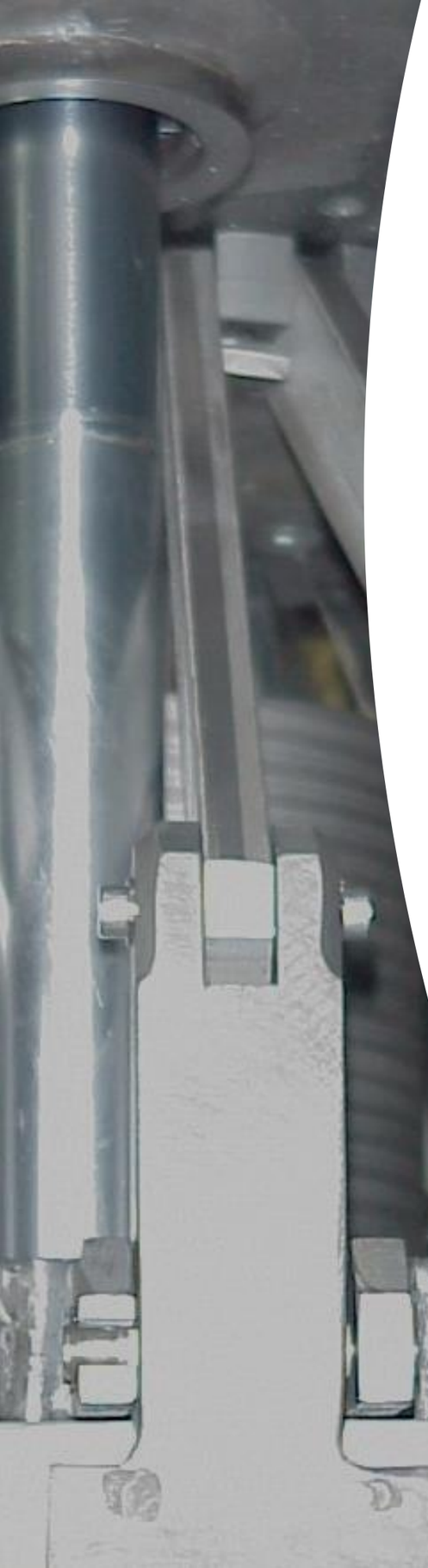


➢ Docking system for hot cells



➢ Docking system for a cementation unit

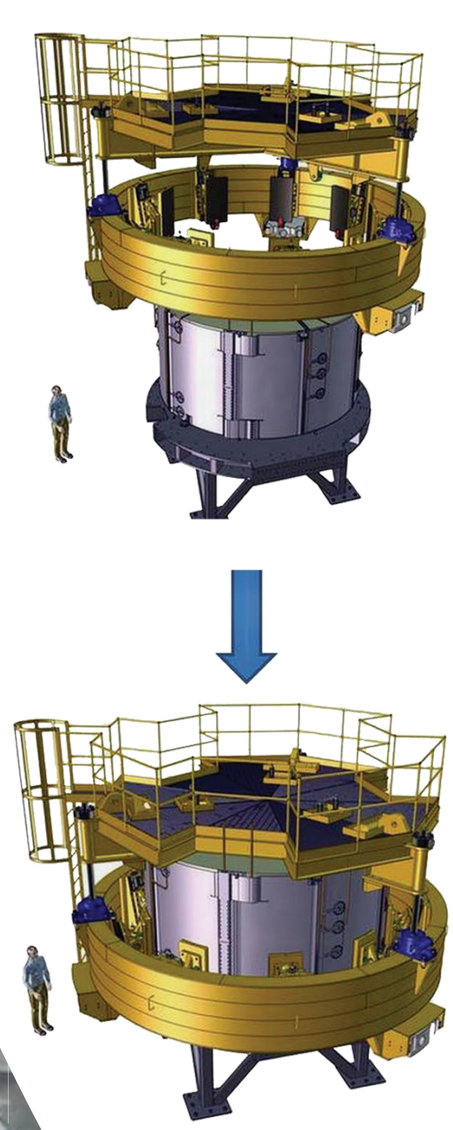
➢ Docking system for a cementation installation



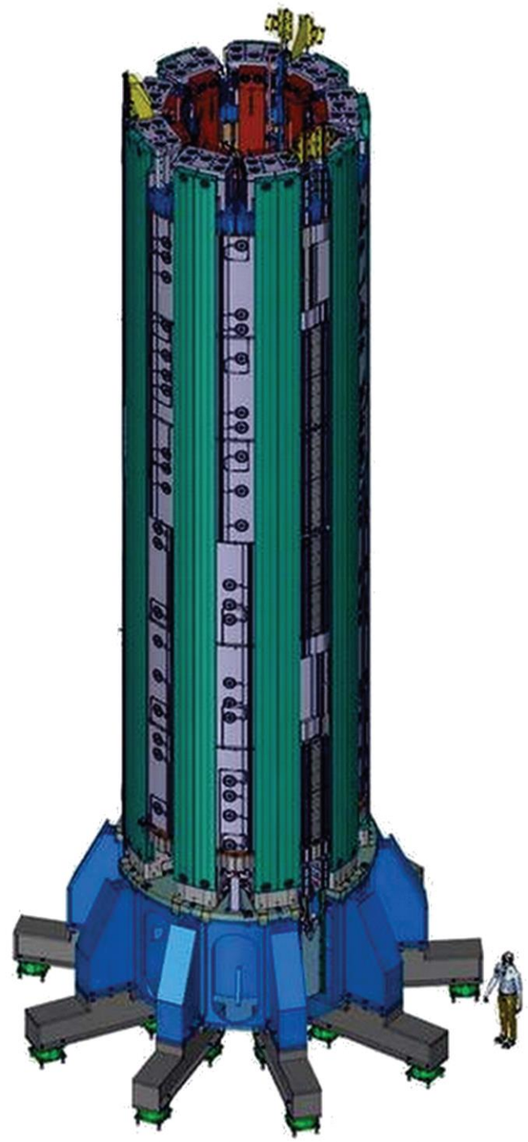
LIFTING AND HANDLING EQUIPMENT

Testing, lifting and handling equipment - US ITER

- Design for Fabrication, fabrication, and testing of:
  - ITER central solenoid lifting fixture (WLL 120 metric Tons)
  - The central solenoid assembly platform, built to support the 6 central solenoids (WLL 1000 metric tons)



➢ Lifting fixture



➢ Central solenoid assembly platform

➢ Lifting fixture under fabrication (at ROBATEL Industries in Genas France)

➢ Central solenoid assembly platform

LIFTING AND HANDLING EQUIPMENT

Design, fabrication, certification testing, and manufacturing of testing fixtures

