Status of the solenoid and focus coil magnets

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MICE Project Board
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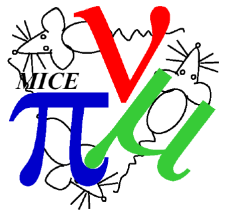
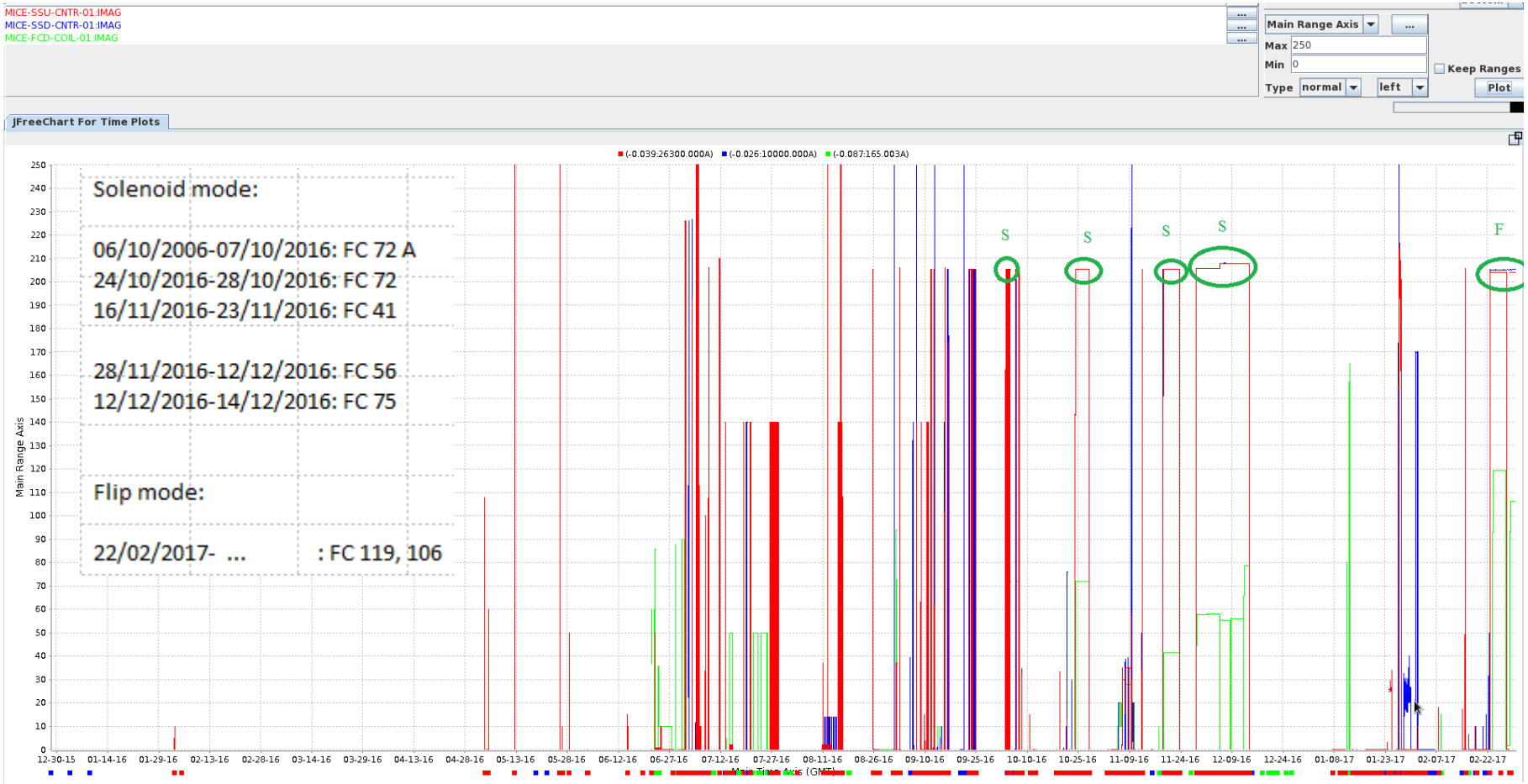


Present situation

1. All three superconducting magnets in MICE hall are operational
2. Useful data have been, and are being taken both in Solenoid mode and in Flip mode. Presently the magnets are configured for Flip mode
3. Longest continuous data-taking period was last November 28 to December 15 when it was cut short by unfortunate software interference. Data were collected in Solenoid mode
4. In January the magnet train was re-configured into Flip mode (SSU still positive polarity, FC pos/neg and SSD negative polarity
5. In early February the magnets were ramped to field in flip mode

