Current Status of The Control System for
J-PARC Accelerator Complex

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J-PARC Facility

Nuclear Transmutation

Materials and Life Science Experimental Facility

Hadron Beam Facility

Neutrino to Kamiokande

500 m

Linac (330m)

3 GeV Synchrotron (25 Hz, 1MW)

50 GeV Synchrotron (0.75 MW)

J-PARC = Japan Proton Accelerator Research Complex

Joint Project between KEK and JAEA
Goals at J-PARC

Need to have high-power proton beams

→ MW-class proton accelerator
  (current frontier is about 0.1 MW)
Phase 1 and Phase 2

- Phase 1 + Phase 2 = 1,890 Oku Yen (= $1.89 billions if $1 = 100 Yen).
- Phase 1 = 1,527 Oku Yen (= $1.5 billions) for ~8 years.
- JAEA: 860 Oku Yen (56%), KEK: 667 Oku Yen (44%).
J-PARC Control System

- Protect from Radiation
  - Intelligent Beam Control
    - Keep stability of electro-magnetic field
    - Keep minimum beam loss
    - Predict beam behavior
      - System identification and definition of response function
      - By link of operation and simulation
      - By link of operation and database

- Integrated Operation Environment
  - Effective use of software technology

In the process of developing
Function of Safety

- **Radiation Measurement System**
  - Legal management of the area boundary

- **Personnel Protection System (PPS)**
  - Make and keep the boundary condition of closed space which is allowed existence of the beam
  - Stop the beam when the condition breaks

- **Machine Protection System (MPS)**
  - Protect machine from high power beam bombardment
  - Stop the beam when something is wrong

- **Computer Control System**
  - Automatic correction, FB, FF
  - Suggest the optimum parameters
PPS Status Monitor

PPS Operator Console

Access Control Table

TV Monitors of an Access Point
MPS hardware configuration. When the threshold is exceeded, the loss monitor module with only the analog circuit is fired.
Fast beam stop procedure using Machine Protection System (MPS)

1: The beam loss is detected by the loss monitor.
2: Loss signal transmission to the RFQ part using MPS.
3: RFQ power off and Ion source injection timing removing.
4: Insertion of the Beam stopper.
5: Because MPS don't want to cool the RFQ, power is turned on again quickly.
LINAC Inter Lock (From MPS Unit)

LINAC Beam Loss Level (From Monitor)

Error Events

Basic Composition

Star Connection around CCR
Standard protocol for redundancy can not make the performance that no connection loss when the pass way is switched.

We selected the protocol of the vender dependence.

For ease of physical fiber topology, we use the combination of ESRP and EAPS.
ESRP test by single fault

No matter appears when the power of switch is down, or when fiber is disconnected.

When the route revives, the connection doesn't become interrupted.

ESRP test by double fault
EAPS test by single fault

EAPS test by double fault

Time of route change < 1.2sec

(including route reviving. Any TCP connection is not closed at this route change.)
TIMING SYSTEM

SEND IOC

RECEIVE IOC

RECEIVE IOC

RECEIVE IOC

RECEIVE IOC

Clock, Trigger, TypeCode

Ether net

Reflective memory net

output

E/O-O/E Converter

Fanout
TIMING SYSTEM

Type train of sending module

LUT of a receiving module

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- Single Shot is generated for the initial commissioning
  - Effective to reduce activation
- Type code means operation mode and beam course
- Individual delay trimming can be done without stopping the beam
  - Two way of changing delay time.
- Delay time changing of selected channels can be done simultaneously
Infrastructure of the J-PARC control system was completed.
  – Covered area will be extended to MR, MLF next year.

Fundamental function of PPS, MPS and TS are successfully established for the 1st stage of commissioning.

High Level Application is developed on the Integrated Operation Environment
  – IOE is written in java, and it’s API can merge several simulation and other IOE tools