

## 1. Introduction

The following report summarises the current signature status of the WLCG Memorandum of Understanding (MoU), WLCG funding and expenditure estimates at CERN up to 2012, resource accounting for Tier-1 and Tier-2 sites and summarises the revised computing requirements and pledges.

## 2. WLCG Memorandum of Understanding Signature Status

For the 11 Tier-1 Centres, with the exception of the Nordic Data Grid Facility (NDGF) for which the MoU signature is outstanding for Finland, Norway and Sweden, signed MoUs have now been received from all other Funding Agencies for Tier 1 Centres. The MoU for Spain was signed shortly after the last report to the Computing Resources Review Board (C-RRB) in July 2007.

For the 53 Tier-2 Federations, signed MoUs have been received from Switzerland, Australia, Israel, JINR/Dubna, Russia and Slovenia since the last report to the C-RRB. A signature is expected soon from Austria and from the German Ludwig Maximilian Universität (LMU) for the Munich ATLAS Federation. A new German Federation for ATLAS has been added comprising the Universities of Wuppertal (BUW), for which the MoU is already signed, and Freiburg (ALU), which is awaiting signature.

The signature on the MoU is still outstanding from the Czech Republic pending budget approval. Table 1 gives the current status of the MoU signatures.

There are currently 7 Tier-2 Centres planning to join WLCG. Of these, 6 Centres were already presented at the last C-RRB. In some cases Centres involve several sites distributed across geographical locations requiring much coordination which takes time before the commitment to signing the MoU can be made. The new Tier-2 Centre planning to join is Turkey. Table 2 lists the planned additional Tier-2 Centres or Federations, indicating the experiments to be served with priority.

Therefore taking into account the latest information made available by the WLCG Collaboration representatives, progress has been made. Several signatures are still required however, and it becomes urgent to obtain the remaining NDGF Tier 1 signatures (Finland, Norway and Sweden).

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

Table 1: Signature Status of WLCG Memorandum of Understanding

Institution	Experiments served with priority			
	ALICE	ATLAS	CMS	LHCb
Brazil, Brazilian Tier-2 Federation - CBPF - UERJ - UFRJ - UNESP	X	X	X	X
Canada, Canada East Tier-2 Federation		X		
Canada, Canada West Tier-2 Federation		X		
Estonia, NICPB, Tallinn			X	
Hungary, Hungarian Tier-2 Federation - KFKI, Budapest - SZTAKI, Budapest - Eotvos University, Budapest - Debrecen University	X		X	
Korea, Korean Tier-2 Federation	X		X	
Turkish Tier-2 Federation		X	X	

Table 2: Planned Additional Tier-2 Centres or Federations

### 3. Funding and Expenditure for WLCG at CERN

The cost and funding estimates for LCG Phase 2 at CERN covering the years 2005-2008 are shown in Table 3. As stated in previous reports to the C-RRB, the personnel planning for LCG Phase 2 relies on the successor to the EGEE2 project, namely EGEE3 (April 2008-March 2010), to fund an estimated 14 Full Time Equivalent (FTE) collaborators to GRID deployment activities.

With respect to the figures presented in the last report to the C-RRB for 2007 and 2008, expenditure on personnel is slightly less due to the move of some personnel from CERN funding to EGEE2 funding. Expenditure on material is also slightly less due to lower prices with respect to original estimates.

An estimated balance of 2.5 MCHF will be carried over from LCG Phase 2 to the first year of the next phase of the project.

The figures presented in the last C-RRB for 2009-2011 predicted an overall balance of -6.1 MCHF at the end of this period. Table 4 which covers an additional 1 year time span, currently predicts an estimated overall balance of -4.2 MCHF. It should be noted that this includes the latest requirements data received from the experiments up to 2012, and an allowance for adapting the CERN infrastructure to the increased power and cooling requirements for these years.

