Experimental Readiness Review for Hall C
Meeting: 24-25 August 2016
Report: Monday, August 29, 2016

Review Committee

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Scope

The charge document includes the following to be reviewed:

• The high-current beam delivery at energy larger than 6 GeV.

• The E12-06-107, E12-10-002, E12-10-003, E12-10-008, E12-09- 017, E12-09-011, E12-09-002 experiments.

• The scattering chamber and targets for commissioning and first year of physics experiments.

• The SHMS & HMS and detectors as needed for these experiments.

Executive Summary

Firstly, the committee offers thanks and congratulations to the Hall A/C) staff for their excellent work. We observe outstanding leadership under difficult, changing circumstances, and we are confident that this group is indeed ready to move on to next steps, including arranging for an Accelerator Readiness Review (ARR) to prepare for 11 GeV beam in the Hall.

For the most part, all subsystems appear to be in good shape. We were also impressed with the starting suite of experiments, which provide a good overall test of the Hall's core capabilities. It is very reassuring to see that the experimenters are coordinating themselves to optimize early data taking opportunities for physics results, while commissioning and debugging the spectrometers and detectors. It was also pleasing to see an excellent working relationship develop between the experimenters and the accelerator, SSG, and other personnel.

We have identified three specific points that warrant special attention.

1) The Hall A/C leadership needs to develop alternate run plans based on different scenarios for delivery of Q2, Q3 and, especially, the SHMS Dipole from Sigma Phi. If it is possible to obtain approval for 11 GeV beam without those magnets on site, then it should be possible to carry out several important commissioning tasks without interfering with the project schedule. Uncertainties in the delivery schedule are most vexing, however, so alternate plans will need to be drawn up depending on when the magnets might arrive. This should include the possibility of commissioning Hall C with the HMS alone, as well as taking physics data in this mode, and using it as a tool for commissioning the SHMS when all the magnets are on site and installed on the spectrometer frame. We emphasize that any of these plans for different scenarios should not by themselves impact the timeline for meeting Project goals.

2) The Hall leadership is well aware of difficulties associated with the SHMS HB, Q1, and Q2 fringe fields, and beam steering to the Hall C dump. A plan is in place and in motion to mitigate fringe fields of HB, which should work for the first seven experiments. They still need to have a plan in place for mitigating Q2 when the time comes, and this impacts (and is impacted by) the small angle beam line design. We recommend that experiment spokespersons be kept informed and interact with the Hall staff as it comes time to mount their experiments.

3) The only serious detector-related issue has to do with the photomultiplier tubes for the quartz hodoscope in the SHMS. The quartz-window tubes appear to be damaged, and we recommend that the laboratory find the $40K necessary to purchase new PMTs. While experiments can be run without this hodoscope, the absence of this device compromises the most efficient trigger conditions, and this will impact any experiment trying to make precision cross section measurements. (We also note that the existing HMS drift chambers need to be repaired, or replaced, on the planned schedule.)

Finally, one overarching issue, which we believe transcends the responsibilities of the Hall A/C group, concerns radiation damage to Hall equipment (especially the HB components), personnel protection, and site boundary limitations. It would be wise for the lab to invest in some technology that can collect dose in a hall in real time, for validating simulations and correlating with low dose boundary monitors, specifically in support of the nuclear physics program.

Charge Items

These items are applied individually as relevant to each of the systems covered by the review.

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

2. Does the beam line allow small-angle operation of the SHMS and have the fringe field effects been properly mitigated?

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

4. Are the formal documentation requirements and reporting (run coordinators through shift leaders) procedures for running the experiment adequate, appropriate and complete (COO, ESAD, RSAD, ERG, OSP's, general equipment operation manuals, etc.)?

5. Are the beam commissioning procedures and machine protection systems in place? Are the calibration procedures for the dump ionization chambers in place?

6. Are the radiation levels expected to be generated in the hall acceptable? Is any local shielding required to minimize the effects of radiation in the hall equipment?

