A Control System of the Slow-Extraction Beam Lines in the J-PARC Project

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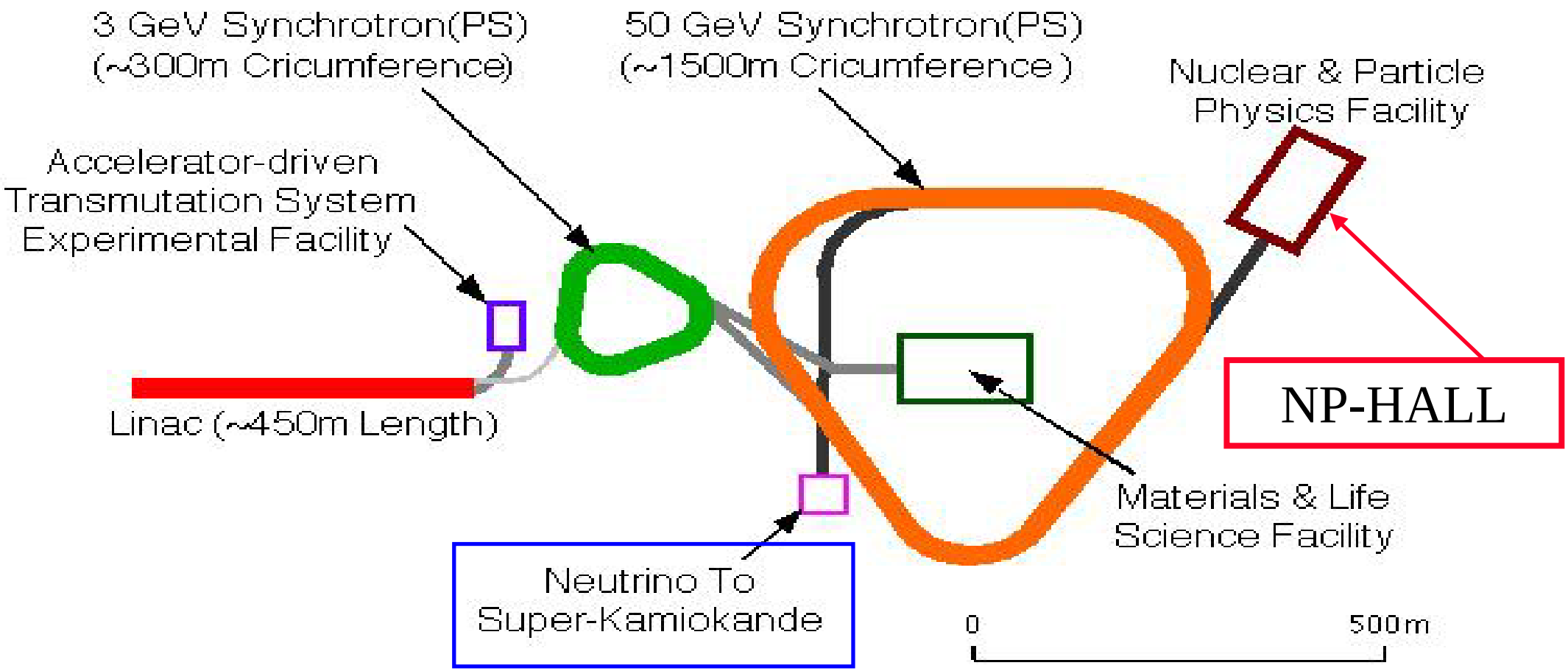
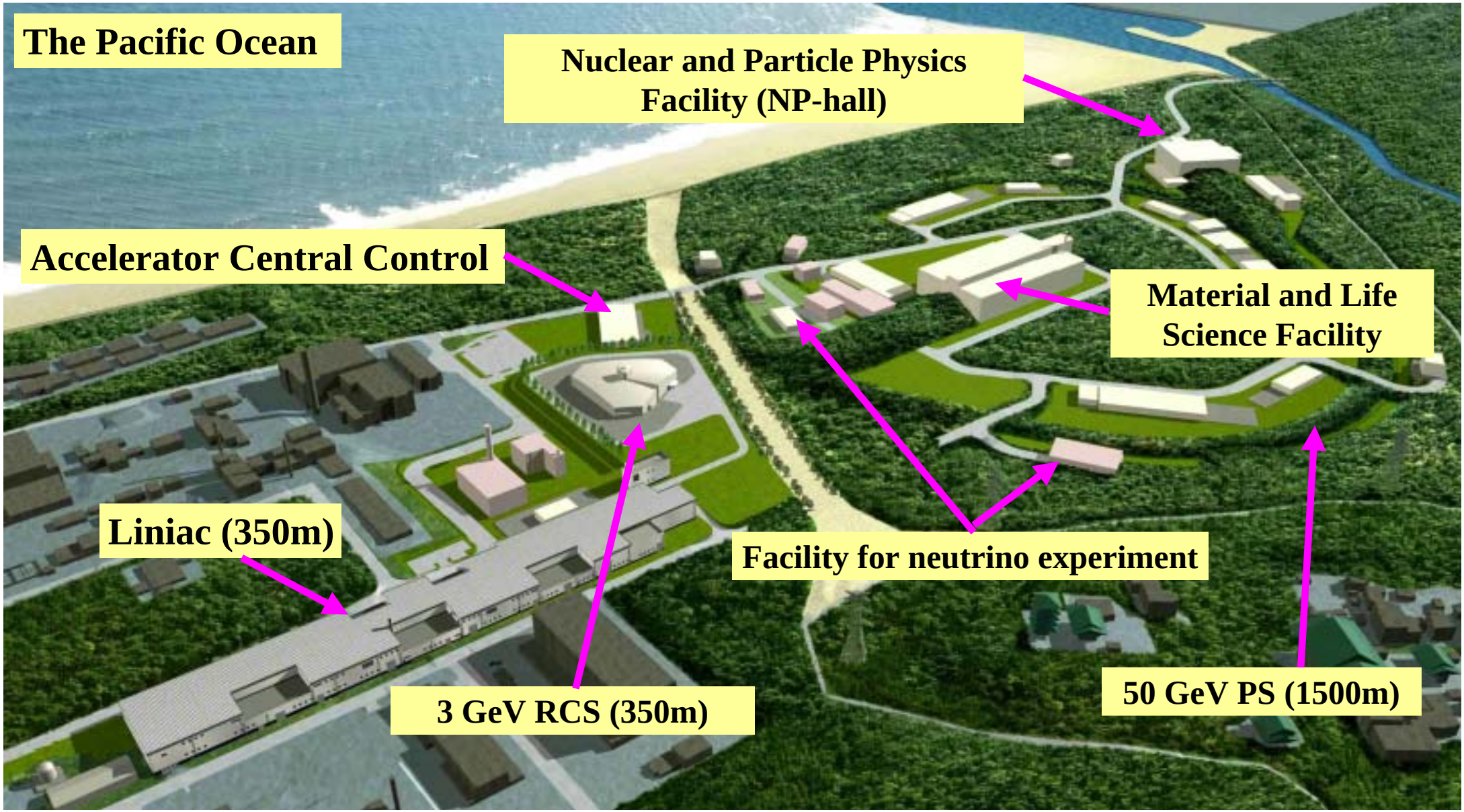
J-PARC: The Accelerator Complex