## LHC Computing Funding and Expenditure Estimates

(all figures in MCHF at 31/08/2007)

	2005	2006	2007	2008	TOTAL
<b>Funding</b>					
<b>From CERN Budget</b>					
- Personnel	1.5	16.5	18.6	17.6	54.1
- Physics	0.0	11.6	12.8	13.0	37.4
- IT		8.4	9.1	9.6	27.0
- PH		3.3	3.7	3.4	10.4
- Additional	1.5	4.9	5.8	4.6	16.7
- IT	1.2	3.6	4.4	3.5	12.7
- PH	0.3	1.2	1.3	1.1	4.0
- Materials	1.8	21.3	14.4	30.1	67.5
- Physics Operations		5.0	5.0	4.9	14.9
- IT		4.5	4.5	4.5	13.5
- PH		0.5	0.4	0.4	1.3
- Tier 0 and CERN Analysis Facility	1.8	16.3	9.4	25.2	52.7
<b>Contributions via Team Accounts*</b>					
- Personnel		2.0	2.3	1.4	5.7
- Material		0.0	0.0	1.1	1.1
<b>In-kind Contributions*</b>					
- Personnel		1.4	1.7	1.4	4.6
<b>Total</b>					
- Personnel	1.5	19.9	22.5	20.5	64.4
- Materials	1.8	21.3	14.4	31.2	68.7
<b>Total Funding</b>	<b>3.3</b>	<b>41.2</b>	<b>36.9</b>	<b>51.6</b>	<b>133.0</b>
<b>Expenditure</b>					
- Personnel **	1.5	19.8	21.9	19.9	63.1
- Materials	1.8	21.3	14.1	30.3	67.4
- Physics Operations		5.0	4.6	4.9	14.6
- Tier 0 and CERN Analysis Facility	1.8	16.3	9.4	25.3	52.8
<b>Total Planned Expenditure</b>	<b>3.3</b>	<b>41.1</b>	<b>35.9</b>	<b>50.1</b>	<b>130.5</b>
<b>Balance Personnel</b>	<b>0.0</b>	<b>0.0</b>	<b>0.7</b>	<b>0.6</b>	<b>1.3</b>
<b>Balance Materials</b>	<b>0.0</b>	<b>0.0</b>	<b>0.3</b>	<b>0.9</b>	<b>1.2</b>
<b>Balance</b>	<b>0.0</b>	<b>0.0</b>	<b>1.0</b>	<b>1.5</b>	<b>2.5</b>

\* As pledged and planned to be pledged in the WLCG MoU (Annex 6.6)

\*\* - Personnel from EGEE and EGEE-II at a cost of 2.9 MCHF will participate in LCG at CERN during the years 2006 - 2008

- Operators Support from Computer Centre at a cost of 1.4 MCHF will participate in LCG at CERN during the years 2006 - 2008

These resources are not included in this Table.

The slight underspending in 2007 and 2008 in personnel will be required to compensate the predicted overspending in later years

Table 3: Cost and funding estimates for LCG Phase 2

## LHC Future Computing Funding and Expenditure Estimates

(all figures in MCHF at 31/08/2007)

	2009	2010	2011	2012	TOTAL
<b>Funding</b>					
<b>From CERN Budget</b>					
- Personnel	11.1	13.6	13.6	13.6	52.0
- Materials	22.2	22.2	22.2	22.2	88.7
- Carry-over from Phase 2					
- Personnel	1.3				1.3
- Materials	0.2				0.2
<b>Contributions via Team Accounts*</b>					
- Personnel	1.1	0.7	0.1		1.9
- Carry-over from Phase 2 Materials	1.0				1.0
<b>In-kind Contributions*</b>					
- Personnel	1.1	1.1			2.2
<b>Total</b>					
- Personnel	<b>14.6</b>	<b>15.4</b>	<b>13.7</b>	<b>13.6</b>	<b>57.3</b>
- Materials	<b>23.4</b>	<b>22.2</b>	<b>22.2</b>	<b>22.2</b>	<b>89.9</b>
<b>Total Funding</b>	<b>37.9</b>	<b>37.6</b>	<b>35.9</b>	<b>35.8</b>	<b>147.2</b>
<b>Expenditure</b>					
- Personnel	14.1	15.5	14.0	13.2	56.9
- Materials	24.7	24.1	22.3	23.4	94.5
<b>Total Planned Expenditure</b>	<b>38.8</b>	<b>39.6</b>	<b>36.4</b>	<b>36.6</b>	<b>151.4</b>
<b>Balance Personnel</b>	<b>0.4</b>	<b>-0.1</b>	<b>-0.3</b>	<b>0.4</b>	<b>0.4</b>
<b>Balance Materials</b>	<b>-1.3</b>	<b>-1.9</b>	<b>-0.1</b>	<b>-1.2</b>	<b>-4.6</b>
<b>Balance</b>	<b>-0.9</b>	<b>-2.0</b>	<b>-0.5</b>	<b>-0.8</b>	<b>-4.2</b>

