MICE: Controls & Monitoring

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Outline

- **Structure and Existing C&M systems**
- **Personnel**
- **Integrating subsystems**
  - **Run Control**
  - **State Machines**
  - **Integrated Quench Protection System**
- **Issues/Risks**
- ***Much of this came from MPB presentation***

C&M Structure

- Environment
- Beamline
- Particle ID
- DAQ/Computing/Electronics

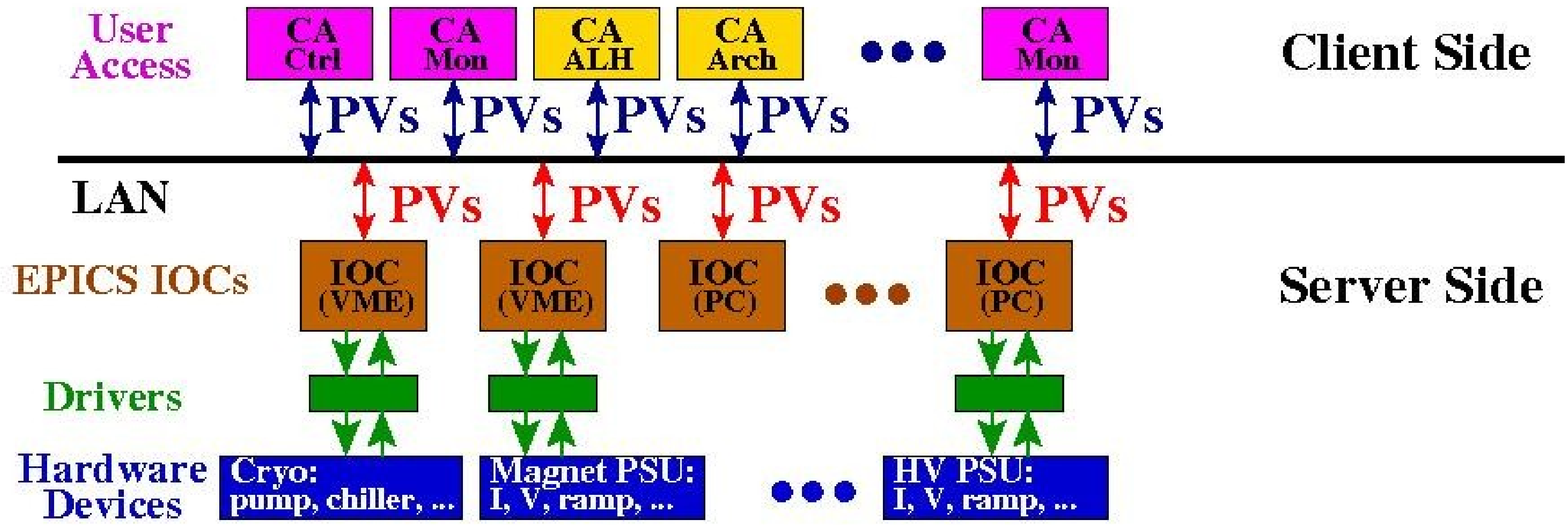
- Spectrometers (SS & trackers)
- Absorbers (FC and absorbers)

- RF (CC and cavities)

C&M Structure

EPICS based

Experimental Physics & Industrial Control Systems



C&M Personnel

- **Large systems provided by controls team from Daresbury lab:**
  - **SS/FC/DS/conventional magnets**
  - **LH_2 system**
  - **Integrated cooling channel controls**
  - **FC/DS quench protection**
- **Target and Tracker controls provided by Leaver/Robinson**
- **Overall coordination/integration by Hanlet**

C&M Personnel

- Smaller systems provided by Hanlet
  - Environment
  - PID: HV—ToF/CKOV/Trigger
  - Radiation monitoring
  - Target monitoring
  - Beamline monitoring
  - LH_2 monitoring
  - Proton absorber
  - RF tuners
  - DAQ monitor

