

LQCD-ext Project Management & Performance

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LQCD-ext Contractor Project Manager

DOE FY2011 Annual Progress Review
Fermi National Accelerator Laboratory
May 10-11, 2011

Outline

- ▶ Project scope and budget
- ▶ Project execution and planning
- ▶ Management and oversight
- ▶ Change in OMB classification
- ▶ FY10/11 performance metrics and results
- ▶ FY10 user survey results
- ▶ Plans for early access to prototype BG/Q
- ▶ FY12 hardware selection process

LQCD-Ext Project Scope

- ▶ Acquire and operate dedicated hardware at BNL, JLab, and FNAL for the study of QCD during the period FY2010–2014.
 - Extension of prior computing project with similar scope: FY2006–2009
- ▶ Computing hardware will be sited at each host laboratory and locally managed following host laboratory policies and procedures (security, ES&H, etc.)
- ▶ Baseline acquisition/deployment plan:
 - FY10/11: Cluster deployments at FNAL
 - FY12: Several options under consideration, including conventional/GPU-accelerated cluster deployment at JLab or BG/Q at BNL
 - FY13/14: Cluster deployments at FNAL (and/or perhaps BNL and/or JLab, depending on outcome of FY12 plan).

LQCD-Ext Project Scope (2)

- ▶ LQCD-ext project was approved following the Critical Decision (CD) process outlined in DOE Order 413.3A
 - Project received CD-2/3 approval on October 29, 2009
 - Performance plan baselined; 5-year funding profile established.
- ▶ Project funding covers:
 - Operations and maintenance of existing systems
 - Acquisition and deployment of new hardware
 - Project management
- ▶ Not in scope:
 - Software development or scientific software support
- ▶ Currently executing against baseline plan, with a few exceptions
 - QCDOC at BNL is being operated through June/July 2011
 - Kaon at FNAL is being operated through FY2011
 - FY11 procurement includes a mix of conventional Infiniband cluster nodes and GPU-accelerated nodes

LQCD-Ext Project Budget

- ▶ Approved Budget = \$18.15 million
 - Jointly funded by DOE Offices of High Energy and Nuclear Physics

Approved Funding Profile (in \$K)

Expenditure Type	FY10	FY11	FY12	FY13	FY14	Total
Personnel	1,139	1,306	1,456	1,340	1,644	6,885
Travel	13	11	12	12	12	60
M&S	104	84	84	84	84	440
Equipment	1,684	1,779	1,974	2,589	2,379	10,405
Management Reserve	60	69	75	75	81	360
Total	3,000	3,250	3,600	4,100	4,200	18,150

- ▶ Personnel budget based on staffing model that takes into account experience gained during the first four years of operations.
 - Staffing model will need to be revised going forward, to take into account deployment of different technologies (e.g., GPU clusters, BG/Q)
- ▶ Equipment budget was determined by subtracting staffing budget needs from the total budget.

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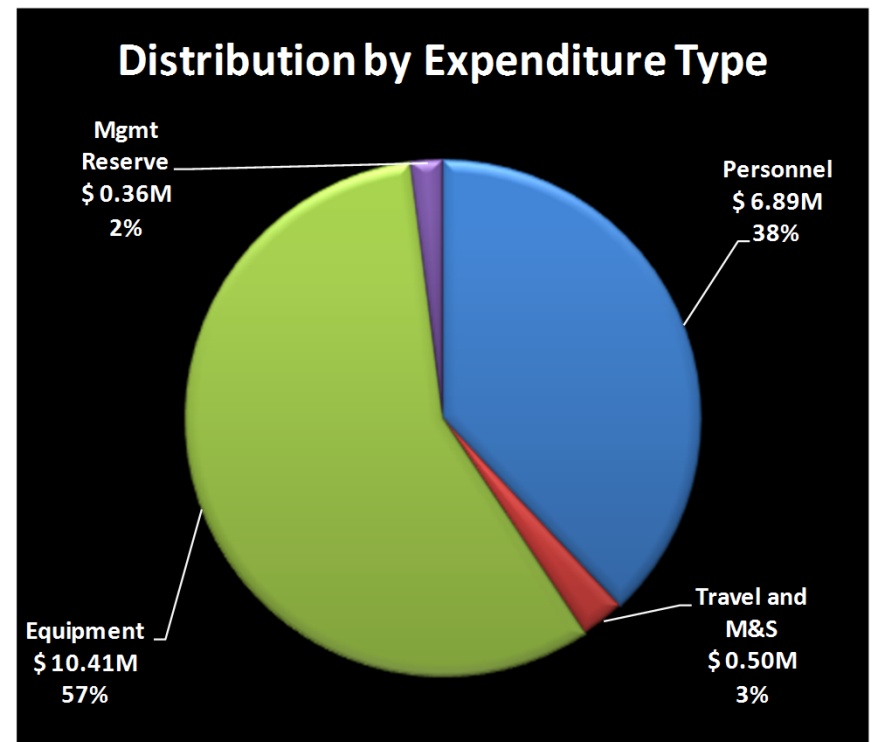
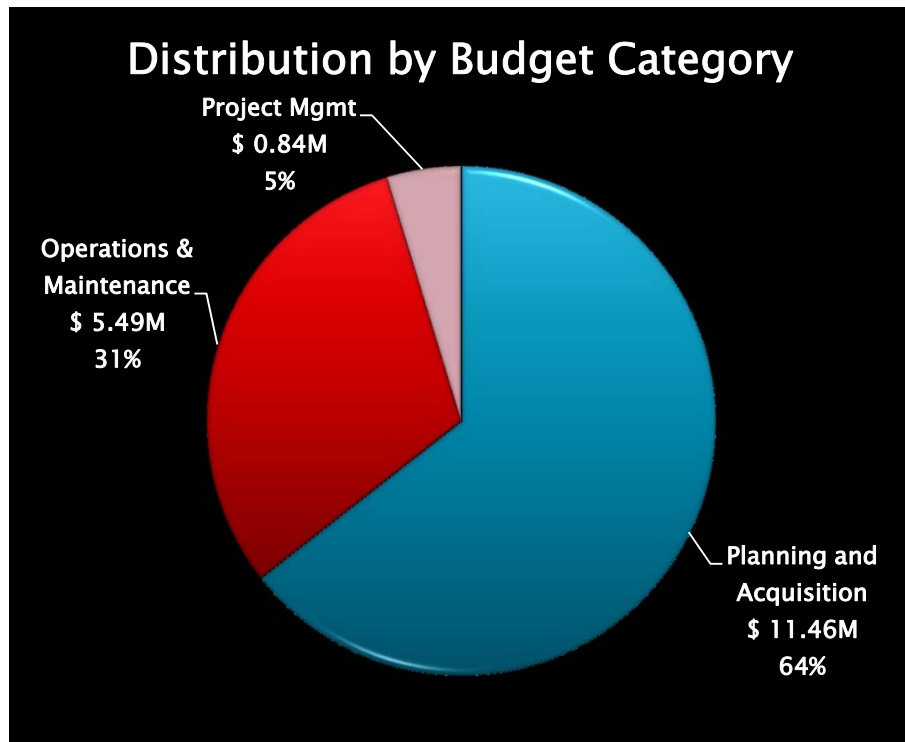
Hardware Budget Breakdown (in \$K)

