ATLAS RRB-D 2001-121
22 October, 2001

ATLAS Construction Completion and Pre-Exploitation Costs for the Initial Detector

Introduction

During the fall of 2000 and in summer 2001, ATLAS has carried out extensive internal reviews to bring up-to-date the completion and pre-exploitation costs for the initial detector (see ATLAS RRB-D 2001-118). The preliminary results of these reviews have been presented in the RRB, and the updated and refined evaluations have been submitted to the LHCC CORE and MAG Review Committees and the RRB Scrutiny Committee for closer examination, respectively.

The revised cost estimates result from several changes that have occurred since laying out the original cost planning assumptions for the 475 MCHF (in 1995 prices), described in the ATLAS Construction Memorandum of Understanding (RRB-D 98-44 rev.). These changes are as follows:

1. Technical developments. Several changes have since taken place in the original detector design based on R&D results and real engineering designs, in the cost of components manufacturing in industry, in the nature of required (pre-)assembly tooling and in the scope of laboratory operations supporting planned construction activities in the experimental area;

2. Technical services charged to the Collaboration. A number of services provided by CERN as Host Laboratory (in the days of LEP) are now being charged to the Collaboration (e.g. cryogenics operation, electricity, services such as crane operation, heavy handling etc.);

3. Availability of technical manpower at CERN during the commissioning and integration period. Due to the decrease in global manpower at CERN and in absence of adequate technical manpower in external institutes available for working at CERN to fill the identified manpower gap, a series of tasks need to be outsourced to external service provider companies.

The first point in particular has resulted in additional CORE and non-CORE items that were not foreseen in the construction MoU. The second and third point has contributed to Maintenance & Operation and Commissioning & Installation related costs.

Financial overview (2002-2006)

1. Construction completion costs, amounting to **52.0 MCHF** (2001 prices):

Over costs in Common Projects:	29.7	MCHF
Additional CORE items:	6.1	MCHF
Non-covered CORE MoU funding:	4.4	MCHF
Additional non-CORE items:	11.8	MCHF

Details on the nature of the above supplementary costs are provided in Table 1. These supplementary costs are divided into system-specific and commonly shared items. A reporting mechanism is also proposed.

The cost sharing is proposed to be based on CORE contributions. An extended membership fee is proposed for the years 2004 – 2006. Using this as a guideline, a cost sharing across the Funding Agencies is drafted in Table 2.

Over costs associated with the in-kind deliverables are assumed to be handled by the respective Funding Agencies, their efforts being gratefully acknowledged by the Collaboration. These are presented by the national communities directly to their Funding Agencies.

The planned total payment profile is as follows (MCHF):

Nature of cost	**2002**	**2003**	**2004**	**2005**	**Total**
1. Construction completion	9.6	21.2	15.4	5.8	**52.0**

2. Pre-exploitation costs (Categories ‘A’, ‘B’, ‘C’), amounting to **46.0 MCHF** (2001 prices):

a. Maintenance & Operation (M&O):	24.9	MCHF
b. Commissioning & Integration (C&I):	21.1	MCHF

The nature of M&O costs and the mechanism for sharing costs is described in the draft MoU for M&O (RRB-BINGO-D 2001-5). Before 2006, a large fraction of the costs are associated with test beam activities, cryogenics operations and general services in the experimental area, including electricity. Category ‘A’ items are to be shared in common whereas category ‘B’ items are systems specific.

C&I includes supporting activities outside the underground area. These activities include large system-specific integration activities at CERN coordinated by the Technical Coordination, operation of assembly areas and laboratory facilities at CERN. Category ‘A’ items are to be shared in common whereas category ‘B’ items are systems specific.

Table 3 summarizes the total M&O and C&I costs up to 2005, separated in Categories 'A' and 'B'.

Figure 1 shows the evolution of M&O and C&I costs up to 2005.

Table 4 provides a cost sharing scenario (excluding Category 'C') using the number of authors as a basis for determining the sharing of M&O Category A costs and CORE contributions for the remaining items.

