DONES and the role of the industry

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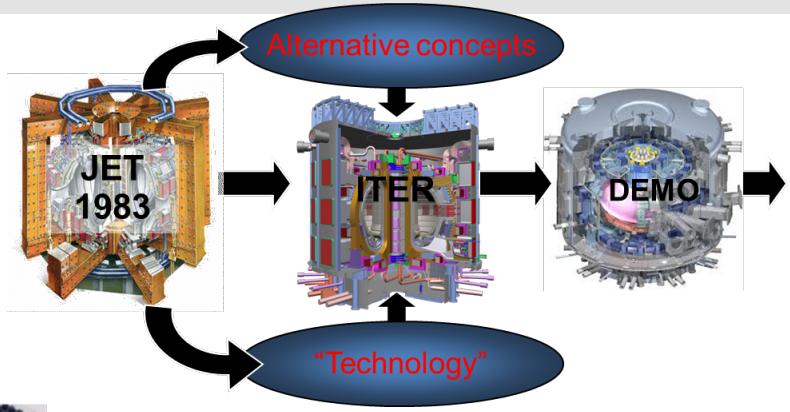
Brokerage event
February 8th 2022

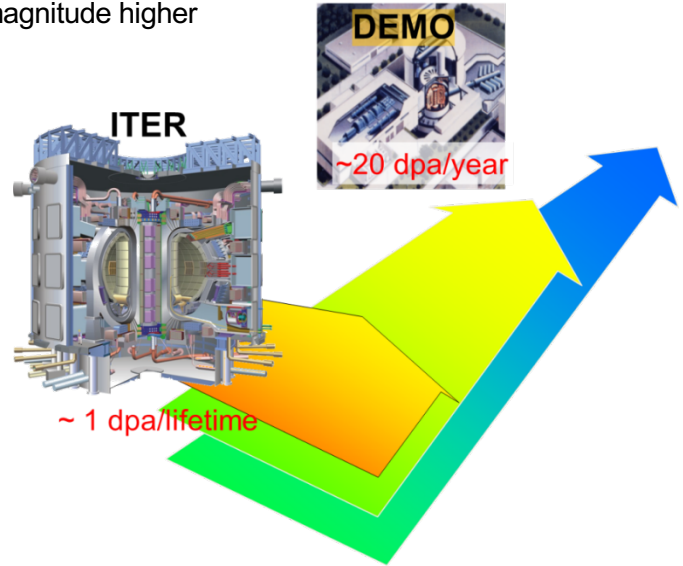
Why DONES?



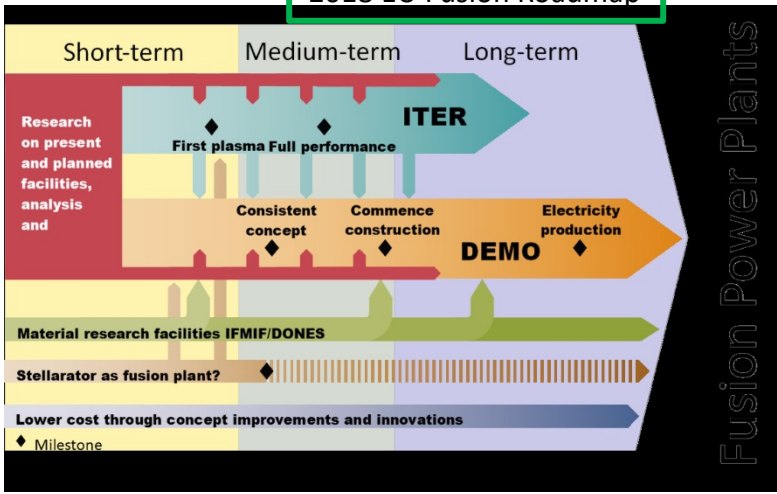
The power plant

EU strategy towards fusion energy

One of the main differences between ITER and DEMO is the radiation dose: at DEMO more that two orders of magnitude higher

