LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Effort & Budget Summary

LEVEL OF EFFORT (FTE-yrs)

	FY15	FY16	FY17	FY18	FY19	Total
Site Management	0.50	0.50	0.70	0.60	0.60	
Steady-state Operations Support	6.14	5.38	4.48	3.86	3.16	
Deployment Planning	0.00	0.30	0.40	0.20	0.20	
Deployment Support	0.00	0.50	0.80	0.30	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	6.99	7.03	6.73	5.31	4.81	30.87
	1,954,035	1,895,627	1,839,985	1,722,773	1,687,721	

BUDGET ($K)

	(closed) FY15	(allocated) FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	1,543,737	1,451,490	1,543,813	1,447,666	1,408,561	7,395,267
Travel	11,000	11,000	11,000	11,000	11,000	55,000
M&S (hardware, repairs, etc.)	281,000	297,786	146,000	120,000	120,000	964,786
Sub-total (SS Ops)	1,835,737	1,760,276	1,700,813	1,578,666	1,539,561	8,415,053
New Hardware Deployment						
Personnel	-	198,800	296,144	141,354	244,374	880,673
Travel	-	-	-	-	-	-
Equipment (compute)	495,000	992,175	719,248	1,008,658	896,203	4,111,284
Equipment (storage)	60,000	50,359	39,452	55,327	77,931	283,069
Sub-total (New Deployment)	555,000	1,241,334	1,054,844	1,205,339	1,218,508	5,275,026
Project Management						
Personnel	110,298	127,351	131,172	135,107	139,160	643,089
Travel	6,000	6,000	6,000	7,000	7,000	32,000
M&S	2,000	2,000	2,000	2,000	2,000	10,000
Sub-total (Project Mgmt)	118,298	135,351	139,172	144,107	148,160	685,089
Total Project Cost						
Personnel	1,654,035	1,777,641	1,971,129	1,724,127	1,792,095	8,919,028
Travel	17,000	17,000	17,000	18,000	18,000	87,000
M&S	283,000	299,786	148,000	122,000	122,000	974,786
Equipment (compute)	495,000	992,175	719,248	1,008,658	896,203	4,111,284
Equipment (storage)	60,000	50,359	39,452	55,327	77,931	283,069
Management Reserve	45,964	83,039	105,173	71,890	93,767	399,833
Total	**2,555,000**	**3,220,000**	**3,000,002**	**3,000,002**	**2,999,996**	**14,775,000**
CD-2/3 Budget Guidance Profile	2,000,000	3,000,000	3,000,000	3,000,000	3,000,000	14,000,000
Carry-over Funds from Past Project	555,000	220,000	-	-	-	775,000
Total Budget Profile	2,555,000	3,220,000	3,000,000	3,000,000	3,000,000	14,775,000
Difference between budget and guidance	(0)	(0)	2	2	(4)	(0)
Compute hardware portion of difference	(0)	(0)	2	2	(4)	

Notes:
1) Management reserve set at 20% of unspent deployment personnel budget and 3% of unspent steady-state ops personnel budget.
2) CD-1 planning guidance profile has been provided for a $14M budget.
3) CD-2/3 budget profile has been set for a $14M budget.
4) FY15 Cost Accounting: Carry-over from past project assigned to FY15 and remainder to FY16

LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Level of Effort Summary, by Site

LEVEL OF EFFORT (FTE-yrs)

