CERN-RRB-2005-088
23rd September 2005

ATLAS Progress Report for the October 2005 RRB

1. Introduction

The emphasis of the ATLAS project has shifted for the detector hardware from distributed construction of components to their integration at CERN on the surface, and most importantly to their final installation and commissioning in the underground cavern. The detector construction is more than 85% complete in terms of expenditure. In parallel distributed computing and physics analysis are being set up and exercised with large simulated data samples, embedded in the LCG framework.

It is briefly recalled here that the ATLAS detector uses a superconducting magnet system with a central solenoid around the inner detector and large air-core toroid magnets for the muon spectrometer. Between the two are the liquid Argon (LAr) and tile calorimeters. A hierarchical trigger and data acquisition System provides the data for the collaboration-wide computing and physics analysis activities.

It is also recalled that the Completion Plan for the staged initial configuration of the detector, taking into account the Cost to Completion (CtC) for the parts which are not covered as deliverables, and including the Commissioning & Integration (C&I) pre-operation costs as well as the available resources, was presented and approved at the October 2002 RRB (CERN-RRB-2002-114rev1), and updated at the last RRB (CERN-RRB-2005-016). The project proceeds within this framework, and an update of the CtC funding situation will be presented in this report.

The ATLAS Collaboration consists today of 152 Institutions from 34 countries with roughly 1850 scientific authors (including PhD students). New Institutions from Argentina, Germany, Italy and U.S. have expressed interest to join ATLAS, and the Collaboration Board will consider these applications following the standard procedures defined in the Construction MoU.

2. Magnet System

The ATLAS superconducting magnet system (a central solenoid, a barrel, two end-cap toroids, and their common services) is the largest of the Common Project items.

2.1 Central Solenoid

Status: The LAr barrel cryostat, housing also the solenoid previously tested at the surface, was installed in the cavern at the end of October 2004 (in a temporary position).
Changes: None.
Concerns: None.
Plans: Services connection after movement into the final position (November 2005), followed by an operational test and field mapping in spring 2006.

2.2 Barrel Toroid (BT)

Status: The BT integration and testing in Hall 180 is completed. One coil, BT3, underwent three thermal cycles in order to investigate a non-conform resistance to ground. With the lowest measured value of 30 kΩ it stayed always well above the acceptance value of 10 kΩ. After a thorough risk analysis (only two real shorts would be harmful) it was decided to accept the coil, and as a precaution to install it closest to the current input where the internal voltage is minimal. All eight coils are now mechanically installed in their final position in the cavern, and their cryogenic connections are being completed, in view of a first cool-down in-situ for the end of year, followed by an excitation test beginning of 2006.
Changes: The installation sequence for one coil was changed to allow more time to investigate a reduced ground insulation value.
Concerns: Schedule impact of the BT completion and tests.
Plans: Complete cryogenic and electrical connections of the eight coils, first cool-down in-situ at the end of 2005, followed by an excitation test at the beginning of 2006.

2.3 End-Cap Toroids (ECT)

Status: All components for the final assembly of the ECTs are at CERN, and integration of the first ECT is in full swing. The first ECT integration is scheduled for completion by May 2006, the second one for October 2006.
Changes: None.
Concerns: None.
Plans: Assembly and integration of the first ECT by May 2006.

3. Inner Detector

The Inner Detector (ID) combines three concentric sub-system layers, from inside out the Pixel detectors, the Silicon detectors (SCT) and the Transition Radiation Straw Tracker (TRT). The module series production is finished for SCT and TRT, and the emphasis has shifted to the assembly of modules onto the support structures (‘macro-assembly’) and to the integration of the overall ID including the services. An important milestone will be the integration of the barrel SCT and TRT sub-systems in November 2005.

3.1 Pixel Detector

Status: The Pixel sensor series fabrication is nearing completion for the full system, all front-end (FE) electronics chips are delivered and tested, and 2/3 of the module production is done. After excellent progress on the Pixel project for years three technical problems have recently affected the schedule. Two of them have been solved: a faulty potting of the controller chip on a fraction of the barrel modules, and delamination of a fraction of the barrel stave supports. As a third problem there are corrosion leaks in some barrel cooling tubes, for which a repair strategy is being sought currently with highest priority, with the aim to minimize cost and schedule impacts. The end-cap Pixel disk macro-assembly is proceeding on schedule, and all installation tooling is ready.
Changes: Work towards a full 3-layer system for LHC start-up.
Concerns: Schedule and cost risks for the full system to be ready for LHC start-up.
Plans: Continue module series production, system assembly and integration steps, repair (and partial replacement) of the barrel staves containing faulty cooling tubes.

