Improvements in the T2K Primary Beamline Control System

K. Nakayoshi, K. Sakashita Y. Fujii (KEK)

for T2K Beamline group

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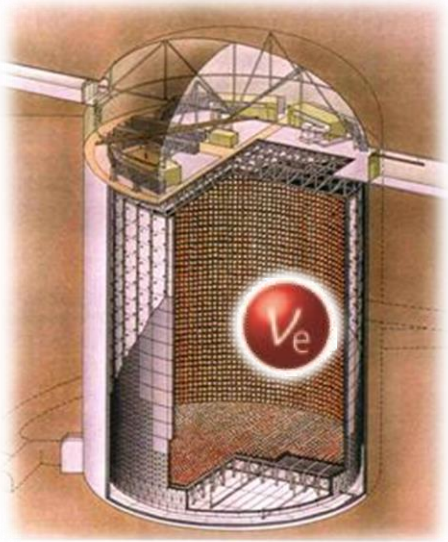
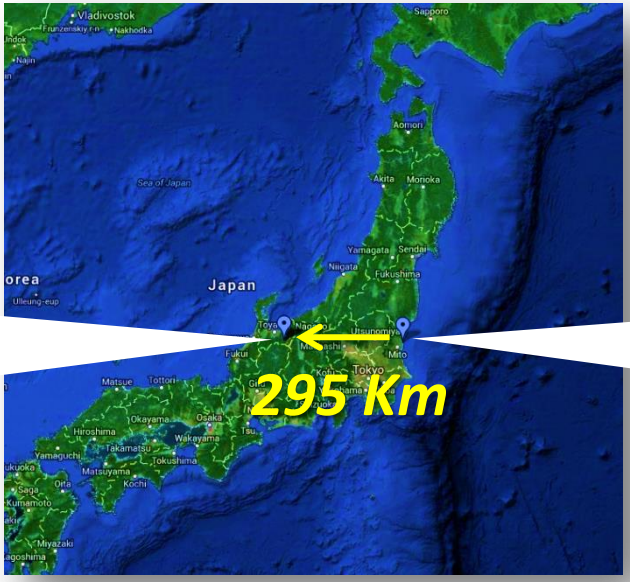
T2K (*T*okai to *K*amioka) Experiment

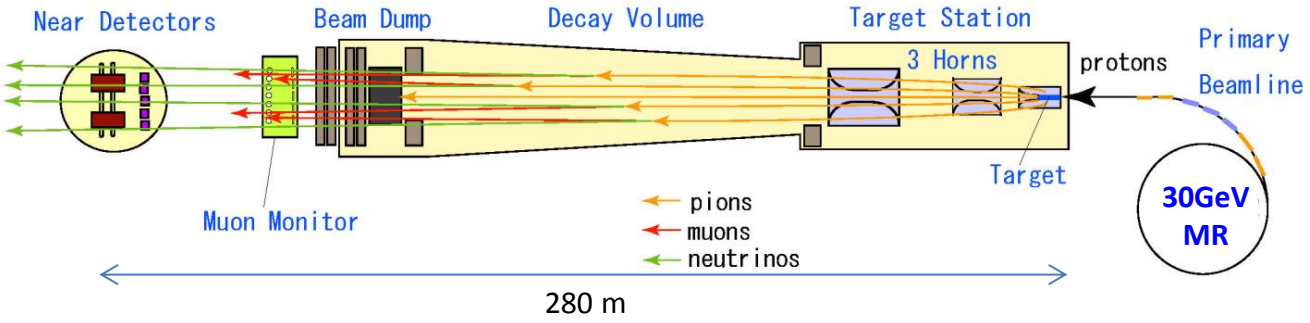
A long-baseline neutrino oscillation experiment at J-PARC