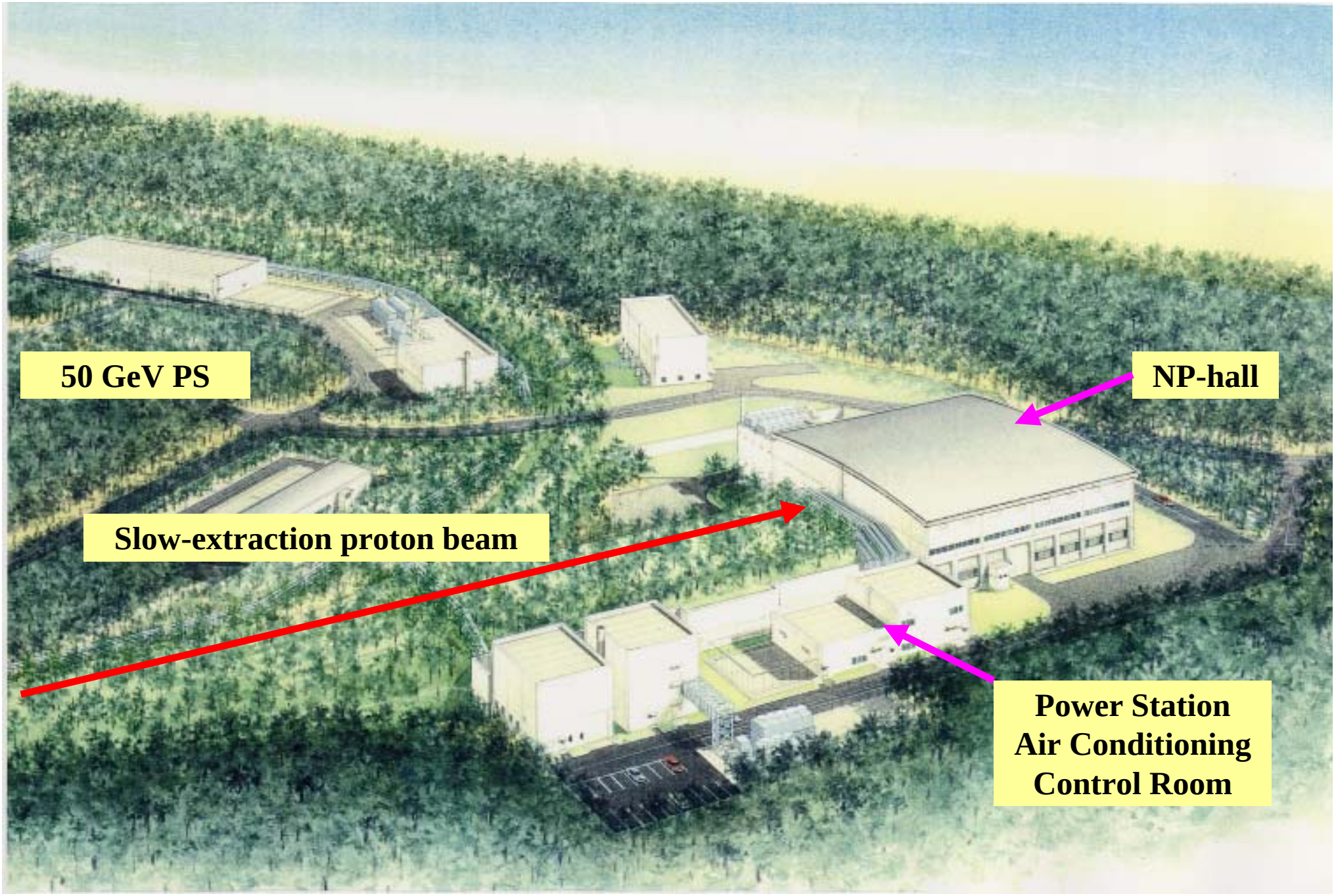


- NP-Hall: Experimental Hall for 50GeV-15 μA Slow Beam
  - The First (Only One?) ***KAON FACTORY*** in the World
- Neutrino Beam Facility (JHF-ν) : Long Baseline Experiment

