

1. Introduction

The following report summarises

- Current signature status of the Worldwide LHC Computing Grid (WLCG) Memorandum of Understanding (MoU)
- WLCG Phase 2 final financial status
- WLCG funding and expenditure estimates at CERN up to 2013
- Resource accounting for Tier-1 and Tier-2 sites
- Experiment requirements revised as a function of the latest LHC schedule for extended running compared with current resource pledges

Complementary information can be found on the WLCG website <http://lcg.web.cern.ch/LCG/>

2. WLCG Memorandum of Understanding Signature Status

Since the November 2008 C-RRB meeting, Austria has signed the WLCG MoU supporting the ATLAS and CMS experiments.

Two additional Tier-2 Centres were also established and MoU's were signed

- Germany: University of Goettingen supporting ATLAS
- Korea: CHEP supporting CMS

Table 1 presents the current signature status of the WLCG MoU.

Brazil is still planning to join WLCG supporting all 4 experiments. Since the letter sent by the CERN Management in June 2008 to the President of CNPq, the National Financial Support Agency, encouraging signature of the document, there has been continued dialogue in the hope to reach agreement as soon as possible.

	Country	Funding Agency/Signatory	Signature status	Comments
Member States	Austria	BMWF	Y	Signed since last C-RRB
	Belgium	FNRS	Y	
	Belgium	FWO	Y	
	Czech Rep.	MSMT CR	Y	
	Denmark	National Science Research Council	Y	
	Finland	HIP	Y	
	France	CEA/DSM/DAPNIA	Y	
	France	CNRS/IN2P3	Y	
	Germany	ALU/DESY	Y	
	Germany	BUW/DESY	Y	
	Germany	UGOE/DESY	Y	T2 ATLAS Federation signed since last C-RRB
	Germany	FZK	Y	
	Germany	GSI	Y	
	Germany	MPG	Y	
	Germany	LMU	Y	
	Germany	RWTH/DESY	Y	
	Italy	INFN	Y	
	The Netherlands	NIKHEF	Y	
	Norway	Research Council of Norway	Y	
	Poland	The Minister of Science & Education	Y	
Portugal	GRICES/FCT/UMIC	Y		
Spain	MEC	Y		
Sweden	Swedish Research Council	Y		
Switzerland	SER/SNF/ETH/CSCS	Y		
United Kingdom	STFC	Y		
Non-Member States	Australia	AusHEP	Y	
	Canada	CFI	Y	
	China	MoST/NSFC	Y	
	Estonia	NICPB	Y	
	Hungary	NKTH	Y	
	India	DAE	Y	
	Israel	ICHEP	Y	
	Japan	Univ. Tokyo	Y	
	JINR, Dubna	JINR	Y	
	Korea	KICOS	Y	T2 CMS Federation signed since last C-RRB
	Pakistan	PAEC/NCP	Y	
	Romania	National Authority for Scientific Research	Y	
	Russia	Federal Agency for Science & Innovation	Y	
	Slovenia	Ministry of Higher Education, Science and Technology	Y	
	Taipei	Academia Sinica	Y	
Turkey	TAEK	Y		
Ukraine	National Academy of Sciences	Y		
USA	DOE	Y		
USA	NSF	Y		

Table 1: Signature Status of WLCG Memorandum of Understanding on 07/04/2009

In collaboration with the External Relations unit at CERN, interest expressed by other countries to collaborate in the WLCG Project and establish a Tier-2 Centre will be followed-up and may lead to additional MoU signatures in the future.

3. Funding and Expenditure for WLCG at CERN

The final status of LCG Phase 2 at CERN covering the years 2005-2008 is shown in Table 2. This phase of the project ended with a zero personnel balance and a materials balance of 0.6 MCHF, less than the estimate at the last C-RRB meeting due to some advance purchasing of 2009 equipment before the LHC incident.