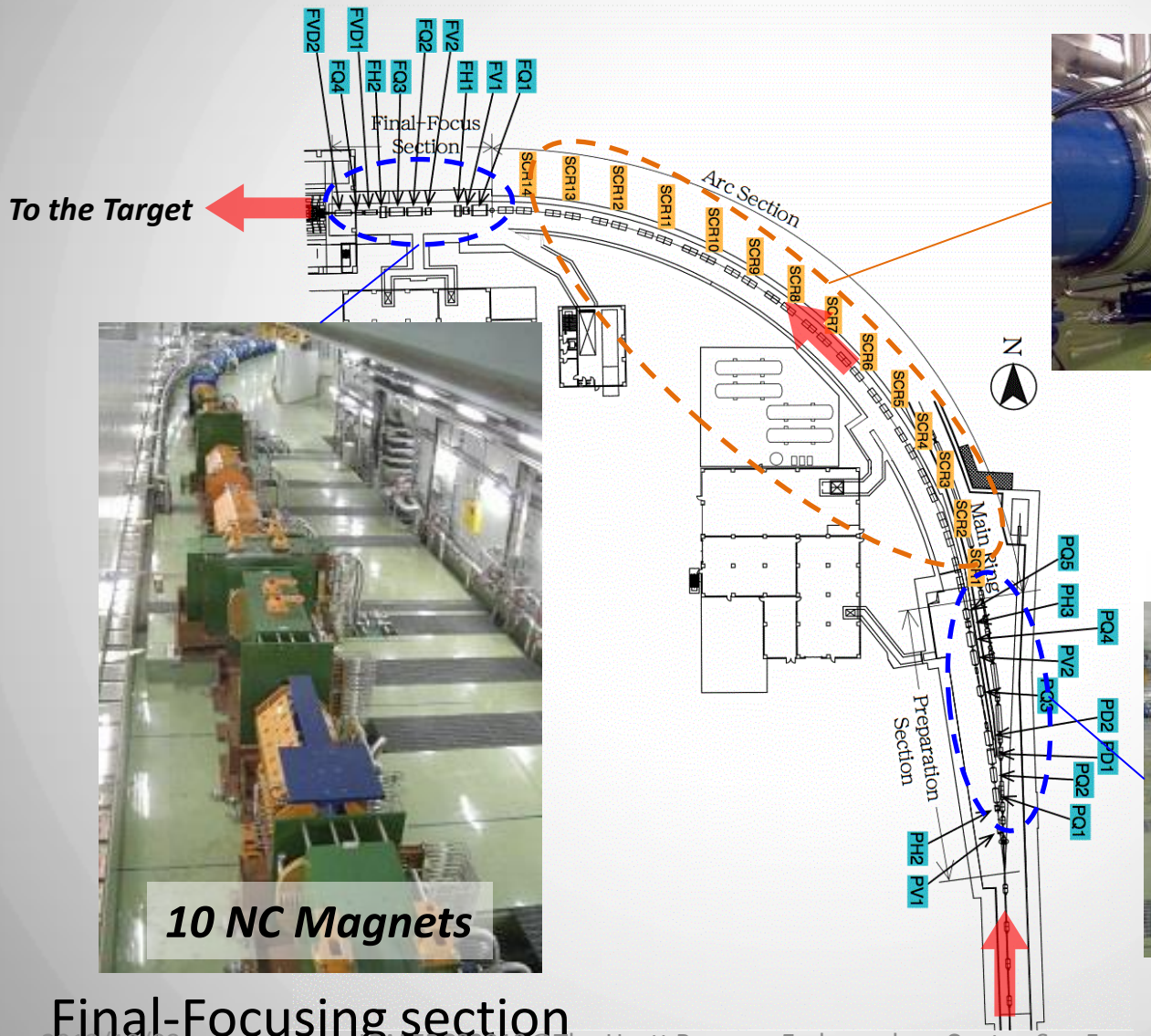
SK@Kamioka



J-PARC@Tokai



T2K Primary Beamline

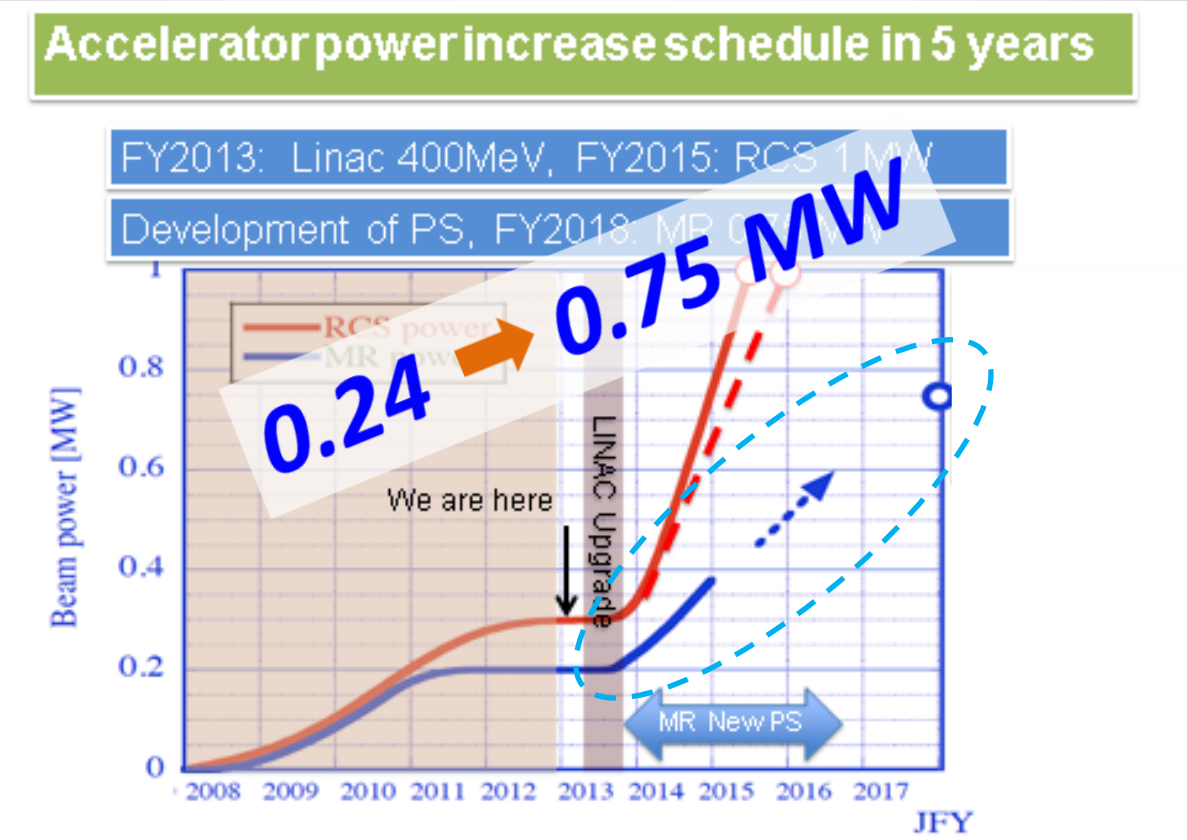


Arc section

Final-Focusing section

Preparation section

Current Status



Taken from Y. Ikeda, Address from J-PARC Center, 17th J-PARC PAC meeting, Sep. 2013.

Under MW-class beam operation,

ONE MISS SHOT can destroy beamline equipment

Machine Protection for Beams

MPS (Machine Protection System)

- An interlock to protect beamline equipment from high intensity beams

In the T2K the healthiness of extracted beam and beamline equipment is assessed shot by shot

If beam loss increases, equips troubles, etc.

→ ***Abort beam by MPS activation***

In MW-Class beam operation,
MPS will become even more important

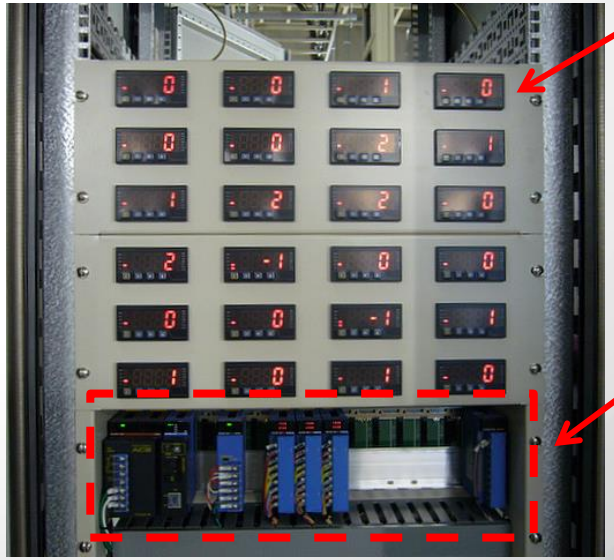
NEW INTERLOCK SYSTEM FOR NC MAGNET POWER SUPPLIES

Interlock System for Power Supply of Normal-Conducting (NC) Magnets

*We have developed a new interlock system using **Digital-Panel-Meters (DPMs) and PLC***

DPM continuously samples and digitizes the DCCT output of NC PS.
DPM allows 4 warning thresholds, HH, HI, LO and LL.

