

MINOS Operations Notes Jan-Feb-Mar Quarter 1 2006

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Accelerator

POT is down quite a bit from the previous 2 weeks but that's because during the previous 2 weeks the TeV was down, so we got all their protons in addition to our usual supply. The TeV came back up last Wed, so we are sharing protons again, although the TeV didn't exactly have great running this past weekend. We had 12hr-long shutdowns on both Tuesday (due to Booster work) and Thursday (due to Anti-Proton work, which was scheduled, then canceled, then scheduled again). There was a short downtime on Friday due to Linac problems. There was a longer downtime on Sunday due to Booster problems.

The Target Hall air-system chiller started occasional trips again last Wed; the symptoms matched a maintenance problem which first arose last Nov - a leaky O-ring in an oil filter. Takes a full day to fix, which was scheduled for Monday (today); if the whole thing busted during the weekend, Jim and Sam had already obtained the necessary dispensation from Accel Div Safety to continue running without the chiller (but it kept running much of the weekend after all). This portion of the chiller is outside the Hall and can be worked on while reduced beam is being taken, so last Friday we decided to run reduced intensity, $2E12$ PPP, for 3 days starting Monday (and this has started this morning). This is 1/2 of the total reduced intensity running which has been requested so far - there will be 3 more days of similar running just before the Shut Down starts on Feb 27.

Sometime during this week's low intensity running - probably during the day Tuesday - there is a request from the Main Injector group to perform a scan of the aperture of the Lambertson, the device where our beam is split from the MI. Alberto and/or Sam will call MINOS Control Room to warn when this will occur, as we should NOT take physics data while this scan is performed (beam will scrape, making different distribution on target). The scan should last about 2 hrs.

The NuMI folks DO understand why our beam-on-target was sometimes so jumpy. It occurs during mixed-mode running (batches loaded into MI split between NuMI and PBar). Mixed mode has occurred all the time... so why does it cause targeting problems now? Well, Peter Lucas explains that previous mixed mode running was symmetric - the same number of pulses were NuMI-only as were NuMI-PBar mixed, and typically alternated. But due to some issue or other in PBar, they now take just 1 mixed mode pulse out of every 10, and this has screwed up our Auto-tune. In a more symmetric mixed mode, the AVERAGE beam position remains stable and Auto-tune does not have to work much to compensate. But in this unbalanced mixed mode, that stable average is gone - Auto-tune sees a "bad" tune from the 1 pulse shared with AP, spends the next 4-5 pulses trying to fix that, gets 4-5 more pulses mostly correct, and then gets messed up again on the next 1-in-10 mixed mode. Peter and others are working on changes to Auto-tune to adapt it to this unbalanced mixed-mode.

Far Det - message sent from Bill

On Thursday we changed out a PMT on 4-2-4-1-2 that has been running low for ever! Many times this channel was worked on over the past few years and every part has been swapped out except for the PMT. After several test runs swapping cables to make sure we understood where the problem was Curt replaced the tube and the base. There are several other channels in the detector that constantly show up in the cold chip plots in the on-line monitoring. We will make a study of these over the next week and confirm that the problem is indeed at the PMT end and decide if they should be swapped out. The other signature of the problem in carte 4 was that the singles rate bounce all over the place. There are a few other low ones that the rate is nice and stable just low. These might just need a small voltage increase. More details on these channels and we can decide how many PMT's should be replaced during the beam shutdown. If there is beam down time on Tuesday there is one in crate 0 that for sure could be changed. Both the tube changing experts will be gone after this Tuesday till Feb 13th so we would wait till after then.

We also completed fixing all the problems left over from crate 15. It turns out the last 2 issues (screaming hot channels and ETC errors) were both bad connector ends. By placing a strain relief clamp on the VARC end we were able to fix both problems without replacing the cables. We have 100 or so of the strain relief clamps so we can't do all the VARC's. At some point we will also need to repair some of control cables that we have. They are really bad ribbon cables to repair since many have the twisted pairs have come totally loose from the cable. We have 27 good spares and replace cables once every few months. All the old cables are still in the original bundles so it would be best if we could replace the connector in place and pull the single spares back out. At the very least we should order some spare connectors.

Near Det

A few CAPID channels have been replaced - nothing different from the usual.

Minerva has a meeting this week concerning their ShutDown plans and schedule. Cat expects to get a summary of their plans after their meeting. They are planning for a time period early in the ShutDown, when the drip ceiling gets an addition, during which we will have very limited access, as the Hall will be considered a "construction site". More details forthcoming, when we know more.

Run Plan, Jan 30, 2006

Run low intensity beam for 3-days-worth this week (72 hours).