The planned total payment profile is as follows (MCHF):

Nature of cost	**2002**	**2003**	**2004**	**2005**	**Total**
2a. Pre-exploitation (M&O)	3.4	4.4	5.8	11.3	**24.9**
2b. Pre-exploitation (C&I)	3.1	5.5	7.5	4.9	**21.1**
TOTAL (M&O and C&I)	**6.5**	**9.9**	**13.3**	**16.2**	**46.0**

It should be noted that the above payment profile (including Category 'C') is being currently re-assessed. A number of actions are being taken to further optimize existing resources.

Conclusions

The following conclusions are made:

1. Due to changes in the original assumptions used for estimating the CORE construction costs (475 MCHF, in 1995 prices), additional funds are needed to complete and pre-operate the ATLAS detector;

2. The needed total funding for covering supplementary costs, C&I as well as M&O (all Categories) amount to 98 MCHF (in 2001 prices);

3. The above estimates do not include over costs on in-kind deliverables, which are assumed to be handled by the respective Funding Agencies;

4. In order to keep the project on schedule, the ATLAS management kindly requests Funding Agencies to contribute towards the identified funding shortfall according to Tables 2 and 4 as a guideline.

Table 1 - SUPPLEMENTARY COSTS ITEM LIST

		Cost (kCHF)		RRB to:		
Nature of Cost	**Item Description**	**System specific**	**Common items**	**De-cide**	**Be in-formed**	**Notes**
1 CORE over-run (CP)	**Cost over-runs on CORE items**	**0**	**29.7**			
1.1 Barrel Toroid Magnet	Engineering & Inspection		1.2	yes		Additional engineering work requested from LASA and US
	Warm structure		1.5	yes		Cost increase in Aluminium (boxes, bolts). Under negotiation
	Coil casing		2.0	yes		Cost increase in Alu. and welding. Sharing under negotiation
	Integration 1 & 2		0.6	yes		Additional manpower needed wrt original planning
	Vacuum vessels		0.5	yes		Transportation option in contract necessary to use
	Tie rods		0.6	yes		Add. material (heads), proof testing
	Cryoring		0.5	yes		Design and cost update
	Installation in cavern		1.0	yes		Additional manpower needed wrt original planning
1.2 End Cap T. Magnet	Engineering & Inspection (contract eng.)		2.1	yes		Additional manpower needed wrt original planning
	Engineering & Inspection		2.9	yes		Exchange rate effects (contract in Pounds)
	Engineering of Common Cryogenics		1.7	yes		Additional engineering requested wrt origanl scope of work
	Cold mass		1.0	yes		Redundant cooling system, manufacturing cost increase
	Assembly, integration and controls		2.0	yes		Additional manpower needed wrt original planning
	Cryogenics/External system		1.0	yes		Design and cost update
	Cryogenics/Proximity & Installation		1.0	yes		Additional manpower needed wrt original planning
1.3 LAr Cryostat & Cryo.	Various items		1.0	yes		Design and cost update
	Integration		1.3	yes		Add. mpower needed wrt original planning. Under negotiation)
1.4 Infrastructure	Shielding elements		1.2	yes		Refined design
	Shielding elements		1.0	yes		Reduction in Russian deliverables
	Traction system to move BT, Calorimeters		1.9	yes		Refined design, manufacturing cost increase
	Access structures (lifts inside detector)		0.8	yes		Refined design and access scenarios
	Support structures		1.4	yes		Refined design,
	Muon wheel supports		1.5	yes		Refined design, overcosts related to deliverables