➢ Transfer cask grapple

➢ Phénix primary pump plug handling

➢ R72 cask plug grapple

➢ GETA grapple

➢ R73 cask pneumatically actuated lifting fixture

➢ DGD cask lifting fixture

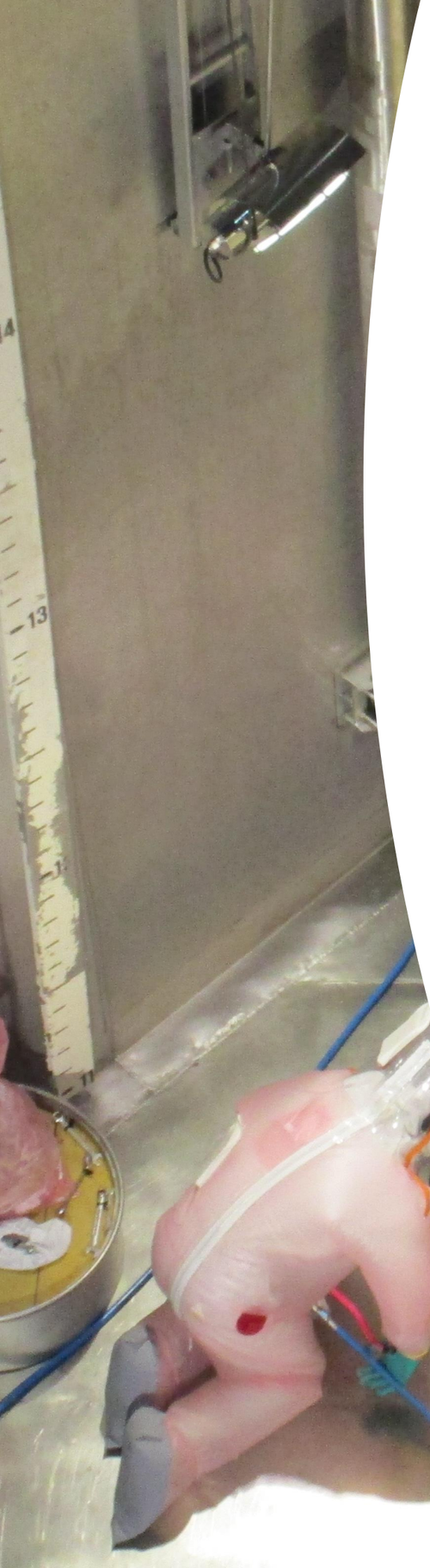
LIFTING AND HANDLING EQUIPMENT

Heavy load lifting fixtures

➢ Lifting fixture for a spent fuel cask ANSTO – 130 T WLL

➢ K15 container lifting fixture with trim adjusting system – 90 T WLL

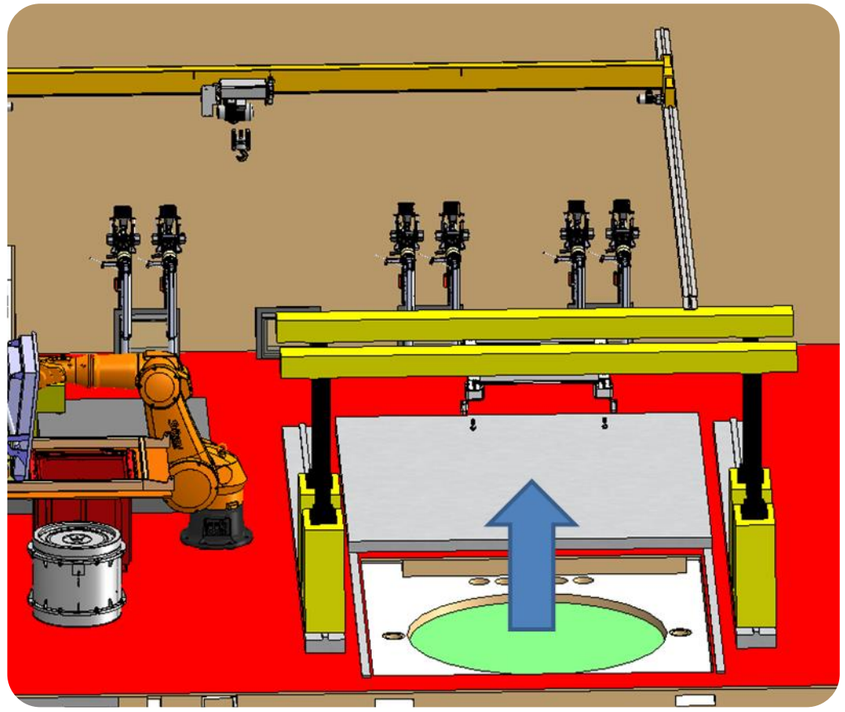
➢ VVP lifting fixture with trim adjusting system – 70 T WLL



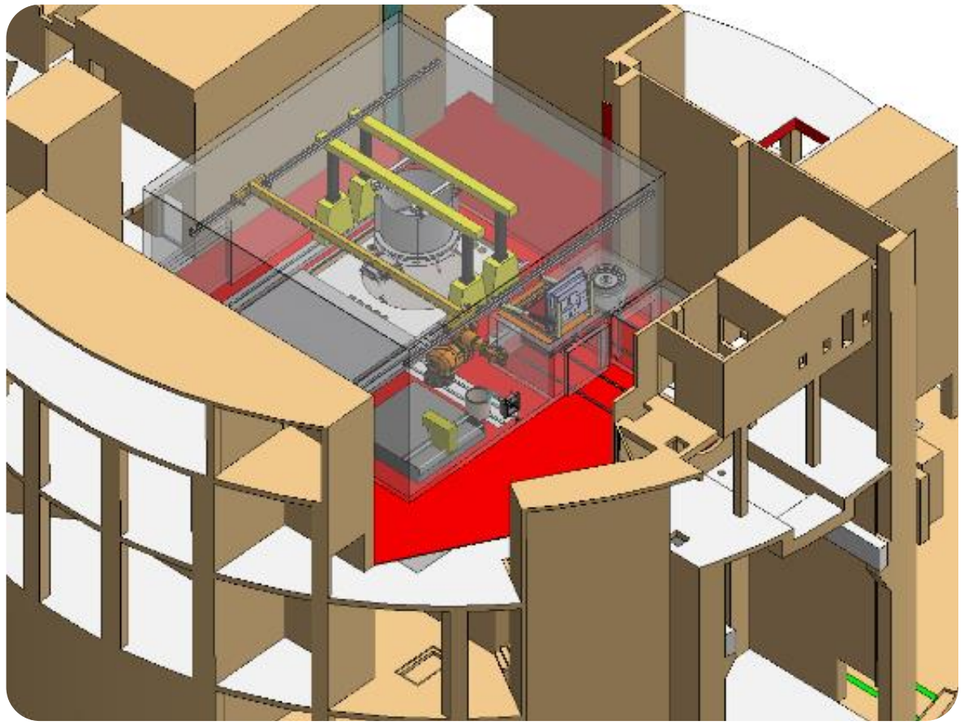
DECOMMISSIONING

Scenario study for the decommissioning of the reactor bloc of Brennilis

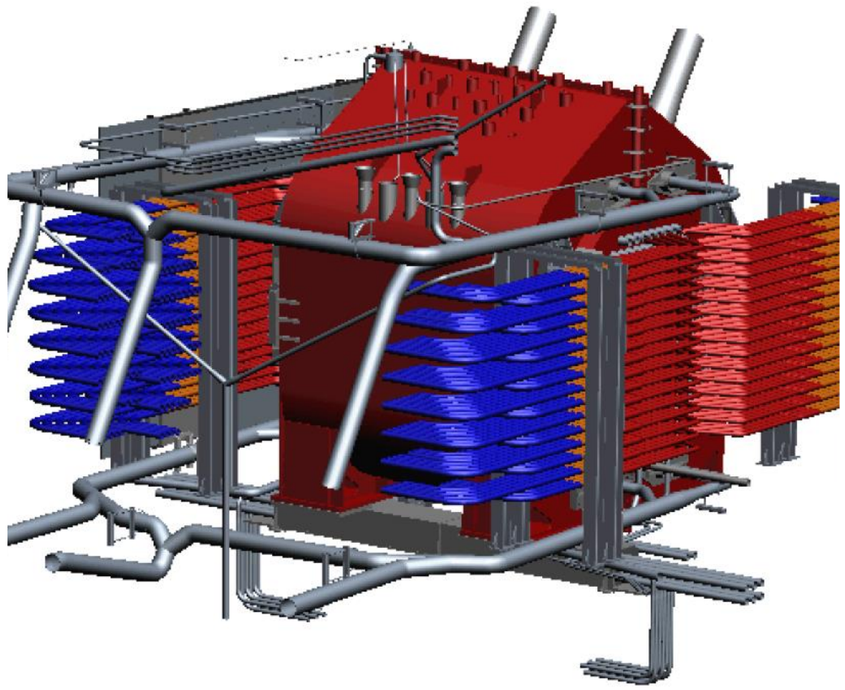
- Design of a scenario for the decommissioning of the reactor vessel, of its internals and of its peripheral circuits located in the immediate proximity:
  - The reactor vessel with its pressure tubes and their channels,
  - Channel internals
  - The thermal shield made of side and axial water barriers
  - The connection pipes of the cooling circuit, heavy and demineralized water
  - Discharge piping
  - The connections with the control circuits (piping and bars) and the control rods
  - The hot and cold piping connected to the channel down to the reactor vessel shield wall