Data-taking with powered magnets, 2016/17



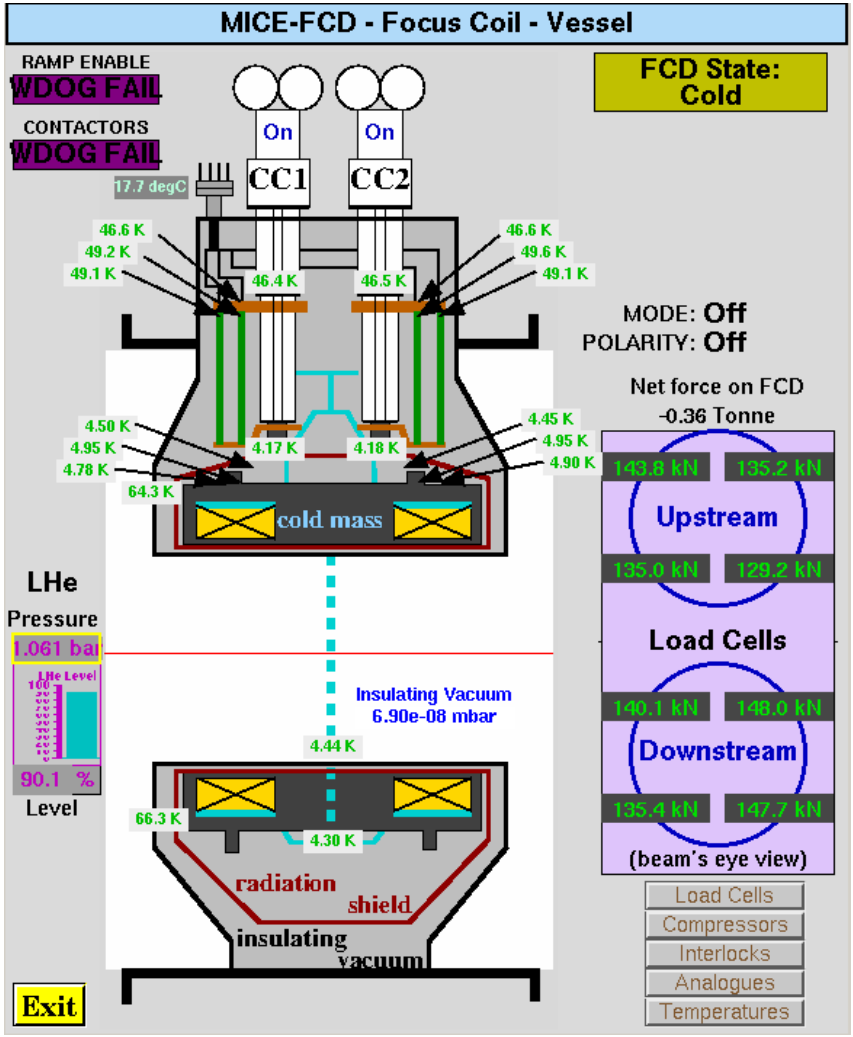
These periods are with the combined magnets, solenoids and FC. In 2015 only SSU was used.

Focus coil

- FCD has been cold for months now
- Cryogenic performance is good and steady (pressure control is given with ramp rates < 15mA/s)
- Ramping is divided into three sections:

  up to 50A: 25mA/s, up to 70A: 15mA/s, above 70A: 10mA/s
- Has been ramped in beamline, without solenoids, to 165A, could be ramped in the past to about 184A
- With solenoid fields and forces present the focus coil quenched, in flip mode, at 160A (15/02/2017)
- This could have been a training quench or indicating internal instability (repulsive force ~ 180t at 160A)
- Time constraints may mean that the focus coil should be down-rated for next runs
- Ramping of focus coil should now be possible from common magnet channel interface (not tested yet)
- Sequence of ramping is: first ramp solenoids, the ramp focus coil on the way u
  remove field of focus coil first on the way down