\* As planned to be pledged in the WLCG MoU (Annex 6.6)

Table 4: LHC Computing Budget Estimates for 2009-2012

## 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 two C-RRB meetings and a full accounting report covering 2006 and January to August 2007 is available on the WLCG Web in the Resources section of the Project Planning page.

Figure1 shows the evolution of CPU, disk and tape usage at CERN and Tier-1 sites for the period September 2006-August 2007.

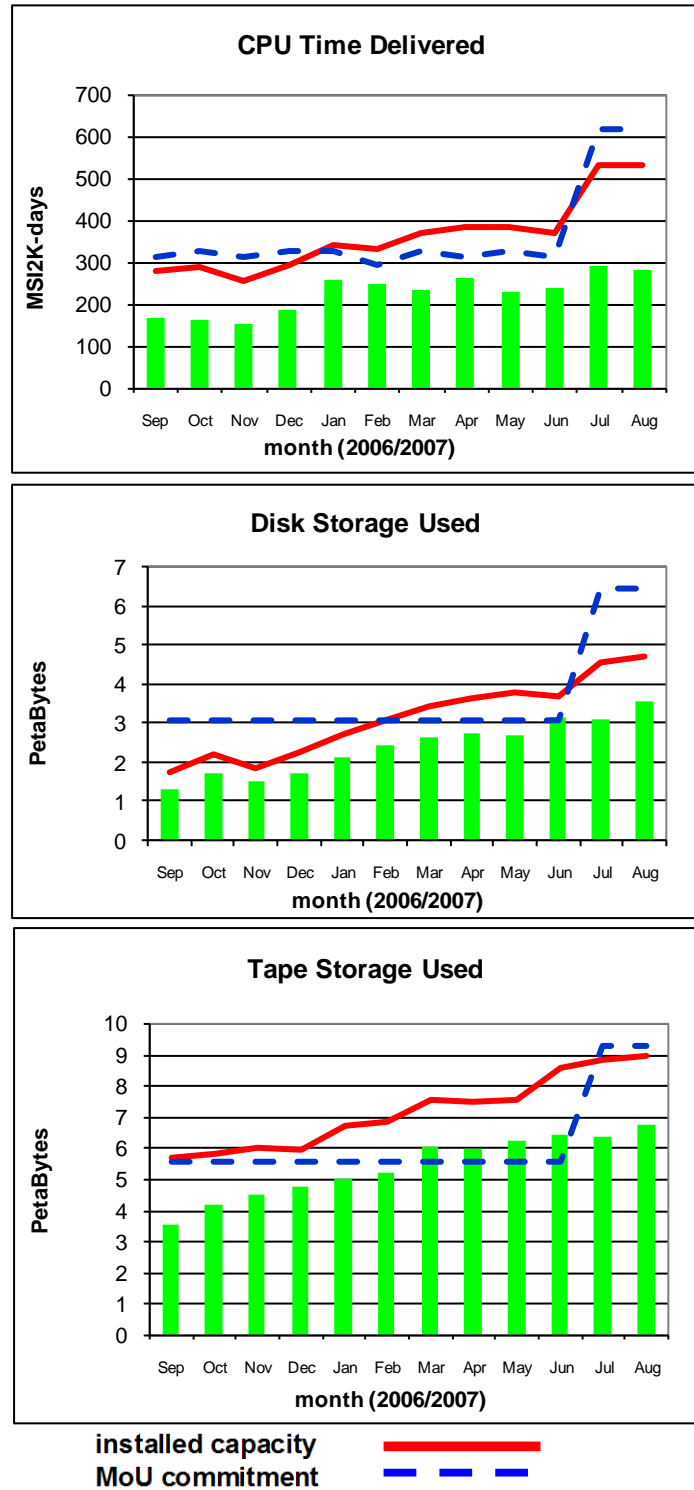


Figure 1: Accounting for CERN and External Tier-1s September 2006-August 2007

Despite the increase in installed capacity, the MoU pledge levels are not reached, particularly for CPU and disk storage. There is an urgent need for 2007 commitments to be fully honoured and that in 2008 the commitments are installed and fully in production by April 2008 at the very latest.

