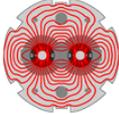


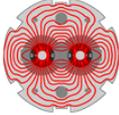


2011 and 2012 DOE Review Recommendation Answers

G. Apollinari
Feb 18th, 2013



- *2011 Review – Recommendation #1 on Management: Provide a detailed plan, including budget profile, to DOE on transition from LARP R&D into HL-LHC by February 1st, 2012. A similar recommendation was stated last year.*
 - Between Summer 2012 and Spring 2013 a concerted effort was initiated to achieve a preliminary definition of the possible US deliverables for the HL-LHC Project. Following the definition of an “Activity Selection Process” (Appendix 2) describing a plan to down-select the US contributions to HL-LHC. The plan, based on funding assumptions of continued LARP support until the start of a construction project capped at approximately 200 M\$ (at year cost), had the following milestones:
 - Provide a management plan to give the process for down selecting deliverables for the LHC High Luminosity Project. **Sep. 4, 2012**
 - Make the list of deliverables with fully burdened cost estimates and schedules within a total cost estimate of about \$200M (at year dollars) and assuming a flat-flat LARP funding for the next four years. **November 1, 2012**
 - Meet with CERN and DOE to finalize the list of U.S. deliverables and the schedule. **December 21, 2012**
 - All milestones have been met.



- *2011 Review – Recommendation #2 on Management: Provide to DOE by February 1st, 2012 a prioritized list of LARP R&D activities indicating which will be emphasized and which will be reduced.*
 - The prioritized list of deliverables was presented to DOE by the beginning of February 2013. Appendix 3 highlights the Letter from the CERN Director General (Ralf Heuer) and the CERN Associate Director for Accelerators (Steve Myers) confirming the agreement on the prioritized list of deliverables. The list of R&D activities follows closely the preliminary list of deliverables with the prototyping of IR quads and Crab Cavities.
 - WBFS is seen as a promising R&D activity to be tested in SPS before a decision on inclusion in HL-LHC can be made.



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Our reference : DG/2012-355

Geneva, 19 December 2012

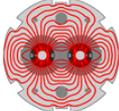
Dear Prof. Siegrist,

Following recent discussions, CERN is assuming that the total US contribution to the Hi-Lumi project is of the order of US\$200 million (construction project, excluding the R&D carried out within the LARP program that is due to continue for another 3-4 years in order to finish the R&D on the hardware and to continue the support for the important activities of accelerator physics and the long term visitor program).

The principle item of this contribution would be the Nb₃Sn low-beta triplet. We understand that a preliminary evaluation of the quadrupoles (with 150 mm aperture) based on a joint study by LARP and CERN amounts to about 75% of the total US contribution, or US\$150 million, for half of the magnets (i.e. 10 cold mass quadrupoles, without cryostat, with no integration nor installation). This proposal (half USA and half CERN) is the preferred solution not only to stay inside budget but it also leverages the advanced US technology (LARP) and would allow CERN to fully master the technology for future maintenance and consolidation. Mutual agreement on this proposal can be discussed at a later date.

CERN proposes that the remaining 25%, or US \$50 million, be used to support hardware contributions on the following items (either full or part system):

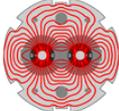
- a. High bandwidth feed-back system for the SPS/Crab cavity with a cryo-module
- b. 11 T dipole (cold mass no cryostat)/electron-lenses