Load and temperature indicators on Focus Coil



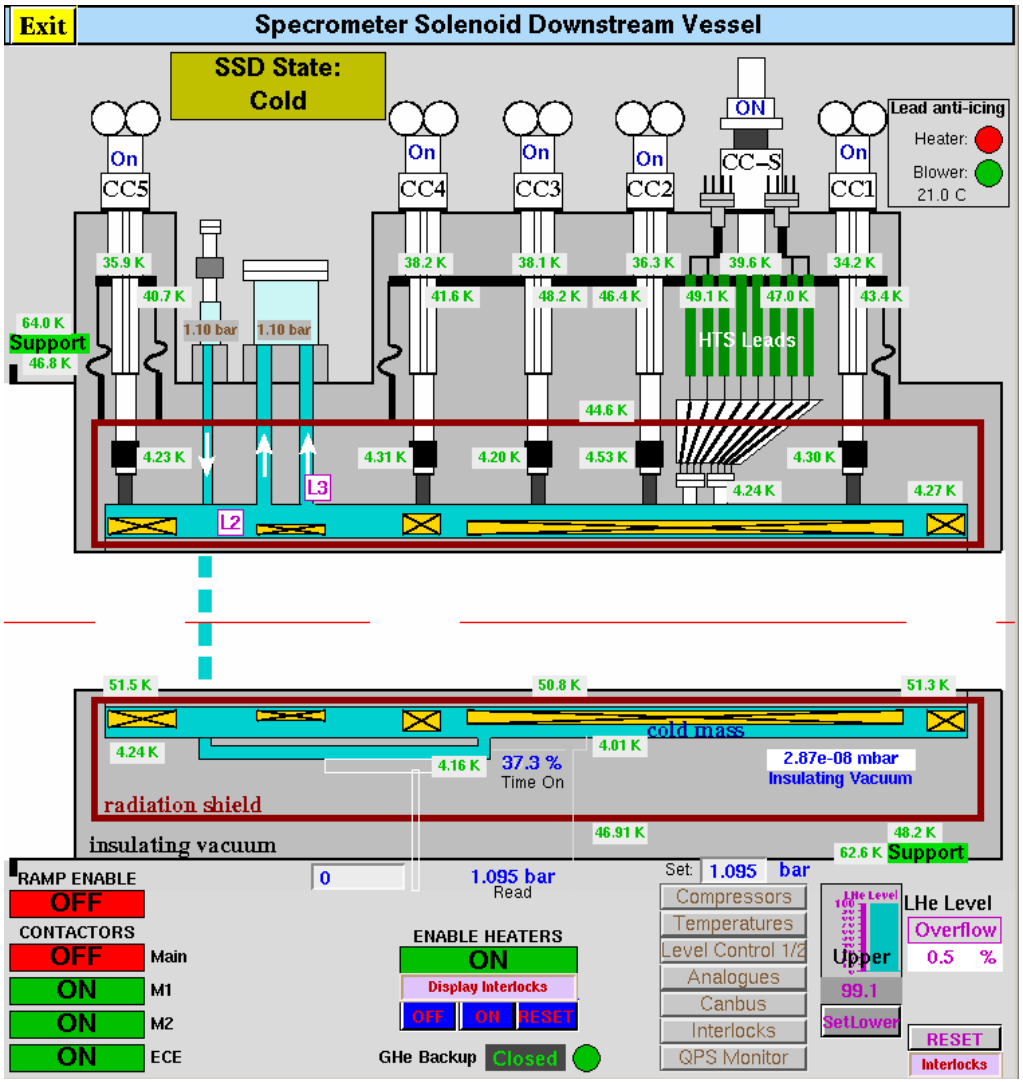
Useful indicators:

- Net Force display
- LHe pressure
- Magnet temperature

Max force seen up to now is 15t in solenoid mode, 13t in flip mode.

There is no force display on the solenoids. The agreement between calculations and force display is good to within 0.5t (500kg).

Solenoid magnets



SSD:

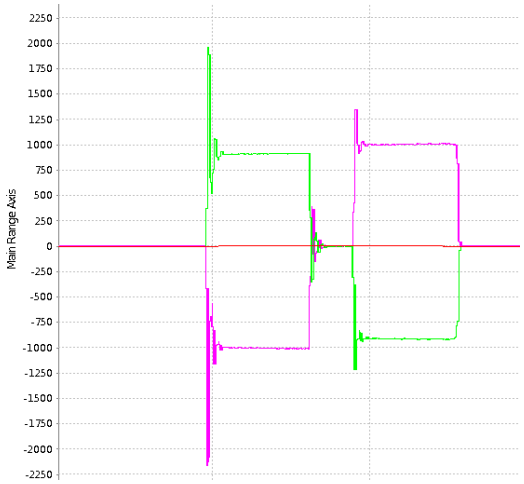
- M1 dis-functional, M2 connected
- Trims not connected (shorts)
- Cryogenically acceptable (>30%) at rest, 0 – 20% when powered (% refers to the cryogenic overhead of the cold heads)

