The Superconducting prototype LINAC for IFMIF

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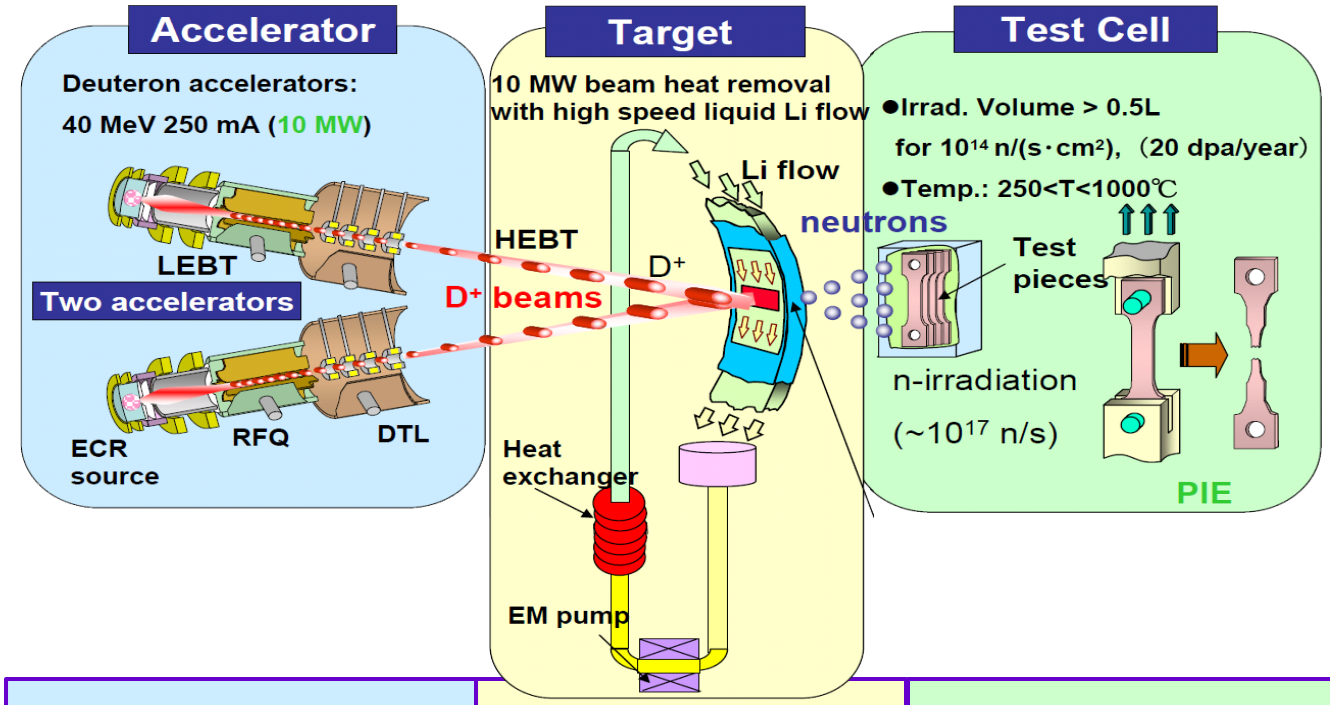
For the Accelerator Activities of
the IFMIF-EVEDA collaboration

The IFMIF Project

(International Fusion Materials Irradiation Facility)

Objective of the project: characterization of materials with intense neutrons flux (10^{17} n/s) for the future Fusion Reactor DEMO (~150 dpa)



• **CEA (France)** • CIEMAT (Spain) • INFN (Italy) • SCK-CEN (Belgium)	• **ENEA (Italy)** • CIEMAT (Spain) • SCK-CEN (Belgium)	• **FZK (Germany)** • CIEMAT (Spain) • SCK-CEN (Belgium) • EPFL (Switzerland)

The IFMIF/EVEDA program

Launched in 2007 for 6 years

Agreement between Euratom & Government of Japan

Objectives of the IFMIF/EVEDA Accelerator Activities

1. **Validate the technical options for the construction of an accelerator prototype, with a full scale of one of the IFMIF accelerator, from the injector to the first DTL** → installation and «commissioning» up to the nominal current at Rokkasho (Japan)

2. **Provide a complete Engineering Design Report for the construction of the IFMIF accelerators**

- Components of the accelerator prototype are provided by European institutions:

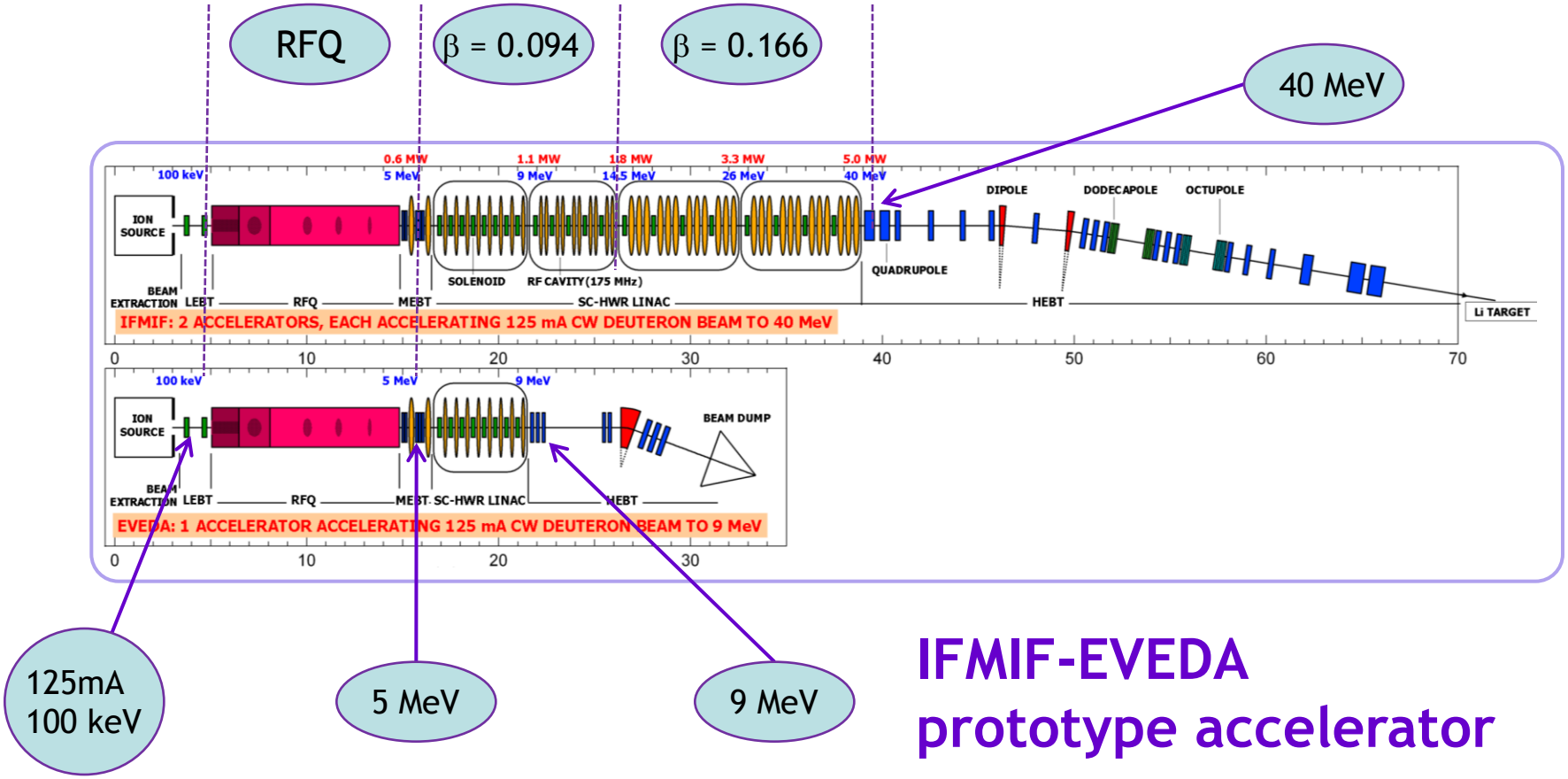
  CEA, INFN, CIEMAT, SCK-CEN: Injector, RFQ, SC-DTL, Beam Transport Lines & Beam Dump, RF System at 175 MHz, Local Control System and Beam Instrumentation

- Building on the Rokkasho site, Control System Supervision, and RFQ couplers are provided by **JAEA**

