

Commissioning on General Control System (GCS) for Materials and Life Science Experimental Facility

Kenji Sakai (J-PAPC Center, JAEA)

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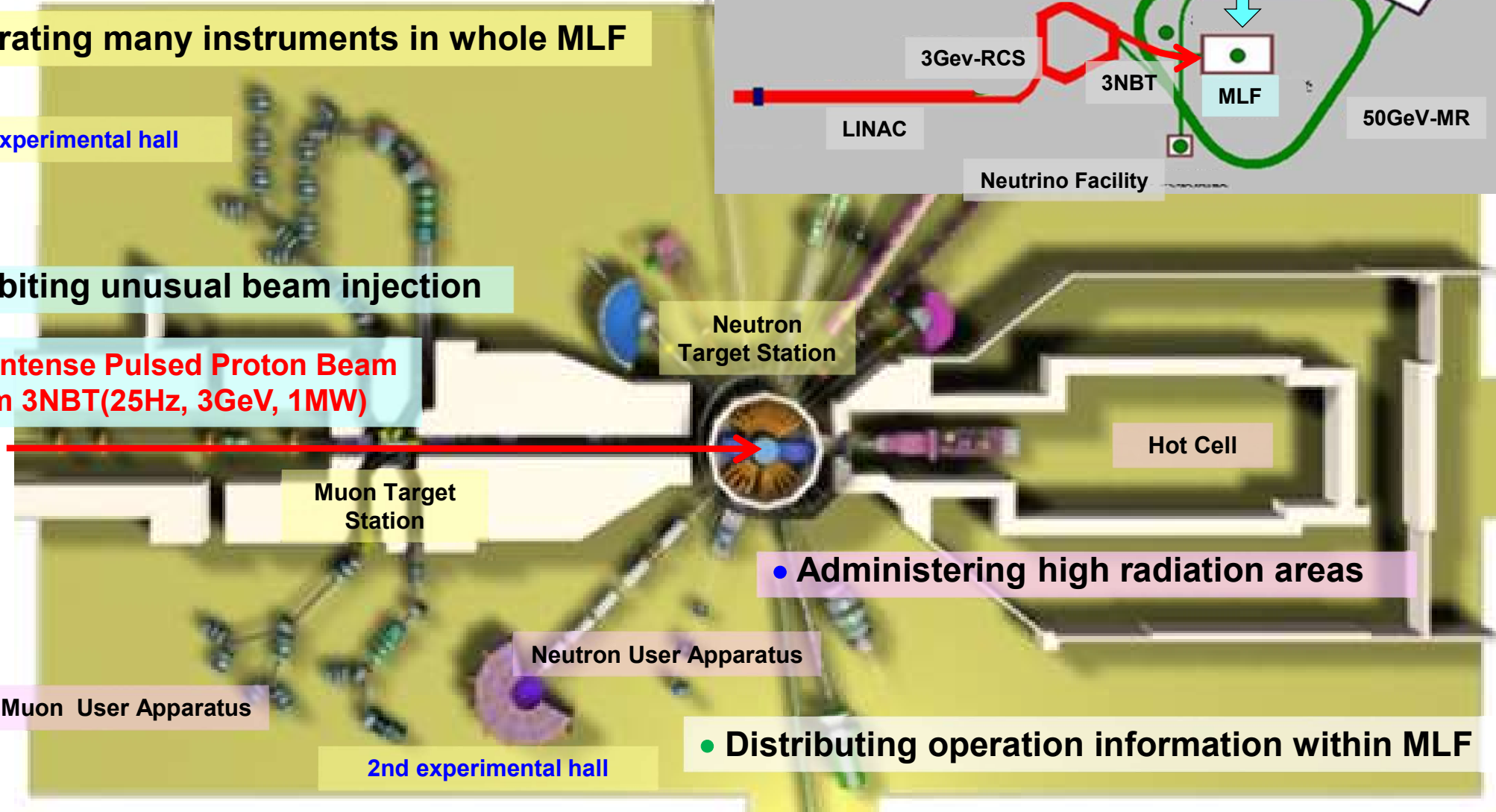
1. Introduction

- Operating many instruments in whole MLF

1st experimental hall

- Prohibiting unusual beam injection

High Intense Pulsed Proton Beam
from 3NBT(25Hz, 3GeV, 1MW)