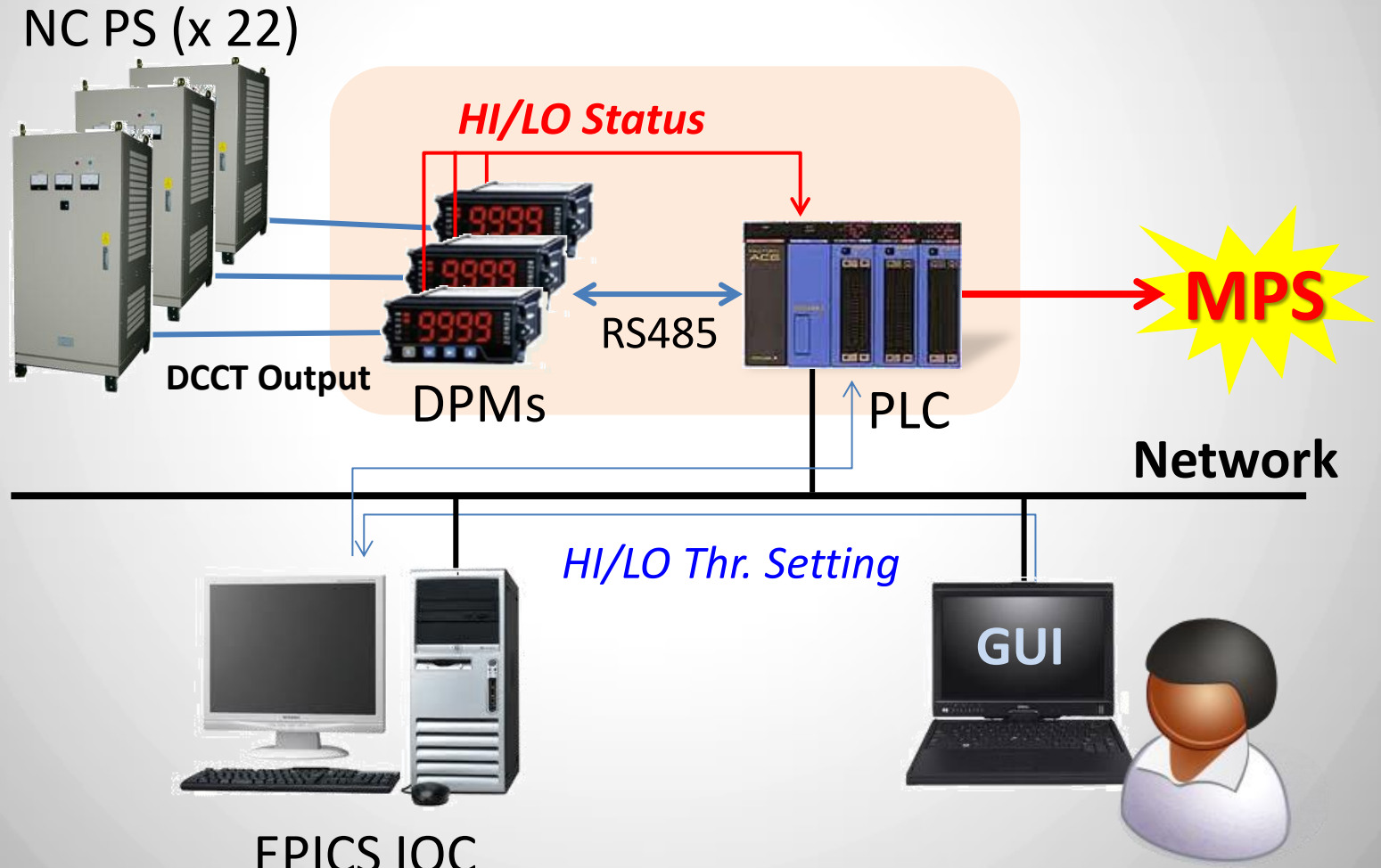
Item	Spec.
Input	DC -9.999 to 9.999 V
Display	-9999 to 9999
Samp. rate	1 kHz
Comm.	RS485/RS232C