Table 1 - SUPPLEMENTARY COSTS ITEM LIST

		Cost (kCHF)		RRB to:		
Nature of Cost	**Item Description**	**System specific**	**Common items**	**De-cide**	**Be in-formed**	**Notes**
2 Additional CORE	**Resulting from R&D work, new items**	**6.1**				
2.1 Systems	ID tooling, test stations, assembly	2.5			yes	Refined desings, not included in the MoU
	LAr integration parts, cryostat transports	0.6			yes	Refined desings, not included in the MoU
	TileCal tooling, cooling, trigger cables	1.2			yes	Refined desings, not included in the MoU
	Muon CSM modules, small wheels supp.	1.8			yes	Refined designs, not included in the MoU
3 Non-covered CORE	**Missing funding in construction MoU**	**2.1**	**2.3**			
3.1 Systems	ID installation tooling	0.3			yes	Originally planned as a swap with Russian deliverables
	LAr EM End Cap components	0.8			yes	Funding for various components not covered
	LAr Electronics	1.0			yes	Funding for various components not covered
3.2 Common Projects	Missing contributions to Common Fund		2.3	yes		Funding missing after 2 new institutes, one withdrawal
4 Additional non-CORE	**Installation support activities at CERN**	**3.3**	**8.5**			**Items originally not considered as Collab. responsibility**
4.1 Systems	ID SR-building for (pre-)assembly, integr.	1.6			yes	Planned to be arranged as M&O advancement
	LAr integration clean room area in B180	1.2			yes	Arranged as a payment advancement within community
	Muons storage areas, equipped labs	0.5			yes	Lack of available storage facilities at CERN
4.2 Tech. Coordination	Electrical distribution		1.0	yes		Assumed as a CERN responsibility
	Vacuum chamber		2.0	yes		Changes in design, R&D production of prototypes
	Cooling & ventilation		2.0	yes		Assumed as a CERN responsibility
	Flexible support carriers		1.4	yes		Changes in design, more complex
	Varia - racks, gas etc.		0.7	yes		Assumed in part as a CERN responsibility
	Safety detectors		1.4	yes		Fire detection/extinguishing in detector area
	TOTAL	**11.5**	**40.5**	**52.0**		

10/1/2001

Planned Supplementary Payments for ATLAS Detector Construction 2002-2006 (Draft, in kCHF)

	System-specific (for IB)			Common items (for RRB)			
	Infrastr; add. CORE (excl. TCn)	Non-covered CORE (excl. CF)	TOTAL (kCHF)	Infra-structure (TCn part)	Missing CORE CF (over costs, non-covered)	TOTAL (kCHF)	GRAND TOTAL (kCHF)
Armenia	7	0	**7**	4	34	**38**	**45**
Australia	52	5	**57**	45	170	**215**	**272**
Austria	0	0	**0**	12	46	**59**	**59**
Azerbaijan	0	0	**0**	4	34	**38**	**38**
Belarus	0	0	**0**	4	34	**38**	**38**
Brazil	6	0	**6**	4	34	**38**	**44**
Canada	196	198	**393**	271	1019	**1290**	**1683**
China NSFC+MSTC	23	7	**30**	16	62	**78**	**108**
Czech Republic	63	2	**65**	25	93	**117**	**183**
Denmark	61	3	**64**	57	216	**274**	**338**
Finland	0	0	**0**	4	34	**38**	**38**
France IN2P3	738	428	**1166**	697	2605	**3303**	**4469**
France CEA	246	134	**381**	238	896	**1134**	**1514**
Georgia	0	0	**0**	4	34	**38**	**38**
Germany BMBF	663	105	**768**	583	2178	**2761**	**3529**
Germany MPI	181	44	**225**	135	510	**645**	**870**
Greece	52	0	**52**	29	108	**137**	**188**
Israel	134	0	**134**	86	324	**410**	**545**
Italy	1072	107	**1178**	812	3043	**3855**	**5034**
Japan	610	26	**636**	574	2152	**2726**	**3362**
Morocco	5	5	**10**	4	34	**38**	**48**
Netherlands	237	7	**244**	275	1035	**1310**	**1553**
Norway	81	9	**90**	74	278	**352**	**442**
Poland	21	2	**23**	16	62	**78**	**101**
Portugal	72	0	**72**	37	139	**176**	**248**
Romania	22	0	**22**	12	46	**59**	**80**
Russia + JINR	727	143	**869**	505	1885	**2389**	**3259**
Slovak Republic	7	7	**14**	8	34	**42**	**56**
Slovenia	31	3	**34**	29	108	**137**	**171**
Spain	239	59	**298**	176	664	**840**	**1138**
Sweden	262	48	**309**	193	726	**919**	**1228**
Switzerland	208	43	**251**	349	1313	**1661**	**1913**
Taipei NSC	53	20	**73**	53	201	**254**	**328**
Turkey	0	0	**0**	8	34	**42**	**42**
United Kingdom	474	49	**523**	615	2307	**2922**	**3445**
US DoE + NSF	1812	442	**2254**	1456	5453	**6909**	**9163**
CERN	1016	236	**1252**	1083	4056	**5139**	**6391**
total	**9,370**	**2,130**	**11,500**	**8,500**	**32,000**	**40,500**	**52,000**