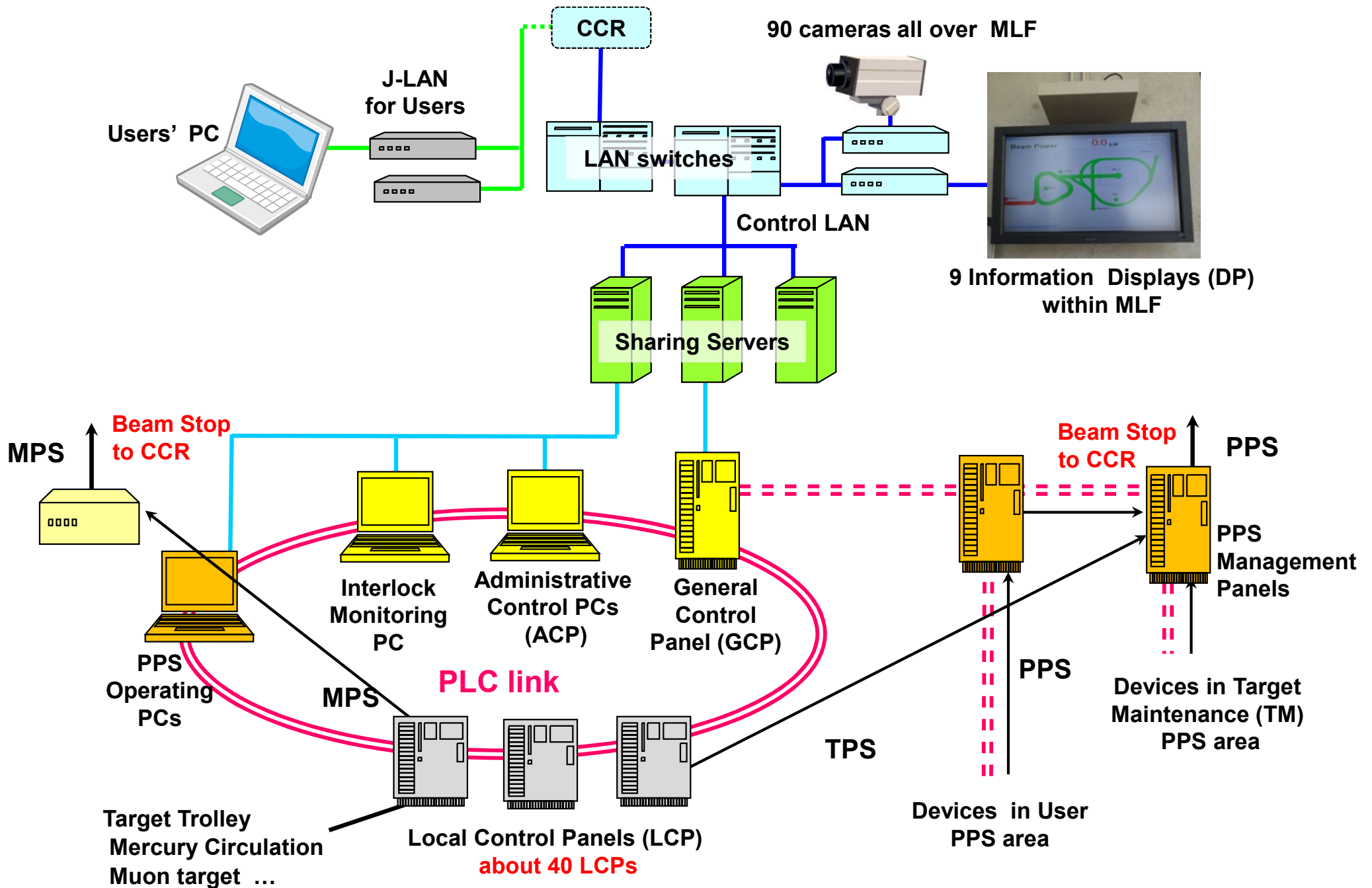


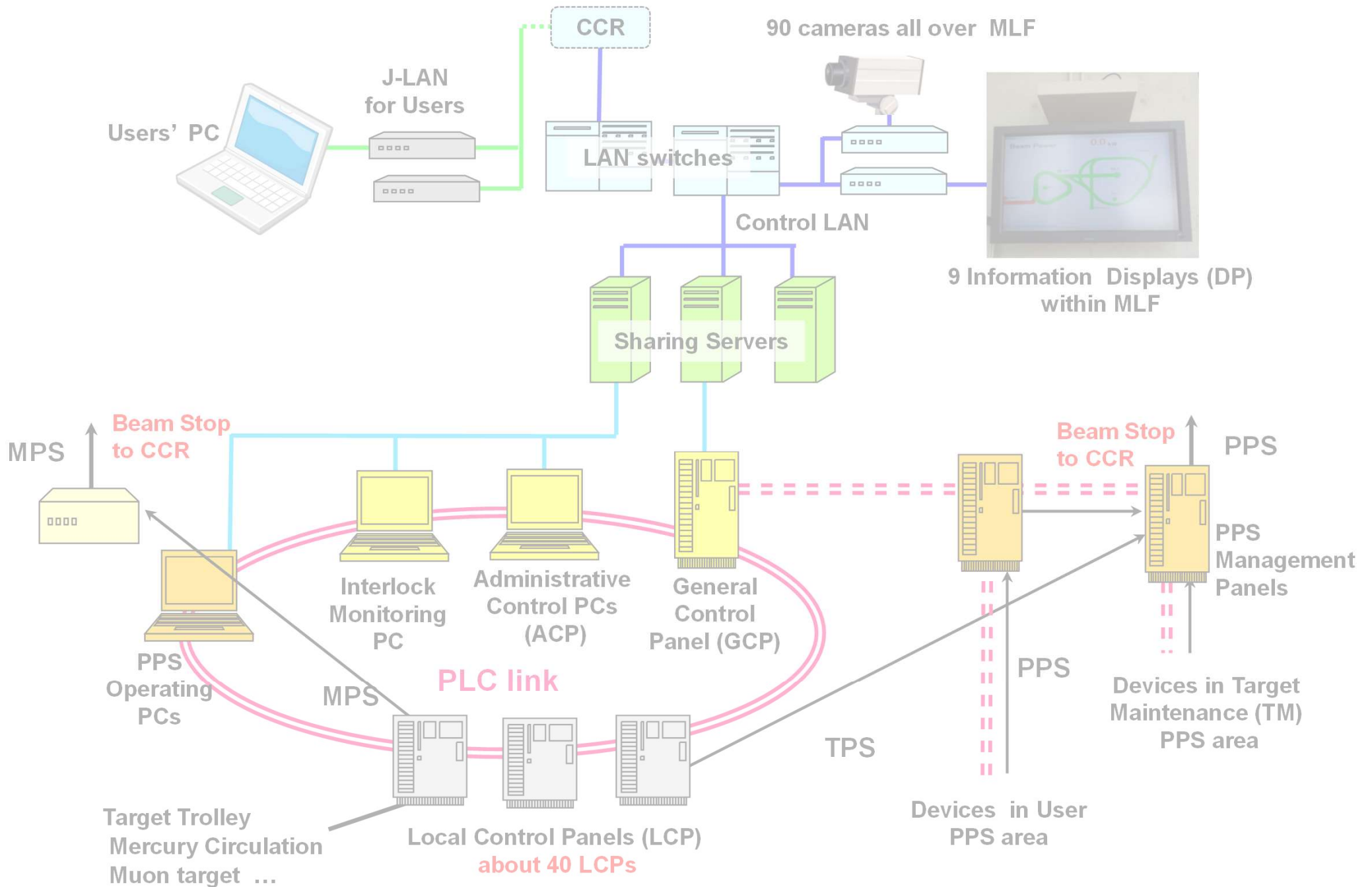
- Administering high radiation areas

- Distributing operation information within MLF

- ◆ For safe and stable beam operation, **General Control System (GCS)** operates within MLF
