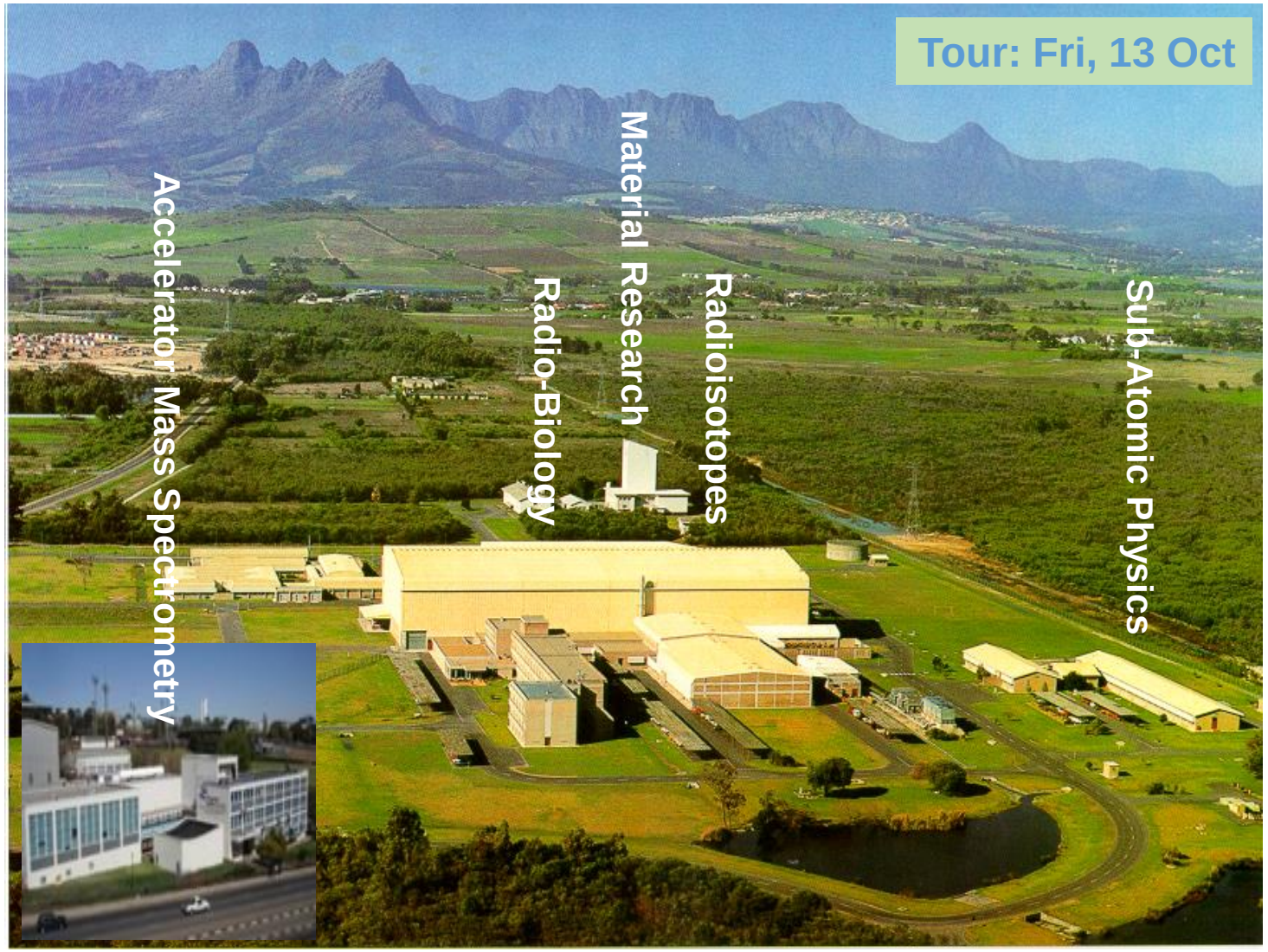
Accelerator Control Development at iThemba LABS

