5. Project Management Review

The project management has demonstrated the necessary level of preparation and readiness such that project construction can begin.

Overview:

Findings:

1. The core management team has extensive experience with similar HEP construction projects and has a track record of working well together as a team.
2. The bigger ATLAS HL-LHC project is complicated by multiple funding sources and reporting. One team handles all projects including this MREFC proposed work.
3. The project planning and scheduling is handled for both funding sources in the same way and allows for reporting to both agencies.
4. The management teams for the 4 sub-projects, muon, LAr, trigger, and Tile Cal are also quite experienced, with detector experts represented in each team.

Comments:

1. ***The management structure and core management personnel are very well suited to the complex task of managing this project***
2. ***The sub-project management teams are strong, with more than adequate experience and training for their respective management tasks.***
3. ***The NSF FDR charge map was particularly useful in confirming that all required documentation has been prepared.***
4. ***There is some concern among reviewers that in a number of cases, L3 and L2 management positions were held by the same person. The fear is that during excessively taxing periods, the management team will be stretched too thin. If with proper mentoring new L3 managers can be identified that would be ideal.***

Management PEP Documentation:

Findings

1. The Project Execution Plan (PEP) conforms to NSF guidelines and adequately describes the scientific objectives and governance of the project. It also describes the project definition, the roles and responsibilities of all stakeholders, the scope management and cost estimation plans as well as risk, contingency and change management plans. The Agency reporting plan is also described. Safety is the highest priority of management and that is reflected in the PEP.

Management RLS:

Findings

1. Following NSF guidelines, the project management team prepared a Resource Loaded Schedule (RLS) of sufficient granularity to manage this project was presented to this review committee. The RLS was used in conjunction with a detailed and vetted risk registry to estimate the project contingency in compliance with NSF.

Recommendations:

Suggested changes to **PEP:**

pg41 – EVMS practice from last qtr of FY18… Not true… needs to be updated

pg 60 – BOEs are not in the cost book reports

Pg61 – talks about use of CET. This is not correct and not supported by BNL anymore.

Control accounts are at L3, but progress report/CPR show EV data at L2

3. Project Budget

Summary-

The cost and schedule documents are put together well and there is credible backup for the estimates. The L2s and CAMs are very aware of their scope and understand Project Management processes. CAMs received enough EVMS training and we think it is time to start practicing, particularly the monthly EV process. There are some minor housekeeping tasks to do in terms of P6/cobra data detailed below.

Findings-

- Base cost from P6, estimate uncertainty/risk register/risk analysis make up the contingency
- 85% Confidence level used as benchmark;
- 36.5% contingency is reasonable; comparing contingency % situation with Phase1 at various periods is a very good idea
- Overall scope contingency is 15% and overall scope opportunity is 11%
- Drilldown of few random activities confirmed that estimates have credible backups
    - LOC1130M; TPHW20790M40; PCR NSF-015; FEE30540M40; FEE30345M40
    - BEE10840M; SMDT630275M40; CSM2661M40
- Team has been practicing EVMS from Mar-19, the little issues are being ironed out
- Very good back up documentation in place, traceability is good. Significant portion of base estimates at L2 levels are based on vendor quotes and historical costs.

- Materials estimate that don't escalate have been separated from the ones that normally escalate. (CSM2661M40) This is a very good practice
- Checked for double counting of estimates where similar work is being done by different institutions. For example, prototype of chip cycle at Columbia and UT Austin – found that these are complementary
- WBS dictionary is well written and ties out to P6
- Contributed labor is included in P6

Comments-

1. Even though the project thinks cost profile is good enough for comparing funding profile, the best practice is to look at obligation profile. NSF criteria 3e specifically mentions use of obligation profile
2. Gustaff's presentation should show variance thresholds. Also, a little more explanation of Estimate uncertainty/ risk register/ risk analysis and how all these contribute to the contingency would benefit the review committee particularly technical team
3. Too much variance to begin the project reporting. If the near term activities (carefully planned) are slipping in terms of cost and schedule, it doesn't convey positive outcome for future activities
4. Reported EAC is different than BAC as current variances are considered, at the same time project thinks that they will recover from these variances, meaning EAC may not be true. Suggest the project team to have multiple EACs in Cobra (statistical/manual) if not done already, and report only what the project team thinks is real… all other EACs should be used only for internal analysis
5. Standing army costs if any should be part of contingency analysis
6. There is a small difference between P6 and Cobra data. Probably because of rounding in P6 resource table. Try to increase the decimals to bring P6 and Cobra as close as possible. This is not required, but makes it so much easier for baseline management and any future PCR's
7. P6 files posted on review site should have columns for labor and total costs.
8. There were few MREFC activities costed (CSM2510), and some obligated (MAB1240M400) before Apr-20. Not high costs but should

follow guidance. Coding of MREFC and Pre-MREFC may not be consistent across P6 and Cobra data