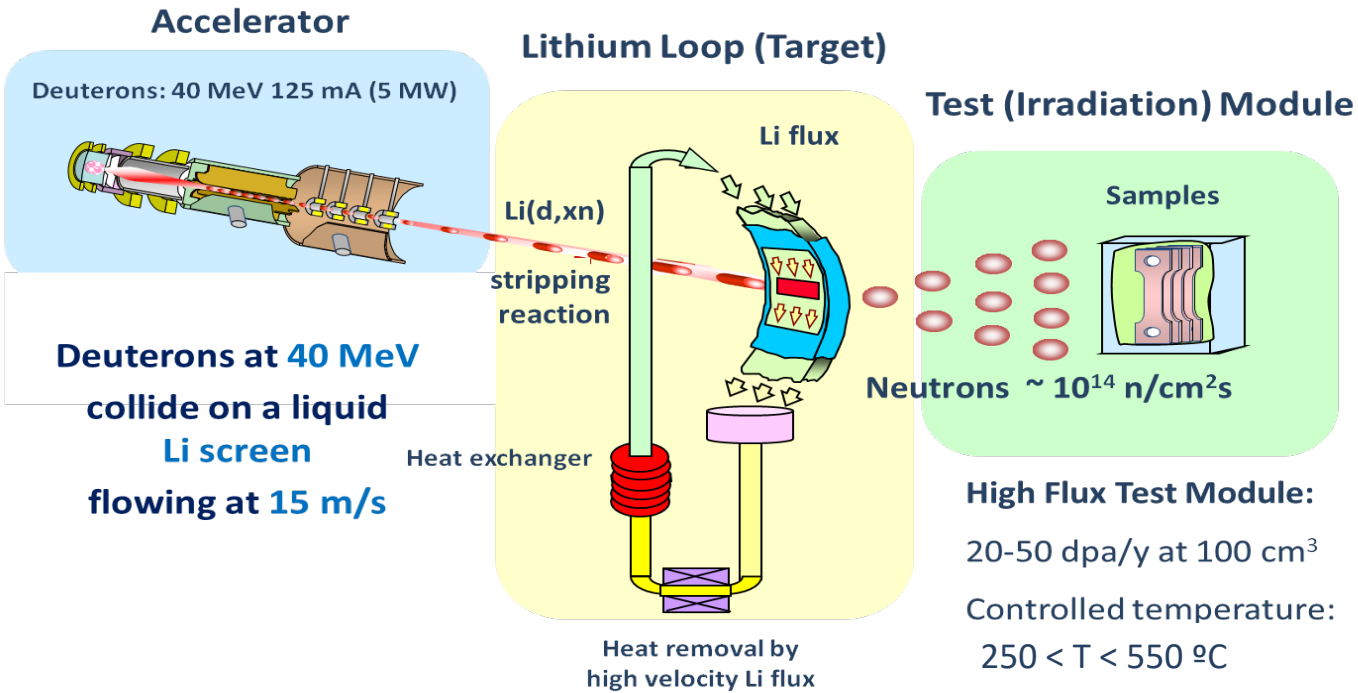


2018 EU Fusion Roadmap



What is IFMIF-DONES?

A fusion-like neutron source required for the qualification of the materials to be used in the EU DEMO



Identified as high priority in the EU Fusion Roadmap
Included in the ESFRI Roadmap as a EU strategic facility