Fiscal Year	Compute Hardware	Storage Hardware	Total
FY10	1,600	84	1,684
FY11	1,690	89	1,779
FY12	1,875	99	1,974
FY13	2,460	129	2,589
FY14	2,260	119	2,379
Total	9,885	520	10,405

Storage at ~5% of total hardware budget

Budget Distribution

- ▶ Total budget = \$18.15M

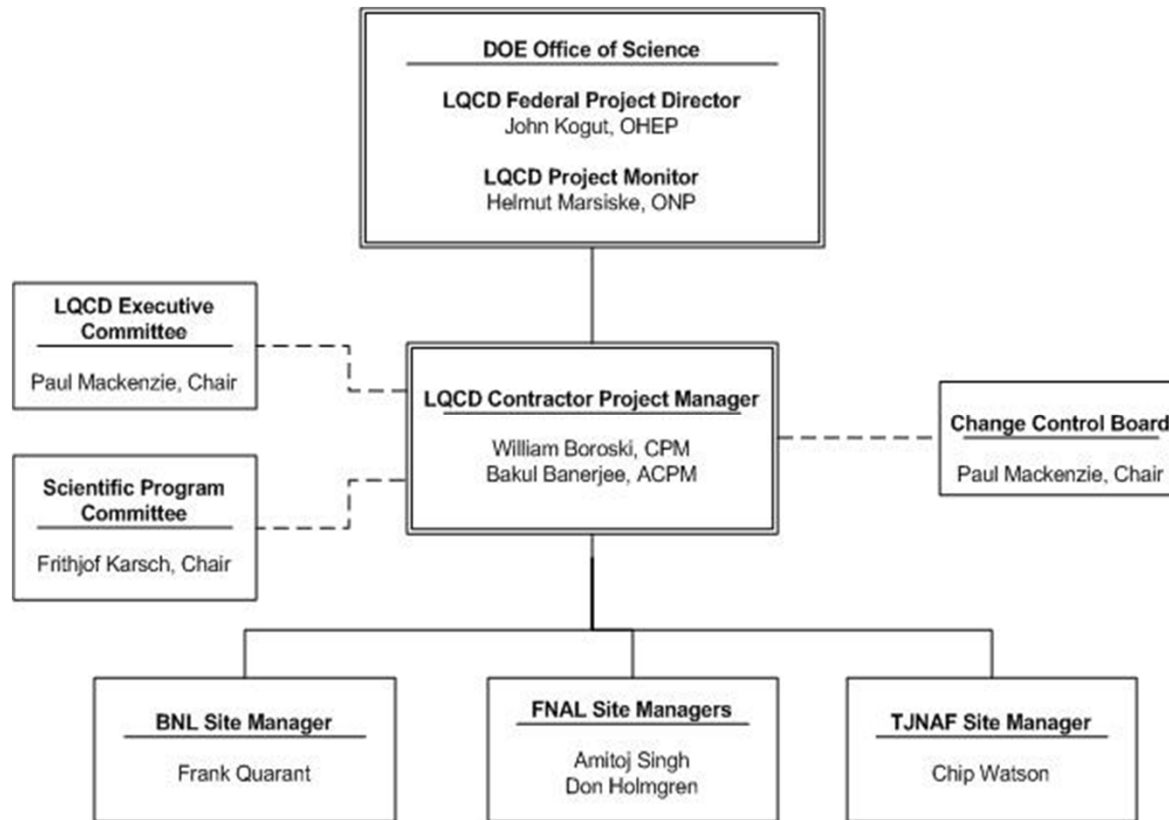


Project Execution & Work Planning

- ▶ Project Execution Plan (PEP)
 - Controlled document defining project need, requirements, scope, management, cost and schedule, change control, etc.
- ▶ Work organized via WBS
 - MS Project used to identify tasks, develop schedules, and track progress against milestones
 - Work broken down into two primary areas:
 - Steady-state operations and maintenance
 - Procurement and deployment of equipment and new systems
- ▶ Other important project documents
 - Risk Management Plan, Acquisition Strategy Documents, Annual Acquisition Plans, C&A Documentation
 - All under formal version control

