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	0.50	0.50	0.50	
Steady-state Operations Support	6.14	5.38	4.51	4.10	3.32	
Deployment Planning	0.00	0.30	0.10	0.30	0.10	
Deployment Support	0.00	0.50	0.30	0.50	0.30	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	6.99	7.03	5.76	5.75	4.57	30.10
	1,954,035	1,895,627	1,551,278	1,470,959	1,344,793	

BUDGET ($K)

	(closed) **FY15**	(allocated) **FY16**	**FY17**	**FY18**	**FY19**	**Total**
Steady-state Operations						
Personnel	1,543,737	1,451,490	1,270,106	1,215,851	1,105,632	6,586,816
Travel	11,000	11,000	11,000	11,000	11,000	55,000
M&S (hardware, repairs, etc.)	281,000	297,786	131,000	100,000	80,000	889,786
Sub-total (SS Ops)	1,835,737	1,760,276	1,412,106	1,326,851	1,196,632	7,531,602
New Hardware Deployment						
Personnel	-	198,800	91,596	277,829	138,267	706,491
Travel	-	-	-	-	-	-
Equipment (compute)	495,000	992,175	1,196,989	1,066,266	1,337,203	5,087,633
Equipment (storage)	60,000	50,359	104,086	92,719	116,278	423,442
Sub-total (New Deployment)	-	1,241,334	1,392,671	1,436,814	1,591,748	6,217,566
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	1,492,873	1,628,787	1,383,059	7,936,396
Travel	17,000	17,000	17,000	18,000	18,000	87,000
M&S	283,000	299,786	133,000	102,000	82,000	899,786
Equipment (compute)	495,000	992,175	1,196,989	1,066,266	1,337,203	5,087,633
Equipment (storage)	60,000	50,359	104,086	92,719	116,278	423,442
Management Reserve	45,964	83,039	56,052	92,230	63,457	340,743
Total	**2,555,000**	**3,220,000**	**3,000,001**	**3,000,002**	**2,999,998**	**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)	1	2	(2)	(0)
Compute hardware portion of difference	(0)	(0)	0	2	(2)	

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	0.10	0.10	0.10	
Steady-state Operations Support (BG/Q)	0.40	0.40	0.40	-	-	
Steady-state Operations Support (Cluster)	-	-	-	-	-	
Deployment Planning	-	-	-	-	-	
Deployment Support	-	-	-	-	-	
Project Management	-	-	-	-	-	
Sub-total (BNL)	0.50	0.50	0.50	0.10	0.10	1.70
Fermilab						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	2.70	2.58	2.11	2.06	1.97	
Deployment Planning	-	-	-	0.30	0.10	
Deployment Support	-	-	-	0.50	0.30	
Project Management	0.35	0.35	0.35	0.35	0.35	
Sub-total (FNAL)	3.25	3.13	2.66	3.41	2.92	15.37
	2.90	2.78	2.31	3.06	2.57	
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	2.00	2.05	1.35	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Sub-total (JLab)	3.24	3.40	2.60	2.25	1.55	13.03
Total						
Site Management	0.50	0.50	0.50	0.50	0.50	
Steady-state Operations Support	6.14	5.38	4.51	4.10	3.32	
Deployment Planning	-	0.30	0.10	0.30	0.10	
Deployment Support	-	0.50	0.30	0.50	0.30	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	6.99	7.03	5.76	5.75	4.57	30.10
	6.64	6.68	5.41	5.40	4.22	
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	FY18	FY19	Total
Site Management	0.10	0.10	0.10	0.10	0.10	0.50
Steady-state Operations Support (BG/Q)	0.40	0.40	0.40	-	-	1.20
Steady-state Operations Support (Cluster)	-	-	-	-	-	-
Deployment Planning	-	-	-	-	-	-
Deployment Support	-	-	-	-	-	-
Project Management	-	-	-	-	-	-
Total	0.50	0.50	0.50	0.10	0.10	1.70

BUDGET

	This FY15 column has not been updated with actuals (closed) FY15	(allocated) FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	76,482	78,776	118,806	30,602	31,520	336,185
Site Management	17,510	18,035	29,710	30,602	31,520	127,377
Operations Support	58,972	60,741	89,095	-	-	208,808
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S	201,000	201,000	51,000	20,000	-	473,000
(Hardware, repairs, spares, etc.)	20,000	20,000	20,000	20,000	-	
IBM BG/Q Maintenance	181,000	181,000	31,000	-	-	393,000
Total (Steady-state Ops)	280,482	282,776	172,806	53,602	34,520	824,185
New Hardware Deployment						
Personnel	-	-	-	-	-	-
Deployment Planning	-	-	-	-	-	-
Deployment Support	-	-	-	-	-	-
Travel						-
Equipment (compute)	-	-	-	-	-	-
Equipment (storage)	-	-	-	-	-	-
Total (New Deployment)	-	-	-	-	-	-
Project Management						
Personnel						-
Travel						-
M&S						-
Total (Project Mgmt)	-	-	-	-	-	-
Total Site Allocation						
Personnel	76,482	78,776	118,806	30,602	31,520	336,185
Travel	3,000	3,000	3,000	3,000	3,000	15,000
M&S	201,000	201,000	51,000	20,000	-	473,000
Equipment	-	-	-	-	-	-
Total	**280,482**	**282,776**	**172,806**	**53,602**	**34,520**	**824,185**