3.2 Silicon Detector

Status: The SCT module construction is finished and the module mounting on all four barrel cylinders has been completed, and they have been shipped to CERN. The four cylinders have been recently integrated inside the thermal enclosure and are being prepared for system tests. The end-cap module assembly on the support disks is well advanced, and for one side already completed. Equipping the end-cap support structures for receiving the disks remains on the critical path because of previously accumulated delays with services components. However the first disks have now been connected to final services and tested. The production of the off-detector read-out electronics and of the power supplies is largely completed.
Changes: None.
Concerns: The schedule, especially the second end-cap, remains critical due to previously accumulated delays. Timely delivery of end-cap services components.
Plans: Completion the macro-assembly of modules for the end-cap disks, integration into the end-cap support structures. Integration of the SCT and TRT barrels. Testing of the barrel at the surface in the ID clean room SR1 until March 2006, prior to installation into ATLAS.

3.3 Transition Radiation Tracker (TRT)

Status: The module production for the initial TRT configuration has been completed, and the last wheels are expected to arrive at CERN end of October 2005. The barrel cylinder is fully integrated, and first cosmic ray events have been recorded with it in SR1. The integration work for the two end-caps is proceeding well. The technical issue reported last time about failures of HV fuses has been overcome by a new fabrication.
Changes: None.
Concerns: None.
Plans: Complete the end-cap integration at CERN. Integration of the SCT and TRT barrels, followed by system tests prior to installation into ATLAS.

3.4 Infrastructure and Common ID Items

Status: The large clean room integration and testing facility SR1 near the ATLAS surface building is fully operational. The underground services installation is in full swing, and the planning for commissioning has also started. The services installation is currently running late, and additional manpower efforts are being made to cope with this critical path activity affecting the overall ATLAS installation schedule.
Changes: None.
Concerns: Squeezed schedule for the integration and system tests of the completed ID units, given the previously accumulated delays in the SCT and TRT sub-systems. Delays in the services availability and installation.
Plans: Continue ID detector integration and tests in SR1, as well as services installation in the cavern.

4. LAr Calorimeter

The main activities for the LAr calorimeter concentrate on completing the last surface cold tests on the second end-cap, and on the installation and commissioning in the cavern. The LAr cryogenics infrastructure at the Pit-1 is well advanced in its commissioning phase.

4.1 LAr Barrel Calorimeter

Status: The barrel cryostat was lowered into the cavern end of October 2004. It is installed and positioned inside the barrel Tile calorimeter, in the temporary position below the smaller installation shaft (side C). The calorimeter barrel is ready for displacement into the final central position at the end of October 2005, after completion of the BT. In the meantime the installation of services and of the FE electronics crates is ongoing.
Changes: None.
Concerns: None.
Plans: Continue installation and commissioning of the FE electronics in the cavern. Transfer into the final central location of the barrel end of October 2005 and start cryogenics connections.

4.2 LAr End-Cap Calorimeters

Status: The surface cold tests of the first end-cap have been completed successfully this spring; it is ready for installation in the cavern before the end of this year. The second LAr end-cap calorimeter is cold and tests are ongoing. Its installation in the cavern is scheduled for March 2006.
Changes: None.
Concerns: None.
Plans: Complete the surface cold tests of the second end-caps, and for both of them installation in the cavern during the coming half year, followed by commissioning.

4.3 LAr Electronics

Status: The critical path item is Front End Board (FEB) production, for which two components (timing circuit, and optical transmitters) needed corrective actions before series fabrication could resume. A special effort is being made to recover part of the accumulated delay (the production stopped for 6 months). On the critical path are also the low-voltage power supplies for which, because of failures, more iterations than anticipated are required with the supplier. The installation of the barrel FEB and the commissioning of the FE system has started. The series production of the other components and the Back End (BE) electronics proceeds on schedule, and the BE electronics installation (already complete for the barrel) and commissioning have started.
Changes: None.
Concerns: The schedule for the FEBs installation has become very tight.
Plans: Complete the accelerated series production and tests for the FEBs, and continue production of many other major components. Continue in situ installation and commissioning of the FEB crates.