Watanabe Elec. Ind.
A7111-C

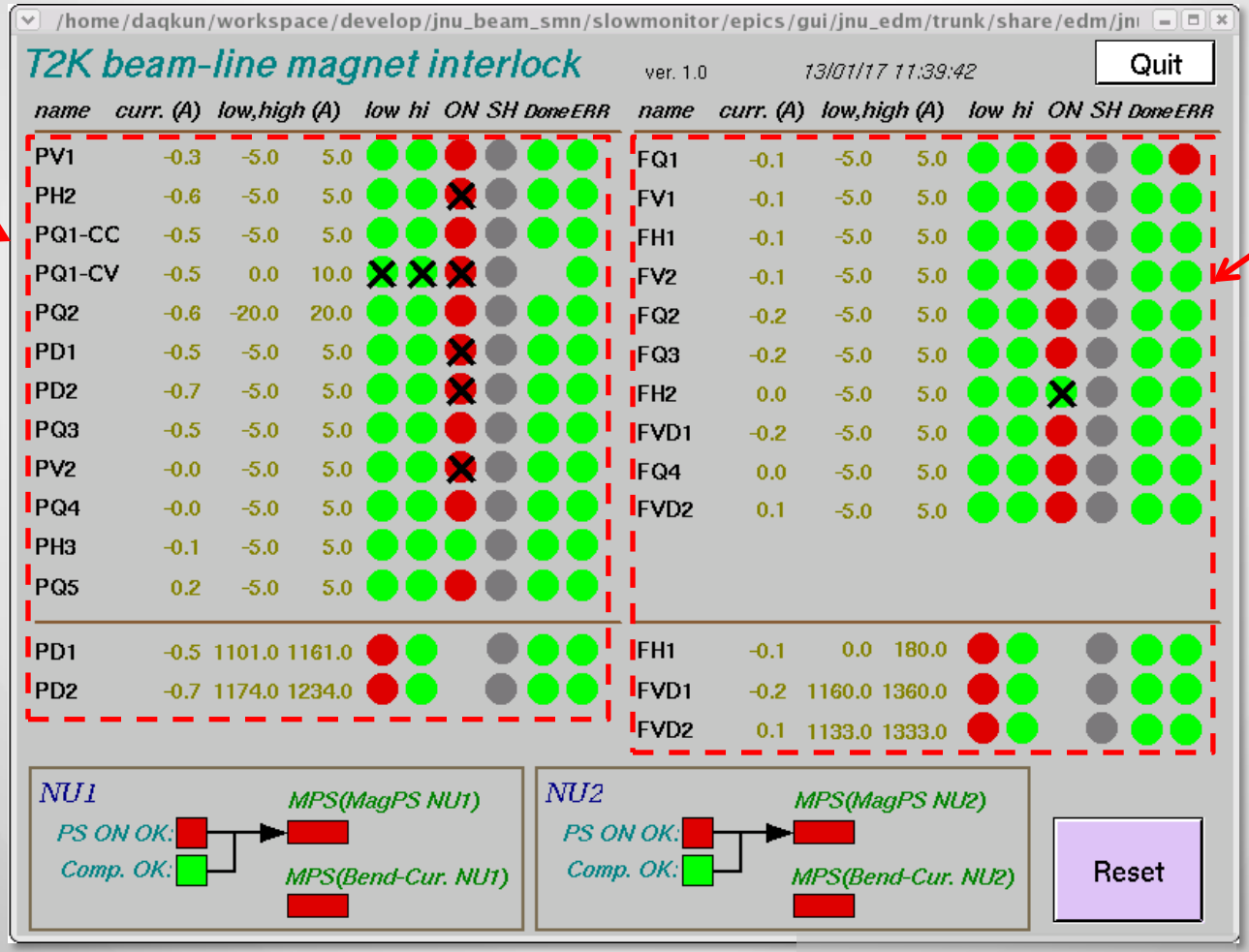
YOKOGAWA
FA-M3

Interlock System for PS of NC Magnets (Contd.)



Interlock System for Power Supply of NC Magnets (contd.)

Power Supplies @Preparation Section



Power Supplies @Final-Focusing Section

Developed by K. Sakashita

Performance measurement

We made some ***preliminary investigations*** of the performance measurement

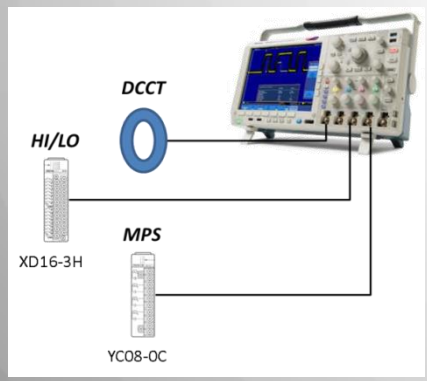
We measured ***the latency time*** of the interlock system by changing ***the number of averaging times*** in the DPM.

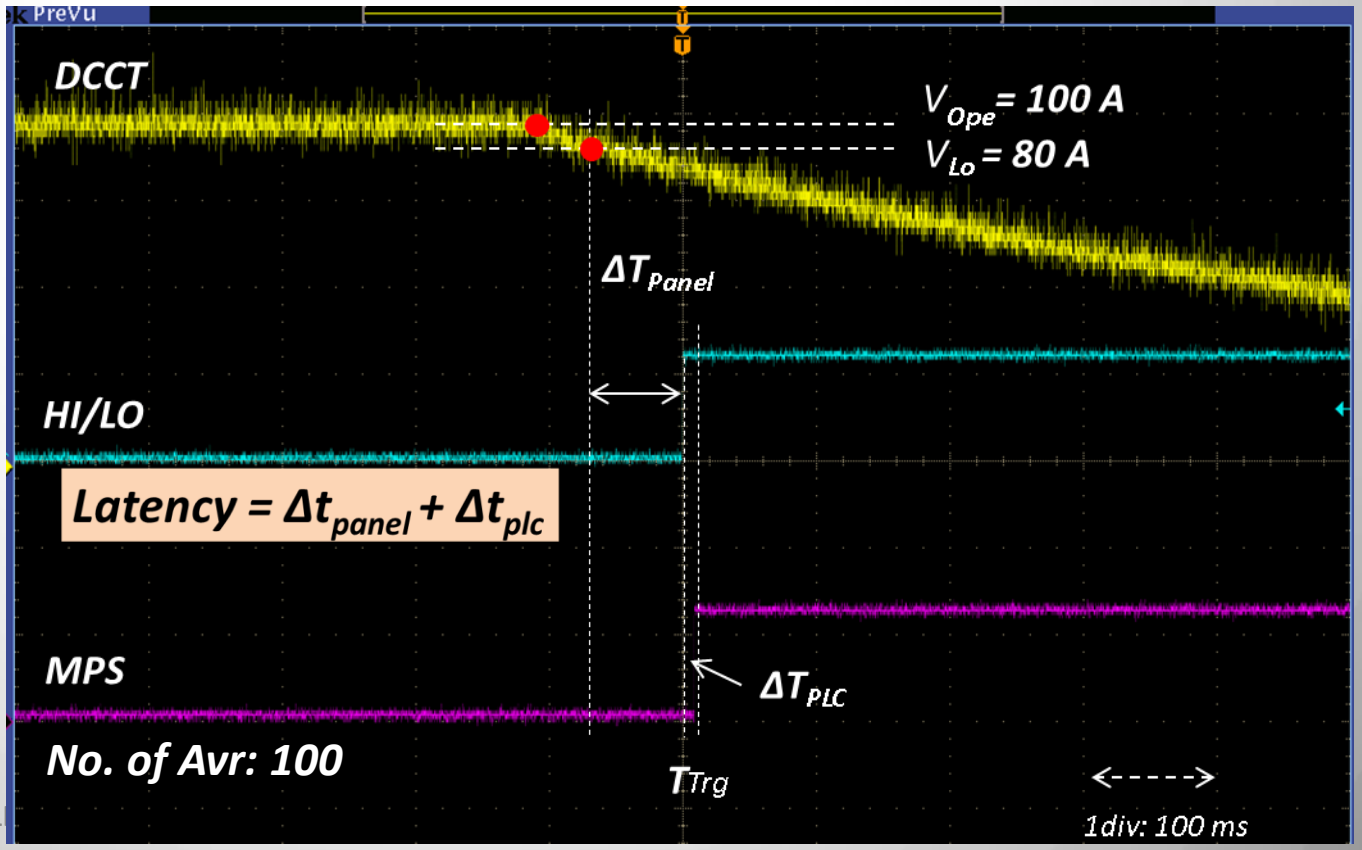
- *Increasing no. of avr. => removing elec. noises/latency worse*
- *decreasing no. of avr. => latency better/increasing fake MPSs*