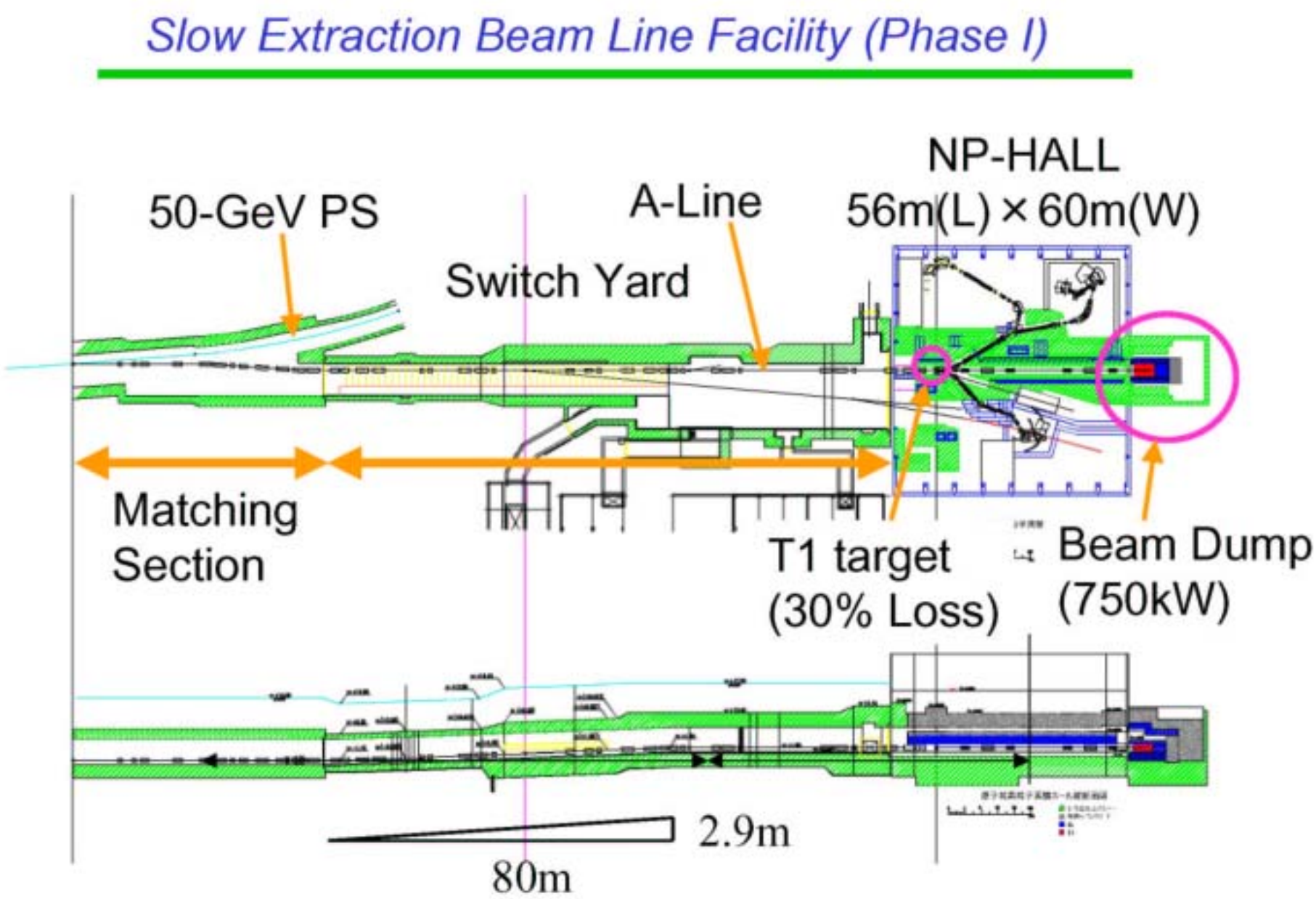
Japan Proton Accelerator Research Complex (J-PARC)
Plan View at JAERI Tokai site