5. Tile Calorimeter

Status: The barrel Tile Calorimeter cylinder was completed in the cavern in the temporary location below the shaft on side C at the end of 2004. Since then commissioning of its electronics has been proceeding, and first cosmic ray events

were recorded this summer. The complete barrel calorimeter is ready for transfer to the final position after the BT completion end of October 2005. The extended barrel Tile Calorimeters for both sides are ready for installation in the pit after surface pre-assemblies. The installations will start in November 2005 and February 2006, for the C and A ends respectively. The fabrication and insertion of the 'drawer' system, housing all on-detector electronics circuits, was finished in May 2005. Good progress can be reported for the off-detector electronics and the power supplies, albeit with a tight schedule for the latter.
Changes: None.
Concerns: None.
Plans: Proceed with the commissioning work for the barrel after moving into the final central position. Installation of the extended barrel cylinders. Continue with the fabrication of the off-detector electronics and power supplies.

6. Muon Spectrometer

The Muon Spectrometer is instrumented with precision chambers for the momentum measurement and with fast chambers for triggering. All chamber sub-systems have reached (or are close to) completion of the series construction. A major effort is spent in assembling of complete stations and sectors. Installation and commissioning in the cavern has also started.

6.1 Precision Chambers

Status: The series construction of bare chambers is essentially complete, except for very few special chambers. About 80% of the MDTs for the initial detector are fully integrated with their services and electronics. All the 32 Cathode Strip Chambers (CSCs), which are used in the innermost end-cap region because of the high radiation fluxes, are produced.
Changes: None.
Concerns: None.
Plans: Complete series chamber fabrication; proceed with integrating services and electronics onto the bare chambers.

6.2 Trigger Chambers

Status: The barrel region is equipped with Resistive Plate Chambers (RPCs). About 80% of the chamber modules are assembled. The fabrication was significantly slowed down earlier in the year because of a delamination problem for support panels, and completion is now scheduled for the end of 2005. This is critical for the overall muon chamber integration and installation schedule. Furthermore, a batch of early-construction RPCs will have to be re-worked because they have high leakage currents. The end-cap regions are instrumented with Thin Gap Chambers (TGCs) that are able to cope with high rates. The TGC series fabrication for the 'Big Wheels' is finished, and only the 'Small Wheel' chambers (2% of the total) remain to be completed. The on-chamber trigger electronics ASICs required a new iteration for both chamber types as reported previously. The full production is in hand, and test results are positive, however both ASICs remain on the critical path and the on-chamber electronics are available just-in-time.
Changes: None.
Concerns: Integration of RPC and MDT chambers into barrel stations is on a tight schedule because of delays in the RPCs.

Plans: Complete RPC and TGC construction and tests. Prepare RPC chambers for integration with the MDT stations, and prepare TGC sectors for installation.

6.3 Muon Spectrometer Integration

Status: The pre-assembly and testing of the combined trigger and precision chamber stations for the barrel are a major focus of this activity. The fabrication for the large end-cap chamber support structures (‘Small and Big Wheels’) is well underway. The first complete end-cap MDT and TGC sectors have been assembled, and this activity is now ramping up rapidly, for the total of 72 TGC and 32 MDT sectors. The installation and commissioning of barrel chamber stations in critical positions in the lower parts of the BT has proceeded according to schedule. The installation and commissioning of the alignment system has also started in-situ for the barrel region as well as on the end-cap sectors.
Changes: None.
Concerns: Tight schedule for the barrel muon station integration.
Plans: Continue the assembly of MDT-RPC barrel stations and of the MDT and TGC end-cap sectors, fast ramp-up of the installation and commissioning of muon stations and alignment system components in the barrel region.

7. Trigger and DAQ System

The Level-1 Trigger, the High Level Trigger (HLT), the Data Acquisition (DAQ) and the Detector Control System (DCS) have all been field-proven in the combined test beam running during 2004. First components of the final system are now being installed at Pit-1.

7.1 Level-1 Trigger

Status: The level-1 trigger system (with the sub-systems calorimeter, muon and central trigger logic, CTP) is in the production phase for both hardware and software. A detailed plan exists for the installation in the cavern. As already noted in Section 6.2, the muon trigger sub-system faces a very tight schedule for the on-chamber components. The calorimeter trigger will be installed following the availability of the corresponding detector signals in the underground counting room. The CTP sub-system is available and will be installed when required for the commissioning steps.
Changes: None.
Concerns: Tight schedule for on-detector muon-trigger electronics.
Plans: Proceed with the construction and commissioning phases for all components, start in-situ installation.