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

The remainder of this report provides separate comments on the individual systems.

Project Status

Response to the Charge Items

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

Nearly all equipment has been demonstrated for readiness. The only serious notable exceptions are the quadrupoles Q2 and Q3 and the dipole for the SHMS, all still at the Sigma Phi factory in France. Delivery schedules are hard to pin down, although Q2 shipment should be imminent. A recent discovery of a vacuum like in the dipole bellows is particularly concerning.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

Yes. The laboratory staff has done a good job working to the project schedule, and is working on contingency plans based on delivery scenarios for the remaining magnets.

Findings

It is particularly difficult to weave the project requirements into the realities of scheduling for first high energy beam into Hall C. It will be necessary for the laboratory and DoE to find flexible avenues for accomplishing beam commissioning in the Hall in an efficient and timely manner.

Comments

Everyone understands the importance of not delaying project completion in order to see first beam, and are working to find ways to get to physics within that constraint.

Recommendations

The Hall staff needs to be ready with plans for beam and beam line checkout, even if project completion has not been achieved due to magnet delivery delays. It is possible to carry out many important tests that work towards the ability to do physics - such as beam transport past the SHMS HB fields into the beam dump - without the full complement of spectrometer magnets, and we encourage the lab to have these plans.

Experiments

Response to the Charge Items

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

Yes. The work that must be done to commission the spectrometers and ancillary equipment to the level necessary to run the experiments, and to then take and analyze the data for the planned initial set of experiments is well understood and thoughtfully organized. We were impressed and pleased by the degree to which the various experiment collaborations are cooperating to complete the commissioning as quickly and efficiently as possible, taking advantage of specific areas of expertise and experience of individuals in the various collaborations.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

Yes

Findings

An intelligent, thoughtful plan is in place with well-defined responsibilities and adequate manpower and other resources.

Comments

The Hall C collaboration has done an admirable job of developing a plan for the initial set of experiments that effectively combines commissioning of the apparatus with physics measurements of interest. There is a steady increase in the performance required as the experiments progress, and well-defined measurements for verifying that performance. Many of these experiments are extensions of related measurements from the 6 GeV program so that analysis approaches and packages are adaptable in a straightforward manner from that experience. We were presented with clear plan of action that will complete the transition from the start of beam to routine running efficiently and effectively. The only complications identified are due to the delivery delays in three of the superconducting magnets for the SHMS and the marginal performance of the old photomultiplier tubes (which must be replaced) in the quartz detector package.

Recommendations

A new set of photomultiplier tubes for the quartz detector plane should be purchased so that the rebuilding and testing of this plane can take place in a timely manner. Also, given the delivery delays for the Q2 and Q3 and dipole magnets for the SHMS spectrometer (and the possibility that they may slip further), it would be wise to develop a plan that would permit as much of the HMS commissioning to be completed as possible before the SHMS is ready for full commissioning. That plan should be flexible, so it can accommodate additional changes in the details of the magnet deliveries that may occur, and that plan MUST be designed so that it in no way interferes with the completion and commissioning of the SHMS itself as this is an essential part of the 12 GeV Upgrade project. Commissioning the HMS would have two benefits. First, having a fully commissioned HMS would provide an instrument that would be an asset in the commissioning of the SHMS by providing a reference for what can be achieved with the combination of target and beam quality available during SHMS commissioning. Second, it would minimize the time before full physics in the hall (which requires both spectrometers) can begin.

SHMS Detectors

Response to the Charge Items

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

The SHMS detector configuration is well defined with clear ownership and responsibilities for beam operation.

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

In general the detectors are ready, to the extent that this can be demonstrated without beam. Exception is the quartz hodoscope that requires replacement of about half of the phototubes. We consider this to pose a low risk for the SHMS operation, assuming that the PMTs are funded by the beginning of November.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

There are sufficient resources to bring the detectors into operation with beam.

