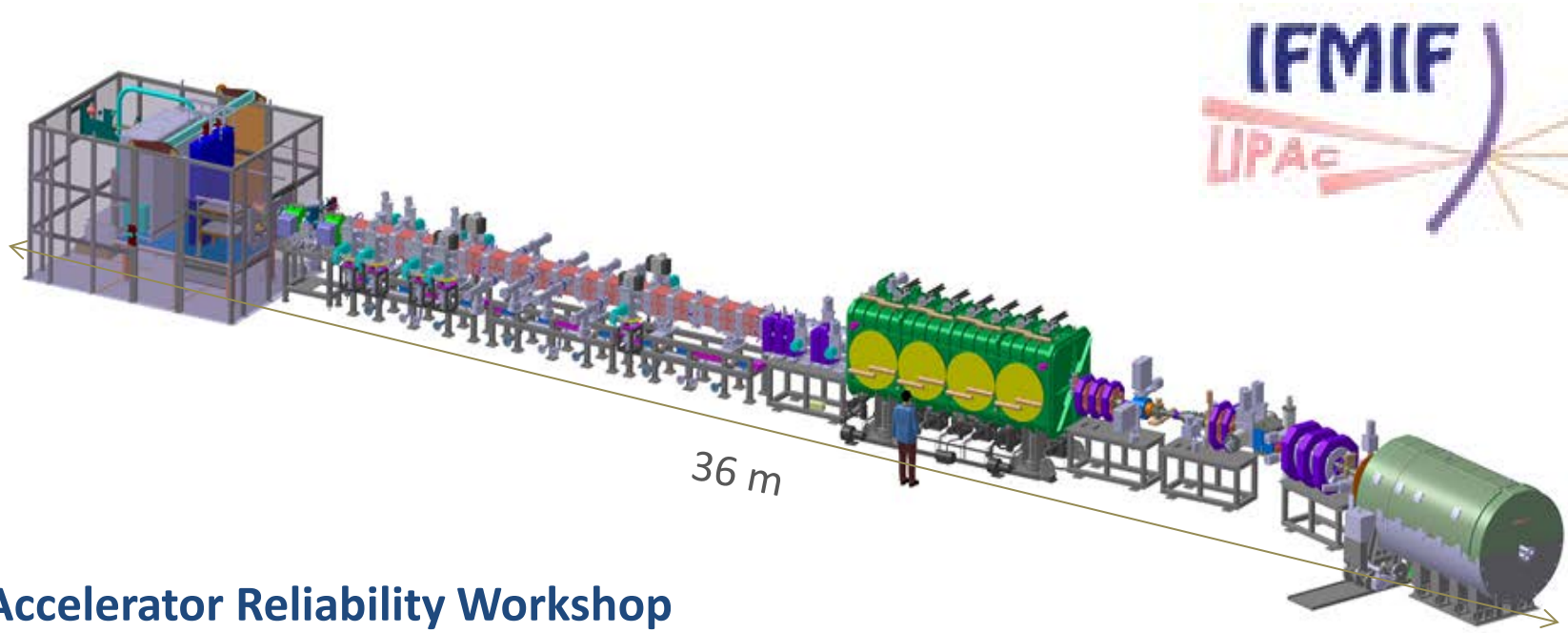
LIPAc Grounding Network

Requirements and functional description

Juan Marcos Ayala

IFMIF/EVEDA Project Team



5th Accelerator Reliability Workshop

Oak Ridge National Laboratory

Knoxville

Outline

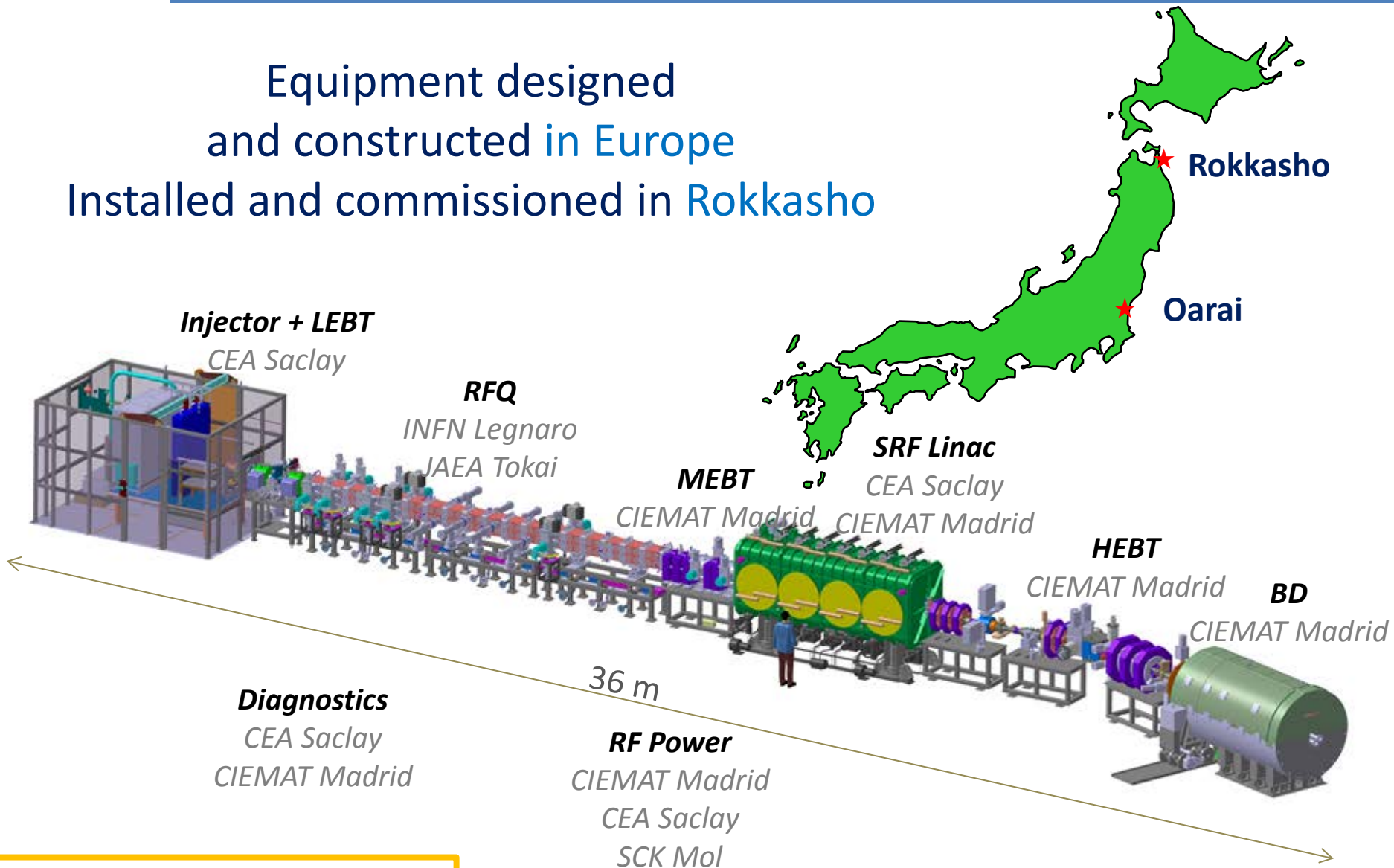
- **Introduction to LIPAc**
  - Description of LIPAc
  - Features of LIPAc
- **Introduction to IFMIF/EVEDA**
- **Introduction to the Broader Approach Agreement**
- **LIPAc electrical background**
  - Electrical Distribution: Outline diagram
  - LIPAc grounding network: Outline diagram
- **LIPAc present status of installation activities**

Introduction to LIPAc

- LIPAc (Linear IFMIF Prototype Accelerator) is a 125 mA CW and 9 MeV deuteron beam Linac presently under installation in Japan
  - for a total beam average power of 1.125 MW
- It will validate the concept the accelerator of IFMIF (International Fusion Material Irradiation Facility)
  - a 40 MeV deuteron beam Linac accelerator for fusion materials testing