LCG Phase 2 Final Status after 2008 Book Closing					
	(in MCHF)				
	2005	2006	2007	2008	TOTAL
Funding					
From CERN Budget					
<u>Personnel</u>	1.5	16.5	17.1	17.0	52.1
- <i>Physics Computing</i>		11.6	12.0	13.0	36.6
- IT		8.4	8.8	10.2	27.4
- PH		3.3	3.2	2.8	9.2
- <i>LCG Project</i>	1.5	4.9	5.1	4.0	15.5
- IT	1.2	3.6	3.9	3.0	11.7
- PH	0.3	1.2	1.2	1.0	3.7
<u>Materials</u>	1.8	21.3	18.6	26.2	67.8
- <i>Physics Operations</i>		5.0	5.1	6.2	16.3
- IT		4.5	4.6	5.8	14.9
- PH		0.5	0.5	0.4	1.4
- <i>Tier 0 and CERN Analysis Facility</i>	1.8	16.3	13.5	20.0	51.5
Contributions via Team Accounts*					
- Personnel		2.0	2.2	1.4	5.7
- Material			0.0	0.8	0.8
In-kind Contributions*					
- Personnel		1.4	1.7	0.9	4.0
Total					
- Personnel	1.5	19.8	21.1	19.3	61.7
- Materials	1.8	21.3	18.6	27.0	68.7
Total Funding					
	3.3	41.1	39.7	46.3	130.4
Expenditure					
- <u>Personnel</u> **	1.5	19.8	21.1	19.3	61.7
- <u>Materials</u>	1.8	21.3	18.6	26.3	68.0
- <i>Physics Operations</i>		5.0	5.1	6.2	16.3
- <i>Tier 0 and CERN Analysis Facility</i>	1.8	16.3	13.5	20.1	51.7
Total Planned Expenditure					
	3.3	41.1	39.7	45.6	129.7
Balance Personnel					
	0.0	0.0	0.0	0.0	0.0
Balance Materials					
	0.0	0.0	0.0	0.6	0.6
Balance					
	0.0	0.0	0.0	0.6	0.6
<p>* As pledged and planned to be pledged in the WLCG MoU (Annex 6.6).</p> <p>** - Personnel from EGEE, EGEE-II and EGEE-III participated in LCG at CERN during this phase of the project - Operators Support from Computer Centre participated in LCG at CERN during this phase of the project These resources are not included in this Table.</p>					

Table 2: LCG Phase 2 Final status

Table 3 shows future funding and estimated expenditure for the years 2009-2013. Personnel expenditure is based on detailed long-term planning including current personnel commitments and planned replacements for key activity areas. The personnel balance shows a slight overspend annually when compared with the personnel budget, however in reality unplanned events such as resignations and replacements arriving later than anticipated will impact these estimates and therefore the final annual balance.

The material expenditure is based on detailed long-term planning for the adaptation of the CERN computer infrastructure and services to cope with the expected data from the experiments in line with their most recent requirements. Planning is still ongoing with respect to the recent change in requirements which is likely to impact expenditure.

LHC Future Computing Funding and Expenditure Estimates						
(all figures in MCHF at 28/02/2009)						
	2009	2010	2011	2012	2013	TOTAL
Funding						
From CERN Budget						
- Personnel	13.3	14.5	14.5	13.9	13.9	70.2
- Materials	24.7	23.5	23.5	23.5	23.5	118.7
Contributions via Team Accounts*						
- Personnel	1.5	0.7	0.1			2.3
- Carry-over from Phase 2 Materials	0.6					0.6
In-kind Contributions*						
- Personnel	1.0	1.0				2.0
Total						
- Personnel	15.8	16.2	14.6	13.9	13.9	74.5
- Materials	25.3	23.5	23.5	23.5	23.5	119.4
Total Funding	41.1	39.8	38.1	37.5	37.4	193.9
Expenditure						
- Personnel **	16.1	16.5	15.0	14.4	14.5	76.4
- Materials	24.5	23.3	24.9	21.9	22.9	117.5
Total Planned Expenditure	40.6	39.8	39.9	36.3	37.3	193.9
Balance Personnel	-0.3	-0.2	-0.4	-0.4	-0.5	-1.8
Balance Materials	0.8	0.2	-1.4	1.6	0.6	1.8
Balance	0.5	0.0	-1.7	1.1	0.1	0.0
* As planned to be pledged in the WLCG MoU (Annex 6.6)						
** - Personnel from EGEE-III will participate until April 2010 in LCG at CERN during this phase of the project						
- Operators Support from Computer Centre will participate in LCG at CERN during this phase of the project						
These resources are not included in this Table.						