Road to EPICS and beyond

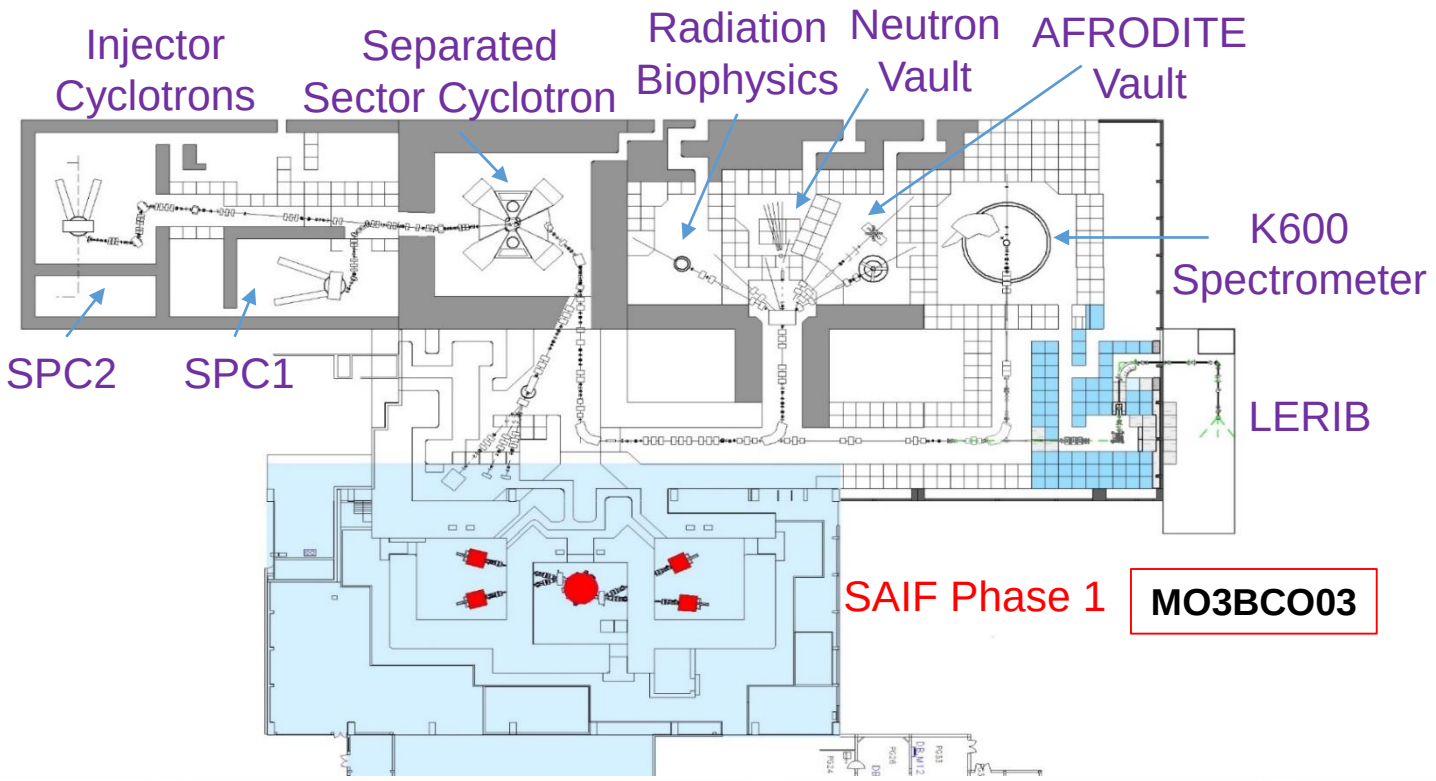
iThemba Laboratory for Accelerator Based Sciences (LABS)

