Linear IFMIF Prototype Accelerator (LIPAc) commissioning and LCS integration in CCS

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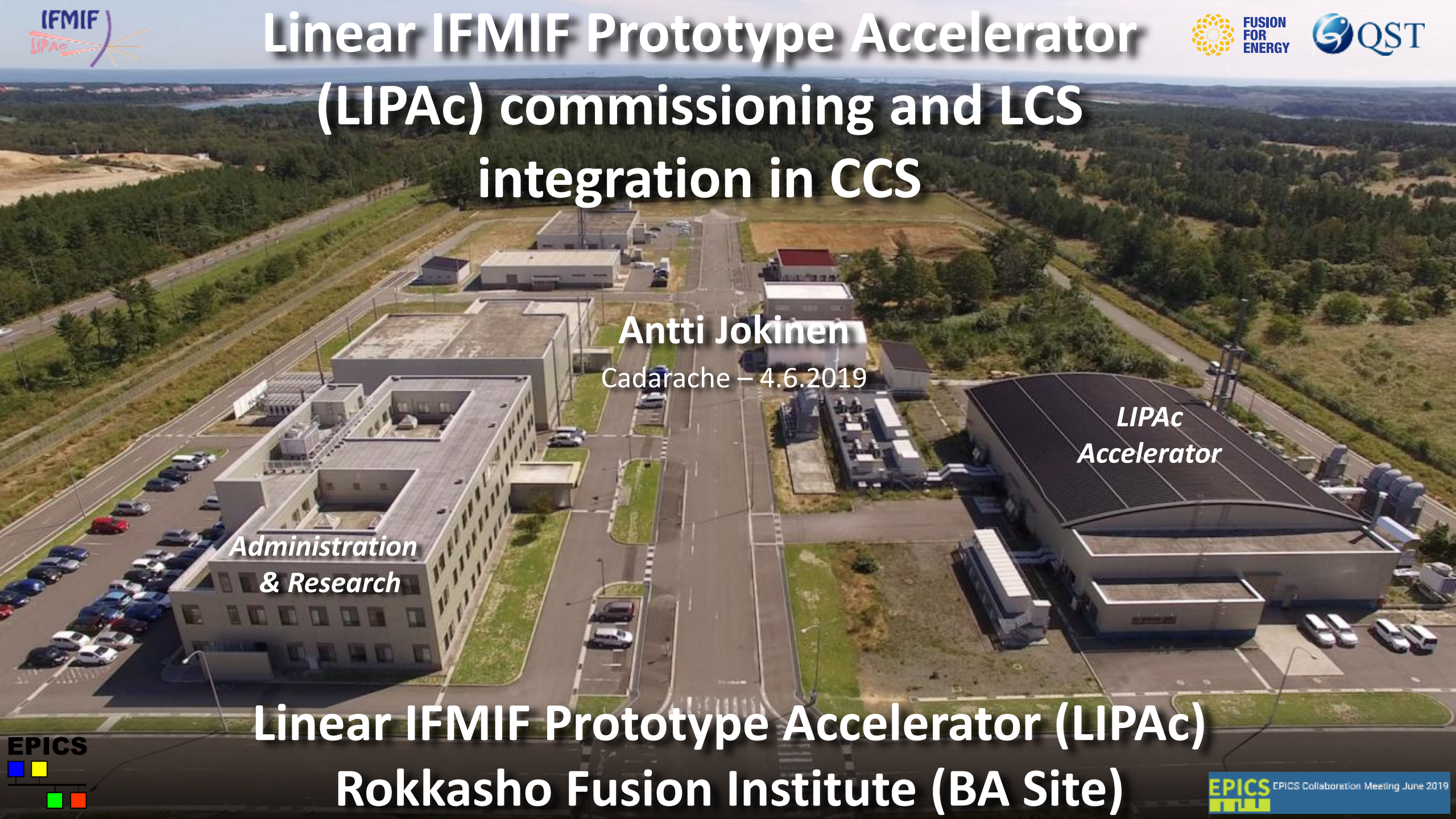
Cadarache – 4.6.2019



Linear IFMIF Prototype Accelerator (LIPAc)
Rokkasho Fusion Institute (BA Site)

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Linear IFMIF Prototype Accelerator (LIPAc) commissioning and LCS integration in CCS

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What and where is LIPAc?

What is LIPAc?