ID	WBS	Task Name	Start	Finish	2010		2011	
					H2	H1	H2	H1
1	1	LQCDEXT	Mon 10/4/10	Fri 9/30/11				57
1	1.1	BNL	Mon 10/4/10	Fri 9/30/11				57
2	1.1.2	LQCDEXT BNL FY11	Mon 10/4/10	Fri 9/30/11				57
3	1.1.2.7	FY11 BNL site operation	Mon 10/4/10	Fri 9/30/11				57
4	1.1.2.7.7	Site operation & management of LQCDEXT	Mon 10/4/10	Fri 9/30/11				58%
5	1.1.2.7.8	Decommissioning QCDOC	Fri 7/29/11	Fri 7/29/11				0%
2	2	LQCDEXT_FINALFY10_14.mpp	Tue 1/19/10	Thu 10/20/11				47
1	2.1	FNAL	Tue 1/19/10	Thu 10/20/11				47
2	2.1.2	LQCDEXT FNAL FY11	Tue 1/19/10	Thu 10/20/11				47
3	2.1.2.1	FY11 FNAL - plan and deploy system	Tue 1/19/10	Thu 10/20/11				37
4	2.1.2.1.1	Deploy FY10 Hardware in "Friendly user"	Tue 9/21/10	Tue 11/30/10				100%
5	2.1.2.1.2	Plan FNAL FY11 deployment work	Tue 1/19/10	Fri 7/15/11				76%
6	2.1.2.1.2.1	Test processors and chipsets for FY	Mon 10/4/10	Fri 10/15/10				100%
7	2.1.2.1.2.2	System Design Document for GPU	Mon 10/18/10	Mon 5/23/11				90%
8	2.1.2.1.2.8	Decision to split Ds expansion purch	Tue 1/19/10	Tue 1/19/10				100%
9	2.1.2.1.2.3	Release RFP (new HW)	Tue 5/31/11	Tue 5/31/11				0%
10	2.1.2.1.2.4	Receive RFP (new HW) responses	Wed 6/1/11	Thu 6/30/11				0%
11	2.1.2.1.2.5	Award FY2011 purchase contract (r	Fri 7/1/11	Fri 7/15/11				0%
12	2.1.2.1.2.6	Exercise FY2011 purchase option 1	Mon 3/7/11	Tue 3/8/11				100%
13	2.1.2.1.2.7	Exercise FY2011 purchase option 2	Tue 5/31/11	Wed 6/1/11				100%
14	2.1.2.1.3	Deploy FY11 hardware	Fri 10/22/10	Thu 10/20/11				0%
15	2.1.2.1.3.1	Delivery of Opt. 1 4 Tflops Ds hardw	Wed 5/4/11	Tue 5/10/11				0%
16	2.1.2.1.3.2	Release to production of Option 1 4 r	Wed 6/1/11	Wed 6/1/11				0%
17	2.1.2.1.3.7	Delivery of 4 Tflops Ds hardware co	Tue 8/9/11	Mon 8/15/11				0%
18	2.1.2.1.3.6	Release to production of Option 2 4 r	Thu 9/1/11	Thu 9/1/11				0%
19	2.1.2.1.3.9	Sample unit received	Mon 8/1/11	Mon 8/1/11				0%
20	2.1.2.1.3.8	Delivery of new HW complete	Tue 9/6/11	Thu 9/15/11				0%
21	2.1.2.1.3.10	Acceptance test complete	Fri 9/16/11	Thu 10/20/11				0%
22	2.1.2.1.3.5	Release to production - new HW	Thu 10/20/11	Thu 10/20/11				0%
23	2.1.2.1.3.3	Support deployment of new HW syst	Fri 10/22/10	Thu 10/20/11				0%
24	2.1.2.1.3.4	Procurement and deployment of 128	Thu 10/20/11	Thu 10/20/11				0%
25	2.1.2.2	FY11 FNAL site operation	Fri 10/1/10	Thu 9/29/11				58
26	2.1.2.2.1	Site operation & management of LQCDEXT	Fri 10/1/10	Thu 9/29/11				58%
27	2.1.2.3	FY11 project management	Fri 10/1/10	Thu 9/29/11				57
28	2.1.2.3.1	Manage LQCDEXT project	Fri 10/1/10	Thu 9/29/11				58%
29	2.1.2.3.2	Management Reserve	Fri 10/1/10	Fri 10/1/10				0%
30	2.1.2.3.3	DOE progress review complete	Tue 5/10/11	Wed 5/11/11				0%
31	2.1.2.3.4	22 Teraflops-years aggregate computing	Thu 9/29/11	Thu 9/29/11				9/2
3	3	LQCDEXT_JLABFY10_14.mpp	Fri 10/1/10	Thu 9/29/11				58
1	3.1	JLAB	Fri 10/1/10	Thu 9/29/11				58
2	3.1.2	LQCDEXT JLAB FY11	Fri 10/1/10	Thu 9/29/11				58
3	3.1.2.1	FY11 JLAB site operation	Fri 10/1/10	Thu 9/29/11				58
4	3.1.2.1.1	Site operation & management of LQCDEXT	Fri 10/1/10	Thu 9/29/11				58%

Management Organization



- ▶ Structure unchanged from the original computing project. Frank Quarant replaced Eric Blum as BNL Site Manager in Feb 2011.
- ▶ All federal and contractor project managers are certified “Level 1 Qualified IT Project Managers.”

Change in Project Classification

- ▶ A significant change in the IT investment classification of the LQCD-ext project occurred in August 2010.
 - The DOE Office of the Chief Information Officer determined that it was appropriate to raise the threshold for mandatory IT investment classification and reporting to \$25 million (PY, CY, and BY) beginning with the BY 2012 IT reporting cycle.
 - The LQCD-ext project budget profile falls beneath this threshold.
- ▶ The LQCD-ext project was reclassified from an OMB Exhibit 300 major IT investment project to an OMB Exhibit 53 non-major IT investment project.
- ▶ Although the formal IT investment classification of the LQCD-ext project has changed, the project continues to be managed through OHEP and ONP using the same management and oversight structure that has been in place since project inception.
 - Performance goals and milestones that had been documented in the OMB Exhibit 300 business case are being incorporated in the appendices of the Project Execution Plan.
 - The project will adhere to all OMB Exhibit 53 reporting requirements and will coordinate reporting through the Federal Project Director.

Planned Changes to the PEP

- ▶ Document change in classification from OMB Exhibit 300 to Exhibit 53
- ▶ Incorporate performance tables from the Exhibit 300 business case as appendices to the PEP
- ▶ Revise performance goals to reflect the impact of deploying GPU-accelerated nodes in addition to conventional Infiniband clusters.
- ▶ Update org charts to reflect change in BNL site manager.