Operation: 100 A

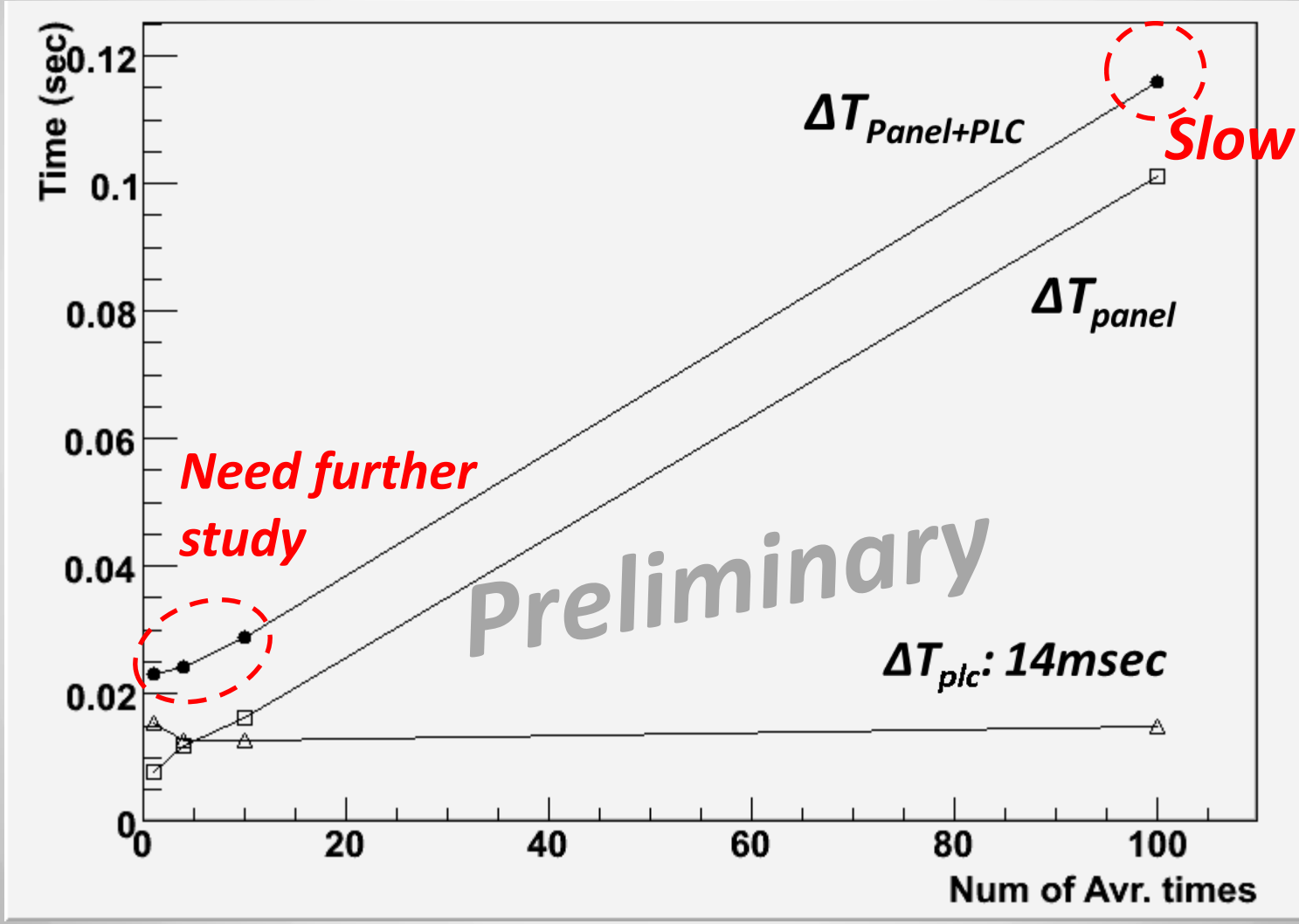
LO Limit: 80 A

No. of Avr: 1, 4, 10, 100





Performance measurement (Contd.)



Operation Result

MPS history

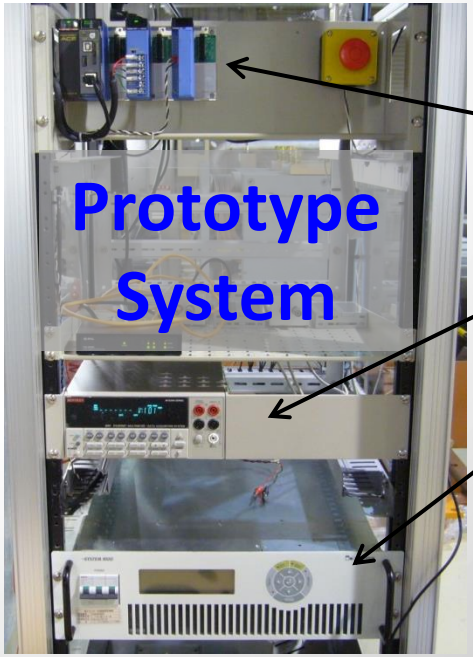
Date	Magnet	Operation	HI / LO	Change
18 May 2012	PQ2	485.0 A	490.0 / 480.0 A	485.0 -> 462.0 A
24 Nov. 2012	PV2	-2.0 A	3.0 /-5.0 A	-2.0 -> 14.6 A
21 Jan. 2013	PD2	1206.9 A	1211.9/1201.9 A	1206.9 -> 60.5 A