SSU:

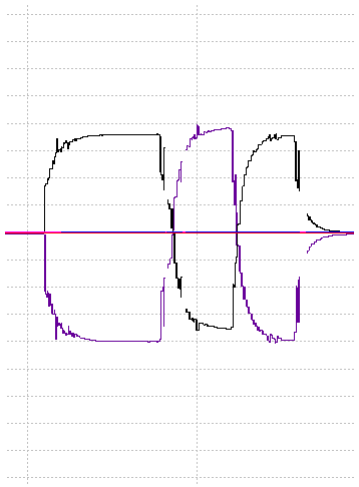
- All coils except trims are connected (PSU issues, may be solvable)
- Cryogenically very good (>50%)
- Had issue with M1 PSU in shorts (voltage set itself), self-setting voltage is being investigated and may be solved with IOC update

Had issues with WDOG errors stopping single stage compressors, this error also closed down the vacuum system: compressors have been disconnected from this controller network (CAN-Bus). Vac system proved to be stable and safe.

Decay on voltage taps



SSU



SSD

After quench of FC at 160A the energised solenoids behaved differently:
SSU went into ‘Fast ramp-down’, no quench or loss of helium
SSD quenched, lost all helium

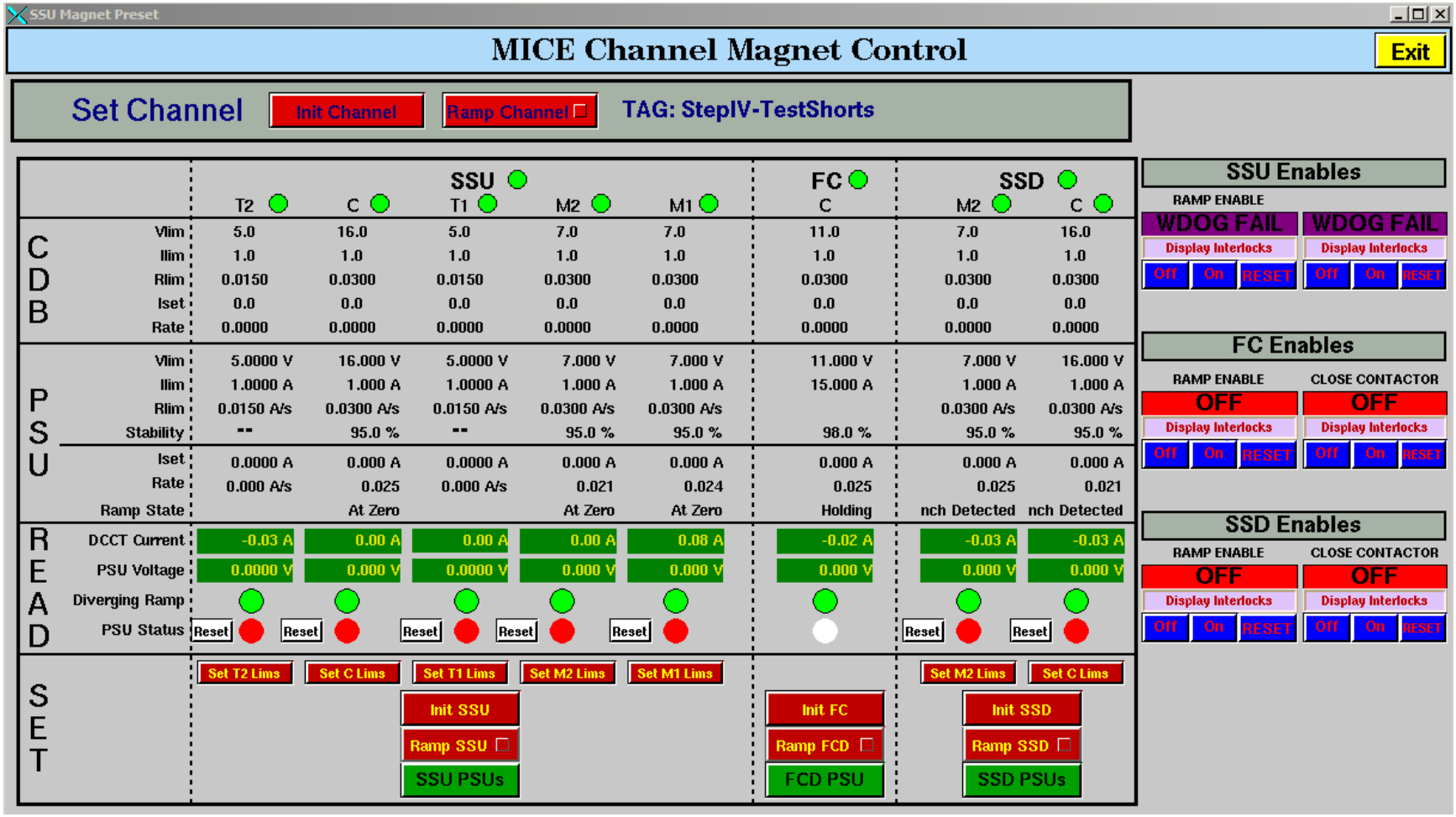
When checking the coils after this event with low-current trips:

SSU dropped coil voltage quickly, as expected

SSD dropped coil voltage slowly (2.5min), indicating some leakage current or resistance (possibly within cold mass as outside cabling could be excluded, all except diodes in energy absorber in rack)

This behaviour of SSD did not stop renewed ramping of the solenoid and it is running since Feb 22

Common Magnet ramping interface



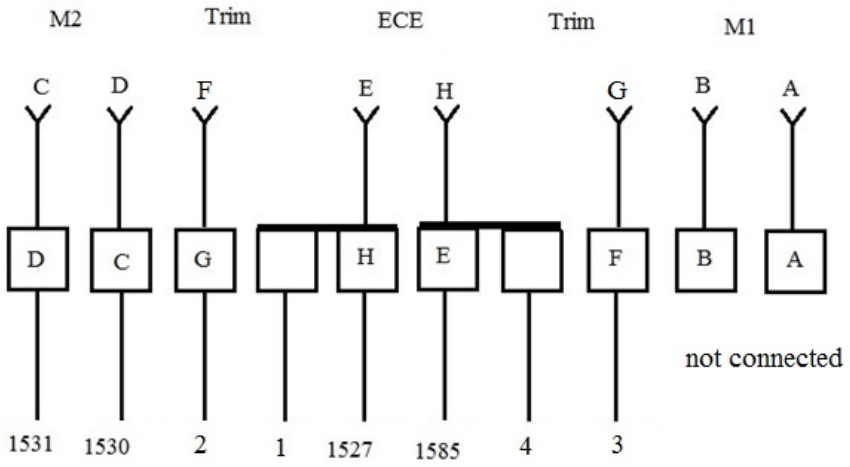
Tags are loaded into data base setting currents and ramp rates, magnet activation can then start. To ramp down we load a zero current (Step-IV-zero). Top current limits are set manually to about 5A above operating current. The magnets can also be run from the individual power supplies (with higher flexibility).

SSD and consequences for operation

- M1 in SSD had a major failure in 2015 and steps were taken to minimise danger to subsequent operations
- An external energy-absorbing circuit was installed which should take energy in a quench situation
- Trim coils in SSD will not be used anymore, they are disconnected in Link boxes
- M2 is not used at this stage, further work would be needed to gain confidence
- The absence of M1 and M2 reduce the stress on the magnet suspension considerably
- Cryogenic performance has been improved by pressure control in compressors for cold heads
- Vac-pumps are constantly run on SSD to counter the residual leak from cold mass
- For FC and SSU a conservative approach is used with respect to interaction forces between the individual cold masses. Data are being taken with the low force settings first before going to higher stresses.

Polarity configuration

- A simple document now exists which describes the lay-out of the various configurations of polarity.
- The three Link boxes (mezzanine) now have windows which allow immediate information as to the configuration



SSD in reverse polarity mode

Next steps

- Install hydrogen absorber in Focus Coil
- Investigate SSD voltage decay to see whether it actually poses a problem (nothing is visible at the moment)
- If time is available try to establish FC performance
- If time is available confirm operation of trims in SSU
- (Decay solenoid is cold and fully operational)
- Target: provide for more uptime to allow more data-taking