Operator Developed Control & Analysis Tools

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As accelerator operational conditions develop during its life, tools used to control it need to be developed and adapted. Technical groups provide detailed access and control of system parameters that may not be optimised for ease of use, clarity and fit for purpose for when dealing with 24/7 operation or repetitive tasks. Operators have developed tools for simultaneous control of multiple insertion devices & beamline front ends, overviews of injection & RF systems that both bring together existing parameters from different machine areas and add control scripts in python. Additional tools focus on analysis such as comparing back-up parameters with the current machine settings or extracting machine protection interlock data from the archive in a human readable format. By being produced by the operators for the operators they have the benefit of developing operational group knowledge of systems as well as being relatively easily and quickly developed as business needs demand.

Diamond Light Source is a 3rd generation light source in the south of England. An operations team of 10 includes 8 shift operators. Due to extensive use of automated processes, only one machine operator is required at a time.

- 3 GeV third generation light source
- 561.6 m circumference storage ring
- 2.74 nm.rad emittance
- Full-energy booster and 100 MeV linac
- Up to 300 mA storage ring current
- 25 operational beamlines
- Top-up operation since October 2008

Beamline Insertion Device Control

An insertion device contains an array of magnets through which the electron beam travels.

Developed due to a requirement to open the gap of insertion devices prior to injection and restoration of that gap to pre-determined positions. Rather than controlling each beamline individually, multiple beam-lines can be selected and set to move gap and phase.

Gaps can be recovered from the EPICS archive when the encoder electronics have been corrupted by radiation resulting from a beam trip.
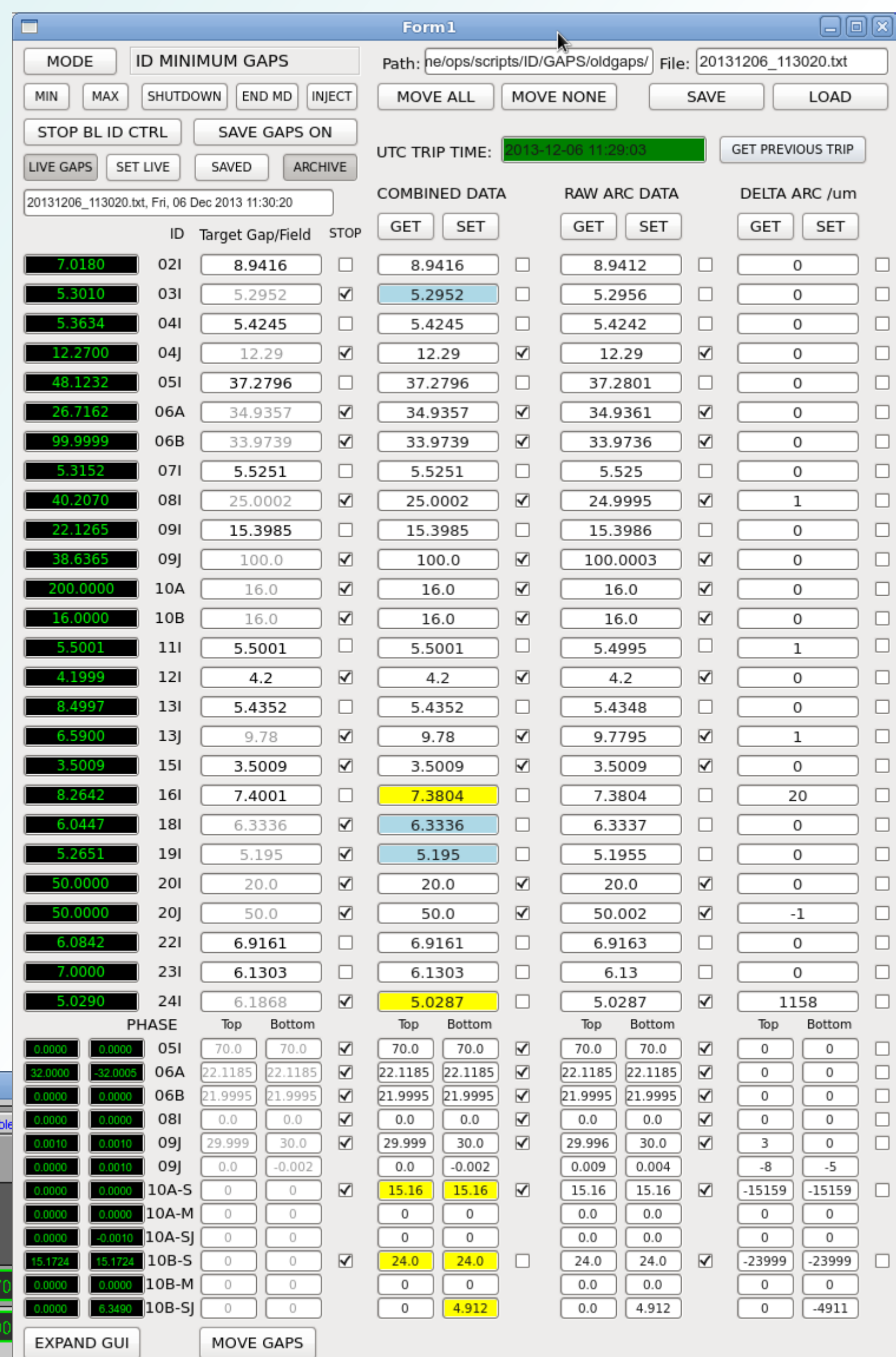
In addition to minimum, maximum and injection gaps, there are specific settings for preferred user beam start position and for shutdown, which sets gaps to minimum stray magnetic field.

During machine physics shifts, the operator can also load and save custom gaps and phase configurations as required.