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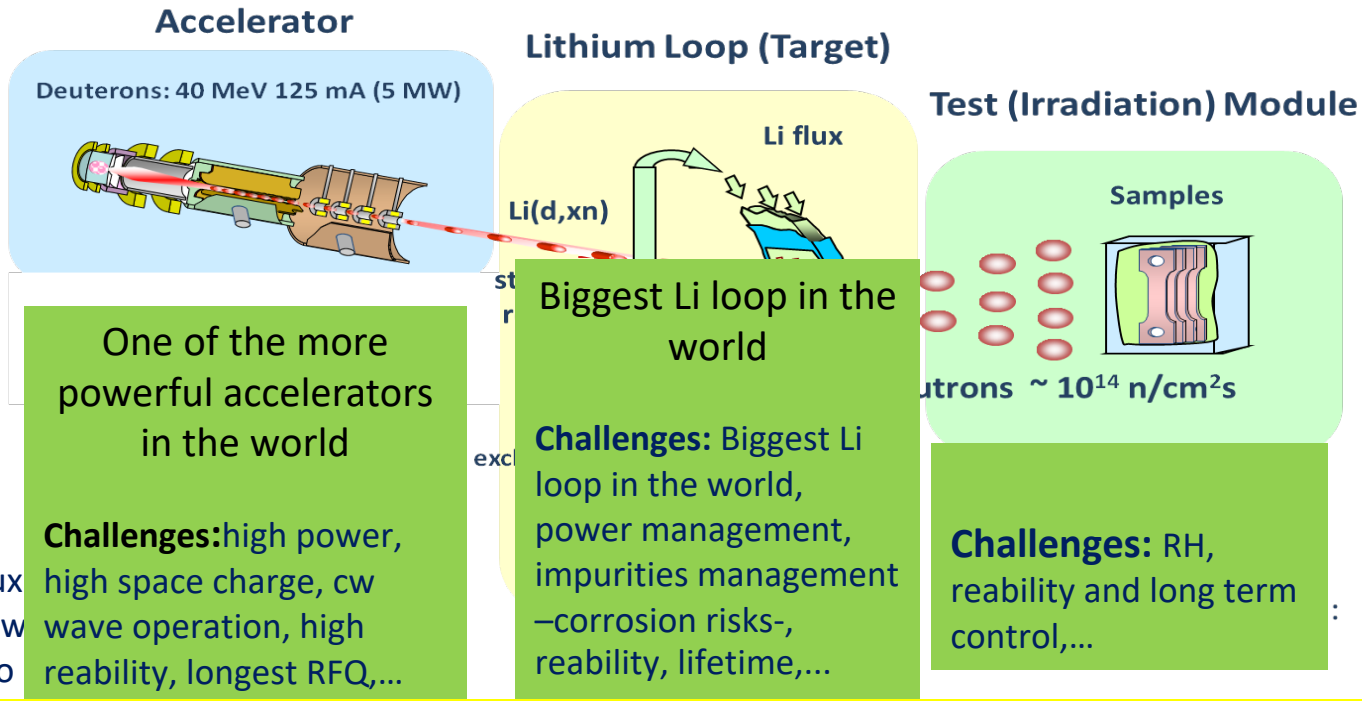


Identified as high priority in the EU Fusion Roadmap
Included in the ESFRi Roadmap as a EU strategic facility

Complementary Experiments

Applications of medical interest

- Radiopharmaceuticals for therapy (e.g. ^{99}Tc)
- Accelerator-based boron-neutron-capture therapy (BNCT)
- ...

Basic physics studies

- Half-life measurements on long-lived isotopes
- Neutron and neutrino oscillations
- Solid state physics studies

Nuclear physics and radioactive ion beam facility

- Nuclear Structure & Astrophysics
- Mechanism of nuclear fission
- Cross-section measurements for applied physics (n,γ), (n,xn), (n,lcp)
- ...

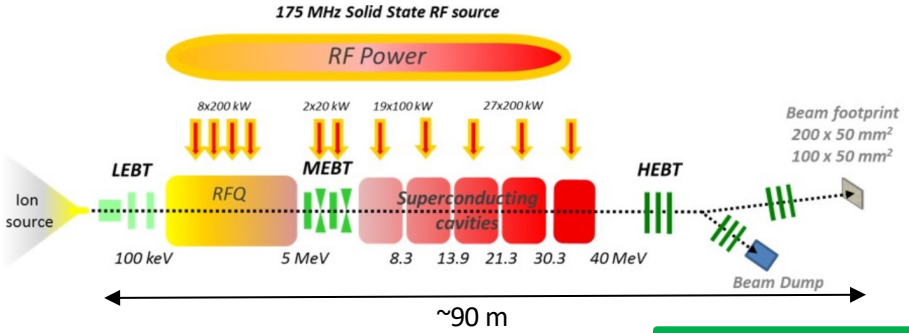
Industrial application of neutrons

- Mechanical properties of irradiated materials from small samples
- Computed tomography imaging using fast neutrons
- Transmutation doping of silicon and radiation-damage testing of electronics

❖**Deuterons** extracted from the accelerator beam but only a small fraction (a few percent)
❖**Neutrons** available behind the Irradiation Module either inside or outside the Test Cell

