**Meson Game Plan for Restart of Beam to MT and MC in Fall 2020**

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**DRAFT**

**There must be gas pressure at MS2 to operate the Meson LCW System. Work to fix the existing compressor system, which is in the past the end of life status, has been only partially successful. Decision in consultation with Des Deshpende, as of 2 Sept. 2020, is to employ the compressed gas option in place of the compressors to operate Meson LCW for the initial phase until alternative to compressed gas solutions can be put in place. Schedule calls for the Meson LCW system to be running by end of Friday, 4 Sept. 2020. Ultimately, it is suggested by Des that we go to a more modern electronic system which does not required compressed gas to operate the Meson LCW system. The electronic system is still in the consideration stage as an option for replacement compressors**

**Magnets at Encl. MC6 must be tested to see if they still work. Indications are that there may be bad or intermittently bad dipole and perhaps quad in MC6. First clues that there may be a dipole problem at MC6D came from unexpected currents used for this magnet string during this spring. Inspection of MC6 found a tub with small amounts of liquid below MC6D-4 last month. Adam Watts also has seen encountered some unexpected focusing problems before the end of the last run with suspicion that something isn’t quite right in MC6. Spreadsheet obtained via Mike Geelhoed on 31 Aug. 2020 has indications that there may also be trim that at least one time had a leak that needs checking. The prime suspects for bad magnets are: MC6D-4, MC6Q3 and MC6V1. Julius Lentz is aware of the need to check out the magnets in MC6. Julius believes that he can probably now find the bad magnets even without LCW system operational and has begun initial phases of checking. Julius has encountered problems even making access into Service Buildings with key that doesn’t work so that problem is being resolved.**

**Plans for changing any bad magnets in MC6 must be developed along with estimates on personnel needed, time required to replace a bad EPB, 4Q120 or 3Q120 is needed. Major problem has been to find documentation on how to do this. Institutional memory/documentation of how the magnets and other components were installed or replaced (there was probably a replacement of a dipole done in 2014) seems to have vanished. A photo taken in 2014 seems to suggest that a magnet may have been replaced then by removing the MC6 “roof” shielding blocks. I just was sent a drawing from 2009 which shows detailed drawing of the shielding blocks (Switchyard Beamline MIPP Beamline Layout including Encl MC6 cross sections by CAder Aug2009 365088-C1) which is likely to help. An e-mail message has been sent to Chris Ader asking if she has any knowledge of how magnets were installed/replaced but she has not yet replied to that message.**

**Once the magnets are found to be in working condition, determination of what is needed to run MC at 120 GeV and if the power supplies and cables are able to support such currents and repetition rates without problems such as overheating. Initial steps along these lines have already been made. If there is a bad dipole in the MC6D string and that bad dipole can be replaced, the needed current for this string will likely be about 1/8 less. Given the current MC6D needs to operate, that 1/8 difference in current requirements will have a significant impact on demands placed on the power supply and cables used. That power difference may determine if additional protection such as temperature sensors on the cables and special ramps for MC6D are required. The results of magnet tests should determine what current is needed for MC6D at 120 GeV. Awaiting test results.**

**Shielding assessments/requirements must be checked to see what max. intensity MC can operate. This is in progress. Waiting for more information on what the users’ needs are. If it turns out that magnet(s) have to be changed in MC6 and the method of magnet change is by removing a portion of the MC6 shield block “roof” which cannot be finished by the start of the fall run, then impact of this on running MT while part of the MC enclosure shielding is compromised needs to be addressed. Enquiry concerning this possibility compromised MC shielding have been sent to Radiation Safety experts and am waiting for feedback.**

**Life safety issues with MC6, the narrow aisle and length of aisle from dead end to nearest exit is an issue that has to be considered. Have gotten initial feedback from Safety issues and prototype sign for use in at MC6 has been provided but there is still an unanswered question concerning maximum occupancy of the area that is allowed. Once the occupancy issue is answered, signs & rope will be installed in the appropriate area to warm people of the potential hazard.**