7.2 High Level Trigger, DAQ and Detector Control System

Status: The HLT, DAQ and DCS work proceeds according to plan. There has been further progress on system performance and scalability studies; the latter are particularly important for the staging needs during the initial running of ATLAS. Major activities concentrate on all aspects of HLT and DAQ software developments. For the HLT and DAQ hardware a pre-series system is installed and operational, hardware and software are now commissioned. An exploitation plan was developed and documented for the assessment of the functionality of the full ‘vertical slice’, including level-2 and event filter algorithms using simulated data sets. An important element was the setting up of local DAQ capability as used for initial detector system commissioning, the so-called Read Out Driver (ROD) crate DAQ. Also the operational infrastructure at Point-1 has started to become active (central file server

and a number of local service machines operational with standard DAQ software, system administration, and networking). The DCS is already widely used and is one of the first systems being operational, at least in part, in the underground installations at Point-1.
Changes: None.
Concerns: The performance of the initial system might be limited by the availability of funds, implying deferrals of processors as foreseen by the Completion Plan, in the case that not all the Cost to Completion resources become available.
Plans: Finalize optimization of the HLT/DAQ/DCS system and continue software developments, exploit the full pre-series system test at Point-1. Extend online software infrastructure as well as DAQ and DCS tools for detector commissioning.

8. Computing, Software and Physics Preparation

Status: The running of Data Challenges (DCs) has been the major computing focus for several years. After completion of DC2 earlier in 2005 giving input to the resources estimates for the Computing Model, a first very broad computing campaign involving mainly non-expert users was launched to simulate events for the 5th ATLAS Physics Workshop which took place in Rome in early June 2005. About 10 Million events were simulated with GEANT4, and the operation was based entirely on POOL persistency and GRID infrastructure (three GRID flavours were used: LCG/EGEE 65%, GRID-3 24%, and NORDUGRID 11%). The data were used for large-scale physics studies, with an emphasis on commissioning the detector and early physics for the first years of LHC.

This large-scale distributed computing activity was fully embedded into the framework of the CERN LHC Computing Grid Project (LCG) of which ATLAS is a very active partner. The operation was largely successful and revealed in a constructive spirit several areas where improvements need to be achieved, and which are now being followed up, in order to reach the planned efficient and smooth running of the collaboration-wide computing for LHC turn-on. A further large effort for the computing was the simulation and analysis for the data from the combined test beam 2004 with as many as possible real components of the software and computing framework deployed as a real-life test.

The computing system commissioning goals are being pursued with the aim to have by mid-2006 a fully working system with all the minimal required functionality, including in particular calibration and alignment procedures, the full trigger chain, Tier-0 reconstruction and data distribution, and last but not least distributed access to the data for analysis. One major goal remains to collect real cosmic ray data from Point-1, which will be used to demonstrate all these steps. The ATLAS computing plans have been documented in the Computing Technical design report (CERN/LHCC/2005-022) that was submitted for evaluation to the LHCC at the end of June 2005.

Much attention over the recent years has been drawn onto the lack of core-computing and infrastructure manpower. Funding Agencies have made significant, acknowledged steps in helping ATLAS to overcome a good part of the deficit, even though the most critical area of infrastructure services tasks is still not yet fully covered. The latter area has been addressed in the Addendum to the M&O MoU approved at the last RRB, and in the budget request for 2006. These service tasks are crucial to enable ATLAS to exploit efficiently the LCG as well as the computing resources available in the collaborating Institutions.
Changes: None.

Concerns: Current shortage of experiment-specific manpower for infrastructure and service tasks (addressed now by the Addendum to the M&O MoU).
Plans: Consolidate and commission the software and computing for a collaboration-wide, distributed approach, in full coherence with LCG. Further improve the usability of the software, and implement all minimally required functionalities.

9. ATLAS Detector Infrastructure

Status: A large part of the heavy radiation shielding components has been delivered to CERN; still missing is the part inside the end-cap toroid support tubes because of fabrication delays. The installation and commissioning of the electrical power distribution is well advanced in the underground control rooms, and a large part is operational. The underground cryogenics plants for the magnet system and the LAr calorimeters proceed well with their commissioning. Continued attention is paid to the overall engineering and integration of the detector, including internal access structures. Naturally, the Technical Coordination activities include all aspects concerning safety and controls.
Changes: None.
Concerns: There are no remaining major technical concerns.
Plans: Completion of the infrastructure components. Close the few remaining engineering issues, and finalize the installation of all the safety systems.