Table 2

ATLAS M&O AND C&I PAYMENTS 2002-2005 (kCHF)

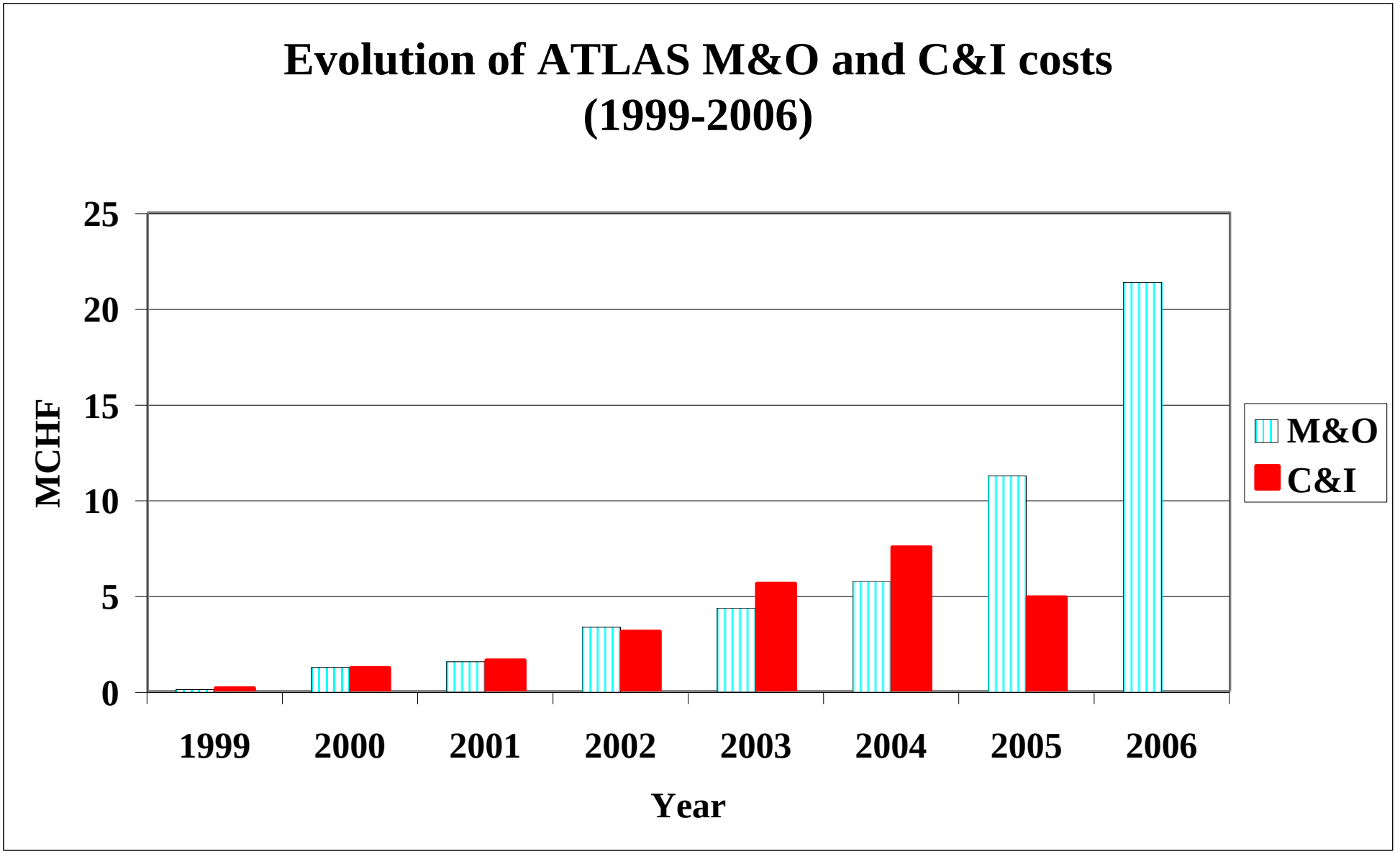
Item	Category 'A'		Category 'B'		Item
	M&O	C&I	M&O	C&I	
Detector related costs	3,410	7,295	2,430	6,980	**Detector related costs**
Secretariat	565				**Secretariat**
Communications	60			85	**Communications**
On-line computing	3,400			760	**On-line computing**
Test beams	1,360	785	2,150		**Test beams**
Laboratory operations	730			3,465	**Laboratory operations**
General services	10,190			1,285	**General services**
Consultancy	360			415	**Consultancy**
Outreach	275				**Outreach**
TOTAL	**20,350**	**8,080**	**4,580**	**12,990**	**TOTAL**

