12 GeV CEBAF Upgrade

Risk Assessment Matrix
and
Risk Document Forms

September 2013

Introduction

The following text, in Sections labeled 4.1 and 4.2, has been copied from the Risk Management Plan for the 12 GeV CEBAF Upgrade project. It outlines the approach and methodology used to determine the appropriate risk level that will be assigned to each WBS element in the Risk Assessment Matrix, and is repeated here for reference. A summary of the risk assessments for all WBS Level 3/4 elements is shown in Appendix A, the Risk Assessment Matrix. Per the Risk Management Plan, any WBS Level 3/4 elements which have an overall risk assessment of moderate or high will require the development of a Risk Document Form to describe the risk mitigation assessment and plan. Updated copies of the Risk Document Forms are included in Appendix B of the Risk Assessment Matrix, and the Risk Registry is included in Appendix C.

4.1 Risk Identification

Risk identification begins by compiling the project's risk events. Along with their Assistant Project Managers, the Associate Project Managers should examine and identify project events by reducing them to a level of detail that permits an evaluator to understand the significance of any risk and identify its causes, i.e., risk drivers. This is a practical way of addressing the large and diverse number of potential risks that often occur in acquisition projects. Risk events are best identified by examining each WBS product and process element in terms of the sources or areas of risk.

4.2 Risk Analysis

A. Risk analysis is a systematic evaluation of identified risk events by determining the probability of occurrence and consequences, assigning a risk rating based on the established criteria, and prioritizing the risks.

B. The first step in the risk analysis process is to determine for each risk event the probability that the event will occur. For the 12 GeV CEBAF Upgrade project, likelihood will be determined in each of three areas: technical, schedule, and cost.

Risk Probability	
Likelihood	**Probability of Occurrence**
High	$\geq$ 90%
Moderate	$\geq$ 50%
Low	$<$ 50%

C. The next step in the risk analysis process is to determine for each risk event the magnitude of the consequence should the event occur. For the 12 GeV CEBAF Upgrade project, consequences will be determined in each of three areas: technical, schedule, and cost.

Risk Consequence			
	Low	**Moderate**	**High**
Technical Impact	Minor degradation of performance	Significant degradation of performance	Desired performance in doubt
Schedule Impact	Delays major milestone or project critical path by < 1 month	Delays major milestone or project critical path by ≤ 3 months	Delays major milestone or Project critical path by >3 months
Cost Impact	≤ $300K	> $300K	> $1M

D. Once the level of likelihood and the consequences of a risk event have been determined, a risk rating can be assigned to the risk event. This rating is a reflection of the severity of the risk and provides a starting point for the development of options to handle the risk.

Risk Rating			
	Consequence		
Likelihood	Low	Moderate	High
High	Moderate	High	High
Moderate	Low	Moderate	High
Low	Low	Low	Moderate

E. At this stage in the risk analysis, a risk rating has been established for each risk. The final step is to prioritize the risk events in the order of importance. Prioritization will be based on the following criteria:

- Risk Rating: High/Moderate/Low
- Consequence: Within each rating, the highest value of consequence
- Likelihood: The probability of occurrence

Risk handling plans and the allocation of risk management resources will be dictated by the ranking of the risk events.

Appendix A: 12 GeV CEBAF Upgrade Risk Assessment Matrix

WBS Item	Description		Risk Rating	Likelihood Assessment Technical	Likelihood Assessment Cost	Likelihood Assessment Schedule	Impact Assessment Technical	Impact Assessment Cost	Impact Assessment Schedule	Comments/Rationale
1.2	**PED**									Majority of activities are extension of previous history experience. Appropriate R&D being done for the remainder.
1.2.1	Accelerator Systems		Low	Low	Low	Low	Low	Low	Low	Design effort is complete.
1.2.2	Upgrade Hall A, B & C		Low	Low	Low	Low	Low	Low	Low	Design effort is complete.
1.2.3	Hall D		Low	Low	Low	Low	Low	Low	Low	Design effort is complete.
1.2.4	Conventional Facilities		Low	Low	Low	Low	Low	Low	Low	Design effort is complete.
1.3	**Construction: Accelerator Systems**									
1.3.1	Cryomodules		Mod	Mod	Mod	Low	Low	Mod	Low	1) Microphonics may be too large for optimal performance. Cost risk due to extra testing.
1.3.2	Power Systems		Mod	Low	Low	Mod	Low	Low	Mod	The delivery schedule for the box power supplies has been delayed. Rebid of contract necessary. Remaining schedule risk.
1.3.3	Cryogenics		Low	Low	Low	Low	Low	Low	Low	Hall D cryo scope moved into baseline.

WBS			Risk	Likelihood Assessment			Impact Assessment			
Item	Description		Rating	Technical	Cost	Schedule	Technical	Cost	Schedule	Comments/Rationale
1.3.4	Beam Transport		Low	Low	Low	Low	Low	Low	Low	Low technical risk on designs.
1.3.5	Extraction		Low	Low	Low	Low	Low	Low	Low	Expansion of existing technology and design.
1.3.6	Instrumentation, Controls & Safety Systems		Low	Low	Low	Low	Low	Low	Low	I&C&S primarily based on existing designs.
1.4	**Construction Upgrade Hall A, B & C**									
1.4.1	Construction Hall A									
1.4.1.5	Beamline		Low	Low	Low	Low	Low	Low	Low	Straightforward extension of existing system.
1.4.2	Construction Hall B									
1.4.2.1	Magnet		High	Mod	Mod	Mod	High	High	Mod	Vendor cost, schedule, and technical performance issues increase Likelihood to Moderate for all categories. SC magnet construction, delivery, and final commissioning requires re-planning for both magnets

WBS Item	Description		Risk Rating	Likelihood Assessment			Impact Assessment			Comments/Rationale
				Technical	Cost	Schedule	Technical	Cost	Schedule	
1.4.2.2	Detectors		High	Low	Mod	Mod	Low	High	Mod	Detector technology similar to existing CLAS, except new SVT. Likelihood of SVT Cost/Sched impacts has risen from Low to Moderate due to possible design changes. Overall risk of SVT elevated from Moderate to High. Manufacturing of SVT elements and support moved to FNAL. Delay of any given detector may impact commissioning procedures.
1.4.2.3	Computing		Low	Low	Low	Low	Low	Mod	Low	Little additional computing capability required for Upgrade.
1.4.2.4	Electronics		Low	Low	Low	Low	Low	Mod	Low	Re-use of existing DC electronics planned.
1.4.2.5	Beamline		Low	Low	Low	Low	Low	Mod	Low	Planned beamline upgrade uses same technologies as existing beamline.
1.4.2.6	Infrastructure		Low	Low	Low	Low	Low	Mod	Low	Re-using existing support structures and utilities; installation tasks similar to previous CLAS.
1.4.3	Construction Hall C									
1.4.3.1	Magnet		High	Mod	Mod	Mod	High	High	Mod	Vendor cost, schedule, and technical performance issues increase Likelihood to Moderate for all categories. Superconducting magnet construction, delivery/ final commiss requires on-site training/possible repairs.