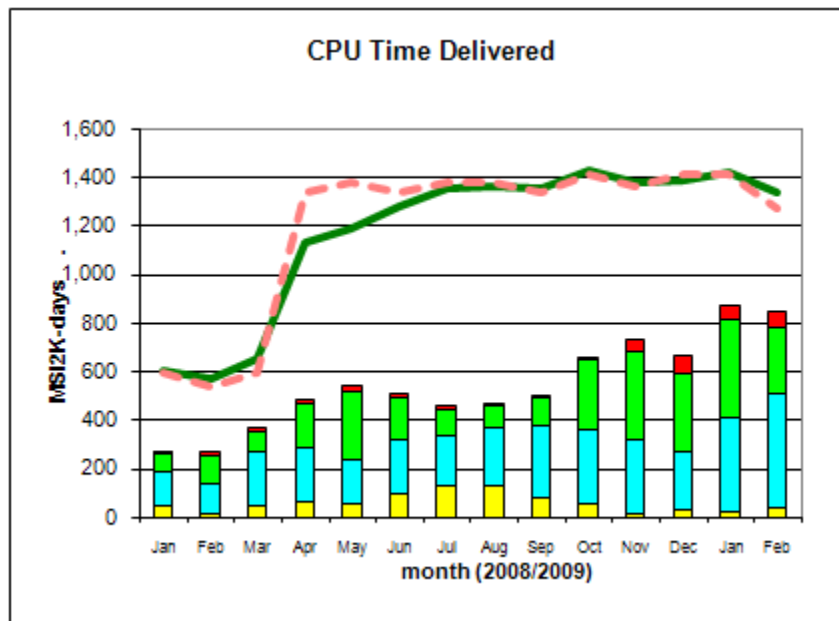
Table 3: LHC Computing Budget Estimates for 2009-2013

4. Resource Accounting

4.1 CERN and External Tier-1 Accounting

Accounting data for CERN and External Tier-1 sites has been reported at the last C-RRB meetings, and full accounting reports covering the years 2006, 2007 and 2008 are available on the LCG website Accounting page <http://lcg.web.cern.ch/LCG/accounts.htm>.