	FY15	FY16	FY17	FY18	FY19	Total
Brookhaven						
Site Management	0.10	0.10	0.30	0.20	0.20	
Steady-state Operations Support (BG/Q)	0.40	0.40	0.40	-	-	
Steady-state Operations Support (Cluster)	-	-	0.98	1.14	1.28	
Deployment Planning	-	-	0.30	0.10	-	
Deployment Support	-	-	0.50	0.30	-	
Project Management	-	-	-	-	-	
Sub-total (BNL)	0.50	0.50	2.48	1.74	1.48	6.70
Fermilab						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	2.70	2.58	2.11	1.93	1.93	
Deployment Planning	-	-	-	0.10	0.20	
Deployment Support	-	-	-	-	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Sub-total (FNAL)	3.25	3.13	2.66	2.58	3.18	14.81
	2.90	2.78	2.31	2.23	2.83	
Thomas Jefferson National Accelerator Facility						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	3.04	2.40	1.97	1.93	1.23	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Sub-total (JLab)	3.24	3.40	2.57	2.13	1.43	12.76
Total						
Site Management	0.50	0.50	0.70	0.60	0.60	
Steady-state Operations Support	6.14	5.38	4.48	3.86	3.16	
Deployment Planning	-	0.30	0.40	0.20	0.20	
Deployment Support	-	0.50	0.80	0.30	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	6.99	7.03	6.73	5.31	4.81	30.87
	6.64	6.68	6.38	4.96	4.46	

Total agrees with TPC Summary?	Yes	Yes	Yes	Yes	Yes

LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Brookhaven National Laboratory

LEVEL OF EFFORT (FTEs)

	FY15	FY16	FY17 (BG/Q+Cluster)	FY18	FY19	Total
Site Management	0.10	0.10	0.30	0.20	0.20	0.90
Steady-state Operations Support (BG/Q)	0.40	0.40	0.40	-	-	1.20
Steady-state Operations Support (Cluster)	-	-	0.98	1.14	1.28	3.40
Deployment Planning	-	-	0.30	0.10	-	0.40
Deployment Support	-	-	0.50	0.30	-	0.80
Project Management	-	-	-	-	-	-
Total	0.50	0.50	2.48	1.74	1.48	6.70

BUDGET

	FY15 (closed) *This FY15 column has not been updated with actuals*	FY16 (allocated)	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	76,482	78,776	397,390	321,670	366,430	1,240,747
Site Management	17,510	18,035	89,131	61,203	63,039	248,919
Operations Support	58,972	60,741	308,259	260,466	303,390	991,828
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S	201,000	201,000	66,000	40,000	40,000	548,000
(Hardware, repairs, spares, etc.)	20,000	20,000	35,000	40,000	40,000	
IBM BG/Q Maintenance; FY17 BG/Q Parts	181,000	181,000	31,000	-	-	393,000
Total (Steady-state Ops)	280,482	282,776	466,390	364,670	409,430	1,803,747
New Hardware Deployment						
Personnel	-	-	204,444	100,782	-	305,226
Deployment Planning	-	-	93,075	31,956	-	125,031
Deployment Support	-	-	111,369	68,826	-	180,195
Travel						-
Equipment (compute)	-	-	503,473	706,060	-	1,209,534
Equipment (storage)	-	-	-	-	-	-
Total (New Deployment)	-	-	707,918	806,842	-	1,514,760
Project Management						
Personnel						-
Travel						-
M&S						-
Total (Project Mgmt)	-	-	-	-	-	-
Total Site Allocation						
Personnel	76,482	78,776	601,834	422,452	366,430	1,545,973
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S	201,000	201,000	66,000	40,000	40,000	548,000
Equipment	-	-	503,473	706,060	-	1,209,534
Total	**280,482**	**282,776**	**1,174,308**	**1,171,512**	**409,430**	**3,318,507**

LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Fermilab

LEVEL OF EFFORT (FTEs)

	FY15	**FY16**	**FY17**	**FY18**	**FY19**	**Total**
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	2.70	2.58	2.11	1.93	1.93	
Deployment Planning	-	-	-	0.10	0.20	
Deployment Support	-	-	-	-	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	3.25	3.13	2.66	2.58	3.18	14.81