Findings

The detector configuration in the SHMS is based on the long-term experience operating the HMS detectors. It has improved flexible particle identification with multiple detectors. The Heavy Gas Cherenkov detector will be used for pion/kaon separation and also for electron/hadron separation when filled with CO_2 for some experiments. Combining the information from the shower and pre-shower detectors also helps significantly to improve the pion rejection. The aerogel detector has exchangeable trays with different indexes of refraction allowing to optimize the efficiency of the kaon/proton separation in a wider momentum range. The new drift chambers are based on a proven design and have shown stable operation with cosmics. The three scintillator planes and the quartz plane are needed to form the single arm trigger. Three out of four planes are required to fire, allowing to determine the trigger efficiencies that is needed for cross-section measurements.

Comments

The lack of possibility to replace any element of the shower detector (glass block, PMT, base) brings concerns but, based on the experience from the HERMES experiment where the modules have been used for a long time, the failure risk is low.

The procedure for replacing the PMTs of the quartz hodoscope is straightforward thanks to the proper detector design. However, the funding and the delivery time for the needed PMTs pushes the schedule close the beginning of the commissioning.

As of the time of this report, the reason for the deterioration in the performance of the PMTs is not clear. The PMTs have quartz windows susceptible to He contamination. To be on the safe side, it is advisable to protect the remaining working PMTs during the magnet installation and testing (as a possible, even very unlikely, source of He) if this does not interfere with the testing and commissioning of the detectors.

Recommendations

No recommendations.

SHMS Magnets

Response to the Charge Items

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

Yes, installation and commissioning steps for the SHMS magnets are well defined, even if the schedule is not yet firm and depends on vendor delivery. Ownership and responsibilities for both installation/commissioning, and subsequent turnover to operations, are well understood.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

Yes, except that depending on exact delivery schedule from the vendor, some of the installation/commissioning activities for Q2 may interfere with work related to maintenance and repair of HMS magnets needed for the initial phase of commissioning experiments (also see HMS section below)

Findings

The magnet work corresponding to the remaining SHMS magnets (Q2, Q3, and D) is well underway and close to completion, however delivery schedule is not yet firm as it depends on actions at the vendor. The entire installation/commissioning schedule is currently keyed in to delivery. The most critical, in terms of overall Hall C commissioning, is Q2, currently expected to arrive onsite by the end of September.

Comments

A generic schedule for installation/commissioning of Q2, Q3, and D has been put together, exact start dates for it are not yet firm and depend on vendor delivery. Depending on magnet arrival, some of the Q2 installation activities may overlap with maintenance/repair work to re-commission HMS. The schedules should be overlapped and resource-loaded, to the extent possible to determine if sufficient personnel is available to carry out the work without impacting Hall commissioning schedule

There is a steel support for the new beam pipe right under the HB magnet. How this steel interacts with the fringe field was not discussed and should be investigated.

Recommendations

Although it is understood the delivery schedule of Q2 is not yet firm, we recommended the project prepare a resource-loaded schedule showing the most optimistic Q2 delivery followed by installation and commissioning, along with HMS maintenance/repair work taking place in parallel. Determine what additional personnel will be needed to support such schedule (if any) and mobilize them accordingly

Estimate the fringe field of the HB magnet at the location of the steel beam support for the new beam pipe and determine if any significant forces are present.

Optics and Commissioning

Response to the Charge Items

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

The specific equipment necessary for the optics commissioning (the sieve slits and related software) is well thought out, in place, and ready to go. The procedures used will be direct analogs of the procedures used successfully to commission the HMS.

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

Yes. The plan for analyzing the optics data (obtained using the sieve slits), optimizing the spectrometer setup, and determining the trajectory reconstruction matrices follows the procedures used successfully in the 6 GeV era. It is well developed and well understood.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

Yes, and the manpower has directly relevant experience following the same procedure in the commissioning of other magnetic spectrometers (including the HMS for the 6 GeV era running).

