The Control Architecture of large scientific facilities: ITER and LHC lessons for IFMIF

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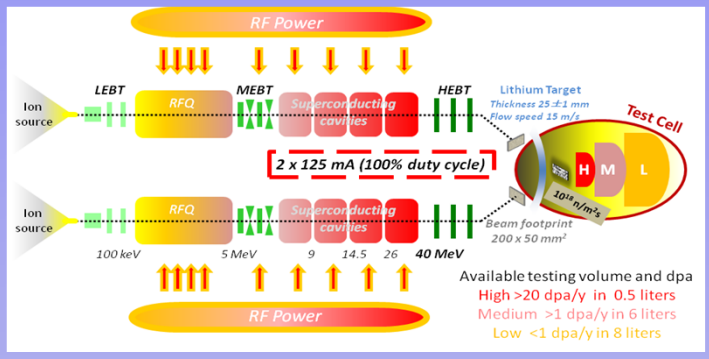
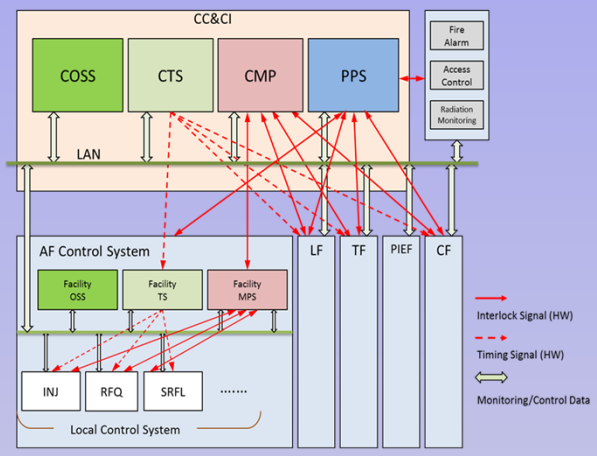
The IFMIF project:

The development of an intense source of neutrons with the spectrum of Deuterium-Tritium fusion reactions is indispensable to qualify suitable materials for the First Wall (FW) of the nuclear vessel in fusion power plants. The FW, an overlap of different layers, is essential in future reactors; they will convert the 14 MeV of neutrons to thermal energy and generate tritium to feed the DT reactions, while being exposed to intense degradation of materials due to neutrons bombardment.

IFMIF will reproduce those irradiation conditions with two parallel 40 MeV CW deuteron Linacs, with 125 mA beam current each, colliding on a 25 mm thick Li screen flowing at 15 m/s and producing a neutron flux of 10^{18} $m^{-2}s^{-1}$ in a 500 cm^3 volume, with a broad peak energy at 14 MeV.





The IFMIF Control System:

Modular design integrating the different facilities:

- Accelerator Facility (AF), providing 10 MW and 40 MeV deuteron beam power in CW,
- Lithium target Facility (LF), to generate neutrons in a suitable flux and spectrum and evacuate the beam power,
- Test Facility (TF), where test specimens are irradiated and includes remote handling hardware,
- Post Irradiation Experiment Facility (PIEF), where irradiated specimens are tested, and
- Conventional Facility (CF), that includes the central control system and the management of the utilities.

Higher layer for central management:

- Central Operation and Supervisory System,
- Central Timing System,
- Central Machine Protection system,
- Personnel Protection System

Estimated ~10^6 process variables overall

Central Control systems based in EPICS software, for implementing:

- Archiving, monitoring, alarming, middleware…

IFMIF Control System: Design Choices

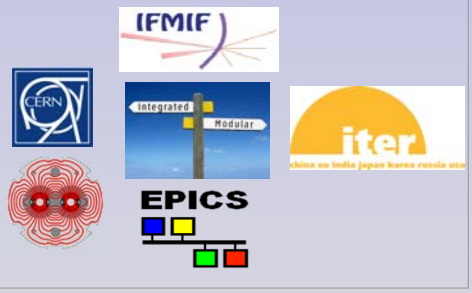
The design of IFMIF control systems has learnt from other large scientific facilities. The modular ITER control system has been compared with the more integrated one of the LHC, and the most suitable technical choices of both will be adopted for IFMIF.

Modular approach based on the constraints:

- Procurement strategy
- Dissemination of development resources
- Software platform for controls (EPICS)
- Standardization of hardware components and development methodology

Integrated approach when required:

- Machine and Personnel protection systems
- Nuclear Safety systems
- Ad-hoc solutions for fast archiving, timing



Main references

[1] M. Pérez et al., IFMIF: steps toward realization, SOFE 2013 San Francisco
[2] J.Knaster et al. "Installation and Commissioning of the 1.1MW Deuteron Prototype Linac of IFMIF", IPAC 2013, Shangai.
[3] J. Knaster et al., "IFMIF: overview of the validation activities", Nucl. Fusion 53 (2013) 116001
[4] IFMIF Integrated Project Team, "IFMIF Intermediate Engineering Design Report", 2013
[5] B.Frammery, "The LHC Control System", ICALEPCS 2005, Geneva
[6] A.Wallander et al., "Approaching Final Design of ITER Control System", Proc. of ICALEPCS 2013, San Francisco
[9] http://www.aps.anl.gov/epics/

Conclusions: IFMIF, possibly next fusion world community big scientific project, will implement the lessons learnt in ITER; which in turn is settling a new approach of controls architecture driven by its international organization and the development of world communications networking; but cannot overlook its technological links with accelerators world.
IFMIF will share with ITER an architecture based on EPICS driven by its likely common worldwide procurement strategy and modular design, but shall also integrate other solutions specific of accelerators technology implemented in the LHC.

ICALEPCS 2013

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