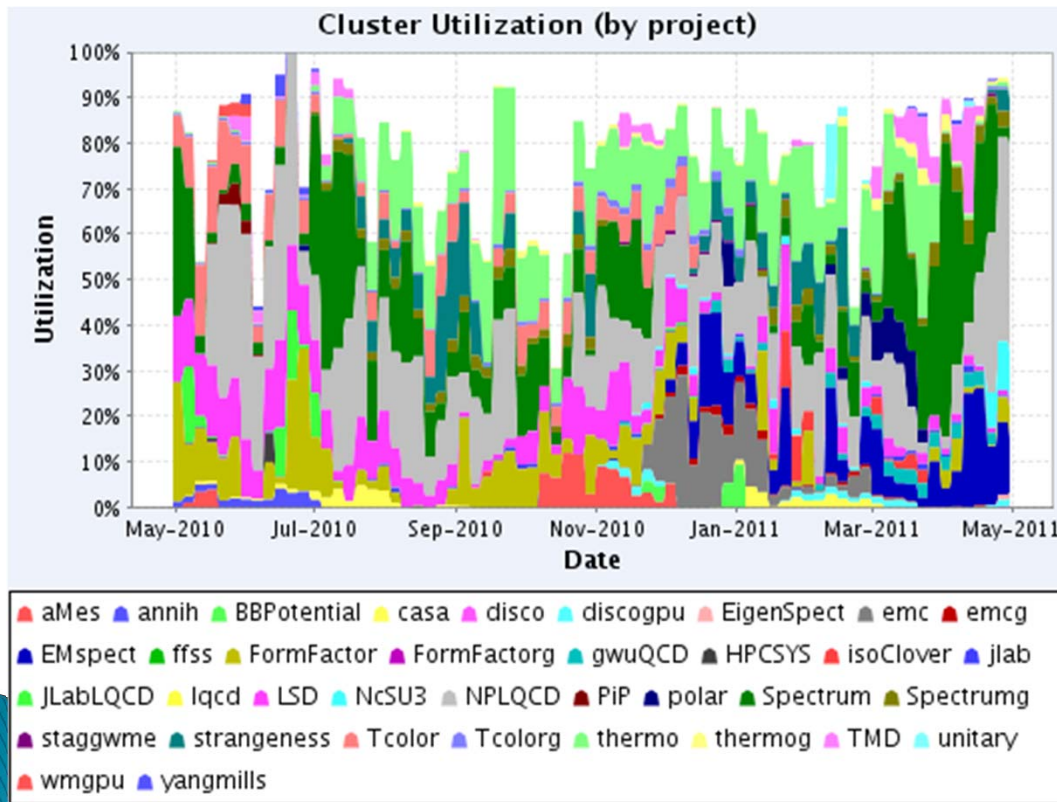
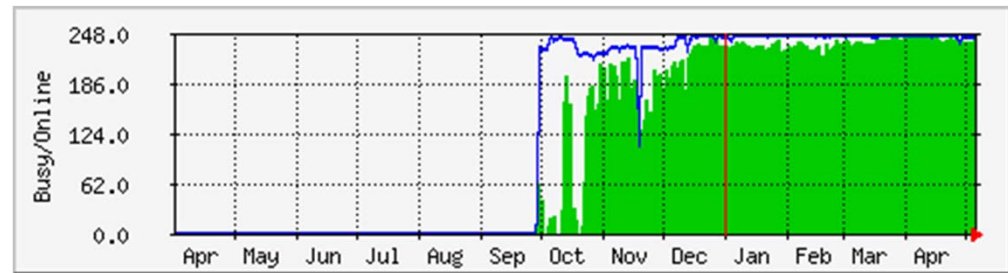
Performance Measures & Metrics

LQCD Hardware Performance Data

- ▶ Performance and utilization data are available online for LQCD resources at all three sites (BNL, JLab, and FNAL)
 - QCDOC at BNL: <http://lqcd.bnl.gov/comp/usage/>
 - 7n at JLab: <http://lqcd.jlab.org/>
 - Kaon, JPsi, and Ds at FNAL: <http://www.usqcd.org/fnal>
- ▶ Available data include:
 - Machine usage on an hourly, daily, weekly, monthly, annual basis
 - Interactive views that allow users to select performance periods
 - System and node health monitoring
 - Node uptime, system temperature, processor temperature and fan speeds, CPU load average.
 - Job data
 - Project allocation usage, jobs running and in queue, nodes allocated to projects.

Capacity Utilization (examples)

Usage plot for Ds cluster at FNAL (Apr2010–Apr2011)



JLab cluster utilization by project (May2010–May 2011)

Performance Measures & Metrics

- ▶ Performance goals and milestones for LQCD-ext had previously been explicitly defined in the OMB Exhibit 300 document.
 - 19 project milestones
 - External reviews of future procurement plans
 - Incremental procurements/TFlops-deployed
 - Aggregate TFlops-yrs delivered
 - 29 performance indicators
 - Additional computing resources brought on-line
 - System performance (i.e., % of time system available for work)
 - Process improvements (i.e., % of tickets closed within 2 business days)
 - Customer satisfaction (measured through user surveys)
- ▶ We are in the process of revising our Project Execution Plan to reflect the change in project classification and to incorporate the performance goals and milestones as appendices to the document.
 - Ensures that the performance goals and milestones remain under formal change control and are readily available to the project team and stakeholders.
- ▶ Progress against these goals is tracked and reported periodically to the Federal Project Manager.

FY10 Performance Summary (1)

Comparison of Actuals to Approved Baseline

Milestone #	Description	Actual Results	Planned Cost (\$K)	Actual Cost (\$K)	Planned Completion	Actual Completion
18	Architecture planning for FY11 procurement reviewed by external DOE committee	Plan reviewed & accepted	52	57	06/30/10	07/02/10
19	Procurement & deployment of 11 TF (sustained) system	12.5 TF (114% of goal)	1,887	1,816*	12/31/10	12/01/10
20	18.0 TF-yrs aggregate computing delivered	19.17 TF-yrs (107% of goal)	1,061	1,009	09/30/10	09/30/10
21	Security controls testing and contingency plan review complete at BNL, FNAL, and TJNAF	Completed as planned	0	0	08/31/10	08/31/10

**Includes costs that were obligated in FY10 for the FY10 cluster procurement, but actually costed in Oct 2010.*

- We met or exceeded all milestone goals
- All milestones were completed on time and within budget.
- No management reserve funds were expended.
- All unspent funds have been carried forward into the FY11 budget.

FY10 Performance Summary (2)