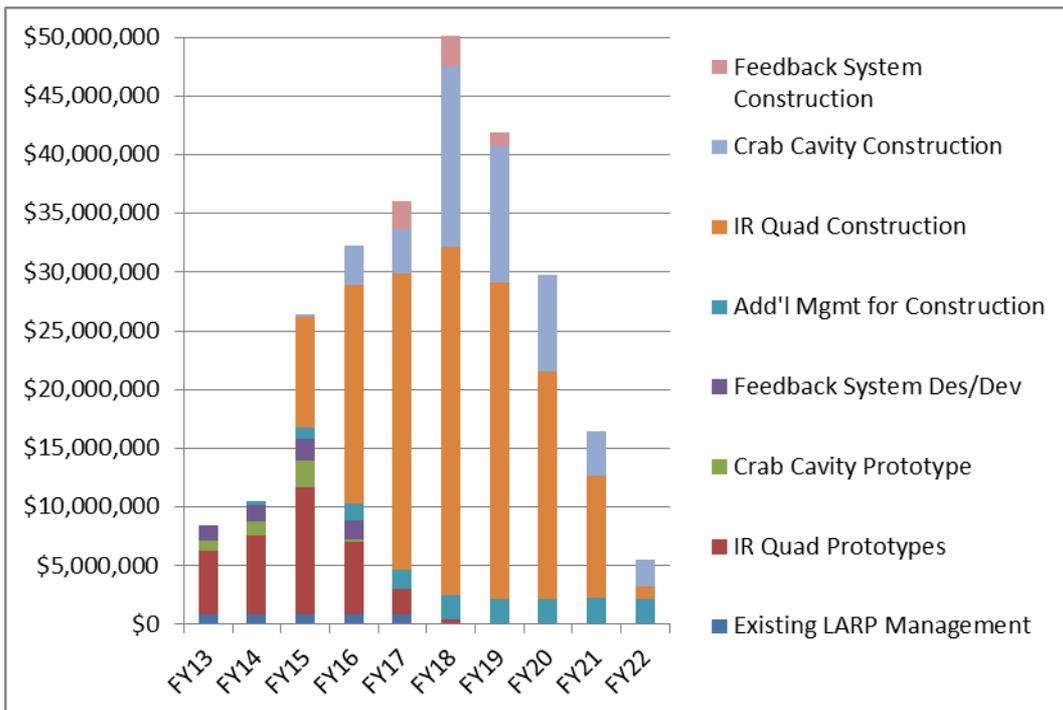
LARP



- *2012 Review – Recommendation #1 on Management: Provide a management plan that documents the process for down-selecting deliverables for the LHC High Luminosity project by November 30th, 2012.*
 - Achieved. See above.
- *2012 Review – Recommendation #2 on Management: Make the list of deliverables with fully burdened cost estimates and schedules within a total cost estimate of about 200 M\$ (at year dollars) and assuming flat-flat LARP funding for the next four years by November 30th, 2012.*
 - This task was completed and reviewed internally by LARP with DOE participation on June 2013. The timescale assumed at the time was the CERN baseline schedule, with LS3 ending by 2023. The funding plot is shown and the report from the Internal Review was provided. Modulo few inconsistencies in term of LARP budget flatness, the reviewers considered the deliverables, cost estimates and funding profile reasonable.
 - Obviously the new CERN baseline schedule, with LS3 ending by mid-2024 will require a reassessment of this point in preparation for the HL-LHC Project phase.

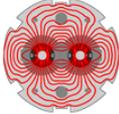


LARP



\$AY w/ contingency

Totals	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
w/Distributed Contingency											
Existing LARP Management	\$900,000	\$900,000	\$900,000	\$900,000	\$900,000	\$0	\$0	\$0	\$0	\$0	\$4,500,000
IR Quad Prototypes	\$5,428,000	\$6,674,495	\$10,787,491	\$6,128,707	\$2,092,806	\$432,039	\$0	\$0	\$0	\$0	\$31,543,537
Crab Cavity Prototype	\$797,492	\$1,200,000	\$2,298,266	\$187,697	\$0	\$0	\$0	\$0	\$0	\$0	\$4,483,455
Feedback System Des/Dev	\$1,317,124	\$1,409,219	\$1,772,012	\$1,711,097	\$0	\$0	\$0	\$0	\$0	\$0	\$6,209,452
Add'l Mgmt for Construction	\$0	\$302,287	\$991,260	\$1,300,231	\$1,678,290	\$2,075,913	\$2,132,028	\$2,189,578	\$2,248,830	\$2,152,449	\$15,070,867
IR Quad Construction	\$0	\$0	\$9,445,813	\$18,642,867	\$25,211,021	\$29,682,904	\$26,944,355	\$19,340,937	\$10,411,064	\$1,043,069	\$140,722,029
Crab Cavity Construction	\$0	\$0	\$195,681	\$3,386,538	\$3,831,668	\$15,353,475	\$11,615,261	\$8,190,661	\$3,800,762	\$2,342,882	\$48,716,928
Feedback System Construction	\$0	\$0	\$0	\$0	\$2,330,342	\$2,536,272	\$1,199,412	\$0	\$0	\$0	\$6,066,027
Totals	\$8,442,617	\$10,486,001	\$26,390,523	\$32,257,136	\$36,044,127	\$50,080,604	\$41,891,056	\$29,721,175	\$16,460,656	\$5,538,400	\$257,312,295



- *2012 Review – Recommendation #4 on Management: Plan the LARP budgets for the next four years to insure the R&D reduces the risk for the US deliverables by January 31st, 2013.*
 - Achieved. LARP Plans for the FY14-FY17 periods will be presented at the next DOE Review.
- *2012 Review – Recommendation#5 on Management: provide a plan for transitioning from LARP R&D to a DOE Construction Project. This must include all aspects in a Project Execution Plan as noted in <http://science.energy.gov/opa/project-management/processes-and-procedures/> by April 1st, 2013.*
 - The LARP “Project Management Plan” to transition from R&D to Construction is actively pursued by managing the activities on the prioritized deliverables with the goals of controlling scope, cost and schedule.
 - Elements of this plan will include convergence with CERN on finalize scope, convergence with DOE on timescale for Critical Decision (CDs) timescale, training of L2 and L3 Managers in all subjects related to DOE Project Execution such as Performance Baseline, Control Accounts, WBS Dictionary, EVMS, etc.
 - More on these aspects will be presented at the next DOE Review.