F=175 MHz: RFQ and cavities

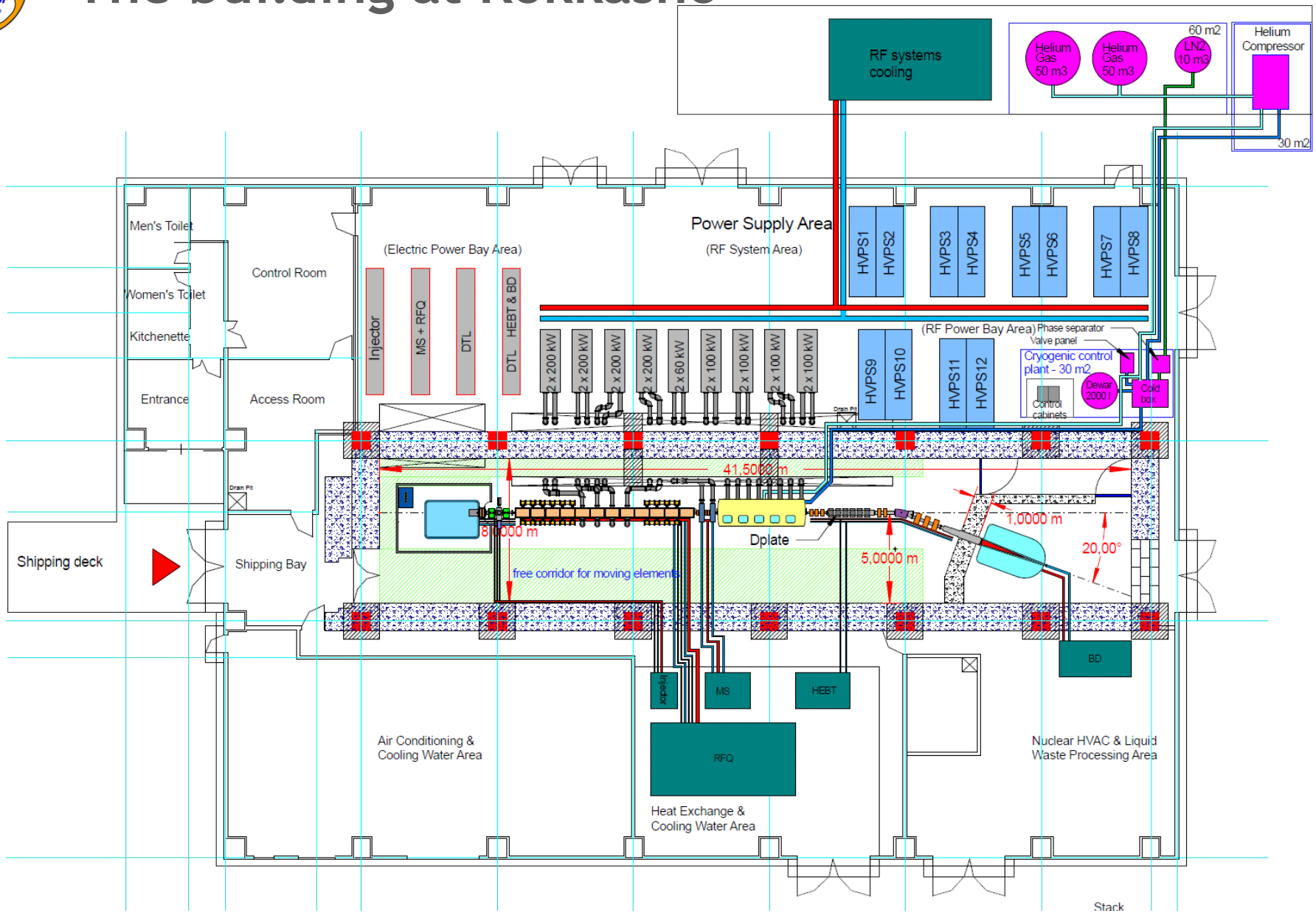
Superconducting HW cavities

One IFMIF accelerator

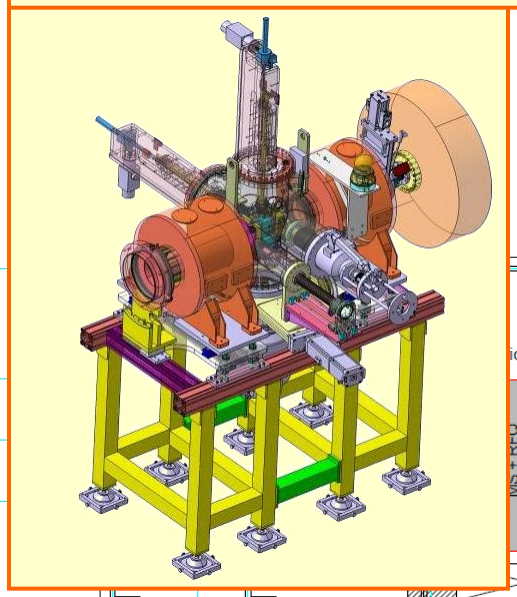