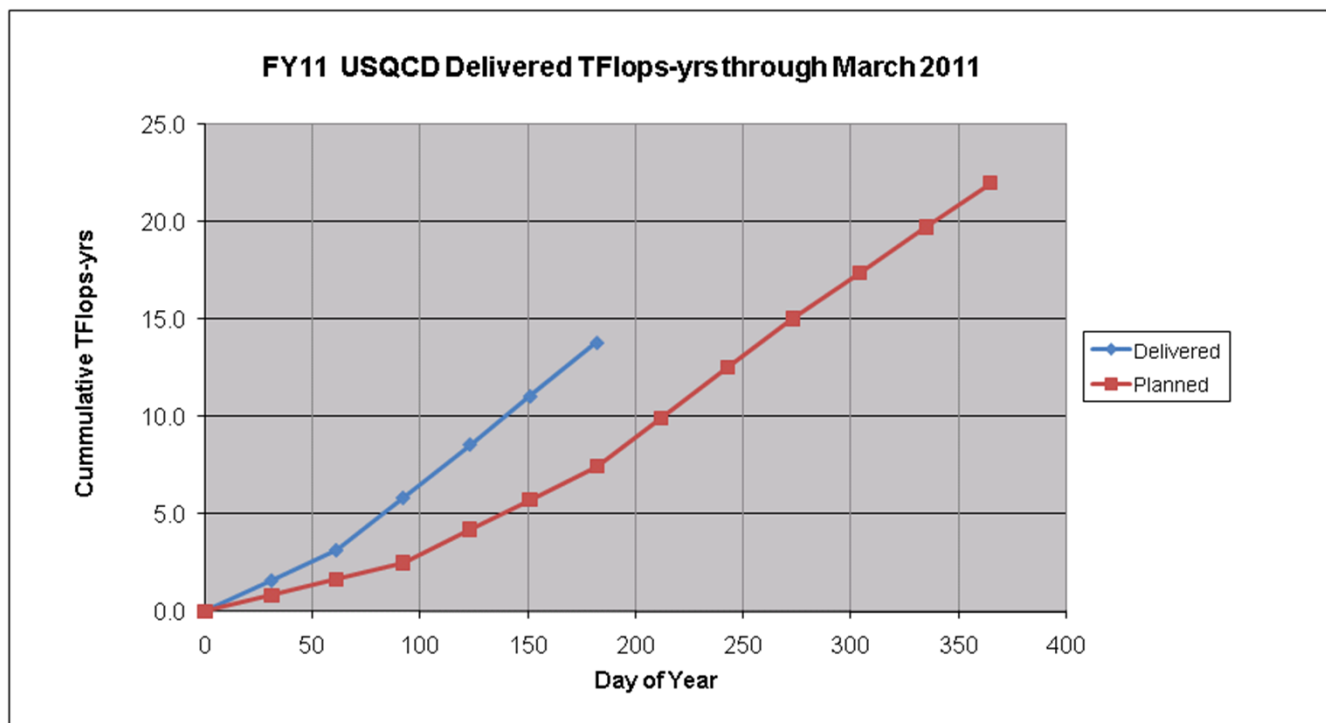
Performance against other Key Performance Indicators (KPIs)

Measurement Indicator	Target	Actual Results
Customer Satisfaction Rating	≥92%	81%
% of tickets closed within two business days	≥95%	95% <i>BNL: 100% (65/65 tickets)</i> <i>FNAL: 98% (252/256 tickets)</i> <i>TJNAF: 84% (56/67 tickets)</i>
% of average machine uptime at the metafacility	≥95%	97.4% (weighted ave) <i>BNL: 97.2%</i> <i>FNAL: 98.8%</i> <i>TJNAF: 92.6%</i>
Weekly vulnerability scans	Scans performed at least weekly at each host institution	Daily scans performed at all sites. Performance goal exceeded.

- ▶ All KPI metrics were met with the exception of our overall Customer Satisfaction Rating
 - Satisfaction rating decreased from 96% in FY09 to 81% in FY10 – more later....

FY11 Milestone Performance *(TFlops-yrs delivered)*

- ▶ Data thru March 2011 are shown. The goal for FY11 is 22.0 TFlops-yrs.
- ▶ Goal through March = 7.44 TFlops-yrs
- ▶ Actual = 13.81 TFlops-yrs (186% of goal)



- We are well ahead of the planned pace
 - Ds is bigger than planned (12.4 TF vs. 11 TF plan)
 - Ds was released to production one month earlier than plan.
 - Baseline plan did not include operating Kaon and QCDOC in FY11, which we continue to run.
- Monthly surplus will begin to narrow
 - FY11 piece of Ds will be smaller than planned (176 nodes instead of 267) to accommodate GPU purchase
 - FY11 portion of Ds did not come online by March
 - QCDOC will be retired at the end of July 2011.

Financial Performance

FY10 Project Cost Summary – Final

Fund Type	FY09 Carry-forward	FY10 Budget	Total FY10 Funds Available	FY10 Actual Costs	FY10 Obligations	% Spent & Obligated
Equipment	\$21K	\$ 1,685K	\$ 1,706K	\$ 544K	\$ 1,048K	93%
Operating	\$ 206K	\$ 1,255K	\$ 1,461K	\$ 1,255K	---	83%
Sub-total	\$ 227K	\$ 2,940K	\$ 3,167K	\$ 1,799K	\$ 1,048K	90%
Mgmt Reserve	\$ 0K	\$ 60K	\$ 60K	\$ 0K	\$ 0K	0%
TOTAL	\$ 227K	\$ 3,000K	\$ 3,227K	\$1,799K	\$ 1,048K	90%

- ▶ Purchase order for the compute hardware portion of the FY10 procurement was awarded to vendor (\$1.487M) and payments were made on the initial cluster delivery (first 3 racks) and storage hardware. The full cluster passed acceptance testing in Sep 2010, so full payment was made early in FY11 (hence the large obligation carry-over). The remaining obligations amount shown above was costed in early FY11.
- ▶ The equipment funds balance (~\$114K) is being applied to the FY11 hardware procurement.
- ▶ No management reserve funds were expended in FY10. Per plan, these have been carried forward and added to the FY11 management reserve.

FY11 Project Cost Summary – YTD

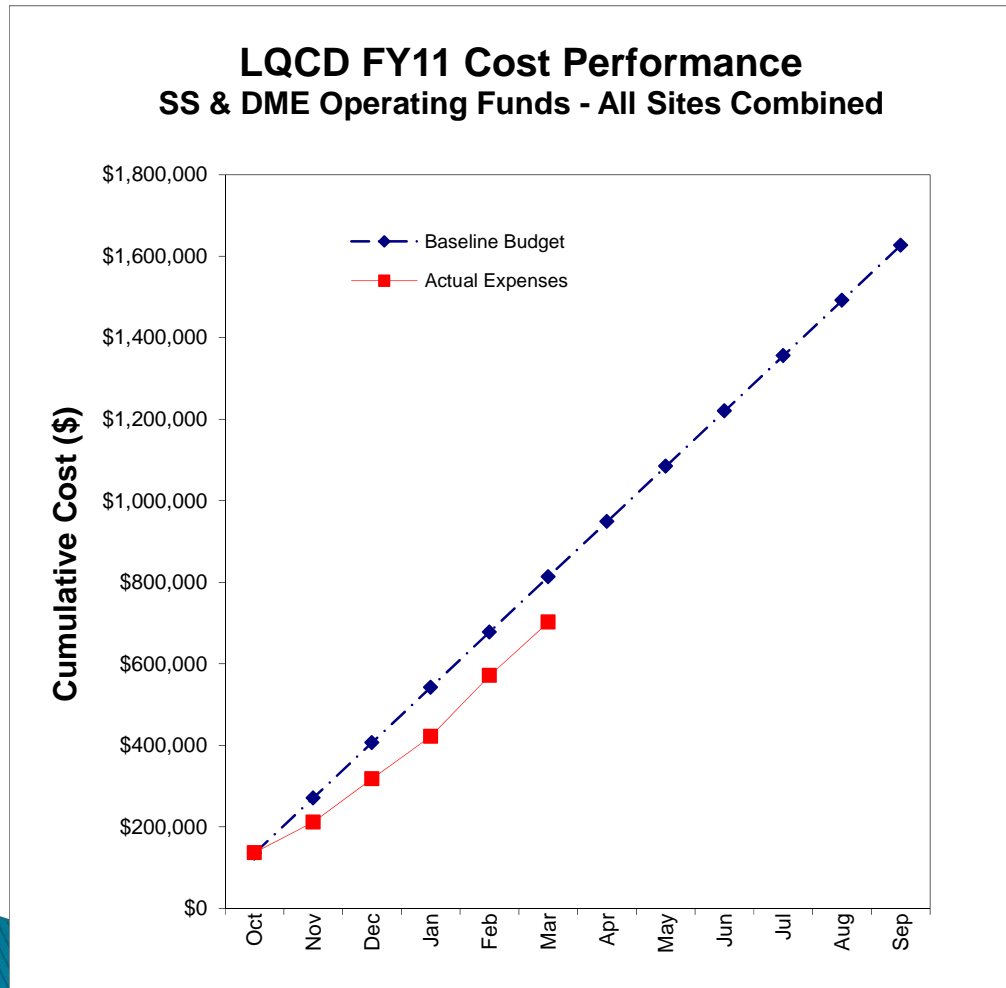
Status through March 2011; fiscal year complete: 50%