- ◆ **GCS** consists of integral control system (**ICS**), interlock system(**ILS**), servers, network (**LAN**) and timing distribution system (**TDS**).

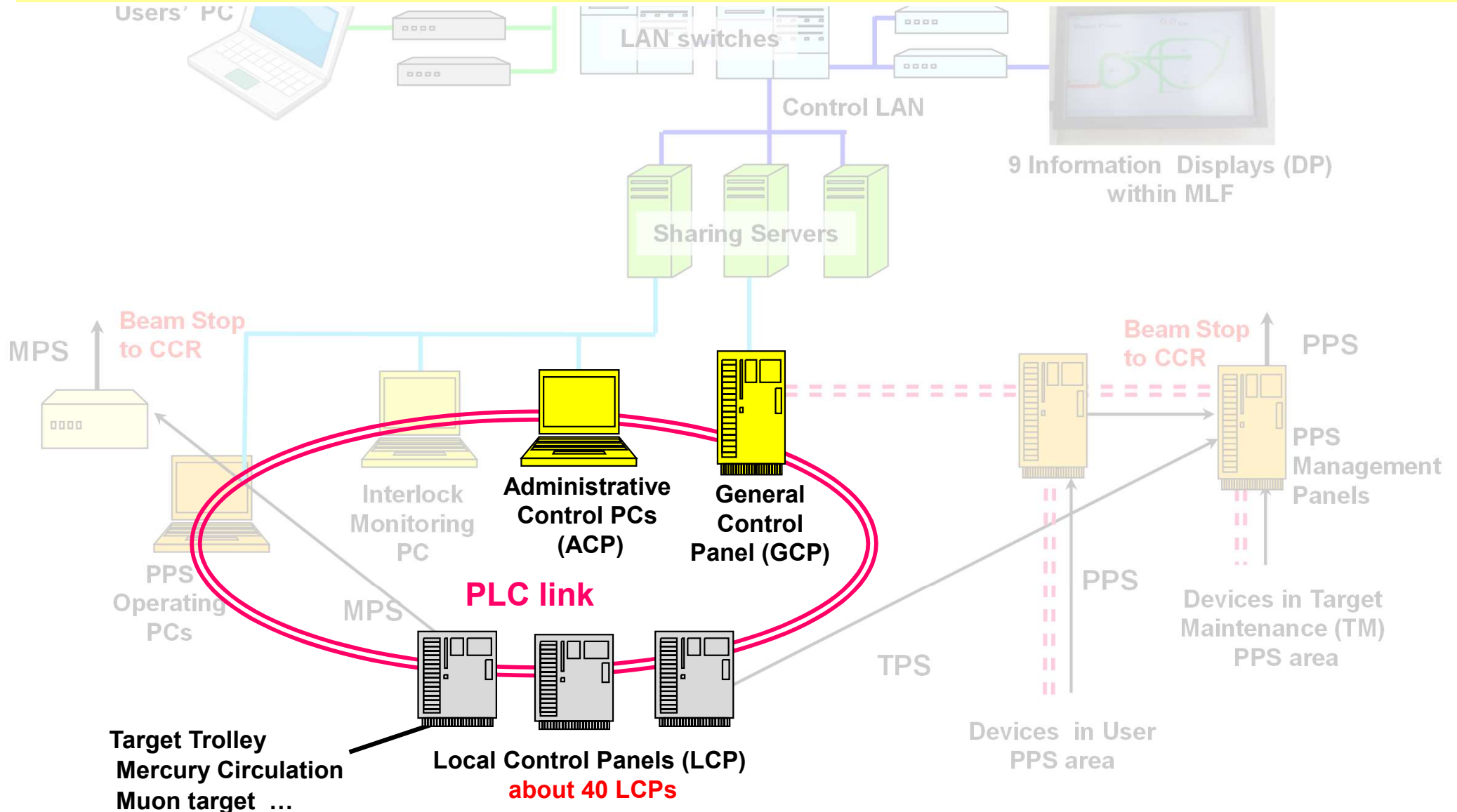
2. Outline of MLF General Control System (GCS)