- Fundamental studies of nuclear phenomena (ALICE & ATLAS)
- Applications of ion beams and associated techniques in materials and nanoscience research
- Research and production of radioisotopes for science and medicine
- Radiation biology
- Accelerator Mass Spectrometry



1964 1987 2011 2014 2017 2022

SUNI NAC iThemba LABS



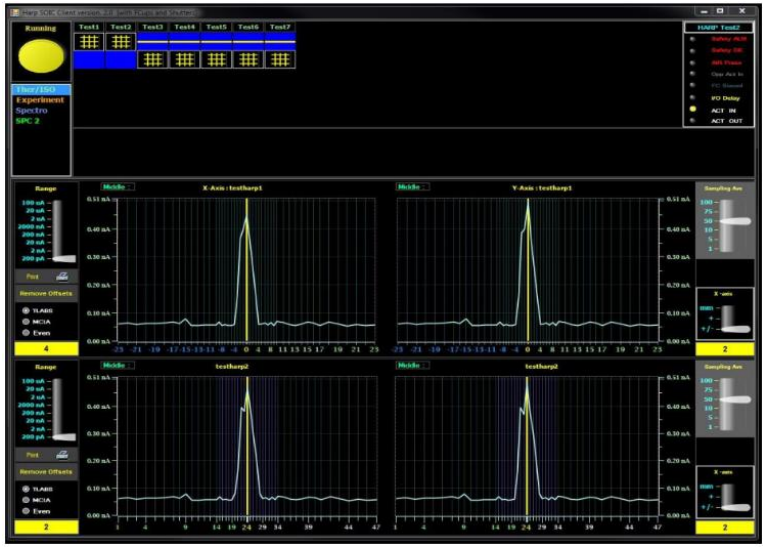
ACS Historical Development (1980s – 90s)

- Accelerator control systems originally designed (late 70s) around a few mini-computers (HP 1000s running RTE)
- Control electronics and instrumentation interfaced via CAMAC
- Lab-built interactive devices (joysticks, set-point units, etc)

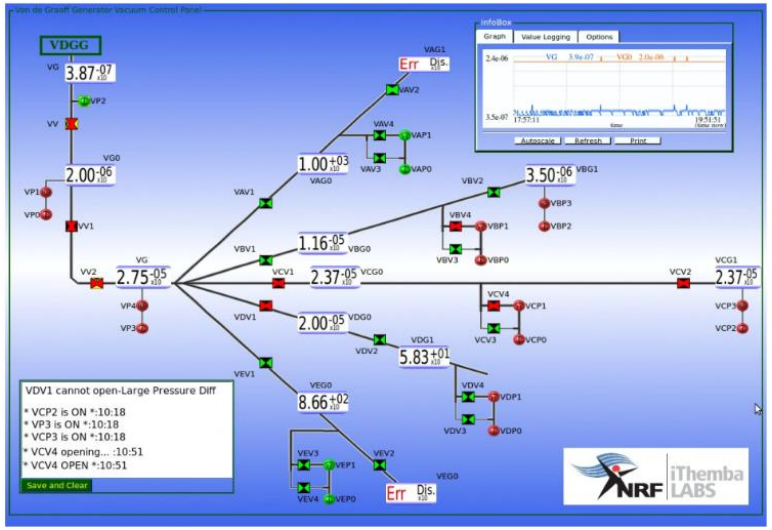
- Control system migrated to distributed PC-based system running OS/2 in the early 90s
- Communication over Ethernet LAN
- Distributed memory-resident tables of control variables
- Development of in-house interface SABUS