Tables 5-8 show the detailed breakdown for September 2006 to August 2007 by site and experiment. The comparison with the installed or pledged capacities is done by taking account of standard utilisation efficiency factors, therefore it should be possible to reach 100% provided there is a consistent load. Where the consumption exceeds 100% of the installed capacity, this indicates that the experiments have been able to use resources more efficiently than expected or have used resources provided for other applications.

<b>Site Summary</b>	<b>cpu used Sep 06 - Aug 07</b>			<b>end of period</b>
	<b>KSI2K-days</b>	<b>% of installed</b>	<b>% of pledge</b>	<b>installed as % of pledge</b>
CERN Tier-0+CAF	863,314	83%	68%	94%
ASGC	74,643	40%	22%	36%
BNL	300,516	71%	71%	102%
CC-IN2P3	205,766	56%	56%	100%
CNAF	185,727	42%	31%	54%
FNAL	291,438	45%	103%	126%
FZK-GridKA	269,053	63%	74%	100%
NDGF	109,505	60%	64%	100%
NL LHC/Tier-1	132,080	68%	79%	46%
PIC	108,159	76%	119%	120%
RAL	134,251	57%	42%	63%
TRIUMF	34,701	44%	74%	191%
<b>Total</b>	<b>2,709,153</b>	<b>62%</b>	<b>61%</b>	<b>86%</b>
<b>Colour coding of % columns:</b>			<b>≥ 90%</b>	<b>&lt; 50%</b>

Table 5: CPU Accounting for CERN and External Tier-1s September 2006-August 2007

Site Summary	disk used Sep 06 - Aug 07			disk at end of period			
	TByte-months	% of installed	% of pledge	TBytes occupied	occupied as % of installed	occupied as % of pledge	installed as % of pledge
CERN Tier-0+CAF	9,032	84%	126%	714	68%	79%	116%
ASGC	976	43%	24%	132	52%	21%	40%
BNL	4,201	94%	81%	665	86%	86%	100%
CC-IN2P3	2,491	82%	53%	388	76%	76%	100%
CNAF	2,151	59%	28%	271	97%	32%	33%
FNAL	4,580	89%	273%	700	139%	143%	103%
FZK-GridKA	1,661	49%	52%	198	32%	32%	100%
NDGF	976	81%	56%	90	92%	33%	36%
NL LHC/Tier-1	696	54%	26%	135	76%	18%	24%
PIC	703	79%	55%	102	52%	66%	127%
RAL	1,187	64%	29%	155	67%	35%	52%
TRIUMF	212	133%	90%	29	173%	38%	22%
<b>Total</b>	<b>28,866</b>	<b>76%</b>	<b>66%</b>	<b>3,579</b>	<b>76%</b>	<b>55%</b>	<b>73%</b>
<b>Colour coding of % columns:</b>			<b>≥ 90%</b>	<b>&lt; 50%</b>			

Table 6: Disk Accounting for CERN and External Tier-1s September 2006-August 2007

Site Summary	tape used Sep 06 - Aug 07			tape at end of period			
	TByte-months	% of installed	% of pledge	TBytes occupied	occupied as % of installed	occupied as % of pledge	installed as % of pledge
CERN Tier-0+CAF	30,885	83%	156%	3,356	84%	139%	166%
ASGC	698	20%	11%	58	21%	7%	35%
BNL	6,483	75%	154%	813	81%	136%	167%
CC-IN2P3	5,103	76%	74%	474	63%	63%	100%
CNAF	4,182	69%	40%	535	89%	54%	60%
FNAL	5,810	96%	187%	600	120%	200%	167%
FZK-GridKA	5,462	64%	92%	397	39%	39%	100%
NDGF	1	0%	0%	0	0%	0%	41%
NL LHC/Tier-1	338	70%	12%	44	85%	6%	7%
PIC	1,704	86%	83%	153	63%	64%	101%
RAL	4,099	88%	47%	305	78%	28%	36%
TRIUMF	34	24%	12%	12	100%	15%	15%
<b>Total</b>	<b>64,799</b>	<b>75%</b>	<b>88%</b>	<b>6,747</b>	<b>75%</b>	<b>73%</b>	<b>97%</b>
<b>Colour coding of % columns:</b>			<b>≥ 90%</b>	<b>&lt; 50%</b>			