BUDGET

This FY15 column has not been updated with actuals

	(closed) **FY15**	(allocated) **FY16**	**FY17**	**FY18**	**FY19**	**Total**
Steady-state Operations						
Personnel	744,828	853,525	718,050	683,417	704,716	3,704,536
Site Management	59,896	76,486	78,781	81,144	83,579	379,886
Operations Support	684,932	777,039	639,269	602,272	621,138	3,324,650
Travel	5,000	5,000	5,000	5,000	5,000	25,000
M&S (hardware, repairs, tape, etc.)	40,000	56,786	40,000	40,000	40,000	216,786
Total (Steady-state Ops)	789,828	915,311	763,050	728,417	749,716	3,946,322
New Hardware Deployment						
Personnel	-	-	-	40,572	244,374	284,946
Deployment Planning	-	-	-	40,572	83,579	124,151
Deployment Support	-	-	-	-	160,796	160,796
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	-	-	302,597	896,203	1,198,801
M&S (storage hardware)	-	-	15,174	34,048	58,448	107,670
Total (New Deployment)	-	-	15,174	377,217	1,199,026	1,591,417
Project Management						
Personnel	110,298	127,351	131,172	135,107	139,160	643,089
Travel	6,000	6,000	6,000	7,000	7,000	32,000
M&S	2,000	2,000	2,000	2,000	2,000	10,000
Total (Project Mgmt)	118,298	135,351	139,172	144,107	148,160	685,089
Total Site Allocation						
Personnel	855,126	980,876	849,222	859,096	1,088,251	4,632,571
Travel	11,000	11,000	11,000	12,000	12,000	57,000
M&S (SS Ops)	42,000	58,786	42,000	42,000	42,000	226,786
M&S (DME)	-	-	15,174	336,645	954,651	1,306,470
Total	**908,126**	**1,050,662**	**917,396**	**1,249,741**	**2,096,902**	**6,222,827**

LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Thomas Jefferson National Accelerator Facility

LEVEL OF EFFORT (FTE-yrs)

	FY15	FY16	FY17	FY18	FY19	Total
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	3.04	2.40	1.97	1.93	1.23	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Total	3.24	3.40	2.57	2.13	1.43	12.76

BUDGET

	This FY15 column has not been updated with actuals (closed) FY15	(allocated) FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	702,994	519,189	428,373	442,580	337,415	2,430,551
Site Management	71,070	58,400	60,152	61,957	63,815	315,394
Operations Support	631,924	460,789	368,221	380,623	273,600	2,115,157
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S (hardware, repairs, tape, etc.)	40,000	40,000	40,000	40,000	40,000	200,000
Total (Steady-state Ops)	745,994	562,189	471,373	485,580	380,415	2,645,551
New Hardware Deployment						
Personnel	-	198,800	91,700	-	-	290,500
Deployment Planning	-	103,800	35,638	-	-	139,438
Deployment Support	-	95,000	56,062	-	-	151,062
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	992,175	215,774	-	-	1,207,949
M&S (storage hardware)	-	50,359	24,278	21,280	19,483	115,400
Total (New Deployment)	-	1,241,334	331,753	21,280	19,483	1,613,849
Project Management						
Personnel	-	-	-	-	-	-
Travel	-	-	-	-	-	-
M&S	-	-	-	-	-	-
Total (Project Mgmt)	-	-	-	-	-	-
Total Site Allocation						
Personnel	702,994	717,989	520,073	442,580	337,415	2,721,051
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S (SS Ops)	40,000	40,000	40,000	40,000	40,000	200,000
M&S (DME)	-	1,042,534	240,053	21,280	19,483	1,323,349
Total	**745,994**	**1,803,523**	**803,126**	**506,860**	**399,898**	**4,259,400**

LQCD-Ext II Cost Forecast - $14 Million
(as of 09/10/2016)

Management Reserve

Baseline management reserve is set at a % of the steady-state operations personnel budget plus a % of the new hardware deployment personnel budget.

% of steady-state ops budget	3%	
% of new hardware deployment budget	20%	

Reference Values (from TPC Summary)	FY15	FY16	FY17	FY18	FY19	Total
Steady-state Operations Personnel Budget	1,543,737	1,451,490	1,543,813	1,447,666	1,408,561	7,395,267
New Hardware Deployment Personnel Budget	-	198,800	296,144	141,354	244,374	880,673

Management Reserve Budget	FY15	FY16	FY17	FY18	FY19	Total
Baseline Budget	46,312	83,305	105,543	71,701	91,132	397,993
Adjustments						
-- Adjustment in management reserve to balance the budget to the guidance	(17,597)					(17,597)
-- 07/01/14 adjustment to offset reduction in JLab salary support correlating with node count adjustment	17,249	(244)	(254)	(194)		16,557
-- 07/01/14 adjustment to offset salary adjustments due to change in hardware split from 60:40 to 50:50.	-	(22)	(116)	383	2,635	2,880
TOTAL	45,964	83,039	105,173	71,890	93,767	399,833

LQCD-Ext II Cost Forecast - $14 Million

(as of 09/10/2016)

Red font indicates changes since last revision.