9. Review the milestones properly. For example, MAB19430 - Tile project complete is marked as start milestone, this should be a finish milestone
10. Delivery times for many procurements are just one month. May need to revisit and make sure these are realistic
11. Drilldown for BEE10840M – CAM acknowledged that there is a minor error between P6 and BOE and will be corrected by FDR
12. Earned value Hours for Contributed labor should be monitored
13. Showing drilldown as an example in presentations is ok, not a common practice. Suggest the presenters tell that this is an example and offer to drilldown any other activity.

Recommendations-

1. L2s and CAMs are very knowledgeable and have received EVMS training. They may need a little more training on analysis of EV reports, ETC, variance analysis etc.
2. Fuse analysis using DCMA metrics shows that the “Critical Path Test” failed. Project needs to further drill down and identify the cause for this and address them. It may be because of hard constraints that are used like “must finish on” instead of using “finish on or before”
3. ***The base year for rates is not consistent across resources. This may lead to costly mistakes if not handled with caution. Suggest bringing all rates up to date and have one base year for all rates***
4. ***54% of activities on Muon subsystem are critical. When we have a handful of critical activities it gets attention, when more than half of the activities are critical the natural tendency is to ignore all. Suggest project team to revisit the schedule contingency at L3 levels to address this issue***

(a) The complete scope of work to be funded by NSF with MREFC funds is captured in a detailed WBS format, accompanied by a WBS dictionary defining the scope of all entries.

(b) A significant proportion of the budget is based on externally provided information such as current vendor estimates or quotes, publicly available supplier prices, and the like, especially for FY 2020 and FY 2021 budgets.

(c) The bottom-up cost estimate is well-supported, assumptions are reasonable, and all costs (including estimated costs for project management staff, common costs, COLA, and teaching buyouts) are incorporated into the resource-loaded schedule.

(d) Methodologies for estimating equipment and material quantities and labor hours are reasonable. Any adjustments from historical data are valid.

(e) The NSF funding and obligation profiles from NSF to the project are consistent with risk-adjusted project obligation/expenditure plan (i.e. the risk-adjusted budget profile includes the contingency budget profile based on forecast risks and when they might be realized).

4. Project Schedules

4.1 Findings

The US contribution to the ATLAS detector upgrades for the High Luminosity LHC is funded about 1/3 by NSF and 2/3 by DOE funding. The NSF funded effort is focused on triggering, implying mostly upgrades to electronics and not detector components (except for the sMDT chambers for the muon subsystem). This report addresses the NSF funded effort. The NSF funded US project is divided into four subsystems: Triggering, Tile Calorimeter, Liquid Argon Calorimeter, and the Muon system. ***The schedules*** for all of these ***are driven by the LHC Long Shutdown 3, scheduled from 2024 to mid 2026***, during which the upgrades are to be installed, and thus the dates by which CERN needs the US deliverables.

4.1.1 Triggering

The ***triggering sub-system has*** three Level 3 tasks. CERN needs deliverables from the US for all three in the 3rd Quarter of 2025. The project schedules call for completion of these tasks in the 1st, 2nd and 3rd Quarters of 2024 respectively. This represents ***a schedule float of close to a year.***

4.1.2 Tile Calorimeter

The Tile Calorimeter sub-system has four Level 3 tasks. The Main Board task is needed at CERN in the 3rd Quarter of 2024. The project schedule shows completion of this task by the 3rd Quarter of 2023, a year schedule float. The other three task deliverables are needed at CERN on the 1st Quarter of 2025. The project schedules show these tasks completing by the end of 2022 or by mid 2023. This represents ***an 18 months schedule float.***

4.1.3 Liquid Argon Calorimeter

The Liquid Argon Calorimeter subsystem has three Level 3 tasks. The Front End electronics task is not to be delivered to CERN as such but will be needed at Columbia University to be incorporated in the FEB2 task. The ***FEB2 boards*** will be ***installed at CERN in stages****,* starting in mid 2025 and finishing in the 1st Quarter of 2026. ***The project schedule shows half of the boards completed by the end of 2023 and the full set of boards by the end of 2024. This represents a schedule float of more than a year.*** The Back End electronics will be needed at CERN in the 1st Quarter of 2026. ***The Project schedule shows the completion of the BE electronics task by the 1st Quarter of 2025, again a one year schedule float.***

4.1.4 The Muon Detector

The Muon Detector subsystem has four Level 3 tasks. These tasks have different dates needed at CERN and scheduled completion dates, as follows:

Task	Date needed at CERN	Project schedule completion
MDT	Quarter 2 of 2025	Quarter 4 of 2023
TDC	Quarter 1 of 2024	Quarter 1 of 2023
CSM	Quarter 2 of 2024	Quarter 3 of 2022
L0MDT	Quarter 4 of 2025	Quarter 3 of 2024

All of these tasks have a schedule float of a year or more.