Accelerator systems summary

175 MHz, 5MW, 125 mA, CW, high availability: One of the more powerful accelerators in the world

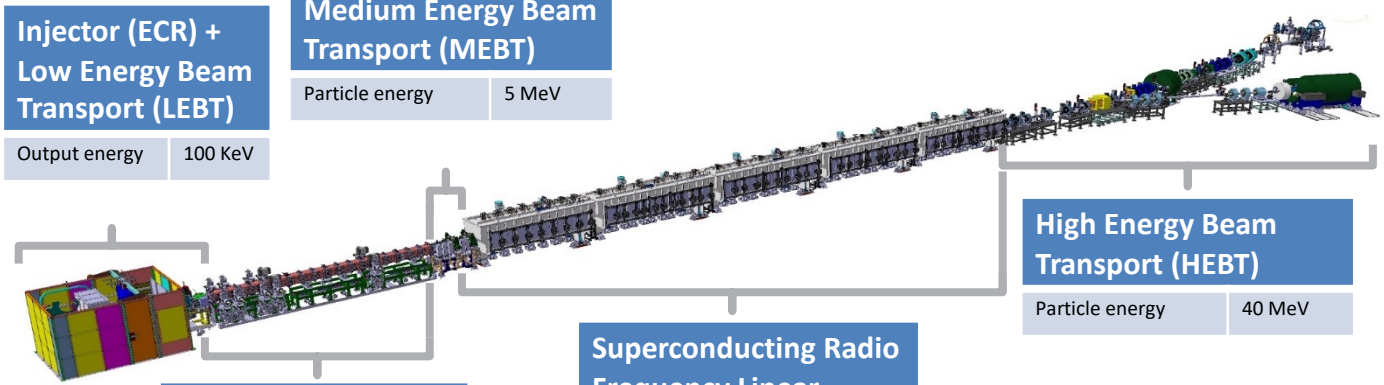


Injector (ECR) + Low Energy Beam Transport (LEBT)

Output energy	100 KeV

Medium Energy Beam Transport (MEBT)

Particle energy	5 MeV



Radio Frequency Quadrupole (RFQ)

Output energy	5 MeV

Superconducting Radio Frequency Linear Accelerator (SRF-Linac)

Output energy	40 MeV

High Energy Beam Transport (HEBT)

Particle energy	40 MeV

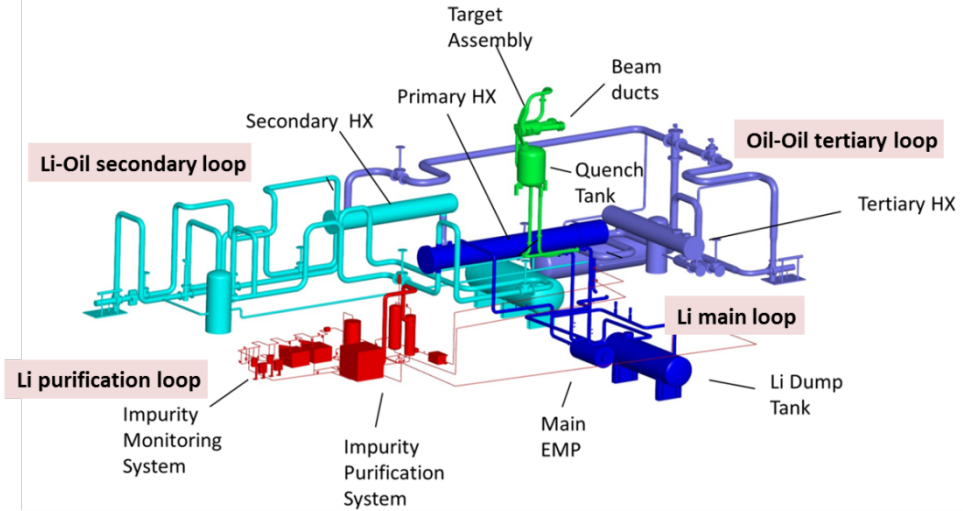
Waiting for validation results from IFMIF-EVEDA: LIPAc Prototype (Rokkasho)

Main involved technologies

- RF
- Cavities
- Magnets
- Mecatronics (Cu, Nb, Al,…)
- Criogenics
- Vacuum
- Power supplies
- Cooling technologies
- Diagnostics
- Control (hardaware and sofware)