Function of ICS

- ◆ It operates instruments in whole MLF through **about 40 LCPs** and looped optical network system (PLC-link) by Administrative Control PCs (ACP) and General Control Panel (GCP)

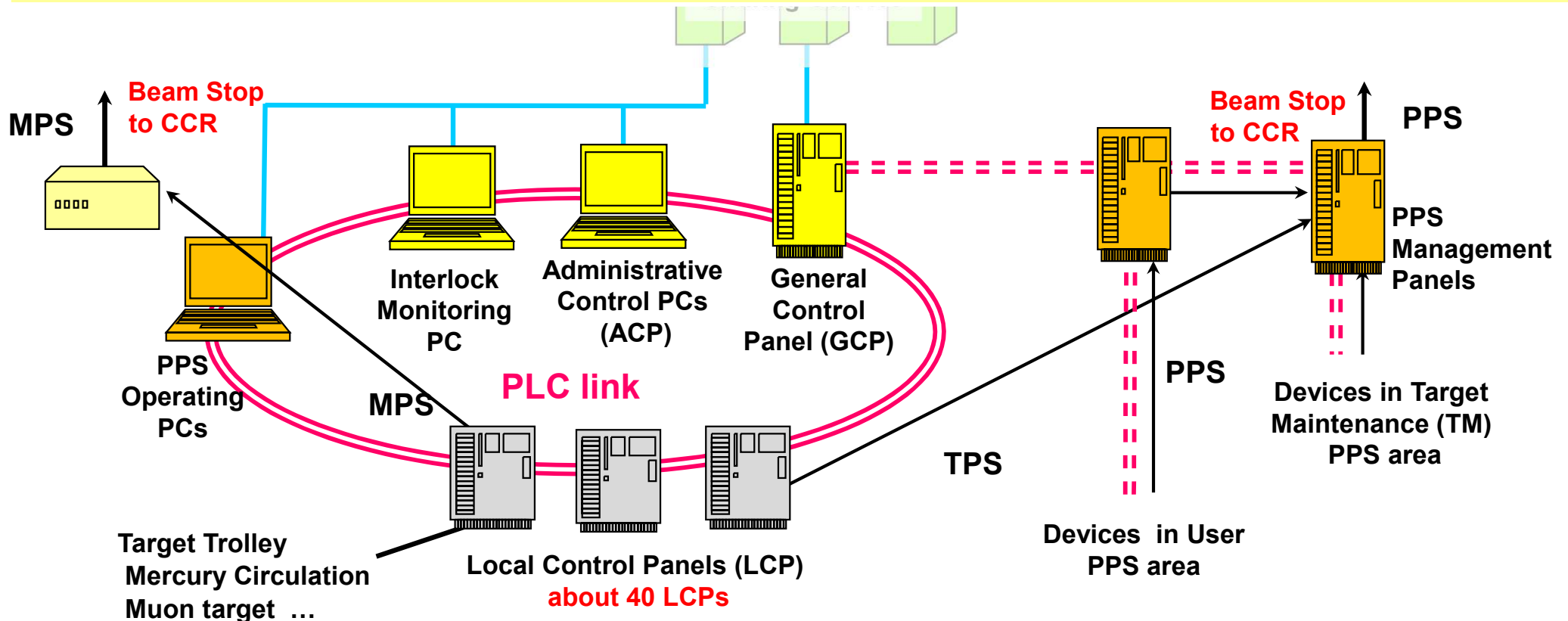


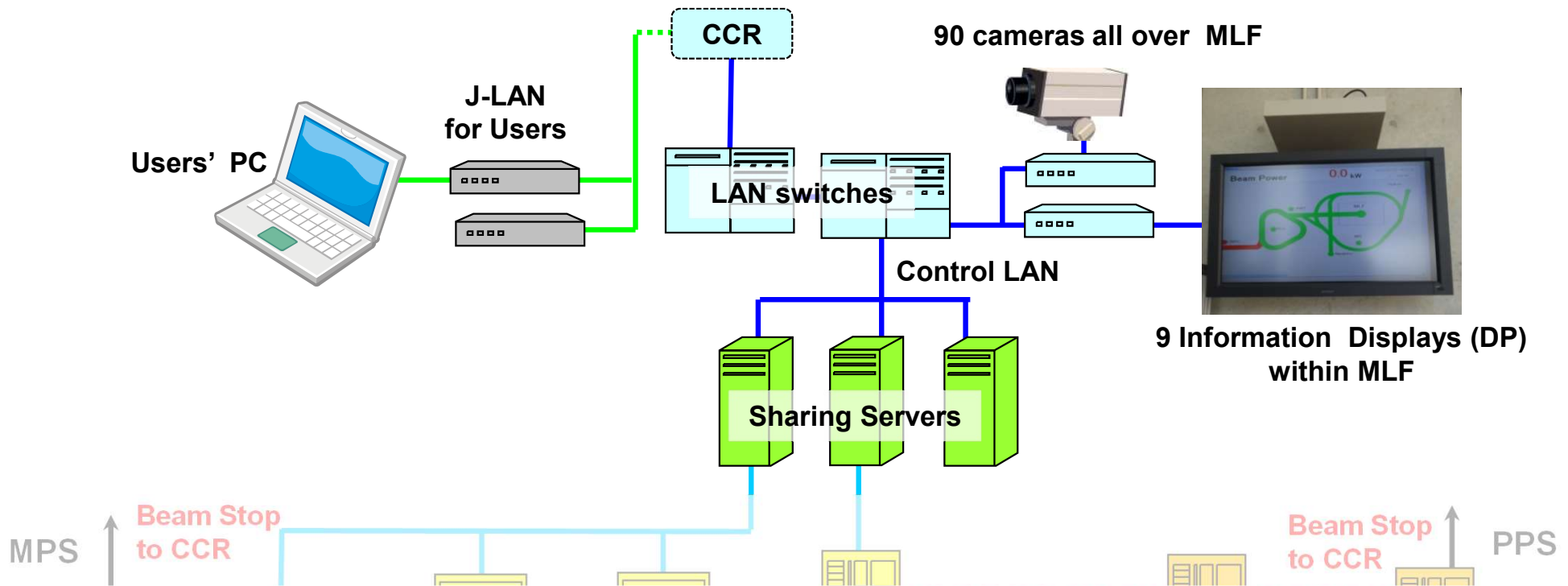
Function of ICS

- ◆ It operates instruments in whole MLF through **about 40 LCPs** and looped optical network system (PLC-link) by Administrative Control PCs (ACP) and General Control Panel (GCP)

Administration of ILS related to beam stop

- ◆ It administers Machine, Target and Personnel Protection System (MPS, TPS, PPS)
- ◆ PPS administers entrance into high radiation areas (PPS area) by PPS operating PCs
- ◆ These interlock information is collected on Interlock Monitoring PC





Function of sharing information

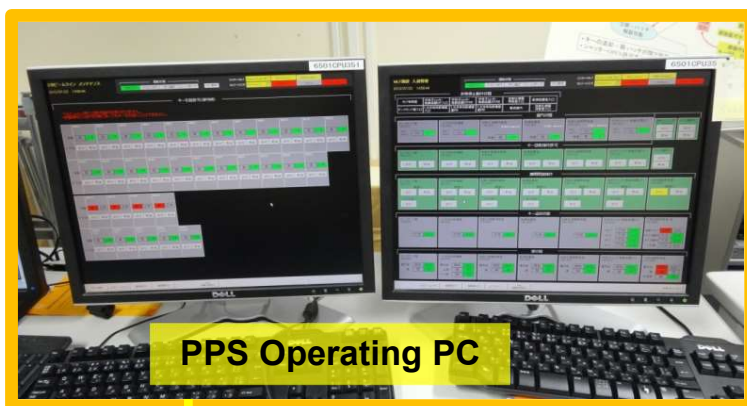
- ◆ These sharing servers acquire, store and display **7000 operation data**