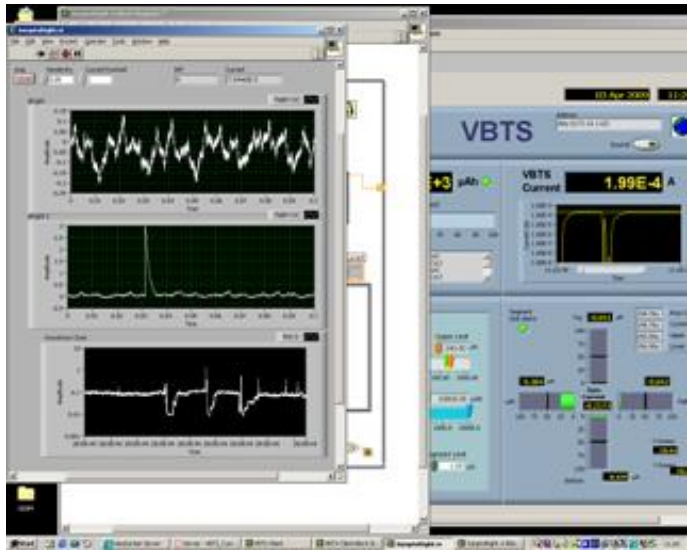
ACS Historical Development (2000s – early 2010s)

- Migrate control system onto EPICS platform
- Mature stable code
- Active development in, and support from, a number of similar international labs
- Many useful utilities available in EPICS (logging, archiving, alarming, etc.)
- LabVIEW development



- Run old and EPICS-based subsystems in parallel
- Gateway between old table-based control variables and EPICS process variables
- Retain hardware (SABUS) interfaces





ACS Recent Developments

- Long design cycles and rapid rate of obsolescence of modern electronics
- Move to commercial off-the-shelf EtherCAT hardware
- Stable open source master (IgH) and existing integration into EPICS (DLS)
- Addresses most process control
  - Motion control (CL up to 1 kHz)
  - Serial comms (RS)
  - Digital IN/OUT
  - Sensors (TC, RTD, 4-20 mA, 0-10V etc.)
  - DAQ up to 100kHz and 23-bit

ACS Recent Developments

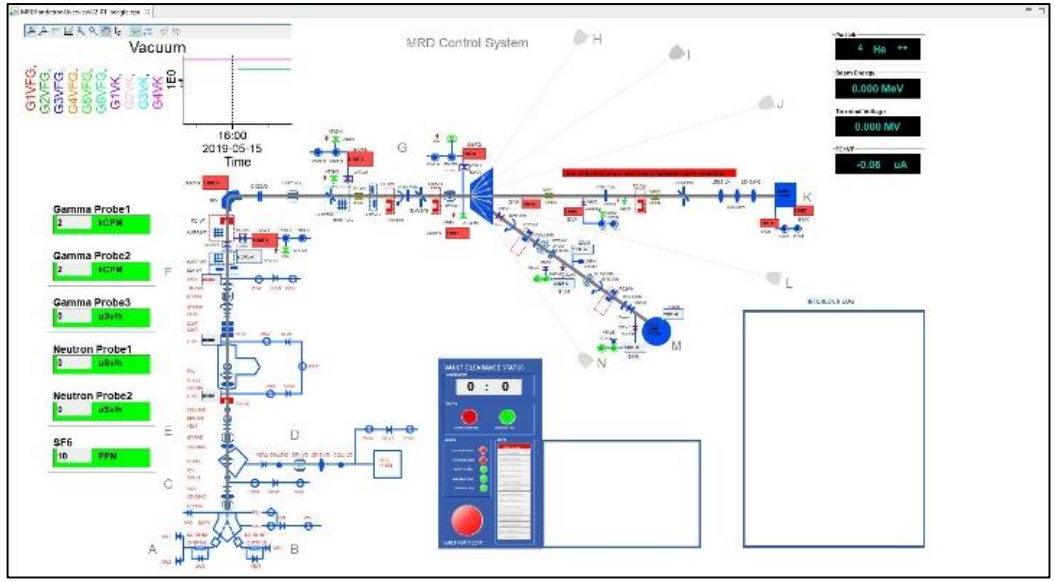
- Control of RF & high speed systems
- Micro, Nano and smaller range measurements
- Low noise and high fidelity signals