10. ATLAS Detector Installation

Status: The most visible progress in the detector installation in the underground cavern over the past half year is the completion of the mechanical assembly of the eight coils of the BT. In the coming months the cryogenics connections between the coils through the so-called cryo-ring will be completed, and the temporary BT support platforms will be dismounted. The full central calorimeter barrel (Tile Calorimeter and LAr EM Calorimeter cryostat, including also the Central Solenoid) was assembled on the support structure under the smaller of the two access shafts. It is planned that it will be moved into the final position at the center of the BT at the end of October 2005. Interleaved with the BT installation the first barrel muon stations were put into place. The installation will reach a peak-activity in the coming months with continuous barrel muon station installation and parallel assembly of the end-cap calorimeter cylinders under both shafts as mentioned before. Furthermore, a massive effort of services and cable installations will continue and go on into 2006. The planning of the activities in the cavern is displayed in Figure 1.
Changes: None, however continuous optimization of detailed installation work planning is necessary to adapt to often rapidly changing technical challenges.
Concerns: Inherent risks by the overall complexity of the installation process, including the cabling and services.
Plans: Movement of the central barrel into its final position (end October 2005), assembly of the end-cap calorimeters under the two access shafts (starting in November 2005 and February 2006), mounting of muon chamber stations continues. Services and cable installations also continue.

11. Milestones and Schedule

Status: The LHCC milestone progress is displayed, in Figure 2, in an integrated way, by the fraction passed, as compared to the baseline planning with respect to the last

revision agreed with the LHCC (end 2004). The current installation schedule (Version 7.09) is shown in Figure 3 which foresees the beam pipe closed in the first half of May 2007. The installation of the forward shielding and of the end-wall muon chambers will be completed in June 2007 (ready for beam end of June 2007). Note that the detector is being commissioned gradually as components are installed, and the plans are that this will lead into a global commissioning and cosmic ray running well before LHC start-up in July 2007.
Changes: None.
Concerns: There is no contingency left, neither in the overall installation schedule nor in several detector component construction schedules, and a delay of about four weeks has been accumulated since the beginning of the year, which put the global commissioning period at risk.
Plans: A detailed and regular installation schedule follow-up procedure is in place that allows Technical Coordination to anticipate and act on changes. Continue the regular monitoring of the construction progress using the Project Progress Tracking (PPT) tool as well as the LHCC milestones.

12. Updates on the Completion Planning

At the RRB meeting in October 2002 a Completion Plan for the initial ATLAS detector was approved. This plan (CERN-RRB-2002-114rev1) took into account the Cost to Completion (CtC) for the parts that are not covered as deliverables, and included the Commissioning and Integration (C&I) pre-operation costs until 2006. It fitted into the framework of the available resources agreed to at that RRB meeting by the Funding Agencies (called category 1 funding in Annex 2 of the above document). The document also included an indication of further funding prospects without commitments yet from the Funding Agencies (called category 2). The detailed implementation of the plan was understood to evolve within the specified overall framework when further financial commitments would become available. The CtC envelope was 68.2 MCHF, whereas category 1 funding amounted then to 46.5 MCHF, therefore imposing on ATLAS at that time a scheme to stage and defer components and activities from its initial detector configuration, in order to redirect a total of 21.7 MCHF to cover the difference.

The detector construction and integration have since continued within this framework. Constructive interactions have been pursued with funding partners. The ATLAS Collaboration is very grateful to all Funding Agencies that committed, initially and more recently, funding towards the CtC. Since the last RRB report ATLAS is pleased to acknowledge an increase in the CtC funding thanks to CEA France and NSERC Canada. The Collaboration also kindly reminds all Funding Agencies that have not yet committed to their proposed share of CtC funding to continue their utmost efforts to secure the missing resources. Only a strong and solid solidarity across all funding partners will allow the Collaboration to complete its powerful detector to fully exploit the great LHC physics opportunities as early as possible.

The updated CtC funding planning is given in Table 1, which shows currently a category 1 funding of 57.8 MCHF and a category 2 funding prospect of 4.8 MCHF. This means that the agreed Completion Plan remains valid, within this funding framework, which will force ATLAS to implement a start-up configuration with limited initial performance, in particular having a reduced trigger rate capability.