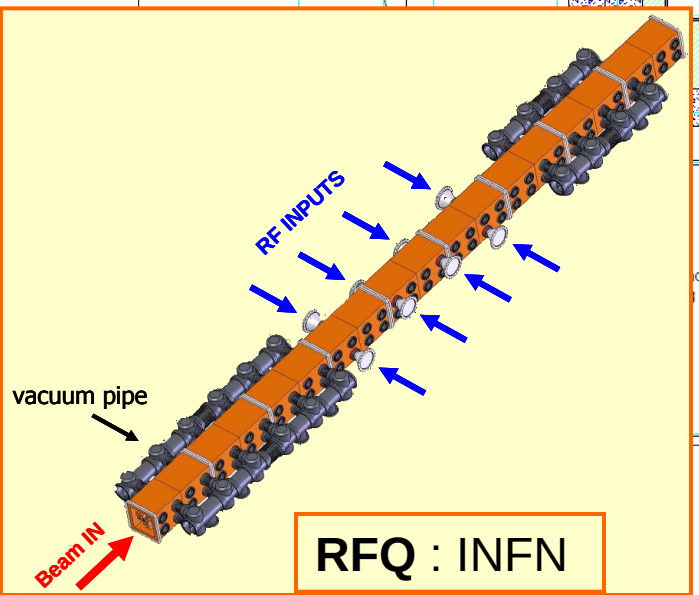
IFMIF-EVEDA prototype accelerator

The building at Rokkasho

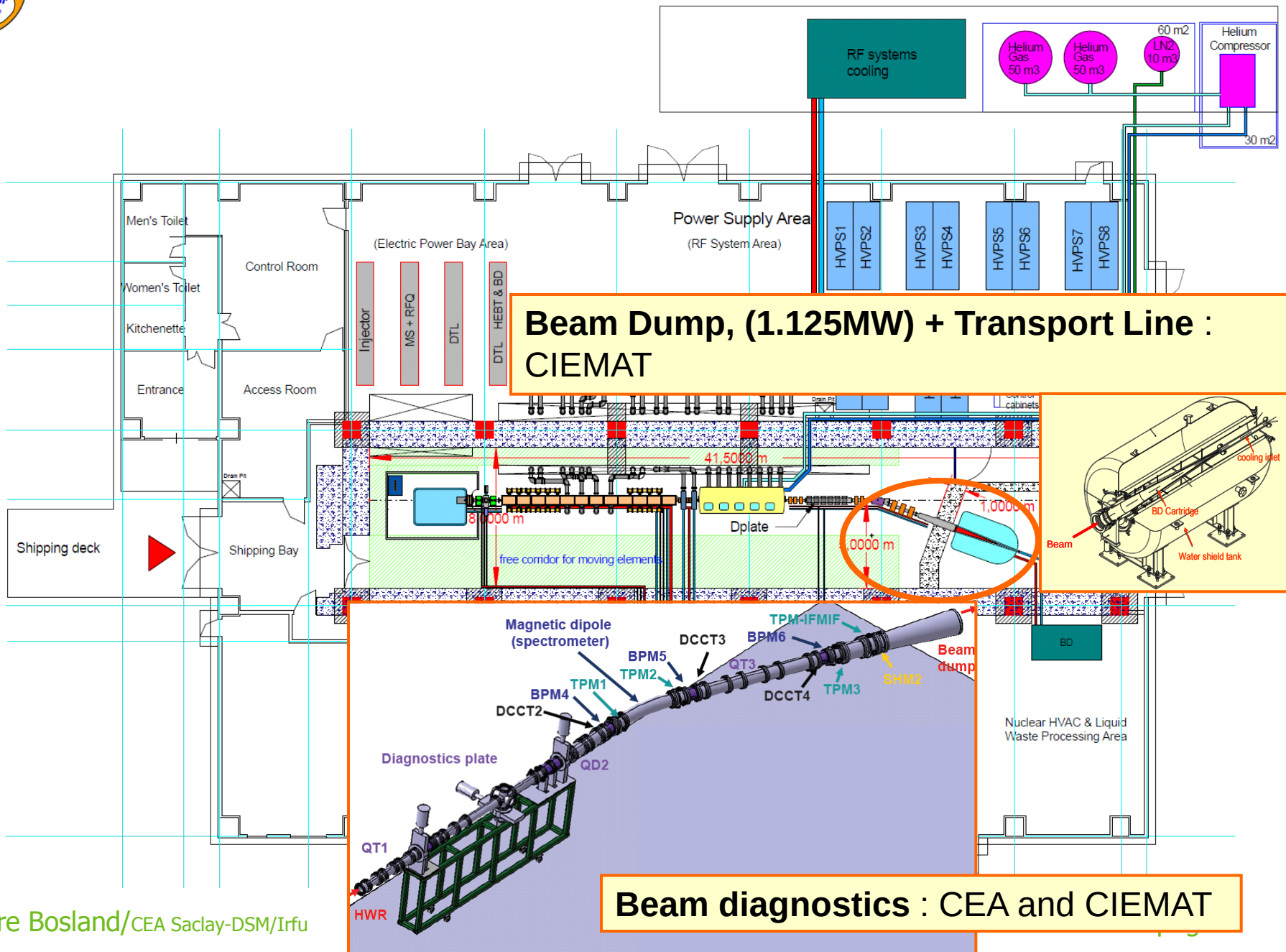


Injector (source + LEBT): CEA