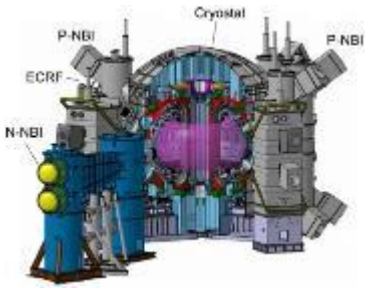
21 November 2006

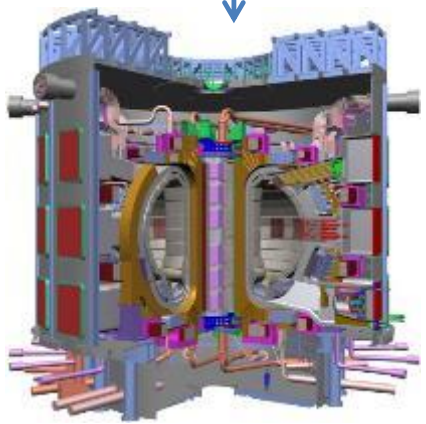
ITER Agreement

1 June 2007

Broader Approach Agreement

JT60-SA





ITER

IFMIF/EVEDA

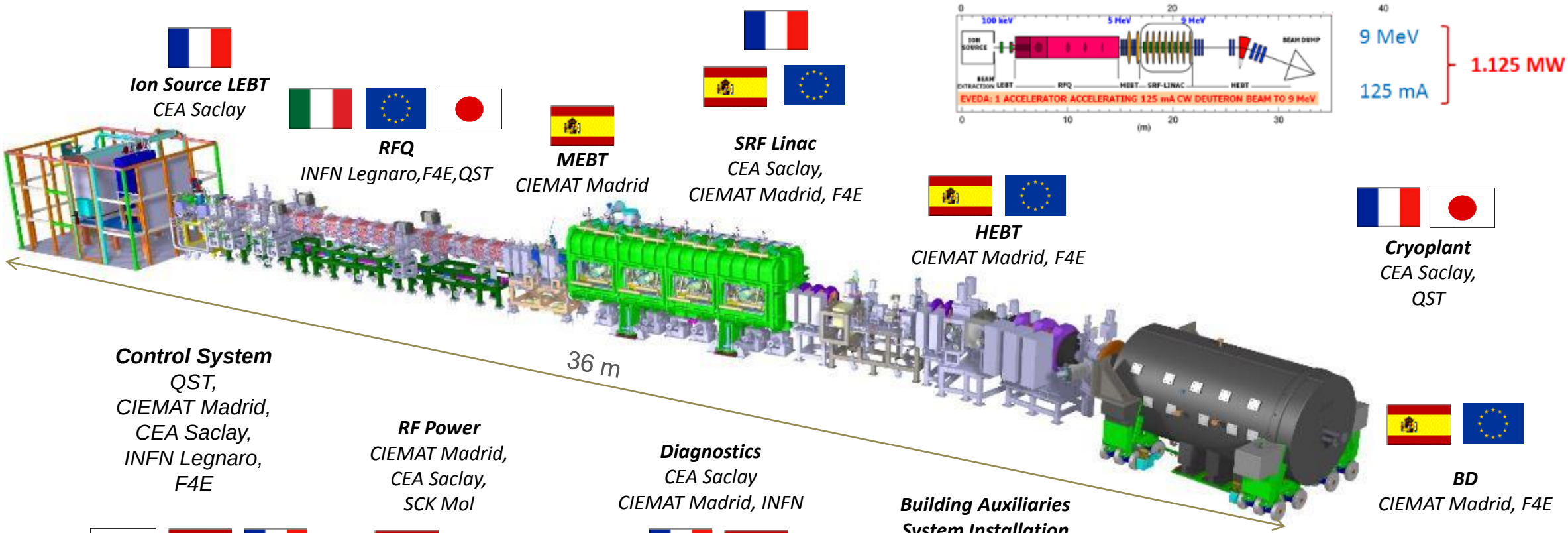
IFERC

Linear IFMIF Prototype Accelerator (LIPAc)

Mission: Test the feasibility of technology.

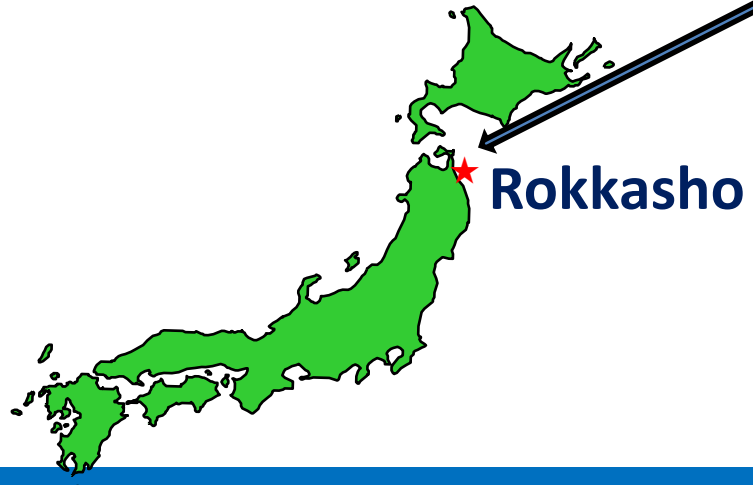
What is LIPAc?