Site Staffing Model

Updated 8/05/2015

Assumptions:

	Basis:			Planned Site Deployments				Number of D
0.35 fte for overall project management	Based on operating experience							
0.1 fte to manage BNL site	Based on operating experience				FNAL	JLab	BNL	FNAL
0.2 fte to manage cluster site (FNAL, JLab) (site specific)	Based on operating experience		FY15	0	0	0	FY15	5
0.3 fte to plan, manage deployment	See assumptions tab		FY16	0	1	0	FY16	5
0.5 fte to deploy new hardware	See assumptions tab		FY17	0	1	1	FY17	4
0.0 fte of additional support for GPU deployment	No additional incremental effort to deploy new GPU cluster (Jan '14 ->)		FY18	1	0	1	FY18	3
0.2 fte/site of base admin support for ops & maint.; and to maintain expertise	Based on operating experience		FY19	1	0	0	FY19	4
0.5 Steady-state file server admin support (Lustre/mass storage)	Based on operating experience (same level as budgeted in FY12-14)							
0.125 Per cluster base effort	Based on operating experience (added 02/25/2014)			Y1 isolated buy = 1 cluster				JLab
900 Number of cluster nodes that can be supported by one FTE	Based on operating experience; updated 01/14/14			Y2 buy with Y1+Y2 funds = 1 cluster			FY15	6.5
900 Number of GPUs that can be supported by one FTE (FNAL)	GPUs at FNAL require on average 2x more support than cluster nodes			Y1+Y2 option = 1 to 1.5 clusters (age,variety)			FY16	5.5
800 Number of GPUs that can be supported by one FTE (JLab)	Tesla and MIC cards: 900 GPUs / fte; Gaming cards: 660 / fte; average = 780.			Y1 + Y3 or later buy = 2 clusters			FY17	4
225 Number of cluster nodes purchased with $1M in equipment funds (per year)	Based on recent cost data; see assumptions tab			Cluster for < 12m = < 1 cluster (0.25 incr)			FY18	4
160 Number of GPUs purchased with $1M in equipment funds (per year)	Based on recent cost data; see assumptions tab						FY19	2
21.28% M&S G&A rate at FNAL (% on the first $500K of the purchase)			CPU Funds Split	FNAL	JLab	BNL		
48.40% M&S G&A rate at JLab (% on the first $50K of the purchase) … **PLU**... 0.6% M&S G&A with no threshold			FY15	0	0	0		BNL
11.07% M&S G&A rate at BNL up to $2M (Frank Quarant - Chip Watson email thread 9/30/2015)			FY16	0	1	0	FY15	0
5% Fraction of total equipment budget allocated to storage hardware (FY10-12)	Based on approved hardware baseline plan		FY17	0	0.30	0.70	FY16	0
8% Fraction of total equipment budget allocated to storage hardware (FY13-19)	Storage budget increased to reflect growing needs		FY18	0.30	0	0.70	FY17	2
75% Fraction of storage budget allocated to deployment site (FY13-19)			FY19	1	0	0	FY18	2
25% Fraction of storage budget allocated to non-deployment site (FY13-19); manually split among non-deployment sites			Total Compute H/w	$1,198,801	$1,207,949	$1,209,534	FY19	2
820 JLab # of conventional nodes - starting point (9q @ 328; 10q @ 224; 12s @ 275 nodes)			balanced w/i $10k		Legend			
604 JLab # of GPUs - starting point (9g @248 GPUs ;10g @ 212 GPUs; 11g @ 32 GPUs;12k @ 168 GPUs; plus XeonPhi cards)					YYC: future unnamed Infiniband cluster			
959 FNAL # of conventional nodes starting point (Ds @ 421 nodes; Bc @ 224 nodes; Pi0+expansion @ 314 nodes)					YYG: future unnamed GPU cluster			
280 FNAL # of GPUs - starting point (Dsg @ 152 GPUs; Pi0g @ 128 GPUs)					YY/YY: designates combined purchases that span fiscal years; treated			