➢ Cell equipment



➢ Treatment cell



➢ Scenario scope boundary

DECOMMISSIONING

Decommissioning of BCC and PBT Creys-Malville

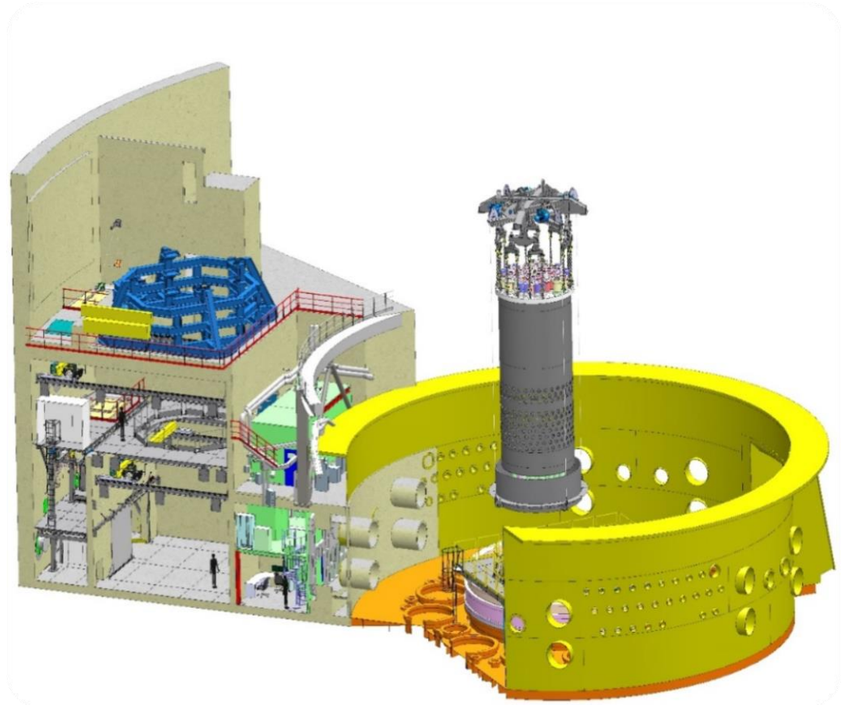
NUVIA

Design and fabrication

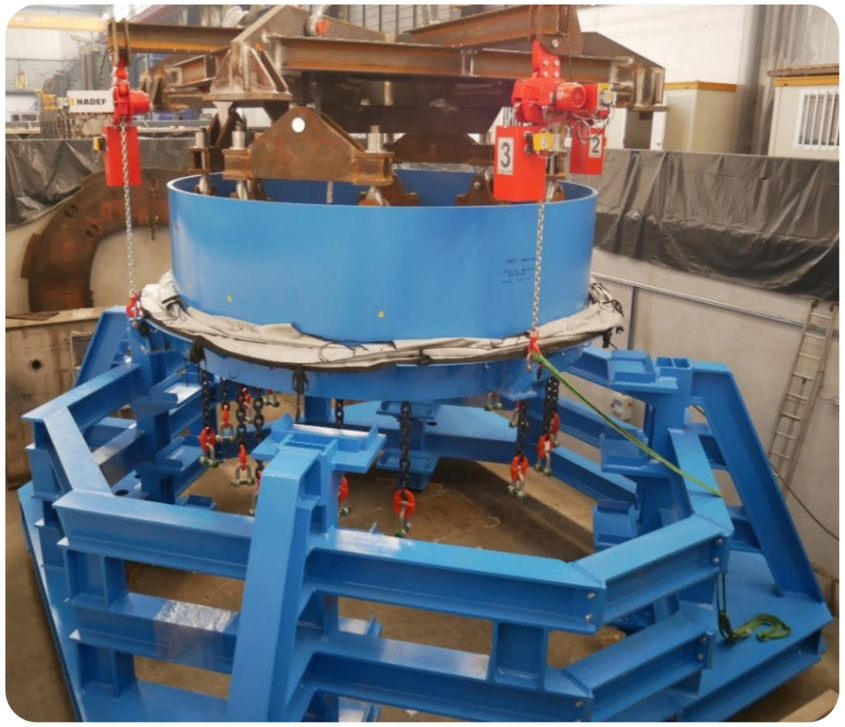
- Cutting station
- Waste re-conditioning workshop
- Lifting and handling equipment (supporting structure, lift beam)
  - BCC – reactor core upper plug (188 Tons and 11 m long)
  - PBT – Small rotating plug (212 Tons et 7 m diameter)
- Steel structural elements
- Radiation shielding
- Hot and cold changing facilities

➢ Lifting fixture and protective skirt set

Consortium: ROBATEL Industries



➢ Overall project view

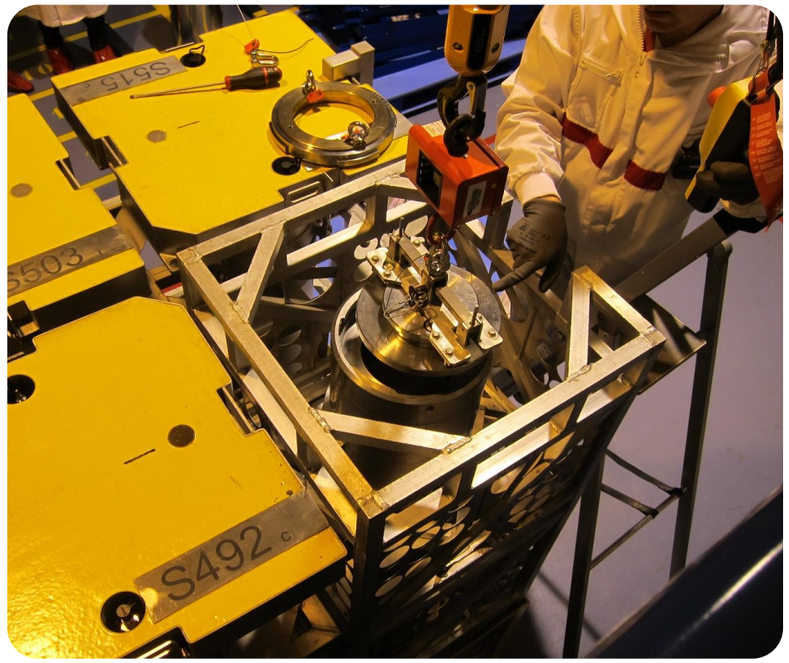


➢ Handling and lifting fixtures

NEUTRON AND GAMMA RADIATION SHIELDING

Cesium traps - CEA

➢ Cyclotron mobile neutron shielding- Italy



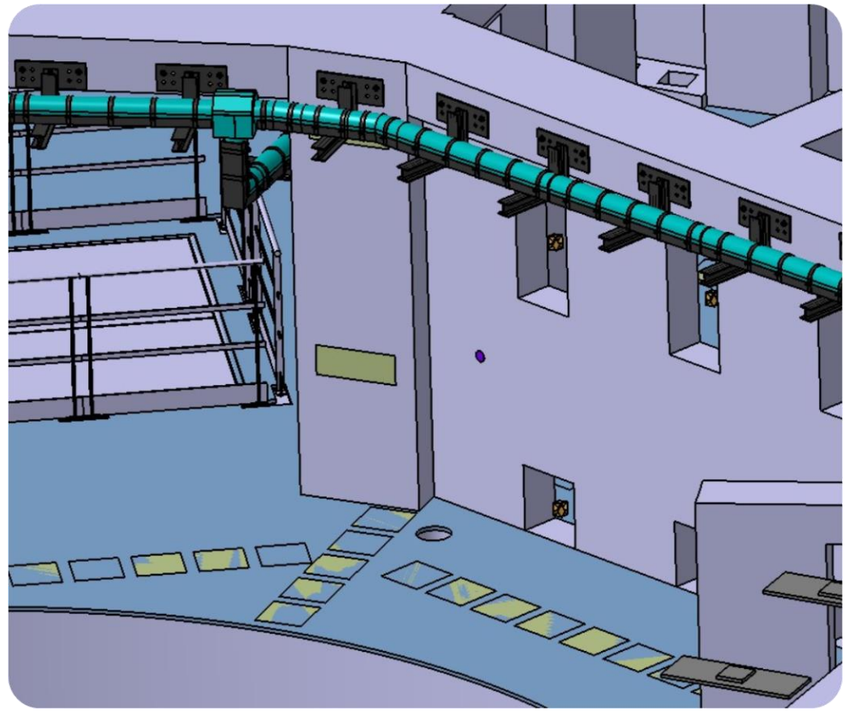
➢ PNT7™ neutron shielding for MAGENTA - CEA