- ◆ Operation data are shared with CCR through Control LAN
- ◆ Camera server monitors all over the MLF through about **90 monitor cameras**
- ◆ WD server Informs operation status, beam power, beam trends..., to users through **9 Information Displays** within MLF through Control LAN, and users' PC connected to JLAN in form of Web browser

Mercury Circulation
Muon target ...

Local Control Panels (LCP)
about **40 LCPs**

PPS area

ment



PPS Operating PC



Interlock Monitoring PC



ACP



MLF Control Room

PCs for Liq. Hydrogen Circulation system

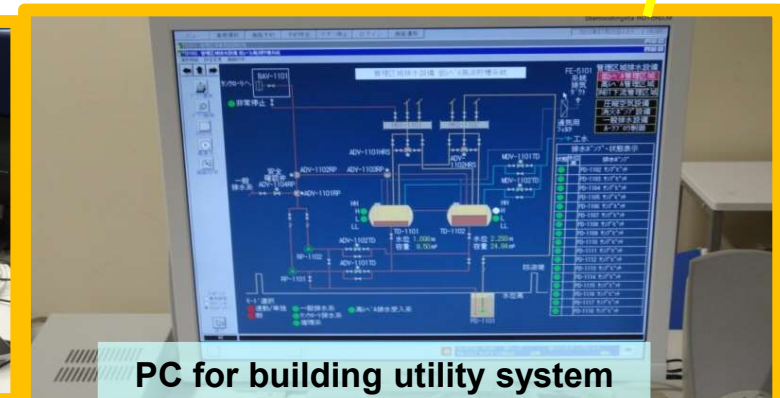
3NBT Operating PC



Radiation safety management system



PCs for monitor cameras



PC for building utility system

3. Outline of MLF Interlock system (ILS)

MPS (Machine Protection System)

- ◆ Protecting important machine from unusual beam irradiation by **quick beam stop** operation