TOTAL (M&O + C&I) FOR A	**28,430**	**17,570**	**TOTAL (M&O + C&I) FOR B**
TOTAL (M&O + C&I)		**46,000**	

Including Categories A+B+C

Table 3

Figure 1


Evolution of ATLAS M&O and C&I costs
(1999-2006)
MCHF
25
20
15
10
5
0
1999
2000
2001
2002
2003
2004
2005
2006
Year
M&O
C&I

Planned M-O and C-I expenses for ATLAS 2002-2005 by Funding Agency, based on authors for M-O (A) and CORE for the others (Draft, kCHF)

	Category A*		Category B		TOTAL
	M&O+	C&I	M&O	C&I	kCHF
Armenia	39.3	3.9	5.2	14.7	**63.1**
Australia	108.0	42.9	9.9	28.0	**188.8**
Austria	58.9	11.7	0.0	0.0	**70.6**
Azerbaijan	68.7	3.9	0.0	0.0	**72.6**
Belarus	137.5	3.9	0.0	0.0	**141.4**
Brazil	49.1	3.9	4.6	13.2	**70.8**
Canada	471.4	257.4	115.8	328.5	**1173.1**
China NSFC+MSTC	245.5	15.6	10.2	28.8	**300.1**
Czech Republic	373.2	23.4	39.4	111.7	**547.7**
Denmark	49.1	54.6	25.3	71.8	**200.8**
Finland	9.8	3.9	0.0	0.0	**13.7**
France IN2P3	1473.1	662.9	445.1	1262.5	**3843.7**
France CEA	550.0	226.2	118.8	336.9	**1231.9**
Georgia	186.6	3.9	0.0	0.0	**190.5**
Germany BMBF	933.0	553.7	302.2	857.0	**2645.9**
Germany MPI	255.3	128.7	83.8	237.6	**705.4**
Greece	255.3	27.3	20.7	58.8	**362.2**
Israel	245.5	81.9	53.9	152.9	**534.2**
Italy	1355.3	772.1	561.2	1591.8	**4280.4**
Japan	481.2	545.9	191.8	543.9	**1762.9**
Morocco	49.1	3.9	2.6	7.4	**63.1**
Netherlands	373.2	261.3	107.8	305.7	**1048.0**
Norway	157.1	70.2	37.5	106.5	**371.4**
Poland	255.3	15.6	7.2	20.4	**298.5**
Portugal	167.0	35.1	54.6	154.8	**411.4**
Romania	147.3	11.7	16.4	46.4	**221.8**
Russia + JINR	2357.0	479.7	406.0	1151.6	**4394.3**
Slovak Republic	235.7	7.8	3.9	11.1	**258.4**
Slovenia	58.9	27.3	5.9	16.9	**109.0**
Spain	441.9	167.7	145.2	411.8	**1166.6**
Sweden	402.7	183.3	123.4	350.1	**1059.5**
Switzerland	167.0	331.5	48.5	137.6	**684.6**
Taipei NSC	98.2	50.7	16.0	45.4	**210.4**
Turkey	147.3	7.8	0.0	0.0	**155.1**
United Kingdom	1571.3	584.9	153.8	436.1	**2746.2**
US DoE + NSF	2573.1	1384.4	893.5	2534.3	**7385.3**
CERN	1276.7	1029.5	569.7	1615.7	**4491.6**
total	**17,825**	**8,080**	**4,580**	**12,990**	**43,475**

* Rebates are not yet applied
* Category 'C' costs are not included
+ TDR author list, PhD students included. To be updated without PhD student

Table 4