Nuclear and Particle Physics Facility (NP-hall)
Plan View



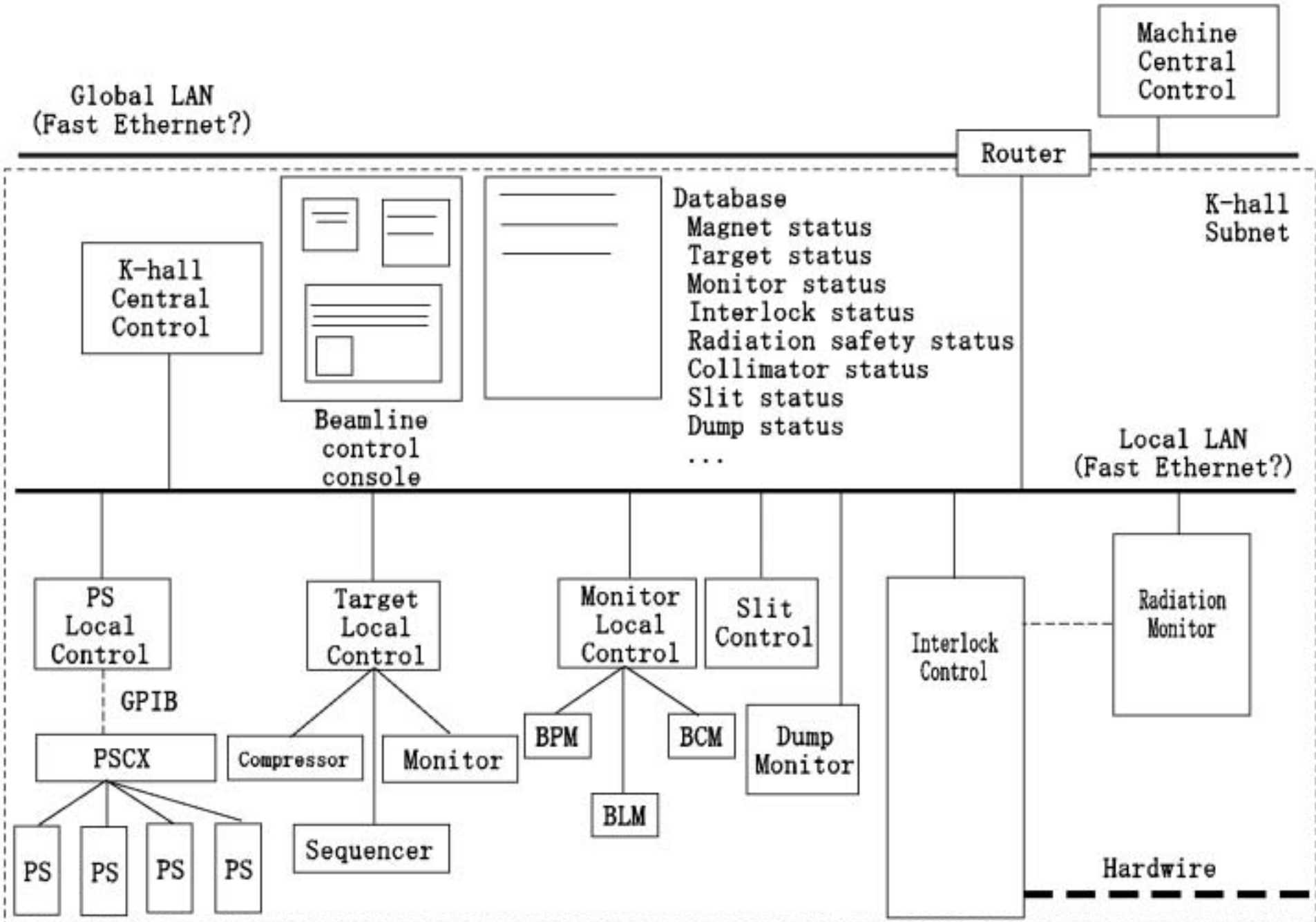
Nuclear and Particle Physics Facility (NP-hall) General Layout



What should be controlled ?