➢ Cesium traps - CEA

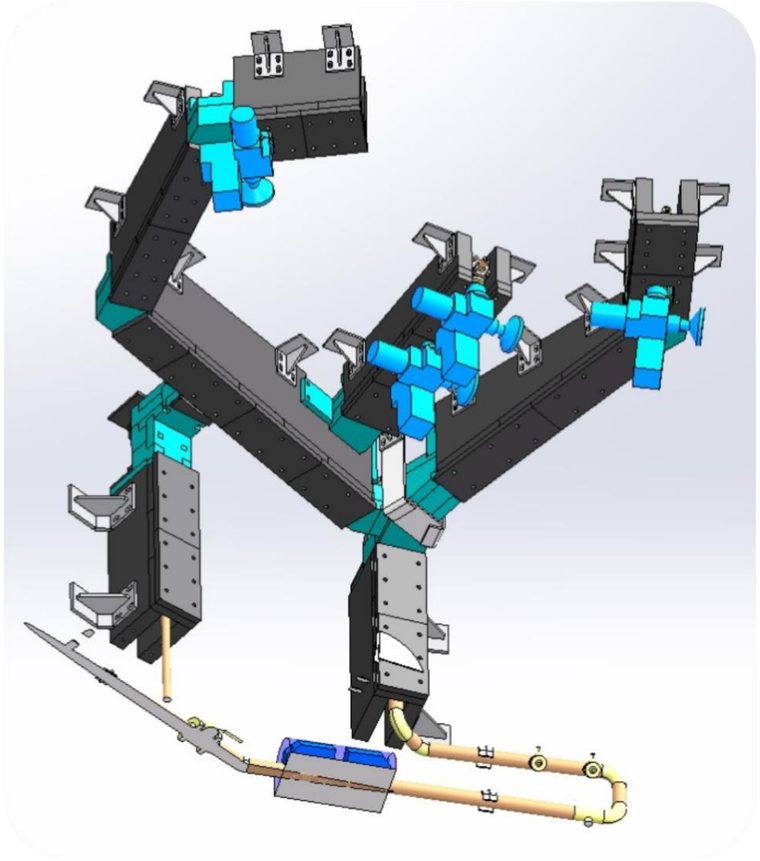
NEUTRON AND GAMMA RADIATION SHIELDING

Radiation shielding RJH – D10

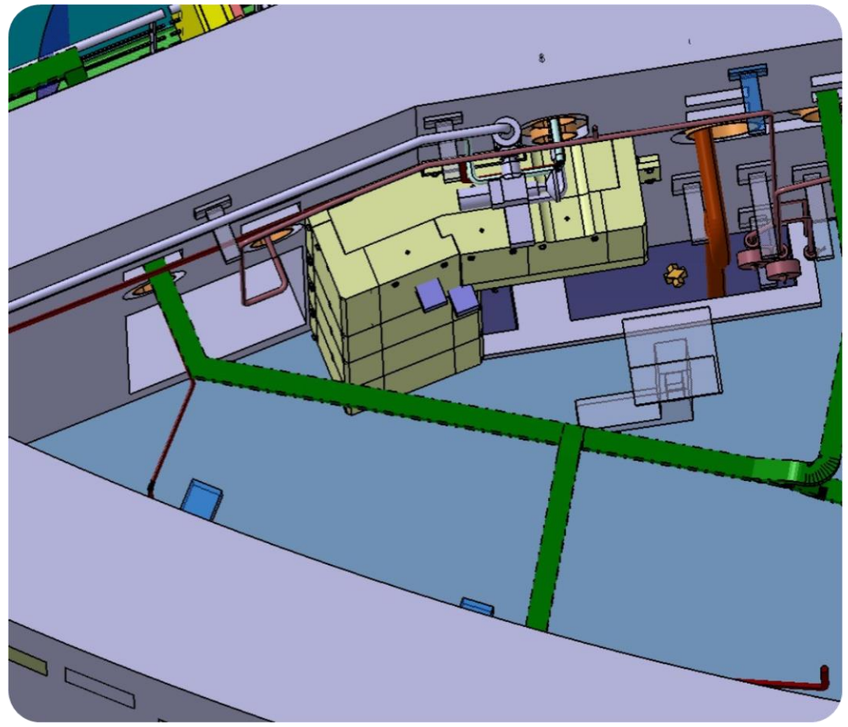
- Design, fabrication, and installation
  - Ceiling Radiation shielding
  - Equipment radiation shielding
  - Piping radiation shielding
- Applied to following circuits
  - MDA (alpha effluents)
  - MDB (beta/gamma effluents)
  - MDG (gaseous effluents)
  - REK (pool purification)
  - RPA (mechanisms scan)
  - RPK (purification, filtration, and outgassing of the primary circuit)



➢ MDG circuit radiation shielding



➢ MDB circuit radiation shielding

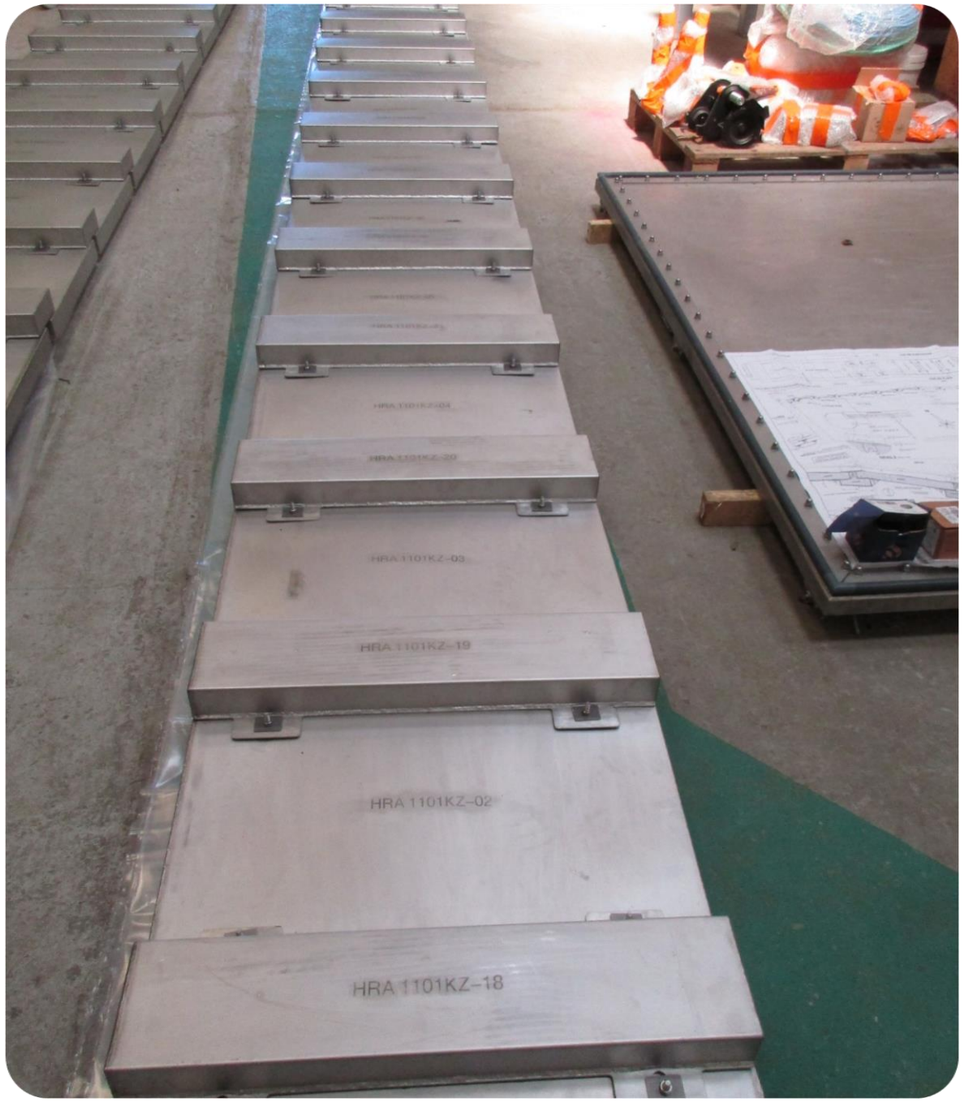


➢ RPK circuit radiation shielding

NEUTRON AND GAMMA RADIATION SHIELDING

EPR Flamanville 3

- Design, fabrication, and assembly of the neutron and gamma radiation shielding for FA3 EPR
  - 34 Tons of radiation shielding equipment
  - Piping shielding
  - Valves shielding
  - Facility shielding
  - Hoppers shielding



➢ Ventilation reservations neutron shielding

➢ Gap compensating system for neutron shielding

➢ Pool / AEROBALL neutron shielding

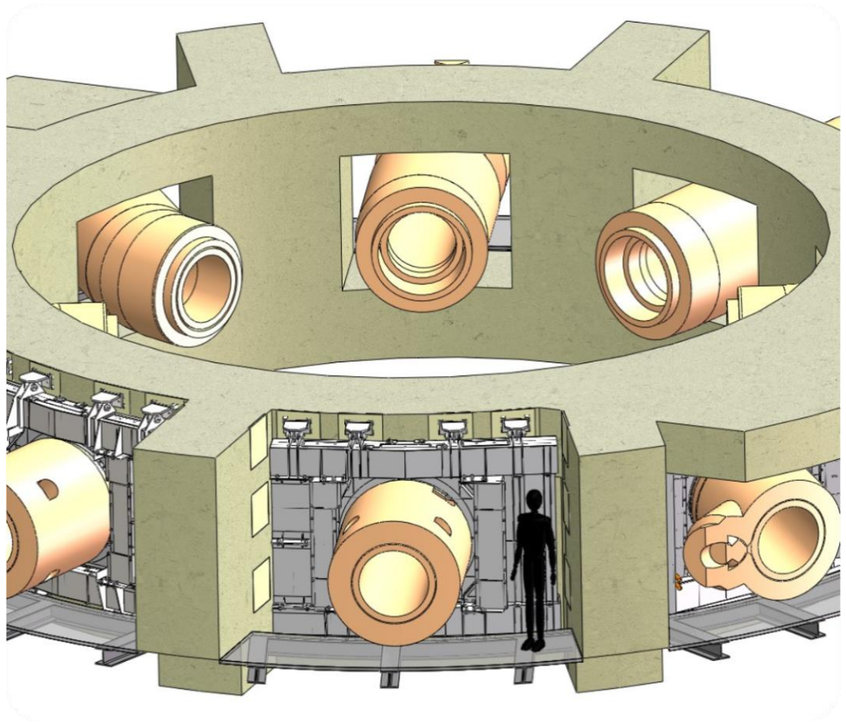
NEUTRON AND GAMMA RADIATION SHIELDING

EPR Taishan 1& 2

- Design, calculation, and manufacturing of gamma and neutron shielding systems for Taishan EPRs
  - Interface study and onsite 3D mapping
  - Design of shielding equipment
  - Engineering and safety validations (including seismic calculations)
  - Supply of complete on-site re-assembly procedures
  - Supply of operation and maintenance documentation
- Shielding can be disassembled and is comprised only of items weighing less than 25 kgs
- Procurement
- Fabrication and shop inspections
- Shop testing and complete assembly
- Conditioning and shipment

➢ Assembled neutron shielding

➢ Pool sluice gate



➢ Overall project view

ROBATEL

TRANSPORTATION AND STORAGE CASKS

“From the first ZOE reactor until today: 60 year of experience and counting”