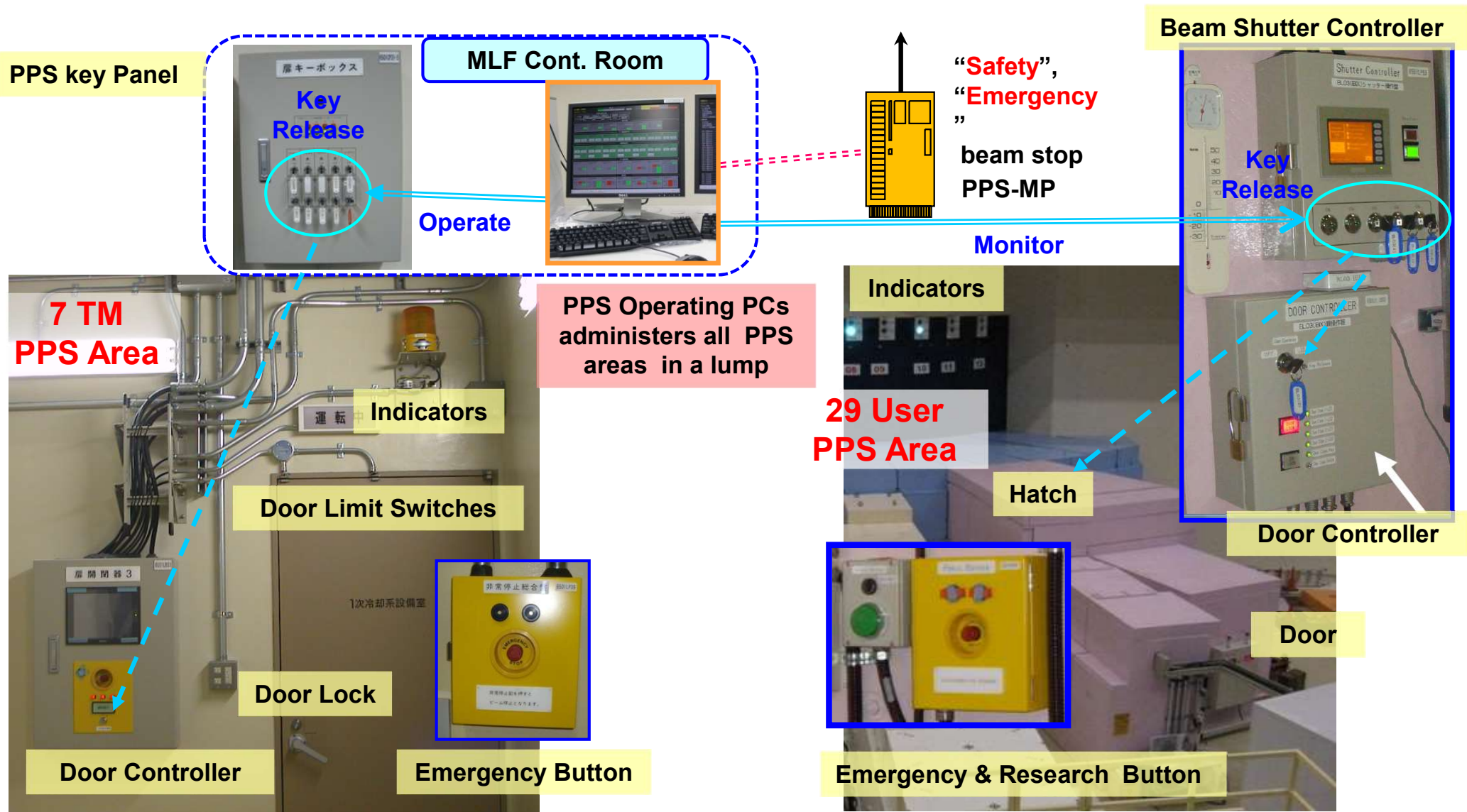
TPS (Target Protection System)

- ◆ Preventing troubles on mercury (Hg) target from expanding to become serious by reliable beam stop which utilizes PPS beam stop procedure.

PPS (Personnel Protection System)

- ◆ Administering entrance into high-radiation areas (PPS areas) for **target maintenance (TM) and user apparatus** during maintenance.
- ◆ Preventing exposure of **personnel** to high-radiation by **reliable beam stop** operation (ion source off..)
- ◆ PPS of MLF transmits four beam stop signals to CCR.
“**Target Status**” for TPS, “**Emergency**” for emergency buttons ,
“**Safety**” for monitoring entrance into the PPS areas,
“**Status**” which is key switch for signifying beam permission to CCR

Procedure of entrance into PPS areas

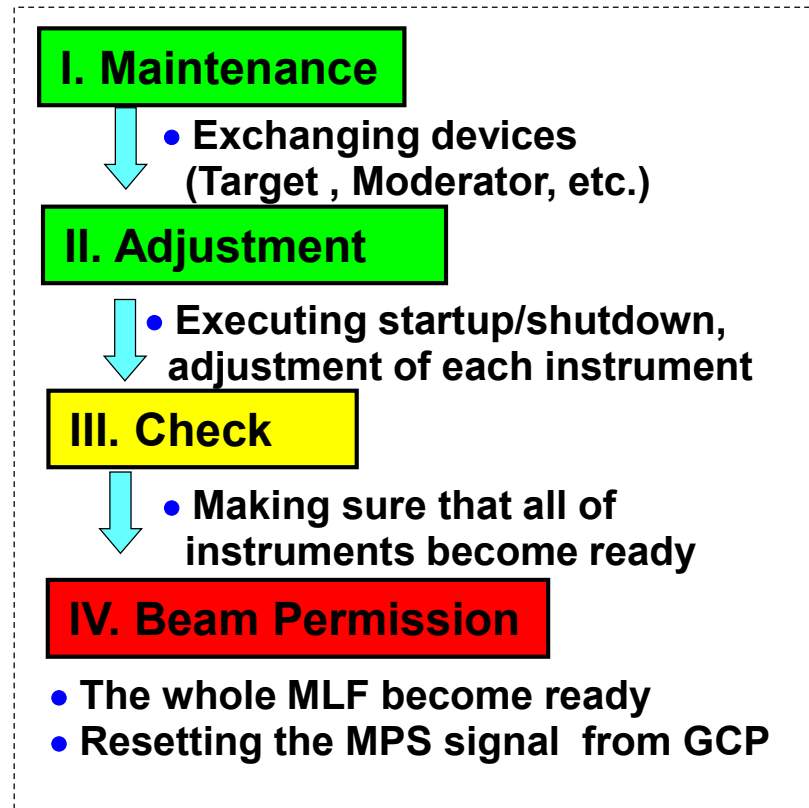


Entrance procedures are designed to become same at all PPS areas.