- LIPAc subsystems are delivered by in-kind contribution from European Laboratories under the Broader Approach (BA) agreement between Japan and Europe (EU)

Description of LIPAc

Equipment designed
and constructed in Europe
Installed and commissioned in Rokkasho



KNASTER, J. et al., *Installation and Commissioning of the 1.1 MW deuteron prototype Linac of IFMIF,* **IPAC 2013 Shanghai**

Features of LIPAc

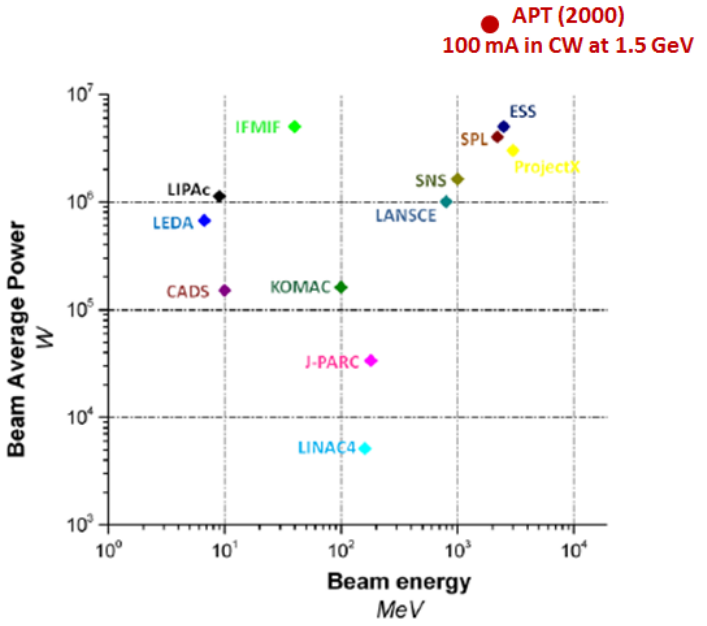
In 1999 LEDA (Los Alamos) reached 100 mA continuous wave at 6.7 MeV protons at the exit of the RFQ

Many of the lessons learnt have been implemented in LIPAc

LIPAC will accelerate:

- 125 mA at 5 MeV CW deuteron beam at the exit of the RFQ
- 9 MeV CW deuteron beam at the exit of the SRF Linac

This will validate the operation at higher energies for IFMIF



SCANTAMBURLO, F. et al., *LIPAc, the 125 mA/9 MeV CW deuteron IFMIF's prototype accelerator: what lessons have we learnt from LEDA?,* **IPAC 2014**