C&M Personnel

- Hanlet continued:
  - Computer monitoring w/Robinson
  - A/C monitoring
  - Run Control
  - State machines
  - AutoSMS
  - Tools:
    - archiver/alarm handler/gateway
- New blood: Ian Taylor (Warwick)

C&M Personnel

- **C&M group has grown by factor of 2!**
- **Ian Taylor (Warwick)**
  - **more sys-admin expertise**
  - **will clean up alarm handler**
  - **will clean up archiver**
  - **will develop FC state machine**
- **Already been helpful**
  - **micecss2 at Wang**
  - **establishing C&M test machine**
  - **cleaned up code in bzr**
  - **developed scripts for automation**

Integrating Subsystems

- To date, C&M systems modular
- OK for Step I
- Will not work for string of coupled superconducting magnets
- Must think globally
- Operations being addressed with:
  - Run Control
  - State Machines
  - Integrated Quench Protection System

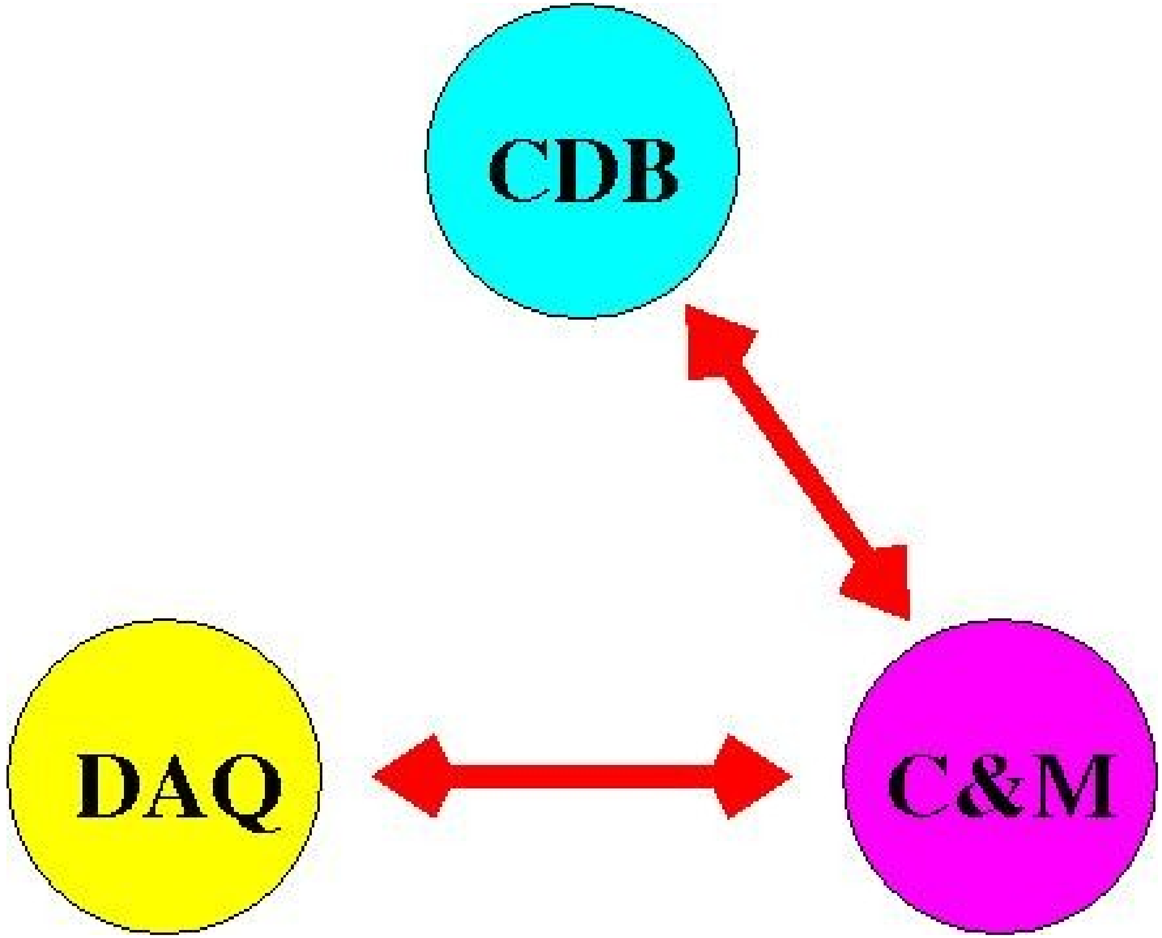
Run Control Goals

MICE is a precision experiment since we require 0.1% measurement. This requires careful documentation of run conditions. To date, we used *"the spreadsheet"*.

***only* as good as the shifter can type**

- **C&M and DATE has complete knowledge of all running parameters**
- **CDB has ability to record this on a run-by-run basis**
- **RC gathers parameters and stores in CDB**
- **RC sets control parameters from CDB**

Run Control Goals



Successfully implemented

Run Control

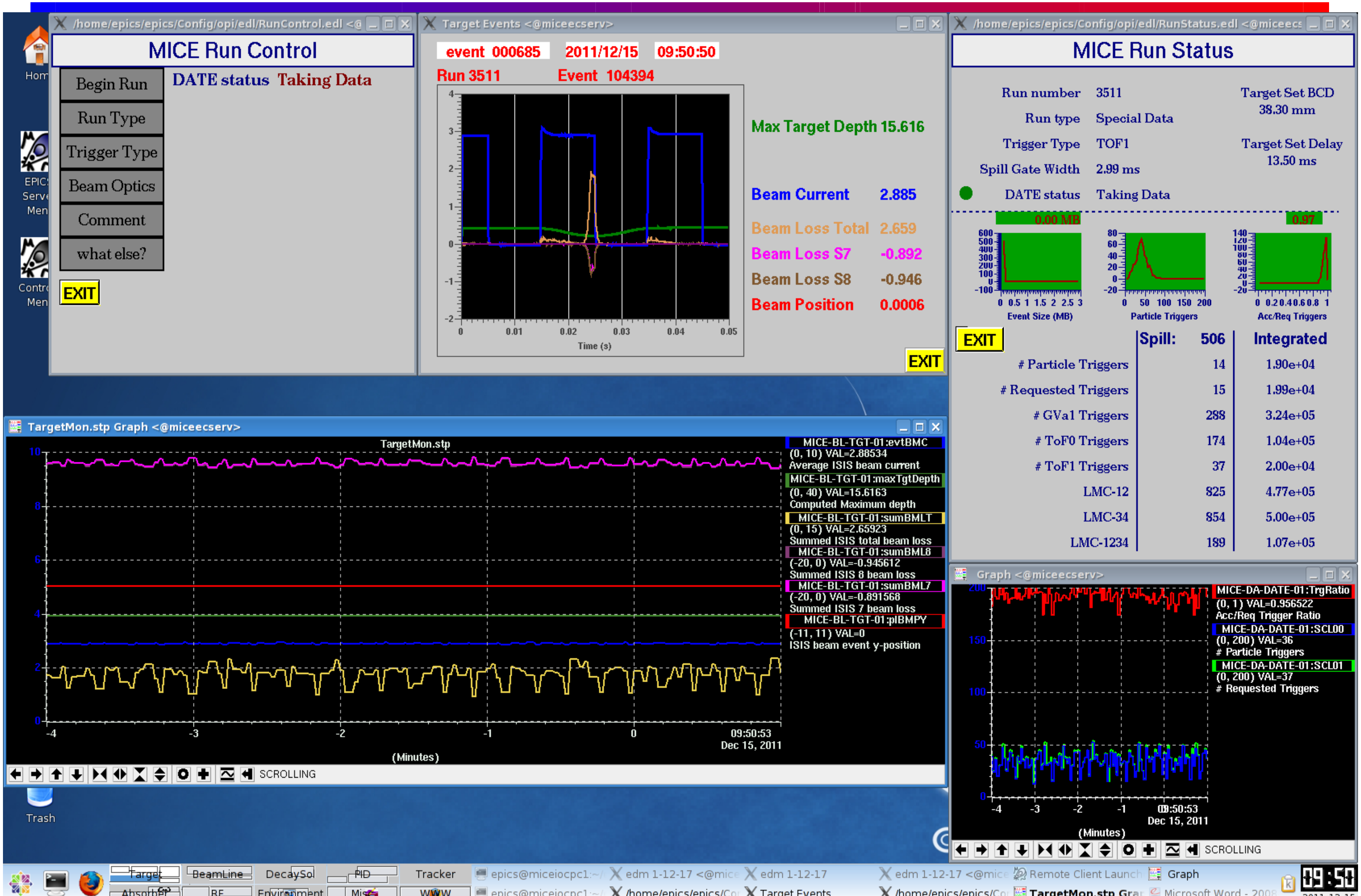
- Query operator for run information
- Query CDB for run parameters
- Set and verify beamline
- Set and verify PID