15 September 2005 | CERN-RRB-2005-088

Cost to Completion Funding Planning (all in kCHF)
(revised 15th September 2005)

Funding Agency	Cost to Completion proposed sharing Total	Constr. Comp.	C&I	Member fee 2004-6 (included in Constr. Comp.)	New funding (category 1) including member fee Total	New funding requests as prospects (category 2) without commitment from FA Total
Armenia	66	48	18	38	45	
Australia	357	242	115	75	140	238
Austria	67	52	15	38	67	
Azerbaijan	43	38	5	38	38	
Belarus	85	75	10	75	75	
Brazil	64	47	17	38	41	
Canada	2090	1528	562	263	2090	0
China NSFC+MSTC	141	99	42	38	141	
Czech Republic	316	196	120	113	316	
Denmark	422	290	132	38	58	375
France IN2P3	5890	4176	1714	225	4260	1630
France CEA *)	1940	1379	561	38	1334	
Georgia	42	37	5	38	38	
Germany BMBF	4531	3250	1281	338	4531	0
Germany MPI	1093	761	332	38	1093	
Greece	261	173	88	113	113	148
Israel	739	497	242	113	739	
Italy	6638	4650	1988	450	4000	
Japan	4362	3029	1333	563	4362	
Morocco	57	47	10	38	41	
Netherlands	1934	1368	566	75	1934	
Norway	581	391	190	75	581	
Poland	136	94	42	75	80	56
Portugal	446	265	181	38	339	107
Romania	140	85	55	38	140	
Russia	2991	1995	996	263	1561	212
JINR	1066	660	406	38	521	
Serbia					300	
Slovak Republic	72	53	19	38	82	
Slovenia	223	152	71	38	223	
Spain	1706	1109	597	113	1706	
Sweden	1691	1121	570	150	1691	
Switzerland	2372	1701	671	75	1560	812
Taipei	445	318	127	38	445	
Turkey	85	75	10	75	75	
United Kingdom	4387	3063	1324	450	3133	1254
US DOE + NSF	12245	8438	3807	1238	6200	
CERN	8452	5770	2682	38	13700	
Total	**68176**	47272	20904	5563	**57793**	4832

*) The commitment shown does not include a 1 MCHF additional engineering contribution provided on the initial BT contract (see MoU Annex 8.A