Findings

Ready to go.

Comments

The incorporation of a sieve slit both before and after the HB magnet in the SHMS is an excellent one as it will clearly permit a full and detailed understanding of the rather unusual magnet configuration of this spectrometer. An idea was presented to augment the data obtainable with a sieve slit by using a GEM detector. This should be encouraged as it would potentially permit a faster and even more precise optimization of the optics.

Recommendations

None.

HMS

<u>Response to the Charge Items</u>

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

"Yes."

A High Momentum Spectrometer (HMS) has been successfully operated during the 6GeV era. There are no significant changes in the outline of the spectrometer for 12GeV operation. The ownership for each individual subcomponents has been defined.

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

"Yes, with exception of drift chambers and magnets, which are expected to be ready by December."

All HMS detectors have been checked out. Calorimeter, scintillators and Cherenkov detector have been demonstrated readiness to operate.

One drift chamber needs to be repaired. As an alternative, a construction of new HMS drift chambers is ongoing and should be ready for commissioning without a beam by December.

Repairs and maintenance of HMS magnets are underway. The expected timeline is about 4-5 Months. Final angular range test will be performed after cleaning of a Hall C.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

"Yes"

The responsibilities and the manpower need for maintenance and control during beam operation have been identified. Most of the equipment needed to finish the commissioning has been purchased.

Documentation for each individual subcomponent is in place. A pre-run checklist is available.

Findings

HMS spectrometer:
Calorimeter, scintillators and Cherenkov detector have demonstrated readiness to operate. Spare parts, such as, for example, PMTs or bases, are available.
No radiation damage has been observed.

HMS Drift chambers:
Tracking chambers are one of the most important detector components in the HMS spectrometer. More than 10% of the sense wires in one of the old drift chambers are broken, so this detector is not sufficient for tracking. Repair work has been started and it is expected to be finished by the end of September and undergo a commissioning test by the end of November. As an alternative, two new HMS drift chambers have been built by Hampton University. A first new chamber plane has been delivered to JLab for tests. A second new chamber plane is expecting for delivery in October with a final test in November. A decision on installation will be taken in December. A new support frame is also needed to hold drift chambers and expected to be finished by middle of September. An installation of the interlock system for HMS drift chamber flammable gas system is expected to be done by middle of September.

HMS Magnets:
HMS dipole and quadrupoles have been tested to a maximum current. Some minor fixes have to be done. Most of the parts required for replaces have been purchased, but need to be installed. An expected timeline is about 4-5 Months. Final angular range test will be performed after a general cleaning of Hall C. Check out procedures are in place for turning over magnets to experiments.

Comments
none

Recommendations

1. A committee would encourage the collaboration to find additional manpower for commissioning of HMS drift chambers and HMS magnets.
2. For HMS magnets, provide a repairs and maintenance schedule, showing which parts of the jobs could be done in parallel to maintenance of SHMS magnets.

DAQ, Triggers, Computers

Response to the Charge Items

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

DAQ system has demonstrated readiness for commissioning.
Trigger and readout hardware is based on JLAB/VME modules which have been successfully tested in Hall-B and Hall-D.

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

A few steps have to be done on integration of standalone DAQs of each spectrometers in common DAQ operation. The schedule and manpower are defined.

Findings

DAQ requirements for commissioning : ~2-5 kHz trigger rate and 1-2 kB event size will certainly fit in the Hall C DAQ configuration, which includes:

- Readout boards: FADC-250 (JLAB) and CAEN 1190.
- VME/VXS crates.
- JLAB trigger distribution boards: TS, TD, TI, SD.
- 10 Gbit network and switches.
- Linux computers running CODA 2.6.
- 20 TB RAID disk should be sufficient for ~20 days standalone running.

Initial production trigger is generated in NIM logic.
The NIM trigger signal also included in readout, providing time reference for TDC and FADC.

In stage 2 evolution of system a “smart” trigger can be generated in FPGA logic (CTP,GTP).

