Fermilab

Closeout Presentation

Director's Progress Review of the Short Baseline Neutrino Program

June 26-28, 2018

This page intentionally left blank

Table of Contents

Contents

This page intentionally left blank

1.0 Executive Summary

2.0 Introduction

2.0 Construction, Installation, and Commissioning

2.1 ICARUS Front-End

Subcommittee: Michelle Stancari, Gary Drake

Charge Questions:

Is the overall progress on ICARUS installation, cryogenics, construction and commissioning consistent with the planned milestones?

Yes. The team is making good progress in the production and checkout of the subsystems. The major milestones are understood. The installation and commissioning tasks have been identified. Planning for execution is in progress.

Is the process for establishing milestones sound and tractable?

Yes, major milestones are understood, but schedules lack intermediate milestones and details, and coordination with the overall program has not yet occurred at a sufficient level.

Are appropriate program driven technical reviews being planned, conducted and responded to?

None are currently planned for this program area. Production of subcomponents is underway.

Are interfaces being adequately addressed?

Yes, interfaces seem to be understood, although no interface documents were presented.

Findings

- The subcomponents for the TPC and PMT electronics are all in production. The proponents are on track for completion and delivery of all subcomponents. The delivery schedule to Fermilab is consistent with their installation plans.
- The dates stated by the proponents for installation of the TPC and PMT electronics into the detector do not match the Microsoft Project, nor the installation plan from the program.
- Details and intermediate milestones for the installation of the TPC and PMT subsystems have not been identified in the schedules presented.

- Both the TPC and PMT electronics groups have identified and quantified the need for manpower support from US institutions for installation and commissioning.

Comments

- The proponents are well along with the construction of the subcomponents. All major technical issues have been addressed.
- While the TPC and PMT electronics proponents did not have formal BOEs, upon drill-down they were able to articulate a good understanding of the effort needed for production and checkout at their home institutions. Much of this work is already in progress.
- While all of the major installation and commissioning tasks have been identified by the proponents, the schedules for both the TPC and PMT electronics seemed tight, planned for success, and optimistic.
- The proponents are requesting support from US institutions (labs and universities), to assist with the installation and commissioning. This has not been formalized as yet to the project, and was stated to be in progress. The presented schedule cannot be achieved without this additional effort.
- There did not seem to be adequate incorporation of tasks and activities associated with the TPC and PMT electronics in the schedules from the program or from the installation group. Interdependencies and conflicts with other installation tasks have not been studied or identified.
- Early testing of a small piece of the installed system - a "Vertical Slice Test" - was suggested before installation proceeds in earnest.
- The PMT flanges cannot be installed and cabled for each penetration until the TPC flanges are installed and cabled for that penetration. A late delivery of the TPC components, or a decision not to proceed with the TPC flange installation until issues found in the Vertical Slice Test are resolved, could cause the entire schedule to slide.
- A Vertical Slice Test of the PMT system cannot be performed until they are "dark," and the DAQ and HV racks are built, tested and have safety reviews. This also applies to any Vertical Slice Test of the integrated PMT-TPC system.
- No details of the class-3b laser installation were available. No time was scheduled for safety review of the laser system. This is not on the critical path, but the 2 weeks that the responsible persons from INFN Milano are planning to be at FNAL for installation of the laser and its light distribution system to the flanges will likely not be sufficient if the safety reviews must also be done in this time..

Recommendations

1. The proponents should review their installation and commissioning plans, and develop detailed plans showing allocation for duty factor and contingency mitigation in the effort estimates.
2. The program should incorporate both major tasks and intermediate milestones for the ICARUS front-end electronics installation and commissioning into the master installation schedule for ICARUS. This should be coordinated with the proponents. Interdependencies should be identified, and conflicts resolved.
3. The proponents might consider including and executing Vertical Slice Tests of the first components installed as early as possible. This should be identified as intermediate milestones in their installation schedule.
4. The proponents are requesting effort and support from US groups in the installation and commissioning. These needs should be discussed with the program as soon as possible, so that arrangements can be made on the US side.
5. The proponents should work with the project to identify support needed from Fermilab for services such as rigging, crane operation, cable pulling, etc. These should be incorporated into the overall planning for the ICARUS installation.
6. The proponents should proceed as soon as possible with requests for safety reviews, ORCs, etc. In particular, safety and operational issues associated with the laser should be addressed.

2.2 SBND Front-End

Subcommittee: Dave Christian, Pam Klabbers

Charge Questions:

1. Is the overall progress on SBND installation, cryogenics, construction and commissioning consistent with the planned milestones? Yes.
2. Is the process for establishing milestones sound and tractable? Yes.
3. Are appropriate program driven technical reviews being planned, conducted and responded to? Yes.
4. Are interfaces being adequately addressed? Yes.

Findings

- The BNL and Manchester groups have conducted a series of tests of Commercial Off-The-Shelf (COTS) ADCs to identify a COTS ADC suitable for use at liquid argon temperature in SBND.
- These tests have demonstrated that the Analog Devices AD7274 ADC will not suffer accelerated aging due to the hot carrier effect if operated at 2.5V.
- Based on these results, SBND has decided to use a Front-End MotherBoard (FEMB) design that uses AD7274 ADCs.
- A minor redesign of the FEMB and FPGA mezzanine card is planned. Tests to date have used the mezzanine card designed for use with the P1 ASIC ADCs used in protoDUNE. The P1 ADC has a differential output whereas the AD7274 has a single-ended output. The redesigned motherboard and mezzanine will be optimized for single-ended connections to the FPGA. The mounting holes in the motherboard will also be moved to facilitate mounting on SBND APAs.
- The second prototype version of all Nevis readout modules is fully functional and needs no further revision.
- A small-scale test of SBND cold electronics (FEMBs, cold cables, WIB, PTC, + Nevis readout) using near final prototype modules has been successfully completed at Nevis Lab. These modules are now at Fermilab and will be used in a vertical slice test in LArIAT.
- The Operational Readiness Review conducted at Fermilab for the LArIAT vertical slice test identified one undersized part (an inductor) on the PTC. The PTC installed for the vertical slice test have been modified and the modification has been included in the PTC design.

- Because of work done in preparation for the LArIAT vertical slice test, development of the SBND TPC electronics is ahead of schedule. Three production readiness and safety reviews have been planned; one in October 2018 for cold electronics, one late in December 2018 for the cold cables and feedthrough board, and one in March 2019 for warm interface electronics. The group now expects that all three of these reviews can be combined and held at the end of October 2018.

- The group plans to cold test LArASIC front end ICs and use only known-good parts in the fabrication of FEMBs. This testing has begun and is being done at BNL organized by a Colorado State graduate student.

- QC for FEMBs will include testing cold as well as warm and multiple thermal cycles. WIBs will be tested using FEMBs as input; outputs will be received using a TLK2501 evaluation board (the TLK2501 is the receiver used on the Nevis Front End Module).

Comments

- The schedule documented in the "May 2018 Excel File of Schedule" (SBN-doc-246) shows that installation and testing of TPC readout electronics in DAB is on or very close to the critical path to the first key SBND milestone (S1: SBND is ready for transport from Dzero Assembly Building to the SBN ND hall). The plan to hold all three production readiness and safety reviews for the BNL-provided TPC electronics elements to October 2018 should improve the schedule for delivery of these components to Fermilab by approximately 8 weeks. This will greatly improve the odds that the S1 milestone will be met on time.

- Similarly, the production readiness and safety review for the Nevis-provided TPC readout will occur in August 2018 rather than in February 2019. Even taking into account the time delay anticipated for long-lead time components, this should add a four-month cushion to the overall schedule.

- The SBND group should ensure that all of the engineering analysis documents related to TPC electronics that will be required for the SBND ORC are completed satisfactorily at the time of the production readiness and safety reviews. This will ensure that no retrofits are required to the production modules.

- Sufficient BNL and Nevis resources are available for remaining design, production, and installation tasks.

Recommendations

1. None.

2.3 Common DAQ, Slow Controls, and Monitoring

Subcommittee: Jim Patrick, Ryan Rivera

Charge Questions:

1. Is the overall progress on installation, cryogenics, construction and commissioning consistent with the planned milestones? Yes.
2. Is the process for establishing milestones sound and tractable? Need minor milestones.
3. Are appropriate program driven technical reviews being planned, conducted and responded to? SBND has a technical review planned for this year. ICARUS has no planned technical reviews.
4. Are interfaces being adequately addressed? Yes, but need controlled interface document.

Findings

- The Common DAQ, Slow Controls, and Monitoring team is strong and experienced with abilities that align well to the deliverables.
- There is adequate time to achieve the DAQ and Slow Controls deliverables, which are primarily software deliverables.
- The Common DAQ, Slow Controls, and Monitoring deliverables do not include procurement of the physical racks. The scope does include the procurement of (non-networking) cabling, SBND power supplies, computer servers, and their installation. For ICARUS, cabling from racks to the detector is outside the scope of Common DAQ. For SBND, cabling from racks to the detector is within their scope.
- Once the server hardware has been procured, work can proceed remotely. Iterating on GUIs to improve user-friendliness can proceed without interfering with the progress of commissioning activities.
- The common DAQ framework, event building, and data logging software is a deliverable for protoDUNE for fall 2018, which is a good driver for debugging and commissioning the features needed for SBN DAQ.
- The SBND vertical slice test at the Fermilab Test Beam Facility has proved valueable for demonstrating key DAQ and Slow Controls deliverables.
- ICARUS is relying on data emulators until hardware arrives to proceed with software development of BoardReader plugins for *artdaq*.

- For both SBND and ICARUS, the DAQ bandwidth is planned to handle untriggered, losslessly compressed, data rates with consideration for detector noise. Steady state running is expected to produce a factor of 5 to 10 less data.
- INFN scientific and technical labor resources have been planned in detail and are making significant contributions to the Common DAQ, Slow Controls, and Monitoring.
- The Common DAQ, Slow Controls, and Monitoring team manages their schedule through an exported Excel spreadsheet and email, not through the Microsoft Project tool.
- SBND DAQ is planning a Final Design technical review in 2018.
- CERN White Rabbit hardware forms the timing system for SBN. Most White Rabbit hardware is in-hand. The CERN White Rabbit development team is generally responsive to questions and their is an active user community.

Comments

- Lab support for the maturation of White Rabbit firmware expertise at Fermilab, especially with regard to the Mock Turtle (Fine-Delay Mezzanine), is valuable to the timing and synchronization efforts of SBN and other future projects at Fermilab.
- The cable installation plan for the SBND power and data cables currently relies heavily on uncosted labor resources. It will be important to monitor installation progress and quality to avoid delays in receiving operational readiness clearance.
- It was identified that the ICARUS racks currently do not have planned a mechanism for recording temperature as a function of time for each rack (i.e. there is no Slow Controls box). It may be worth considering using the Slow Controls boxes planned for SBND.
- Considering potential labor resource conflicts with Mu2e commissioning could be important for avoiding schedule delays in the years 2019 and 2020. Specifically, labor resource examples with demands from both experiments may be PPD technicians, CCD networking, SCD offline, SCD *artdaq* core developers, and SCD node management.
- ICARUS DAQ has not performed a external technical review and has no planned external technical review. It may be valuable to conduct a technical review.

Recommendations

1. Identify appropriate and descriptive minor milestones with the goal of giving more progress visibility to program management. A good target would be one minor milestone per level three WBS at two to three month intervals. Minor milestones that have dependency links across subsystems should be considered.

2. Create an installation procedure document that details the responsibilities of uncosted labor and technical staff.

3. Create an interface document that details the external interfaces with other subsystems and attain the sign-off from their team leads.

2.4 SBND Detector and Cryostat

Subcommittee: Bruce Baller, Don Mitchell

Charge Questions:

1. Is the overall progress on SBND installation, cryogenics, construction and commissioning consistent with the planned milestones? Yes

   ●.1 TPC/APA/Field Cage/H.V. Feedthrus/PDS/CRT/LCS/PMTs: These components are well established in design and most in full production. There are no issues with the proposed schedule. Existing delays have been accounted for and the schedule has been updated.

   ●.2 The cryostat will be designed by GTT after a contract has been signed. However, the contract cannot be awarded until cost sharing is agreed upon. A MOU is being developed to keep CERN's contribution under a budgetary limit that will allow the contract to proceed. This is a well known issue that the SBN management team is working hard to resolve. There is a direct impact to the schedule which has made this issue a top priority for SBN.

   ●.3 Continue applying pressure on all shipping documentation. Long delays on importing materials from overseas can severely impact the schedule. Currently being addressed.

2. Is the process for establishing milestones sound and tractable? Yes

   ●.1 Since most of the effort is now in the fabrication phase, the time estimates are very straightforward to estimate. The schedule is up-to-date and incorporating all known delays.

   ●.2 The cryostat will be designed by GTT, a vendor with extensive experience building similar systems. The start date is the only unknown. All design and fabrication milestones for the cryostat are well known.

   ●.3 The installation schedule is well developed but lacking a clear start date based upon the unknown starting date for the cryostat design effort by GTT. Once this date is established, the installation schedule will be complete.

3. Are appropriate program driven technical reviews being planned, conducted and responded to? Yes

   ●.1 Design reviews have been completed for the majority of the components with the exception of the cryostat. A conceptual design of the cryostat exists. Final design and review of the penetrations will be done when the GTT contract is in place.

   ●.2 All engineering documentation is being collected and will be prepared in time for the ORC review.

4. Are interfaces being adequately addressed? Yes

●.1 There is a formal Integrated Control Document being managed on Docdb for the full integration of every sub-system of the detector and cryostat.

●.2 For the cryostat, design modifications to lower cost have been integrated into the conceptual design.

●.3 Interfaces with the cosmic ray tagger, laser calibration system and photon detection systems are well-defined.

Findings

- A design for attaching cable trays to the APA frames was recently developed. This design does not require any welding or machining of the APA frames.
- Design of the support steel structure by CERN, with INFN input, is complete

Commentshttps://web.fnal.gov/organization/OPSS/Projects/SBN/SBN%20June%202018/Review%20Documents/Executive_Session.pptx?Web=1

- Significant progress has been made on the main sub-systems. The cryostat procurement plan is in place but must be executed ASAP.
- There is good collaboration effort on the sub-system fabrication. This is being managed effectively.
- Wire winding in the UK and US is progressing well. There was a cumulative 3 month delay in the original schedule caused by the need to correct fabrication errors and parts delivery delays. All assembly processes have now been exercised and are well understood. The schedule is based on the known production rate and the percent complete.
- The designs are complete or near complete with most of the sub-systems under construction. The schedule is well understood with only one significant unknown - the start date for the cryostat design.
- Resources are well defined.
- There are plans to perform a mechanical cold test of the UK APAs. A decision has been made to not test the US APAs. The rationale given for this decision is to minimize the risk of damage during transportation and handling.

- It is noteworthy that a significant recommendation at the November 2017 review, "The program office should evaluate the cost and schedule impact of late APA delivery" is obviated by the scheduled delivery of the first APAs in August.

- There is an opportunity to begin the engineering note process of a major portion of the cryostat since the steel structure design is complete. The steel structure supports all the hydraulic and pneumatic pressure loads.
- The definition of sub-systems that are (not) subject to import duties needs continued attention. Of particular importance is the method of "procurement" of the cryostat and APAs. The definition may not result in a significant cost or schedule impact for SBN but could set a precedent that could affect LBNF/DUNE adversely.

Recommendations

1. Initiate a FESHM 5031.7 membrane vessel engineering note for the cryostat warm structure prior to the initiation of the GTT membrane design study.

2. Integrate the TPC installation plan with the overall installation plan so that all overlaps are identified and scheduling conflicts avoided.

2.5 External and Proximity Cryogenics

Subcommittee: Jack Fowler, Mike White

Charge Questions:

1. Is the overall progress on installation, cryogenics, construction and commissioning consistent with the planned milestones? Yes
2. Is the process for establishing milestones sound and tractable? Yes
3. Are appropriate program driven technical reviews being planned, conducted and responded to? Yes, in particular all safety reviews are explicitly in the schedule.
4. Are interfaces being adequately addressed? Yes, but all scope is not yet fully defined for several sub-project areas.

Findings

-

Schedule Risks	Planned Schedule Risk Mitigation	Reviewer Comments[MJWx11]
Protego valve for side penetrations takes 40 weeks to deliver upon placement of order for NP03	Recent increase in SBND insulation thickness to 80 mm now matches ProtoDUNE, so minimal design work required	Placement of order and delivery of Protego valve should be schedule milestones
Unclear who is responsible for installing the “warm” proximity cryogenics supplied by CERN	Discussions have started but no decisions made	The responsible party for this task should be identified soon

Equipment used by European collaborators and subcontractors requires 220V/50 Hz. Likely that at least some “European” power converter/generator is required.	Johan recently sent equipment list for required items to install proximity cryogenics. In most cases, “American” equipment can be substituted. One exception is likely the highly specialized welding machines for the thin-walled membranes.	This equipment list should be carefully reviewed by CERN and FNAL to ensure that all necessary equipment is readily available for installation
Shipping damage. CERN plans to send proximity cryogenics components just in time for Demaco to do the inspection upon arrival at Fermilab	Having Demaco inspect the components upon arrival at Fermilab is likely to be helpful. However, if any component were to be damaged during shipment then it would be helpful to start the repair process as soon as possible. Johan noted that a transfer line segment had been damaged during shipment to CERN for storage. The boxes used to crate the proximity components for shipment to CERN	Carefully review shipping specifications, support system and crate design. Monitor shock loading during shipment.

	will also be used for shipment to FNAL. Shock logger results were within acceptable levels.	
Shipments could be delayed by customs. The date of shipment needs to be determined so that appropriate customs paperwork can be prepared	Shipment determined once top of cryostat and platforms are for ready for valve boxes	
Strain gauge plan is only now being finalized.	FNAL/TD expert in strain gauges has been assisting with updating and finalizing plans	There are likely to be very limited times where humidity is sufficiently low to install strain gauges in the near future due to Icarus being stored outside. This may delay when Icarus is moved into the pit, which is the critical path for many other required activities

Preparation of operation procedures is not included in the schedule	Per Barry Norris, these procedures will be prepared by the operations side of ND, not the project side. This approach is used to ensure consistency across ND operating areas	Management needs to be able to track progress so that operating procedures are ready in time. If not explicitly included in schedule, then consider using method similar to one used for engineering notes. Time should be dedicated during the commissioning stage towards updating the procedures as experience is gained in using them.
Large number of engineering notes will be required for safety review	A master spreadsheet will be used to track progress of all engineering notes	Management should regularly review this spreadsheet to ensure adequate progress is made in generating engineering notes

Engineering note reviewers may become overwhelmed by a large number of engineering notes delivered close to planned ORC date	Program will make an effort to get necessary engineering notes to CSS SBN review panel with sufficient time to review prior to ORC. SBN engineers in regular contact with CSS SBN review panel chair	Contact CSS chair and CSS SBN review panel chair if a large number of engineering notes need to be reviewed simultaneously. Fermilab has a large pool of qualified reviewers if additional reviewers are needed
Responsibility for contracting and coordinating radiographic examination needs to be defined	Fermilab regularly contracts with local companies that perform radiographic examination. Advance notice will be required to prepare contract. Johan will send an estimate of the number of welds to be examined	
No pressure test procedure has been agreed upon between CERN and FNAL for the cryostats.	Demaco will be pressure testing proximity cryogenics per European standards for pressure vessels and piping. Using	This topic has been debated for years. If not resolved soon, this will become a major issue during safety review

	these standards is allowed per FESHM.	
The overall quantity of documentation required for the engineering notes will be quite large, come from many different parties, and fall under both “American” and “European” standards used to satisfy pressure equipment regulations/directives	Fermilab has been actively updating FESHM to give clear requirements about using components and systems falling under EN standards. Engineers for SBN are participants in the safety subcommittees writing the white papers and updating FESHM.	Contact safety subcommittees early and often when questions about using international standards at Fermilab arise.
The process of placing a contract for regular liquid cryogen deliveries typically takes close to 6 months at Fermilab from start to finish	Project already has RFI and is aware of options offered by commercial liquid cryogen suppliers	Process of generating RFQ should be started in the next couple months. May be dependent on fill time (see one row below).
The planned filling time for Icarus is undetermined. Needs agreement with CERN and INFN.	Scaling from INFN experience, filling may take as little as 2 weeks. Scaling from MicroBoone experience this process may take as long as 14 weeks	Filling time has a large effect on when the detector will be ready to start taking physics data. The planned fill time needs to be finalized soon so that accurate

		estimates of completion date can be determined
The time necessary to purify the system has some uncertainty and could be affected by the impurity levels delivered by the supplier	The time necessary to purify ProtoDUNE can be used to refine the purification time estimate. Purity levels of each shipment will be tested at FNAL.	Consider getting samples from suppliers that can be tested for purity. Consider having the supplier regularly test purity at plant.
Recent experience from ProtoDUNE has not yet been used to update SBN schedules	Johan will be writing a lessons learned document for the ProtoDUNE cryo system, which has many similarities to the SBN cryo systems	A ProtoDUNE lessons learned document would be very helpful input towards modifying the SBN schedule to make more realistic and accurate. Past experience provides a good baseline for making schedule estimates.

A large number of platforms and supports need to be installed prior to when Demaco arrives to install proximity cryogenics	FNAL has a 3-d model that includes the platforms and supports for proximity cryogenics. The model is undergoing updates based on feedback from CERN. FESS is actively working with ND.	The final model and specifications for the platforms and supports should be carefully reviewed and documented. A lot of installation work needs to occur in a short time frame to be ready, so a lot of information needs to be transferred to many parties quickly and accurately
CERN wants Demaco to be able to work autonomously while at Fermilab	This is difficult, since there is a lot of work that needs to be completed by many different groups in a restricted space.	Unclear how much the work of Demaco overlaps with the work of other groups in the area. A very active coordination effort will be required by Fermilab as the host to accommodate the many different groups working in the area.

Time should be devoted to writing installation plans and Job Hazard Analysis in order for international collaborators and contractors to be able work efficiently soon after arrival at Fermilab.	Installation procedures and JHAs are planned to be written ahead of time	Recommend that all international collaborators receive a copy of installation plan and Job Hazard Analysis prior to arrival at Fermilab. Conduct a detailed briefing upon arrival at Fermilab.
The routing of 5 transfer lines for SBND has yet to be defined and had to be dropped from the current order with Demaco	Contract with GTT needs to be signed so that GTT can perform design study to determine where cryogenic feedthroughs are located	This has the potential to cause work to stop and wait to restart for the final 5 transfer line sections. Specifications and design need to be finalized soon to avoid stoppage in work.
The gas filter specifications for NP01 have not been fully defined	Ongoing discussions between INFN and Fermilab	

Proximity cryogenic control specifications have not been given to FNAL. FNAL is responsible for cryogenic controls equipment and programing.	This document is expected to be delivered to Fermilab soon.	Cryogenic controls groups are generally one of the last groups to be able to test their systems since they have to largely wait until installation is complete. Effort should be made to review controls logic and implement logic before installation is complete. This allows the cryogenic controls group to focus on quickly performing system check out after installation.
Competition for engineering resources between the two SBN systems and also with the LBNF & DUNE systems	Neutrino Division will assist LBNF & DUNE but hire new engineers to ensure sufficient support for SBN and other ND projects.	Coordination of engineering resources will require active effort to ensure all three cryostats receive the engineering resources necessary to avoid schedule delays

- _____
-

Comments

-

Recommendations

4. Determine the responsible party for installing the "warm" proximity cryogenics components delivered by CERN

5. The pressure test procedure for the SBN cryostats should be written and agreed upon soon, otherwise this issue is likely to cause a delay during the safety review for ORC.

6. The planned fill time for the Icarus cryostat needs to be determined soon, so that a contract can be finalized in time for the required deliveries of liquid argon. The fill time has a large effect on the overall schedule.

7. Incorporate lessons learned from ProtoDUNE into the installation of SBN cryostats. The ProtoDUNE experience should be used to update and refine SBN schedules

8. Detailed written installation plans and job hazard analysis should given to international collaborators & subcontractors prior to their arrival at Fermilab. In order to meet the schedule, these collaborators will need to work quickly and efficiently as soon as they arrive at Fermilab

9. There are 5 transfer line sections that are not defined and can not be defined until GTT completes the design study for the SBND cryostat. The design and fabrication of these transfer lines should proceed as quickly as practical in order to meet the installation schedule

10. The SBN project maintains a detailed risk registry. The risk registry should be compared to this review report and updated as necessary to accurately capture all known schedule risks.

3.0 Project Management

3.1 SBND Installation Schedule

Subcommittee: Dave Pushka, Jay Theilacker

Charge Questions:

1. Is the technically driven schedule and associated milestones complete, comprehensive and achievable with available resources? Yes for TPC assembly and No for installation. The availability of required resources is not guaranteed, and key engineering individuals may be pulled away from SBND TPC assembly, leading to delays. SBND installation is likely to be delayed due to cryostat availability.

Findings

- Program high level milestones were presented as:

S-1	SBND is ready for transport from DAB to the SBN ND hall	Aug 2019
S-2	SBND detector is ready to fill with liquid argon	Jun 2020
S-3	SBND detector is filled and ready for commissioning	Oct 2020
S-4a	SBND detectors are ready for physics data	Nov 2020
S-4b	SBND detectors are ready for physics data, shielding in place	Dec 2020

- SBND assembly and installation milestones were presented as:

UID	WBS	Name	Date
		Milestone Levels: T2 Milestones	
2979	SBN.2.08.03.14 (T2) -	TPC Cold Electronics Arrived at FNAL	1/7/19
2982	SBN.2.08.04.05 (T2) -	ND Cryostat Ready for Cryogenics & Detector Installation	6/4/19
3105	SBN.2.08.04.16 (T2) -	Detector Installed into Cryostat	11/7/19
1110	SBN.2.08.05.06 (T2) -	Near Detector Approved for Cold Commissioning	2/17/20
		Milestone Levels: T3 Milestones	
1111	SBN.2.08.01.18 (T3) -	Near Detector Installation Design Reviews Completed	5/11/18
4171	SBN.2.08.03.19 (T3) -	ND Detector ready for transport from D0 to SBN-ND Bldg	4/1/19
2192	SBN.2.08.03.22 (T3) -	Completion of ND Transportation to ND Bldg	5/6/19
3810	SBN.2.08.04.07 (T3) -	Start CERN Proximity Cryogenics Installation Begins	6/4/19
2194	SBN.2.08.04.15 (T3) -	Completion of Detector Insertion into Cryostat	11/7/19
4174	SBN.2.08.05.05 (T3) -	ND ORC received	2/17/20
		Milestone Levels: T4 Milestones	
1130	SBN.2.08.02.08 (T4) -	Completion of Assembly Facility Setup	5/11/18
2981	SBN.2.08.04.04 (T4) -	SBND Bldg Ready for Cryostat Installation	6/20/18
2189	SBN.2.08.03.02 (T4) -	TPC Component Arrived at Fermilab for Assembly	8/8/18
3106	SBN.2.08.03.03 (T4) -	All TPC Components Delivered to Fermilab	8/8/18
2190	SBN.2.08.03.08 (T4) -	Completion of TPC Component Assembly	9/13/18
2191	SBN.2.08.03.09 (T4) -	Cryostat Top Delivery to Fermilab for TPC Installation	11/16/18
2980	SBN.2.08.03.16 (T4) -	TPC Feed-through Flanges Arrived at FNAL	1/18/19
3811	SBN.2.08.04.08 (T4) -	CERN Proximity Cryogenics Installation Completes	10/10/19
2983	SBN.2.08.04.17 (T4) -	Start Internal Cryogenics and HV Feed Through Installs	11/7/19

2985	SBN.2.08.04.19 (T4) -	Completion of Pipe Installation Inside Cryostat	11/21/19

UID	WBS	Name	Date
		Milestone Levels: T2 Milestones	
762	SBN.2.09.02.11 (T2) -	Installation of ND Cryostat Support Structure Completed	9/14/18
4175	SBN.2.09.02.04 (T2) -	Delivery of GTT membrane materials to Fermilab	12/4/18
		Milestone Levels: T3 Milestones	
4169	SBN.2.09.01.05 (T3) -	Final Design Review of ND Cryostat Structure & Interfaces	1/16/18
4176	SBN.2.09.02.02 (T3) -	Delivery of Cryostat steel support to Fermilab	5/22/18
782	SBN.2.09.02.07 (T3) -	Start of ND Cryostat Installation Tasks	5/22/18
4170	SBN.2.09.02.06 (T3) -	ND Cryostat Top Cap Arrive at Fermilab	11/16/18
787	SBN.2.09.02.14 (T3) -	Installation of ND Cryostat Membrane Completed	6/4/19
791	SBN.2.09.02.17 (T3) -	ND Cryostat Top Install & Weld Completed	12/11/19

- A Work Package Agreement document (SBN-doc-716) between collaborating parties was made available, but it is only in draft form. The version presented was dated November 30, 2016
- It was mentioned that the project office is working with an import company to help foreign components clear customs.
- Detector components will come with QC measurements in a database that will be expanded with measurements taken upon receipt.
- Installation schedules were presented as relative schedules instead of absolute due to slipping of important milestones related to the detector design review that are required to proceed with important installation items such as hanging the TPC from the cryostat top plate.
- A detailed assembly plan (SBN-doc-5684) was presented
- A detailed transportation plan (SBN-doc-5681) was presented
- The cryostat top cap will be designed and built by CERN as two halves. Interfaces to the SBND installation was presented in SBN-doc-552.
- Floor preparation was presented in SBN-doc-4107
- The PDS detectors need to be the last installed in order to minimize exposure to UV radiation.
- Cable tray routing will be incorporated into the hall solid model to help minimize interferences.

-

Comments

- The importance for having a customs plan in place ahead of time for all components coming from overseas should not be underestimated in order to avoid delays.
- Completing the Work Package Agreement document was a recommendation from the November 2017 review. There have been no edits to the document online since this review.
- It was not clear when the cryostat design study will begin. We were told that once the cryostat design study starts, it will take about 14 months to complete cryostat installation and to have cryostat top cap ready for detector. The schedule for completion of the TPC assembly at DAB is 14 months out. As a result, there will be a one to one gap buildup between TPC assembly completion and installation beginning now and when the GTT design study begins.
- Critical path was not presented.
- Communication between the project and the SBND detector component collaborators appears to be good.
- We are pleased with the testing plans for the mockup APA frame assembly as well as the Assembly and Transportation Frame (ATF) test transport between DAB and SBN-ND.
- The cable tray and cable installation may need to be a fixed price contract due to the laboratory's desire to minimize T&M usage. This will require additional resources for developing the required drawings and specifications necessary for a fixed price contract.
- There is a concern of losing required resources due to the potential schedule gap that could develop between the TPC assembly completion and the cryostat availability. This would reduce the efficiency of available resources in the SBND Installation WBS.

Recommendations

1. Initiate the design review and fabrication of the Assembly and Transportation Frame as soon as possible to ensure that it does not delay APA and CPA installation

3.2 ICARUS Installation Schedule

Subcommittee: Dervin Allen, Jim Grudzinski

Charge Questions:

Is the technically driven schedule and associated milestones complete, comprehensive and achievable with available resources?

There is a technically driven schedule with associated milestones. However, the installation schedule is in process of being updated and identifies dates several months behind the current program schedule. This careful look at the installation schedule is a positive and should continue. That said, there have been delays in the recent major infrastructure tasks and several near term activities do not have fixed dates identified. A better understanding of the achievability of this schedule is needed.

Findings

- The installation schedule is being updated and is not currently reflected in the master schedule and currently indicates a 3-month delay for milestone I-1.
- Current technician effort for the installation task is believed to be the proper effort but the group is currently made-up of temporary workers (three summer interns). One new permanent position has recently been approved.
- The current installation and commissioning plans assume that access to the top of the detector persists during the LAr fill.
- The scope of the installation coordinator ends before the installation of the Top CRT
- Details of the commissioning activities were presented along with estimates of the the required effort. The effort was estimated based on prior ICARUS installation at Gran Sasso.
- There currently are two weekly meeting between the installation coordinator, technical coordinators, and sub-system/working group leads which is helps with coordination of resources and activities.
- SBN working groups are being formed and will participate in the development of a commissioning plan.
- Internal reviews are being held for the various sub-systems.
- The CRT has many aspects that can be performed in parallel allowing potential speed-up if delays are encountered.

- There has been a recent change at Fermilab related to how electrical work is completed requiring bid packages rather than simple time and material charging.

Comments

- **Excellent progress has been made in developing a detailed schedule and the project is encouraged to continue to develop this.**
- A new installation coordinator has started work on in the last two months and has made good progress coming up to speed and re-evaluating and updating the schedule.
- **Consider reorganizing the installation related meetings for the purpose of improving efficiency and communication.**
- The change in the electrical work on site at a minimum adds delay to initiating work and the impact of this should be considered in the installation schedule.
- Continue to stay on top of the receipt of all documentation necessary of all safety and operational approvals so as to avoid potential delay. This is particularly important for the cryogenic system which is being developed by multiple parties not familiar with FESH.
- The current state of interim technicians being counted on for the longer term installation should be addressed.
- **The cryogenic installation is done by groups from CERN, Fermilab, and the contractor Demacco. This task requires careful coordination. It is recognized that the detailed installation plans for the cryogenic installation is not the responsibility of this installation team. It is suggested that more details of the cryogenic installation such as key activities and resources needed are added to the installation schedule with oversight by the installation coordinator. The detail necessary and purpose of this is to allow the installation coordinator to ensure that sufficient resources are available when needed and that there are not schedule/activity conflicts.**

Recommendations

- Resolve question as to whether there are any restrictions to accessing the top of the detector are imposed by FESH during the LAr fill.
- Reevaluate the scope of the installation coordinator with respect to the Top CRT.
- The installation coordinator should continue to look carefully at the installation schedule and further develop detail. Add additional detail to arrive at a single overall master installation schedule that can be used to identify schedule conflicts.

- Continue with the development of the commissioning plan and consider developing a resource loaded schedule of commissioning and integrate it into the master installation schedule to allow schedule tracking.
- Proactively assist international collaborators in making arrangements to travel to the US well in advance of the needed arrival date to avoid delays.
- Review the installation schedule in three months to reassess that milestones are achievable.

3.3 Integrated Schedule

Subcommittee: Rich Marcum, Mohammed Elrafih

Charge Questions:

Is the technically driven schedule and associated milestones complete, comprehensive and achievable with available resources?

Not yet; however, before the review, efforts were started to improve the Icarus Installation schedule, and these efforts are addressing many gaps in the current schedule.

Findings

- The SBN Program schedule contains all Program scope
- System schedule appears to be well defined for
    - Brookhaven SBND Electronics schedule which is not on the critical path.
    - DAQ/DCS which is independent of other systems.
- The current Icarus installation schedule has slipped approximately three months to date.
- The current integrated schedule is missing several interfaces including
    - Icarus electronics coordination between TPC and PMT
    - Safety training for U.S. collegiate institution contributors
    - Argon fill time, which is a predecessor to installation and commissioning. The projected fill time varies from two weeks to fourteen weeks, but there is no detailed fill time shown on the schedule.
    - Restrictions to top access of vessel during a purge, fill, or testing are not identified, which could affect electronic installations and other activities.
    - Pre-commissioning and commissioning plans are not in the schedule because a detailed commissioning plan has not been formally accepted.
- The schedule has six activities with negative float.
- Logic errors were found in the schedule; for example, the ‘Filling Complete’ milestone completes before the ‘Ready for Filling’ milestone.

Comments

- The SBN Program teams were very cooperative and collaborative.
- Although the current schedule contains the complete work scope for the SBN Program, it is not comprehensive as evidenced by missing coordination between several systems.
- The SBN Program could reduce schedule delay risks by understanding key handoff points and constraints. The visibility that a more comprehensive schedule would provide great value to the Program. This visibility is particularly important to international partnerships and sub-contractor coordination. However, much of the daily coordination can be handled using other communication tools. All communication and coordination tools should be identified and used appropriately.
- The current schedule as presented is not achievable, as there are too many gaps in the Cryogenics, Icarus, and SBND installation areas including
    - The current six-month installation schedule is short by at least two months according to the current understanding
    - Logistics and timelines for providing international labor force at FNAL are often not accounted for in the schedule such as visa processing time
    - Safety training required for U.S. Institution labor
    - Lead time to resolve Protego valve, which could take up to 40 weeks
    - Strain gauge delivery and installation delays
    - Procurement cycles or lead-times
    - Argon fill time, which is a predecessor to installation and commissioning. The projected fill time varies from two weeks to fourteen weeks, but there is no detailed fill time in the schedule.
    - Restrictions to top access of vessel during a fill, purge, or testing are not identified, which could affect electronic installations and other activities.
    - Pre-commissioning and commissioning plan timelines or milestones are not reflected in the schedule because a detailed commissioning plan has not been formally accepted.
    - Resource constraints with Engineering and Program Management Office coordination
    - Missing schedule coordination between systems

  - Other missing elements for success including tracking of document approvals and replacement of T&M with electrical contracts
  - Date to execute the GTT contract for SBND Cryostat installation is unknown

- Icarus Electronics schedule needs improved coordination between the TPC and PMT.
- SBND Program schedule should identify and incorporate more intermediate and coordination milestones
- Look at available Engineering resource needs and make adjustments as needed.

Recommendations

- Informed by the best practices of the CERN process model of the "Impact Statement", describe and document work scope to be performed, equipment requirements, performance needs, durations, etc. This process would be especially useful to understand the schedule impacts related to Cryo welding requirements and Icarus installation.
- Using an appropriately tailored CERN model for building and area coordination, as demonstrated by ProtoDUNE coordination
  - Create a Responsibility Assignment Matrix to ensure the appropriate individuals take ownership for identifying and planning work including handoff activities
  - Building and Area Coordination Matrix to identify possible impacts, restrictions, or constraints to work groups in potentially restricted areas and buildings
- Continue to focus on an integrated installation schedule to
  - Improve coordination between systems. All Systems should understand interface points and effects of plans on other systems.
  - Increase visibility of deliverables and provide better coordination of domestic and international needs.
  - Ensure there are adequate milestones, including intermediate deliverables, to provide visibility of constraints, and coordination.
  - Ensure all non-catalog procurements are identified with adequate lead-times to facilitate successful deliveries.
- Ensure Program management office has adequate labor resources to support schedule development efforts.

- Regularly verify Program schedule critical and near-critical paths including
    - Domestic and international needs vs. deliverable dates
    - Formalizing the commissioning plan and reflect this in the Program integrated schedule via milestones
    - Logical interactions i.e. predecessor/successor relationships, especially for cooldown, filling, and commissioning efforts

3.4 Management

Subcommittee: Gina Rameika

Charge Questions:

Is the program being properly managed for the successful execution of the SBN?

There is a strong management team in place dealing with a very complex organization of partnerships and collaborations. The committee feels that the management team could benefit by being augmented with someone dedicated to strategic planning of the tasks required to meet milestone I-1 and I-2.

Are the projected personnel resources sufficient to complete design, construction, installation and commissioning of the SBN program and are these resources likely to be available when needed?

There is concern that the source of the resources needed to execute each aspect of the installation of the cryogenics is not clearly identified, though there is good communication started and this should be resolvable in the near future.

Are the remaining significant risks understood and adequately managed?

Yes, the risks are recognized and managed; however, new risks are being identified as the work moves forward and constant vigilance is required.

Is the boundary between construction/installation and commissioning well defined?

The boundaries are understood, though there are overlaps which may make the boundaries seem fuzzy. For example, detector commissioning must take place prior to the installation of the CRT and shielding on top of the detector.

Are the resources needed for initial ICARUS operations understood and identified?

The needed resources, in particular scientific staff (post-docs and students) coming from the collaboration are understood and can be realized if adequate funding for support of long term stays at Fermilab can be realized.

Findings

- Using the resource loaded schedule for construction as well as understanding of the post construction/installation tasks the program management has produced conservative, technically driven dates for meeting each of the key milestones.
- There is significant scope, in particular that covered by non-DOE partners that is not detailed in the program schedule and therefore, there are inconsistencies in the dates when tasks are expected to start and complete.
- A list of specific tasks and accomplishments which are needed to meet each of the key milestones has been developed.
- A detailed weekly work list is maintained by the Far Detector installation manager.

Comments

- Since the last review the SBN team has made good progress in defining the scope of work needed to meet the key milestones.
- Good progress is being made on the tasks needed to be completed in advance of rigging the ICARUS-T600 vessels into the far detector building.

Recommendations

1. Based on the task lists that are associated with each of the key milestones, establish clearly defined and reasonably spaced **intermediate milestones** to lead to each of the key milestones.
2. The intermediate milestones should be monitored monthly and milestones that will be missed should be documented with an explanation and forecast for completion submitted to the Program Manager.
3. Develop a detailed plan for the needs of the U.S. University groups that want to participate in Far Detector (ICARUS-T600) installation and commissioning that can be submitted to DOE.
4. An updated schedule, that extends through completion of the key milestones should be prepared and posted to the DocDB, available to reviewers, by the end of July.
5. Plan for a follow-up schedule review in the Fall 2018.

4.0 Appendices

A. Charge

B. Agenda

C. Review Committee Contact List and Writing Assignments

Appendix A

Charge

Fermi National Accelerator Laboratory

Date: **April 23, 2018**

To: Bob Tschirhart, Chief Project Officer
From: Nigel Lockyer, Director
Re: Director's Progress Review of the Short Baseline Neutrino Program

---

Message:

Please organize and conduct a Director's Review on June 26th – 27th, 2018 to assess the progress of the Short Baseline Neutrino Program. This review should focus on the technically driven schedule of the following program elements:

- Installation of the ICARUS detector;
- Design, construction, and installation of the ICARUS cosmic ray tagger;
- Design, construction, and installation of the SBND detector system (TPC, cosmic ray tagger, light collection, electronics, DAQ) and its cryostat;
- Design, construction, and installation of the necessary support infrastructure such as cryogenic systems, DAQ and overburden;
- Commissioning plan

The focus of this review is the forecast for completing installation of ICARUS and SBND in the context of a technically driven schedule. Topics will include schedule, management, ES&H, and technical readiness to execute the remainder of the SBN program. The review committee should respond to the following questions:

1. **Construction, Installation and Commissioning.**

   a) Is the overall progress on ICARUS installation, cryogenics, construction and commissioning consistent with the planned milestones? Is the process for establishing milestones sound and tractable? Are appropriate program driven technical reviews being planned, conducted and responded to? Are interfaces being adequately addressed?
   b) Is the overall progress on SBND installation, cryogenics, construction and commissioning consistent with the planned milestones? Is the process for establishing milestones sound and tractable? Are appropriate program driven technical reviews being planned, conducted and responded to? Are interfaces being adequately addressed?

2. **Technically driven construction and installation schedule**.

   Is the technically driven schedule and associated milestones complete, comprehensive and achievable with available resources?

3. **Management.**

   Is the program being properly managed for the successful execution of the SBN? Are the projected personnel resources sufficient to complete design, construction, installation and commissioning of the SBN program and are these resources likely to be available when needed? Are the remaining significant risks understood and adequately managed? Is the boundary between construction/installation and commissioning well defined? Are the resources needed for initial ICARUS operations understood and identified?

4. **Environment, Safety, and Health**.

   Is ES&H being appropriately addressed? Are the required safety approvals on track to meet the schedule?

The committee is asked to present a draft of their report at the review closeout and to issue the final report within three weeks of the review's conclusion.

Nigel S. Lockyer
Director of Fermilab

Appendix B

Agenda

Director's Progress Review of the Short Baseline Neutrino Program
June 26-28, 2018

Wilson Hall (WH), Fermi National Accelerator Laboratory

Tuesday, June 26, 2018

Time	Session	Location	Speaker
08:00	Executive Session	Comitium – WH2SE	Gina Rameika
08:30	Plenary – Welcome	One West – WH1W	Joe Lykken
08:40	Plenary – SBN Overview	One West – WH1W	Peter Wilson
09:30	Breakout Sessions (see below)		
10:30	Breakout Coffee Break	Comitium Alcove– WH2SE	
10:45	Breakout Sessions		
12:00	Lunch	15th Floor Crossover	
13:00	Tour of ICARUS	Bus from front of WH	Catherine James, Claudio Montanari, Aria Soha
14:30	Executive Session	Comitium – WH2SE	Gina Rameika

BREAKOUT 1 – ICARUS Electronics – Location: Virtual Reality – WH3SE

Time	Session	Speaker
09:30	TPC Electronics (incl cables, feedthroughs)	Alberto Gugliemi
10:00	PMT Electronics and Calibration	Gian Luca Raselli
10:45	Discussion	

BREAKOUT 2 – SBND Electronics – Location: OPSSession – WH2SE

Time	Session	Speaker
09:30	Cold Electronics	Hucheng Chen
10:00	SBND TPC Back-end Electronics	Jose I. Crespo-Anadon
10:45	Discussion	

BREAKOUT 3 – Common Online – Location: One East – WH1E

Time	Session	Speaker
09:30	Common Online	Kurt Biery
10:00	ICARUS Specific	Wesley Ketchum
10:45	SBND Specific	William Badgett

BREAKOUT 4 – ICARUS Installation – Location: Snake Pit – WH2NE

Time	Session	Speaker
09:30	Installation Schedule	Aria Soha
10:00	Infrastructure for ICARUS	Catherine James
11:00	Collaboration Resources	Claudio Montanari

BREAKOUT 5 – SBND Detector and Cryostat – Location: Comitium – WH2SE

Time	Session	Speaker
09:30	SBND TPC Components Fabrication	Kostas Mavrokoridis
10:00	Cryostat Design and Fabrication	Marzio Nessi
10:45	WBS 2.4: PMT-PDS Status	Richard Van de Water
11:15	WBS 2.5: CRT and LCS	Igor Kreslo
11:45	Discussion	

BREAKOUT 6 – SBND Installation – Location: Black Hole – WH2NW

Time	Session	Speaker
09:30	SBND Assembly	Juan Estrada
10:00	Cryostat Installation Preparation	Min Jeong Kim
11:00	Discussion	

BREAKOUT 7 – Cryogenics – Location: Director's Conference Room – WH2E

Time	Session	Speaker
09:30	ICARUS Proximity Cryogenics	Johan Bremer
10:00	WBS 4.03 Cryogenic Systems – ICARUS and SBND	Michael Dinnon
10:45	SBND Proximity Cryogenics	Johan Bremer
11:15	SBND External Cryogenics, Controls and Integration	Michael Dinnon

Wednesday, June 27, 2018

Time	Session	Location	Speaker
08:30	Breakout Sessions (see below)		
09:30	Breakout Coffee Break	Comitium Alcove– WH2SE	
12:00	Lunch	15th Floor Crossover	

13:00	Tour of SBND Assembly	Bus from front of WH	Juan Estrada
14:15	Executive Session	Comitium – WH2SE	Gina Rameika

BREAKOUT 4 – ICARUS Installation – Location: Snake Pit – WH2NE

Time	Session	Speaker
08:30	Answers to questions	
09:00	ICARUS Cosmic Tagger (Sides)	Anne Schukraft
09:45	CRT Top	Umut Kose
10:15	Transition to Commissioning	Angela Fava, Claudio Montanari
10:45	Discussion	

BREAKOUT 6 – SBND Installation – Location: Black Hole – WH2NW

Time	Session	Speaker
08:30	Answers to questions	
09:00	Cryostat Installation	Min Jeong Kim
09:45	TPC Installation	Juan Estrada
10:15	CRT Installation	Igor Kreslo
10:45	Discussion	

BREAKOUT 7 – Cryogenics – Location: Director's Conference Room – WH2E

Time	Session	Speaker
08:30	Answers to questions	
09:00	Overflow from Tuesday	Min Jeong Kim

Thursday, June 28, 2018

Time	Session	Location	Speaker
09:00	Executive Session	Comitium – WH2SE	Gina Rameika
11:00	Closeout	One West – WH1W	Gina Rameika

Review Committee Contact List and Writing Assignments

Director's Progress Review of SBN
June 26-28th

Chairperson:
Gina Rameika rameika@fnal.gov 630-840-2262

Integrated Schedule :
Rich Marcum, FNAL rmarcum@fnal.gov 630-840-8236
Mohammed Elrafih, FNAL melrafih@fnal.gov 630-840-8697

Icarus Front-End:
Michelle Stancari, FNAL mstancar@fnal.gov 630-840-4953
Gary Drake, ANL drake@anl.gov 630-252-1568

SBND Front-End:
Dave Christian, FNAL dcc@fnal.gov 630-840-4001
Pam Klabbers, FNAL pamela@fnal.gov 630-252-8704

Common DAQ, slow controls & Monitoring:
Jim Patrick, FNAL patrick@fnal.gov 630-840-2626
Ryan Rivera, FNL rrivera@fnal.gov 630-840-5012

SBND Detector & Cryostat:
Bruce Baller, FNAL baller@fnal.gov 630-840-2427
Don Mitchell, FNAL dmitchel@fnal.gov 630-840-4166

SBND Installation Schedule:
Dave Pushka, FNAL pushka@fnal.gov 630-840-8767
Jay Theilacker, FNAL theilacker@fnal.gov 630-840-3238

Icarus Installation Schedule:
Dervin Allen, FNAL dervin@fnal.gov 630-840-2511
Jim Grudzinski, ANL jjg@anl.gov 630-252-344

External and Proximity Cryogenics:
(Breakout hosted at CERN)
Jack Fowler Duke fowler@phy.duke.edu 919-660-2562

Mike White FNAL	mjwhite@fnal.gov	630-840-6858

Observers:

Kevin Flood, DOE/HEP	kevin.flood@science.doe.gov	301-903-4829
Paul Philp DOE/FSO	paul.philp@science.doe.gov	630-840-4481
Simona Rolli, DOE/HEP	simona.rolli@science.doe.gov	301-903-0504
Glen Crawford, DOE/HEP	glen.crawford@science.doe.gov	301-903-4829

Closeout remote participants:

Eckhard Elsen, (CERN)
Antonio Ereditato, (Bern)
Antonio Masiero, (INFN)
Tony Medland, (STFC)