We caught *3 failures* by this system from March 2012 to the present

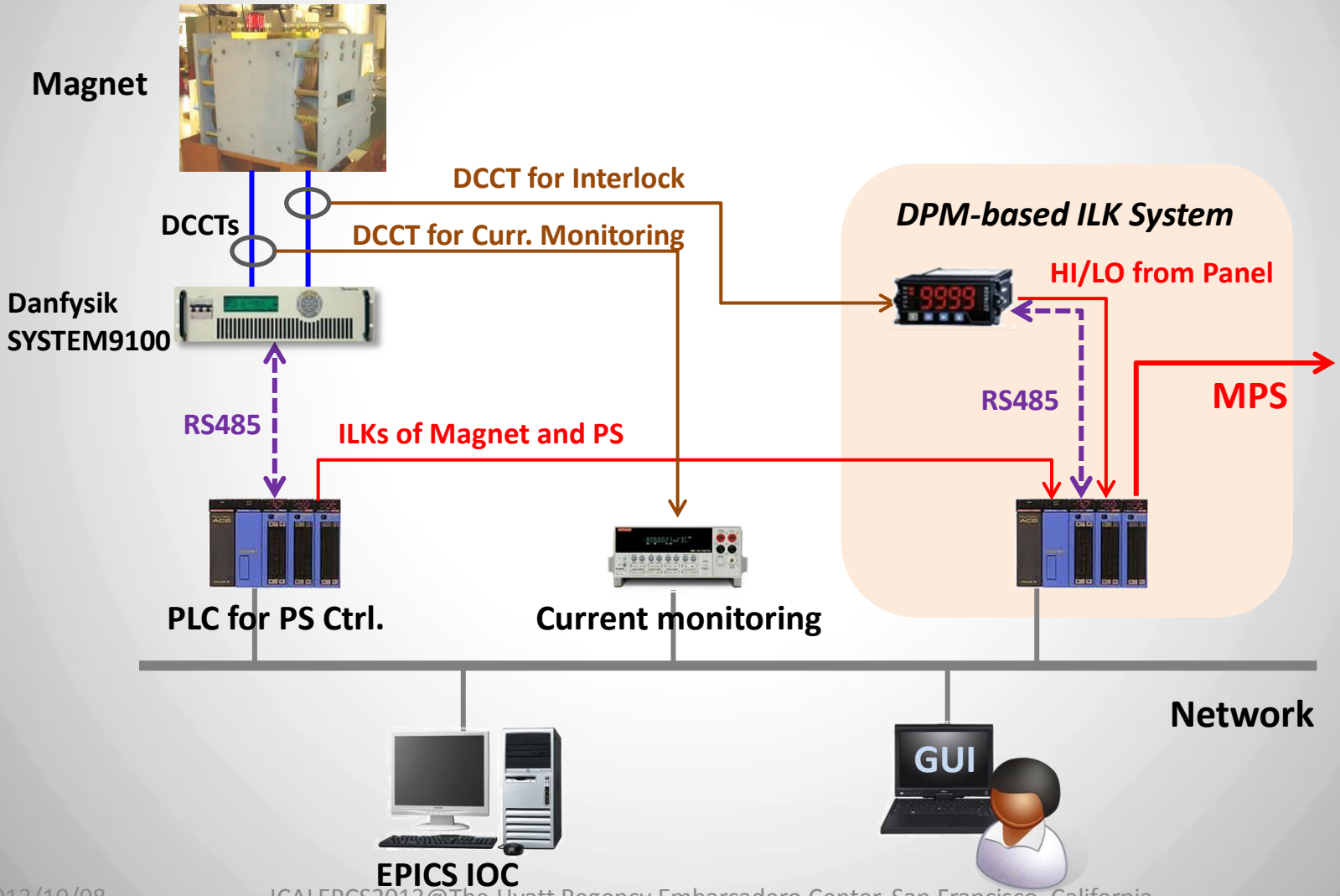
NEW POWER SUPPLY AND CONTROL SYSTEM

New PS and Control System

- We plan to replace all the PSs for NC magnets and modernize its control system
- We developed a prototype of control system



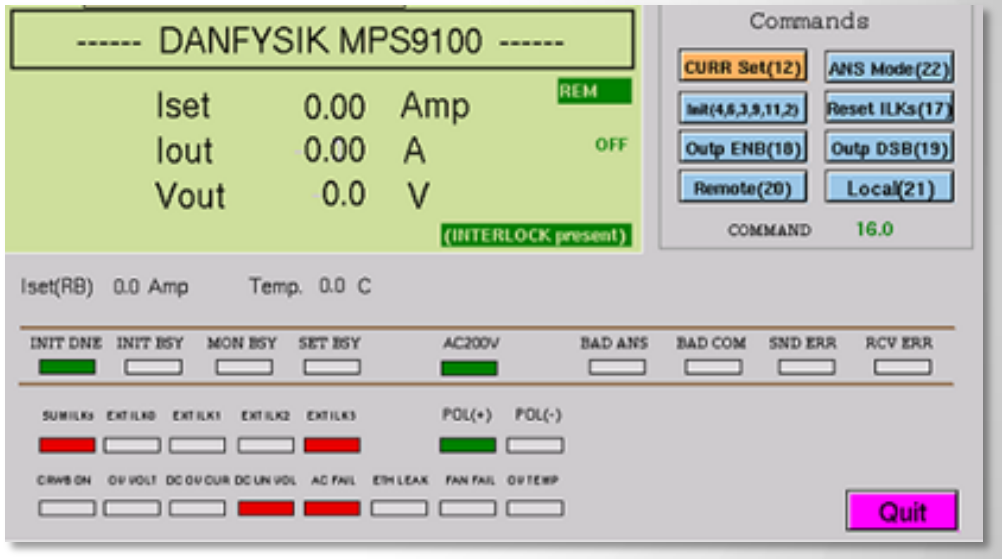
New PS and Control System (Contd.)



New PS and Control System (Contd.)