										Delays would impact commissioning schedule.
WBS			Risk	Likelihood Assessment			Impact Assessment			
Item	Description		Rating	Technical	Cost	Schedule	Technical	Cost	Schedule	Comments/Rationale
1.4.3.2	Detector		Low	Low	Low	Low	Low	Low	Low	Straightforward application of existing technologies. Availability of lead glass blocks had been a concern, but are now at JLab.
1.4.3.3	Computing		Low	Low	Low	Low	Low	Low	Low	Upgrade is a straightforward extension of existing Hall C computing.
1.4.3.5	Beamline		Low	Low	Low	Low	Low	Low	Low	
1.4.3.6	Infrastructure		Low	Low	Low	Low	Low	Mod	Mod	Support structure and shield house are straightforward, but may require on-site modifications to fit.
1.5	**Construction Hall D**									
1.5.1	Solenoid		Low	Low	Low	Low	Low	Low	Mod	Refurbished Solenoid assembled in Hall D. Operated at 1500 A, and later at 1350 A. Field maps measured at 1300 A. Interim quench carefully analyzed. High risk reduced to Low.
1.5.2	Detectors		Low	Low	Low	Low	Low	Low	Mod	Fiber production and delivery schedule impacts calorimeter fabrication. Only 2 of 29 deliveries remain. Barrel calorimeter installation impacts subsequent detector installation. Increased schedule risk to assemble CDC due to delay in straw delivery. Straw delivery for CDC resolved. FDC construction has little

WBS Item	Description		Risk Rating	Likelihood Assessment Technical	Cost	Schedule	Impact Assessment Technical	Cost	Schedule	Comments/Rationale
										float yet its installation must precede CDC and Start installation.
1.5.3	Computing		Low	Low	Low	Low	Low	Low	Low	Commodity items
1.5.4	Electronics		Low	Low	Low	Low	Low	Mod	Low	Cost per channel depends on achieving expected channel density per board.
1.5.5	Beamline		Low	Low	Low	Low	Low	Low	Low	Extensive experience with successful tagging system of similar design.
1.5.6	Infrastructure		Low	Low	Low	Low	Low	Low	Mod(1)	1. Mod Impact for Sched slip in infrastructure which could have significant impact on detector installation schedule. 2. Hall D cryo scope moved into baseline. High risk reduced to Low.
1.5.7	Spare Solenoid		Low	Low	Low	Low	Mod	Mod	Mod	SC magnet construction, delivery, and final commissioning requires on-site training and possible repairs.
1.6	**Conventional Facilities**									
1.6.1	Accelerator		Low	Low	Low	Low	Low	Low	Low	Scope 92% complete. Remaining effort well understood.
1.6.2	CHL		Low	Low	Low	Low	Low	Low	Low	
1.6.3	Hall D		Low	Low	Low	Low	Low	Low	Low	Scope complete.
1.7	**Project Management**									

1.7.1	Project Office		Low	Low	Low	Low	Low	Low	Low	
1.7.2	Office of Project Management		Low	Low	Low	Low	Low	Low	Low	Level of effort activity now funded through Non-DOE funding.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY0506-1</td><td>WBS: 1.4.2.1
(Hall B Magnets)</td><td>Report Date: September 2012
(LAST REPORT PRIOR TO SEPARATING MAGNET RISKS)</td></tr>
<tr><td colspan="3">Description: Unforeseen technical problems in Hall B superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work. Vendor performance issues.</td></tr>
<tr><td>Probability:
Moderate</td><td>Impact: High</td><td>Risk Rating: High</td></tr>
<tr><td colspan="3">First Indicator: Previous experience at JLab with procuring superconducting magnets</td></tr>
<tr><td colspan="3">Mitigation Approaches:

1. Perform R&D and optimization studies to reduce risks where appropriate.
2. Thorough review of design.
3. Vendor selection to emphasize previous successful projects of a similar nature.
4. Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage.
5. Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor.
6. Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning.
7. Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.
8. Additional JLab oversight at vendor including engineering, procurement, and QA.
9. Analyze baseline schedule contingency for possibilities to increase schedule float.
10. Assess impacts and path forward should a contract termination be required for either magnet.</td></tr>
<tr><td>Date Started:
July 2005</td><td>Date to Complete:
CD-4</td><td>Owner: Associate Project Manager for Physics - G. Young
Staff responsible for specific mitigation elements:
1) R&D: V. Burkert/L. Elouadrhiri.
2) Design review: G. Young
3) Vendor selection: V. Burkert/L. Elouadrhiri.
4) Milestone specifications: V. Burkert/L. Elouadrhiri.
5) Monitoring of vendor work: D. Kashy/L. Quettier/E. Salpietro.
6) Provision for schedule float: V. Burkert/L. Elouadrhiri/D. Kashy.
7) Maintain core staff: P. Brindza.</td></tr>
<tr><td colspan="3">Current Status:
11/2005: Identified the CLAS12 Torus Magnet as a long-lead procurement item.</td></tr>
</table>

01/2006:	Contracted with a highly qualified collaborating institution to produce a detailed conceptual design study for the CLAS12 Torus Magnet.
03/2006:	Approved first intermediate progress report on conceptual design study.
04/2006:	Approved second intermediate progress report on conceptual design study.
06/2006:	Contracted with a highly qualified collaboration institution to produce a detailed conceptual design study for the CLAS12 Solenoid Magnet.
07/2006:	Conceptual design report for torus received, initial design.
09/2006:	Conducted external peer review of superconducting magnets, including the torus and solenoid.
10/2006:	Identified design engineering resources with unique experience in toroidal magnet Design.
11/2006:	Identified additional potential vendors for superconducting magnets.
01/2007:	Contracted with French collaborators for revised solenoid design study.
04/2007:	Received final report on solenoid, initial design.
04/2007:	Received draft report on revised torus design.
05/2007	JLab staff visited Russian collaborators (~ 1 week, V. Burkert and P. Brindza).
06/2007	Design collaborator visit to JLab (2 weeks, S. Egorov, V. Korsunsky).
08/2007	Performed re-evaluation of contingency estimates for these magnets. Increased contingency estimate from 39% to 43%.
08/2007:	Contracted with consultant to review detailed cost estimates for torus and
10/2007:	solenoid.
	Contracted with highly qualified vendor to produce the Reference designs for the
12/2007:	Torus and Solenoid magnets.
01/2008:	Received 1^{st} progress reports on Reference designs.
	Contracted with Consultant (Eddie Leung) to assist JLab with magnet
02/2008:	procurement.
02/2008:	Received draft References design report for Torus magnet for evaluation.
	Advanced Procurement Plan (APP) approved by 12 GeV Upgrade Project
02/2008:	Manager.
03/2008:	Sources Sought Notice sent to over 20 potential vendors.
	Hall B lead engineer visits Russian design contractors to evaluate draft Reference
03/2008:	design report and strength of analysis and design teams.
03/2008:	Received 6 Letters of Interest to date for Torus Fabrication.
04/2008:	Establish Source Evaluation Board for Torus and Solenoid magnet procurements.
04/2008:	Superconducting Magnets Review
04/2008:	Reference Design for the Torus completed
04/2008:	Reference Design for the Solenoid completed
05/2008:	Advance Procurements Plans (APP) developed for both Solenoid and the Torus
06/2008:	Saclay Technical Design Report completed
06/2008:	Evaluation of the responses from sources sought completed
06/2008:	Final specification for the Torus and Solenoid developed, under review
08/2008:	Purchase Request to Procurement for both Torus and Solenoid in preparation
09/2008:	Procurement package for the Torus completed and sent out for bids
11/2008:	Procurement package for the solenoid completed and sent out for bids
12/2008:	Proposals for Torus magnet manufacturing received
	Initial evaluation of the torus proposals completed and first round of questions
12/2008:	submitted to potential vendors.
	Evaluating issues related to the high peak field in the solenoid for each of the