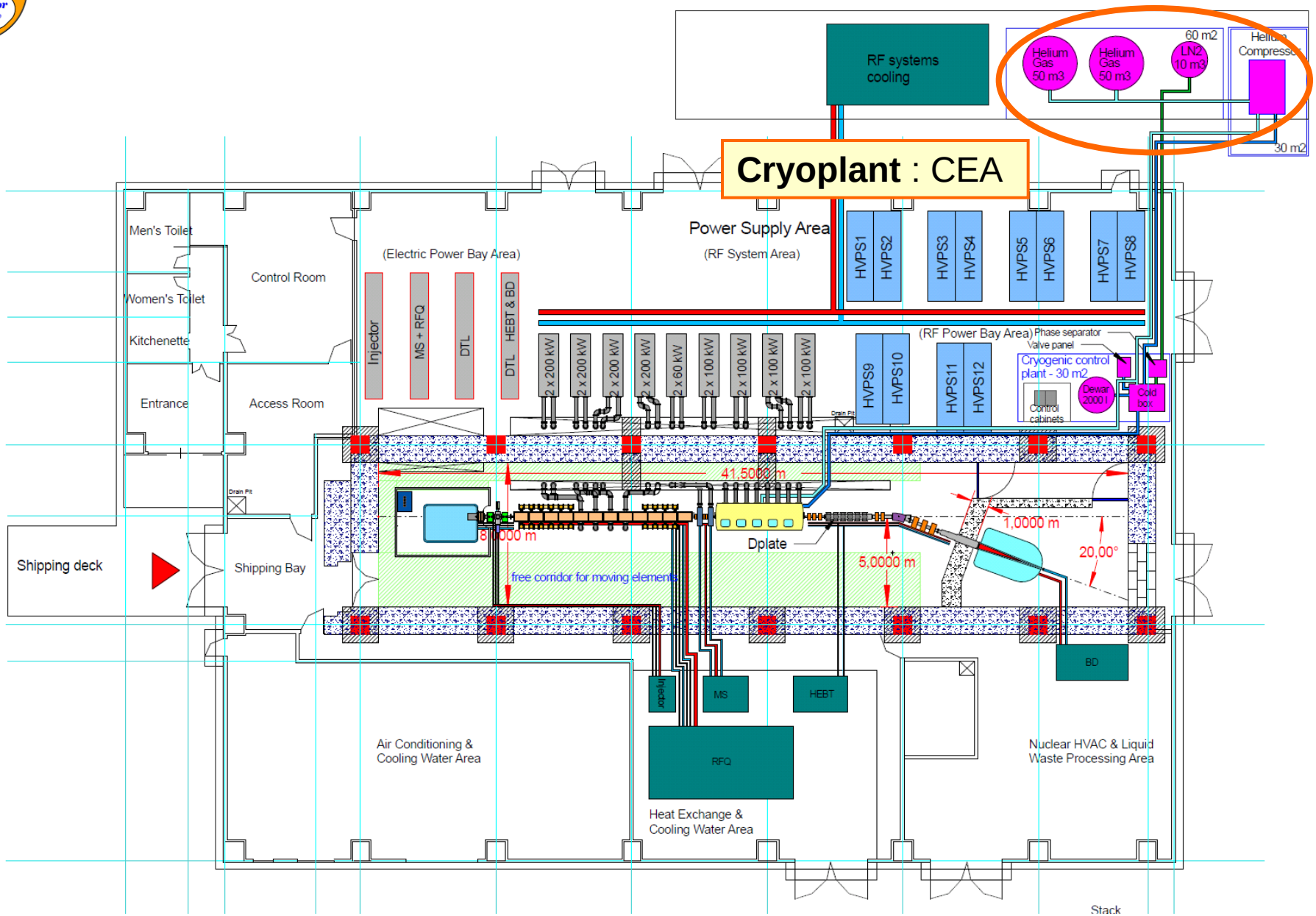


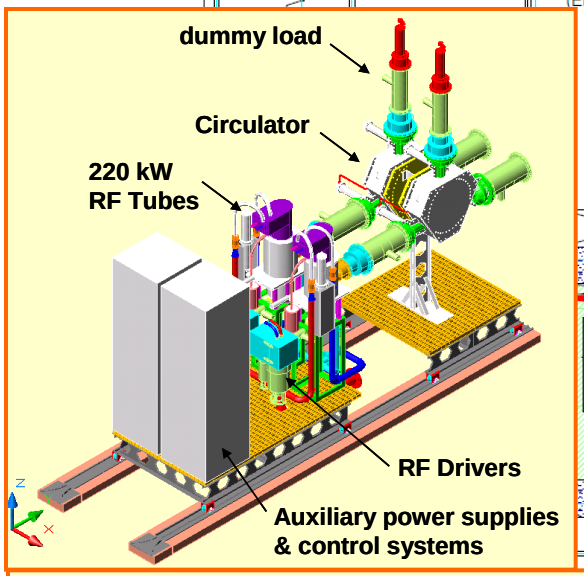
RFQ : INFN



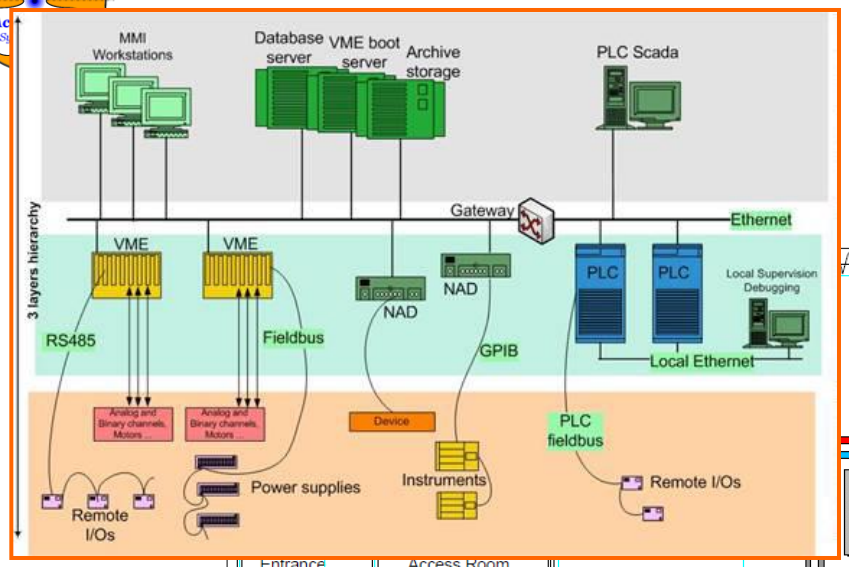
Beam Dump, (1.125MW) + Transport Line : CIEMAT