Fund Type	FY10 Carry-forward	FY11 Budget	Total FY11 Funds Available	FY11 Actual Costs	FY11 Obligations	% Spent & Obligated
Equipment	\$ 1,163K	\$ 1,690K	\$ 2,852K	\$ 1,085K	\$ 563K	58%
Operating	\$ 206K	\$ 1,491K	\$ 1,697K	\$ 702K	---	41%
Sub-total	\$ 1,369K	\$ 3,181K	\$ 4,549K	\$ 1,787K	\$ 563K	52%
Mgmt Reserve	\$ 132K	\$ 69K	\$ 201K	\$ 0K	\$ 0K	0%
TOTAL	\$ 1,501K	\$ 3,250K	\$ 4,750K	\$1,787K	\$ 563K	49%

- FY11 equipment funds have been obligated for the first half of the Ds cluster expansion option. Second half of the option will be exercised once project funds are released from the FNAL budget office.
- A requisition for the FY11 GPU purchase (128 GPUs; 64 hosts) is under preparation and will be submitted for signature approvals once project funds are released.

Operating Funds Spend Rate

(through March 2011 accounting period)



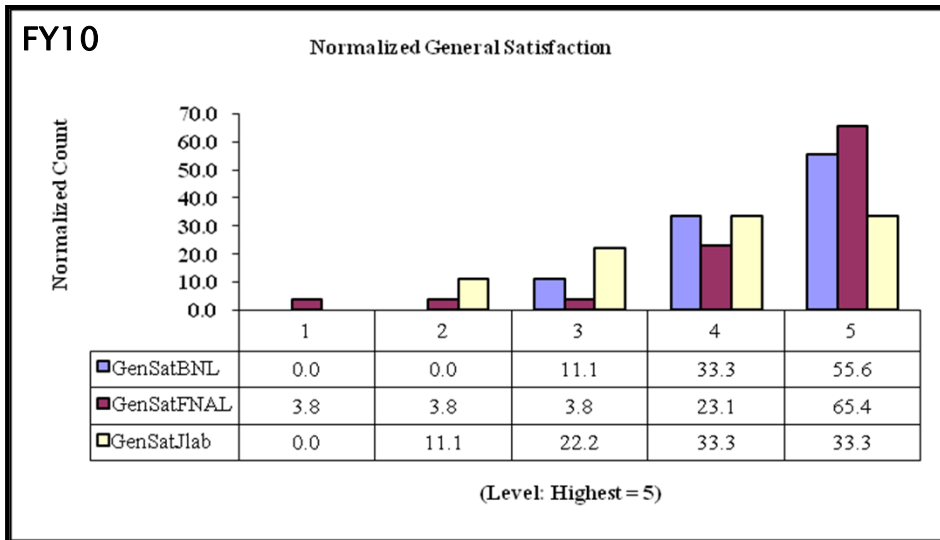
- Operating funds spend rate tracking baseline spending plan, albeit with DC offset
- JLab spend rate on track with baseline
- BNL spend rate less than baseline; level of effort to support QCDOC less than anticipated. Operating funds will be used to support QCDOC decommissioning activities in June/July 2011 timeframe.
- FNAL spend rate below baseline due to delays in procurement activities. Spend rate will increase when deployment activities begin.

User Survey Results

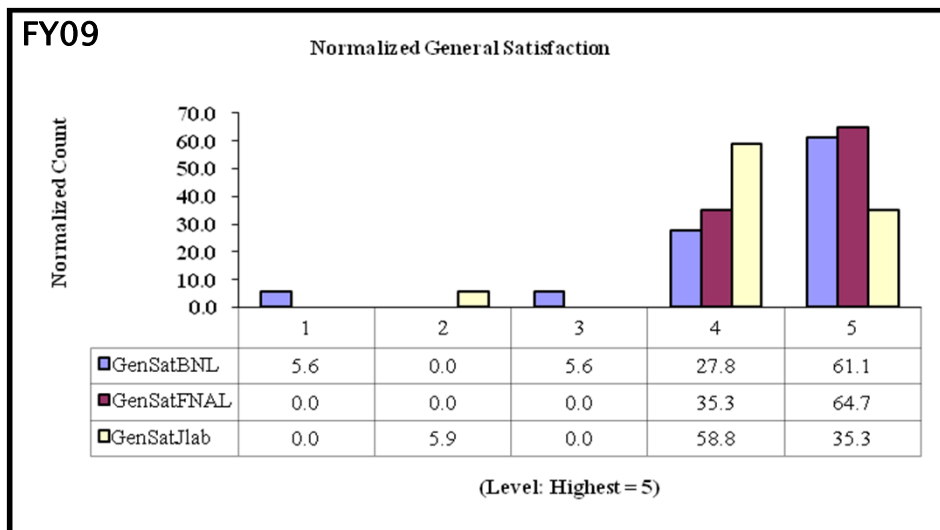
FY10 Survey Results

- ▶ Online survey consisted of 44 questions covering various aspect of compute facility operations and service delivery, as well as the allocation process.
 - Many questions had sub-questions specific to the three host laboratories
- ▶ Received input from 39 users (small statistical sample).
 - Approximately 100 users submitted jobs to one of the three facilities during the past year
 - FY10 response rate = ~39%
 - Down from FY09, when 55 users responded to the survey call.
- ▶ We have slipped in mean satisfaction ratings in a number of areas (i.e., % of 4's or 5's received on a scale of 1-5)
- ▶ Number of free-form user comments received was significantly less than prior years, making it more challenging to identify specific areas of concern.

