LQCD-Ext II Cost Forecast - $14 Million
(as of 07/02/2014)

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	6.22	5.50	4.80	4.44	3.59	
Deployment Planning	0.00	0.30	0.10	0.30	0.10	
Deployment Support	0.00	0.50	0.30	0.50	0.40	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	7.07	7.15	6.05	6.09	4.94	31.30

	1,954,035	1,842,873	1,712,982	1,516,213	1,298,808	

BUDGET ($K)

	FY15	FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	1,543,737	1,429,266	1,295,967	1,277,187	1,056,166	6,602,323
Travel	11,000	11,000	11,000	9,500	9,500	52,000
M&S (hardware, repairs, etc.)	281,000	281,000	281,000	100,000	100,000	1,043,000
Sub-total (SS Ops)	1,835,737	1,721,266	1,587,967	1,386,687	1,165,666	7,697,323
New Hardware Deployment						
Personnel	-	223,103	112,460	236,690	147,843	720,097
Travel	-	-	-	-	-	-
Equipment (compute)	-	779,047	1,024,471	1,068,355	1,370,303	4,242,175
Equipment (storage)	-	67,743	89,084	92,900	119,157	368,885
Sub-total (New Deployment)	-	1,069,893	1,226,015	1,397,945	1,637,303	5,331,157
Project Management						
Personnel	110,298	113,607	117,016	120,526	124,142	585,590
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	121,607	125,016	129,526	133,142	627,590
Total Project Cost						
Personnel	1,654	1,766	1,525	1,634	1,328	7,908
Travel	17	17	17	17	17	84
M&S	283	283	283	102	102	1,053
Equipment (compute)	-	779	1,024	1,068	1,370	4,242
Equipment (storage)	-	68	89	93	119	369
Management Reserve	46	87	61	86	64	344
Total	**2,000**	**3,000**	**3,000**	**3,000**	**3,000**	**14,000**
CD-2/3 Budget Guidance Profile	2,000	3,000	3,000	3,000	3,000	14,000
Additional funding for larger budget	-	-	-	-	-	-
Total CD-2/3 Planning Budget Profile	2,000	3,000	3,000	3,000	3,000	14,000

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.

2) CD-2/3 budget profile has been set for a $14M budget.

LQCD-Ext II Cost Forecast - $14 Million
(as of 07/02/2014)

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	0.40	0.40	0.40	-	-	
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	2.76	2.64	2.16	2.12	2.10	
Deployment Planning	-	-	-	0.30	0.10	
Deployment Support	-	-	-	0.50	0.40	
Project Management	0.35	0.35	0.35	0.35	0.35	
Sub-total (FNAL)	3.31	3.19	2.71	3.47	3.15	15.84
	2.96	2.84	2.36	3.12	2.80	
Thomas Jefferson National Accelerator Facility						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	3.06	2.46	2.24	2.32	1.49	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Sub-total (JLab)	3.26	3.46	2.84	2.52	1.69	13.76
Total						
Site Management	0.50	0.50	0.50	0.50	0.50	
Steady-state Operations Support	6.22	5.50	4.80	4.44	3.59	
Deployment Planning	-	0.30	0.10	0.30	0.10	
Deployment Support	-	0.50	0.30	0.50	0.40	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	7.07	7.15	6.05	6.09	4.94	31.30
	6.72	6.80	5.70	5.74	4.59	
Total agrees with TPC Summary?	Yes	Yes	Yes	Yes	Yes	

LQCD-Ext II Cost Forecast - $14 Million
(as of 07/02/2014)

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	0.40	0.40	0.40	-	-	1.20
Deployment Planning	-	-	-	-	-	-
Deployment Support	-	-	-	-	-	-
Project Management	-	-	-	-	-	-
Total	0.50	0.50	0.50	0.10	0.10	1.70

BUDGET

	FY15	FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	76,482	78,776	81,139	19,134	19,708	275,239
Site Management	17,510	18,035	18,576	19,134	19,708	92,963
Operations Support	58,972	60,741	62,563	-	-	182,276
Travel	3,000	3,000	3,000	1,500	1,500	12,000
M&S	201,000	201,000	201,000	20,000	20,000	643,000
(Hardware, repairs, spares, etc.)	20,000	20,000	20,000	20,000	20,000	
IBM BG/Q Maintenance	181,000	181,000	181,000	-	-	543,000
Total (Steady-state Ops)	280,482	282,776	285,139	40,634	41,208	930,239
New Hardware Deployment						
Personnel						-
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	81,139	19,134	19,708	275,239
Travel	3,000	3,000	3,000	1,500	1,500	12,000
M&S	201,000	201,000	201,000	20,000	20,000	643,000
Equipment	-	-	-	-	-	-
Total	**280,482**	**282,776**	**285,139**	**40,634**	**41,208**	**930,239**

