**Run Plan for Beam to MC, Fall 2020**

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**MCenter Run Plan**

Until just recently, the initial run plan for MCenter beam line called for resuming beam taking at 64 GeV, followed by the testing of the beam line at 120 GeV setting all the way to Enclosure MC7, before returning to an upper limit of 64 GeV for normal operations. However, given the problems encountered with the water leak on the MC6D-2 dipole, it will not be possible to attempt the complete 120 GeV tests at this time. The present plans call for MC6D-2 dipoles to be operated at a reduced water flow/pressure condition to limit the possible loss of Low Conductivity Water, LCW, through the dipole. This dipole has had an epoxy patch applied to the leaking location since a more permanent leak fix cannot be implemented with the magnet in situ. It is hoped that with lower water pressure provided by a new water pressure regulator for the MC6D-2 LCW input, rerouting the water flow so that the fixed leak is on the return lower pressure leg of LCW flow, and with the applied patch, that the magnet can function in the ramped mode at 64 GeV current or less. The calculations of current at which MC6D-2 will be operated in ramped mode seems to allow 64 GeV operation but will not permit MC6D dipoles to operate at 120 GeV levels. That the ramped MC6D dipole string can safely operate at 64 GeV, even without LCW cooling for MC6D-2, will be tested once LCW is again available to the MC6D power supply. This without LCW cooling MC6D-2 dipole test will be done before the return of beam to Meson. We cannot operate the MC6D power supply without LCW cooling to it regardless of the cooling status to the MC6D dipole string. A temperature sensor, F: MC6D2T, has been installed on the MC6D-2 magnet to measure the temperatures it reaches due to the restricted LCW flow as well as during the test done where there is no LCW to MC6D-2. Additionally, there are klaxon temperature sensors designed to trip MC6D power supply off should the temperatures at the sensors mounted on the dipoles reach 80 degrees C. As previously, the MCenter beam line is still intended to operate at 120 GeV up to the MC6TGT target. It is the post MC6TGT portion of the beam line that is now restricted to 64 GeV currents or less while there are cooling problems with the MC6D-2 dipole.

It is not yet known whether the tests needed for future 120 GeV MCenter beam to Encl. MC7 will be done before or after the start of the use of MCenter beam by the NOvA Experiment in late fall of 2020. Regardless of whether the 120 GeV test are done before or after the resumption use by the NOvA Experimenters, the startup plan is as follows. MC7. Make sure F:MC6IC is operating correctly (cable for F:MC6IC may have been taken for F:MC6D26T). It is ASSUMED for the purposes of this run plan that the “dry run” (the test of MC6D-2 magnet heating with NO LCW flow through this dipole) has been successfully completed and found to possible. It FURTHER ASSUMED that there will be a small flow of LCW (rate not determined yet) through MC6D-2 and it will be assumed that there is full LCW flow through MC6D-1, MC6D-3 and MC6D-4 dipoles for the “normal” operation during the 2020-2021 run).

1. Make sure the MCTGT is still in the position of Spring 2020 (assuming “as found” for MC6TGT has taken place earlier and that there may have been movement of MC6TGT in the process).
2. Check that MC users are ready for beam to be sent to Encl. MC7.
3. Make sure MC2 pinhole collimator is OUT of beam.
4. Make sure F:MC6IC is in the beam and operating correctly (cable for F:MC6IC may have been taken for F:MC6D26T).
5. Make sure F:MC6D2T temperature sensor on MC6D-2 is working (with new cable?)
6. Properly dispose any LCW water (It is likely to contain some glycol) from the catch bucket for MC6D-2 drips and note date and time that the bucket was emptied or was found to be empty.
7. Check to see that the MC6D-2 magnet’s LCW supply and return valves are open and pressure regulator is set in its proper position.
8. Properly dispose any LCW water (it is likely to contain some glycol) from the catch tub for MC6D-4 drips and note date and time the tub was emptied or was found to be empty.
9. Check to see that MC6D-1, MC6D-3 and MC6-4 dipoles have their LCW supply and return valves fully open.
10. Check that the fan blowing air on MC6D-2 is on and secured so it will not fall off.
11. Re-establish beam using the best 64 GeV tune for MC making sure MC6D is ramped. Baginski Acnet Bunny page on D97, saved as e-log entry on 16:17, 8 April 2020 is useful. Files on Acnet page D1 “Acnet Global Save/Compare/Restore” files 242 and 433 in “Ext Beams” is where the files were saved.
12. Check and record temperatures & water level
    1. D:OUTMP (outside temperature)
    2. F:MS2SUP (MS2 supply temperature) Power supply temperature protection makes supply trip at 60 degrees C (140 degrees F) to protect SCRs.
    3. F:MS2RET (MS2 return temperature) Alarm maximum set now at 100 degrees F
    4. F:MS2LVL (MS2 expansion tank level)
    5. F:MC6D2T (MC6D-2 temperature sensor)
13. Make sure the MC tune is “good” all the way to Encl. MC7
    1. Record MC profiles
       1. Upstream profiles (for calculating spot size on MC2 pinhole)
       2. MC profiles, all the way downstream including MC7WC1 and MC7WC2 (in new position?)
    2. Record intensities
       1. MC6IC
       2. MC1SEM
       3. F:MC7SC1
       4. F:MC7SC2
    3. Record currents for
       1. F:MC2V
       2. F:MC5U
       3. F:MC6D