Japan-Europe scientific collaboration



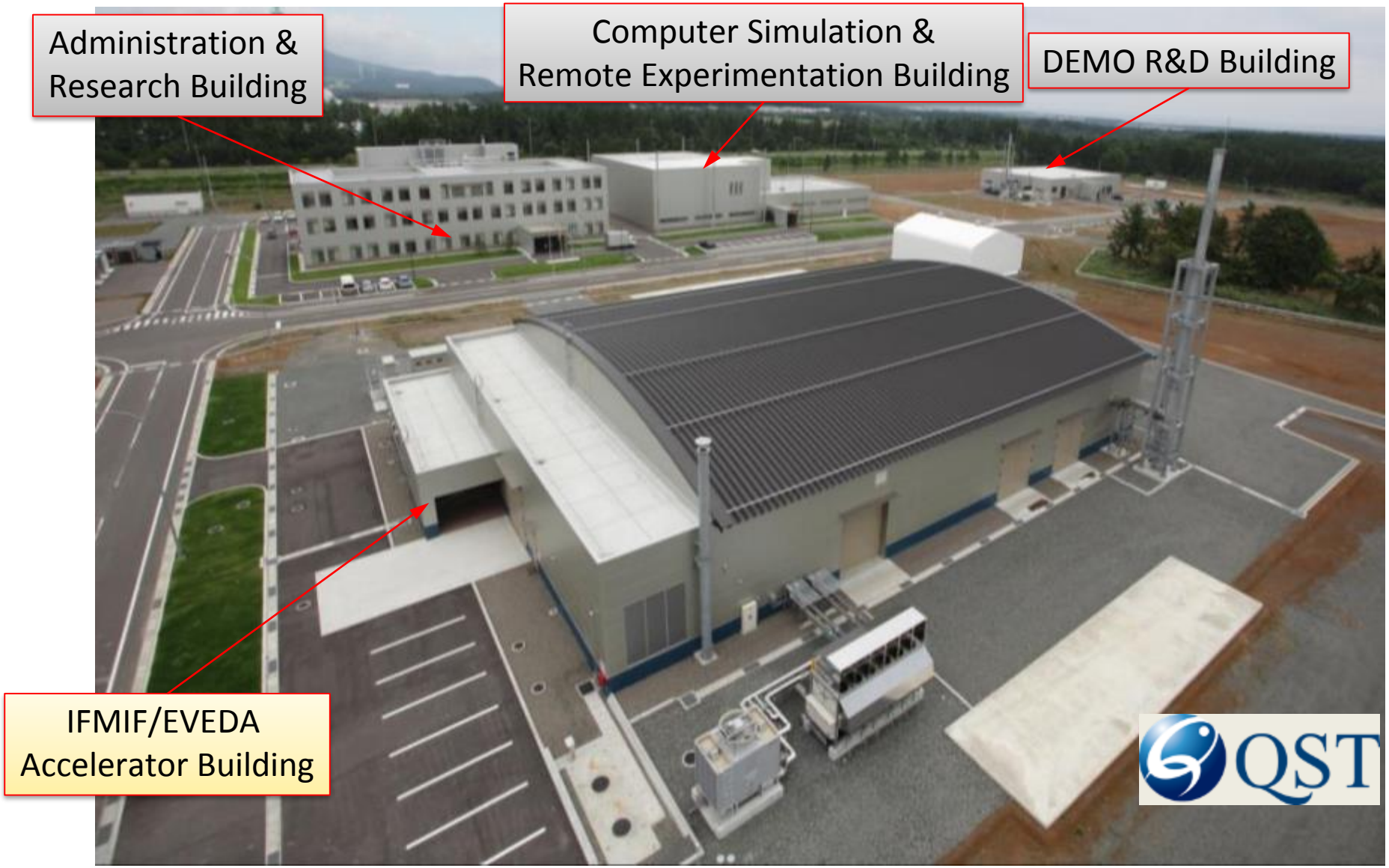
Where is LIPAc?

Gym/Pool



International School

Where is LIPAc?

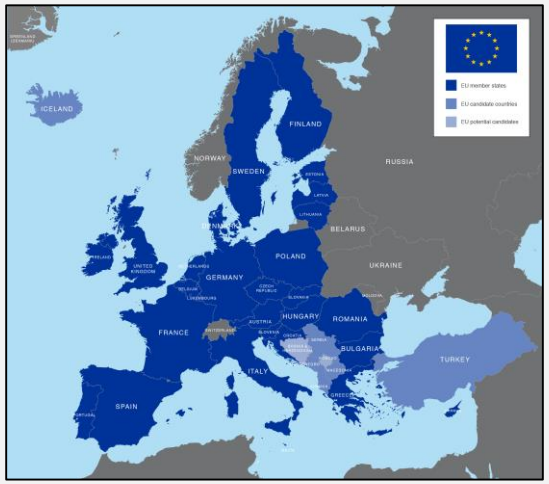


Control Tasks at LIPAc

Control Tasks at LIPAc

EU Contribution - Local control systems (LCS):

- Injector
- RFQ
- MEBT
- Diagnostics
- SRF LINAc
- HEBT
- Beam Dump
- RF power system
- Cooling systems



EPICS

LCS at a glance:

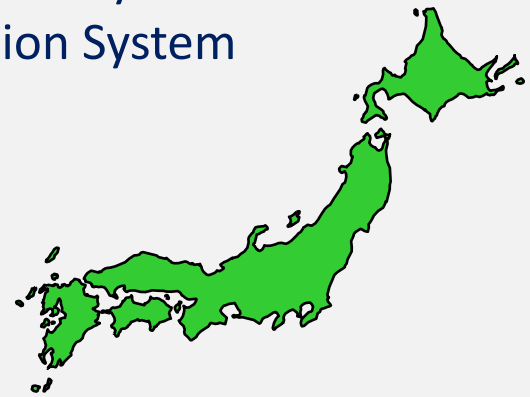
- Typically PLC based (a lot of S7-300) but we also have VMEs / VxWorks systems.
- Typically we have industrial PCs interfacing with EPICS via Siemens S7 PLC driver.
- Microboxes.
- OPIs.

Interface

All these interfacing with CCS.