reference design options put forward.

Current Status:

02/2009: Site visits for quality assurance to potential magnet vendors.

04/2009: Hired a consultant at 20% basis to aid with SC magnet technical evaluations during the procurement process.

03 to 05/2009: Modified Warm Bore radius of Torus magnet from 76mm to 125 mm. This will increase available space to place the Moller shielding. This will reduce technical risk of not achieving the design luminosity. The technical implications of this change to the magnet design were validated to be minor by engineers and a consultant. The change was incorporated in CR09-029.

02 to 06/2009: The peak field in the solenoid (7.8T) of one of the reference design options was uncomfortably high leaving not much temperature margin, as suggested in a November 2008 Director's Project Review. The volume of strict field homogeneity of the Solenoid magnet was slightly modified in order to facilitate reduction of the maximum field in the solenoid coil from 7.8T to 7.0T. This goal is achievable as confirmed by designs provided by potential vendors.

06/2009: The torus and solenoid procurement processes are now about half a year delayed. Part of this delay is due to longer than planned iterations with potential vendors, and part due to the delay in hiring a dedicated SC magnet engineer to assist with the technical evaluations of vendor questions and proposals during the procurement process. In addition, for the solenoid an extended deadline was granted to potentially increase the number of vendor responses. The lack of dedicated SC magnet engineering manpower has been remedied with help from both outside consultants and a Hall C engineer. A junior SC magnet engineer has now been hired to start in August 2009. The delay in contract award has reduced float for these magnets by about half.

09/2009 Magnet engineer started work. Contract for Torus awarded 9/4/2009; see 12 GeV CR09-049. The float between torus delivery, assembly, and acceptance tests and the subsequent installation on the CLAS12 support structure was reduced from 52 to 44 weeks based on the contract schedule.

10/2009 System requirements review for the Torus held at Jefferson Lab with the vendor, Lab staff and outside consultants.

11/2009 Contract for Solenoid construction awarded 11/20/2009; see 12 GeV CR10-005. The float between solenoid delivery and acceptance tests and the subsequent installation on the CLAS12 support structure was increased from 46 weeks to 77 weeks based on the contract schedule.

12/2009	The preliminary design review required in the Torus contract was held Dec.8 at the vendor's site with vendor staff, Lab staff and outside consultants. Part of the system requirements review was held for the solenoid with completion set for January.
3/2009	After several vendor discussions, a Change Request (CR 10-044) was processed to adjust schedule and allow for more manufacturing design time as well as tests and reviews of manufacturing steps. This change held the contractual end-dates but reduced the total float by 3 months and the free float in the projects to 18 weeks for each magnet. Superconducting cable short samples were sent to the U. Twente (Netherlands) who have a facility for short sample field and quench tests.
4/2010	Conductor design reviewed. Vendor prepared winding and cable-soldering machines. First results from cable testing at U. Twente available.
5/2010	Solenoid preliminary design review of manufacturing plan held at vendor site on May 11, 2010. Two persons engaged from Lawrence Berkeley National Lab, one an expert on magnet design and the second on magnet manufacturing, to serve as local JLab representatives and make weekly vendor visits on JLab's behalf. Hall B personnel now visit the vendor monthly.
6/2010	Design chosen for cross section of copper stabilizer and subcontractor engaged to prepare needed extrusions, to be soldered to the superconducting cable by the magnet vendor. Final results from testing at U. Twente, showing cable is satisfactory and thus shipped to vendor.
7/2010	Torus intermediate design review of manufacturing plan held at vendor site Jul 8, 2010. Ongoing calculations at JLab to review quench, hot-spot temperatures, and insulation design, as well as field uniformity given designed dimensions of copper stabilizer and resultant planned current and number of conductor turns for the solenoid in particular. Vendor site visit by ESH&Q personnel to review vendor welding qualifications for pressure vessels prior to future review of helium vessel and cryostat.
8/2010	Solenoid Intermediate Design Review
10/2010	Torus Final Design Review
11/2010	Copper Extrusion procurement placed, test extrusions, soldering tests at vendors, winding tests at vendor
11/2010	FEA checks of both magnets' stresses, field uniformity
12/2010	Solenoid Final Design Review: cryostat design and integration with other central region detectors
	Solenoid Final Design Review; solenoid cryostat design and integration with other central region detectors including possible future upgrades