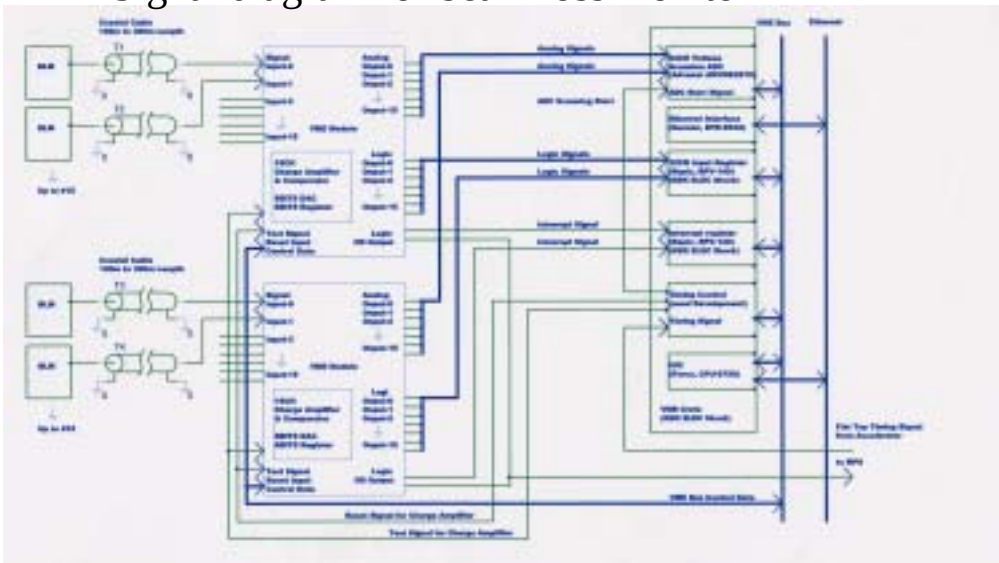
- Primary proton beam
  - Energy: 50 GeV, Intensity: 15 μA (750kW)
  - Slow-extraction: 0.7 sec in 3.4 sec cycle
  - Beam monitors
    - Beam current monitor (BCM): total 4
      - Dynamic range: 0.1– 50 μA
    - Beam profile monitor (BPRM): total 16
      - Maxmum beam size: ~ ϕ 40 cm
    - Beam loss monitor (BLM): total 100-200
  - Magnet and power supply
    - Magnet current
    - Interlocks (water, over-current, etc.)
  - Production target (Rotating Ni disks)
    - Rotation speed
    - Temperature
    - Water flow rate
  - Beam dump and collimators
    - Temperature of copper block: total 1000-2000 ch
- Secondary beam line
  - Slit control
  - Electrostatic Septum
- Safety control
  - Personal Protection System (PPS)
    - Doors
    - Air conditioner
    - Cooling water
    - Bending magnets
    - Personal keys
    - Emergency
  - Machine Protection System (MPS)
    - Beam line magnets
    - Collimators
    - Beam dump
    - Vacuum
    - Beam loss monitors
  - Radiation safety
    - Area monitor
    - Air activation monitor
    - Beam intensity monitor

A schematic drawing of the local control system for the slow-extraction beam lines and NP-hall



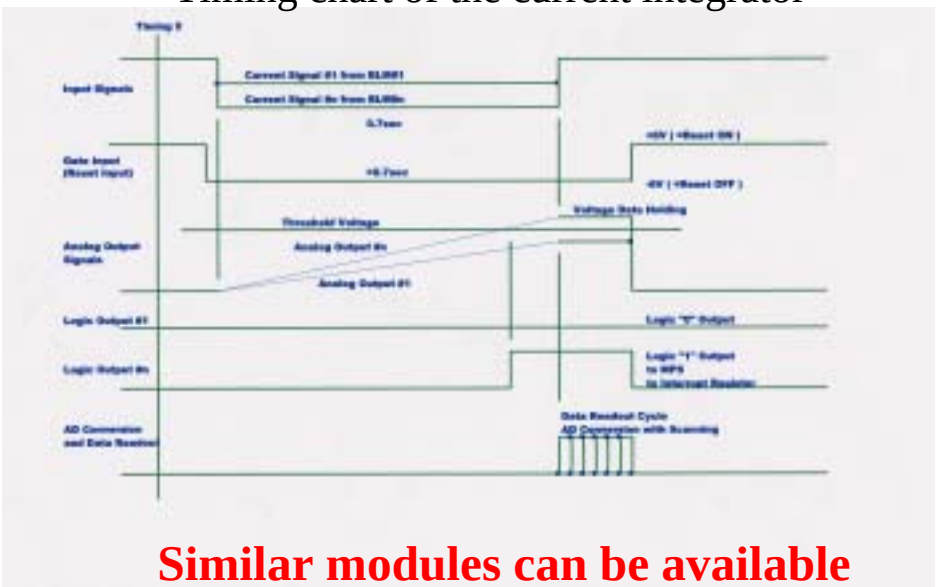
Typical read-out diagram for beam monitors based on VME