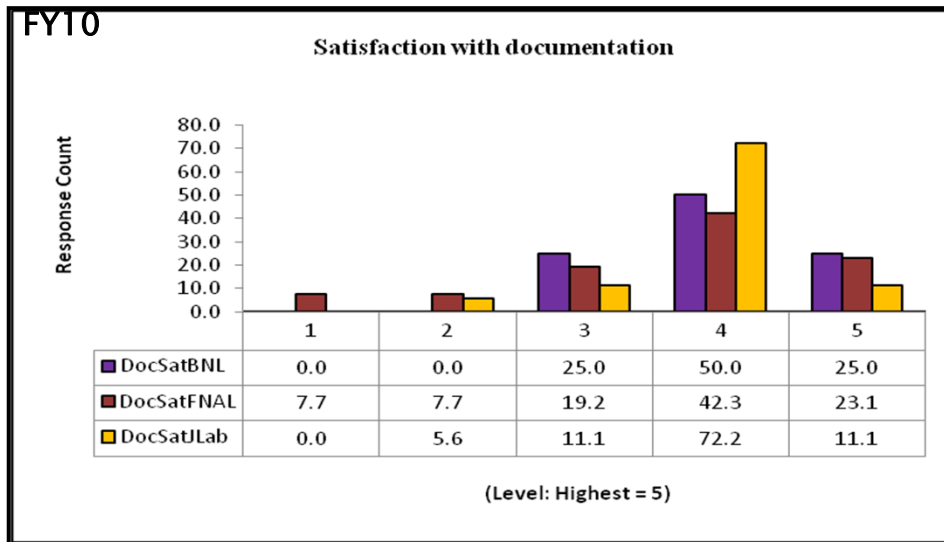
Survey Results – Overall Satisfaction



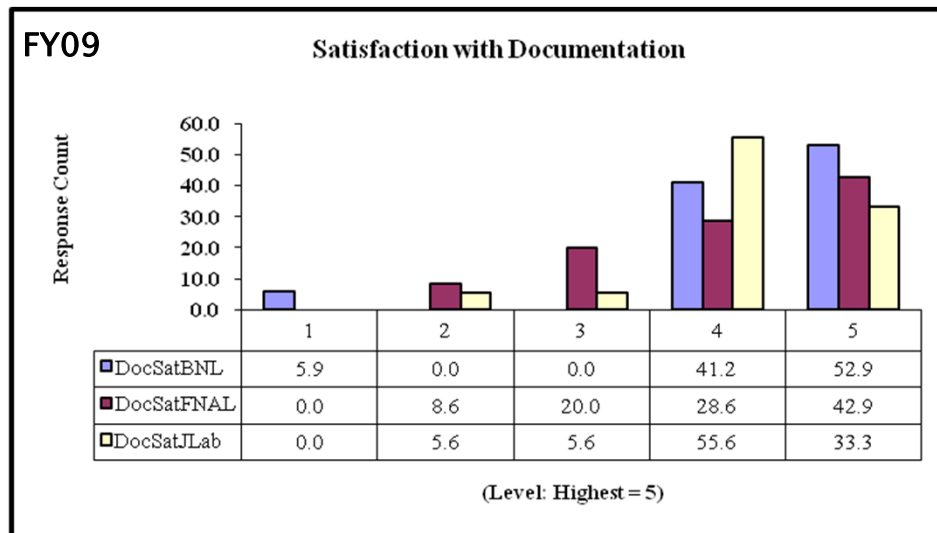
- ▶ FY10 aggregate satisfaction rating = 81%
- ▶ By comparison, FY09 rating = 96%
- ▶ BNL rating stayed consistent (FY09 rating was 89%; same as FY10).
- ▶ FNAL and JLab ratings are down from FY09, when ratings were 100% and 94% respectively.
- ▶ Lower JLab rating may be the result of resources being focused on ARRA machine deployment
- ▶ Lack of free-form comments makes it challenging for us to understand how to address shortcomings.