Beam diagnostics : CEA and CIEMAT

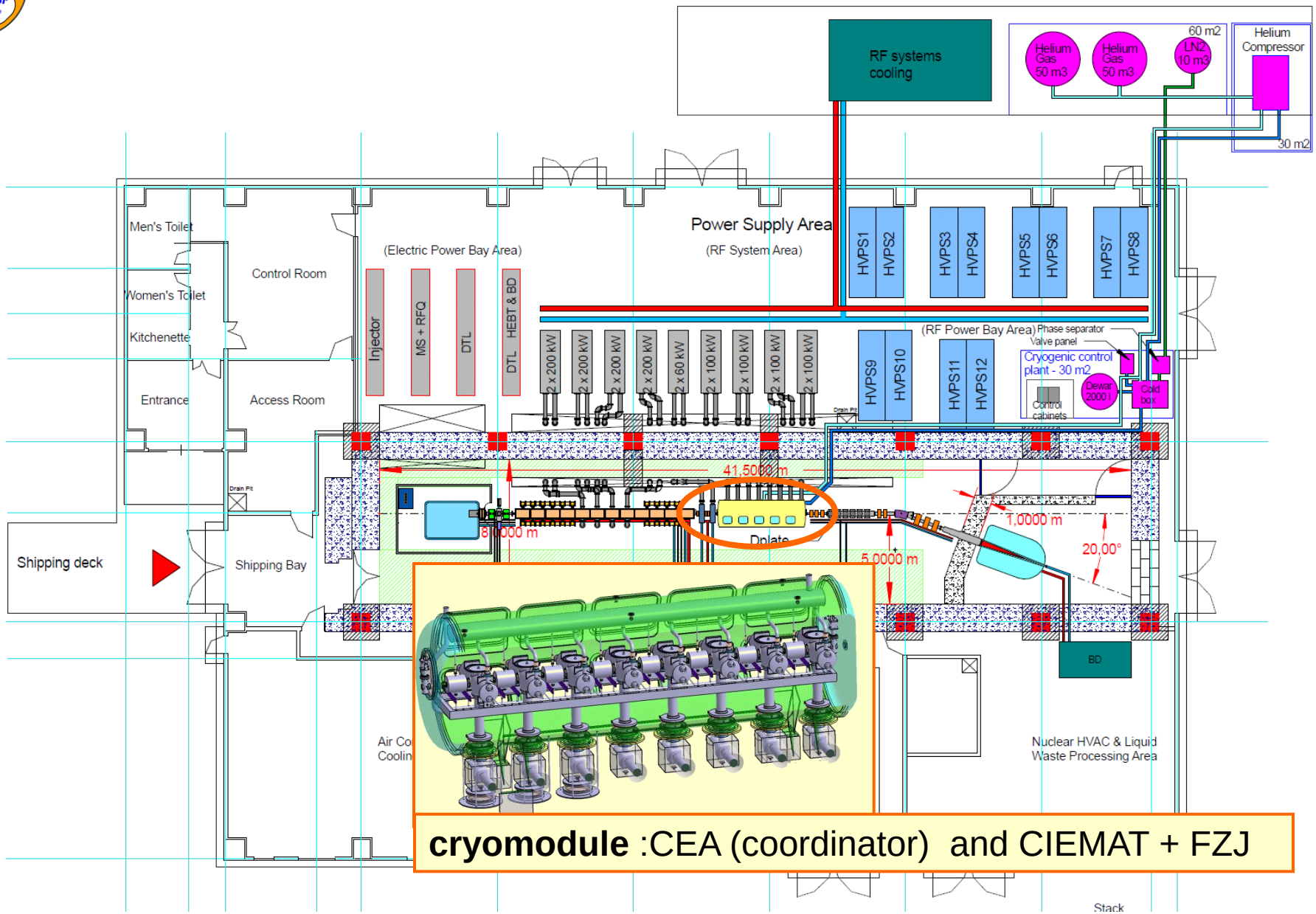

RF systems cooling
Helium Gas 50 m3
Helium Gas 50 m3
LN2 10 m3
60 m2
Helium Compressor
30 m2
Cryoplant : CEA
Men's Toilet
Women's Toilet
Kitchenette
Entrance
Control Room
Access Room
(Electric Power Bay Area)
Power Supply Area
(RF System Area)
HVPS1
HVPS2
HVPS3
HVPS4
HVPS5
HVPS6
HVPS7
HVPS8
Injector
MS + RFQ
DTL
DTL HEBT & BD
2 x 200 kW
2 x 200 kW
2 x 200 kW
2 x 200 kW
2 x 60 kW
2 x 100 kW
2 x 100 kW
2 x 100 kW
2 x 100 kW
(RF Power Bay Area)
HVPS9
HVPS10
HVPS11
HVPS12
Phase separator
Valve panel
Cryogenic control plant - 30 m2
Dewar 2000 l
Cold box
Control cabinets
Drain Pit
41,5000 m
8,0000 m
Dplate
1,0000 m
20,00°
5,0000 m
free corridor for moving elements
Shipping deck
Shipping Bay
BD
Injector
MS
HEBT
RFQ
Air Conditioning & Cooling Water Area
Heat Exchange & Cooling Water Area
Nuclear HVAC & Liquid Waste Processing Area
Stack



RF Power : CIEMAT (coordinator) ,CEA, and SCK-CEN



Control system :CEA



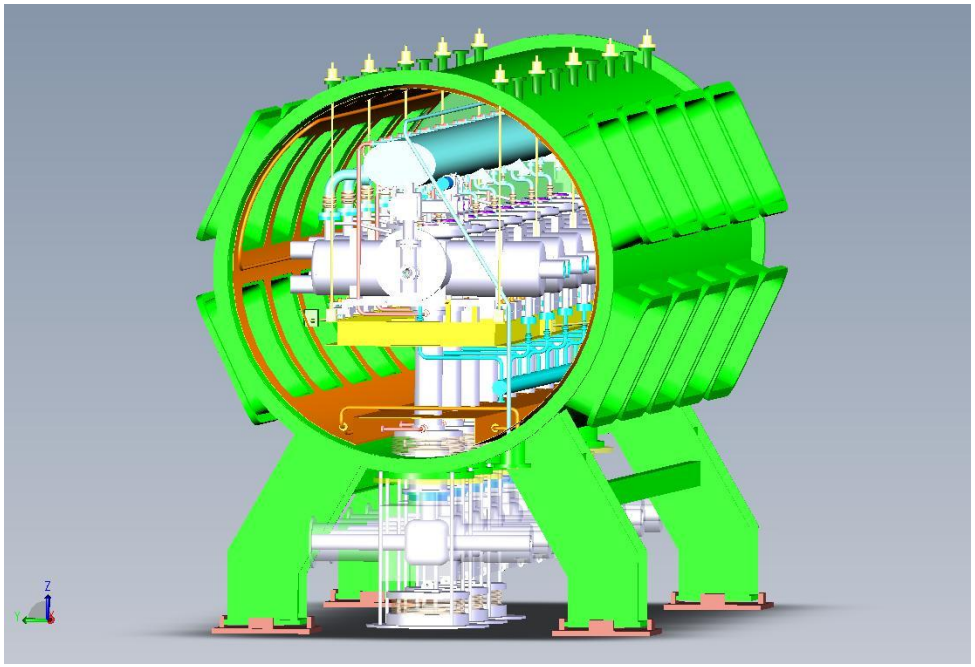
cryomodule :CEA (coordinator) and CIEMAT + FZJ