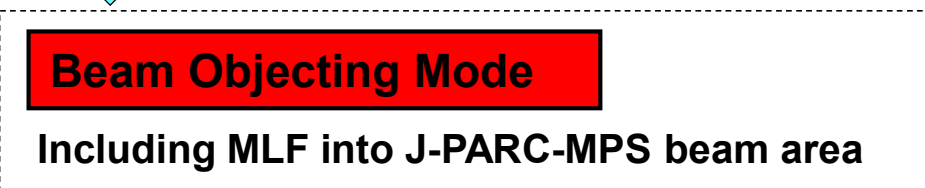
- Pull off key from key panel ⇒ Put into Door Controller ⇒ Unlock the door, and Enter into area ⇒
- Check all users exit ⇒ Lock the door ⇒ Pull off and Return keys into key panel ⇒ **Beam permission**

Startup Procedure of GCS

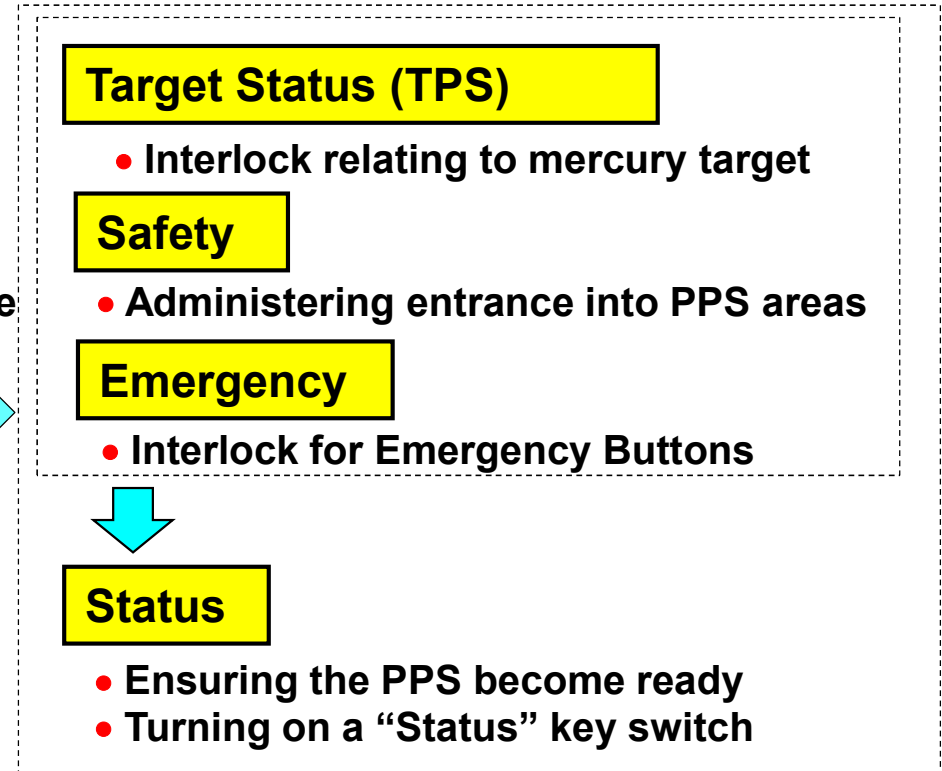
◆ Startup of MPS/ICS part



MLF-MPS Ready
CCR - MPS



◆ Startup of PPS / TPS part



MLF-PPS Ready
CCR - PPS



Exchange Data

4. Commissioning on GCS

- ◆ After finishing the construction of GCS in **June 2007**, commissioning on operation and control of the whole MLF started step by step.
- ◆ During short period before first neutron production on **30 May 2008 (Day 1)**, the trial operations, performance tests, and improvements of GCS were executed based on check items of commissioning.
- ◆ After Day 1, GCS was improved according to experience on the beam operations and upgraded based on plan of increment of instruments and user apparatus until starting user beam operation on **23 Dec. 2008**.

Check items of commissioning on ICS and ILS (except PPS)

1. Data Transmission test

- ❑ **About 5300 data** can be transmitted between GCP and LCPs for instruments based on correct network address and value.

2. Remote Operation test

- ❑ **About 360 Remote Operations** can be executed by using ACP of ICS.
- ❑ Cooperation between several instruments can be executed as designed.

3. Interlock and Alarms test

- ❑ Interlock signals of MPS and TPS can be emitted to exclusive devices such as MPS controller through metal cables.
- ❑ Items of **97 MPS, 11 TPS** and **about 1500 Alarms** can be informed with buzzer and flicker on ACP of ICS.

4. Integral interlock test

- ❑ MLF operation status can transit from “Maintenance” to “Beam Permission” according to startup procedures of the whole MLF.

Check items of commissioning on PPS

1. Data Transmission and Operation test

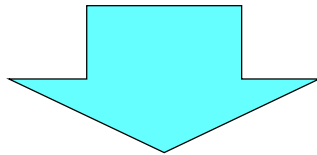
- ❑ PPS devices located around PPS areas can be monitored and operated by PPS monitoring PCs.