TRANSPORTATION AND STORAGE CASKS

Providing turnkey solutions for radioactive material transportation

- Design and licensing of over 80 type B cask models with French and international safety authorities
- Design of multiples transportation packages: type A, IP2, IP3, type B(U), type B(M), fissile.
- Amendment and extensions of licenses
- Special arrangements or authorization letters
- Original patented techniques:
  - Neutron shielding : ROBATEL compounds n° 9™, 10™, 21™, 22™ , 23™, PNT7™, PNT3™
  - Thermal shield « thermal switch »
  - Triple gasket leak tightness
  - Transportation chassis
- Fabrication and testing
  - Design and fabrication of scale models
  - Performance of drop tests on our own certified target
  - Performance of Fire tests (800°C, 30 min)
- Fabrication of over 1000 casks since the 1960s






R72: SPENT FUEL ROD TRANSPORTATION - TYPE B(M) FISSILE CASK

Scope

- Design, licensing
- Fabrication of one cask and the supporting operation and maintenance ancillary equipment

Applications

- Transportation of up to ten highly irradiated spent fuel rods for research and development purposes
  - Fuel rods of type UO2 or MOX
  - Rods coming from PWR reactors 900, 1300 or 1450 MW
  - Capable of carrying EPR fuel rods
- International transportation made to research centers in
  - France, Italy, Switzerland , Germany, Sweden, Denmark, Spain
- Road or rail transportation

Key points

- Double containment enclosure (high standard water barrier) leaktight, during NCT and HAC:
  - Cask cavity closed by two leaktight lids
  - Independent internal canister closed by two shielded and leaktight plugs
- Possible wet Loading/unloading in a fuel pool
  - Immerged in a pool
  - Connected under a pool with a docking system
- Possible horizontal or vertical loading or unloading
- Delivered with a transportation chassis allowing cask rotation (to vertical or horizontal positions)
- Delivered with all the dedicated operation and maintenance tooling and equipment

Overall dimensions and weight: *(with shock absorbers)*

- Length : 6 255 mm (20,5')
- Diameter : 1 680 mm (5,51')
- Gross weight (loaded) : 21 500 kg (47 400 lbs)

Loading capacity:

- Cavity length : 5 330 mm (17,5')
- Cavity diameter : 140 mm (5,5'')
- Max payload : 650 kg (1 430 lbs)

Radiation shielding: *(lead equivalent thickness)*

- Radial: 210 mm (7,0'')

License: *(France + international licenses)*

- **UN 3329 - Type B(M) Fissile** : ADR + RID

➢ R72 cask on its transportation chassis

R73: Irradiated metals transportation and storage Type B(U) - EDF

Scope

- Design, licensing
- Fabrication of 37 casks
- Supply of all operation and maintenance equipment
- Cask maintenance services
- Cask license amendment for new contents

Applications

- Transportation of highly irradiated (HI) metallic hardware from the decommissioning of the first nuclear power plants generation
- Certified for road and rail transportation

Key points

- Very large loading capacity (2 250 kg / 790 L)
- Possibility to load waste in bulk
- Heavy radiation shielding
- Equipped with a secondary plug, shielded and sealed, located under the closure lid to ensure :
  - Gamma radiation shielding
  - Content activity containment even during the opening of the closure lid
- Delivered with a transportation chassis that is adapted for trailers and equipped with ISO corners
- Delivered with all operation tooling and equipment

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 2 370 mm (7,8')
- Diameter : 2 210 mm (7,3')
- Gross weight (loaded) : 23 900 kg (52 690 lbs)

Loading capacity:

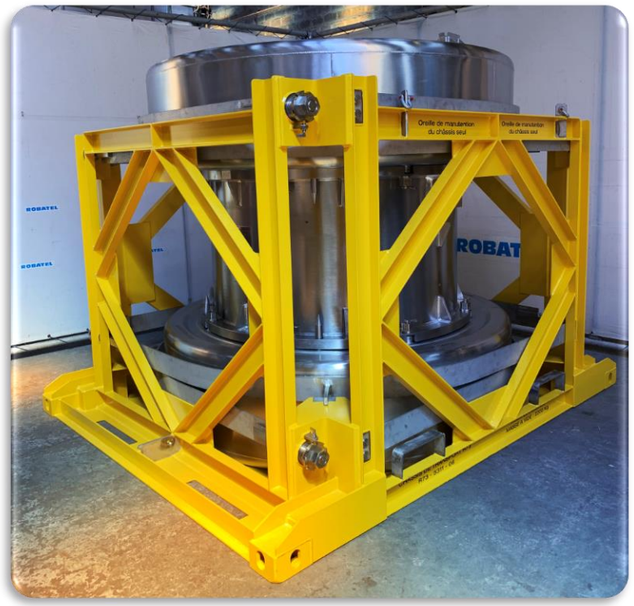
- Cavity height: 935 mm (3')
- Cavity diameter: 1 040 mm (3,4')
- Max payload: 2 250 kg (4 970 lbs)
- Max activity: 6 500 A2 / 12 700 TBq
- Max γ activity: 2 000 TBq / 1 TBq/kg (equivalent Co60).

Radiation shielding: ***(Lead equivalent thickness)***

- Radial : 220 mm (8,6'')

License:

- **UN 2916 - Type B(U)** : ADR + RID



➢ R73 cask

R74: Radioactive waste transportation - type B(U) cask

Scope

- Design, licensing
- Fabrication of two casks
- Design and fabrication of operation and maintenance equipment
- User technical assistance and maintenance services

Applications

- Radioactive wastes transportation between Scotland (Dounreay) and Belgium (SCK)
- For cemented wastes derived from spent fuel reprocessing

Key points

- Large loading capacity (3 x 500L drums)
- Chassis equipped with ISO corners to facilitate transportation
- International Transportation

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 2 350 mm (7,3')
- Diameter : 2 710 mm (9,0')
- Gross weight (loaded) :24 500 kg (54 080 lbs)

Loading capacity:

- Cavity height: 1 320 mm (4,4')
- Cavity diameter: 1 780 mm (5,9')
- Max payload: 4 280 kg (9 430 lbs)
- Max activity: 80 TBq / 320 A2
- max γ activity: 75 TBq (équivalent Cs137)

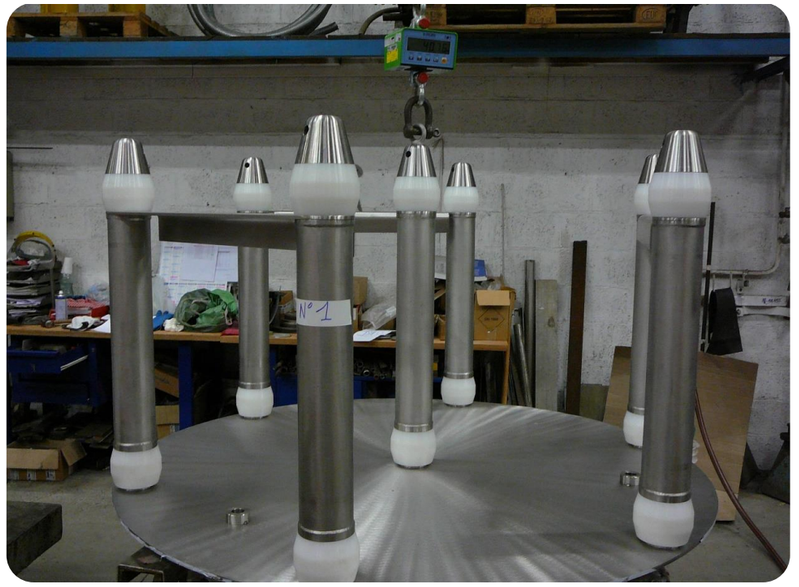
Radiation shielding: ***(lead equivalent thickness)***

- radial : 85 mm (3,4'')

License:

- **UN 2916 - Type B(U)** : ADR + RID + IMDG

➢ R74 cask on its transportation chassis



➢ R74 basket

R75: Transportation of control rod guide tubes Type B(U) cask - EDF

Scope

- Design, licensing
- Fabrication of one cask
- User technical assistance and maintenance services
- Fabrication and supply of operational tooling and equipment

Applications

- Transportation of 5 irradiated control rod guide tubes
  - Activated and contaminated metallic hardware
  - Coming from PWR 900, 1300 or 1450 MW
- Certified for road transportation

Key points

- Optimized shielding following the control rod guide tube activation dose rate profiles
- Loading and unloading under water in the vertical position
- Transportation chassis facilitates rotation of the cask to the vertical or horizontal position, and is equipped with ISO corners
- Modular basket allows for the transportation of different types of guide tubes

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 4 755 mm (15,6')
- Diameter : 2 100 mm (6,7')
- Gross weight (loaded : 24 080 kg (53 090 lbs)

Loading capacity:

- Cavity height: 4 540 mm (14,9')
- Cavity diameter : 880 mm (2,9')
- Max payload : 2 225 kg (4 905 lbs)
- Max activity : 13 A2
- Max γ activity:10 TBq, 80 GBq/kg. (equivalent Co60).