The cryomodule IFMIF/EVEDA

Length ~5 meters

Weight ~ 10 tons

Diameter: 1.5 m



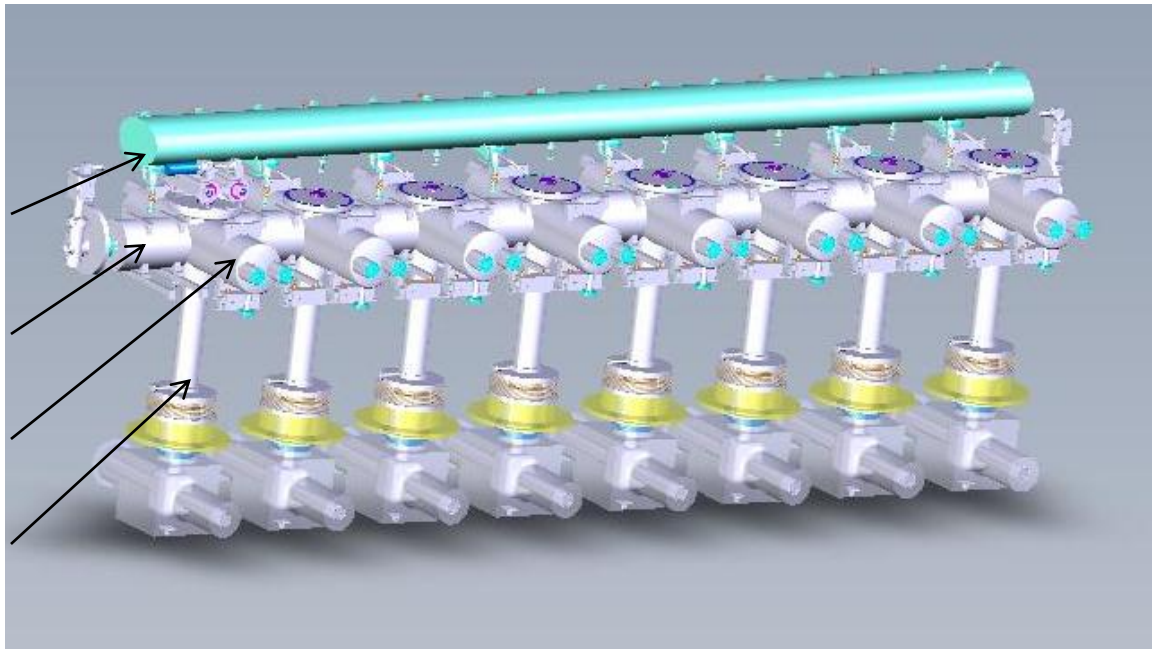
- 8 cavities: HWR at 175MHz – β = 0.094 - E_{acc} = 4.5MV/m maximum
- 8 power couplers: 70 kW CW (same couplers at 200 kW for IFMIF)
- 8 solenoid packages: superconducting solenoids + BPM + steerers