Table 1

ATLAS Installation Activities in the Cavern

20-Oct-2004

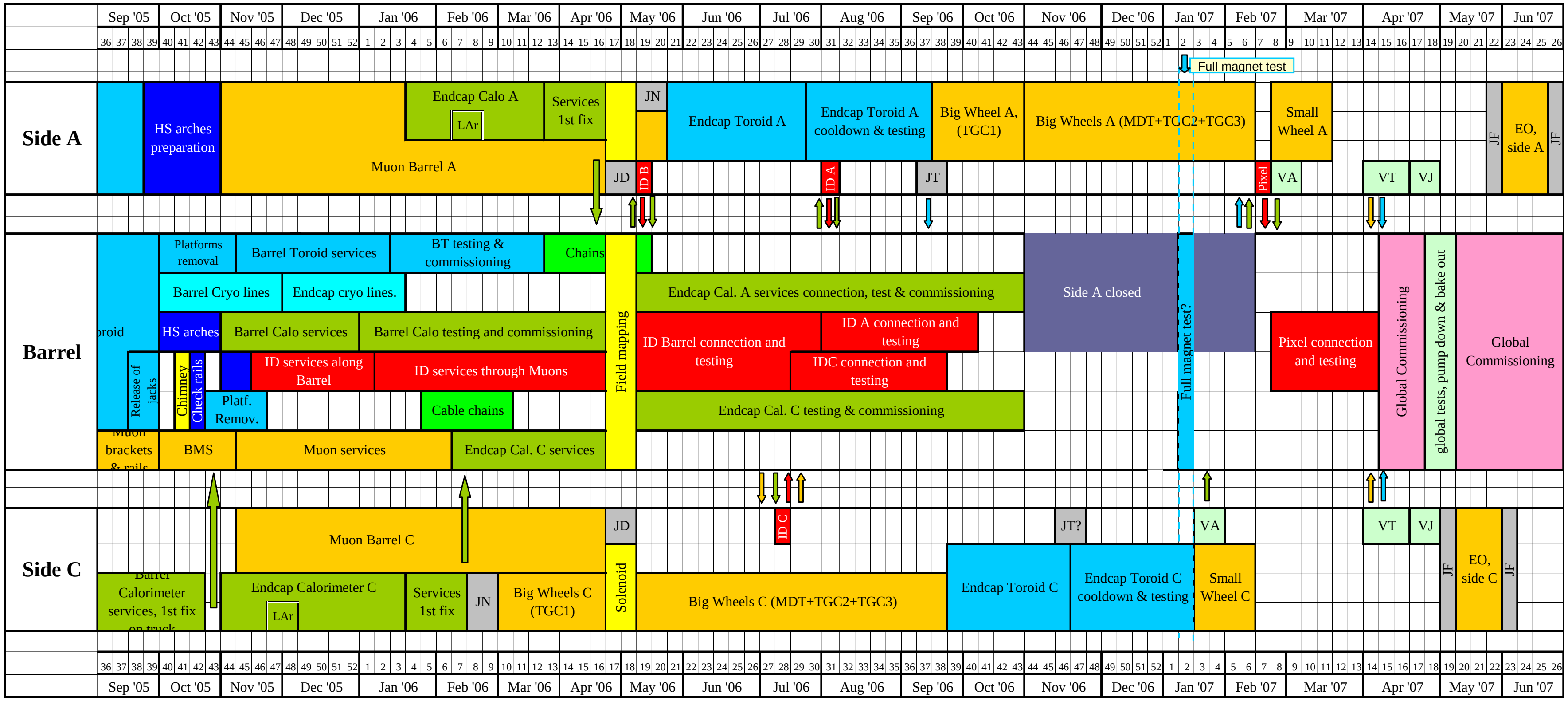

Figure 1

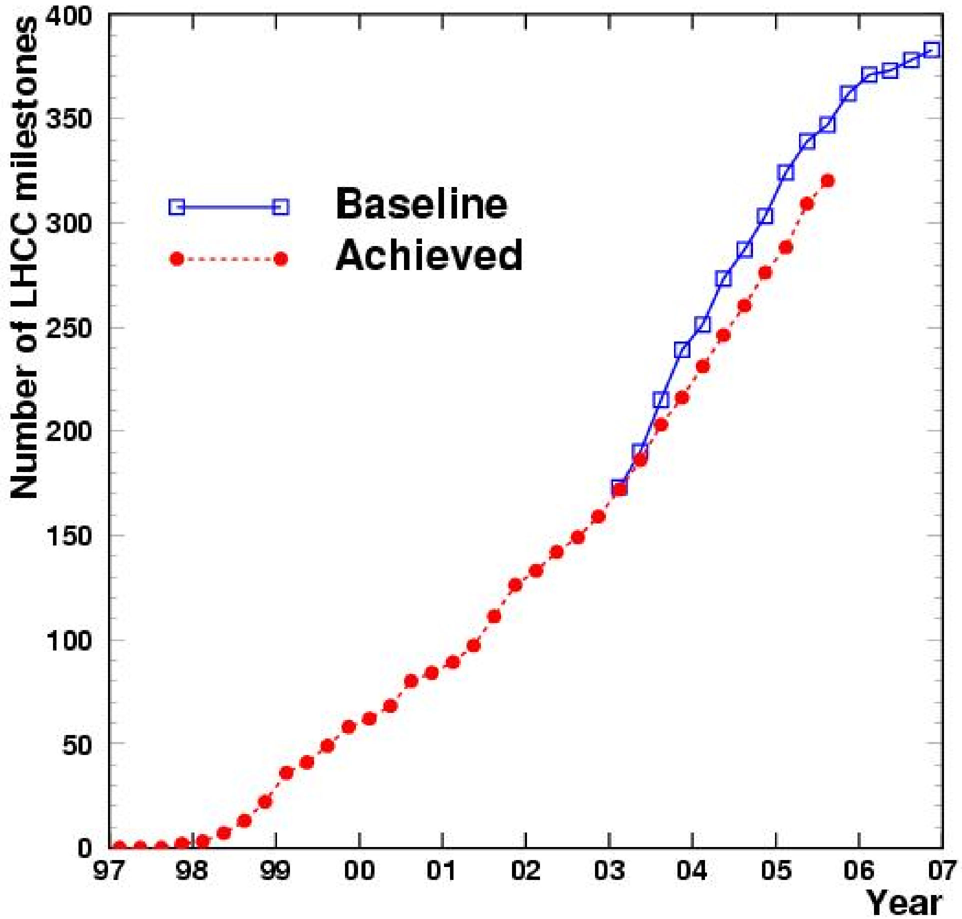

Figure 2: Integrated LHCC Milestone Plot

Task Name	Start	Finish
PHASE 2: Barrel Toroid & Barrel Calorimeter	03 Sep '03	31 Jul '06
Phase 2b: Barrel Toroid	15 Mar '04	14 Feb '06
Phase 2c: Barrel Calorimeter	07 Jan '04	31 Jul '06
Phase 2d: Racks, Pipes & Cables	29 Nov '04	15 Dec '05
PHASE 3: End-cap Calorimeters & Muon Barrel	23 May '05	12 Dec '06
Phase 3a: Pipes & Cables	23 May '05	26 Sep '06
Phase 3b: Endcap Calorimeter C	26 Oct '05	27 Oct '06
Phase 3c: Muon Barrel	28 Sep '05	22 May '06
Phase 3d: Endcap Calorimeter A	24 Jan '06	12 Dec '06
PHASE 4: Big Wheels C, Inner Detector	15 Feb '06	03 Apr '07
Phase 4a: Big Wheels, side C	15 Feb '06	14 Sep '06
Phase 7a: Big Wheels, side A	14 Sep '06	13 Feb '07