Table 7: Tape Accounting for CERN and External Tier-1s September 2006-August 2007



<b>Experiment Summary Sep 06 - Aug 07</b>	<i>cpu</i>		<i>disk occupancy</i>		<i>tape occupancy</i>	
	<i>KSI2K-days</i>	<i>% of total</i>	<i>TBytes at end of period</i>	<i>% of total</i>	<i>TBytes at end of period</i>	<i>% of total</i>
ALICE	260,749	10%	166	5%	898	13%
ATLAS	1,082,026	40%	1,615	45%	2,231	33%
CMS	967,283	36%	1,355	38%	2,918	43%
LHCb	399,095	15%	443	12%	700	10%
<b>Total</b>	<b>2,709,153</b>	<b>100%</b>	<b>3,579</b>	<b>100%</b>	<b>6,747</b>	<b>100%</b>

Table 8: Experiment Accounting Summary September 2006-August 2007

## 4.2 Tier-2 Accounting

Following an information campaign to the Tier-2 sites and 2 months of test reporting, formal reporting of CPU usage will begin for September 2007 data. At the time of writing this report, the September Tier-2 accounting report is not yet available, however, it will be included in the presentation at the October C-RRB meeting. For the April 2008 C-RRB meeting the Tier-2 accounting data for the period September 2007-February 2008 inclusive will be presented.

Of the 53 Tier-2 Federations defined in the MoU, 5 have still not provided the information requested on site identity needed to retrieve the accounting information from the accounting database. It is urgent now that formal reporting has begun, to receive this information as soon as possible from the WLCG Collaboration representatives. Of the 108 sites identified so far, 94 are at present reporting accounting data.

## 5. Revised Computing Requirements and Pledges

The 4 LHC experiments were requested to revise and update their computing requirements for the period 2008-2012 during the summer months. The information was received from July to mid-September. All Tier-1 and Tier-2 Federations were asked to confirm their pledge values for 2008 by end September, and in accordance with the MoU, provide planned pledge values for the years 2009-2012 inclusive for presentation at the C-RRB meeting. At the time of writing this report several Federations have not yet responded: of the 11 Tier-1 Federations, 4 have responded and of the 53 Tier-2 Federations, 16 have responded. From the data received, particularly from the Tier-2 Federations, in many cases pledge values for 2011 and 2012 remain the same as for 2010. This is a major cause for concern, as if all the remaining data to be received follows the same trend, we will have major discrepancies between the requirements which rise based on the accumulated data volumes, and the pledges which will not rise to the expected extent.

Table 9 shows the situation to date for 2008. Where a response has been received the new pledge value has been used, otherwise the old pledge value has been used in the meantime. It should be noted that the situation will change when all responses have been received and could deteriorate if they include reduced pledge values for 2008 or improve if they include increased pledge

values. It becomes urgent that those Federations who have not yet responded provide their updated pledge information as soon as possible.

From the information available for 2008 the Tier-1 situation looks very comfortable for LCHb and ATLAS, less so for CMS with respect to disk and tape, and for ALICE the situation looks problematic. The Tier-2 situation looks very comfortable for LHCb, CMS and ATLAS apart from disk for CMS and ATLAS. For ALICE the situation looks problematic.

Table 10 shows the situation for external Tier-1s and Tier-2s from 2008 to 2012 inclusive. Where a response has been received the new pledge values have been used, otherwise the old pledge values have been used in the meantime. For years where no value was provided (typically 2011 and 2012), the last existing pledge value has been copied across. This gives a very pessimistic picture which will change as the remaining responses arrive, hopefully confirming increased pledge values for this period.