4.2 Comments

All four of these subsystems have done a careful and thorough job in developing their project schedules, as presented at this review. They include critical path and near critical path milestones, end dates and schedule contingencies. Task durations and schedule estimates are reasonable, based on technical requirements and previous experience. The schedules include complete scope of work, including quality control and acceptance testing. Milestones associated with scientific labor have appropriate tracking metrics. Project control systems include means of monitoring contributions from scientific labor. The projects have feasible methods in place to track, manage and report on the progress as the project proceeds. Milestone granularity is appropriate to allow timely corrective management decisions. The Resource Loaded Schedules (RLS) have evolved from those presented at the Preliminary Design Review last year by incorporating considerable technical progress, final MOU negotiations, and alignment with the latest international ATLAS baseline schedules.

As summarized in the Findings section above all of the tasks in the four subsystems have a schedule float of close to a year or more. This appears to the review committee to be sufficient at this stage of the project.

4.3 Recommendations

None

6. Risk Management Plan

Observations:

Overall, the Risk Management Plan is well done and largely consistent with the DOE Risk Management Guide (DOE G 413.3-7A). The risk management plan outlines the techniques, tools and responsibilities for risk identification, risk analysis, risk response planning and risk monitoring and control well. The panel feels that consideration of the following observations could strengthen the plan.

Figure 2. Risk Ranking. This was well thought out, though incomplete and it seems inconsistent with the risk register. There were Very low, low, moderately low, moderately and high in the risk register, while the RMP only had 3 (Low Med, High). The risk register and the RMP do not seem to match. In the risk register it seems the risk probability categories are more granular below 50% probability (3 categories) than above (2 categories). This means that higher probability risks are less granularly assessed than lower probability risks (less than 50% probability).

Risk Sensitivity: Section 4: Qualitative risk analysis assigned a value for the probability and impact of each risk when calculating the risk factor. The risks were prioritized and the highest scoring risks (threats and opportunities) are most actively managed as part of risk response planning. Risk sensitivity is not specifically addressed (though Monte Carlo analysis is). It should be noted that risk probability is not a fixed value, but are a range of values and dependent on other impacts. I would recommend a comment about this and regular assessment of the determined values as part of the risk monitoring process.

Section 6.1 Residual and Secondary Risks. Though the risk management plan addresses residual risks, it does so in a cursory manner, and there does not appear to be any treatment of residual risk (that I could find) in the risk register. ***On documenting risk retirement mention should be made of residual risk*** (either the identification of the residual risk element, or secondary risk spawned, or a statement of ‘no residual or secondary risks were identified following retirement of this risk).

The RMP did not address ‘Risk Triggers’. A risk trigger is a condition or other event that will cause a risk to take place. Risk triggers for a given risk

are identified during the risk analysis. ***This could be called out in section 7***, Risk Monitoring and control of the RMP. Triggers tell you when you need to implement or plan or call a lien against contingency.

The RMP does not address "Force Majeure" clause (French for "superior force"). Force Majeure issues (also known as 'acts of God') arise from circumstances that well beyond the control of the project team which make performance inadvisable, commercially impracticable, illegal, or impossible. ***There is no need to have a plan for these sorts of events, but it should state this in the RMP. This caveat will often keep the project team focused on risks that can be controlled.***

Risk Register.

Observations:

As a tool for documenting and managing risks, the risk register seems well done and largely comprehensive. Risks are logged on the register and response actions are detailed. ***The risk register has a high level of technical detail, which is good.***

The team did not seem to consistently apply risk probabilities across the various level 2 groups in the risk register. This is quite common in distributed teams like ATLAS, but there should be some peer review function across the project whereby project leadership agrees with the Level 2 managers scoring. In particular, the muon subsystem stands out as having a large number of risks in the "very low" category.

The previous review noted that there was a feeling that risks were double counted. The panel notes that this issue has largely been addressed, although L0MDT seemed to be an area where risk can be evaluated more closely for this double counting.

The risk of the standing army costs, due to a potential one-year delay in CERN schedule, were not sufficiently addressed.