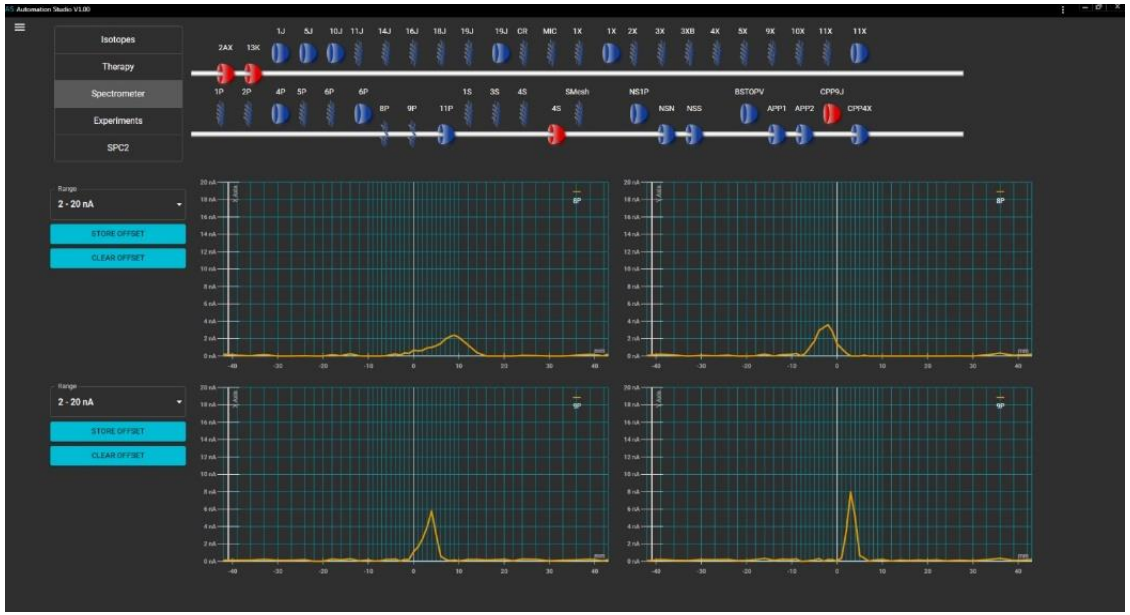
- Digital Low-Level Radio Frequency Control System
  - Replaced all RF control systems at iThemba LABS
  - Installation abroad and international interest

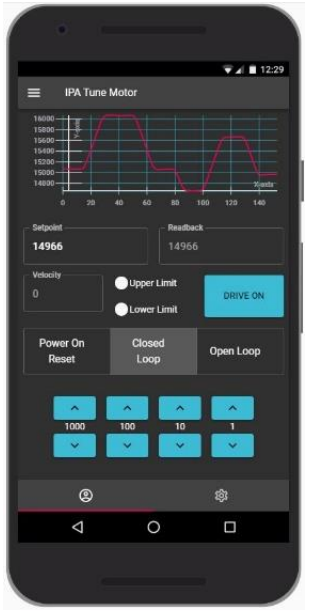
- Multichannel Precision Current Integrators
  - 8 and 48 channel
  - 10 pA to 100 uA

ACS Recent Developments

- UI development in CS-Studio and Qt
- Move to Phoebus
- Development of React Automation Studio
  - Progressive web application framework
  - EPICS control from smart device or web
  - Components and widgets
  - Archiver interface, plots, alarming
  - FR2BCO01







ACS Development at the South African Isotope Facility (SAIF)