								Initial Cluster Node Counts (FNAL)			
Compute hardware budget baseline (PEP)	-	847,000	1,114,000	1,161,000	1,489,000	4,611,000			**Name**	**# nodes**	**# GPUs**	**Cores**
Compute hardware budget overrun / (underrun)	(0)	(0)	2	2	(4)	(0)		*FNAL Conventional Clusters*	Ds	421	0	
	(closed)	(allocated)							Bc	224	0	
	FY15	FY16	FY17	FY18	FY19	Total			Pi0+Pi0 exp	314	0	
Compute hardware budget ($)	-	1,042,714	758,700	1,063,985	974,134	3,839,533			Total	959	
Cluster compute hardware budget ($)	-	992,175	719,248	1,008,658	896,203	3,616,284	*Cluster deployment site*				
Storage hardware budget ($)	-	50,539	45,522	63,839	58,448	218,348	*Base Storage H/w budget at deployment site before contribution*				
Storage hardware budget ($)	-	-	31,865	44,687	-	76,553	*BNL Storage contribution to Cluster Compute budget*				
Storage hardware budget ($)	-	50,539	13,657	19,152	58,448	141,795	*Cluster deployment site*	*FNAL GPU Clusters*	Dsg	76	152	16
Storage hardware budget ($)	-	-	15,174	21,280	19,483	55,936	*Fully Non-deployment site*		Pi0g	32	152	16
Storage hardware budget ($)	-	-	10,622	14,896	-	25,518	*Non-deployment portion for partial deployment site*		Total	108	
Total equipment budget ($)	-	1,042,714	758,700	1,063,985	974,134	3,839,533					
			JLab/FNAL/JL	FNAL/JLab/FNAL							
Overhead portion of equipment budget (used be	-	30,456	84,357	82,448	106,400	303,662	Thresholds impacts total equipment budget, not CPU/GPU separately				
			FNAL defers its FY18 EQ$ to FY19								
% of compute budget allocated for IB clusters	100%	50%	50%	50%	50%			Initial Cluster Node Counts (JLab)			
Allocation for conv. cluster hardware ($)	-	496,088	359,624	504,329	448,102	1,808,142			**Name**	**# nodes**	**# GPUs**	**Cores**
Direct portion of conv. cluster budget	-	480,859	317,445	463,105	394,902	1,656,311		*JLab Conventional Clusters*	9q	320	0	8
Overhead portion of conv. cluster budget	-	15,228	42,179	41,224	53,200	151,831			10q	224	0	8
Allocation for GPU hardware ($)	-	496,088	359,624	504,329	448,102	1,808,142			12s	276	0	16
Direct portion of GPU budget	-	480,859	317,445	463,105	394,902	1,656,311			Total	820	
Overhead portion of GPU budget	-	15,228	42,179	41,224	53,200	151,831					
Estimated # of cluster nodes purchased	-	108	71	104	89	373		*JLab Accelerated Clusters*	9g	36	144	8
Estimated # of GPUs purchased	-	77	51	74	63	265			10q	50	200	8
									11q	7	28	8
Actual cluster nodes purchased	-	-	-	-	-	-			12k	42	168	16
Actual GPU nodes purchased	-	-	-	-	-	-			12m	16	64	16
Actual GPUs purchased	-	-	-	-	-	-			Total	151	
Check: dep+nondep storage	-	50,539	39,452	55,327	77,931	223,249		*Note: Retired machines typically taken offline by June 30 of the retirement y*			
same as: site sheets storage	-	50,359	39,452	55,327	77,931	223,069					