64 GeV tune from 27 Jan. 2020 from which MCenter tunes can be scaled.

To perform the truncated “120 GeV” test of the MCenter beam line without beam

1. Run all MC power supplies up to MC6TGT target (without beam) at 120 GeV currents and MC6D at the ramped 64 GeV currents (453 Amps).
   1. Check MC6D2T (MC6D-2 temperature)
   2. D:OUTMP (outside temperature)
   3. F:MS2SUP (MS2 supply temperature) Power supply temperature protection makes supply trip at 60 degrees C (140 degrees F) to protect SCRs.
   4. F:MS2RET (MS2 return temperature) Alarm maximum set now at 100 degrees F
   5. F:MS2LVL (MS2 expansion tank level)
   6. Check that the fan blowing air on MC6D-2 dipole is on and secured so it doesn’t fall off.
2. Assuming that the previous non-beam power supply tests (see above) have been successful or problems encountered resolved

a) Set the MC2 pinhole collimator is in place at the Acnet numbers for upstream and downstream horizontal and vertical positions where beam should be centered (this should be provided by survey data if available or at the previously used positions (see figure).

b) Tune MC for best transmission at 64 GeV tune (120 GeV beam to MC6TGT and with MC6D at 64 GeV).

c) Measure MC1SEM/MC6IC ratio, beam intensities on MC7SC1 & MC7SC2, profiles on MC7WC1 & MC7WC2 and loss monitor readings.

d) Do scan of MC2 pinhole positions to see if tune (transmission) can be improved.

e) Set the MC2 pinhole to best transmission position if rad limits allow.

f) Turn off MC beam.

g) Turn OFF the quads downstream of the MC2 pinhole.

h) Turn on MC beam.

i) Measure MC1SEM/MC6IC ratio, beam intensities on MC7SC1 & MC7SC2, profiles on MC7WC1 & MC7WC2 and loss monitor readings.

j) Do tuning of MCenter beamline upstream of MC6D to get best tune.

k) Measure MC1SEM/MC6IC ratio, beam intensities on MC7SC1 & MC7SC2, beam profiles through MC7WC2 and loss monitor readings.

l) Document results.

m) Turn off MC beam.

n) Move MC2 pinhole collimator out of the beam trajectory.

o) After radiation survey, return MC7TGT to position used for the 64 GeV and lower momenta and lock controls to prevent change in position.

p) Go back to 64 GeV or less running conditions as needed by users.

**Do the items on the checklist prior to startup including:**

MC2 pinhole drive refurbishment and alignment are complete.

MT3U-2 repairable water leak fix is finished, water valves open and checked out

MT3 pinhole collimator drive is repaired, ready to operate and Critical Device Controller can observe changes to it.

Compressed gas for the MS2 LCW system (check supply, this is at present a gas bottle)

Vacuum pumps and vacuum in MT & MC beam pipes ok (turned on, running, at acceptable values)

HV to loss monitors, profile monitors, scintillators

Gas to loss monitors, profile monitors

Check valves for magnets & power supplies to make sure they are open

Fans working and pointed in right direction?

Empty the tub/bucket catching leaking LCW

Are the Service Building MS2 tower fans operable?

Shielding assessments up to date?

MC6TGT target in the proper position?

“MC6DIC Test” cable was used for F:MC6D2T RTD temperature sensor. This is likely the cable that was used for MC6IC intensity monitor. Must check out to see if MC6IC can still be read out and if not a new cable for MC6D2T sensor must be found and the cable to MC6IC is restored

Check M4TGT operation (problems noted in e-log 18 Mar. 2020 but no final resolution mentioned)