IFMIF/EVEDA

IFMIF

International Fusion Materials Irradiation Facility

EVEDA

Engineering Validation & Engineering Design Activities

A fruitful Japanese- European International collaboration
with 7 countries involved
with the involvement of research labs in Europe and main universities in Japan

Availability of the Facility >70%

The Design of IFMIF is broken down in 5 Facilities

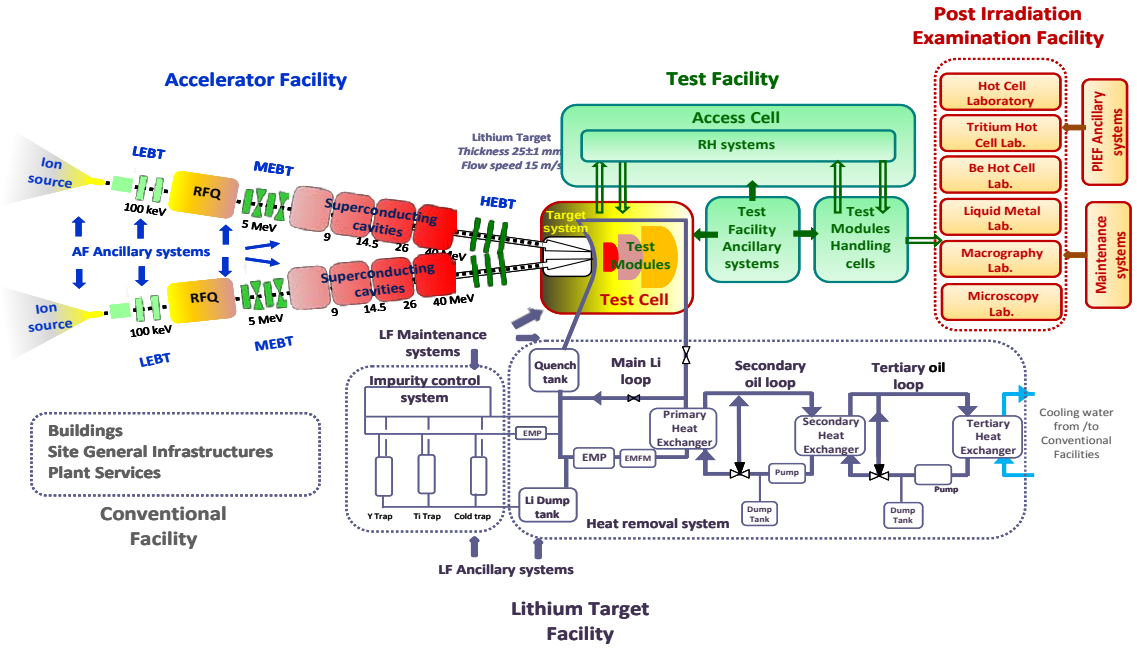
Accelerator Facility

Lithium Target Facility

Test Facility

Post-irradiation and Examination Facility

Conventional Facilities



to maximize dpas on tested materials

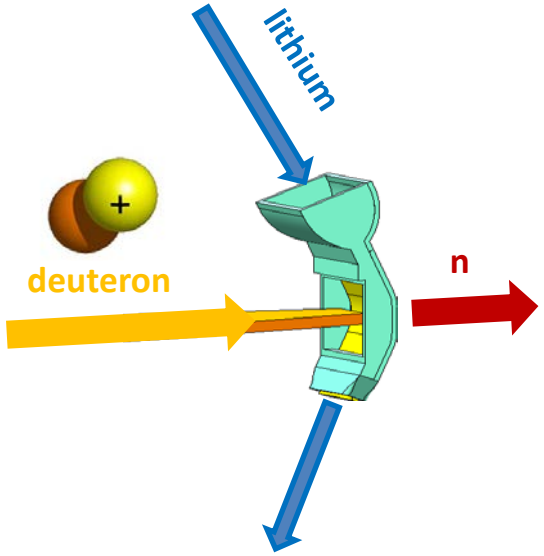
the availability of the full IFMIF >70% has demanded careful RAMI analysis for each Facility

Enric and Jose Manuel know well about it…

14 MeV neutrons through stripping reactions

- Neutrons would be mainly produced through their stripping from a deuteron beam

SERBER, R., *The Production of High Energy Neutrons by Stripping,* **Phys. Rev. Vol. 72, No 1, December 1947**

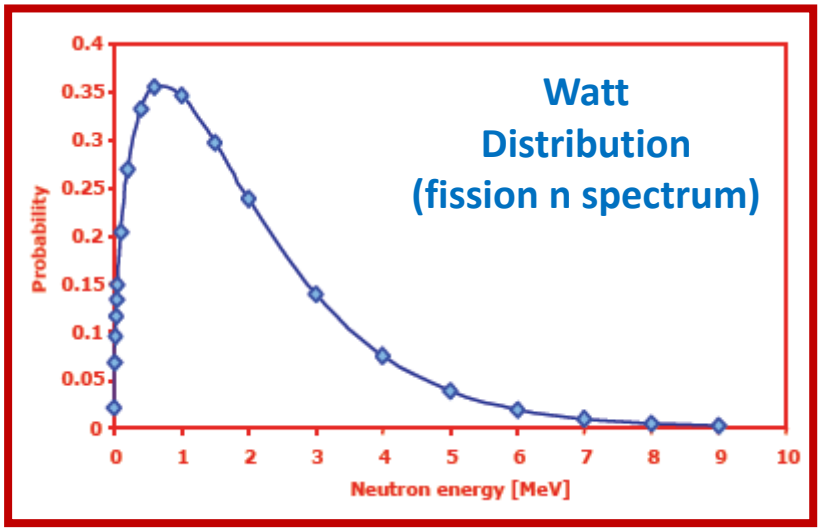


- Li(d,xn) Accelerated deuterons would react with Lithium to generate neutrons in the forward direction typically with an energy **0.4 E_{inc}**