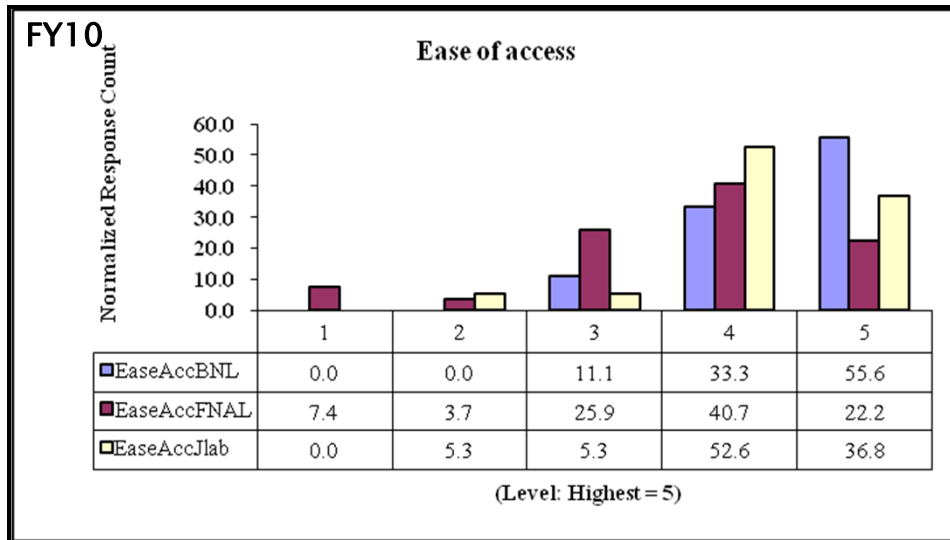
Survey Results – User Documentation



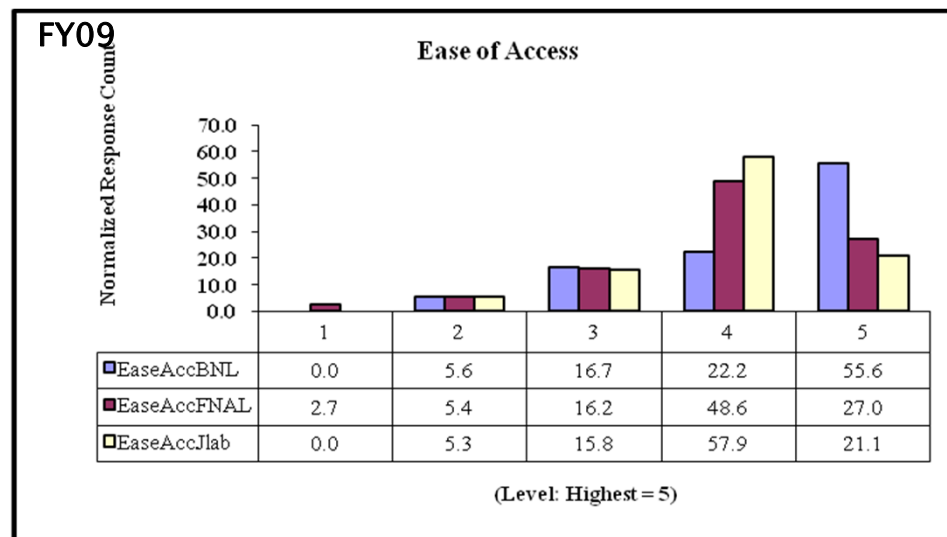
- ▶ FY10 aggregate satisfaction rating = 75%
- ▶ By comparison, FY09 rating = 85%
- ▶ Ratings were lower than FY09 at all three sites
- ▶ Survey respondents cited out-of-date, hard-to-find, or difficult-to-use documentation.
- ▶ We need to work on improving documentation.



Survey Results – Ease of Access



- ▶ FY10 aggregate satisfaction rating = 80%
- ▶ By comparison, FY09 rating = 78%
- ▶ BNL and JLab ratings significantly better than FY09 ratings (89% vs. 78% and 90% vs. 79% respectively).
- ▶ FNAL rating decreased from 76% to 63%, pointing out user difficulties with FNAL Kerberos access. Since we can't get rid of Kerberos, we need to work on improving documentation and tools.



Satisfaction with Allocation Process

Performance Ratings Over Time:

	FY07	FY08	FY09	FY10
Overall satisfaction with the proposal process	69%	81%	84%	86%
Clarity of the Call for Proposals	79%	91%	93%	93%
Transparency of the allocation process	61%	64%	79%	86%
Apparent fairness of the allocation process	63%	73%	88%	86%
Belief that the allocation process helps maximize scientific output	70%	78%	85%	79%

- ▶ Ratings are consistent with past years, with a couple of exceptions
 - “Transparency” showed a notable rating increase.
 - “Belief that allocation process maximizes scientific output” showed a decrease.
- ▶ We received no free-form comments related to the allocation process from FY10 survey respondents.

FY10 Survey Results – Summary

- ▶ Some key takeaways from the survey
 - We need to work on improving documentation.
 - “Reliability” at JLab is associated with resources being devoted to the new ARRA machines and not necessarily available for 7n, at least not in as timely a fashion as in previous years.
 - Low “Ease of access” rating at FNAL points out difficulties with FNAL Kerberos access.
 - Lack of free-form comments from the survey respondents makes it difficult for the project to understand areas of concern and develop corrective actions
- ▶ We have reached out to the collaboration to provide additional insight into areas of concern, which will help us identify corrective actions to improve service delivery.

Early Access to Prototype BG/Q

- ▶ BNL is planning to purchase and install (2) prototype BG/Q racks in the fall of 2011.
- ▶ The USQCD collaboration has been offered 20 TFlops, or 10% of a BG/Q rack in exchanged for a modest amount of support for hardware and system administration.
 - The LQCD-ext project will be responsible for 5% of the manpower cost of the system, which equates to \$27.5K in year 1 and \$15K thereafter.
 - BNL would continue to pay the cost of electricity, cooling, and space, consistent with our agreement for operating the QCDOC.
- ▶ Total estimated cost to the project = ~\$58K
- ▶ The Executive Committee has endorsed this plan.
 - Getting early access to BNL's prototype BG/Q hardware in exchange for some maintenance support will enable prototyping and code development in preparation for later running on ANL BG/Qs.
- ▶ Our DOE program managers support this proposal.
- ▶ Will require amended MOU with BNL (in progress).

FY12 Acquisition Strategy & Planning

- ▶ Old Strategy
 - Each year, we procure a machine with the best inverter performance
- ▶ New Strategy
 - Procure machine(s) that will best optimize our portfolio of hardware (including anticipated supercomputer time) against our portfolio of applications (including configuration generation)
- ▶ These two strategies used to produce the same result, but with the emergence of a hardware platform (GPUs) that does incredibly well on only a portion of our workload, the old strategy doesn't really work.
 - It is now time to more formally accommodate these multiple architectures and application requirements.

FY12 Acquisition Planning (2)

- ▶ In FY12, we will have several options to consider:
 - Infiniband clusters, GPU clusters, BG/Q
- ▶ In order to maximize the use of hardware funds, we are in the process of gathering critical information
 - We are working closely with the collaboration to help us optimize the use of hardware funds and best meet scientific computing needs.
 - What applications will be able to be run on GPUs at that time?
 - What portion of the analysis computing can be done more cost effectively on GPUs vs. IB clusters?
 - We are gathering information on the IBM BG/Q
 - Pricing and availability of production BG/Q hardware
 - Cost model for operating a BG/Q at BNL
- ▶ We have established a process for finalizing the FY12 acquisition plan, which we will discuss in more detail later in the day

Summary

- ▶ We successfully met all but one of our key performance goals and milestones in FY10.
 - User survey results indicate areas of improvement that will be addressed by the project team.
- ▶ We are on target to meet nearly all of our FY11 performance goals
 - Our site managers continue to do a very good job of operating their respective systems to minimize downtime and maximize output. Facility utilization remains high.
 - Hardware systems at the three host laboratories continue to operate effectively and efficiently, and we are exceeding our performance goal for TF-yrs delivered to the scientific community.
 - Plans are well along for the FY11 hardware procurement
 - The Continuing Resolution has negatively affected our ability to meet some of our performance goals in FY11. We will process Change Requests once the budget situation is finalized.
- ▶ Given several options for hardware acquisition in FY12, we have developed an acquisition strategy that actively involves the scientific community and establishes a clearly defined timeline for making critical purchasing decisions.