**The details of the leak on MT2Q1 must be determined & appropriate fix applied. At the moment it is believed that the fix many be relatively simple but we need LCW system running to locate the leak and decide on how to attempt to fix the leak. it If leak cannot be fixed in situ, replacement will be required. Need to identify the techs are available who can do the fix. Candidate replacement quads if they are needed have been identified but they need to be checked out (electrical, hydro, vacuum, stands) to see if they are still good quads. This check out has not been done yet. The check out will be requested if it turns out that MT2Q1 or a similar quad in MC6 requires replacement. The request for a check out of a possible replacement quad will be on hold until it is known that a replacement is needed. It would be good if we did not wait for the check but given the personnel limits, making spare quad check at this time seems unreasonable.**

**Leak on MT3U-2 must be checked to see if it is worse and whether the dipole is still working. if the magnet is still functional we will run as is as the leak is not repairable. There is a spare for MT3U-2 that is identified in case it is needed. Previous dipole used as MT3U-1, which was the same type magnet as MT3U-2, also had a leak but kept in use until it failed totally. There are contingency plans both to operate this bend point with only a single dipole (this requires a magnet move) and plans for ultimate replacement of these dipoles must be worked out as there are no further spares of this type dipole except for the one known spare.**

**Target MT6TGT must be made movable/controllable remotely. Information from J. Kilmer on 2 Sept. 2020, indicates that there is no remote control capability and only very limited manual adjustments may be possible. I have not yet been able to find any documentation/drawing on the adjustment mechanism but the search by me and others continue for those. There is a radiation safety lock on the box that appears to hold the present manual adjustment equipment. It is not possible to see inside the box at this time. To open the box requires unlocking the radiation safety lock (Joel Fulgham has the key) and the removal of the stand which holds F:MC6IC ion chamber that is adjacent to it. It has been determined that high precision alignment of F:Mc6IC is not needed so marks on the floor of the present stand position for it along with some good tape measure backup should be sufficient as far as alignment needs. Hazard analysis still needs to be written for moving this ion chamber and associated stand. To make the MC6TGT remotely controllable will likely require expert design, fabrication, installation and alignment of the necessary components. That probably will not be possible given the time scale before the start of the next run. This means that if we have to move the MC6 target in or out of the beam, down time will be required and personnel will likely be subjected to radiation exposure whenever the position changes are needed. It is assumed that the MC6 target will be out of the beam trajectory when 120 GeV beam is being delivered to the users.**

**Pin hole collimators for MT & MC must be checked out to make sure they are functional. Initial request to the Main Control Room to just see if they can be moved has been made. I am not able to control the pin holes via Acnet from home. There is a collimator in MT3 with a coupling that needs to be replaced. Chis Ader is aware of the need for the replacement. This coupling I’m told has been held together for years already with some tape but it looks like it has come close to the end of life. No one seems to have attempted to do a proper repair. I am not aware of whether Chris has been able to obtain the needed replacement part yet. I will be checking. Additional pin hole collimator must be identified and checked out in case MC beam requires a second pin hole to get the desired beam intensity/spot size and the first pin hole already in the beam line is not adequate. There may be a possible pin hole collimator available in NS2 but it will have to be modified (it looks like it has 2 holes in it at present) and it’s condition is unknown. There may be other pin holes that are “available”, such as the ones that used to be the Neutrino Area but they have to be checked to see if they are still there. Given that these Neutrino Area collimators, if they are still there, haven’t been used in a very long time and in poor environment, will likely need major overhall if they are to be used. The location for the second MC pin hole must be determined and necessary controls for it installed if so.**

**Need a clear statement of what is needed by future MC users in terms of spot size and intensity, whether they need to have the beam swept over some region.**

**The ventilation system for Meson needs to be checked. Are all fans operational at design capacity? Are fans that are not fixed pointing in the correct directions? If pinhole(s) are used for 120 GeV MC beam, short lived air-born radioactive particles routes to the outside must be re-examined for the intensities required. In the past it seems the air flow rates and distances to the outside were deemed sufficient to mitigate the short lived air-born radioactive particles problem but it should be revisited once the experimental needs are better defined. This is especially true if a second pin-hole is needed elsewhere in the beam line.**