Supported Commands

Command	Description
N	Power ON
F	Power OFF
RS	Reset Interlocks
AD	Read Monitor Channel
DA	Set Output Current
REM	Set Remote Mode
LOC	Set Local Mode
ASW	Set Answer Mode
CMD	Read Command Mode
S1	Read Status



Control Panel (EDM) for the New PS

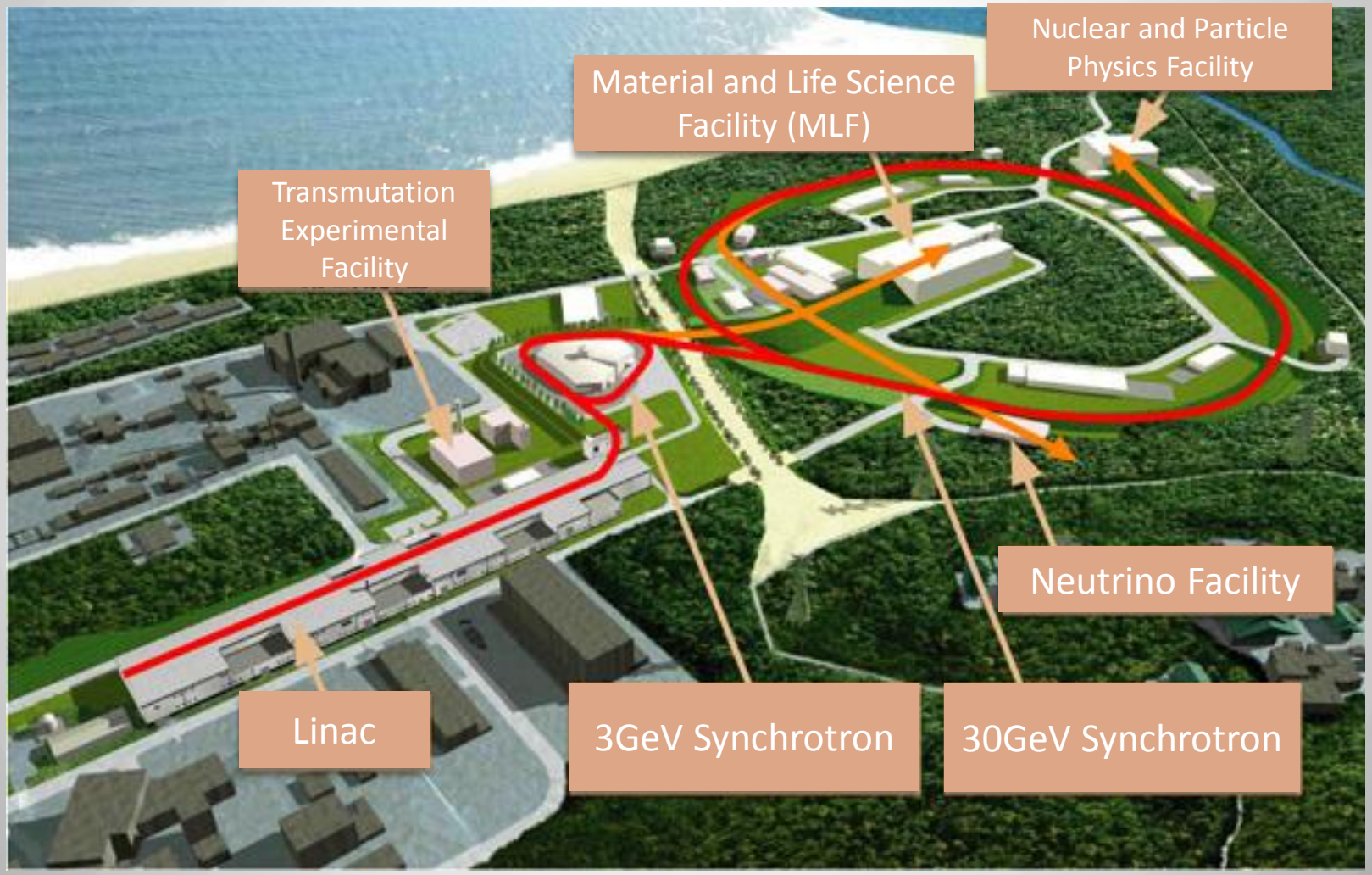
Summary

- We developed DPM-based interlock system for NC magnet PSs applied in March 2012.
- We measured the latency of DPM interlock system
  - The latency of PLC: ~14 msec
  - The latency of MPS increases in proportion to no. of avr. times of DPM
  - We need more investigation of latency improvement
- We developed a prototype of power supply control system for steering magnets. They have been used successfully since Oct. 2012. Based on this system, we will install new PSs and control system in fall 2014