Figure 1 shows the CPU delivered, Disk and Tape used at CERN and the external Tier-1s for the period January 2008-February 2009 inclusive which therefore includes the change to the 2008 pledges in April 2008. Globally these pledge levels were met for CPU, and largely met for tape and disk.



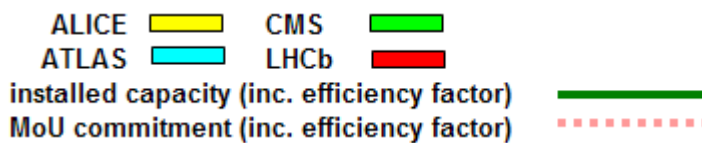
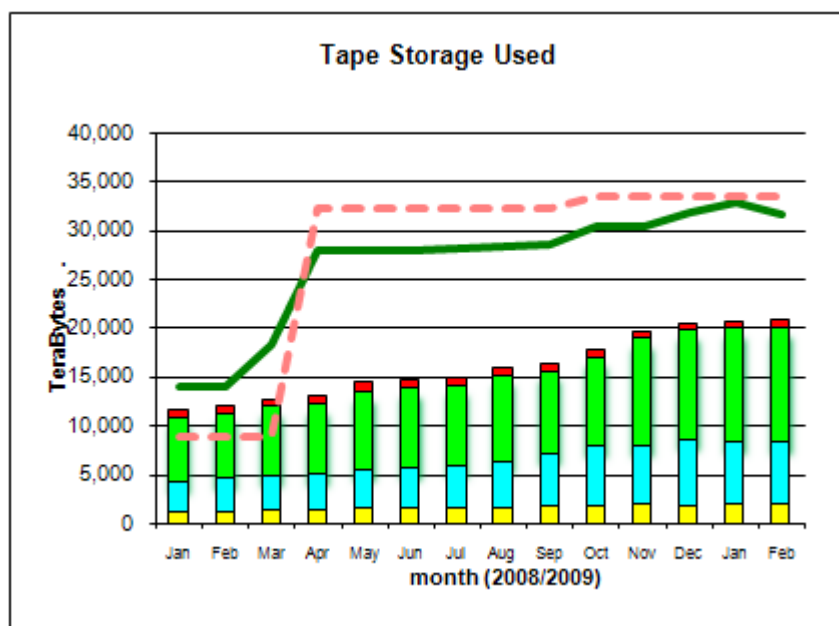
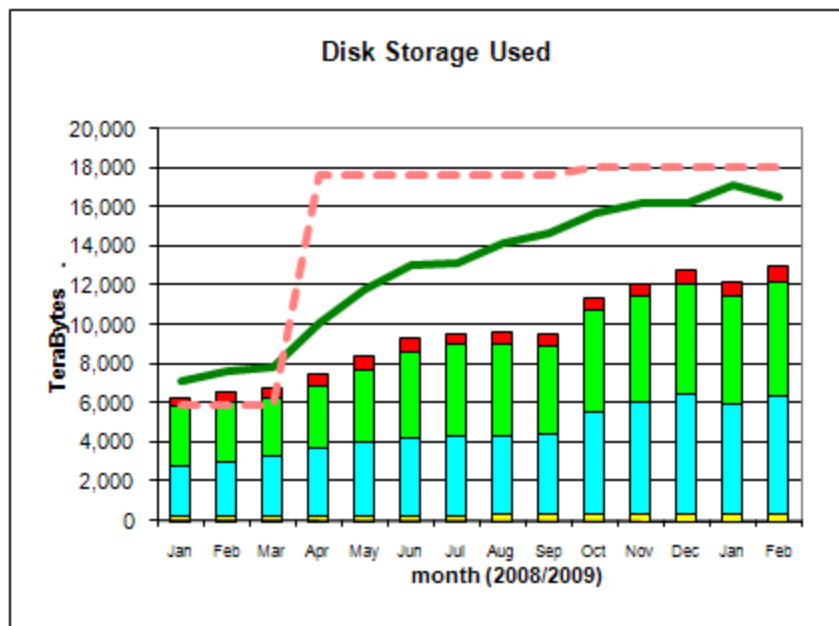