Inspection and repair work on the Target Hall air chiller unit can proceed during beam while we are at low intensity. As of Wed morning, the chiller problems are not understood. If the problems are still not understood when we are ready to return to normal intensity, well then we may have a problem, as it keeps tripping off, and we cannot run normal intensity without it for very long.

Wed afternoon there is an underground tour for the FNAL Directorate, purpose to inspect areas where tritium is being detected, as well as an overall tour. Beam off at 12:00pm. Beam return by 4-5pm.

Thursday afternoon - another underground access, this time to install "humidity collectors" in the continuing effort to understand sources of tritium. Expect beam off between 11am-12pm. Beam return 3-4 hrs after turn-off.

We run low intensity, 2E12 PPP, between the Wed and Thurs down times. Return to normal intensity when we come back up Thursday afternoon UNLESS we decide to first run at an intermediate intensity, 5-7E12 PPP for some time period. It is the fuzziness of this time period that makes this a not-completely-decided-upon request. Shifters will be informed when we know better.

Soudan folks and Computing folks have been informed of these scheduled beam-down periods this week. Far Det wants to swap a phototube, which requires turning off HV and so they wait for beam-down. Computing has been waiting for a down-time to install a Linux security update on ALL of the Control Room computers. This is currently scheduled for 1pm-3pm Wed. So if you cannot get the CRL such things Wed afternoon, that's why.

The Lambertson scan mentioned in the Monday Ops meeting (see minutes in link below) is still planned to occur, but no time has been set for it. Our own low intensity running is still too high for this scan. Alberto and others are still working on their plans for this.

Run Plan Feb 6, 2006

Last week's repair work on the Target Hall air chiller unit was eventually successful, and Thursday evening saw a return to normal intensity running after low intensity running (72 beam hours performed over 3.75 days). Then a different problem emerged. A radiation monitor in the Power Supply room, which measures the activation of the air in that location, started to read higher and higher levels. This was noticed within hours of returning to normal intensity, and eventually caused a trip of the beamline on Friday. Such sudden trips can damage power supplies if they recur frequently, and it was clear that this monitor was going to cause more trips. So an operating mode was approved where the Main Control Room Ops kept an eye on this monitor, and when it was close to causing a trip, they turned off the NuMI beam. After letting things cool off a bit, they would start up the beam again, until the trip level was approached again. We ran in this off-on-off-on manner all weekend.

Monday, and every day so far this week, we have turned off during the workday so that the cause of these trips could be determined. Fans to push air back, from PS and RAW rooms to the Target Hall, were installed. The PS and RAW penetrations were covered as much as they could be. The exhaust fan down in the DK tunnel was turned to a higher speed so as to draw air out of the Target Hall and away from the PS room. It was thought that a change in the temperature or air pressure was causing a "back-flow" into the RAW room (although we have been running at normal intensity in many different weather conditions without this particular problem occurring). None of this worked.

On Wed. afternoon, a possible cause was discovered. There are two air monitors located in the PS room. One samples the PS room air. The other one samples Target Hall air, and this air is pumped in to the monitor, and then returned to the Target Hall, via a closed-loop hose system. A loose hose was discovered, and fixed. We then returned to normal intensity running. But, within an hour, it was clear that the monitor sampling the PS room air was still reading levels much higher than it should. There is some thought that perhaps the pump used to circulate the air for the Target Hall air monitor is leaking Target Hall air into the PS room.

At any rate, no normal intensity running for Wed evening. We went to medium intensity, 3-turns, for the remainder of Wed evening. And we will again be turned off during Thursday working hours so that this problem can continue to be investigated.

Run Plan, and Summary of running, Feb 13, 2006

A radiation monitor in the Power Supply room, which measures the activation of the air in that location, caused trips of the NuMI beamline. The trips began within hours of returning to normal intensity Friday Feb 3rd. The weekend was spent in an on-off-on-off running mode, turning off the beam whenever this monitor came close to causing another trip. Gave up doing any further normal intensity running on Monday, and went to a 3-turn reduced intensity special runs mode. Monday through Thursday daytimes were spent looking for the cause of the trips. While one group was searching for air leaks, another group with Jim Hylan was dealing with the Horn-2 water cooling system, whose pumps had started to have problems, starting also on Friday Feb 3rd, as it happened.

The two problems turned out to be the same problem. There are two pumps in the Horn-2 cooling system, one to push water in, the other to pull it out from a holding tank located below the horn. It is this 2nd pump which is failing, and could not keep up the flow rate of the 1st pump. As the return flow rate dropped, the water level in the RAW expansion tank dropped. As the water level dropped, air filled the tank instead. When the water level went back up every now and again, the air was pushed out a relief valve. This air becomes highly activated as it runs through the Horn's water system, and this expansion tank is located in the Mechanical Room, next door to the Power Supply room. It was this escaping air, moving from one room to the other, which caused the radiation trips in the Power Supply room.