JA Contribution - Central control system (CCS):

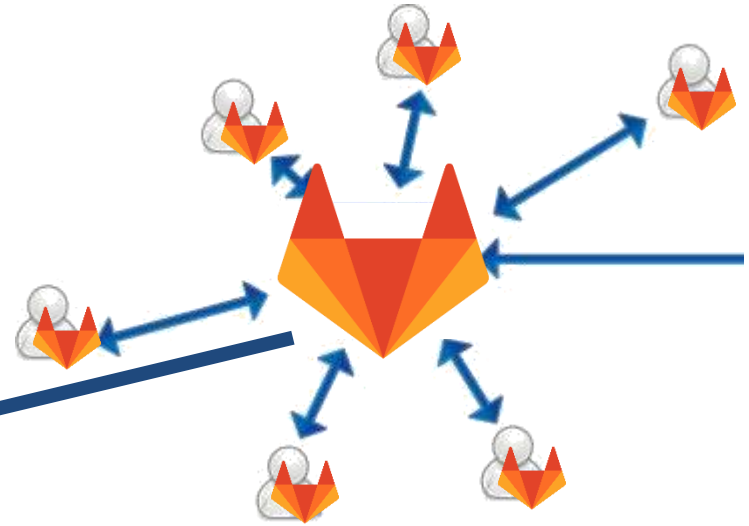
- Machine Protection System
- Personal Protection System
- Timing System
- Archivers



Control Tasks at LIPAc

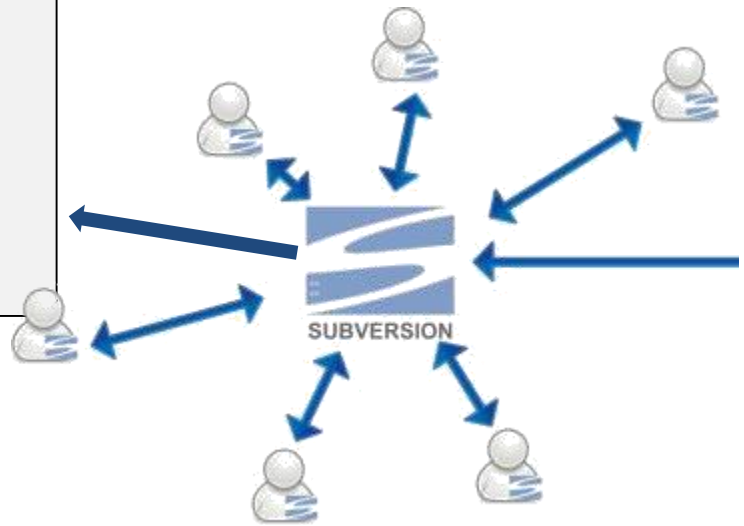
LIPAc controls in glance:

- Common System Platform: **EPICS v.3.14.12, CSS4.5.0, CentOS7**
- PV count: **~60 000 PVs alive**
- Archiver data/day (@EPICS archiver appliance): **~10GB / day**
- IOC count: **~70 IOCs in operation @ ~100 DBs**



Top repositories centralized – IOCs distributed

- topIFMIF_INJ
- topIFMIF_RFQ
- topIFMIF_MEBT
- topIFMIF_SRF
- topIFMIF_SoftIOC
- topIFMIF_OPI
- …
- …



Services on DMZ for version control:

- SVN in use since 2015
- Gitlab in use since 2019

EPICS Control Tools Development

Control Tools Development

LLRF automatic rearming tool developed using pyEPICS:

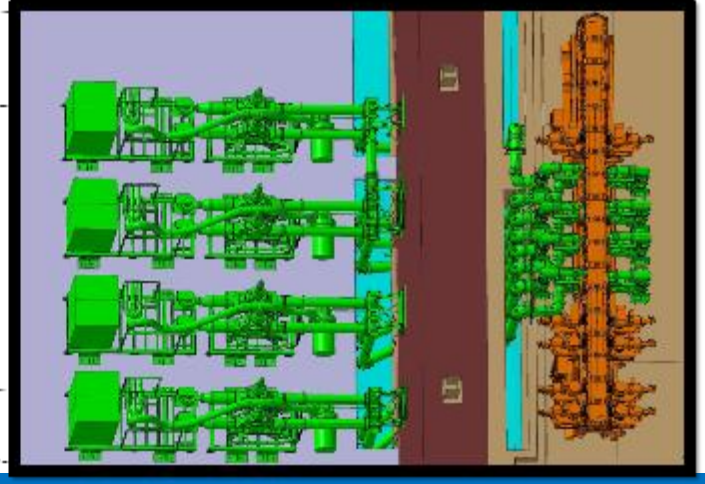
- RFQ cavity needs conditioning -> 8 x 200kW chains.
- LLRF units control the power and react to interlocks.
- The rearming tool allows the RF chains to restart automatically from “safe” interlocks.