Phase 4b: Inner Detector	11 May '06	03 Apr '07
PHASE 5: End-cap Toroid	23 May '06	25 Jan '07
Phase 5a: Flexible chains	16 Jun '06	12 Oct '06
Phase 5b: End-Cap Toroid A	23 May '06	26 Sep '06
Phase 5c: End-Cap Toroid C	29 Sep '06	25 Jan '07
Full Magnet Test	12 Jan '07	18 Jan '07
PHASE 6: Beam Vacuum, Small Wheels, Start closing	21 Nov '06	08 May '07
Phase 6a: Small Wheels	21 Nov '06	13 Mar '07
Phase 6b: Beam Vacuum, both sides	04 Apr '07	08 May '07
PHASE 7: Forward Shielding & End wall chambers	01 May '07	21 Jun '07
Phase 7a: Forward Shielding & End wall Chambers (EO)	02 May '07	21 Jun '07
Beam Pipe closed	*01 May '07*	*01 May '07*
Global Commissioning	04 Apr '07	26 Jun '07
ATLAS Ready For Beam	*26 Jun '07*	*26 Jun '07*
Cosmic tests	27 Jun '07	21 Aug '07

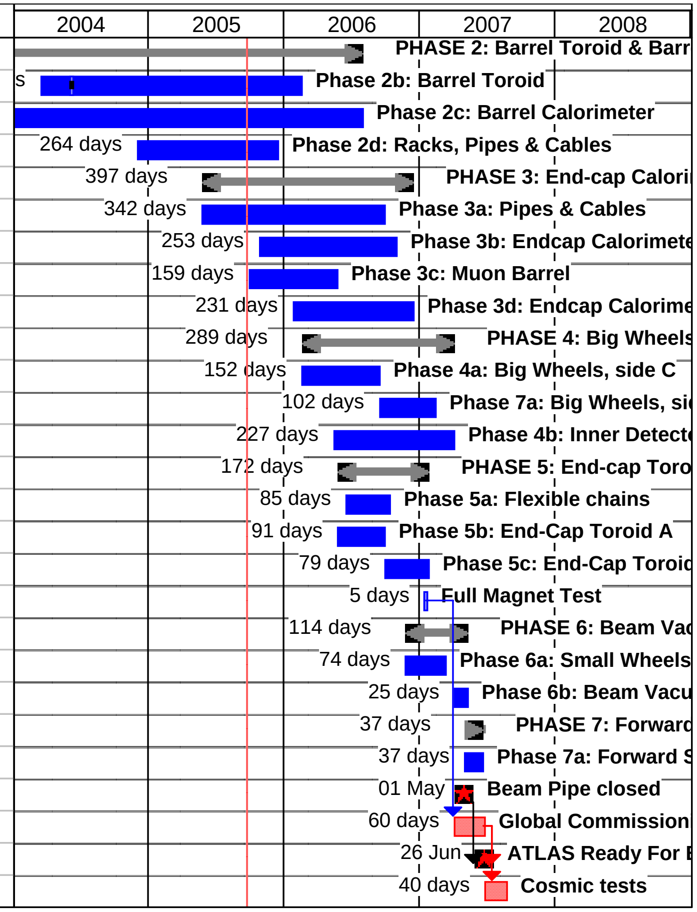

Figure 3: ATLAS Installation Schedule Version 7.09