The radiation trips were solved by attaching a hose to the air relief valve, and sending this activated air back into the Target Hall. But the Horn-2 cooling system pump is still failing. To keep the water level in the expansion tank above a trip-off point, the speed of the 1st pump has been adjusted to match the speed of the failing 2nd pump. But this reduces the overall water flow rate, and means there is less cooling water being sprayed onto the horn. There have been 3 adjustments to the pump flows in the past 5 days, and the failing pump continues to slow down. As of Friday Feb 10, we are just at the point where Horn-2 can be kept cool enough to run at nominal intensity. Jim Hylan strongly advises that we perform the Horn Off running, which is done with nominal intensity, while we can still accept that intensity. As this pump continues to fail, we will be forced to run at reduced intensity, and perhaps just turn off entirely if Horn-2 gets too hot (thermally). Reminder - beam heating requires that the Horn cooling system be running even if the Horns themselves are at zero current.

Horn Off running period is 2 days, starting as soon as Jim OKs this with Ops.

Week of Feb 13, 2006 : continue running normal intensity only if Horn-2's cooling system allows this. Otherwise return to the 3-turn medium intensity running.

The accelerator complex will begin to "tone down" all the machine intensities starting Tuesday, Feb 21. Tuesday to Thursday they will deliver no more than 3-turns intensity to NuMI, and after Thursday, Feb 23, no more than 1-turn intensity

Run Plan Feb 20, 2006

The Tevatron blew a magnet last Wednesday evening. So the Shutdown has started for the Colliders. This event puts increased pressure on moving the Shutdown forward for everyone else. Program Planning - Jeff Appel - spent Thursday morning visiting us and the other Fixed Target experiments to understand what an earlier Shutdown means for all of us. The verdict which was returned Thursday afternoon is to keep the Main Injector running through 11:59pm Saturday.

For the week of Feb 20, 2006 : The accelerator complex will begin to "dial down" the Booster output, starting Tuesday, Feb 21. Tuesday-Thursday, they will deliver no more than 3-turns intensity to NuMI, and after Thursday, Feb 23, no more than 1-turn intensity. We run as long as the Horn-2 pump system is functional. We ran 3-turns last Friday & Saturday, 2/17-18, to be certain of getting this data in case one of the problem pump systems completely failed. We ran normal intensity Sunday morning, 2/19 through Tuesday morning 2/21. ES&H made a water sampling access in the Target Hall which lasted until 4pm Tuesday 2/21. 3-turns will be delivered Tuesday through Wednesday afternoon. 1-turn from Wed afternoon to the end of beam. A Main Injector study, scanning the NuMI Lambertson aperture, will take 4hrs of beam away from us Thursday afternoon.

History

Pump Problem #1 - There is a leak or crack somewhere in the Horn-2 cooling water system. Water does not appear to be leaking out, but air is getting sucked in, which lowers the efficiency of the pump. The end effect is that the water spray onto the Horn-2 inner conductor is reduced in coverage area, and the inner conductor cannot be kept cool. A side effect was radiation trips, caused by the additional air in the system getting activated, and then getting vented into the Target Hall utility rooms; these trips were solved by redirecting the air back into the Target Hall. However, the Horn-2 cooling system continues to lose efficiency. To nurse it along, the pump speed, nozzle spray rate and valve settings have been adjusted, but the adjustments are always downward in terms of water flow, and this process can only go so far. As of Friday Feb 17, Jim Hylan used his last trick with such adjustments, and gained a bit of time. When this pump system water level drops below a trip-off point, then that's it - NuMI is OFF.

The inefficiency in the pumping system is likely due to a leak - either a crack in a pipe or in a connection fitting or in a valve. If this leak is located above the steel Target shielding, then it can be repaired. If it is instead located closer to the Horn, down in the target chase, then the problem area will be very radioactive, and whether or not it can be repaired is not known. We will discover reparability during the Shutdown, when the concrete shield blocks can be removed and the upper part of the plumbing inspected.

Pump Problem #2 - At the MINOS end, there are pumps within the sump which supply cooling water to both the Beam Absorber (for the Absorber and for the DK Pipe) and the Near Detector (for the electronics racks and the coil). These are not the big sump pumps which send water to the surface, but pumps which recirculate water between the sump and the Absorber/Near Hall and back again. There are two of these pumps. One has broken - shorted to ground. The second seemed to have a problem with it's controller or water-level-sensing hardware - it suspiciously tripped off almost exactly at 4:15pm for 4 days in a row. Finally someone went to look at the controller and removed a timer, which was trying to swap pumps once per 24hrs - except that the 2nd pump was broken, and the controller wasn't smart enough to return to the working pump. The overall design of this pump system is being re-examined now, since the amount of water running into the sump has declined a bit over the past year, and the existing equipment is not well matched to the water flows.