Figure 1: Accounting for CERN and External Tier-1s January 2008-February 2009

4.2 Tier-2 Accounting

Tier-2 accounting began in September 2007 and as for Tier-1 accounting past reports can be found on the LCG website Accounting page <http://lcg.web.cern.ch/LCG/accounts.htm>. It has

taken quite some time to get all Tier-2 sites fully on-board and reporting but this has evolved reasonably positively. Ukraine still has to start reporting, and as can be seen from the graphs below, no CPU usage is being reported by certain Tier 2 sites which is being followed up with the sites concerned.

Figure 2 shows the Federations with MoU pledge values below 800 KSI2K. Figure 3 shows all those with pledge values above 800 KSI2K, in both cases ordered by pledge. The data shows the status for February 2009 for the CPU used.

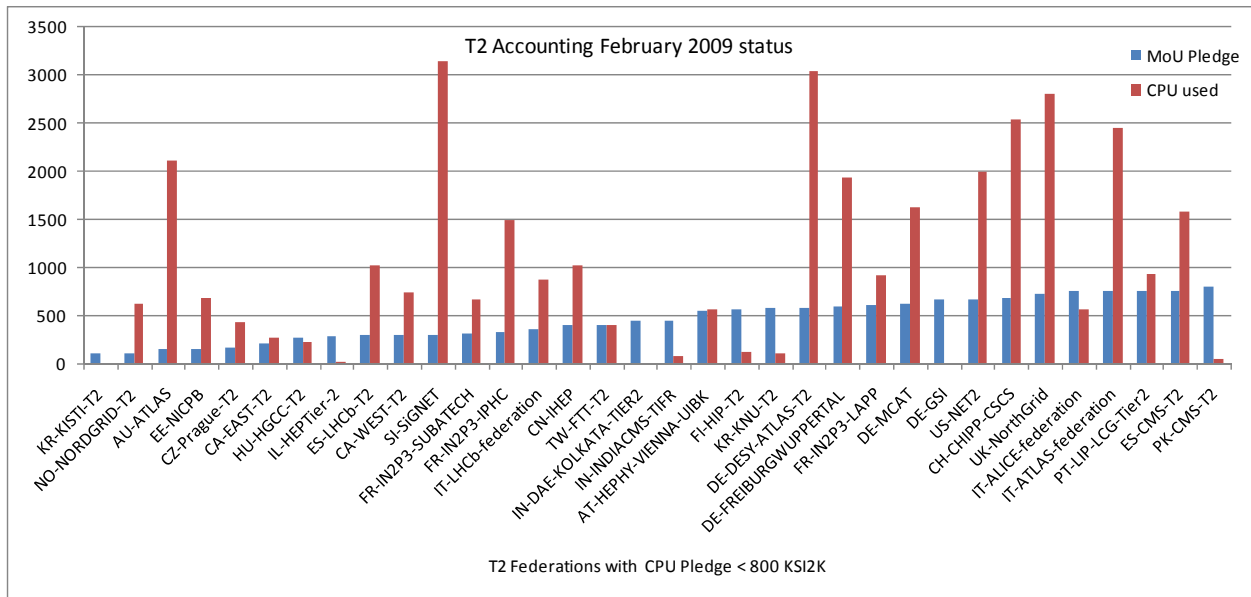


Figure 2: Accounting for Federations with CPU Pledge < 800 KSI2K in February 2009

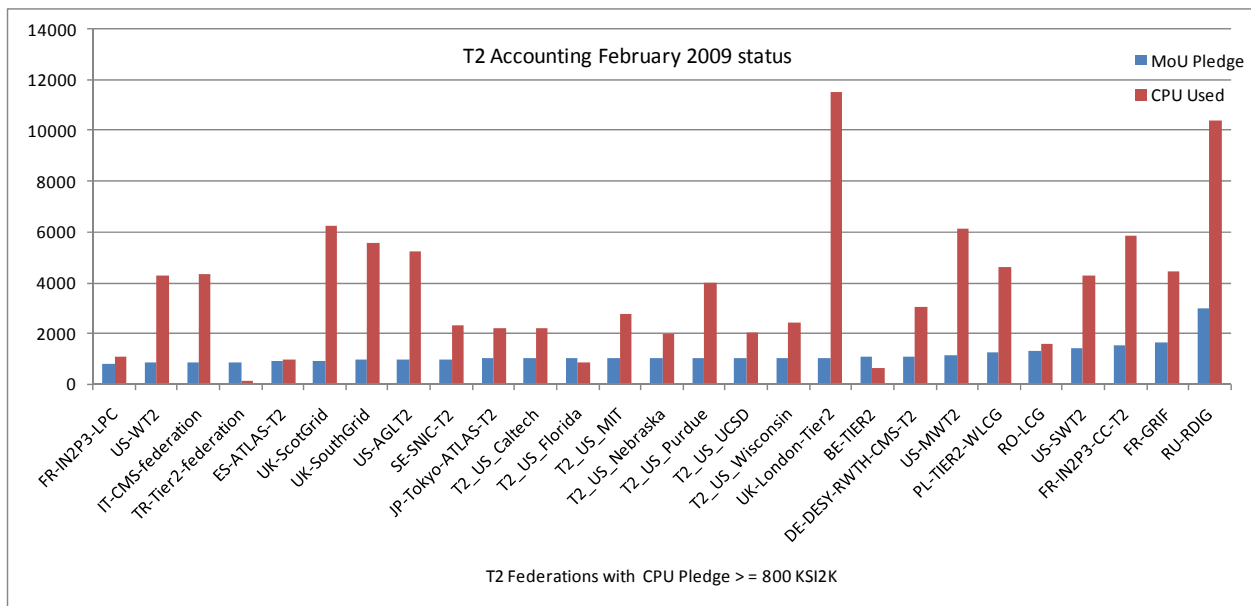


Figure 3: Accounting for Federations with CPU Pledge >= 800 KSI2K in February 2009

Globally, as can be seen from these graphs, the comparison of CPU used against the 2008 MoU Pledge is significantly above 100%.

Figure 4 shows the global status of CPU used in the first months of 2009 by country and experiment.

