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Distribution: R. Ent, P. Rossi, J. Gomez, J. Creel, A. Freyberger, V. Burkert, C. Keppel, S. Wood, S. Lassiter, R. Fair, D. Kashy, W. Oren, N. Hasan, S. Suhring, J. Wilson, C. Perry, J. Butler, H. Fansler, D. Insley, D. Gaskell, J. Segal, P. Brindza

Subject: Minutes of Summer SAD 2018 meeting concerning Halls A and C warm up and cool down, held May 3, 14:30 CC rm L102

Attendees: D. Kashy, C. Keppel, S. Wood, J. Gomez, J. Wilson, C. Perry, S. Lassiter, J. Buttler, H. Fansler, D. Gaskell, J. Segal

ACTION ITEMS are underlined with person assigned in ALL CAPS

- The goal of the meeting was to try to determine a good path to get the ESR complex back on line to support the physics program. A range of options were discussed and a tentative path to be further investigated was setup.
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- Critical parameters were set by Javier.
 1. We must have at minimum 3 Halls ready to run the physics program on August 22, 2018. One of these is Hall D, and since they have their own refrigerator it was not discussed further
 2. The other two Hall were nominally set to be B and C along with their associated targets. In Hall B that is the Saclay Cryotarget $\sim 0.3\text{g/s}$ of 4K liquefaction load and in Hall C a 300-500W H2 target supplied off the 15K circuit from the ESR. This was a fairly easy choice as the maintenance needed in these two Halls can be done at 80K.
- Dave and Steve said that Halls B and C would like to remain as close to 80K as possible using LN2 cooled helium.
- Hall A has maintenance that should be done and this maintenance must be done while the full spectrometers and transfer lines are at 300K. All agreed, that if possible, the work should be done, and the Hall should go to 300K.
- Hall A needs to be cold and operational by $\sim$ September 10 $\pm$ 1 week to avoid cancellation of the APEX experiment
- The biggest limitation to success for re-cooling all 3 ESR complex Halls is the capacity of the helium purifiers at CHL. The exact amount of recovery capacity (purifier bed limited) is dependent on the maximum capacity and also on the loads needed to support other users, including, Linac cryomodule work, CHL gas management, and ESR loads. The baseline max flow was described as 30g/s. At a second meeting later the same day the peak flow was given as 38g/s, this will help greatly in recovering the system and allowing all Halls to get back to 4K as quickly as possible.
- The table below gives the desired plan which should be further flushed out to determine if it is possible or what changes can or should be made

Date/time	Event	Purifier Flow for Halls (g/s)	Notes
May 6/06:00	Beam off/CHL to ESR TL off/ shed target loads/ramp down superconducting magnets and secure power supplies	4-5	Flow will be reduced a bit from nominal 5g/s
May 7/TBD	Shut off Hall A	10 to 15-A 1-B 1.5-C	Capture Hall A boiloff and measure contamination (see Jack Segal) Add load in Hall B or C if needed to keep ESR stable (warm return or electric heat in Hall B)
May 7-9	Tests in Halls B and C (no fast dumps from high current!)	4 –B/C 5 - A	Circulate 5g/s of warm helium to determine contamination in Hall A if not too high
May 9	Only one recovery compressor	1-A 1-B 1.5-C	Total limit of recovery system 18g/s
May 10	Start warm up of Halls B and C by shutting off the 4K supply and 4K return, shut down ESR	1-A 5-B 10-C	Recover helium 12-24hrs
May 11-July 9	Circulate gas through Halls A/B/C Halls B and C need LN2 to cool the Helium to 80K	2-A 1-B 4-C	Hold B and C at ~100K
June 7-8	No Recovery System available	0	Need to keep systems positive pressure (<u>must determine which portions hold pressure and which need a supply in advance (ALL))</u>)
July 9	Start 300-100K cooldown of Hall A, with goal of reaching ~100K by August 22	10 to 15-A 1-B 4-C	Both Arms must cool together
July 23	Increase flows to Halls B and C to bring them back down below 100K by August 1	10-A 3-B 7-C	

August 1-17	Hall C 4K cooldown with CHL boost if needed (purifier may be the limit)	5-A 2-B 10-C	May be possible to start earlier if CHL's are running stably on July 22 (*IF CHL boost is available Hall B could cool in parallel with 3g/s of 4K flow)
August 18-19	Hall B 4K cooldown	10-A 6-B 1.5-C	Hall C may do low current tests (* see one row up)
August 20	Hall B and C Target cool down	10-A 3-B 6-C	Target cooling is run status and Hall desire dependent (2g/s ~8 hrs for Hall B target and 5g/s ~8 hrs for Hall C target)
August 21	Hall B and C system checks and magnet ramping to full current Hall A still on GHe/LN2 cooldown	10 to 15-A 1-B 1.5-C	
August 22- September 5	Physics B/C Hall A 4K cool down ~10-15g/s of 4K (from ESR and CHL combined)	10 to 15-A 1-B 1.5-C	Extra care to avoid CHL or ESR trip during Hall A cool down

- Other notes:

- Hall C will want to use their moeller magnet system during the Fall run but Division Management has stipulated that if necessary runs of this system can be limited to 2 times during the August to November time frame. This will limit the load to be a 1-2 day transient vs steady load on the cryogenic plants.
- 4 atm helium will be down for a few hours during the down time and thus there will be no cooling during that time, but systems can float on recovery to keep them at positive pressure
- May 9 there will only be 1 recovery compressor so the total recovery flow will be limited to ~18g/s
- June 7-8 there will be no recovery system available. – Plans need to be developed on how to keep the Halls (and ESR?) at positive pressure to avoid contamination.**
DHK/JDW
- The Halls should plan for ~5g/s going to the recovery system for the first part of the down time but may be able to take/send more depending on other users.
- Dave brought up an option that Hall A be cooled by LN2 in the helium circuit and then purified. This is not without risk, and has not been done on large scale at JLab previously. It would require a lot of thinking and work and was tabled as an option at present.
- Javier asked: Is there any chance to buy LHe and dump it overboard to use to get Hall A cold faster? DHK said we can't afford ths but said he would do some calcs and provide a cost estimate. Result of DK calculation: 6 weeks at 15g/s all vented is 2.25M\$**

8. If portions of the system are proven to be very clean (<2-3ppm could we avoid using the purifier? Needs to be discussed in a different group. If the physics division could purchase more contamination sensors, would it help? Are they needed and would it allow more capability/capacity for cooldown?
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- THIS IS NOT A FINAL PLAN BUT WOULD LIKELY MEET THE GOALS OF THE PHYSICS DIVISION TO SATISFY THE CRITICAL PARAMETERS ABOVE AND TO GET HALL A ON LINE AS SOON AS POSSIBLE. IF THERE ARE CHANGES NEEDED BY THE HALLS OR CRYOGENIC GROUP THOSE SHOULD BE BROUGHT TO THE ATTENTION OF J. CREEL, D. KASHY AND THE HALL LEADERS ASAP