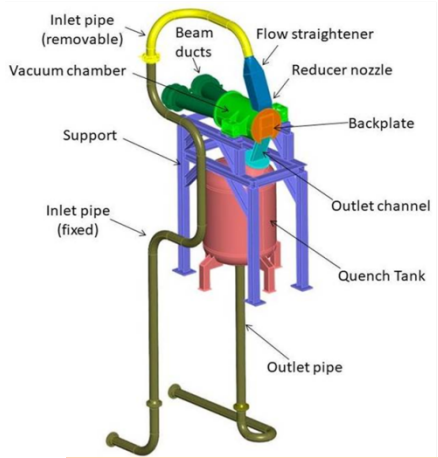
Li systems summary

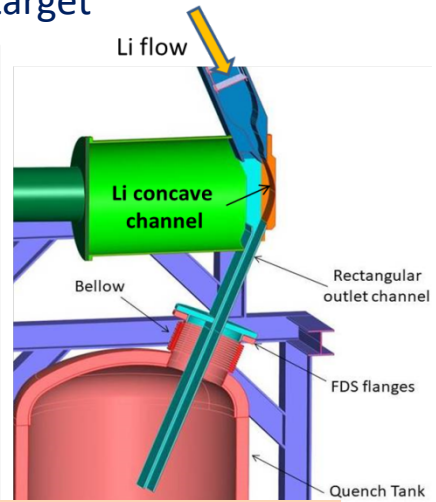
5 MW power handling, 15 m/s Li velocity, remote handling
Main requirements: Li flow stability and Li impurities control



Li volume ~8 m^3 Li flow rate ~100 l/s
Temperature (cold side) ~300 °C

Lithium target





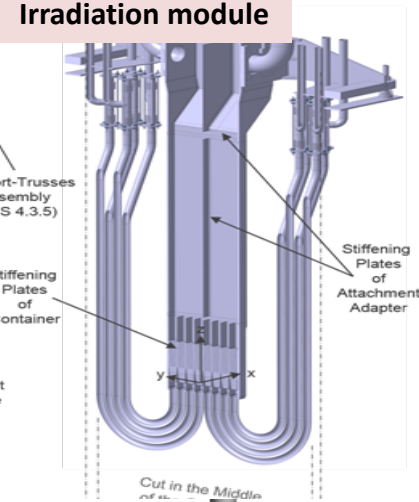
Jet thickness: 25±1 mm Li flow velocity: 15 m/s
Chamber pressure: 10^{-3} Pa Heat flux: 500 MW/m^2

Main involved technologies

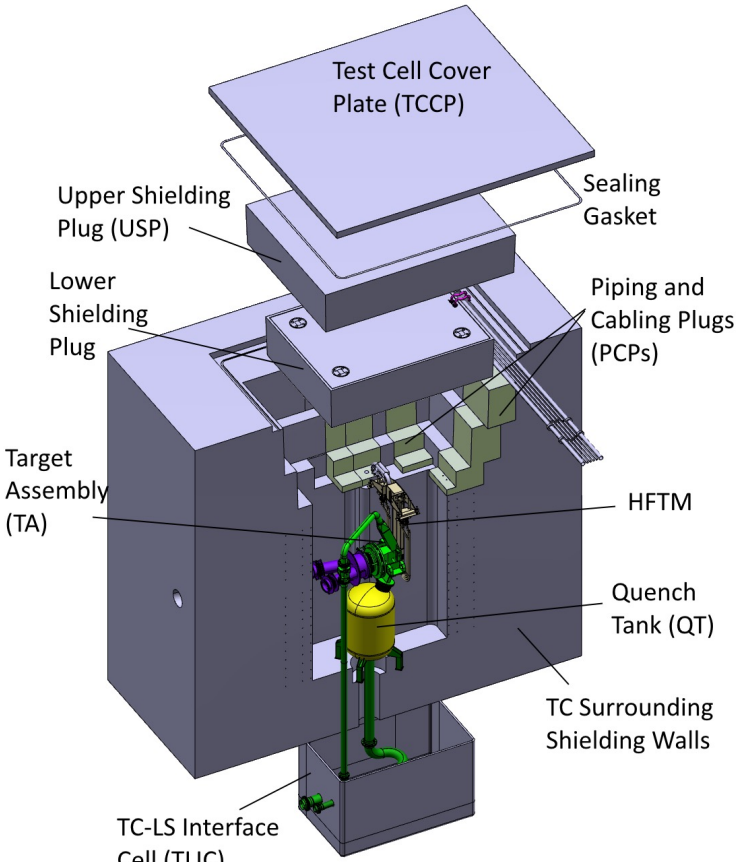
- **Liquid metals (fluids, monitoring and purification)**
- **Complex cooling loops**
- **Diagnostics**
- **Remote maintenance**
- **Control (hardware and software)**