- Query operator for cooling channel information
- Query CDB for cooling channel parameters
- Set and verify cooling channel

Run Control

- **When DAQ started, collect statistics**
- **At end of run compute sums, averages, and rms for scalers**
- **Write end-of-run comment**
- **Write target, DAQ, and scaler statistics and comment to CDB**
- **Offer user opportunity to tag run parameters**
- **Initiate data copy to grid**

Run Monitoring



State Machines

Defining State Machines for MICE allows:

- **selecting *only* parameters of interest**
- **limited control of system**
- **selecting whether these are monitored or required to maintain strict tolerance on value**
- **setting alarms based on these limits**
- **invoking the autoSMS for selected variables which go out of tolerance**
- **determining archiving parameters:**
  - **scanning and scanning frequency**
  - **monitoring and dead band**

State Machines

A state machine is:

- **"... an abstract machine that can be put in one of a finite number of states."**
- **"... a mathematical model of computation used to design both computer programs and sequential logic circuits."**
- **"... is defined by a list of its states and the triggering condition for each transition."**

State Machines

- Major subsystems have many PVs of varying importance depending on the state of the subsystem
  - E.g. temperatures, LHe levels, currents are of no value when pumping insulating vacuum space of SC magnet
- Subsystem state machines are being developed to organize PVs according to their states
- State machines ensure alarms and archiving are appropriately handled

State Machines

Example: SS states

- offline
- pumping
- pumped & warm
- cooling & LHe filling
- cold & stable
- ramping
- running
- error

State Machines

- **Lists of PVs and their fields in CDB:**
  - **alarm limits (upper major/minor, lower major/minor)**
  - **archiver scanning/monitoring frequency**
  - **archiver dead band**
  - **AutoSMS switch**
  - **state transitions**