**Air conditioning system at MS2, 3 systems, must be made to work adequately to provide the needed cooling when power supplies are running. It has been determined by FESS as of 2 Sept. 2020 that the rooftop unit is likely usable once the final repair checkout, which should have been done by now, is complete. The other 2 air condition units have gone beyond the “end of life” date and are deemed not worth repairing as the cost of repairs, if parts are still available, will exceed 50% of the cost of new units. With cooler weather expected for the latter part of the fall and winter, it is believed that the roof air conditioner will be adequate to cool the MS2 Service Building sufficiently for the power supplies to operate. By the time warmer weather returns in the spring of 2021, it is planned to have additional air conditioning capabilities installed. Detail calculations should be done on what kind of heat load to expect in the era where 120 GeV beam is the maximum. This heat load calculation has not been done.**

The wet areas that are particularly bad have to be mitigated to prevent hazards such as slipping as well as preventing equipment damage such as in the region of the “M03 Alcove”. Where there is mold or other biological activities which can present health hazards such as mold allergy reactions, have to be mitigated. Groundwater seepage is a significant problem that keeps getting neglected. Often the sumps are in the wrong location and ventilation of the tunnels aren’t adequate to dry some of the persistent areas of wetness. There have been efforts to mitigate some of the wet floors by using vacuuming and other techniques. Max Monningh has been very helpful recently in trying to mitigate some of the worst areas. Better ventilation might help but one must take into consideration air flow patterns and the possibilities of release of short lived air borne radioactivity. Heaters may help as might fans. Detail studies are needed to mitigate these problems..

Areas such as the downstream end of Meson beam lines where beam pipes make it difficult to go from one side of the tunnel aisle to the other to continue must be made easier to transverse. This is a safety issue so that in cases of emergencies a more rapid egress is possible without having additional difficulties having waist high beam pipes in the way. This also will help with reducing possibilities of picking up radioactive contamination on clothing and the possibility of misaligning beam pipes that one bumps into. Request has been made to Paul Allcorn to try to mitigate the worse locations for these problems.

Inspection tours of Meson beam enclosures that have not had recent inspections must be inspected, checked for any problems. Bad lights have been persistent problem. A list of the major lighting problems in the MT and MC beam lines have been submitted and addressed so problems in those areas are not as bad. It did require repeated requests to get those lights replaced due to personnel shortages. However, there are other areas of Meson tunnels which seem quite dark but we have not had the time to investigate their conditions. It is important that even those areas get their lights repaired so that search and secure of the tunnels can be done safely and properly.

Transport decks must be updated to reflect correct serial numbers and components. This is something that is in progress.

ArCo2 gas system at MS3 must be turned on and checked out at least several daysa before any expected start up of beam. Adequate supply of gas bottle spares must be on hand as the supply is used.

All the LCW system valves must be checked to be sure they are in their proper positions prior to any return of beam or if tests are being conducted on magnets prior to return of beam. This check will have to be done again just prior to return of beam to make sure no changes have taken place.

Drawings and documents of significant beam line items, such as for pin hole collimators, target stations, instrumentation must be identified, made up to date and filed for easy access, reference. At the moment missing drawings include those for pin hole collimators, MC6TGT, etc. have made the job of trying to understand the scope of the what is needed to restart MC and keep MT operational a most difficult job and requires a huge amount of time and effort. I’ve undertaken an effort to collect drawings/documents and will try to sort them out a bit removing obsolete drawings, asking for updates, etc. if possible, and will be saving them in extbeam.bd area. I don’t want to place documents that are basically redundant or incorrect into this area both to save storage space and to make it easier to find the needed information. This is work in progress.

Check loss monitors & wire chambers for gas flow, proper voltage settings.

Check ramp parameters to make sure magnets ramp properly. If we do change magnets, polarity checks must be done as well as any klaxon drop checks.

Get list of people who are now responsible for each device, e.g., target drive, power supplies, etc. There have been lots of retirements, etc.

Was Meson Detector Building crane used to build Encl. MC6? If so, is it operational and are there people who are trained to use it properly? I have been informed that it has a 20 ton capacity but that needs to be verified. The range of crane coverage also needs to be checked to see if it can cover the entire MC6 area.

Place a plan to demonstrate the ability to transport 120 GeV primary beam to MC7 and place it (as per T. Kobilarcik, email 1 Sept. 2020) in:<https://beamdocs.fnal.gov/AD-public/DocDB/ShowDocument?docid=8615>