Helium phases separator

Solenoid package

Cavity

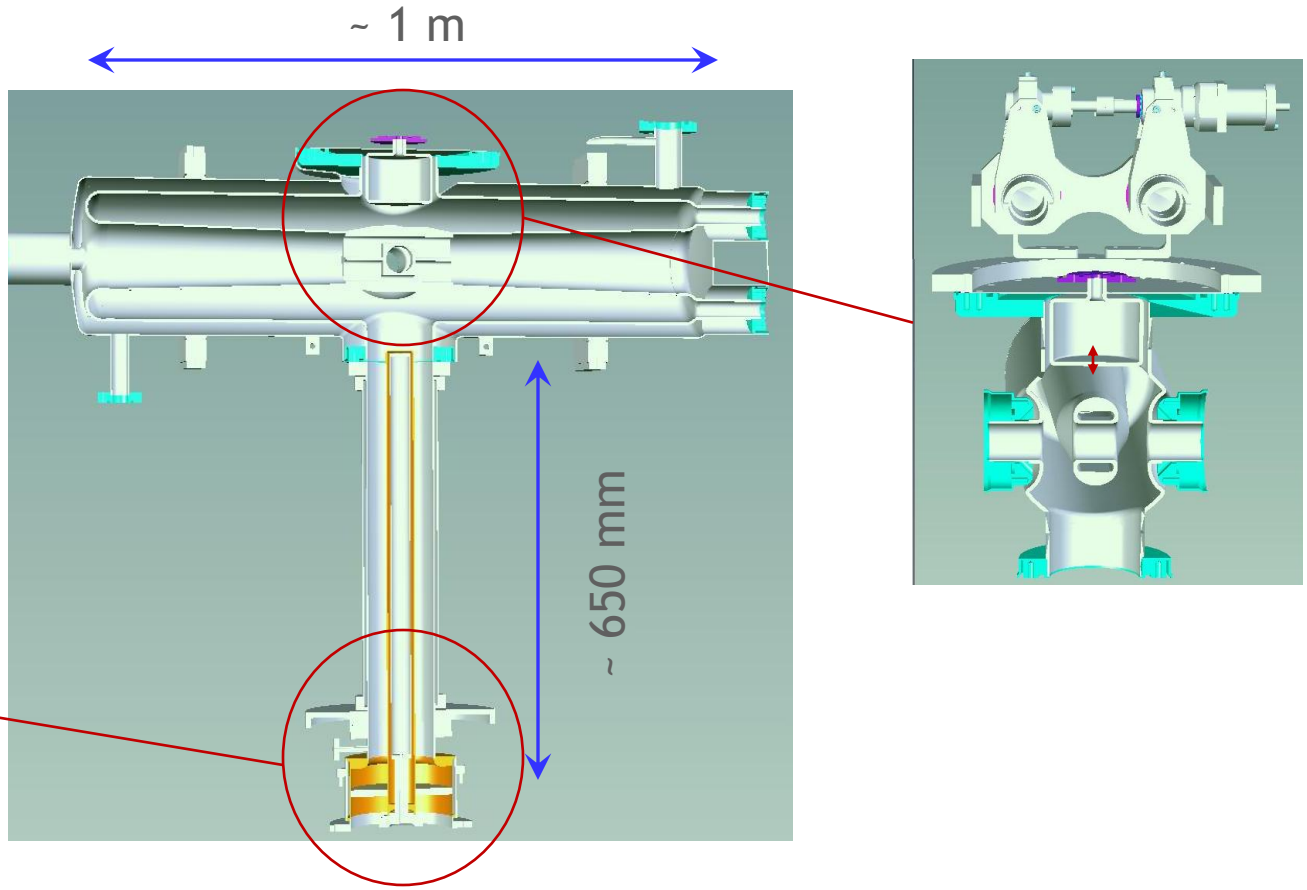
Power coupler



- ***Horizontal position of the cavities*** + vertical position of the power couplers
  - ⇒ minimize the risk on the coupler ceramic window during transport to Japan (very small risk of bad cooling of the cavity)
  - ⇒ large volume above the cavities for tuners and cryogenic pipes
  - ⇒ cylindrical vacuum tank
- Cavity tuners: ***plunger in the electric field region*** ± 50 kHz tuning range
- Cavity vacuum ⇔ insulating vacuum: **separate vacuum**

The cavity/tuner design: Evgeny ZAPLATIN - ***THPPO015***

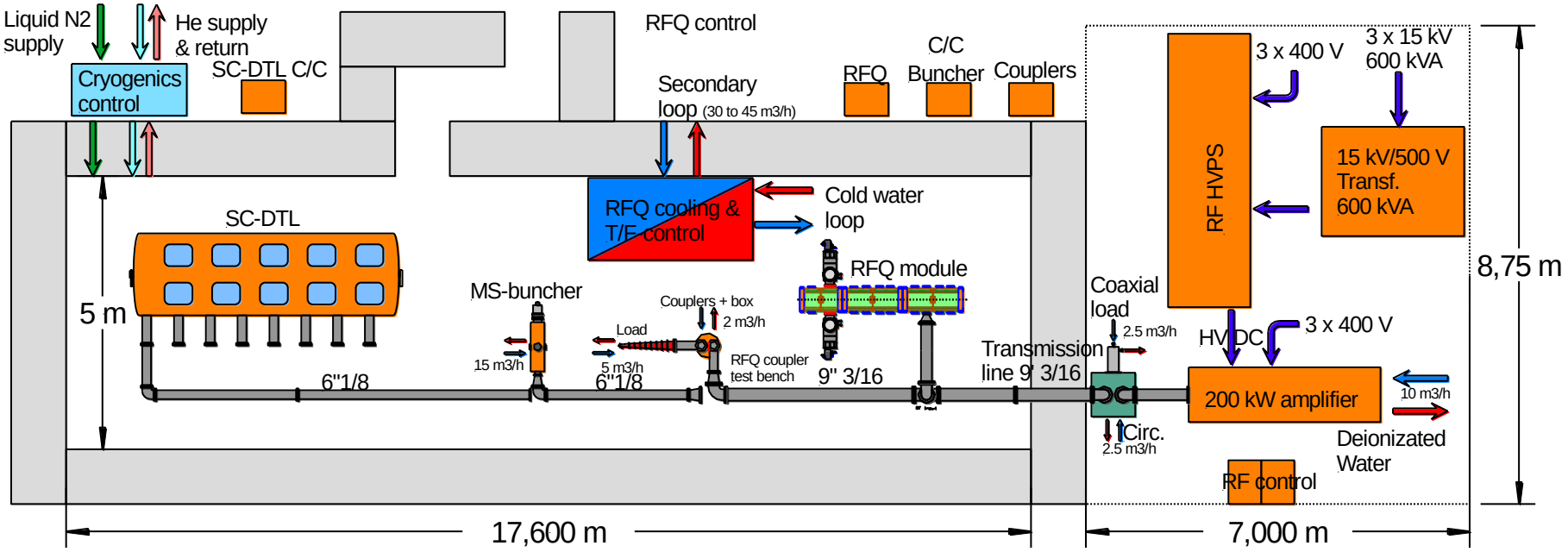
"IFMIF-EVEDA SC beta=0.094 Half-Wave Resonator Study"



The coupler design: Juliette PLOUIN - ***THPPO033***

"Main Choices and Preliminary Design for the IFMIF RF Couplers"

Tests of the cryomodule at Saclay before transport to Rokkasho



200kW amplifier

General layout of the test stand

Schedule

- ***Oct. 2008 → Nov. 2010:*** ***design and prototypes***
  - 2 cavity prototypes ordered (ZANON + SDMS)
  - RF couplers (call for tender launched)
  - 1 solenoid package prototype

- ***Jun. 2010 → Sept. 2012 :*** ***manufacturing of the components***

- ***2013:*** ***cryomodule assembling and RF power tests at Saclay***

- ***2013 → 2014:*** ***Installation and commissioning in Japan***

Thank you for your attention