Log number (provided by project office): **CR16-02**		
1) DATE: [date of origination] 5/13/2016 Text last revised: 6/10/2016	**2) Laboratory/WBS**: This CR does not affect the WBS or schedule per se. It affects: a. All Deployed Computing goals for FY16-FY19 b. All Delivered Computing goals for FY16-FY19	**3) ORIGINATOR:** Robert D. Kennedy, Associate Contract Project Manager

4) WBS DESCRIPTION OF PRIMARY AFFECTED TASKS:

This change request replaces the separate Conventional Computing and Accelerated Computing goals for Deployed Computing and Delivered Computing with a goal that does not distinguish between Conventional and Accelerated Computing. This allows the LQCD Project more freedom to select technology in each acquisition year, and then support in subsequent years, which optimizes the scientific output of the USQCD collaboration.

Currently, the project assumes it will split acquisitions roughly 50-50 by dollar between Conventional Computing (example: nodes hosted by CPUs each with a few cores) and Accelerated Computing (example: GPUs added to a CPU-hosted node). This approach was optimal for several years for LQCD acquisitions after GPU's were proven to be a cost-effective technology for some Lattice QCD calculations. The project baselined in 2014/2015 assuming that this approach would continue to be close to optimal. Due to this, the annual project goals for Deployed Computing and Delivered Computing each have separate Conventional Computing and Accelerated Computing components.

Several issues have arisen which undermine the project's "50-50 is optimal" assumption. New technologies like MIC (Many Integrated Cores, example: Intel Xeon/Phi) have emerged which do not fit neatly into either the Conventional Computing or the Accelerated Computing category, yet appear to be most cost-effective for at least some Lattice QCD calculations. USQCD needs may evolve due to software development on one technology or another in such way that a 50-50 acquisition split is no longer optimal. The project may consider buying a single larger cluster of one technology in a particular year to meet USQCD needs for larger jobs, rather than buying two smaller clusters split between technologies each year. Any of these situations could cause the project to fail to meet one or both of the Conventional and Accelerated Computing components for Deployed and Delivered Computing even though the project is acting to support optimal USQCD scientific output. This change will allow the project to consider these alternatives and still meet its annual goals for Deployed and Delivered Computing.

5) TECHNICAL DESCRIPTION AND PRIMARY MOTIVATION OF CHANGE:

The project developed a scheme to approximately equate CPU (TFlop units) and GPU (Effective TFlop units) benchmark results. The Scientific Program Committee, for instance, uses this in its allocation process. We propose to use this scheme to combine Conventional and Accelerated Computing goal values. Each new goal value is the sum of the Conventional Computing (TFlop units) and Accelerated Computing (Effective TFlop units) goal values for Deployed and Delivered Computing, applied to FY16 through FY19, and carrying Effective TFlop units. KPI's that have been combined are labeled by the combination of their old ID to preserve history. KPI ID 7 and 8 become KPI ID 7-8. FY15 goals are not changed.

6) ASSESSMENT OF COST IMPACT: [identify any change in resources needed as reflected in the WBS]

Estimated Labor Cost Increase ($):   0
Estimated M&S Cost Increase ($):   0
Estimated Equipment Cost Increase ($)   0
<u>Estimated Management Reserve Increase ($): 0</u>
Estimated Project Cost Increase ($):   0

Estimated scientific impact (high, medium, and low): Low

7) ASSESSMENT OF SCHEDULE IMPACT AND AFFECTED MILESTONES:

There is no impact on schedule or WBS content.

The new Deployed Computing and Delivered Computing KPIs for Conventional and Accelerated computing are documented in Appendix D of the PEP. In the case where CR16-01 is not approved but this CR is approved ("this-CR-only"), the goal values change as follows from the project baseline state (Conventional + Accelerated):

Deployed Computing [TFlop/s]	FY15 (none)	FY16 ID 7, 8	FY17 ID 15, 16	FY18 ID 23, 24	FY19 ID 31, 32
Before CR16-02	0 + 0	10 + 39	14 + 52	28 + 106	36 + 136
Combined	0 + 0	49	66	134	172

Delivered Computing [TFlop/s-years]	FY15 ID 1, 2	FY16 ID 9,10	FY17 ID 17, 18	FY18 ID 25, 26	FY19 ID 33, 34
Before CR16-02	88 + 92	68 + 67	70 + 95	85 + 145	80 + 290
Combined	88 + 92	135	165	230	370

In the case where CR16-01 is approved ("both-CRs"), the goal values change as follows from the CR16-01 state (Conventional + Accelerated):

Deployed Computing [TFlop/s]	FY15 (none)	FY16 ID 7, 8	FY17 ID 15, 16	FY18 ID 23, 24	FY19 ID 31, 32
After CR16-01, Before CR16-02	0 + 0	13 + 85	9 + 36	26 + 100	23 + 89
Combined	0 + 0	98	45	126	112

Delivered Computing [TFlop/s-years]	FY15 ID 1, 2	FY16 ID 9,10	FY17 ID 17, 18	FY18 ID 25, 26	FY19 ID 33, 34
After CR16-01, Before CR16-02	88 + 92	91 + 73	73 + 117	63 + 178	73 + 267
Combined	88 + 92	164	190	241	340

8) ASSOCIATED DOCUMENTATION:

The following controlled documents are affected by the proposed changes in this CR:
- Project Execution Plan (PEP): The PEP documents are in the folder "CR16-02 PEP"
  - PEP "this-CR-only": applies this CR *only* to the content.
  - PEP "both-CRs": applies this CR and CR16-01 to the content.
  - Updated boilerplate text as is proposed in CR16-01.
  - Separate Conventional and Accelerated Computing goals has been combined for FY16-FY19 in Table 2 (Level 1 Milestones) and Appendix C.
  - Deployed and Delivered Computing KPIs are changed in Appendix D

9) SECONDARY IMPACT AND OTHER COMMENTS:

Change Control Level: Level 3
This change request involves a "modification to the technical performance baseline defined in a Level-1 milestone" since the separated Level-1 milestones defined in the Project Execution Plan for *Conventional Resources* and for *GPU-accelerated Resources* are combined. This qualifies the change request for change control level 3 according to the project change control process defined in the Project Execution Plan. This level requires approval up to and including the Federal Project Director.

Risk Assessment:
1. Project purchases more X technology and less Y technology than is optimal for USQCD science output.
    a. This risk exists independent of this CR. There is already a process in place to mitigate this risk as described in the PEP and the Acquisition Strategy as well as in several Risk Register entries.
    b. As noted in the existing risks, we can adjust the portfolio of LQCD computing to match the evolving needs of the USQCD software portfolio by acquiring the technology that is needed in larger quantity in our next annual acquisition.

10) APPROVALS

Level 4 – Acquisition Executive _____(***not required***)_____

Level 3 – Federal Project Director _____ Date _____

Level 2 - Chair, Change Control Board _____ Date _____

Level 1 - Contractor Project Manager _____ Date _____

11) CCB Approvals

Amber Boehnlein
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date

William Boroski
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date

Steve Gottlieb
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date

Kerstin Kleese van Dam
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date

Paul Mackenzie (CCB Chair)
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date

Rob Roser
O APPROVED   O DISAPPROVED   _____
                                                                              Signature/date