Signal diagram for beam loss monitor

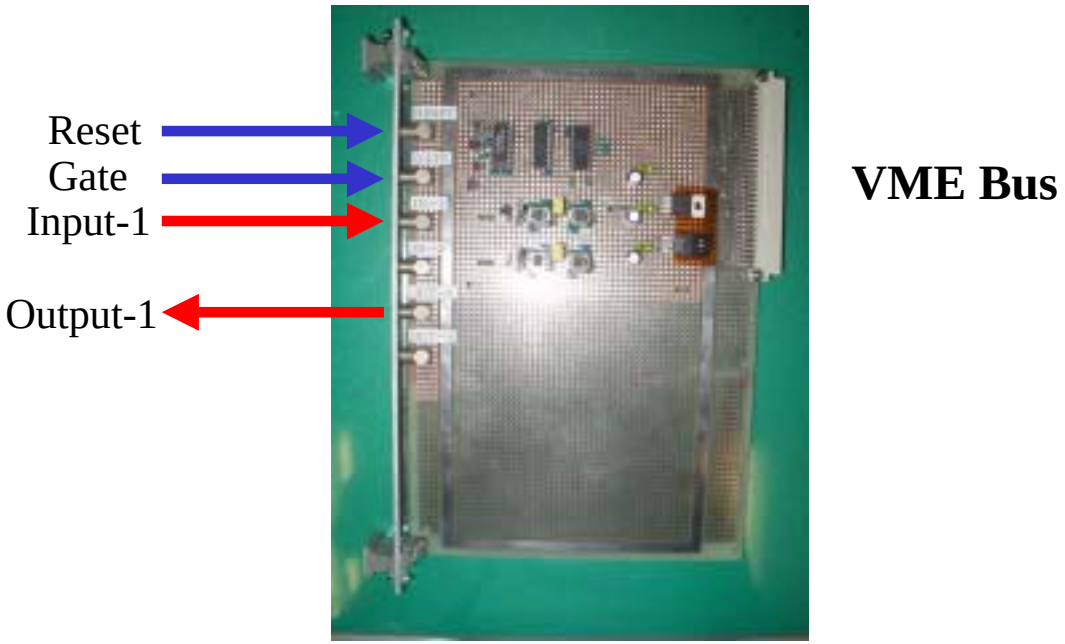


A small prototype of beam loss monitor

Timing chart of the current integrator

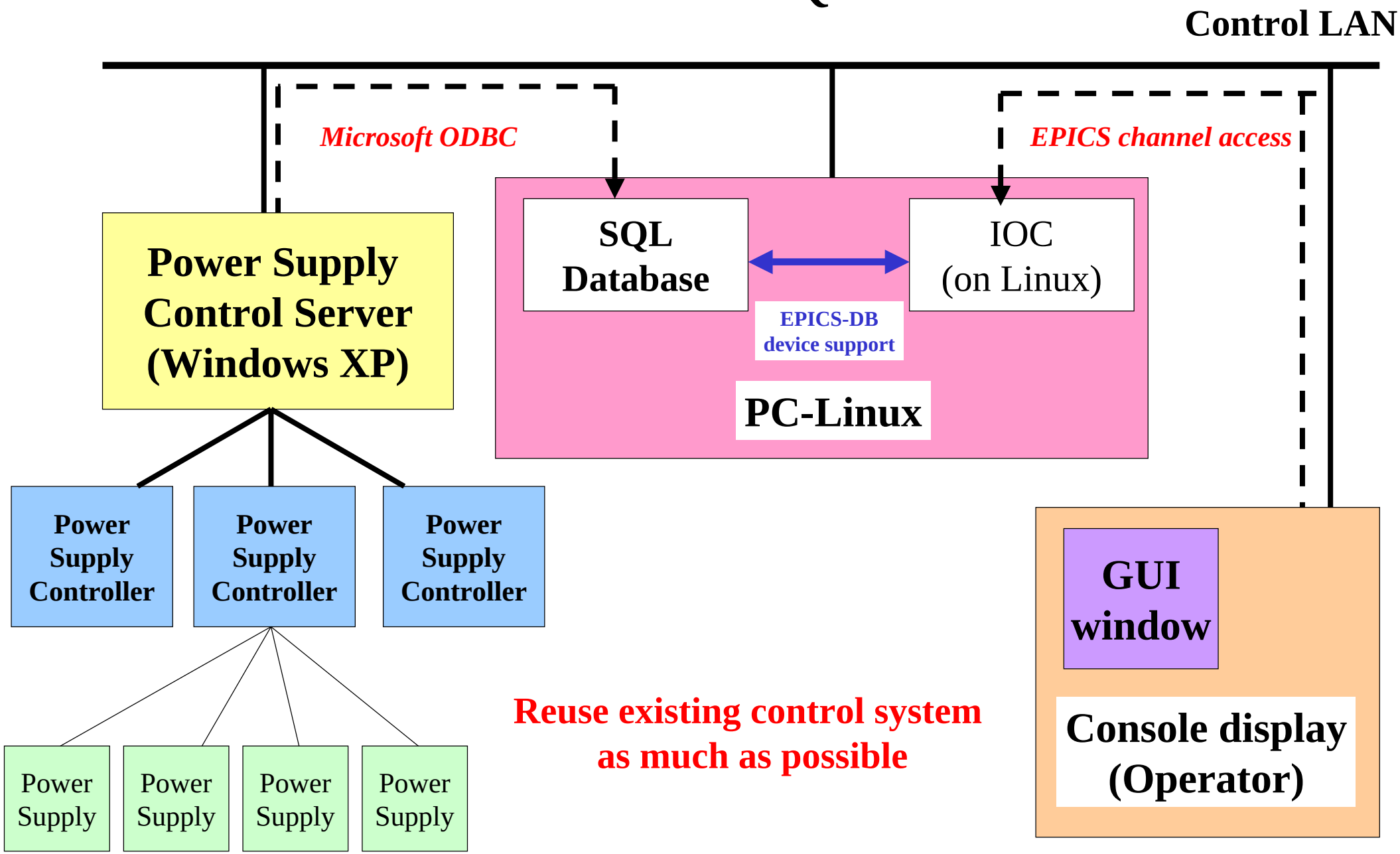


A mock-up of current integrator on VME (w/o interlock)



Similar modules can be available for other beam monitors with minor modifications

Control system for magnet power supply with EPICS and SQL database



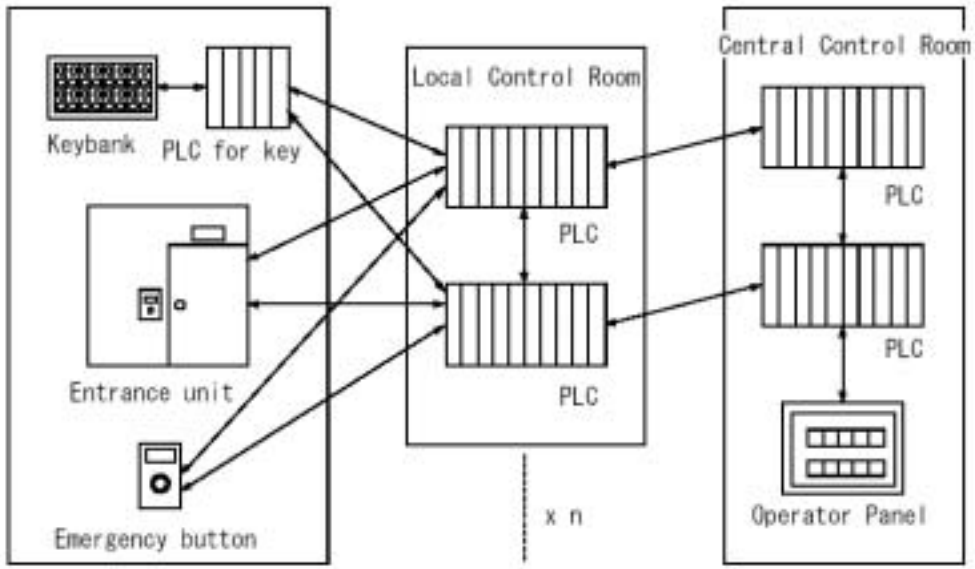
Safety Control System

Interlock elements

Element	PPS/MPS	# of channel
Extracted beam intensity	M	1
Septum magnet	MP	1
SY-magnet	M	All
Beam plug	M	2
SY bending magnet	P	8
Production target	MP	1
Collimators	M	2
Beam dump	M	1
SY, NP vacuum	M	9
SY, NP air conditioner	P	2
Personal keys	P	65
Doors, shields	P	15
Cooling water	P	3
Radiation	P	All
Emergency	P	10

- Personnel Protection System (PPS)
- Machine Protection System (MPS)

Signal connection



Programmable Logic Controller (PLC) with ethernet module