RF module for RFQ (Tetrode system)
(INDRA, Spain)
175 MHz, 200 kW, CW × 8 chains

RF transmission line
(Spinner, Germany)
9 8/16” Coaxial wave guide

High Voltage Power Supply (HVPS)
(JEMA, Spain)
13 kV, 400 kW × 8

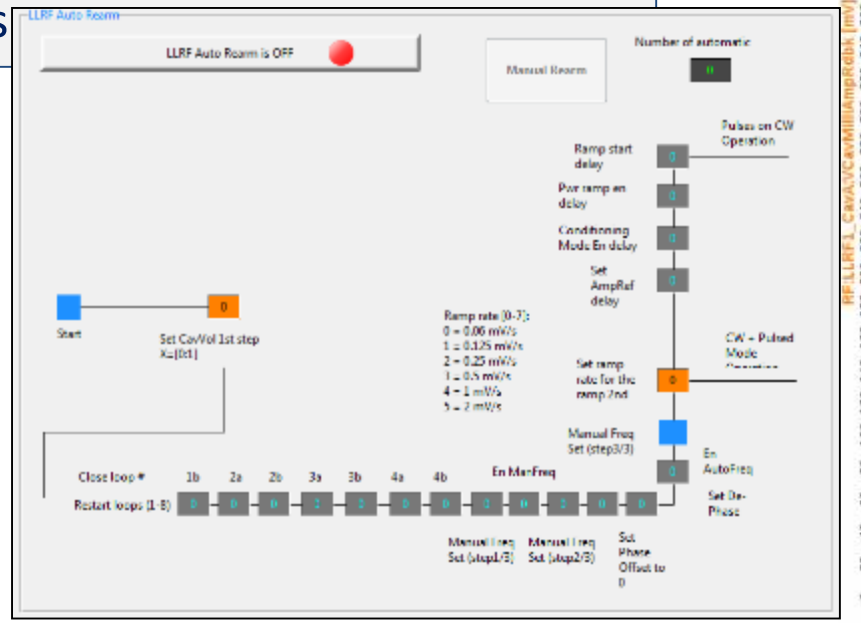
Top view of the 4 x RF modules, coaxial lines and RFQ cavity

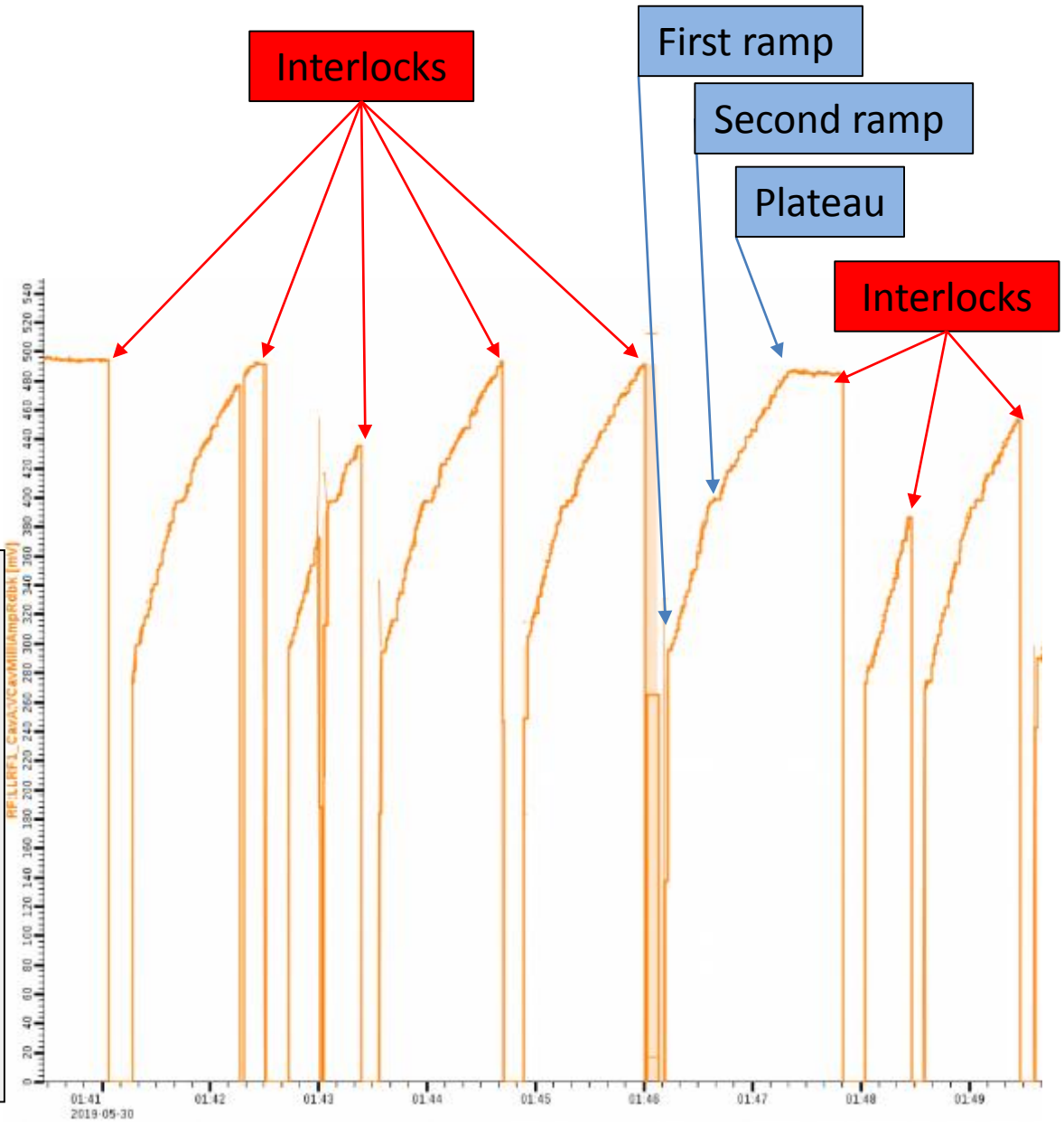


Control Tools Development

LLRF rearming tool workflow (main points only):