Radiation shielding: ***(lead equivalent thickness)***

- Max radial : 130 mm (5,1'')

License:

- **UN 2916 - Type B(U)** : ADR

➢ R75 cask on its transportation chassis

R76: Transportation of legacy wastes - type B(M) cask - CEA

Scope

- Design, licensing
- Fabrication of four casks

Applications

- Road transportation of two to five drums containing HLW and ILW:
  - Activated and contaminated wastes, metallic, mineral, or organic wastes
  - Drum capacities from 60L to 200L each
  - Modular internals (basket, shield plugs)

Key points

- An extremely robust containment boundary
  - Withstands an internal hydrogen explosion (demonstrated by actual explosion testing)
- Useful capacity, heavy shielding, and equipped with secondary shield plugs
  - Allowing for continuous radiation shielding even during loading operations
- Triple gasket leaktight system
- Additional impact limiting feature added to the cask body for lifting and handling operations performed on site

Overall dimensions and weight: *(with shock absorbers)*

- Height : 2 215 mm (7,3')
- Diameter : 2 210 mm (7,3')
- Gross weight (loaded) : 20 150 kg (44 420 lbs)

Loading capacity:

- Cavity height: 655 mm (2,15')
- Cavity diameter: 1 100 mm (3,6')
- Max payload: 920 kg (2 030 lbs)
- Max activity: 36 000 A2 / 100 A2/kg
- Max γ activity : 125 TBq *(equivalent Co60)*

Radiation shielding: *(lead equivalent thickness)*

- Radial : 185 mm (7,3'')

License:

- **UN 3329 - Type B(M) Fissile** : ADR

➢ R76 cask leakage tests

➢ R76 casks

R77s: Transportation of alpha wastes – ORANO Cycle

Scope

- Design and certification for the ORANO La Hague on-site transportation
- Fabrication of one cask

Applications

- « Onsite » cask for the transportation of alpha waste drums
  - 4 x 120 L drums
  - 1 x 460 L drum
- Modular inner shoring
- Fissile materials transportation allowed

Key points

- Large cubical cavity (≈1580 L)
- Spherical shock absorber
- Designed specifically to respond to site constraints and specific needs (interfaces, loading methods)

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 1 702 mm (5,6')
- Width : 1 876 mm (6,1')
- Gross weight (loaded) : 3 500 kg (7716 lbs)

Loading capacity:

- Cavity height: 1 220 mm (4')
- Cavity width : 1 140 mm (3,7')
- Max payload : 725 kg (1 600 lbs)
- Max activity: 20 000 A2
- Max dose rate$_{\text{at drum contact}}$: 12mSv/h

License:

- **Certified for ORANO site transportation**

➢ R77s cask

➢ R77s cask body

R79: Transportation of radioactive wastes - Type B

Scope

- Design, Licensing
- Fabrication of six casks
- User technical assistance and maintenance services

Applications

- Transportation of Petten site historical wastes to COVRA (Netherlands)
- Certified for road transportation

Key points

- Modular cask that can change package type depending on the loaded contents:
  - IP1, IP2, IP3, Type B(U) or Tube B(M) according to the contents
  - Compatible with the transportation of three casks at a time on a trailer (in IP1, IP2, IP3 configurations)
  - Compatible with the transportation of up to two casks on a trailer (in Type B configurations)
- Shock absorbing material: FENOSOL™

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 2 111 mm (6,9')
- Diameter : 1 700 mm (5,6')
- Gross weight (loaded) : 10 094 kg (22253 lbs)

Loading capacity:

- Cavity height : 1 060 mm (3,5')
- Cavity diameter : 650 mm (2,1')
- Max payload : 300 kg (661 lbs)
- Max activity : 3 000 A2
- Max γ activity : 125 TBq (equivalent Co60)

Radiation shielding: ***(Lead equivalent thickness)***

- Radial: 150 mm (5,9 '')

License:

- **UN 2916 - Type B(U)** : ADR
- **UN 2917 - Type B(M)** : ADR

➢ R79 cask

➢ R79 cask on trailer

R80: Transportation of multiple radioactive wastes - type B

Scope

- Design, licensing
- Fabrication of two casks

Applications

- For all transportation means: road, rail, water, air
- For multiple waste streams and forms

Key points

- Modular type B cask:
  - IP2 without shock absorber, and type B with shock absorber
  - Transportation of up to three casks per truck shipment (IP configuration)
  - Transportation of up to two casks per truck shipment (Type B configuration)
- Several cask versions
  - Standard version « ST » : Large loading capacity
  - Standard version « ES » : maximized shielding
  - Option for embedded drainage feature « STW »
- Equipped with a shielded plug for radioprotection during lid removal and closure
- Shock absorbing material: FENOSOL™

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 2 111 mm (6,9')
- Diameter : 1 700 mm (5,6')
- Gross weight (loaded) : 11 000 kg (25250 lbs)

Loading capacity:

- Cavity height :
  - STW: 1 154 mm (3,8')
  - ESW: 1 004 mm (3,3')
- Cavity diameter:
  - STW: 788 mm (2,6')
  - ESW: 670 mm (2,2')
- Max payload:
  - STW: 2 145 kg (4728 lbs)
  - ESW: 600 kg (1322 lbs)
- Max activity: up to 100 000 A2
- Max γ activity : 42 TBq (equivalent Co60)

Radiation shielding: ***(lead equivalent thickness)***

- Radial :
  - STW: 85 mm (3,3'')
  - ESW: 140 mm (5,5'')

License:

- **UN 2916 - Type B(U)**

➢ R80 cask

➢ R80 cask on trailer

R83: Spent fuel and wastes transportation - Type B - NRG

Scope

- Design, licensing
- Fabrication of two casks
- Fabrication and supply of all cask operation equipment
- User technical assistance and maintenance services

Applications

- Transportation of:
  - Spent fuel assemblies / Control rod blades : up to 37 per cask
  - Spent filters (from Mo99 production facility) : up to 96 per cask
- Certified for road transportation

Key points

- Wet loading (immersion in a pool)
- Modular internal baskets and shoring
- Baskets made of Stainless steel or borated stainless steel
- Shock absorbing material: FENOSOL™

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 2 145 mm (7')
- Diameter : 2 050 mm (6,7')
- Gross weight (loaded) : 16 260 kg (35850 lbs)

Loading capacity:

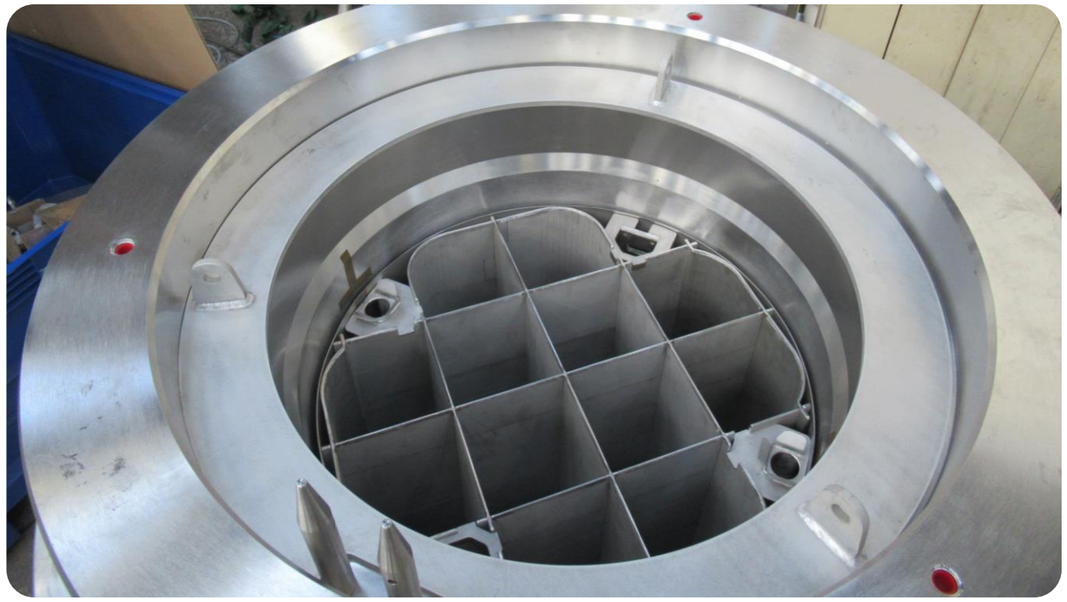
- Cavity height: 950 mm (3,1')
- Cavity diameter: 743 mm (2,4')
- Max payload: 1 000 kg (2205 lbs)
- Max activity: 20 900 A2
- Max γ activity : 62 TBq (equivalent CS137)

Radiation shielding: ***(lead equivalent thickness)***

- Radial : 175 mm (6,9 '')

License :

- **UN 3328 - Type B(U)** : ADR



➢ R83 basket in its cask

➢ R83 cask

R85: Transportation of control rod guide tubes - Type B - EDF

Scope

- Design, obtaining approval
- Manufacture of 10 units
- Manufacture and supply of operating tools
- Technical assistance services for users and maintenance