In this case the NIM time reference for TDC will be lost, and only detectors relative time measurement will be possible.

Comments

Date Quality Monitoring (DQM) is running by hand with latency of ~10 min.
Depending on the temperature drift of the detector electronics, it may be necessary to incorporate a regular pedestal calibration of FADC-250.

Recommendations

Evaluate the required TDC time resolution, and the possibility of analyzing data with relative time measurements.

Beamline

Response to the Charge Items

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

3. Have the specific equipment been demonstrated for readiness to operate the spectrometers? This includes magnets, detectors and DAQ. Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

Findings

Extensive lists of beamline components have been developed that identify ownership (financial and technical), maintenance responsibility and control during beam operations.

The Target Group is building a new cryogenics target ladder for the Hall. The upgrade includes new loops, cryo cells, solid targets and alignment system as well as upgrades to the gas distribution and controls. The target operation is performed by Users who have been trained by System Experts. The Accelerator Operations staff are provided all relevant control system signals and operational restrictions to ensure safe operations.

All beamline elements from the shield wall up to the scattering chamber are installed. The beamline beyond the scattering chamber is not yet installed. The segment immediately down beam of the scattering chamber is still being optimized for radiological considerations. Two “Big” BPMs have been fabricated and will be installed at the entrance of the beam dump tunnel. They have vacuum leaks that need to be repaired before they can be installed. The electronics for these two BPMs is based on receiver technology developed as part of the 12 GeV upgrade and are in hand.

The electronics for the harp system are being upgraded with receivers that were developed as part of the accelerator 12 GeV upgrade.

The Compton and Moeller Polarimeters have been upgraded. All components are installed. The Moeller power supplies need to be hooked up to the quads.

The raster has been upgraded by adding an additional coil in each plane. The setup with beam needs to be completed.

The final alignment of beamline components needs to be performed once all components are installed.

The beam current measurement system was upgraded as part of the Q-Weak experiment. A resonating cavity triplet was added to the existing Unser system. No modifications are required for the 12 GeV beamline.

Comments

- There have been historic issues regarding the dividing line of ownership between Physics, Accelerator and Engineering Divisions for beamline components. It's clear from these presentations and the success of the recent beam run in May that significant effort has been made to clearly define roles and responsibilities.
- The Target Group has a track record of delivering systems that effectively meet the requirements of the physics program while integrating well with machine protection systems and the requirements of the Operations Group. This new target system meets this same standard.
- The Hall C Dump upgrade is critical path for the upcoming run. Resources need to be provided for the timely completion of this work.
- Every effort should be made to ensure that the "Big" BPMs are operational before the test of the SHMS fringe fields is performed.
- Beam loss monitor placement for the upgraded beamlines should be coordinated with input from RADCON, Safety System, Operations and Accelerator Physics Experiment Liaisons to ensure we have effective protection from beam strike to sensitive components.

Recommendations

- None.

Beam Delivery

Response to the Charge Items

5. Are the beam commissioning procedures and machine protection systems in place? Are the calibration procedures for the dump ionization chambers in place?