1-4/2011	Vendor prepared cable soldering line and wrapping line. Insulation overlap resolved. Set up was prepared for torus prototype winding. Contract issued for FEA work at ANL on torus stability and integrity against stresses encountered.
4-6/2011	Copper extrusion for stabilizer received from vendor for torus and solenoid. First reel of conductor, consisting of SSC cable soldered into flat groove in copper stabilizer, for torus prototype coil was soldered and wrapped with insulation. First production reel of torus conductor was soldered. Coil case, winding table, tension apparatus for torus prepared. Prototype torus coil starting to wind and being checked for shorts, both coil to case and turn-to-turn. Void detection, short detection, and turn-to-turn short detection equipment being procured. First coil case and winding station for solenoid prepared. QA reviews of welding, of training records, of procedures, of engineering and manufacturing drawings control and revision control, and of non-conformance detection, tracking and reporting held, all scheduled for July.
7/2011	Reviews of conductor cleaning/soldering set for July/August 2011 together with development efforts at JLab in support. Review of plans for epoxy impregnation planned for July with parallel development and sample tests at JLab planned for July-September. Initial FEA results from ANL contract. Corrections to FEA model from vendor made and communicated to vendor. Ability of model to “solve” computationally demonstrated. Specific computational runs to assess load stability, integrity during cool-down steps, stability and maintaining of coil winding pack compression during cool-down and powered operation, and resistance to loading from earthquakes planned and started. Plan developed for future computational program to study coil under various possible “fault” conditions such as coil-to-ground short, turn-to-turn short, or quench of superconductor.
9/2011	Vendor schedule performance for Torus magnet continues to deteriorate. Technical issues are unresolved. QA integrity during prototype coil development has not been documented. Overall Risk elevated to HIGH.
12/2011	Contracts for both Torus and Solenoid magnet have been terminated. Alternate strategies are under development including new vendors for either entire magnets or at least the magnet cold mass scope. Parallel plans are being developed to set up a conductor soldering line at JLab while seeking a qualified outside vendor.
1/2012	Government-furnished equipment has been returned to JLab from the previous magnet vendor.
5/2012	Contract signed with FNAL to provide the Torus cold mass. RFP for solenoid magnet released. RFP for conductor soldering released.

6/2012	Solenoid vendor conference held. Torus design review held at FNAL. Torus stress analysis underway at JLab. Bids for conductor soldering received and under evaluation.
9/2012	Solenoid bids received, and undergoing technical evaluation by the Source Selection Board. Soldering contract awarded, and Hall B staff being trained on QA/QC procedures at vendor facility.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY0506-1A**	**WBS:** 1.4.2.7 **(Hall B TORUS Magnet)**	**Report Date: June 2013**
Description: Unforeseen technical problems in Hall B superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work. Vendor performance issues.		
Probability: Moderate	**Impact:** High	**Risk Rating:** High
First Indicator: Previous experience at JLab with procuring superconducting magnets		
Mitigation Approaches: 1. Perform R&D and optimization studies to reduce risks where appropriate. 2. Thorough review of design. 3. Vendor selection to emphasize previous successful projects of a similar nature. 4. Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage. 5. Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor. 6. Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning. 7. Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair. 8. Additional JLab oversight at vendor including engineering, procurement, and QA. 9. Analyze baseline schedule contingency for possibilities to increase schedule float. 10. Assess impacts and path forward following the contract termination. 11. Contract with FNAL for coil cold mass fabrication. 12. Establish JLab Magnet Task Force includes design effort and cryostat factory.		
Date Started: February 2013	**Date to Complete:** CD-4B	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: 1) Design review: G. Young 2) Vendor selection: L. Elouadrhiri. 3) Milestone specifications: L. Elouadrhiri. 4) Monitoring of vendor work: D. Kashy/M Wiseman/E. Salpietro. 5) Provision for schedule float: L. Elouadrhiri/D. Kashy. 6) Maintain core staff: R. Ent
Current Status: Dec 2012: Details of magnet task force organization outlined. Lead for Cryostat Factory at JLab identified.		

12 GeV CEBAF Upgrade Risk Document Form
Jan 2013: Magnet Task Force rolled out. Two new SC magnet engineers hired to work on Hall B magnets. Feb 2013: Consultant, Ettore Salpietro, develops common risk analysis and mitigation plan. Eight technical areas specified, with risk matrix tied to lower level risk elements. Lead engineers, design staff, and technical staff begin detailed risk analysis. Feb 2013: Full bottoms-up ETC for Torus magnet underway, lead by Hall B CAM and Physics APM. Feb 2013: Soldering of conductor reels for Torus magnet starts at AES. Feb 2013: Preliminary Design Review held. Action item list being tracked. Mar 2013: FNAL vendor visit (Wiseman, Ghoshal) to witness progress on insulation of conductor for prototype coil. Apr 2013: FNAL spool tensioner assembled and tested. Trial winding begun. Epoxy curing studies underway. May 2013: Prototype winding readiness review held at FNAL. Insulating machine is fully commissioned. Work continued on a 70cm length R&D potting test. Conductor soldering at AES continued; reel #5 cleaned and soldered. June 2013: Soldering continued at AES with improved procedure for cleaning excess solder. Reel #6 complete. Practice winding began at FNAL. First cryostat factory lifting fixtures arrived at JLab.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY0506-1B</td><td>WBS: 1.4.2.7
(Hall B SOLENOID Magnet)</td><td>Report Date: June 2013</td></tr>
<tr><td colspan="3">Description: Unforeseen technical problems in Hall B superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work. Vendor performance issues.</td></tr>
<tr><td>Probability:
Moderate</td><td>Impact: High</td><td>Risk Rating: High</td></tr>
<tr><td colspan="3">First Indicator: Previous experience at JLab with procuring superconducting magnets</td></tr>
<tr><td colspan="3">Mitigation Approaches:

1. Perform R&D and optimization studies to reduce risks where appropriate.
2. Thorough review of design.
3. Vendor selection to emphasize previous successful projects of a similar nature.
4. Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage.
5. Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor.
6. Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning.
7. Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.
8. Additional JLab oversight at vendor including engineering, procurement, and QA.
9. Analyze baseline schedule contingency for possibilities to increase schedule float.
10. Assess impacts and path forward following the contract termination.
11. Contract with FNAL for coil cold mass fabrication.
12. Establish JLab Magnet Task Force including design effort and cryogenics.</td></tr>
<tr><td>Date Started:
February 2013</td><td>Date to Complete:
CD-4B</td><td>Owner: Associate Project Manager for Physics - G. Young
Staff responsible for specific mitigation elements:
7) Design review: G. Young
8) Vendor selection: L. Elouadrhiri.
9) Milestone specifications: L. Elouadrhiri.
10) Monitoring of vendor work: J. Hogan (SOTR).
11) Provision for schedule float: L. Elouadrhiri/D. Kashy.
12) Maintain core staff: R. Ent</td></tr>
<tr><td colspan="3">Current Status:
Nov 2012: Solenoid magnet contract awarded to Everson Tesla, Inc. John Hogan identified as contract SOTR.</td></tr>
</table>

12 GeV CEBAF Upgrade
Risk Document Form

Dec 2012: Details of magnet task force organization outlined. Lead for Cryostat Factory at JLab identified.

Jan 2013: Magnet Task Force rolled out. Two new SC magnet engineers hired to work on Hall B magnets.

Feb 2013: Consultant, Ettore Salpietro, develops common risk analysis and mitigation plan. Eight technical areas specified, with risk matrix tied to lower level risk elements. Lead engineers, design staff, and technical staff begin detailed risk analysis.

Feb 2013: Full bottoms-up ETC for Torus magnet underway, lead by Hall B CAM and Physics APM.

Feb 2013: Preliminary Design Review held at vendor on Feb 20th (~2 weeks ahead of schedule). Punch list of items being addressed.