2. Integral interlock test for each PPS area

- ❑ **TM and user apparatus PPS areas** can be administered as designed, based on entrance / exit procedures including beam shutter operation.

3. Integral interlock test on PPS

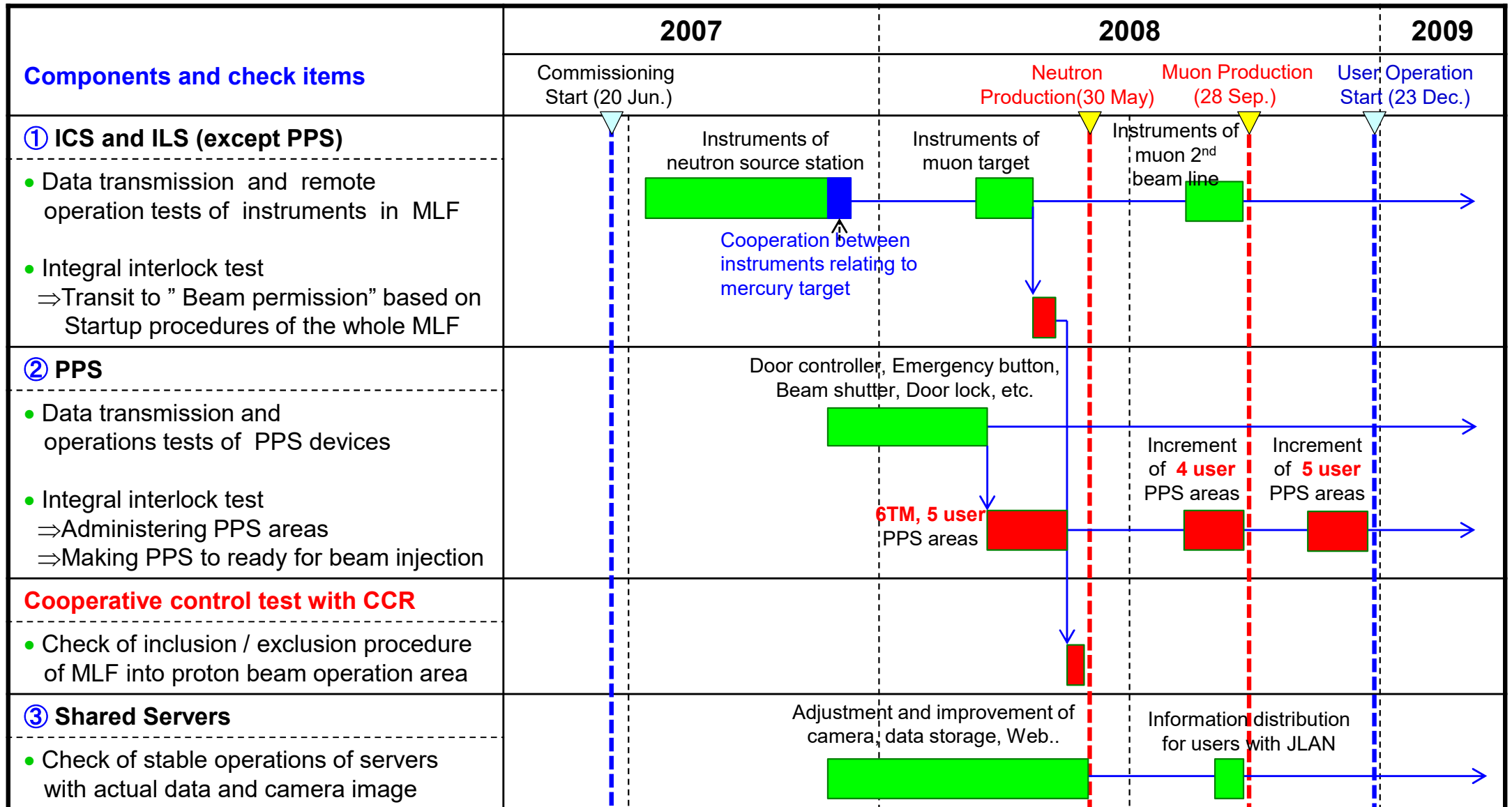
- ❑ “Target Status”, “Safety”, “Emergency” can be ready, “Status” key switch can be turned on to for PPS of MLF being ready for proton beam injection.
- ❑ Interlock signals for beam stop can be transmitted between MLF and CCR



◆ **Cooperative control test with CCR**

- ❑ After both MPS and PPS of MLF being ready for beam injection, MLF can be included into proton beam operation area of J-PARC.

Time series of commissioning on GCS between Jun. 2007 and Mar. 2009



5. Summary

- ◆ Outline of MLF general control system (MLF-GCS)
- ◆ Overview of commissioning on GCS

After commissioning, GCS has operated without serious troubles under annual incremental upgrades of the target instruments and user experimental apparatus.

References

- “Construction status of a general control system for the Materials and Life Science Experimental Facility (MLF) at J-PARC”, K. Sakai, et al, NIM A, Vol. 600, 2009, pp 75-77
- “Progress of General Control System for Materials and Life Science Experimental Facility in J-PARC”, K. Sakai, et al., *Proc. of ICANS-XXI, JAPAN, 2014*, JAEA-Conf. 2015-002 / KEK Proceedings 2015-7, 2015, pp.593-598
- “ Upgrade history and present status of the general control system for the Materials and Life Science Experimental Facility at J-PARC“, K. Sakai, et al., JPS Conference Proceedings (Internet), 33, 2021, pp.011151_1 - 011151_6