Test Systems summary

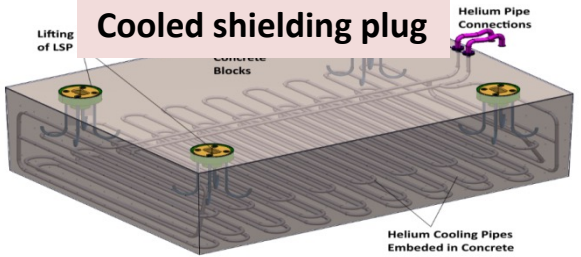
Irradiation module



Duct penetration



Cooled shielding plug



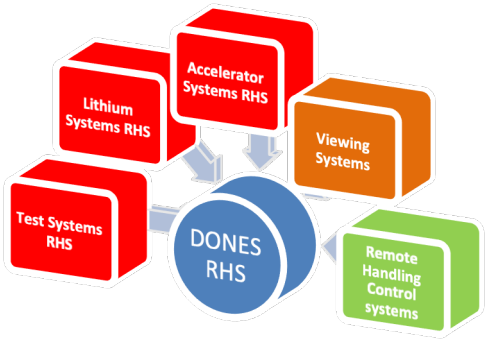
Main characteristics driven by the presence of neutrons and Li

- **Internal components cooling by He**
- **Remote Maintenance required**

Main involved technologies

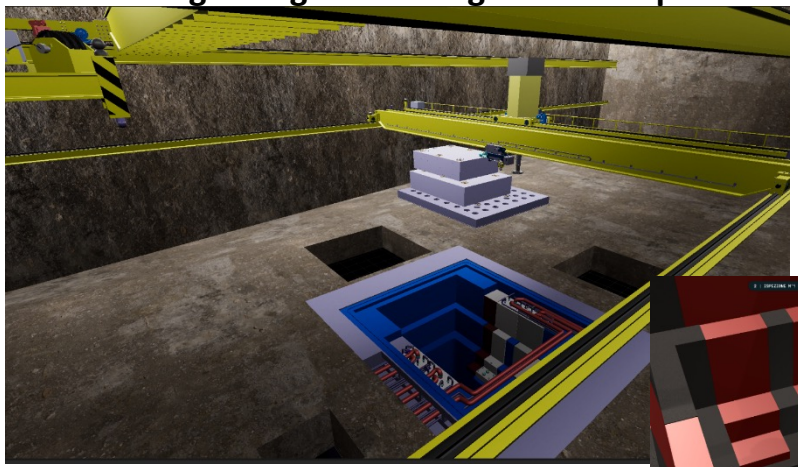
- **Mecatronics**
- **He and water cooling**
- **He, Ar and water systems**
- **Shielding materials and technologies**
- **Remote maintenance**
- **Vacuum**
- **Diagnostics**
- **Control (hardware and sofware)**

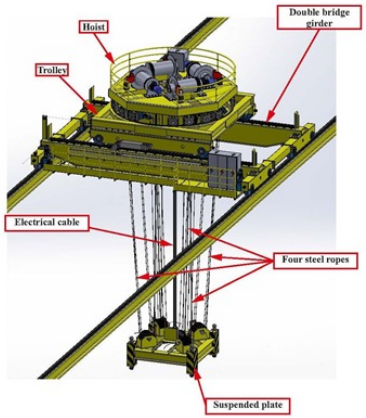
Remote Handling system



Access Cell

- Main Remote Handling Equipment : HROC and ACMC
- Access Cell big enough for storage of all components





Main involved technologies

- Special cranes
- Telemanipulators
- RH tools
- Radiation monitoring

Others systems and transversal topics

- Do not forget “conventional” systems: half budget will go to buildings and conventional systems