Apr 2013: Cryogenic design and thermal analysis underway. BNL consultants reviewing the magnet 3-D model.

May 2013: ETI submits documentation in support of Intermediate Design Review. Submittal was missing key components, so IDR was postponed. JLab/BNL team generated detailed list of prerequisites for scheduling of IDR.

Jun 2013: IDR documents received. Review held on June 26th. Key components (stress analysis and construction tolerances) were not accepted. Follow-on review planned for September 2013.

Jun 2013: Visit to conductor soldering vendor (AES). Discussed lessons learned from previous soldering. Schedule developed for transition from torus set-up to solenoid set-up.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY0506-2**	**WBS:** 1.4.2.2 **(Hall B Detectors)**	**Report Date: June 2013**
Description: Cost over-runs in fabricating the Hall B Silicon Vertex Tracker (SVT)		
Probability: Moderate	**Impact:** High	**Risk Rating:** High
First Indicator: Lack of in-house experience with SVT detector technology		
Mitigation Approaches: 1. Perform R&D and optimization studies to reduce risks where appropriate. 2. Thorough review of design. 3. Develop alternative procurement strategy in case selected vendor or components become unfeasible. 4. Vendor selection to emphasize previous successful projects of a similar nature. 5. Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage. 6. Close monitoring and coordination of vendor work with laboratory representatives, including on-site visits of the vendor. 7. Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning. 8. Convene Director's Review of SVT design changes under consideration.		
Date Started: July 2005	**Date to Complete:** CD-3	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: 1) R&D: V. Burkert/L. Elouadrhiri. 2) Design review: G. Young 3) Alternative procurement strategy: Detector Physicist (see below) 4) Vendor selection: V. Burkert/L. Elouadrhiri. 5) Milestone specifications: V. Burkert/L. Elouadrhiri. 6) Monitoring of vendor work: Detector Physicist (see below). 7) Provision for schedule float: V. Burkert/L. Elouadrhiri.
Current Status: 06/2005: Carried out a successful parasitic beam test of a Silicon Vertex Tracker prototype. 11/2005: Made a decision to hire an experienced Detector Physicist to lead and coordinate the full prototyping and design effort for the Silicon Vertex Tracker. 04/2006: Received and tested prototype DAQ PCI card. 05/2006: Identified collaborator resources and expertise for construction of prototype module at Moscow State University (MSU). 10/2006: Made offer to Detector Physicist.		

11/2006: Finalized specifications for prototype module. 12/2006: Contracted with collaborating institution to build prototype module.
02/2007: Established start date of 14 May for Detector Physicist. 03/2007: Conducted meeting and review of SVT with external consultants. 03/2007: Identified 3 candidate electronic chips for use in final detector. 03/2007: Identified collaborator resources and expertise for silicon detector electronics at MSU. 03/2007: Identified collaborator resources and expertise for mechanical support of ultra-thin silicon wafers at Fermilab. 07/2007: JLab staff attended training class in VHDL programming language (W. Teachy). 10/2007: Attended wire bonder training at K&S in Philadelphia, PA. 11/2007: Detail Geant simulation and reconstruction to optimize detector layout. 12/2007: Troubleshooting, repair, & testing of PCI Test Adapter (PTA) DAQ PCBs. 12/2007: Troubleshooting, repair, & testing of Programmable Mezzanine Card (PMC) DAQ PCBs. 01/2008: Compiled requirements for FSSR2 DAq system. 01/2008: Started on new R&D task to study the FSSR2 chip as an option for the SVT readout. 01/2008: Wrote procedure on the construction of a test station for MSU collaborators. 02/2008: Prepared shipping documents for DAQ boards to be delivered to Russia. 02/2008: Advanced the design of the SVT support structure. 03/2008: Hall B lead engineer visits MSU group to discuss the design of the support structure. 04/2008: SVT Detector & Safety Review. 04/2008: Provide detailed grounding and shielding documentation as per review. CLAS-Note 2008-008 04/2008: Q&A plans. CLAS-Note 2008-003, -004 05/2008: Document possible hardware component risks. CLAS-Note 2008-005 05/2008: Electrical Safety during development. CLAS-Note 2008-006 05/2008: Required precision in/during construction. CLAS-Note 2008-009 06/2008: Expand DAQ documentation. CLAS-Note 2008-007, -010, -011 06/2008: FSSR2 Test Board PCB completed, sent to vendor for population. 06/2008: Attach MSU sensor to SVX4 hybrid for evaluation. 09/2008: Rate handling capability of FSSR2, design simulation and optimization of FST. 10/2008: Prototype support and cooling structure for Barrel Region 1. 12/2008: Prototype SVT LV Mainframe arrives, begin compliance testing. 12/2008: FSSR2 hardware testing (testing with internal pulser, external pulser and source). 02/2009: Test Plans documented for FSSR2 Evaluation. CLAS-Note 2009-008 03/2009: Instrumentation Installation documented, CLAS-Note 2009-010 04/2009: Completed environmental test chamber for silicon sensor evaluation. CLAS-Note 2009-014 05/2009: FSSR2 Register Test completed. CLAS-Note 2009-015. 06/2009: Completed first draft of sensor specifications for expert review. CLAS-Note 2009-020 06/2009: FSSR2 Noise Tests completed. CLAS-Note 2009-021

Current Status (continued):

07/2009: Sensor mask layout CLAS-Note 2009-022; equivalent noise charge calculations for barrel SVT CLAS-Note 2009-023; Bit error rate and hold time studies CLAS-Note 2009-025.

08/2009: Sensor layout drawings produced; specifications include single-sided sensors, aluminum strips AC-coupled to p+ strip implants, and high-resistivity n-type silicon.

08/2009: Thermal, cooling and deflection analyses made of staves and support structure concept; cable specifications made

10/2009: Results of noise tests with the FSSR2. CLAS-Note 2009-029

12/2009: Meeting at Saclay to discuss possible incorporation of the micro-megas technology into the SVT detector design.