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	2.06	1.97	
Deployment Planning	-	-	-	0.30	0.10	
Deployment Support	-	-	-	0.50	0.30	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	3.25	3.13	2.66	3.41	2.92	15.37

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	723,007	716,444	3,755,854
Site Management	59,896	76,486	78,781	81,144	83,579	379,886
Operations Support	684,932	777,039	639,269	641,862	632,866	3,375,968
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	768,007	761,444	3,997,640
New Hardware Deployment						
Personnel	-	-	-	277,829	138,267	416,095
Deployment Planning	-	-	-	121,716	41,789	163,506
Deployment Support	-	-	-	156,112	96,477	252,590
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	-	-	1,066,266	1,337,203	2,403,469
M&S (storage hardware)	-	-	26,022	69,539	87,209	182,769
Total (New Deployment)	-	-	26,022	1,413,634	1,562,678	3,002,334
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	1,135,942	993,871	4,815,038
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)	-	-	26,022	1,135,805	1,424,411	2,586,238
Total	**908,126**	**1,050,662**	**928,243**	**2,325,748**	**2,472,283**	**7,685,062**

<div align="center">

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

Thomas Jefferson National Accelerator Facility

</div>

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	2.00	2.05	1.35	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Total	3.24	3.40	2.60	2.25	1.55	13.03

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	433,250	462,243	357,668	2,475,345
Site Management	71,070	58,400	60,152	61,957	63,815	315,394
Operations Support	631,924	460,789	373,098	400,287	293,853	2,159,951
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	476,250	505,243	400,668	2,690,345
New Hardware Deployment						
Personnel	-	198,800	91,596	-	-	290,396
Deployment Planning	-	103,800	35,638	-	-	139,438
Deployment Support	-	95,000	55,958	-	-	150,958
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	992,175	1,196,989	-	-	2,189,164
M&S (storage hardware)	-	50,359	78,065	23,180	29,070	180,673
Total (New Deployment)	-	1,241,334	1,366,649	23,180	29,070	2,660,233
Project Management						
Personnel	-	-	-	-	-	-
Travel	-	-	-	-	-	-
M&S	-	-	-	-	-	-
Total (Project Mgmt)	-	-	-	-	-	-
Total Site Allocation						
Personnel	702,994	717,989	524,846	462,243	357,668	2,765,741
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	1,275,054	23,180	29,070	2,369,837
Total	**745,994**	**1,803,523**	**1,842,899**	**528,423**	**429,738**	**5,350,577**

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	1,270,106	1,215,851	1,105,632	6,586,816
New Hardware Deployment Personnel Budget	-	198,800	91,596	277,829	138,267	706,491

Management Reserve Budget	FY15	FY16	FY17	FY18	FY19	Total
Baseline Budget	46,312	83,305	56,422	92,041	60,822	338,903
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	56,052	92,230	63,457	340,743

Site Staffing Model
Updated 8/05/2015

Red font indicates changes since last revision.

Assumptions:

Assumption	Basis:
0.35 fte for overall project management	Based on operating experience
0.1 fte to manage BNL site	Based on operating experience
0.2 fte to manage cluster site (FNAL, JLab)	Based on operating experience
0.2 fte to plan, manage deployment	See assumptions tab
0.5 fte to deploy new hardware	See assumptions tab
0.0 fte of additional support for GPU deployment	No additional incremental effort to deploy new GPU cluster (Jan '14 ->)
0.2 fte/site of base admin support for ops & maint.; and to maintain expertise	Based on operating experience
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)
900 Number of cluster nodes that can be supported by one FTE	Based on operating experience; updated 01/14/14
900 Number of GPUs that can be supported by one FTE (FNAL)	GPUs at FNAL require on average 2x more support than cluster nodes
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.
225 Number of cluster nodes purchased with $1M in equipment funds (per year)	Based on recent cost data; see assumptions tab
160 Number of GPUs purchased with $1M in equipment funds (per year)	Based on recent cost data; see assumptions tab
21.28% M&S G&A rate at FNAL (% on the first $500K of the purchase)	
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	
11.07% M&S G&A rate at BNL up to $2M (Frank Quarant - Chip Watson email thread 9/30/2015)	
5% Fraction of total equipment budget allocated to storage hardware (FY10-12)	Based on approved hardware baseline plan
8% Fraction of total equipment budget allocated to storage hardware (FY13-19)	Storage budget increased to reflect growing needs
75% Fraction of storage budget allocated to deployment site (FY13-19)	
25% Fraction of storage budget allocated to non-deployment site (FY13-19)	
820 JLab # of conventional nodes - starting point (9q @ 328; 10q @ 224; 12s @ 275 nodes)	
604 JLab # of GPUs - starting point (9g @248 GPUs ;10g @ 212 GPUs; 11g @ 32 GPUs;12k @ 168 GPUs; plus XeonPhi cards)	
959 FNAL # of conventional nodes starting point (Ds @ 421 nodes; Bc @ 224 nodes; Pi0+expansion @ 314 nodes)	
280 FNAL # of GPUs - starting point (Dsg @ 152 GPUs; Pi0g @ 128 GPUs)	