1. In a case of a safe interlock - Stop the RF system.
2. Save the previous cavity voltage and frequency.
3. Reset interlocks.
4. Start the master LLRF chain at low cavity voltage value.
5. Restore previous frequency mode.
6. Start other LLRF chains.
7. Set ramps and ramp to the previous cavity voltage in two steps

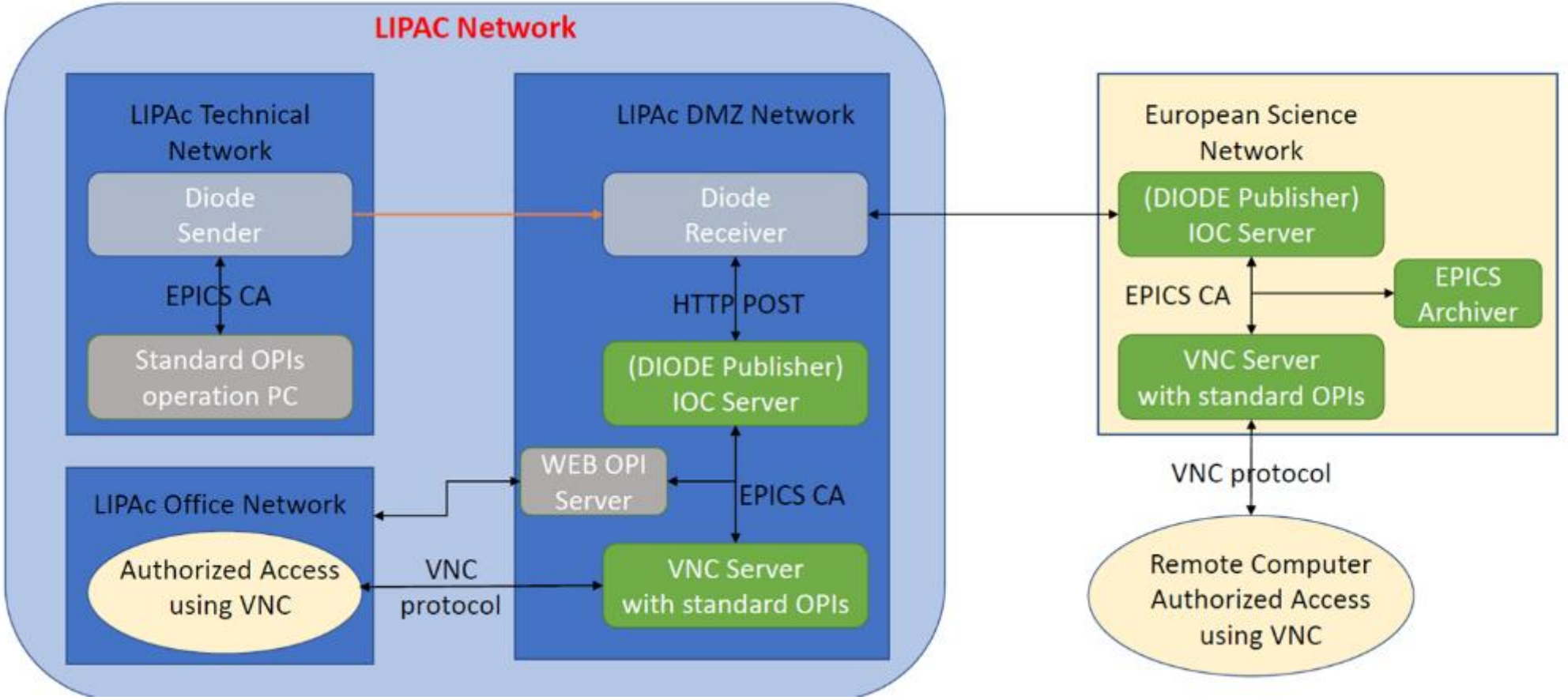




Control Tools Development

Remote participation (EU to JP) and sharing the experimental data. Data-share scheme has been developed:

1. Database cloning -> share archived data.
2. Data-diode -> share Live PV data.



Schedule:

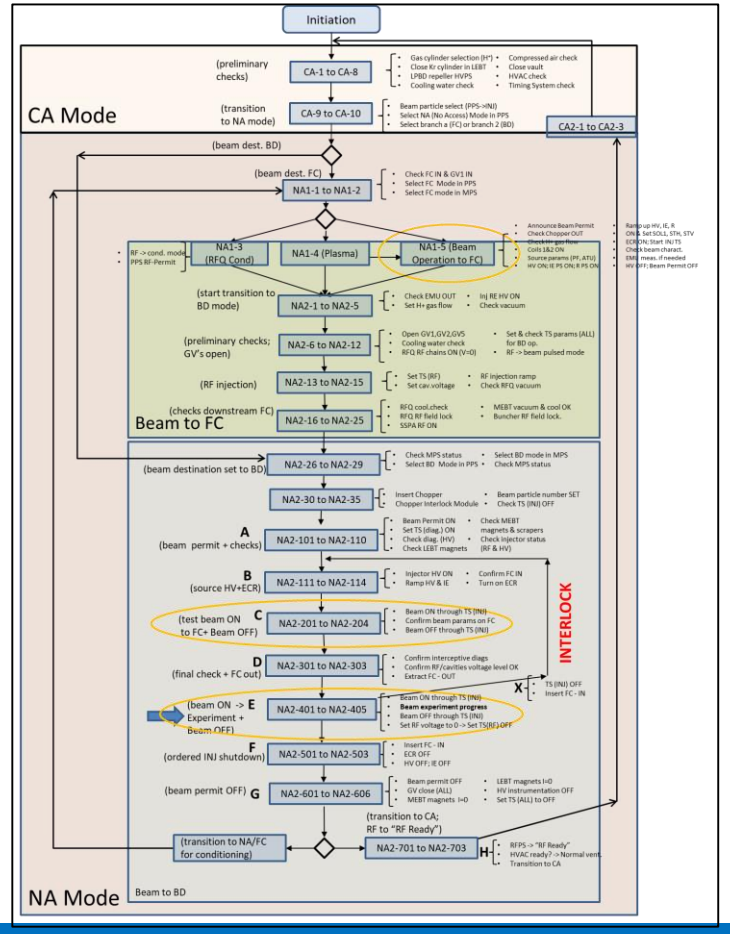
- Internal tests started in 2018 (WebOPI).
- Trials to share with Europe scheduled in June 2019.

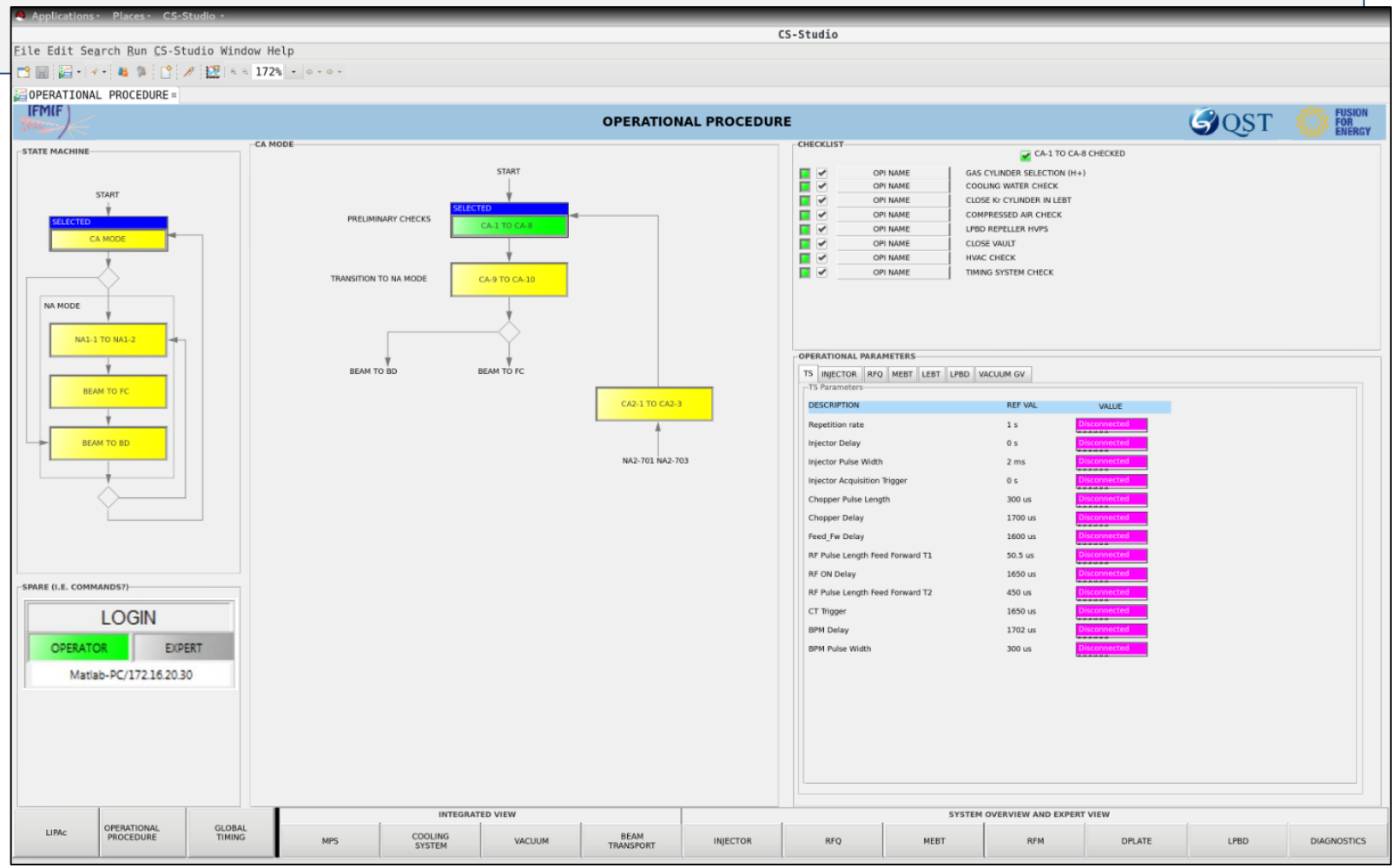
LCS Integration

LCS Integration

Beam Operation OPI (and integrated OPI):

- When operating the machine there are certain conditions that have to be checked.
- Beam operation OPI was developed to automatize some of these checks.
- User management with pwd.