Fission and spallation sources no fusion n relevant

- Existing neutron sources do not provide the needed answers
  - $^{56}Fe(n,\alpha)^{53}Cr$ and $^{56}Fe(n, p)^{56}Mn$ presents transmutation thresholds >3 MeV

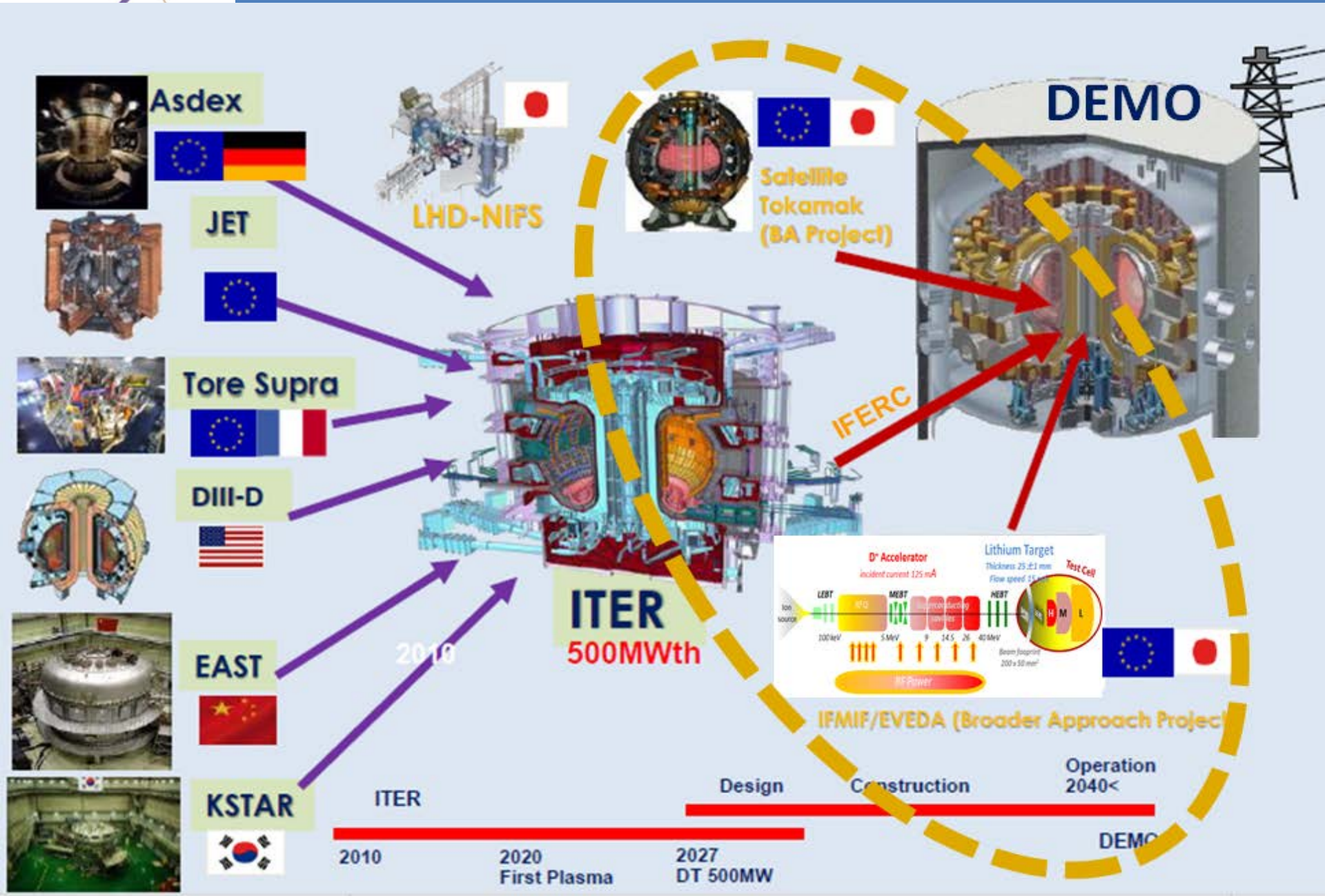
- Fission reactors n average energy ~2 MeV



No efficient
p^+ or α-particle generation

- Spallation sources present a wide spectrum with tails in the order of hundreds of MeV Generation of light isotopes in the order of ppm

Introduction to the Broader Approach Agreement



LIPAc Electrical Distribution: outline diagram

Steady State Electrical Network:

About 3.5 MVA continuous power

Main consumers:

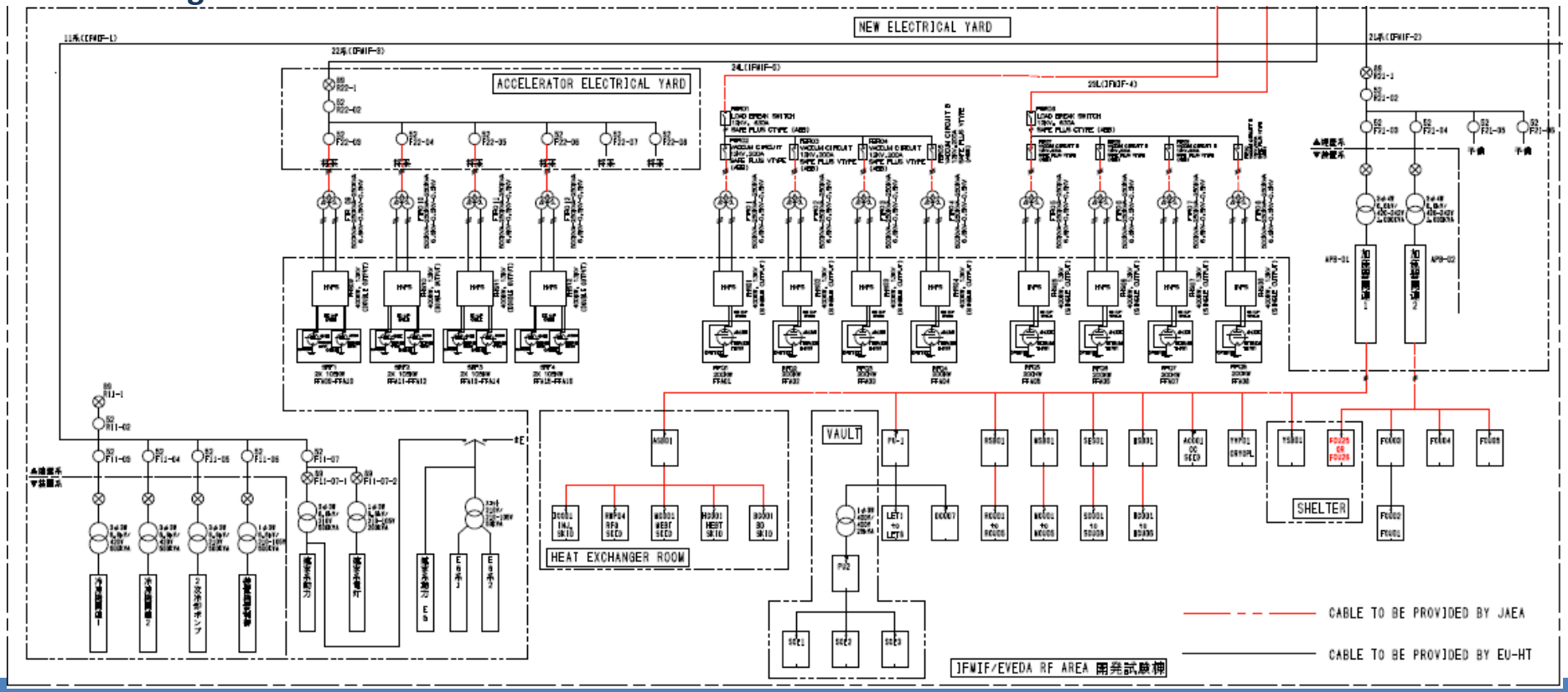
- Cooling water system
- Radio Frequency chains, HEBT, Cryoplant
- Building services

Pulsed Power Electrical network:

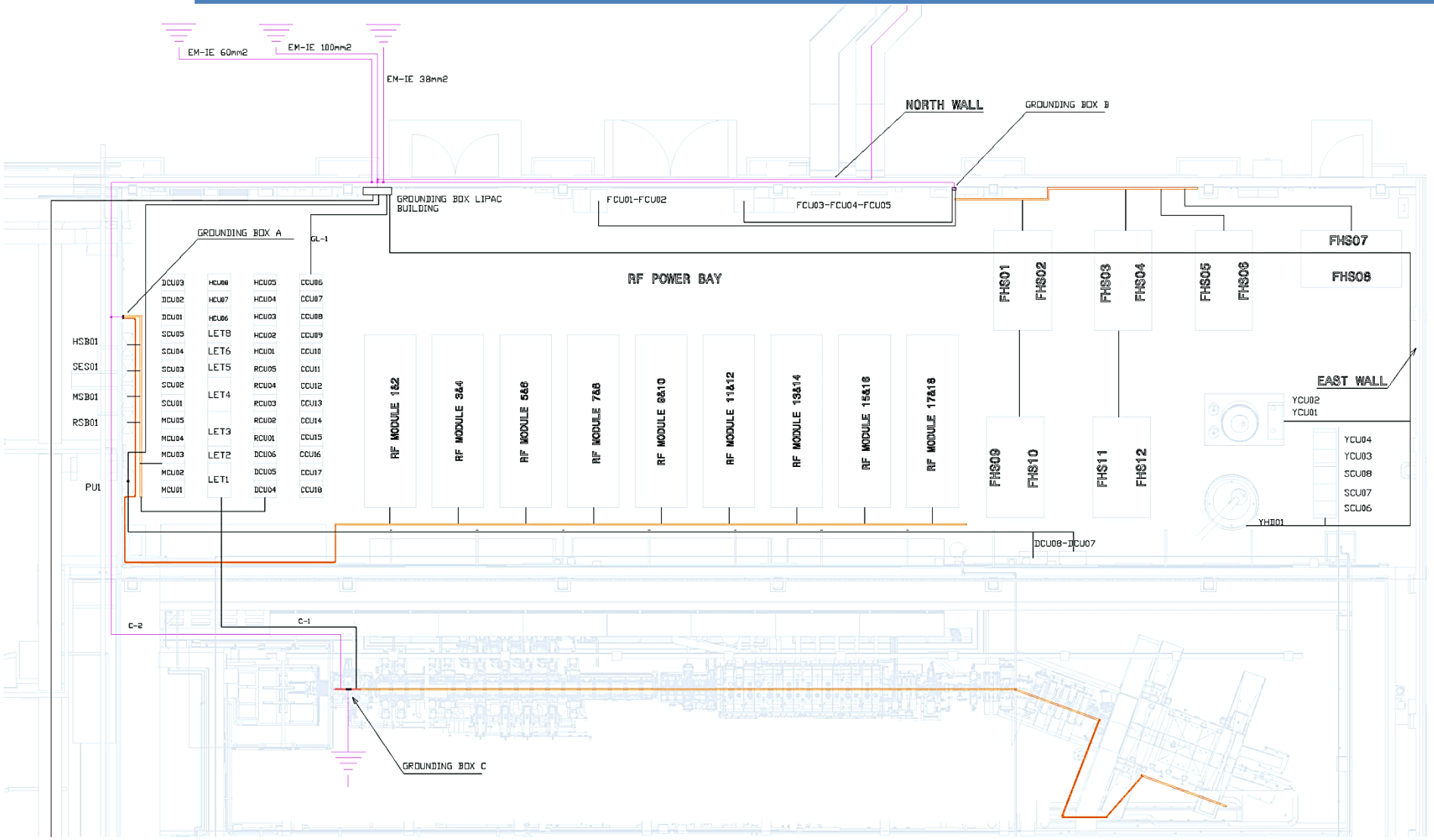
About 6 MVA peak pulse

Main consumers:

- Radio Frequency



LIPAc Grounding Network: outline diagram



LIPAc grounding network, scenario faced

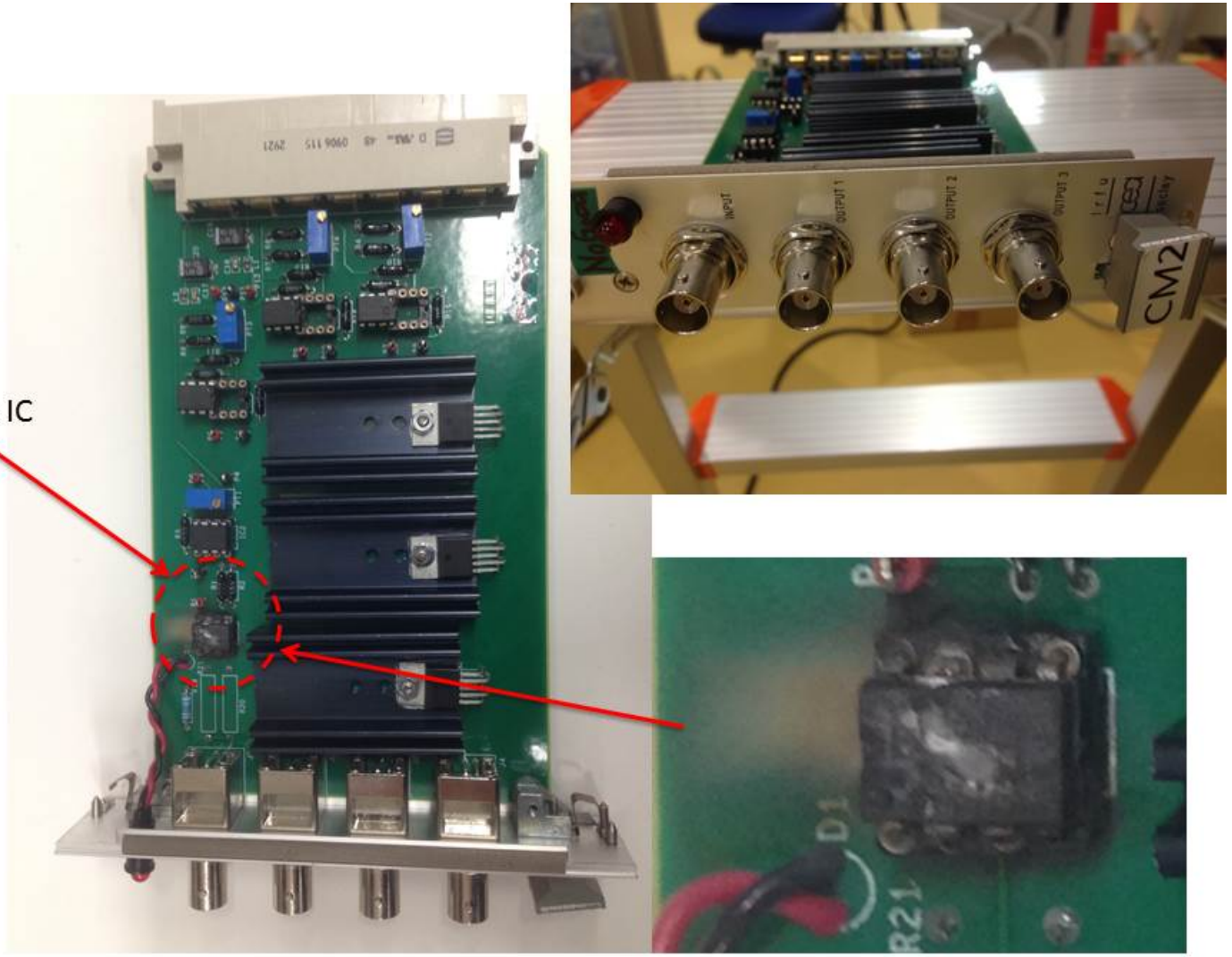
- **Two independent grounding networks were installed**
  - **The two grounding networks were unified possibly because of misunderstanding of the TN-S distribution system not frequent in Japan.**
- **The impedance of the grounding network has not been assessed**
  - **The ground resistance is about 2,5 Ω**
- **No specific EMC recommendations were observed**