Planned Site Deployments

	FNAL	JLab	BNL		Number of D / FNAL
FY15	0	0	0	FY15	5
FY16	0	1	0	FY16	5
FY17	0	1	0	FY17	4
FY18	1	0	0	FY18	4
FY19	1	0	0	FY19	4

	JLab
Y1 isolated buy = 1 cluster	FY15 6.5
Y2 buy with Y1+Y2 funds = 1 cluster	FY16 5.5
Y1+Y2 option = 1 to 1.5 clusters (age,variety)	FY17 4
Y1 + Y3 or later buy = 2 clusters	FY18 2
Cluster for < 12m = < 1 cluster (0.25 incr)	FY19 2

	BNL
	FY15 0
	FY16 0
	FY17 0
	FY18 0
	FY19 0

CPU Funds Split	FNAL	JLab	BNL
Total Compute H/w	$2,403,469	$2,189,164	$0

Legend
YYC: future unnamed Infiniband cluster
YYG: future unnamed GPU cluster
YY/YY: designates combined purchases that span fiscal years; treated...

Budget Tables

	FY15 (closed)	FY16 (allocated)	FY17	FY18	FY19	Total
Compute hardware budget baseline (PEP)	-	847,000	1,114,000	1,161,000	1,489,000	4,611,000
Compute hardware budget overrun / (underrun)	(0)	(0)	0	2	(2)	(0)
Compute hardware budget ($)	-	1,042,714	1,301,075	1,158,985	1,453,481	4,956,255
BG/Q compute hardware budget ($)	-	-	-	-	-	-
Cluster compute hardware budget ($)	-	992,175	1,196,989	1,066,266	1,337,203	4,592,633
Storage hardware budget ($)	-	50,539	78,065	69,539	87,209	285,351
Storage hardware budget ($)	-	-	26,022	23,180	29,070	78,271
Storage hardware budget ($)	-	-	-	-	-	-
Total equipment budget ($)	-	1,042,714	1,301,075	1,158,985	1,453,481	4,956,255
Overhead portion of equipment budget (used be...	-	30,456	32,006	106,400	-	168,863
% of compute budget allocated for IB clusters	100%	50%	50%	50%	50%	
Allocation for conv. cluster hardware ($)	-	496,088	598,495	533,133	668,601	2,296,316
Direct portion of conv. cluster budget	-	480,859	582,491	479,933	668,601	2,211,885
Overhead portion of conv. cluster budget	-	15,228	16,003	53,200	-	84,431
Allocation for GPU hardware ($)	-	496,088	598,495	533,133	668,601	2,296,316
Direct portion of GPU budget	-	480,859	582,491	479,933	668,601	2,211,885
Overhead portion of GPU budget	-	15,228	16,003	53,200	-	84,431
Estimated # of cluster nodes purchased	-	108	131	108	150	498
Estimated # of GPUs purchased	-	77	93	77	107	354
Actual cluster nodes purchased	-	-	-	-	-	-
Actual GPU nodes purchased	-	-	-	-	-	-
Actual GPUs purchased	-	-	-	-	-	-
Check: dep+nondep storage	-	50,539	104,086	92,719	116,278	363,622
same as: site sheets storage	-	50,359	104,086	92,719	116,278	363,442

Row notes:
- BG/Q deployment site
- Cluster deployment site
- BG/Q or Cluster deployment site
- Non-deployment site
- Storage increment
- Thresholds impacts total equipment budget, not CPU/GPU separately
- Apportioned per % direct portion

Initial Cluster Node Counts (FNAL)

	Name	# nodes	# GPUs	Cores
FNAL Conventional Clusters	Ds	421	0	
	Bc	224	0	
	Pi0+Pi0 exp	314	0	
	Total	959		
FNAL GPU Clusters	Dsg	76	152	16
	Pi0g	32	152	16
	Total	108		

Initial Cluster Node Counts (JLab)

	Name	# nodes	# GPUs	Cores
JLab Conventional Clusters	9q	320	0	8
	10q	224	0	8
	12s	276	0	16
	Total	820		
JLab Accelerated Clusters	9g	36	144	8
	10g	50	200	8
	11q	7	28	8
	12k	42	168	16
	12m	16	64	16
	Total	151		

Note: Retired machines typically taken offline by June 30 of the retirement ...