Applications

- Transport of 21 control rod guide tubes
- Transport by road

Key points

- Adapted for 900, 1300 or 1450 MW power reactor guide tubes

Overall dimensions and weight: ***(with shock absorbers)***

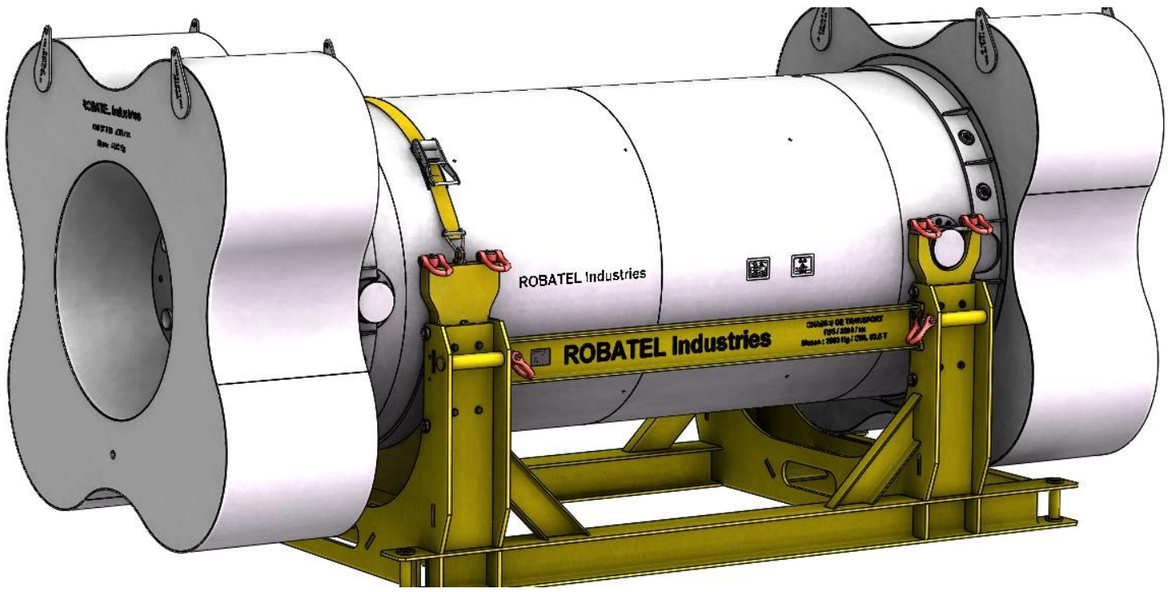
- Height : 4 980 mm (16,3')
- Diameter : 3 170 mm (10,4')
- Gross weight (loaded) : 54 692 kg (120 575 lbs)

Loading capacity:

- Cavity height: 4 535 mm (14,9')
- Cavity diameter: 1 580 mm (5,2')
- Max payload: 10 116kg (22 301 lbs)
- Max activity: 7,5 A2
- MAx γ activity : 7,5 TBq (équivalent CS137)

Radiation shielding: ***(lead equivalent thickness)***

- Radial : 103 mm (4,1 '')



➢ R85 cask on its transportation chassis

RT100: Transportation of Spent resins and filters - Type B(U) – WCS (USA)

Scope

- Design, licensing
- Fabrication of four casks following ASME code and NQA-1
- Fabrication and supply of operational equipment and tooling
- User training on US NPPs and nuclear facilities
- Annual maintenance of the cask fleet
- Technical assistance and corrective maintenance services
- License amendment for transportation of new contents

Applications

- Transportation of class B & C wastes
  - Spent resins
  - Spent filters
- Certified for road transportation

Key points

- Large Loading capacity (6804 Kg)
- Can withhold and transport a wide variety of secondary containers up to size HIC 10-160

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 3 320 mm (131'')
- Diameter : 2 587 mm (8,5')
- Gross weight (loaded) : 41 500 kg (91491 lbs)

Loading capacity:

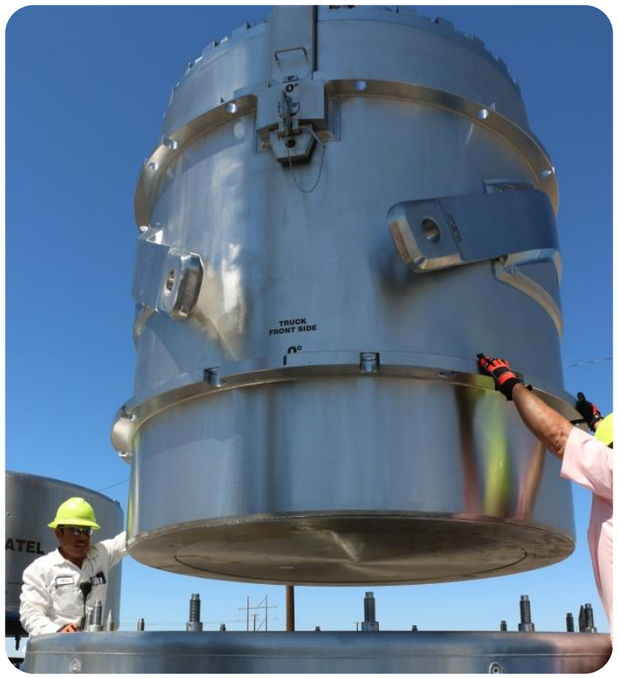
- Cavity height: 1 956 mm (77'')
- Cavity diameter : 1 730 mm (68'')
- Max payload : 6 804 kg (15 000 lbs)
- Max radiation shielding: 500 R/hr
- Max activity: 3 000 A2

Radiation shielding: ***(lead equivalent thickness)***

- Radial : 135 mm (5,2'')

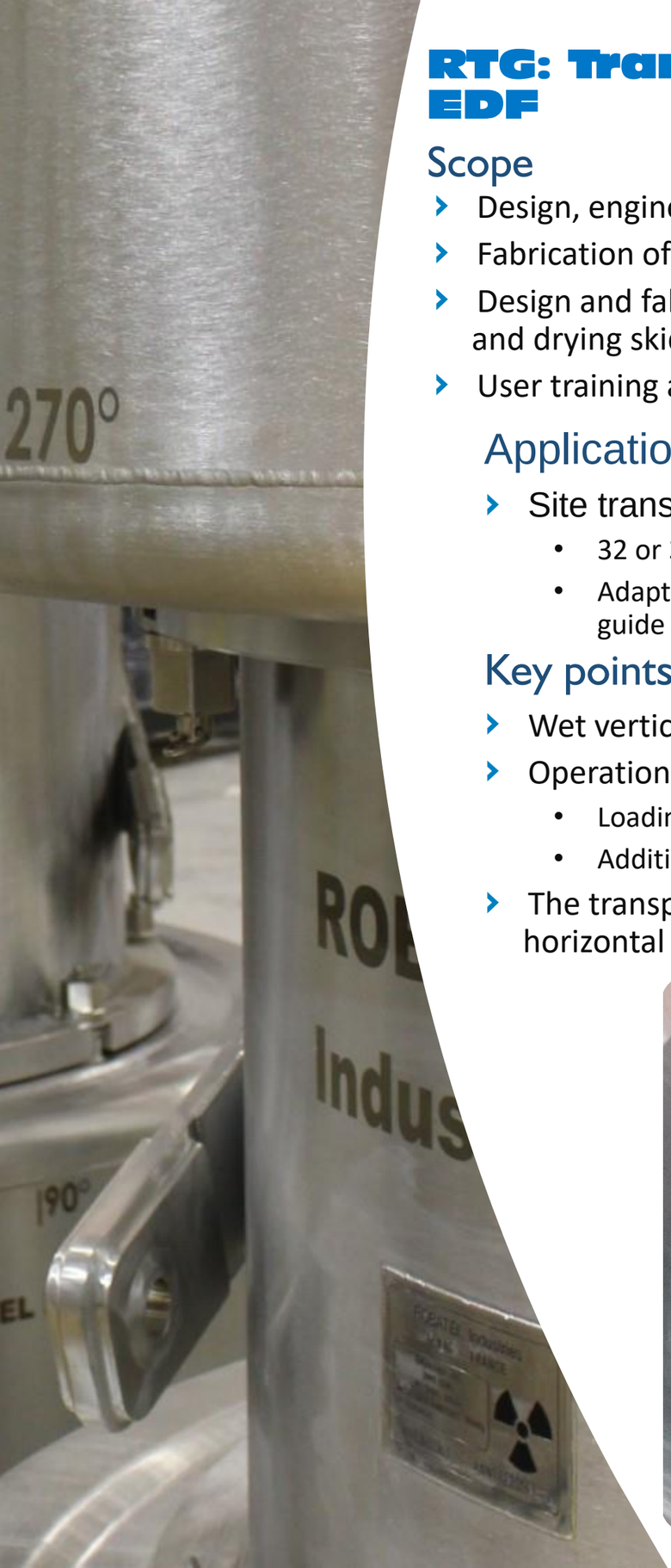
License:

- **USA/9365/B(U)-96**



➢ Handling RT100

➢ RT100 cask on its dedicated trailer



RTG: Transportation and storage of guide tubes - onsite - EDF

Scope

- Design, engineering validation
- Fabrication of fifteen casks and their internals
- Design and fabrication of ancillary equipment including draining and drying skid, worker platform, lifting fixture, tools
- User training and technical assistance

