Report of the II ATLAS Phase-II Upgrade Project Review (P2UG)

ATLAS-P2UG Meeting, 5-6 November 2019

In-Depth Review: TDAQ, ITk-Pixel, ITk-Common and Tile projects
Regular Review: ITk-Strip, LAr, and Muon projects

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Process

After the first ATLAS P2UG review held at CERN on May 6-7th, the P2UG convened again on Sept. 4th for a status update video meeting with the participation of the ATLAS Phase II Upgrade Coordinator (UC) and the Peoject Leaders of the ITk-Pixel and TDAQ projects.

The panel examined the documentation provided by ATLAS, namely the status of the milestones updated on the Milestones Reporting System (MRS) on July 1 and the updated summary and detailed GANTT charts. For the first time the re-baselined schedule for ITk-Pixel, ITk-Common-Mechanics and TDAQ were also made available to the P2UG and a preliminary evaluation of the impact on the ITk-Strip schedule of the contractual Hamamatsu timetable was presented.
The P2UG panel submitted to ATLAS written requests for further clarifications and answers and these were received on Sept. 30th.   Moreover, the P2UG examined the status of the milestones and submitted a few requests for minor changes that were applied with the new version of the milestones uploaded to the MRS on Oct. 11th. As a follow-up of the video meeting, the P2UG panel also submitted to ATLAS a list of topics and questions to be addressed in the second P2UG review to be held in November.

In preparation for the November review, the P2UG panel received from ATLAS, by Oct. 23rd, the usual set of documents, submitted in advance, consisting of the summary reports of the most recent internal reviews, the updated versions of the WBS, the recently modified Risk Register files and documentation on changes implemented in the project management structures. A snapshot of the milestones taken on Oct. 1st was also uploaded to the MRS.

On November 5-6 the P2UG review took place at CERN.   The 6-hour long plenary session started with an introduction by the UC and two special talks requested by the P2UG - the first on the LS3 schedule and the second on the status of the lpGBT development - and continued with presentations by all the projects coordinators.   For the projects under in-depth review, i.e. TDAQ, ITk-Pixel, ITk-Common and Tile Cal, breakout sessions were then held in the afternoon and on the following morning. ATLAS was asked to address a list of questions submitted at the end of the first day and written answers were received by the ATLAS UC the following morning. The Project teams were then invited to participate in a close-out session on Nov. 6th, where the preliminary outcome of the review was presented.

We would like to express our deep appreciation to ATLAS for the well structured and informative presentations and materials, they prepared for the review, that were made available to the P2UG in direct response to our prior questions.   The great collaborative attitude demonstrated by the ATLAS teams, in particular during the parallel sessions, has been very beneficial for the work of the P2UG.   This made it possible to discuss in detail a large number of technical issues that gave us an excellent impression overall of the commitment and the technical competence of the groups involved.

Milestones

We would like to commend ATLAS for the remarkable effort made in aligning the update of the milestones status for all projects to the same reference dates (1st of January, April, July and October). This has allowed the milestone snapshots to be loaded in the MRS where they are identified with the labels Q1 to Q4.

The Q3 snapshot included for the first time the milestones of all projects and its second version has been signed off by the P2UG.

In September, the P2UG invited ATLAS to insert additional milestones to those being regularly checked via the MRS; most of them were related to the ITk-Pixel project and were requested for tracking in more detail the setting-up of the production sites and the progress of the production activities.

Q4 snapshot

The status of milestones completion, updated on Oct. 1st, and the progress in the last reporting period (Jul. 1st - Sep. 30th) are summarized in the following table:

Project	All			Expected to be completed in the reporting period (Jul.1st- Sep. 30th)		
	Tracked by P2UG	*Completed*	*Completed over Tracked*	*Tracked by P2UG*	*Completed*	*Completed over Tracked*
TDAQ	162	2	1.2%	6	1	17%
ITk-Pixel	340	2	0.6%	5	1	20%
ITk-Strip	200	10	5.0%	6	4	67%
ITk-Common	69	9	13.0%	6	5	83%
LAr	87	11	12.6%	3	2	67%
Tile	112	18	16.1%	6	4	67%
Muon	141	19	13.5%	19	14	74%
TOTAL	1111	71	6.4%	51	31	61%

The table shows that, in general, there has been good progress but it also signals that for some projects the completion rate has been rather low. Details are provided, project-by-project in the following sections of this document.

Recommendations

GE-1) We noted that for some projects the critical path-related information, reported in the milestone snapshot, is not yet fully dependable. This suggests that the critical path analysis may also not be entirely under control as seems to be the case for the TDAQ project. We invite ATLAS to address with determination and sufficient resources the remaining inconsistencies so that, starting from the Q1 snapshot in 2020, we can rely on a clearer vision of the impact of any new schedule modifications introduced.

General comments and recommendations

Overall P2 upgrade schedule

The re-baselined ITk-Pixel schedule and the inclusion of the Hamamatsu sensor delivery timetable in the ITk-Strip schedule, presented to us in September, clearly showed that the ITk readiness for installation was becoming completely incompatible with the end of the LS3 shutdown, currently planned by CERN for mid-2026. Further delays recently announced have pushed the ITk-Pixel availability for integration to February 2026 (as described further below). The P2UG is convinced that shifting LS3 has become almost unavoidable and we would definitely support a request by ATLAS for a one year shift.

However, there are still significant risks of further schedule slippages and we are particularly concerned that the ITk final float, even assuming the one year LS3 shift just mentioned, amounts to just 3 months.

In our opinion, this float needs to be at least one year long in order to provide minimum margin for a project of this scale, or otherwise the schedule cannot be considered credible at this stage.

Recommendation

GE-2) We invite ATLAS to seriously examine the possibility of recovering the required additional contingency by making a special effort in re-examining and optimizing the entire ITk-Pixel project schedule; our impression is that there is probably not much to be gained in the early part of the schedule, but there might be opportunities down the line, e.g. in revisiting the production timetable, even if this might require some re-organization of the activities. At the moment the imbalance among the projects completion dates is very large and this may also represent an opportunity to exploit some global optimization of resource allocation among the projects.

GE-3) We propose to discuss with ATLAS a plan of work that goes in this direction at the next intermediate Vidyo meeting and to plan a special session dedicated to the Pixel schedule optimization in one of the following P2UG reviews.

Schedule of LS3 activities

We very much appreciate the effort expended to prepare the updated version of the LS3 schedule, presented to the P2UG for the first time in the November review, together

with the associated work program to be carried out in 2020/21 for the necessary further refinements.

The LS3 schedule looks extremely tight, and the current planning calls for a total duration of 33 months with no explicit contingency embedded in the model. In most cases, physical constraints exist that do not allow activities to be further parallelised. Some initial tasks are already planned to be carried out in two shifts. However the schedule presented represents just a preliminary exercise, so we think it's not possible at the moment to make a very strong case for an extension of the shutdown beyond 2.5 years.

Recommendations

GE-4) We would recommend ATLAS to keep the target of 2.5 years duration when carrying out further refinements/optimizations of the LS3 schedule; since, with a shift of the LS3 start, some projects could have a rather long float before installation, the use of EYETS should also be investigated, although we are aware there will probably not be many cases where this opportunity can be really exploited.

GE-5) We invite ATLAS to present, during the next intermediate Vidyo meeting in February 2020 :

   ◦ A plan for the future work on the LS3 schedule. It is indeed appropriate now to establish a roadmap for the work ahead, with the definition of some clear milestones that could also be beneficial for collecting in a timely way all required information from the P2 upgrade projects.

   ◦ A first evaluation of possibilities to recover a few months of contingency by examining carefully all the options available e.g. organizing some of the work that sits on the critical path on multiple shifts or during the week-ends, with an analysis of the additional costs involved.

GE-6) As one of the future P2UG tasks, we would also deem it important to look at the schedule of the commissioning activities that will have to carried out after the detector is closed to become ready for Physics data taking.

Other general comments

Internal reviews

We strongly support and commend ATLAS for the commitment in pursing the intense program of internal reviews for the P2 Upgrade projects, which is essential to monitor the progress, to validate important technical choices and to establish the readiness of the projects in moving from one phase to the next. We noticed some concern about the possibility that, at times, the review schedule may be so tight that it could introduce delays and lead to milestones being missed. We therefore encourage ATLAS efforts aimed at strengthening the review central team and at optimizing the schedule to avoid any inconvenient bottlenecks.

Recommendations to LHCC

Decision on the LS3 beginning date

LH-1) We would like to stress the importance of taking a decision on the start date of the LS3 shutdown as soon as feasible, so that the experiments can review their schedules.

ASICS development and lpGBT

ASICS developments are most critical for several P2 upgrade projects and surprises can lead to large delays, as it has been recently the case for the lpGBT developments. The lpGBT issue is becoming rather critical for ATLAS and we therefore welcome the move by CERN to strengthen the lpGBT team. In general terms, not having sufficient manpower with specific expertise in the community represents a risk of not been able to avoid or cope with critical situations.

LH-2) We would therefore advise CERN to consider investing more in internal resources for expanding the capacity of carrying out common developments and providing additional support to the experiment at critical moments.

Projects in in-depth review

TDAQ

General Observations/Comments:

The project has made major steps in organization and technical progress since the last review, and is still essentially on track, despite having delayed most of the recent milestones. The reviewers congratulate ATLAS on concrete progress in several key areas. A well-defined schedule is in place, with sufficient slack against the current master schedule in most areas. A firmware coordinator has been appointed, addressing a major area of risk for the project. There are, however, clearly key decisions yet to be made in the project, mostly in the area of the HTT architecture and implementation. Contention of firmware engineering effort across several projects starts to appear.

Sub-project specific Observations/Comments:

For the Event Filter, AM07 testing results look very promising. The AM08 schedule is tight but feasible and a possible backup solution, based on FPGAs instead of AM, is now under study. Moreover, significant results from the study of a software-based track trigger solution have been shown, indicating a 6-7x speed increase over TDR expectations. This solution represents a viable fallback for HTT delay, or cover for extended HTT commissioning, up to PU 140, but further performance improvements may come from the exploitation of accelerators that has just started to be studied. The latter represents an option that we believe should definitely be explored.

The Global Trigger has been delayed by about 3 months, which is not considered a risk to the overall schedule. There are concerns about the risk evaluation around the

evolution option, in particular regarding the impact on technical planning for L0 subsystems.

The L0Muon subsystem has narrowly failed to meet a specification review milestone; follow-ups are pending. This is not seen as a risk to the overall schedule, although it indicates the danger of delays to important reviews due to 'pile-up' within the ATLAS management regime.

CTP, TTC and MUCTPI have made good progress in evolving the design.

Readout and Dataflow as well as other DAQ infrastructure have generally made good progress in definition and design of the system. The impact of the pixel readout RD53B design (driven by cabling issues) on FELIX is still a concern. Aggressive compression leads to additional requirements concerning resources (cost) and latency. In general, there is a complex interaction between the pixel and TDAQ technical planning, as part of a complex decision tree for the experiment. Keeping the "evolution" option open appears to result in significant additional complexity for some components.

Recommendations:

TD-1) ATLAS should closely watch the RD53B-related decision process. A regional readout seems to have advantages from the TDAQ point of view. The earliest possible decision should be made on the pixel / TDAQ interface, to avoid the risk of further delay to the overall schedule.

TD-2) Given the number of technical options that we invite ATLAS to thoroughly evaluate, a decision tree for choosing the final HTT solution should be put in place, showing dates and criteria for key decisions. This should include consideration as to when keeping the evolution option open becomes too costly, e.g. regarding the potential to cause delay. We would like to examine the proposal already in the next P2UG intermediate meeting.

TD-3) TDAQ should work with ATLAS management to understand if any key deliverables for detector upgrades can be brought forward to the pre-LS3 era, i.e. where possible detector upgrade work during an intermediate EYETS would otherwise be blocked by the lack of compatible TDAQ.

TD-4) Care should be taken not to allow a possible extension of LS2 to interfere with the medium-term Phase-2 schedule, though it is inevitable that some re-planning would be required.

TD-5) A strategy for firmware coordination, including assessment of how to avoid contention for development resources across projects, and make maximum use of common frameworks and components, should be put in place and reviewed next time.

ITk-Pixel

General Observations/Comments:

The ITk–Pixel project has undergone several substantial changes since the Spring 2019 P2UG review. Chief among them are changes in Management, as both the Project Leader Craig Buttar and Deputy Heinz Pernegger are new.

In addition, the schedule has been fleshed out considerably, was baselined in July, and been through one status-ing cycle in October. The schedule now includes a suitable set of milestones for the P2UG to effectively track the progress. Currently the availability of the pixel detector, as predicted by the schedule, drives the overall installation plan of ATLAS, which not only assumes a shift by one year of the LS3 start, but has a 33 month duration, 10% longer than the nominal duration of LS3.

The entire Pixel team put together effective presentations of the plan for their scope, demonstrating clear command of both the technical and managerial challenges involved in building this large pixel detector.

The project has clearly pivoted from an R&D stance to a construction project, with several options recently decided, such as the direct data transmission scheme, and a clear plan for promptly closing the remaining open options, including the pixel dimensions and the L0 radius choices, to be resolved in the next month. Each area in the project is actively managing their risks, and there is a robust plan for Specification Review, Preliminary Design Review and Final Design review with component dependencies included. There have been a few delays in the Reviews, chiefly from the delay of the Services and Hybridization PDRs.

There are many participants in the Pixel project. In general, the Inner System is being fabricated by U.S. collaborators, one Endcap by Italian collaborators, the other by U.K. collaborators, and the Outer Barrel by a consortium of European and Japanese collaborators. This results in a very distributed production flow, with:

- 5 3D Sensor and 13 Planar Sensor QC sites;

- At least 3 vendors plus 4 institutes to perform at least some of the bump bonding procedure;

- 26 Module Hybridization Sites, 18 of which build and test, 3 which only build, and 5 which only test.

The wide distribution of sites for various activities, in particular module hybridization, may have benefits in terms of throughput but also often has some loss of efficiency or other complications due to the component distribution logistics, site equivalency validation, and site maintenance during fabrication.

There is a lot of procurement activity going on, with currently 3 market surveys in progress, for planar sensors, 3D sensors, and Hybridization. Two more are planned in the near future, for power supplies and hybrids.

Sub-project specific Observations/Comments:

The project involves in excess of 7 major ASICs, for many of them SEE and the total radiation dose effects are yet to be fully evaluated. Realization of any of these risks could result in significant scheduled delays.

Of particular interest is the readout ASIC ItkPix, the descendent of the RD53 enterprise, as it drives the critical path. Version 1 is due to be submitted to the foundry imminently, having successfully passed Final Design Review. The production schedule is success oriented, assuming only small changes are necessary between V1 and V2. As Region of Interest ROI readout, a significant design change, is not implemented in V1, and cannot be implemented before what is presumed to be the final chip submission, this option poses a high probability risk to delay the Pixel schedule by at least 6 months, and should be considered very carefully.

There is a problem with routing of services, where in some cases the envelope between Layer 3 and Layer 4 is not respected due to cables and piping. A re-design effort of the PP0 connection is underway which may relieve this situation.

There is a new baseline for readout that divides 4 MHz readout and 1 MHz readout which reduces the number of data cables by 23%, saving cost, material, and service volume

Recommendations:

PI-1) Consider the risks/benefit of the wide distribution of sites involved in fabrication, and develop a backup plan to consolidate labor resources in a smaller number of locations

PI-2) Review in detail and revise the schedule to develop strategies to accelerate the schedule at the possible cost of increased risk, in order to create some schedule contingency for ATLAS LS3 installation

PI-3) Clearly delineate and debate the risk/benefit analysis associated with incorporating the ROI readout scheme in the Pixels as soon as possible

ITK Common items

The overall common items schedule is on track. It was conceived on an 'as needed' basis by the subsystems and could in some places increase float with Pixel and Strip delaying. It inherits some delays from other sub-projects, with the major concerns being the "ITk readiness for installation" date now given as October 2026 and a LS3 installation period of 33 months (see general comments). While all 5 ITk sub-project schedules were baselined, the links between the schedules are still under evaluation. The process is expected to end in early 2020.

ITk Common Mechanics

Observations/Comments:

A roadmap towards the large CO2 cooling systems of ATLAS and CMS is existing and industrial suppliers for the relevant cooling plant components are available. A governance group of the key stakeholders (ATLAS/CMS/Cooling coordinators/CERN EP, EN management) is in place to evaluate, coordinate and obtain the needed resources including the required civil engineering and construction of surface buildings. Considering the long lead times and the anticipated risk of lacking personnel at CERN in this project, P2UG expects regular status reports in future P2UG meetings on the progress with the CO2 cooling systems.

The ITk surface integration schedule shows a gap of 10 months between "ITk ready for pixel insertion" and "Pixel Outer System ready for insertion". The cooling plant in SR1 is shared between Pixel and Strip projects and can operate at one point of time at one temperature only. A meticulous planning and prioritization on its use during testing and commissioning phase will be therefore required.

Common structures are mostly on track with the Outer Cylinder reaching the PRR end of the year. The pixel interface to common structures still needs some development. The polymoderators and other components require a Fire Derogation; the according approval process shall be started in a timely manner.

Installation in the pit: A successful ITk lowering test with a mock-up cylinder was performed.

ITk Common Electronics

Observations/Comments:

Environmental Monitoring and Interlock System projects are on schedule and an interlock strategy document is expected by the end of the year. A solid concept and corresponding procedures to assure the proper grounding of the experiment is in place. The P2UG supports the proposed strategy to appoint "grounding checkers" in all installation sites and supply all installation sites with proper ground fault monitors.

The "Luminosity and Beam Monitoring" project was restarted after a 1 year break with the inclusion into the pixel MoU. The BCM is included in Pixel common mechanics reviews and requires support from the Pixel teams for integration and services. Care has to be taken to define clear responsibilities allowing for a coherent integration into the Pixel project. Front-End and readout architecture have still open options and developments ahead.

The Phase I FELIX project is on schedule, while the FELIX II firmware developments are delayed by one year anticipating the present FELIX II production schedule of TDAQ. This is not regarded as critical, as they are only needed as replacement for the final ITk installation.

ITk Common Production DB

Observations/Comments:

Significant progress over last 6 months has been shown; now the ITk groups are starting to use the database for pre-production parts. The FDR/PRR for the database are delayed by 5 months to align with Pixel and Strip schedule updates and it is compatible with the implementation of Pixel/Strip component details at FDR level.

Tile

General Observations:

The project is in good shape overall. Schedule delays were found to be relatively minor and far from the critical path. The Tile group have demonstrated a good understanding of the main issues and challenges ahead.

Specific sub-project Observations

In this review, comprehensive updates were given in the 8 primary L2 categories:

- Drawer Mechanics and Tools: all WP's have now passed FDR's, except for Mini Drawer Services which will happen by the end of this year. Mini Drawer mechanics are now in pre-production.

- On-Detector Electronics: all PDR's are complete except for the Daughter Board which has a follow-up to the first PDR in March and must undergo a new program of radiation testing. Focus is now on preparing for FDR's.

- Off-Detector Electronics: PDR's just starting. The Carrier Board recently passed with the other main components scheduled for March'20.

- LV System: PDR's passed for everything except the Auxiliary Board which is now under development and will undergo a PDR by end of the year. Conclusions on the radiation tests of the LV Bricks (dc/dc converters) needed before the FDR in Q1 of 2020.

- HV System: PDR's passed for everything, except for bulk HV supplies scheduled for PDR in Q1 of 2020. Focus now on FDR's planned for Q2 of 2020.

- The first PDR for the Calibration Systems concerns the Cs-system control electronics and is scheduled for the end of the year.

- Drawer Assembly and Installation: assembly and installation tool WP's have now passed FDR's.

Sub-project specific Comments:

The FENICS front-end board has had its FDR pushed back 3 months to allow adjustment of the saturating charge point in the low gain channel. This is a sensible move in order to give flexibility to operate PMT's at lower HV if needed.

An extra risk, associated with purchasing more PMT's if they are needed at end of Run3 to replace aging units, has been introduced and we support accounting for it in the risk register.

The HV distribution group would prefer to run 12-pair cables into the detector to avoid splitting thick cables at the power supply end (the `octopus' solution) which comes with a higher risk of noise from breaking the continuity of cable screening. The solution requires an extra 30% of cable routing space to be made available so options must be discussed with ATLAS-TC.

We note that personnel have been identified, and work has started, on a Production DB now that pre-production is starting (e.g. Drawer Mechanics). Grouping this work, as a single WBS item together with the installation DB, is a sensible move.

The LV system can use ELMB2 if the plan is to either replace or swap (between barrel and end-cap) during HL-LHC running.

Two possible implementations of the Cs calibration system are considered. One implementation, involves using the ELMB++ hub, while a second alternative implementation is based on the Daughter Board. We support the proposal for the Cs electronics proceeding to PDR with the second implementation as the baseline option, given the uncertainties associated to the development of the ELMB++ hub.

Vertical slice tests for both LV and HV distribution, together with integration tests of the electronics chain, planned for 2020, are going to be crucial pre-cursors to FDR's of the sub-systems involved.

Recommendations:

TI-1) The Tile were asked to comment on whether a long technical stop in Run 3 could be used to start upgrade installation ahead of LS3. The feedback was that it would be a challenge to keep essentially the old and upgraded system working side-by-side, but we encourage the group to continue exploring this possibility. We also invite the group to review how they would best use additional float that may become available if a delay to LS3 is imposed.

TI-2) The Tile group and ATLAS management need to verify that CERN is committed to support development of the so-called ELM++hub and be prepared to use ATLAS resources if this development is going to happen.

TI-3) TDAQi developers should verify the planned data format from the TDAQ group (for FELIX and L0 trigger interface)

Other Projects

ITk Strip

General Observations/Comments

The ITk strip project has had significant advancements on many fronts since the May P2UG meeting. The team should be congratulated on their remarkable technical achievements and on successfully managing the schedule and risks in this enormous and complex project.

The ITk strip schedule has been updated to account for sensor delivery timeline after signing the contact with HPK, and for delays in pre-production of FE ASICs due to mitigation required for the observed SEE effects. These changes have resulted in about a 4-months delay in the completion/readiness of ITK strips for integration: from 13/09/24 to 22/01/25. Some of the foreseen risks have been realised, in particular the observation of SEE in FE ASICs necessitating design revisions resulting in schedule delays.

Since the May P2UG meeting the team has completed 5 milestones, including 2 FDRs (Modules, and Global Support Barrel). Four other reviews passed with recommendations or required follow-up. The project is entering pre-production and will be reviewing production site qualifications in the coming year.

Sub-project specific Observations/Comments:

FE ASIC submission is now on critical path. New ABCstar and AMAC submissions, incorporating the outcome of the SEE mitigation efforts, will be approved after the ASIC FDR follow-up (part II) on November 8. The mitigation work on HCCstart is on-going and new submission is expected after the ASIC FDR (part III) in late January.

Sensor availability is also near critical path, now potentially limiting the module production rate.

Other delays - but not on critical path - include: Type 1, 2,3 prototype cables, EC global mechanics components, LS cores FDR. The new schedule baseline does not yet include the impact of potential delays from the availability of ESE chips: BPOL12V, BPOL12V5 and lpGBT. The current plan assumes local support pre-production using prototype ESE chips.

A new Integration FDR has been added and is required to be completed before all mechanics PRR, except global mechanics.

Additional potential delays are possible due to the availability of lpGBT. The current mitigation strategy is to use temporary EOSs with prototype lpGBTs on about 10% of staves in order to avoid significant delays in ITK strip integration. The P2UG committee concurs with the project team that this plan is concerning, as it involves both additional costs and technical risks. In light of probable changes to lpGBT availability and the overall ITK and phase-2 schedule, the mitigation options should be re-examined in the future.

LAr

General Observations:

In general the project is in good shape and on schedule for many PDR's in early 2020.

Sub-project specific Observations:

There has been good progress on the Calibration Board ASIC (CLAROC v2), which was submitted in June and it's expected back in Dec. as foreseen in the current schedule.

The ADC Coluta V3 submission has been delayed 3.5 months, but with many improvements over V2.   A very little knock-on delay affecting the FEB 2 test board has been accumulated however the board, which employs the LAUROC1, COLUTAV2 and lpGBT prototypes, has shown encouraging initial results and has been produced in 6 copies.

It has been confirmed that both barrel and endcap LV can use the ELMB2 board, and therefore they are no longer dependent on the ELMB++ development.

The LASP Spec. Review is on course for end of year/early 2020.

Sub-project specific Comments

The ADC seems to be one of the more difficult ASIC to be develop and is one of four *high risks* currently active. We expect therefore to have a very detailed report during the May P2UG review on Coluta V3, and the alternative options.

The remaining 3 `high' risk items concern the LAr Signal Processor and are related to possible delays and outstanding technology choices. The May meeting should also be used to review progress with the LASP, as we approach milestones scheduled for the Summer of 2020.

Muon

General Observations/Comments:

Much progress has been made in the last quarter. Twenty milestones were completed, either on time or with modest delays. Seven milestones were delayed, with a maximum delay of approximately four months. In all sub-projects, there is still substantial schedule contingency. In some cases the contingency is quite large (>400 days).

Since the last P2UG review, many internal reviews were completed, including nine specification reviews, six PDRs, two PRR, one FDR1 and one FDR. Most of the reviews had few or no comments, but one review had extensive recommendation for follow-up

Sub-project specific Observations/Comments:

MDT: A preference was indicated to replace the DC-DC converters in the MDT electronics with linear regulators. This can have many implications, including increases in heat load, LV cable cross section, radiation hardness.

RPC: RPC chambers and FE electronics SPR had many recommendations that should be followed up seriously and promptly. In particular there was a concern about complications of the proposed LV powering scheme.

Recommendations:

MU-1) The LV powering scheme should be reviewed internally in a comprehensive way that involves all stakeholders.

MU-2) The LV schema of the RPC FEB design should be reviewed and possibly simplified in order to reduce to possible problem generated by having too many power lines and cables.

MU-3) The combined test of MDT and RPC should be better described with a clear set of milestones.

Follow-up

The topics we invite ATLAS to address in the upcoming P2UG Vidyo meeting in February 2020 are summarized here:

1. plan of work for recovering float in ITk-Pixel project (milestone GE-3)

2. plan for the future work on the LS3 schedule (m. GE-5)

3. first evaluation of possibilities to shorten the LS3 duration (m. GE-5)

4. decision tree for choosing the final HTT solution and consideration on as to when keeping the evolution option open becomes too costly (m. TD-2)