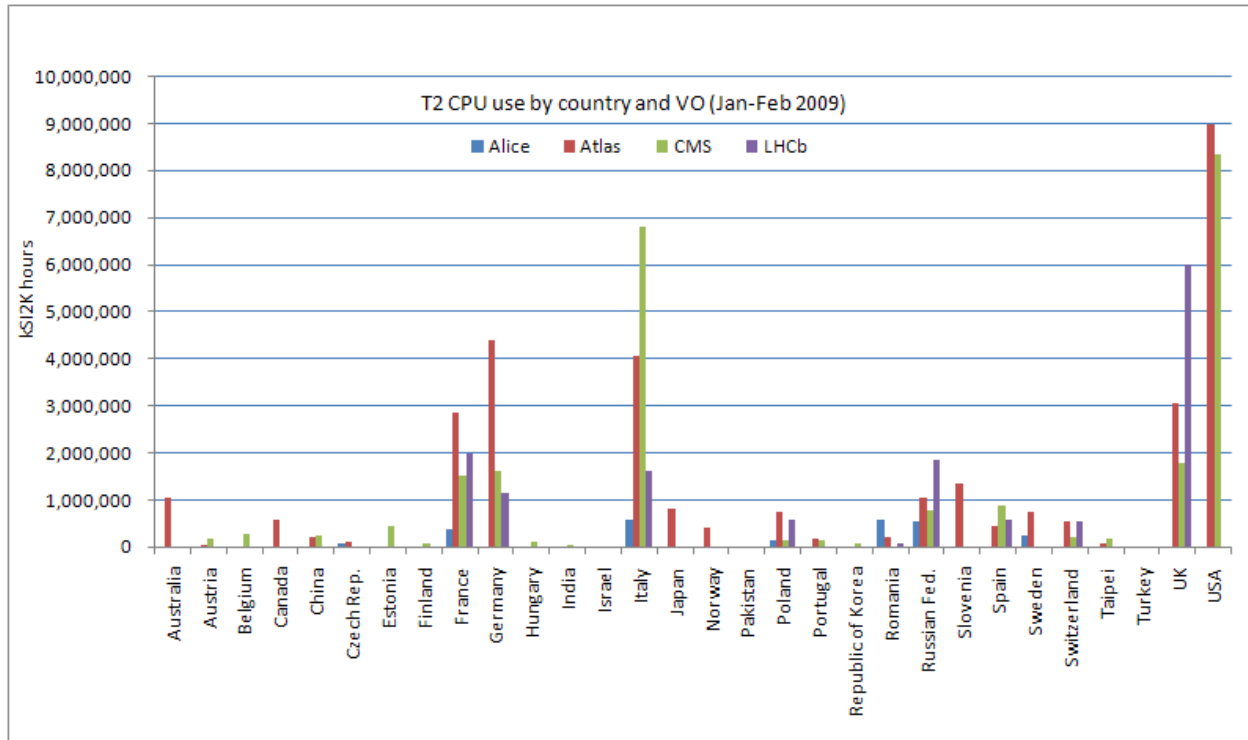


Figure 4: T2 CPU use in January and February 2009 by experiment shown by country

5. Revised Computing Requirements and Pledges

Annex 1 of the report CERN-RRB-2008-104 presented at the November 2008 C-RRB meeting included pledge tables as the basis for the 2009 pledge data to be confirmed and to present the planned pledges for 2010-2013.

Since the last C-RRB meeting, T2 pledge values were added for:

- France: Strasbourg
- Germany: University of Goettingen
- Korea: CHEP of KNU, Daegu

The 2009 T2 pledge split by experiment was provided by Russia, and changes were made to the Belgium T2 pledges.

In addition, following a recommendation to the WLCG Management Board by a dedicated working group, the new CPU unit HEP-SPEC06 was agreed to. All pledge values including the above-mentioned changes were converted to the new unit, the result of which can be found on

the WLCG website Resource page as Revised Resource Tables dated 05/02/09.
<http://lcg.web.cern.ch/LCG/Resources/WLCGResources-2008-2013-05FEB2009.pdf>

Since the LHC incident and the revised LHC schedule, the experiments were asked to review their requirements. In light of this new schedule two consecutive resource periods have been defined:

- 2009: October 2009-March 2010
- 2010: April 2010-March 2011

The revised requirements were discussed at the WLCG Management Board meeting of 07/04/09 and numbers are still changing at the time of writing this paper, therefore Tables 4 and 5 are intended to give an indication of the status. It should be noted that the experiment requests have not been reviewed by the LHCC or Resource Scrutiny Group bodies.

Table 4 shows the current status for 2009 based on the revised experiment requirements and the pledges which were confirmed at the Autumn C-RRB meeting.