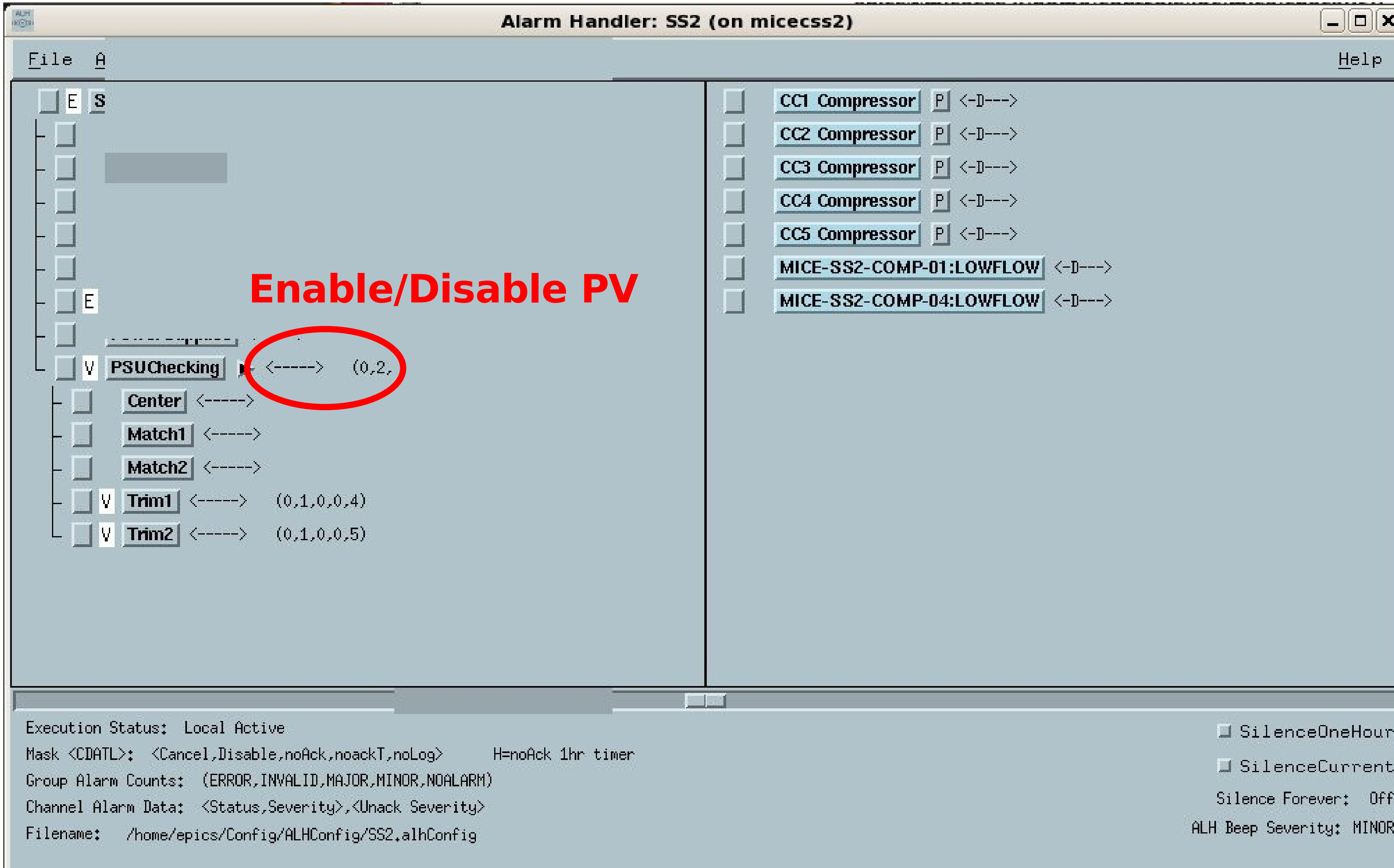
- **Little control in state machines**
  - **e.g. SS – turn on/off compressors, ps's**

State Machines

State Machine Sequence:

- transition
- read CDB for new state
- set PV fields
- enable/disable alarm handler group
- re-initialize archiver
- check for errors
- check for next transition

State Machines



Risks

- Personnel
- Expertise
- Time
- Need to identify SS/FC differences in stand-alone and integrated systems

MPB-4 Recommendations

- SS C&M review completed and changes made and tested, caveats:
  - Lakeshore PSU issues
  - New scheme for LHe level
- HTS leads now monitored
- Plan under development for operating integrated magnets

Conclusions

- ***MUCH* progress in C&M**
- **Most recently for SS2**

- **Added help with Ian Taylor**
- **RunControl/MICEStates regular operation**