Applications

- Site transportation and interim dry storage
  - 32 or 33 irradiated and contaminated guide tubes
  - Adapted for 900, 1300 or 1450 MW power reactor guide tubes

Key points

- Wet vertical loading
- Operation tooling and equipment supplied
  - Loading kit, draining and drying skid and leak testing equipment
  - Additional worker radiation shielding
- The transport chassis allows for rotation to the vertical or horizontal positions

Overall dimensions and weight: ***(with shock absorbers)***

- Height : 5025 mm (16,5')
- Diameter : 2480 mm (8,1')
- Gross weight (loaded) : 57 000 kg (125 700 lbs)

Loading capacity:

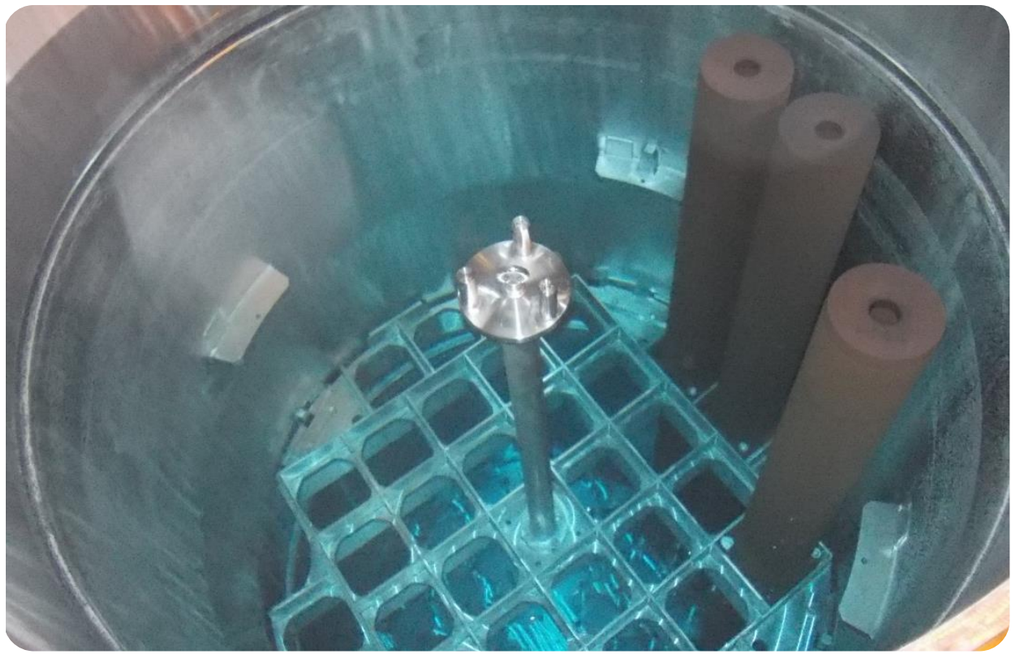
- Cavity height: 4505 mm (14,8')
- Cavity diameter: 1940 mm (6,4')
- Max payload: 12000 kg (26456 lbs)
- Max activity: 70 A2
- Max γ activity : 18 TBq (equivalent Co60)

Radiation shielding: ***(lead equivalent thickness)***

- Radial : 100 mm max (3,9'')

Certification:

- **Ti2** : (EDF directive)



➢ Under water loading tests

➢ RTG 32 cask

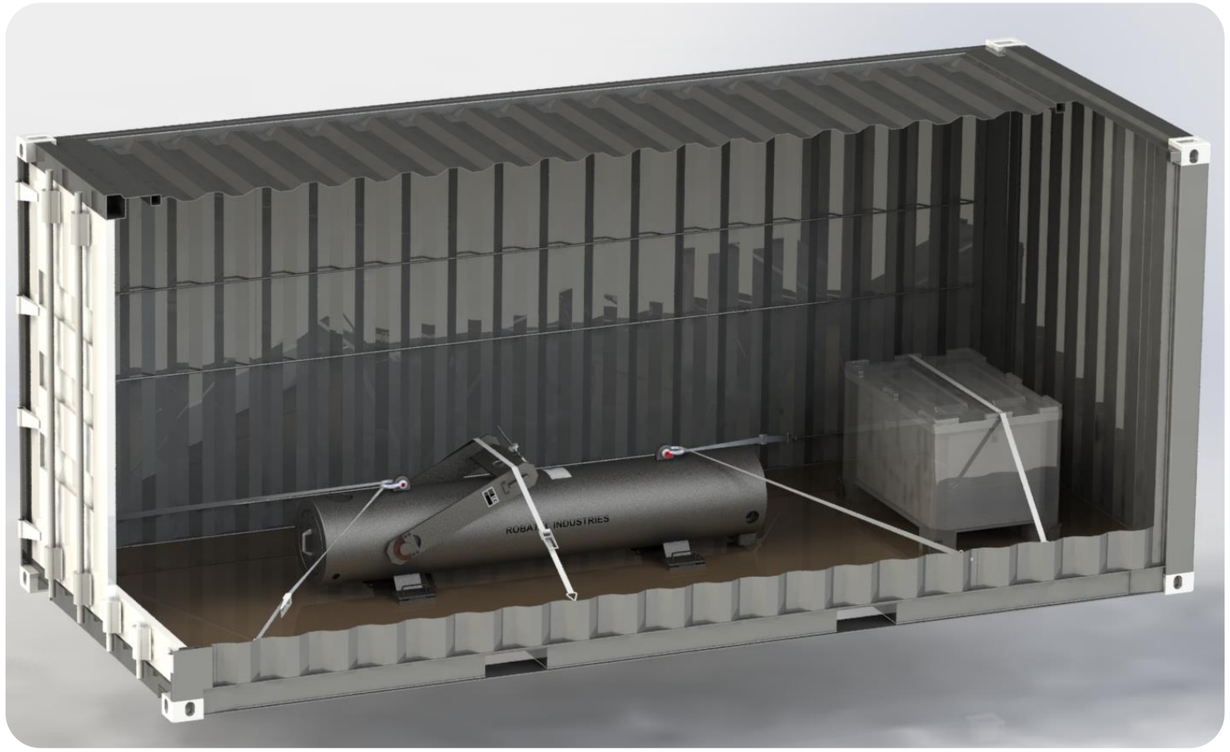
RA03: Transport of PSI capsules - Site packaging - EDF

Scope

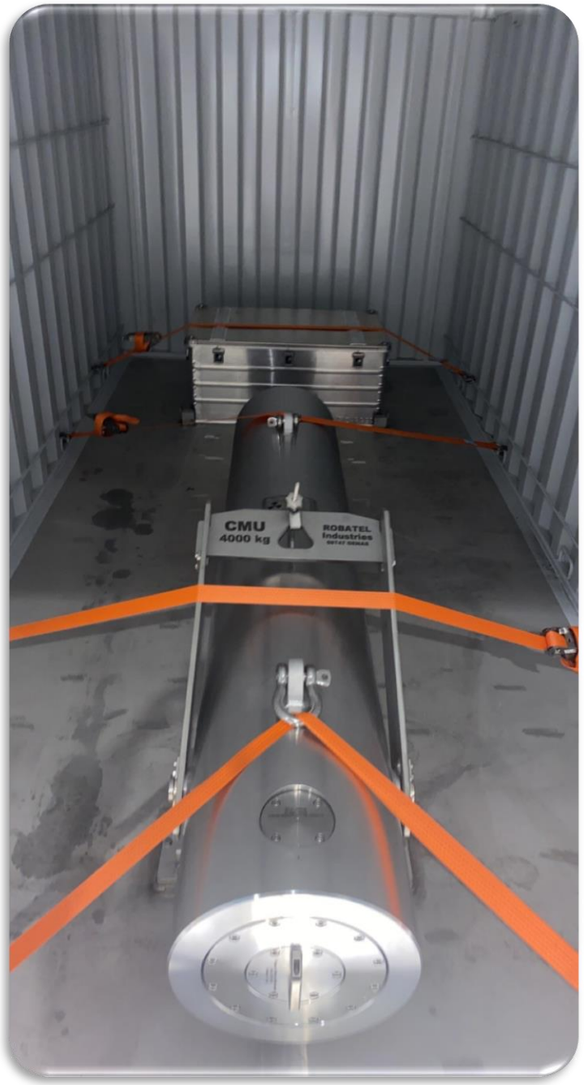
- Design and certification of conformity type A
- Manufacture of one copy

Applications

- Transport of EPR capsules
- Transport of small irradiating objects



➢ PSI RA03 packaging in its container (CAD model)



➢ PSI RA03 packaging in its container (real cask)

TRANSPORTATION AND STORAGE CASKS

Serial production

- EDF CIDEN – Design, certification and fabrication of 58 PNL casks

- Spent fuel storage racks and baskets

- CEA : 10 type B R64 casks for the transportation of neutron sources

- EDF – 900 x 30B and 48Y casks - for UF_6 transportations

ROBATEL Industries
12 rue de Genève CS 80011
F-69747 GENAS Cedex
FRANCE

Tél. +33(0)4.72.22.10.10

commercial@robatel.fr
www.robatel.fr