CERN	Split 2009	ALICE	ATLAS	CMS	LHCb	SUM 2009
CPU (HEP-SPEC06)	Offered	46400	26480	54800	4200	131880
	Required	42800	57800	48100	17000	165700
	Balance	8%	-54%	14%	-75%	-20%
Disk (Tbytes)	Offered	4500	2074	2500	991	10065
	Required	2400	3600	1900	780	8680
	Balance	88%	-42%	32%	27%	16%
Tape (Tbytes)	Offered	7300	6213	9300	2270	25083
	Required	3700	7800	9500	1200	22200
	Balance	97%	-20%	-2%	89%	13%
Summary Ext. Tier1s						
	Split 2009	ALICE	ATLAS	CMS	LHCb	SUM 2009
CPU (HEP-SPEC06)	Offered	40924	120904	63756	20216	245800
	Required	42800	90000	53500	31000	217300
	Balance	-4%	34%	19%	-35%	13%
Disk (Tbytes)	Offered	3881	19864	8436	2709	34890
	Required	4300	23800	6500	2800	37400
	Balance	-10%	-17%	30%	-3%	-7%
Tape (Tbytes)	Offered	6181	14723	16021	3264	40189
	Required	5900	11300	10500	1300	29000
	Balance	5%	30%	53%	151%	39%
Summary Tier2s						
	Split 2009	ALICE	ATLAS	CMS	LHCb	SUM 2009
CPU (HEP-SPEC06)	Offered	39880	114160	115912	35372	305324
	Required	36000	108000	54100	30000	228100
	Balance	11%	6%	114%	18%	34%
Disk (Tbytes)	Offered	2822	11241	8413	371	22847
	Required	4400	13300	5000	20	22720
	Balance	-36%	-15%	68%	1755%	1%

Table 4: 2009 Revised experiment computing requirements and confirmed pledges for CERN, Tier-1 and Tier-2 sites – status 07/04/09

Table 5 shows a summary of the situation for 2009-2012 using the updated requirements for 2009 and 2010, the old requirements for 2011 and 2012 and the pledges which were confirmed at the Autumn C-RRB meeting.

Summary Ext. Tier1s		SUM 2009	SUM 2010	SUM 2011	SUM 2012
CPU (HEP-SPEC06)	Offered	245800	406164	518668	613048
	Required	217300	497400	608920	767240
	Balance	13%	-18%	-15%	-20%
Disk (Tbytes)	Offered	34890	60336	79682	94377
	Required	37400	65100	96791	123892
	Balance	-7%	-7%	-18%	-24%
Tape (Tbytes)	Offered	40189	65938	89805	115423
	Required	29000	50900	114610	152396
	Balance	39%	30%	-22%	-24%
Summary Tier2s		SUM 2009	SUM 2010	SUM 2011	SUM 2012
CPU (HEP-SPEC06)	Offered	305324	475752	607096	746016
	Required	228100	570400	874880	1100040
	Balance	34%	-17%	-31%	-32%
Disk (Tbytes)	Offered	22847	35221	45196	58571
	Required	22720	48520	47903	61963
	Balance	1%	-27%	-6%	-5%
Tape (Tbytes)					

Table 5: 2009-2010 revised experiment computing requirements, 2011-2012 original experiment computing requirements and current RRB pledges for 2009-2012 – status 07/04/09

An update and more complete information on experiment requirements will be sent in preparation for the Autumn C-RRB meeting with the request to confirm 2010 pledge data including split across experiments where more than one is supported, and indicate planned 2011 and 2012 values. This follows the reduced timescale for pledge information agreed to at the last C-RRB meeting. Funding Agencies should already note that this information should be provided by end September at the very latest. CPU pledges should be provided in HEP-SPEC06 units.

6. Conclusion

The MoU signatures are now well advanced with the signature of Brazil requiring follow-up.

The final status of Phase 2 of the project following the 2008 book-closing gave a positive overall balance of 0.6 MCHF. The future funding and expenditure estimates up to and including 2013 illustrate that some very minor over-spending on personnel is possible, however globally the project will not run into financial difficulties. This will continue to be monitored and reviewed frequently.

Tier-1 and Tier-2 accounting continues to be monitored on a monthly basis. Work is on-going to automatically obtain installed capacity for Tier-1 and Tier-2 sites which should lead to more reliable and harmonised accounting reporting in future.

In light of the LHC incident, the experiment requirement data has changed. Funding Agencies are requested to review their pledge data in light of the revised requirements to ensure that for the Autumn C-RRB meeting their confirmed 2010 data, and planned 2011-2012 pledge data is available. The deadline for submission is end September 2009.