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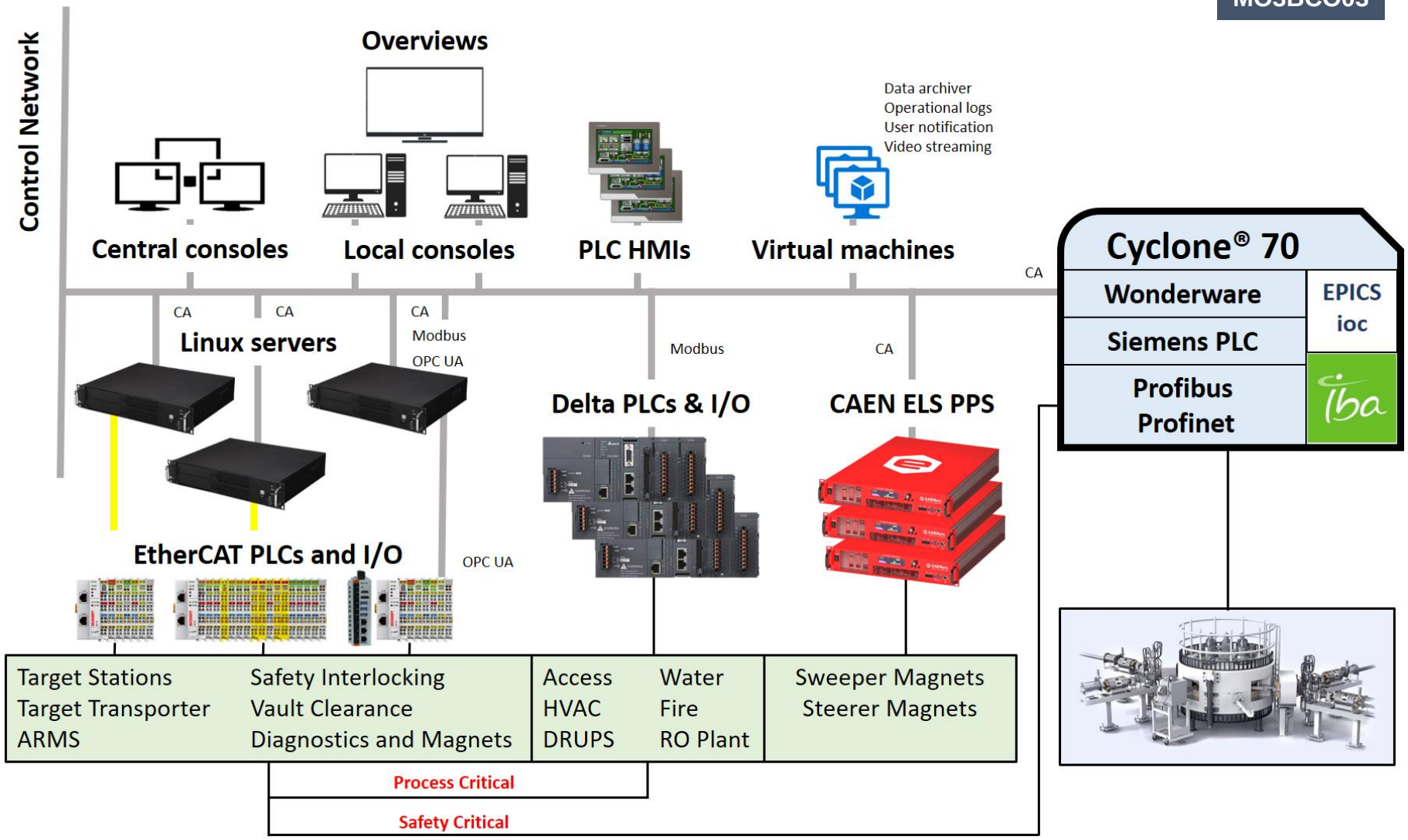

Future Developments

- Move to EPICS7
- iocs on SBCs (EtherCAT master?)
- EPICS Support for EtherCAT Motion Controller (ECMC) and Generic IO Controller
- Identify high fidelity and high speed control hardware with existing EPICS support