Beamline Front End Control

Each beamline has photon beam absorbers and shutters, along with vacuum valves these make up the "Front End" (FE) photon transfer path within the storage ring.

The GUI on the left gives the operator an overview of the status of all the FE's, whilst allowing quick access to more detailed parameters such as beamline personal safety system status and beamline machine protection.

Scripts can be launched to either part way or fully, open or close individual FE's.

Individual control of each Front End component is also provided for convenience on one compact GUI.
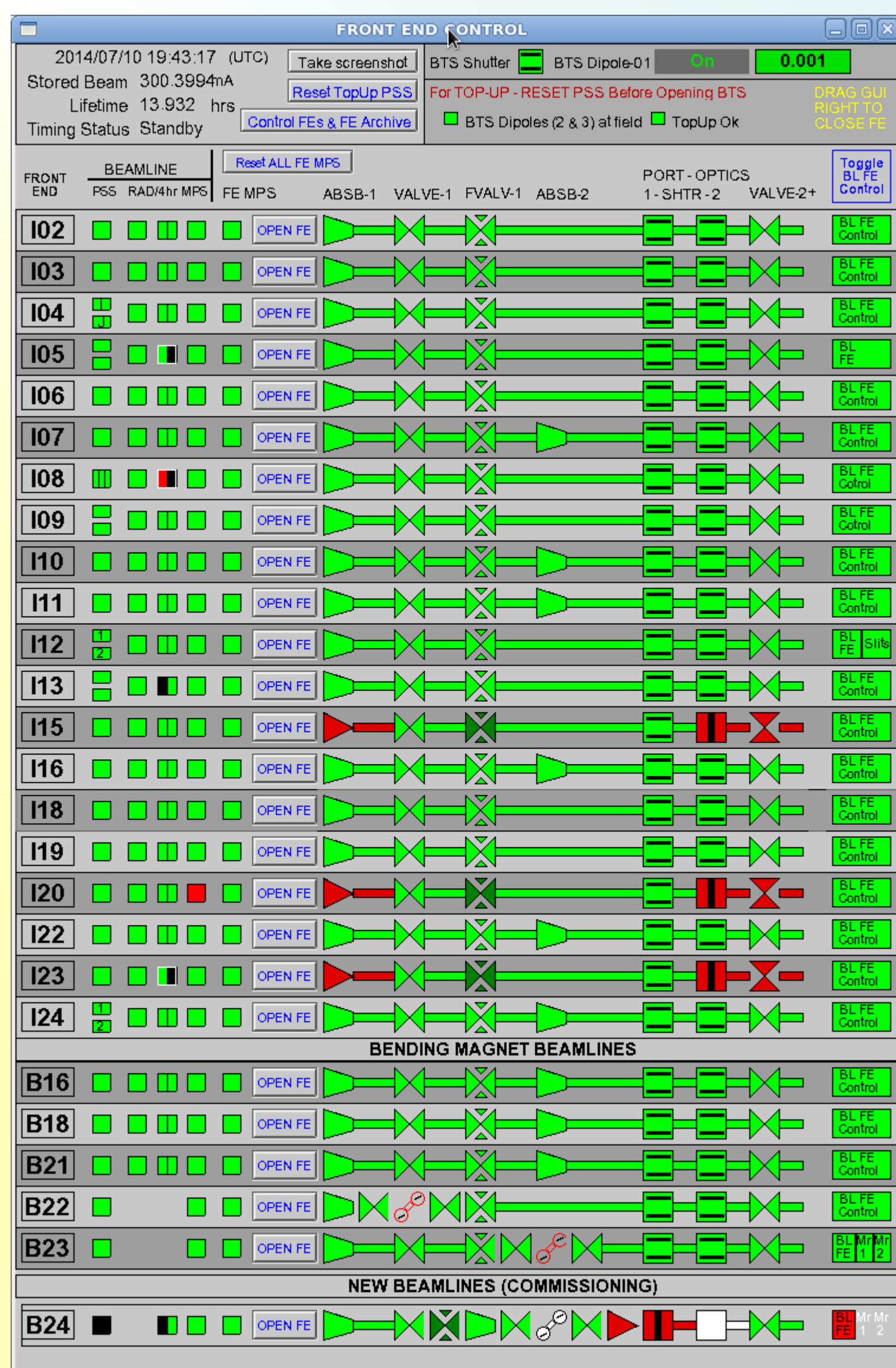
As with beamline insertion device control, multiple simultaneous FE operation was required early on in user operations. Since loss of the storage ring beam results in the automatic shutting of FE shutters, python scripts are accessed to restore FE's to archived states once beam is restored.

Manual control of multiple FE's is also provided.

Machine Protection Archive Viewer

Diamond's comprehensive Machine Protection System logs all state changes to the EPICS archive as a 16bit binary. For speed in interpreting these archive values when diagnosing historical events, an MPS archive viewer was designed.

3 Modes representing Front End MPS, Beamline MPS and Storage Ring MPS had to be considered due to the varying channels the MPS uses.

The viewer can be used for up to 24 locations at once.

"Get MPS" function allows the user to identify a "Beam Trip" date/time stamp and feed this into 24 FE's or BL's at once, with the archive searching back for the last event on each location.

"Roll Back" produces a time sequence for a single PV. Feeding the PV and event date/time stamp result from the top left PV into the next change of state search until the last location is reached.

Back-up Comparison Tool

Any process variable (PV) can be stored in a back up file and later used to restore the machine to a pre-determined set-up. This tool allows the user to compare versions of these back up files with each other, or the back up files themselves with the current machine settings.

PV Filtering with independent tolerance setting is available, as is a plotting function for those PV's that are made up of arrays.

For more information please visit www.diamond.ac.uk or contact vincent.winter@diamond.ac.uk

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