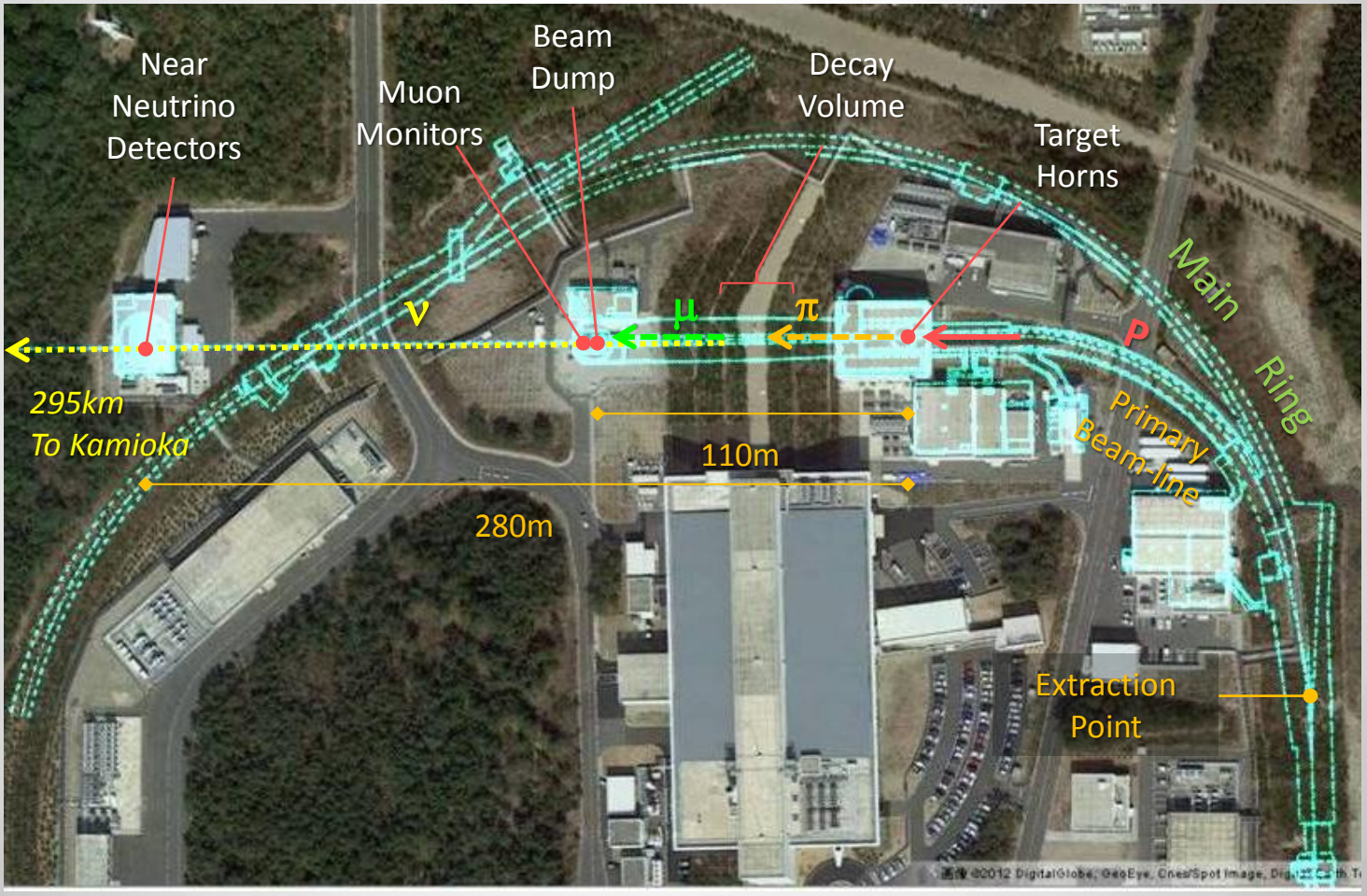
Backup Slides

J-PARC

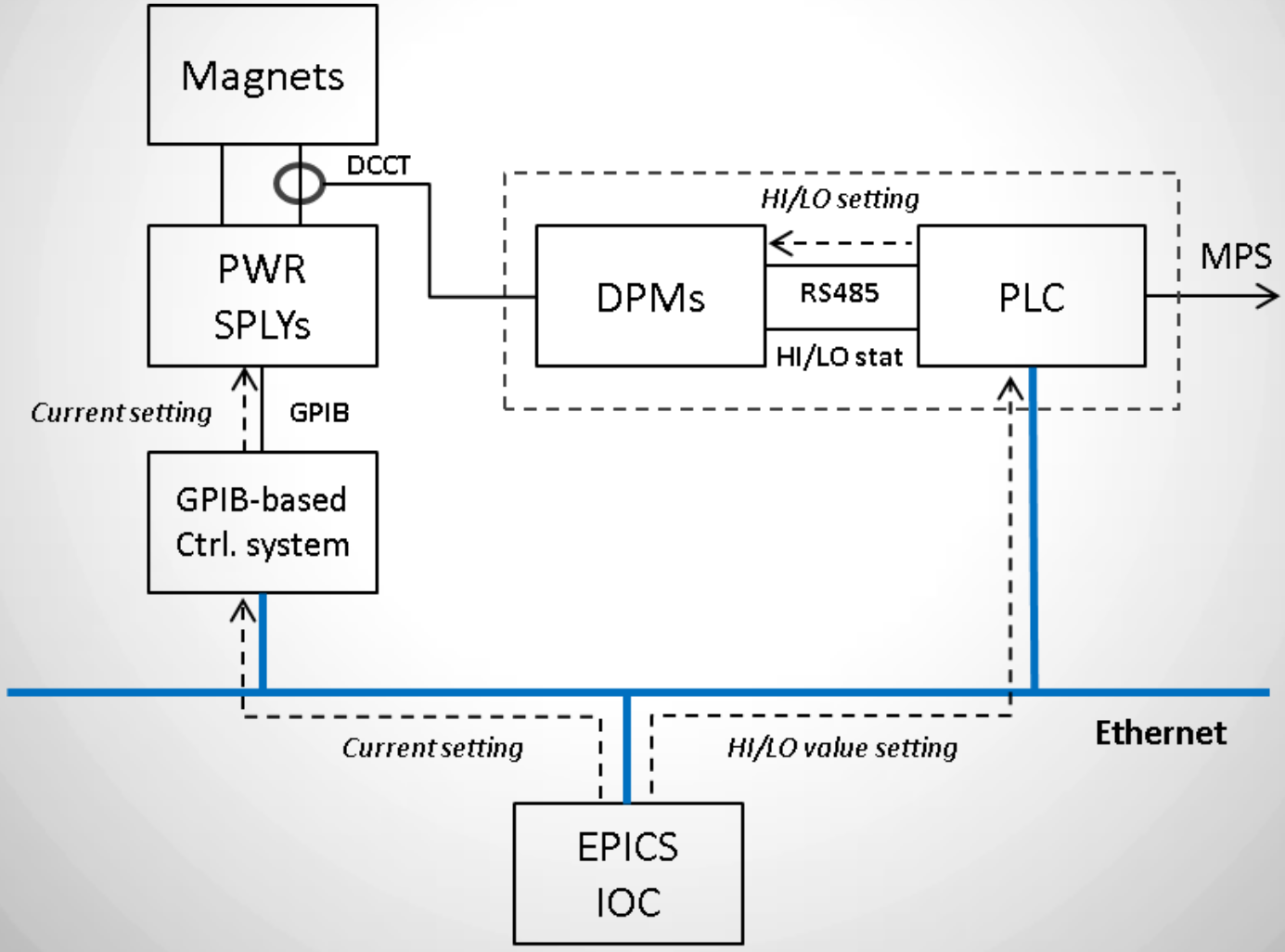
Japan Proton Accelerator Research Complex



Neutrino Facility at J-PARC



Interlock System for Power Supply of NC Magnets



Interlock System for Power Supply of NC Magnets