LIPAc grounding network, scenario faced

- EU acce rily the same to
  - The e ment is differe
  - The g ratory is differe
  - Electri

- Thus EMC performance in LIPAc can be different…

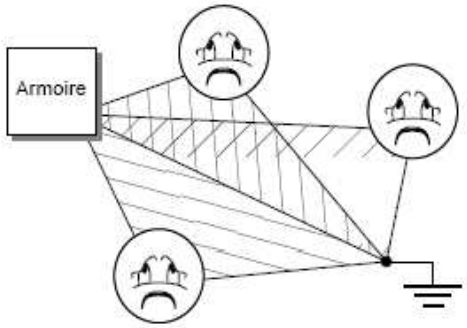
LIPAc grounding network: Tackling uncertainties



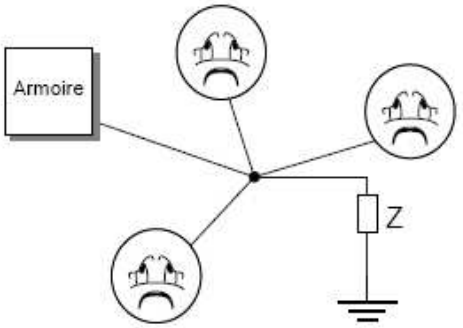
LIPAc grounding network: Tackling uncertainties

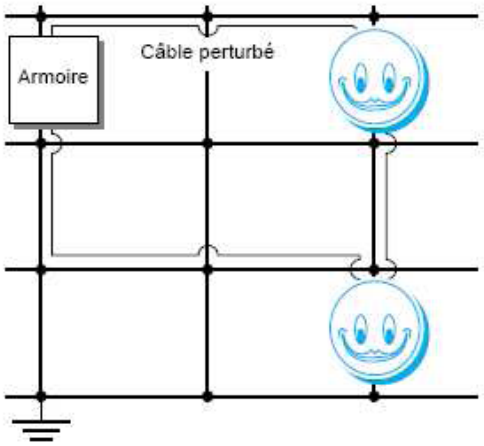
Upgrading the grounding network

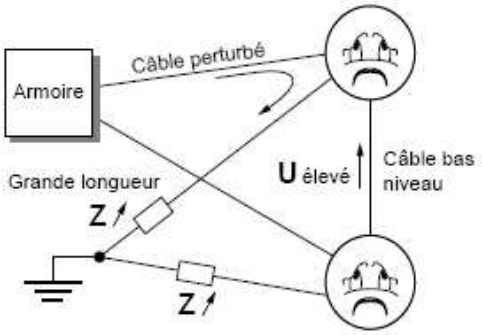
- Create a grounding network mesh or interconnect the chassis creating a mesh



Boucles de masse de grande surface



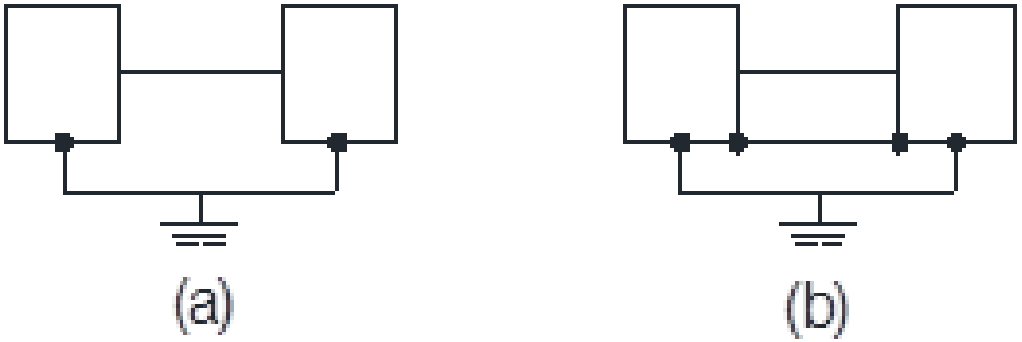




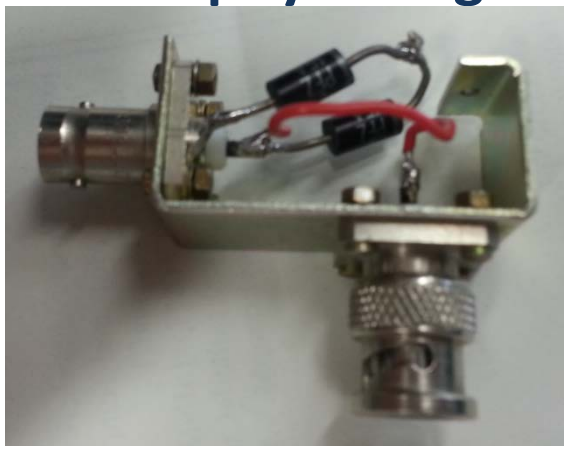
Forte impédance commune
==> ddp entre les équipements