1/2010: Three-ring design for barrel CLAS-Note 2010-001, accommodations for polarized target

2/2010: Test stand prepared to measure leakage currents in SVT sensors CLAS-Note 2010-002

3/2010: Tests of leakage current. Sensor RFP and PR prepared after extensive vendor discussions based on earlier sources sought memo. Two experienced vendors have responded and stated intent to bid. Cable design for High density Flexible Circuit Board (HFCB) determined CLAS-Note 2010-004. Cooling, support, and integration with CLAS polarized target studied

3/2010: Change Request is drafted to rebaseline the SVT assembly schedule to reflect delays in procurement and assembly start

4/2010: Identified potential construction issue with bonding two-sided HFCB; start investigation of viable alternative designs

4/2010: Test stand for capacitance measurements CLAS-Note 2010-007. Vendor procuring existing multi-project wafers which include the FSSR2 preamp ASICs has obtained the wafers from the MOSIS service, and is preparing test probe head, which is to be used for later wafer probing and marking of dice which fail power and simple functionality testing, preparatory to wafer dicing to obtain individual FSSR2 ASICS for production mounting on the HFCB

5/2010: Equivalent Noise Charge of readout strips determined CLAS-Note 2010-011. Level-1 trigger interface card location determined relative to support structure CLAS-Note 2010-010

5/2010: Cost/schedule/technical impact analysis begins for proposed SVT design changes to Barrel and Forward SVT

Current Status (continued):

6/2010: Design of HFCB reviewed with Moscow State U for manufacturing issues. Alternatives to 'wing' extensions used to wire-bond to lower-side sensors under discussion

6/2010: Plan in place to continue work on readout electronics and construction plans while implications of proposed detector design changes are evaluated

6/2010: Overall risk of SVT detector raised from Moderate to High due to potential cost increases and schedule delays in assembly, as well as cost/schedule risk related to design changes under consideration.

8/2010: PO with Test Edge to produce probe card for preamps and test preamps on the manufacturing wafers

10/2010: Test Edge results – over 97% yield from power and digital function tests of all preamp chips

10/2010: FNAL Si-Det lab visit, discussion possible performance of primary stave manufacture in that facility

11/2010: Sensor contract placed for barrel region 1-3 sensors, option for region 4

11/2010: Position description for scientific staff to lead SVT manufacture

11/2010: HFCB cable and boards-only procurements placed

11/2010: First Pitch Adapter specified for transition from sensor to HFCB/preamp

11/2010: Moscow State U first coupling of production preamps to prototype sensors; four sensors bonded in series; noise test performed; all strips checked and all electronics functions exercised

12/2010: Planning underway for Director's Review of SVT to be convened in January 2011.

2/2011: Director's review of SVT. Cost, schedule, resources, and path forward reviewed. Particular emphasis on adding staff and confirming proposed contract with FNAL for assembly. Decision to have FNAL perform assembly instead of MSU.

3-6/2011: Negotiation with FNAL over Memorandum Purchase Order to produce support structures and staves/modules for Barrel SVT there. Review of all electrical and mechanical specifications and assembly tolerance by FNAL staff experienced in silicon detectors. FSSR2 chips received from power-and-digital testing vendor and analog testing started in-house.

6/2011: Physicist with extensive silicon-detector construction experience started work. Clean room for SVT completed and started operations.

3-6/2011: Re-baselining of SVT fabrication plan to reflect re-organization of effort, de-scoping of Forward Silicon Tracker (FST) part of SVT, and current understanding of costs and time needed including extensive input from FNAL SiDet Lab, who will now perform assembly of the barrel SVT modules and their supporting carbon-fiber backings. Preparation of full-scale prototype at MSU with prior silicon detectors but correct preamplifer, interface board, and pitch adapter demonstrated good noise performance, with acceptance band.

6-12/2011: First barrel SVT module received from FNAL exhibits a signal/noise ratio of 12, better than minimum requirement of 10. Electrical prototype being assembled to be used for a full chain test.

Current Status (continued):

1/2012: External technical review held at JLab with experts from BNL, FNAL, LANL, and ORNL. Committee concluded that the sensor design was mature and could proceed to production. Extensive technical comments provided on cables, wire bonds, PS, QA, and shielding.
4/2012: An in-beam test of two electrical-grade SVT modules began parasitically in the Hall B alcove using the prototype interface boards.
7/2012: Procurements were placed for the HFCB cable and the bus cable. The third of seven major deliveries of SVT sensors was made to FNAL.
9/2012: A contract award was made for the low and high power supplies. The final delivery of sensors was made to FNAL. Over 98.5% of sensors have passed reception testing.
2/2013: Prototype modules built at FNAL and successfully tested. Met S/N specifications.
3/2013: Director's Technical Review held at JLab on March 27-29, 2013 with a panel of external experts. Good discussions on possible improvements in QA during assembly procedures. The committee made no recommendations.
4/2013: SNR of ~15 achieved. Mechanical grade module meets specifications. QA/QC procedures developed and documented.
5/2013: Barrel assembly plan finalized.
6/2013: Manufacturing Readiness Review planned for FNAL in July 2013. Anticipate production will begin following that review.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY0506-3</td><td>WBS: 1.4.3.1
(Hall C Magnets)</td><td>Report Date: September 2012
(LAST REPORT WITH COMBINED MAGNET RISKS PER HALL)</td></tr>
<tr><td colspan="3">Description: Unforeseen technical problems in Hall C superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work.</td></tr>
<tr><td>Probability:
Mod</td><td>Impact: High</td><td>Risk Rating: High</td></tr>
<tr><td colspan="3">First Indicator: Previous experience at JLab procuring superconducting magnets</td></tr>
<tr><td colspan="3">Mitigation Approaches:

1) Perform R&D and optimization studies to reduce risks where appropriate.
2) Thorough review of design.
3) Vendor selection to emphasize previous successful projects of a similar nature.
4) Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage.
5) Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor.
6) Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning.
7) Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.</td></tr>
<tr><td>Date Started:
July 2005</td><td>Date to Complete:
CD-4</td><td>Owner: Associate Project Manager for Physics - G. Young
Staff responsible for specific mitigation elements:
1) R&D: R. Ent/H. Fenker
2) Design review: G. Young
3) Vendor selection: C. Rode/H. Fenker
4) Milestone specifications: G. Young/H. Fenker
5) Monitoring of vendor work: P. Brindza
6) Provision for schedule float: G. Young/H. Fenker
7) Maintain core staff: P. Brindza</td></tr>
</table>

Current Status:

02/2005:	Completed study of superconducting wire properties.
04/2005:	Completed manufacturing feasibility study of the Combined-Function magnet.
04/2005:	Completed study of "burnout-proof" high current leads.
12/2005:	Design study by Hall C User scientist: preliminary indications are that an alternate design approach with significantly less technical risk could achieve the same goals for the SHMS Combined-Function magnet using a separate quadrupole and dipole within the same cryostat. Still needs to be validated by Monte Carlo studies.
05/2006:	Design studies and simulations conclude simpler, separated magnet design is feasible.
05/2006 -	06/2006: Performed vendor survey to probe the market for interested SC magnet vendors.
05/2006 -	08/2006: Developed and refined conceptual design for new 5-magnet spectrometer, resulting in doubled acceptance for a spectrometer of simpler design.
09/2006:	Contracted to perform an engineering evaluation of the cold mass of the HB dipole magnet.
09/2006:	Contracted to perform phase 1 of a feasibility study for the coil winding of the Q1 quadrupole magnet using the SSC superconductor.
09/2006:	R&D study of SHMS Q1 quadrupole magnet options.
09/2006:	Contracted to perform preliminary engineering analysis of SHMS main dipole cold mass and force collar.
09/2006:	Contracted to perform preliminary engineering analysis of SHMS Q2/Q3 cold mass and force collar.
09/2006:	Conducted external peer review of superconducting magnets, including all Hall C magnets.
10/2006:	Reduced (vertical) gap in Horizontal Bend magnet by ~20% based on detailed acceptance simulation studies, reducing fields/forces.
02/2007:	Completed unrolling of the keystoned superconducting cable according to specifications, to be tested for degradation at Brookhaven in May 2007.
04/2007:	Designed and built test device to measure radiation heat at the position of the Horizontal Bend magnet, to be exposed to beam in Hall C in May/June 2007.
07/2007:	Completed R&D on superconducting cable performance before and after reshaping. Found no measurable degradation in performance.
07/2007:	Completed R&D study of expected radiation-induced heating at the position of the Horizontal Bend magnet.
08/2007:	Received report on independent cost estimate of superconducting magnets.
08/2007:	Performed re-evaluation of contingency estimate for these magnets. Increased contingency estimate from 35% to 38%.
08/2007:	Contracted w/consultant to review detailed cost estimates for all SHMS magnets.
08/2007:	Received consultant's cost estimate review – strongly supportive.
08/2007:	Received report on preliminary engineering analysis of Q2/3 quadrupoles.

09/2007:	Received report on structural analysis of dipole magnet.
10/2007:	Received results on trial wind of Q1 coils.
11/2007:	Received report on stress analysis of Q2/3 magnets.
11/2007:	Received report on stress analysis of dipole magnet.
04/2008:	Received R&D report on progress in trial wind of HB magnet.
04/2008:	Subjected superconducting magnet designs and plans to JLab-convened independent design and safety review. Resulting recommendation was to produce a formal Reference Design of the HB dipole prior to proceeding with procurement.
06/2008:	Initiated a contract with National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University to produce a formal Reference Design for the HB dipole.
10/2008:	Interim progress report on winding trials of HB magnet coil.
11/2008:	Received report on tooling and techniques used to successfully perform trial-wind of full-size coil for Q1 quadrupole.
12/2008:	NSCL successfully wound first full-size HB magnet coil.
12/2008:	Obtained measurements of bulk material properties of the composite superconductor intended for use in the Q2, Q3, and D magnets.
02/2009:	Received full Reference Design for the HB Magnet, as recommended by the 04/2008 Review Committee.
05/2009:	Implemented a Change Request to assure timely delivery of critical long-lead components so that testing time will not be lost and to help assess overall schedule adequacy during installation phase.
01 to 05/2009:	Careful, critical assessment of capabilities and qualifications of potential vendors for Q1 fabrication contract prior to contract award.
05/2009:	Extended deadline for vendors to submit proposals for the Q2/Q3/Dipole superconducting magnets in order to increase the number of vendor responses.
08/2009:	Technical proposal received from MSU-NSCL on HB magnet; questions arising from this and requests for further information sent to MSU.
10/2009:	Initial review at Q1 vendor site of manufacturing plan for the quadrupole.
11/2009:	Supplemental information received from MSU-NSCL about HB on technical questions.

12/2009:	Informed potential vendors for Q2/Q3/Dipole that the requisition was being withdrawn. A change request, CR 10-008, captures this for the project and modifies the planned schedule to reflect a revised plan as follows. The specifications were divided into two parts, one for Q2/Q3 and another for Dipole, and reviewed. Vendors were informed new requests for modified proposals would be forthcoming. A formal response was received from MSU Grants and Contracts office for the HB dipole with all technical and business information we had requested. A preliminary review was made of this proposal, with final review to be completed in February.
12/2009 – 6/2010	Negotiated and placed contract with MSU-NSCL for fabrication of HB magnet.
2/2010 – 3/2010	Issued new RFPs for Dipole Magnet and for Q2/Q3 magnets, and took steps to assure that as many potential vendors as possible became aware of the postings.
5/2010 – 7/2010	Formal, careful, critical assessment of vendor qualifications and technical proposal(s) for fabrication of dipole magnet.
6/2010 – 8/2010	Formal, careful, critical assessment of vendor qualifications and technical proposal(s) for fabrication of Q2 and Q3 magnets.
1/2010- 6/2010	Procurements placed for several systems critical to the magnets, including the vapor-cooled current leads (delivered), the cryogenic control reservoirs (first item to be delivered July 2010), the copper stabilizer extrusions (awarded), the power supplies (awarded) and the cryogenics controls system (JLab fabrication). This ensures these associated systems move ahead and senior engineers and managers can focus on the magnets.
8/2010- 12/2010	Copper stabilizer extrusions made. First shipments made to vendor for soldering superconducting cable to extrusions. Test run of soldering made. Weldments underway for first two cryogenic control reservoirs, to be complete in Q2FY2011.
11/2010- 12/2010	Dipole contract awarded to SigmaPhi (France). Q2/Q3 contract awarded to SigmaPhi (France). Second coil wound at Michigan State U for HB dipole.
12/2010	Q1 vendor final design review. Test winding started, reached 35% complete by 1/2011.
2/2011	First two cryogenic control reservoirs finished. One shipped to Michigan State for HB, second held at vendor for shipment to Q1 vendor. Dipole power supply design report from vendor.
1-3/2011	First coil wound and cured for Q1.
1-6/2011	Test extrusions of copper stabilizer made at vendor, followed by production extrusions and QA dimensional checks along full length of reels. Cleaning process developed to allow soldering.
3-6/2011	Test soldering of copper stabilizer to SSC cable at soldering vendor; pull tests done and arrangements made for void testing.

5-6/2011	Extensive discussions with Q2/Q/D vendor about coil end stability, stresses, cross-section and tolerances of copper stabilizer. Exchange of FEA analyses with vendor to verify design features. Test extrusion of 'keystoned' copper stabilizer made. Winding tooling preparations started at vendor.
11/2011	HB magnet vendor did initial work to set up cryogenic dewar test of the coils. A consensus was reached with the French vendor for the D/Q2/Q3 magnets, Sigma Phi, about the shape of the conductor. It is expected that work will progress in parallel there on the prototype dipole coil. The magnet delivery from this vendor is in jeopardy until all technical issues related to the conductor are resolved.
12/2011	One HB magnet coil was damaged at MSU during handling, and will have to be replaced. The cryogenic testing of the second HB magnet coil at MSU provided insufficient cooling resulting in a quench with burn-through of the power bus.
1/2012	RISK ELEVATED FROM MODERATE TO HIGH
	Delivery schedule of D/Q2/Q3 magnets continues to slip. HB magnet vendor recovering from coil mishaps.
5.2012	Production soldering of the conductor for the D/Q2/Q3 magnets is on track. JLab engineer on-site during all production runs. However, magnet vendor continues to express technical concerns about conductor. Q1 and HB vendors making good progress. Installation schedule being re-optimized to account for anticipated late magnet delivery.
7-9/2012	Design review held at D/Q2/Q3 vendor, but technical issues not resolved. Conductor test plan under development.
	Design review held at HB vendor, revised schedule indicates significant delay in delivery. Discussions with management underway. Conductor test plan being carried out at both Sigma Phi and at JLab.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY0506-3A</td><td>WBS: 1.4.3.1.1
(Hall C HB Magnet)</td><td>Report Date: June 2013</td></tr>
<tr><td colspan="3">Description: Unforeseen technical problems in Hall C superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work.</td></tr>
<tr><td>Probability:
Mod</td><td>Impact: High</td><td>Risk Rating: High</td></tr>
<tr><td colspan="3">First Indicator: Previous experience at JLab procuring superconducting magnets</td></tr>
<tr><td colspan="3">Mitigation Approaches:

1) Perform R&D and optimization studies to reduce risks where appropriate.
2) Thorough review of design.
3) Vendor selection to emphasize previous successful projects of a similar nature.
4) Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage.
5) Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor.
6) Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning.
7) Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.</td></tr>
<tr><td>Date Started:
February 2013</td><td>Date to Complete: CD-4B</td><td>Owner: Associate Project Manager for Physics - G. Young
Staff responsible for specific mitigation elements:
1) Design review: G. Young
2) Vendor selection: C. Rode/H. Fenker
3) Milestone specifications: G. Young/H. Fenker
4) Monitoring of vendor work: E. Sun (SOTR)
5) Provision for schedule float: G. Young/H. Fenker
6) Maintain core staff: P. Brindza</td></tr>
<tr><td colspan="3">Current Status:

Nov 2012: MSU re-organizes internal effort on the HB magnet contract. FRIB Project Management expertise added to MSU team. Weekly vendor conference calls instituted.

Dec 2012: Details of magnet task force organization outlined including individual SOTR for each magnet vendor.

Jan 2013: Magnet Task Force rolled out. Eric Sun identified as SOTR for HB magnet

Feb 2013: Consultant, Ettore Salpietro, develops common risk analysis and mitigation plan.</td></tr>
</table>

Eight technical areas specified, with risk matrix tied to lower level risk elements. Lead engineers, design staff, and technical staff begin detailed risk analysis.

Feb 2013: Full bottoms-up ETC for HB magnet underway, lead by Hall C CAM and Physics APM.

Feb 2013: Michigan State Univ completed a bottoms-up ETC. Iteration with JLab followed. Final result to be included in JLab 12 GeV rebaseline plan.

Mar 2013: QA Review held at MSU. Vacuum vessel drawings 100% complete.

Apr 2013: Plate bending and annealing complete. Some delay incurred due to complexity of this task.

May 2013: Start of helium vessel welding.

June 2013: Two-shift welding in place to recover schedule delay. Vacuum chamber parts and current leads arrived at MSU. Vendor visit by JLab CAM. Fabrication of thermal shield began.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY0506-3B**	**WBS:** 1.4.3.1.2 **(Hall C Q1 Magnet)**	**Report Date: June 2013**

Description: Unforeseen technical problems in Hall C superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work.

Probability: Mod	**Impact:** High	**Risk Rating:** High

First Indicator: Previous experience at JLab procuring superconducting magnets

Mitigation Approaches:

1) Perform R&D and optimization studies to reduce risks where appropriate.
2) Thorough review of design.
3) Vendor selection to emphasize previous successful projects of a similar nature.
4) Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage.
5) Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor.
6) Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning.
7) Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.

Date Started: February 2013	**Date to Complete:** CD-4B	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: 1) Design review: G. Young 2) Vendor selection: C. Rode/H. Fenker 3) Milestone specifications: G. Young/H. Fenker 4) Monitoring of vendor work: S. Lassiter (SOTR) 5) Provision for schedule float: G. Young/H. Fenker 6) Maintain core staff: P. Brindza

Current Status:

Oct 2012: Contract with local area engineering consultant from Daresbury Lab to visit vendor bi-weekly.

Nov 2012: Q1 magnet vendor, Scientific Magnetics (SMI), is falling behind schedule. Rebaseline schedule requested. Vendor visit scheduled.

Dec 2012: Details of magnet task force organization outlined including individual SOTR for each magnet vendor.

Jan 2013: Magnet Task Force rolled out. Steve Lassiter identified as SOTR for Q1 magnet.

Feb 2013: Consultant, Ettore Salpietro, develops common risk analysis and mitigation plan. Eight technical areas specified, with risk matrix tied to lower level risk elements. Lead engineers, design staff, and technical staff begin detailed risk analysis.

Feb 2013: Full bottoms-up ETC for Q1 magnet underway, lead by Hall C CAM and Physics APM.

Feb 2013: SMI rebaseline plan developed. Iteration with JLab followed. Final result to be included in JLab 12 GeV rebaseline plan.

Mar 2013: Vendor visit (JLab engineer and Procurement rep). Yoke stacking proceeding. Incentive payments to accelerate production are under discussion.

Apr 2013: Yoke stacking at 85% point. Schedule incentive contract mod in place.

May 2013: Yoke stacking complete. Proceeding with fit-up of coil end-clamp plates and yoke-clamp brackets.

Jun 2013: Yoke stack split into four quadrants. Trial fit of coils to yoke quadrants planned for early July. Cryoreservoir shipped from JLab to SMI.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY0506-3C**	**WBS:** 1.4.3.1.2 **(Hall C D/Q2/Q3 Magnet)**	**Report Date: June 2013**
Description: Unforeseen technical problems in Hall C superconducting magnets that are severe enough to compromise ultimate performance or that require costly re-work.		
Probability: Mod	**Impact:** High	**Risk Rating:** High
First Indicator: Previous experience at JLab procuring superconducting magnets		
Mitigation Approaches: 8) Perform R&D and optimization studies to reduce risks where appropriate. 9) Thorough review of design. 10) Vendor selection to emphasize previous successful projects of a similar nature. 11) Specification of contract milestones to provide appropriately staged testing and adequate schedule float to recover from problems identified in early stage. 12) Close monitoring and coordination of vendor work with laboratory engineering representatives, including on-site visits of the vendor. 13) Provision of adequate schedule float in commissioning stage to address problems discovered during commissioning. 14) Maintain core staff at laboratory with relevant experience to recover from problems: superconducting magnet engineering, cryogenic engineering, vacuum and cryogenic fabrication and repair.		
Date Started: February 2013	**Date to Complete:** CD-4B	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: 7) Design review: G. Young 8) Vendor selection: C. Rode/H. Fenker 9) Milestone specifications: G. Young/H. Fenker 10) Monitoring of vendor work: P. