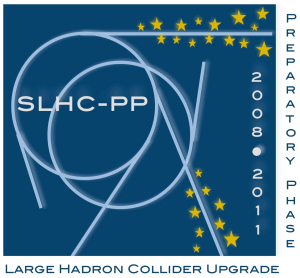

SLHC-PP

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1.0	25.3.2011	First version created for comments	Steinar Stapnes
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The Preparatory Phase of the Large Hadron Collider upgrade (SLHC-PP) is a project co-funded by the European Commission in its 7th Framework Programme under the Grant Agreement n° 212114. SLHC-PP began in April 2008 and will run for 3 years.

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1. EXECUTIVE SUMMARY

The ATLAS upgrade plans are implemented as closely coordinated projects. These projects undergo three phases; first the R&D phase and feasibility/performance studies, then the prototype phase developing the project into a construction project, and ultimately the construction phase where the project execution is carried out within a defined scope, technical specifications, cost-estimates and schedule. In the ATLAS experiment the upgrade project definition and approval process is now agreed and established (ref 1), and the main upgrade project that is scheduled for installation during the LHC shutdown in 2013-14 is already in the construction phase, namely the Insertable B-Layer (IBL) project (ref 2). Several other smaller projects are also being studied but the IBL project remains the reference project for the initial upgrade, and the main topic of this report. An Interim MoU and cost-books for the phase I pixel system upgrades foreseen for this shutdown (IBL) have been produced (ref 3), and have been presented to and agreed by the Collaboration.

2. UPGRADE PROJECTS AND THE FORMAL STEPS TOWARDS IMOU AND COSTBOOKS

The first significant LHC machine shutdown is currently foreseen for 2013-14 and the major upgrade the ATLAS collaboration has foreseen for this shutdown is the insertion of a new PIXEL layer including replacement of the current central beampipe (IBL). Other upgrade projects considered are: FTK (Fast Track Trigger) (ref 4), new small muon wheels, new topological trigger at L1, possibly new calorimeter electronics and possibly a new warm FC. Among these the largest and most significant project, the IBL, has prepared a Technical Design Report, an Interim Memorandum of Understanding and a detailed Cost Book, including the installation work. The FTK project has the similar steps in progress, while the other projects mentioned is being considered.

The organization of the ATLAS upgrade projects is shown in figure 1. Note that the establishment of key parts of this organization is described in milestone report 3.2.

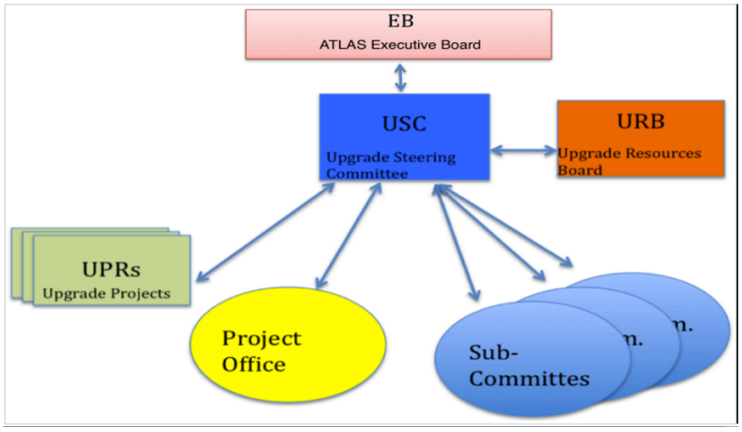

Figure 1: The ATLAS upgrade organization, showing the various bodies that are involved in setting up, costing, defining and approving the cost estimates and Interim Memorandum of Understanding for the upgrade projects (from ref 1).

Every major project that is intended as a part of the ATLAS upgrade has to pass through several steps. The process is illustrated in figure 2 (from ref 1) below where the steps are numbered from 1 to 6:

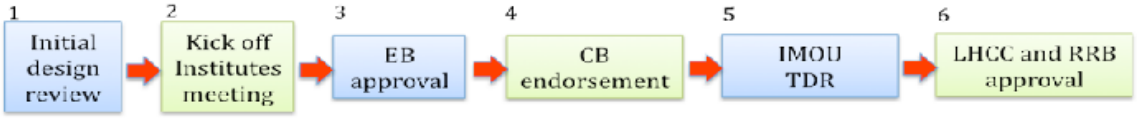

Fig. 2: Stages in Upgrade Project approval process

The key scientific, technical and resource documentation is a Technical Design Report (TDR), written by the main responsible groups in the upgrade project. The Technical Design Report for the IBL upgrade project was written in the Spring 2010. It is a 200 page document containing a full technical description of the project, a cost estimate (table 43, page 200), the organization structure, and a list of the participating institutes (see table 1 below). The schedule and detailed planning are also included in the document.

The ATLAS CB (Collaboration Board) consisting of one member per institute of the collaboration provides the final approval of the upgrade plans for the experiment – based on the TDR, before it is presented the LHC Committee (LHCC). LHCC is the external scientific programme committee installed by CERN to review the LHC experiments at regular intervals, and also major upgrade projects are reviewed by this committee. The IBL TDR was presented to the LHC Committee (LHCC) in 2010 at two occasions, once initially and the second time to provide answers to a list of the questions by the review committee.

The Interim Memorandum of Understanding, included a detailed cost estimate, was prepared in parallel (August 2010), and presented the Resource Review Board (RRB) in October 2010. The Resources Review Board (RRB) comprises the representatives of each Experiment's Funding Agencies and the managements of CERN and of each Experiment's Collaboration. It is chaired by the CERN Director for Research and Computing.

The role of the RRB includes:

- reaching agreement on the Memorandum of Understanding
- monitoring the Common Projects and the use of the Common Funds
- monitoring the general financial and manpower support
- reaching agreement on a maintenance and operation procedure and monitoring its functioning
- endorsing the annual construction and maintenance and operation budgets of the detector.

The management of the Collaboration reports regularly to the RRB on technical, managerial, financial and administrative matters, and on the composition of the Collaboration.

3. COSTBOOKS

As already mentioned the TDR already contain a fairly detailed breakdown of the costs of the upgrade project. The IBL system is broken down in several main areas as shown in figure 3 below.

	System	MoU Item	Description
1	**Module**	1	Sensor - prototype (including bumping to FE-I4), production, procurement & QC
		2	FE-I4 prototype (v1), production (v2), test
		3	Bump-bonding, thinning, bare module - prototype, production & QC
2	**Stave**	4	Local support (stave): CF structure, TM, pipe - prototype, production & QC
		5	Module assembly, stave loading, flex-hybrid, internal electrical services - design, production & QC
3	**Off-detector**	6	R/O chain: opto-board, opto-fiber, TX/RX, BOC, ROD, TDAQ (S-link, TIM, SBC, ROS, crate)
		7	Power chain: HV/LV PS, PP2 regulators, type2, 3 & 4 cables, interlock, DCS
4	**Integration & Cooling plant**	8	Integration in SR1 & System test
		9	Cooling plant & cooling services to PP1
5	**Beam-pipe & Installation**	10	Beampipe & mechancal interfaces (to staves, to type 1 services, IST)
		11	Installation in the pit: beampipe extraction, IBL+beampipe insertion, services installation

Figure 3: The parts of the IBL system as they appear in the IMoU and costbooks. A further division into WBS items are used for detailed technical estimates (from ref 3).

For each system there are 2-3 MoU items, and the cost are estimated based on the a detailed technical description of the project as well as cost-estimate based on a detailed technical evaluation, including prototyping with the major potential suppliers of the key components. The costs include several development circles in some cases, up until the final production runs. A further subdivision of items into a Work Breakdown Structure underlays the planning.

The cost drivers are the modules and the installation work. The costs are divided on each participating institute, and the SLHC-PP partners of WP3 are all strongly involved.

MoU Item 4 *Annex 1*

WBS Items: 4.1, 5.2, 9.1.1 ***Bare Stave & Cooling Pipe***

Description: Stave prototype with carbon foam, pipe prototype in titanium (Ti) and carbon fiber (CF) (2, 3 & 4mm OD), pipe Ti/Ti welds, CF to Ti and Ti to Ti fittings, internal pipes from EoS to PP1. Thermal management (TM) qualification with CO2 and C3F8, mock-up for measuring thermal parameters from beam-pipe bakeout. Stave production and piping to PP1 (14 + 6 spares). Production QC.

Total Cost:

WBS	kCH	
4.1.1	242	Stave prototype (include Ti and CF pipes, Ti/Ti welding and fittings)
4.1.2	100	Stave production
5.2	95	Internal cooling pipes (PP0 to PP1) - Prot. (30kCH)+ prod. (65kCH)
9.1.1	30	Cooling design qualification (prototype)
	467	*Total*

Work Responsibility

Annecy	Design and QC Ti-to-Ti fittings, Ti-brazing
CERN	Thermo-mechanical prototype & QA
LPNHE	Material budget (software activity)
Marseille	Ti-pipes, stave prototype, TM qualification
Milano	CF pipe, CF-Ti joint, TM qualification, bakeout mock-up, material irradiation
Nikhef	CO2 test on stave, test of Ti-weld
SLAC	Contribution to CO2 test on stave
Wuppertal	CF pipe prototype, stave prototype, CF pipe QC

Cost Sharing:

	Prototype %	Production %	Total %
Annecy, LPNHE, Marseille (F)	30%	30%	30%
CERN	10%	10%	10%
Milano (I)	30%	30%	30%
Wuppertal (D)	30%	30%	30%
Unassigned	-	-	-
Total	100%	100%	

Figure 4: An example for one of the items in the costbook, showing the cost for this item and cost-sharing among those partners that have committed to development and construction of this part (from ref 3).

4. INTERIM MEMORANDUM OF UNDERSTANDING (IMOU)

The Interim Memorandum of Understanding for the IBL upgrade project consists of three parts:

1) A first part outlining the partners of the agreement, the purpose, the scope, the cost and the cost oversight, the cost sharing and procedures. This is the most formal part of the Interim Memorandum of Understanding that the partners have to sign.
2) Part two is the costbook as outlined in chapter 3 above.
3) A description of the IBL organisation, including the management, the organisation of work, the institute board, the role of the partners. As an example the organisational structure is shown below in figure 5.

More details are available in the report for deliverable 3.1.2: https://edms.cern.ch/document/1133533/1

5. CONCLUSIONS

The procedure for agreeing on, approving and initiating upgrade projects in ATLAS is set up. The first of these projects and the main project foreseen for the installation in the shutdown in 2013-14, the Insertable B-Layer, has produced its Technical Design Report, and has a signed IMoU including a detailed costbook. Other projects will follow in the same path.

6. REFERENCES

1) ATLAS upgrade organization definition: https://edms.cern.ch/document/1093133/3
2) CERN-LHCC-2010-013, ATLAS-TDR-019 ATLAS Insertable B-Layer Technical Design Report: http://cdsweb.cern.ch/record/1291633
3) Interim Memorandum of Understanding including costbook as annex (CERN-RRB-2010-118)
4) Proposal to prepare a technical design report for FTK, a hardware track finder upgrade to the ATLAS trigger: https://edms.cern.ch/document/903426/1