LQCD-Ext II Cost Forecast - $14 Million
(as of 07/02/2014)

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	2.76	2.64	2.16	2.12	2.10	
Deployment Planning	-	-	-	0.30	0.10	
Deployment Support	-	-	-	0.50	0.40	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	3.31	3.19	2.71	3.47	3.15	15.84

BUDGET

	FY15	FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	758,913	751,143	645,696	653,618	666,697	3,476,067
Site Management	59,896	61,693	63,544	65,450	67,414	317,997
Operations Support	699,016	689,449	582,152	588,168	599,284	3,158,070
Travel	5,000	5,000	5,000	5,000	5,000	25,000
M&S (hardware, repairs, tape, etc.)	40,000	40,000	40,000	40,000	40,000	200,000
Total (Steady-state Ops)	803,913	796,143	690,696	698,618	711,697	3,701,067
New Hardware Deployment						
Personnel	-	-	-	236,690	147,843	384,534
Deployment Planning	-	-	-	98,175	33,707	131,882
Deployment Support	-	-	-	138,515	114,136	252,652
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	-	-	1,068,355	1,370,303	2,438,658
M&S (storage hardware)	-	16,936	22,271	69,675	89,368	198,250
Total (New Deployment)	-	16,936	22,271	1,374,720	1,607,514	3,021,441
Project Management						
Personnel	110,298	113,607	117,016	120,526	124,142	585,590
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	121,607	125,016	129,526	133,142	627,590
Total Site Allocation						
Personnel	869,211	864,750	762,712	1,010,835	938,683	4,446,190
Travel	11,000	11,000	11,000	12,000	12,000	57,000
M&S (SS Ops)	42,000	42,000	42,000	42,000	42,000	210,000
M&S (DME)	-	16,936	22,271	1,138,030	1,459,671	2,636,908
Total	**922,211**	**934,686**	**837,983**	**2,202,865**	**2,452,353**	**7,350,098**

LQCD-Ext II Cost Forecast - $14 Million

(as of 07/02/2014)

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	3.06	2.46	2.24	2.32	1.49	
Deployment Planning	-	0.30	0.10	-	-	
Deployment Support	-	0.50	0.30	-	-	
Project Management	-	-	-	-	-	
Total	3.26	3.46	2.84	2.52	1.69	13.76

BUDGET

	FY15	FY16	FY17	FY18	FY19	Total
Steady-state Operations						
Personnel	708,343	599,347	569,131	604,435	369,761	2,851,017
Site Management	71,070	73,202	75,398	77,660	69,000	366,330
Operations Support	637,273	526,145	493,733	526,775	300,761	2,484,687
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)	751,343	642,347	612,131	647,435	412,761	3,066,017
New Hardware Deployment						
Personnel	-	223,103	112,460	-	-	335,564
Deployment Planning	-	92,540	31,772	-	-	124,311
Deployment Support	-	130,564	80,688	-	-	211,252
Travel	-	-	-	-	-	-
M&S (compute hardware)	-	779,047	1,024,471	-	-	1,803,517
M&S (storage hardware)	-	50,807	66,813	23,225	29,789	170,635
Total (New Deployment)	-	1,052,958	1,203,744	23,225	29,789	2,309,716
Project Management						
Personnel	-	-	-	-	-	-
Travel	-	-	-	-	-	-
M&S	-	-	-	-	-	-
Total (Project Mgmt)	-	-	-	-	-	-
Total Site Allocation						
Personnel	708,343	822,451	681,591	604,435	369,761	3,186,581
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)	-	829,854	1,091,284	23,225	29,789	1,974,152
Total	**751,343**	**1,695,305**	**1,815,875**	**670,660**	**442,550**	**5,375,733**

LQCD-Ext II Cost Forecast - $14 Million
(as of 07/02/2014)

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	1,429,266	1,295,967	1,277,187	1,056,166	6,602,323
New Hardware Deployment Personnel Budget	-	223,103	112,460	236,690	147,843	720,097