LCS Integration

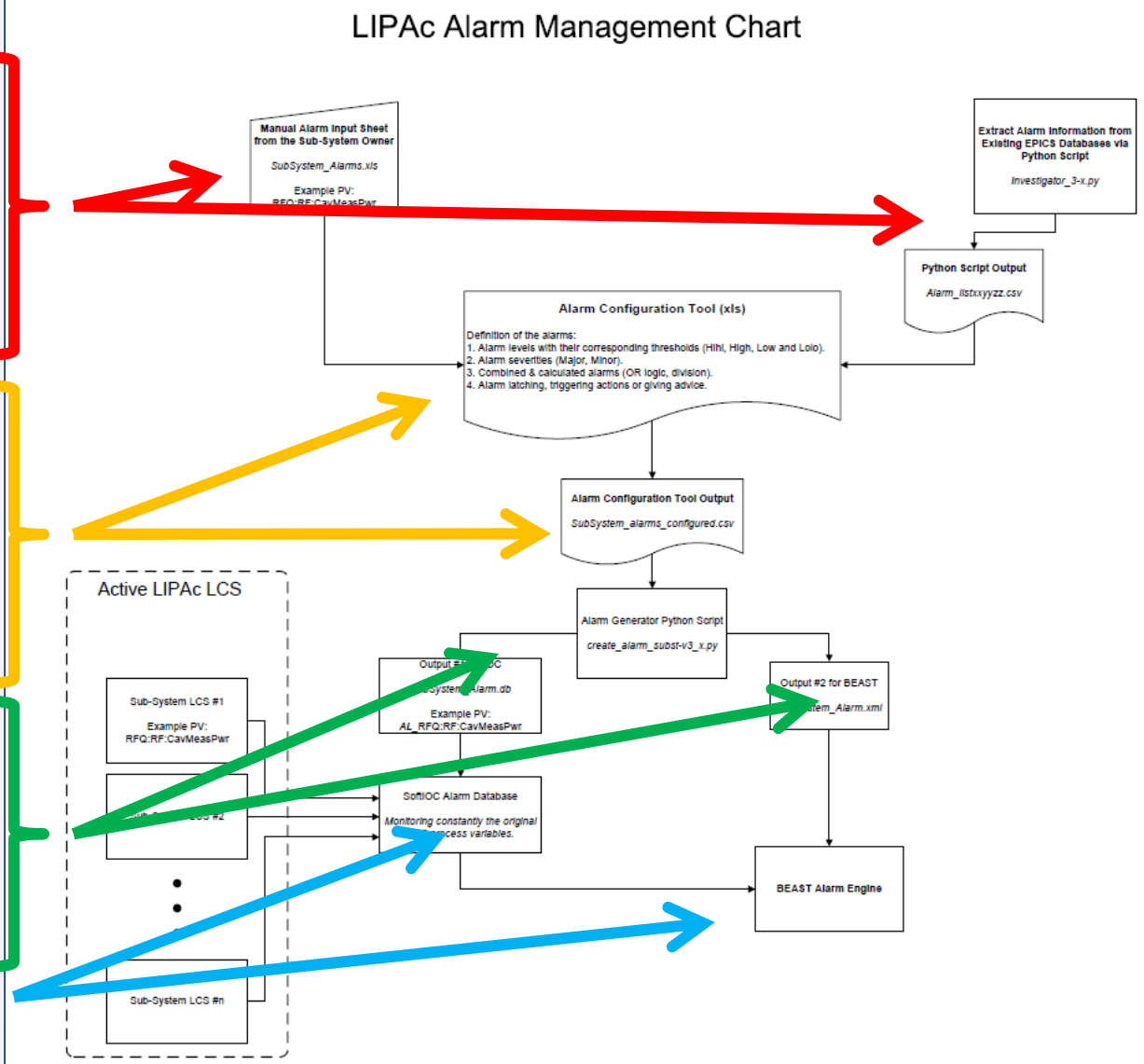
LIPAc Alarm System (BEAST)

1. Sub-system alarm data:
- Pre-defined (from institutes). Alarm template.
- Extracted (from PVs by using a script). Create CSV file.

2. Alarm configuration tool:
- All alarms listed.
- Severity/Levels.
- Logic e.g. OR/AND
- Advice, latch, etc.
- -> Out = xxyyzz.CSV file.

3. Alarm Generator Script:
- Reads the CSV
- Creates Alarm IOC (input from the LCS)
- Creates XML for BEAST.

4. Run Alarm IOC and BEAST with the info defined above.



RFQ

MEBT

RFPS

Cooling

LPBD

Next Steps

Next Steps

The big picture in terms of controls.

Short haul plan:

1. Establish collaboration with other institutes to share info.
2. Integrate LCS of HEBT/BD, SRF LINAc, Cryoplant (Phase B+ and Phase C).

Long haul plan:

1. Think about the LIPAc future in terms of Phase BA II (= Activity from 2020 – 2025).
   - Renovation of the control systems of LIPAc.
   - Timing system improvements.
   - Virtualization.

Summary

LIPAc controls are evolving:

1. LCS for many sub-systems successfully integrated -> The machine is being operated in daily-basis.
2. Challenges have been faced but they've been sorted out.

The future looks bright:

1. We are currently open to collaboration to share the gained knowledge and operational feedback.
2. The refurbishment of the current control system is planned from 2020 onwards.