Findings

- The Hall C Beam delivery procedure (version 43) has been in place for many years and is a well-written document covering beam operations in the Hall. It was recently exercised as part of a beamline run in May with good results. This procedure also covers the process for tuning up the Compton beamline.
- An ATLis is in place for assessing the SHMS fringe field effect on beam transport. This test does not require the 'Big" BPMs to be place but having them operational would provide an obvious advantage to assessing the steering effects of the fringe fields.
- The upgrade of the Hall C beam dump is a critical path item for running beam in the Hall. There is a comprehensive ATLis in place that covers the work to complete the upgrade. Resource limitations have recently affected this workflow but now that the LERF experiment is underway the resources can return to the dump upgrade. We did not hear any schedule details at this review.
- The Hall A Ion Chamber Calibration procedure has been marked up for use in Hall C. It incorporates the SHMS fringe field effects. The draft has been approved by the Safety System Group. The team plans to release the procedure by the end of September. It includes lessons learned from the Hall A Ion Chamber Calibration procedure.
- The Energy Measurement procedure and Moeller Measurement procedures were archived at the end of the 6 GeV era. The Energy Measurement procedure is required for the upcoming run and will be updated before its needed. The Moeller Measurement procedure will not be needed for the upcoming run.
- Beamline drawings for all segments are updated with the exception of the area around the Compton Polarimeter.
- There was no specific set of slides that spoke to the Machine Protection System readiness. There are three components to this system:
    - The Beam Loss Accounting System uses a 499 MHz pillbox cavity to measure beam current in the Hall relative to beam current leaving the CEBAF Injector. The hardware is still in place and has been working in the other Halls. It is expected that this system will perform as well as it has in the 6 GeV era.
    - There are four Ion Chambers that protect components in the High Power Beam Dump. They will be reinstalled as part of the dump upgrade. Control system tools and procedures are in place to integrate these devices into the Machine Protection System.

    - Photomultiplier tubes were used during the 6 GeV error as discrete loss detectors around sensitive components. Devices will be installed in similar locations for the upgraded beamline.

<u>Comments</u>

- The Energy Measurement and Moeller procedures should be taken out of archive status and updated before they are needed.

<u>Recommendations</u>

- None

Small Angle Operation

Response to the Charge Items

2. Does the beam line allow small-angle operation of the SHMS and have the fringe field effects been properly mitigated?

Yes, fringe fields from SMHS have been analyzed, and mitigation measures for small angle operation have been determined. The solution involving modifications to only HB is sufficient for all seven initial experiments (Hall C commissioning). A simple solution exists to mitigate Q2 fields that will accommodate all planned and approved experiments. No mitigation of the other magnets fringe fields is needed.

Findings

Fringe field calculations indicate that all initial 7 experiments can be run at small angle by adding iron wedges to HB, no further action is needed.

For the long term, the solution of adding a thin iron shield around the beam pipe will also correct fringe field from Q2 for all possible experimental scenarios currently approved.

Comments

When SHMS is operating at low angle, and a magnet quenches, the resulting interaction may or may not be sufficient to trigger a machine protection action. This was discussed, but no specific plan was presented for how these interlocks are going to be implemented

The team needs to consider means for keeping the spectrometer momentum settings below beam momentum to avoid a momentary mismatch that will make the beam miss the dump.

Recommendations

None

Target Systems & Operations

Response to the Charge Items

1. Has the entire beamline, target, spectrometers, detector configuration been defined (including ownership, maintenance and control during beam operations)?

The target system (including long, short, LH2, LD2, dummies, carbon, etc.) needed for the experiments are well defined. The target group is responsible to build, test and maintain the target system. Hall-C will take care of the vacuum chamber installation and maintenance. People in charge of building, testing and operating are identified.

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

All the jobs that need to be done to mount and run the target are identified and defined well. This target system is almost identical to the Hall-A target.

The target operation training plan is adequate.

The target manuals and procedures of operation exist.

8. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?

The responsibilities for carrying out each job identified, and the manpower and other resources necessary to complete them on time are in place. (There is one month contingency time, if the target installation is on time.)

Findings

None.

Comments

The upper limit of beam current is 5µA, if target is warm. This current limit is needed in order to prevent damaging the target system.

Recommendations

Update the control/operation software to limit the beam current to 5µA whenever the target is warm. The target temperature higher than the normal liquid H2/D2 values should automatically trigger the 5µA limit.

Radiation Assessment

Response to the Charge Items

6. Are the radiation levels expected to be generated in the hall acceptable? Is any local shielding required to minimize the effects of radiation in the hall equipment?

Yes, they are acceptable, based on calculations available to this committee.

Findings

Excellent work has been done by RCD on assessing radiation conditions, especially including the small angle beam pipe.

Comments

None.

Recommendations

We recommend that the Hall A/C group evaluate and allocate resources needed for design optimization related to minimizing radiation and expected radiation damage at small SHMS angles. This especially includes damage to HB from the 1 MRad per hour dose for 60 uA at 5.5 degrees, and the effect this might have on epoxy, teflon, and other non-metallic components of the magnet. Another area to examine for potential cumulative radiation damage are the power supplies on the SHMS platform.

Hall Checkout & Documentation

Response to the Charge Items

4. Are the formal documentation requirements and reporting (run coordinators through shift leaders) procedures for running the experiment adequate, appropriate and complete (COO, ESAD, RSAD, ERG, OSP's, general equipment operation manuals, etc.)?

Yes, for the most part.

Findings

A COO for Hall C has been developed that jointly addresses E12-06-107, E12-10-002, E12-10-003, E12-10-008, E12-09-017, E12-09-011, and E12-09-002 (COO).

Experiment Safety Assessment Document (ESAD) has been developed for E12-06-107, E12-10-002, E12-10-003, E12-10-008, E12-09-017, E12-09-011, and E12-09-002.

Similarly, an ERG has been developed that address E12-06-107, E12-10-002, E12-10-003, E12-10-008, E12-09-017, E12-09-011, and E12-09-002. Hall C Worker Safety Awareness Training (SAF112) has been revised and Physics Division is requiring retraining.

A completed RSAD was provided for reference: the Spring 2016 beam test. (This provides substantial and helpful information.) A site boundary does assessment was completed for E12-10-008, E12-10-02, E12-06-107, E12-10-103 designated "2017 round 1" and for E12-09-017, E12-09-011, and E12-002 designated "round 2" which uses smaller SHMS angles namely. The remainder of RSAD needs to be completed. This requires final beam-pipe configuration information to RadCon.

The base equipment manual is well developed. There are some areas that still require editing which is in progress: Controls, DAQ/Trigger and Analysis, for example.

However, there are new systems in the SHMS, for example, that should be operated on the basis of OSPs according to Physics Division requirements.

Some OSPs have been developed:

- Drift Chamber Gas and Mixing System – ENP-16-47415-OSP

Others need to be developed:

- Pivot Area access: controls access to area around target, which, during operations includes hazards from thin vacuum windows and elevated work, HMS Gas Cerenkov
- SHMS Heavy Gas Cerenkov
- SHMS Noble Gas Cerenkov

- All other new detectors – Drift Chambers (SHMS+new HMS), scintillators, quartz plane, preshower, etc.

Some operations manuals have been developed: e.g Ops Manual written for Preshower and Shower Calorimeter.

Comments

New equipment is arriving and being placed into service: e.g. new Moeller Quad power supply added this summer. New Drift Chamber gas system will be installed by mid Sept. that has safety interlocks related to smoke detection. Ensure that operations manuals are under development for new and upgraded systems.

Recommendations

Complete RSAD for suite of experiments E12-06-107, E12-10-002, E12-10-003, E12-10-008, E12-09-017, E12-09-011, and E12-09-002.

Create a prioritized list of OSPs needed for new equipment/systems and start development of OSPs.

Ensure that the Jefferson Lab Hall C Standard Equipment Manual is up-to-date for all baseline equipment in Hall C and there are up-to-date associated general equipment operation manuals.

If not done recently as part of HB and Q1 magnet commissioning, the ODH monitors (alarm) should be checked for proper functionality before the Hall is re-commissioned (by SSG, or the Hall). Both the ODH alarms and the ventilation fans should be put on a yearly check-out and maintenance schedule

7. Have all the jobs that need to be done to mount, run and analyze the experiments been identified and defined adequately?

Yes.

Findings

Roles and responsibilities are outlined in a robust manner in the COO.

Resources have been identified for each system.

Checklists supplied by Hall C adequately address detail tasks that are pre-requisite to safe operation.

Comments

None.

Recommendations

None.