Management Reserve Budget	**FY15**	**FY16**	**FY17**	**FY18**	**FY19**	**Total**
Baseline Budget	46,312	87,499	61,371	85,654	61,254	342,089
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	87,233	61,001	85,843	63,889	343,929

LQCD-Ext II Cost Forecast - $14 Million

(as of 07/02/2014)

Site Staffing Model

Updated 05/28/2014

Assumptions: | **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*
780	Number of GPUs that can be supported by one FTE (JLab)	*Tesla and MIC cards: 900 GPUs / fte; Gaming cards: 660 / fte; average = 780.*
283	Number of cluster nodes purchased with $1M in equipment funds (per year)	*Based on recent cost data; see assumptions tab*
249	Number of GPUs purchased with $1M in equipment funds (per year)	*Based on recent cost data; see assumptions tab*
21%	M&S G&A rate at FNAL (% on the first $500K of the purchase)	
50%	M&S G&A rate at JLab (% on the first $50K of the purchase)	
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)	
985	FNAL # of conventional nodes starting point (Ds @ 421 nodes; Bc @ 224 nodes; FY14c @ 340 nodes)	
304	FNAL # of GPUs - starting point (Dsg @ 152 GPUs; FY14g @ 152 GPUs)	

Planned Site Deployments

	FNAL	JLab
FY15	0	0
FY16	0	1
FY17	0	1
FY18	1	0
FY19	1	0

Number of Distinct Clusters in Operation

	FNAL	Clusters		JLab
FY15	5	Ds, Bc, FY14c, Dsg, FY14g	FY15	6.5
FY16	5	Ds, Bc, FY14c, Dsq, FY14q	FY16	5.5
FY17	4	Bc, FY14c, Dsg, FY14g	FY17	5
FY18	4	Bc, FY14c, FY14g, 18C, 18G	FY18	5
FY19	4	FY14c, FY14g, 18/19C, 18/19G	FY19	2

Legend

YYC: future unnamed Infiniband cluster

YYG: future unnamed GPU cluster

YY/YY: designates combined purchases that span fiscal years; treated

Compute hardware budget overrun / (underrun) (0) (1) (1) 1 0 (1)

	FY15	FY16	FY17	FY18	FY19	Total	
Compute hardware budget ($)	-	846,790	1,113,555	1,161,255	1,489,460	4,611,060	
BG/O compute hardware budget ($)	-	-	-	-	-	-	*BG/O deployment site*
Cluster compute hardware budget ($)	-	779,047	1,024,471	1,068,355	1,370,303	4,242,175	*Cluster deployment site*
Storage hardware budget ($)	-	50,807	66,813	69,675	89,368	276,664	*BG/Q or Cluster deployment site*
Storage hardware budget ($)	-	16,936	22,271	23,225	29,789	92,221	*Non-deployment site*
Storage hardware budget ($)	-	-	-	-	-	-	*Storage increment*
Total equipment budget ($)	-	846,790	1,113,555	1,161,255	1,489,460	4,611,060	
% of compute budget allocated for IB clusters	100%	50%	50%	50%	50%		
Allocation for conv. cluster hardware ($)	-	389,523	512,235	534,177	685,152	2,121,088	
Direct portion of conv. cluster budget	-	364,523	487,235	427,777	685,152	1,964,688	
Overhead portion of conv. cluster budget	-	25,000	25,000	106,400	-	156,400	
Allocation for GPU hardware ($)	-	389,523	512,235	534,177	685,152	2,121,088	
Direct portion of GPU budget	-	364,523	487,235	427,777	685,152	1,964,688	
Overhead portion of GPU budget	-	25,000	25,000	106,400	-	156,400	
Estimated # of cluster nodes purchased	-	103	138	121	194	555	
Estimated # of GPUs purchased	-	91	121	106	170	489	
Actual cluster nodes purchased	-	-	-	-	-	-	
Actual GPU nodes purchased	-	-	-	-	-	-	
Actual GPUs purchased	-	-	-	-	-	-	

Initial Cluster Node Counts (FNAL)

	Name	# nodes	# GPUs	Cores
FNAL Conventional Clusters	Ds	421	0	
	Bc	224	0	
	FY14c	340	0	
	Total	985		
FNAL GPU Clusters	Dsg	76	152	16
	FY14g	76	152	16
	Total	152		

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	9q	36	144	8
	10g	50	200	8
	11g	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 y