- Do not forget “transversal” activities: maintenance, safety, security, control,… they will be continuos activities all along the time of the facility

Main involved technologies

- **Buildings**
- **Cooling**
- **HVAC**
- **Control (hardware and software)**
- **Gas management**
- **Electrical systems**
- **Electronics**

- **Maintenance**
- **Safety and security**
- **….**

Project Organization

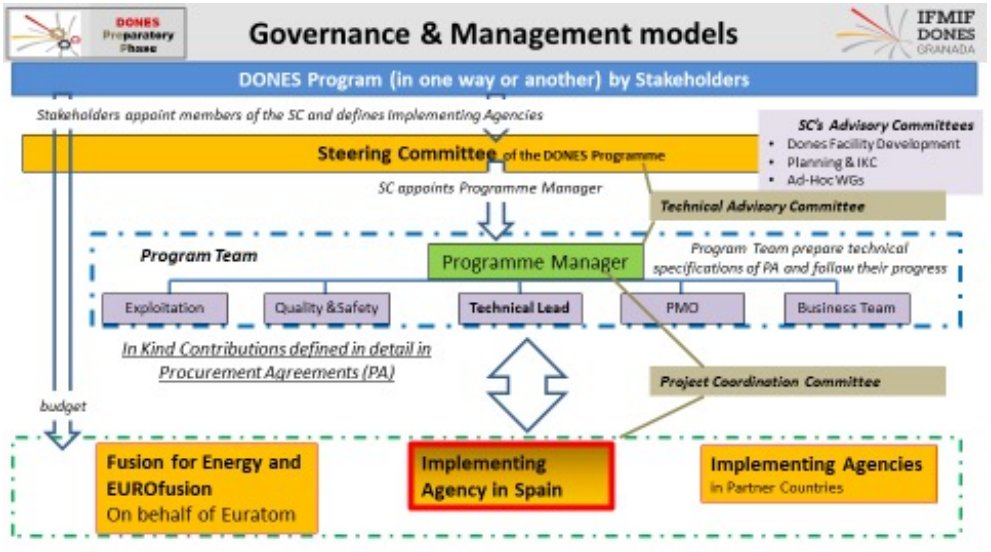
Aim is the DONES Program (not just the DONES Facility)

- Project run by very flexible Project Team built up on In-Kind Contributions from different partners
- Design Authority in the Project Team
- **Owner/Operator responsibility on the Spanish Legal Entity**

Partners contributions would be:

- In-kind components, and/or
- People to the Project Team, and/or
- Cash for Common Expenses and Reserve Fund

Contributions will be agreed in a qualitative way by the stakeholders (in the MoUs) and in detail by Procurement Arrangements between Implementing Agencies



Model similar to the one used in the Broader Approach project

Opportunities for the industry-I

In all the Big-Science projects, industry must be involved in the Project as soon as posible (both for the benefit of the Project and for the benefit of the industry)

- A specific effort has been made in the DONES Project to promote the participation of the industry since the beginning:
  - Industry was involved in the Validation Activities (IFMIF/EVEDA Project) during the last 15 years: most of the EU contributions were developed by EU industry
  - Industry is being involved very significantly in the engineering design work developed up to now
  - Collaboration projects with industry are being strongly promoted (ACTECA, FUSION FUTURE, EVO or NEXT projects in the Spanish case)

But this is also a work for you!!!:
If you are interested you must start to be familiar with the Project as soon as possible

Opportunities for the industry-II

- Short term future contracts:
  - Calls for auxiliary building construction (12 M€), DONES research building (6 M€), three different prototypes construction (0,5-1,5 M€ each), some labs under development
  - Expected since last few weeks to mid-2022

To be (informally) announced in ifmifdones.org webpage

- Long term contracts (linked to the initial steps of the program):
  - Engineering support (expected maybe in 2023)
  - Buildings and other plant systems (several contracts maybe from 2023-2025)
  - Accelerator systems (injector, RFQ, RF, SRF,…) (expected maybe from 2024-…)
  - Li systems (Li loop others…) (expected maybe from 2025-…)

Still to be defined how they will be announced

Most of them will require Industry Consortia to be developed!!!

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