Summary Tier-1 Sites		Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
CPU (kSI2K)	Offered		5446	20464	10375	3544	39829
	Required		10100	18120	9600	1770	39590
	Balance		-46%	13%	8%	100%	1%
Disk (Tbytes)	Offered		2448	11601	5168	1889	21106
	Required		4000	10730	7200	1025	22955
	Balance		-39%	8%	-28%	84%	-8%
Tape (Tbytes)	Offered		3029	7970	9116	1436	21551
	Required		5800	8070	9800	860	24530
	Balance		-48%	-1%	-7%	67%	-12%
Summary Tier-2 Sites		Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
CPU (kSI2K)	Offered		6602	18645	17365	4399	47011
	Required		12500	17510	13400	4550	47960
	Balance		-47%	6%	30%	-3%	-2%
Disk (Tbytes)	Offered		1535	5900	4550	320	12305
	Required		1700	7770	5100	9	14579
	Balance		-10%	-24%	-11%	3454%	-16%
CERN Tier0		Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
CPU (kSI2K)	Required		1800	3705	5300	360	11165
	Offered		1800	3710	5300	360	11170
	% of Req.		100%	100%	100%	100%	100%
Disk (Tbytes)	Required		1600	152	400	270	2422
	Offered		1600	153	400	270	2423
	% of Req.		100%	101%	100%	100%	100%
Tape (Tbytes)	Required		3300	2449	4400	630	10779
	Offered		3300	2450	4400	630	10780
	% of Req.		100%	100%	100%	100%	100%
CERN Analysis Facility		Split 2008	ALICE	ATLAS	CMS	LHCb	SUM 2008
CPU (kSI2K)	Required		500	2081	2100	0	4681
	Offered		500	2080	2100	0	4680
	% of Req.		100%	100%	100%	100%	100%
Disk (Tbytes)	Required		100	1146	1800	80	3126
	Offered		100	1146	1800	80	3126
	% of Req.		100%	100%	100%	100%	100%
Tape (Tbytes)	Required		0	370	900	0	1270
	Offered		0	370	900	0	1270
	% of Req.		100%	100%	100%	100%	100%

Table 9: 2008 Computing Requirements and Pledges – status on 10/10/07 (**NB: figures not yet finalised**)

<b>External Tier-1 Sites</b>		<b>SUM 2008</b>	<b>SUM 2009</b>	<b>SUM 2010</b>	<b>SUM 2011</b>	<b>SUM 2012</b>
<b>CPU (kSI2K)</b>	<b>Offered</b>	39829	62088	99718	114837	125620
	<b>Required</b>	39590	69600	114720	152230	191810
	<b>Balance</b>	<b>1%</b>	<b>-11%</b>	<b>-13%</b>	<b>-25%</b>	<b>-35%</b>
<b>Disk (Tbytes)</b>	<b>Offered</b>	21106	35006	58089	71681	79258
	<b>Required</b>	22955	40179	71000	96791	123892
	<b>Balance</b>	<b>-8%</b>	<b>-13%</b>	<b>-18%</b>	<b>-26%</b>	<b>-36%</b>
<b>Tape (Tbytes)</b>	<b>Offered</b>	21551	39908	63930	78779	89807
	<b>Required</b>	24530	46260	78664	114610	152396
	<b>Balance</b>	<b>-12%</b>	<b>-14%</b>	<b>-19%</b>	<b>-31%</b>	<b>-41%</b>
<b>Tier-2 Sites</b>						
<b>CPU (kSI2K)</b>	<b>Offered</b>	47011	66344	101784	115037	117538
	<b>Required</b>	47960	80750	164540	218720	275010
	<b>Balance</b>	<b>-2%</b>	<b>-18%</b>	<b>-38%</b>	<b>-47%</b>	<b>-57%</b>
<b>Disk (Tbytes)</b>	<b>Offered</b>	12305	20629	32918	39075	39849
	<b>Required</b>	14579	23023	34243	47903	61963
	<b>Balance</b>	<b>-16%</b>	<b>-10%</b>	<b>-4%</b>	<b>-18%</b>	<b>-36%</b>

Table 10: 2008-2012 Computing Requirements and Pledges – status on 10/10/07 (**NB: figures not yet finalised**)