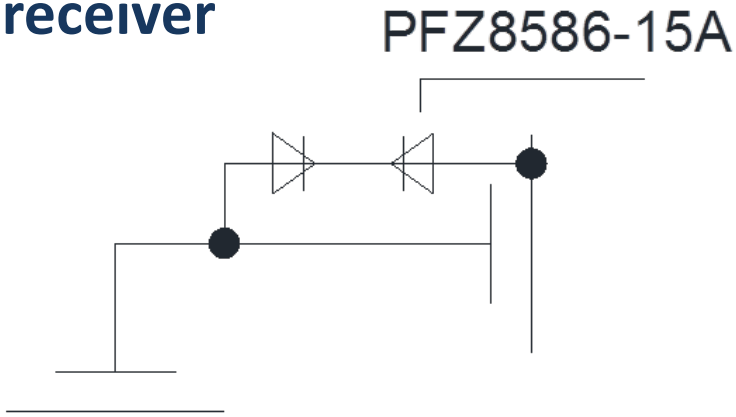
LIPAc grounding network: Tackling uncertainties

- **Protect your electronics creating multiple paths for CM currents**



- **Intercept your signals close to the receiver**



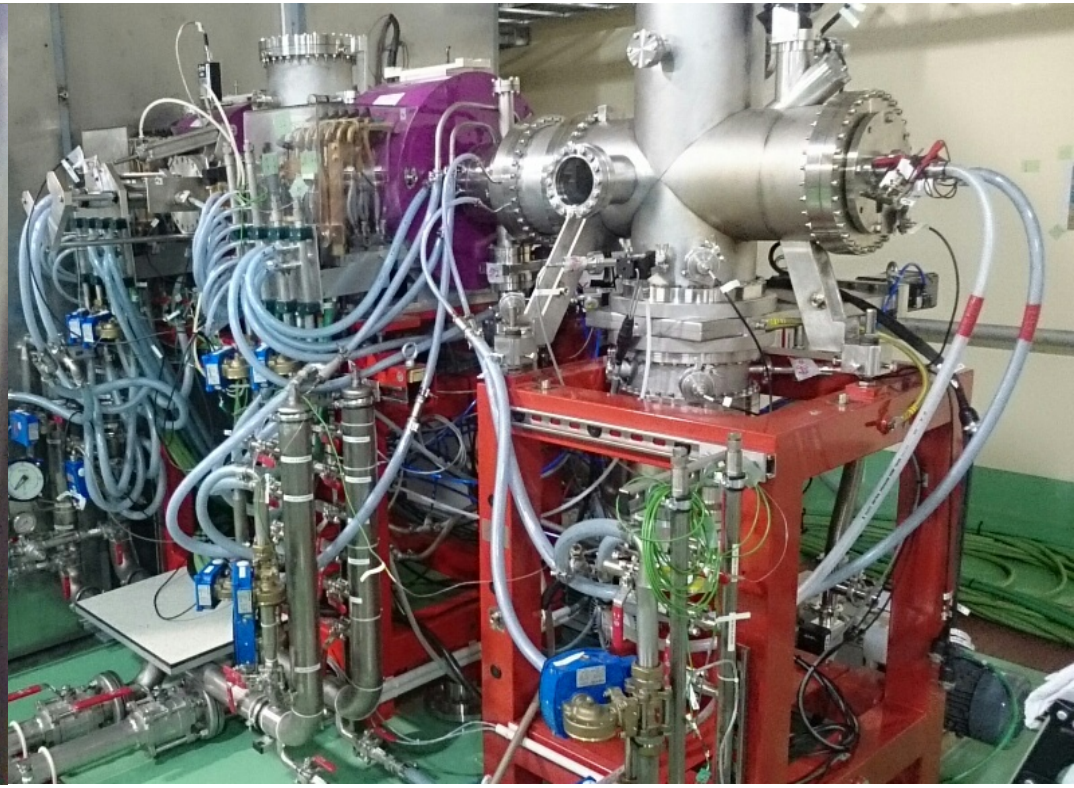


LIPAc Present status of installation

- Ion source and LEBT under commissioning on p^+ on-going
- Ion source and power supplies cooling skids are running
- RF power system (RFQ, MEBT and SRF Linac) starting June 2015

HV deck, ECR source

Accelerator column



LBET and Diagnostics

Conclusions

- The Lipac commissioning has started at good progress
- The grounding network at Lipac will be updated to include EMC considerations
- The lack of an own EMC guideline makes it the usual excuse to explain faults, downtime and signal distorsion
- However, simple solutions can still be implemented to protect the electronics against the observed EMI issues

Thank you for your attention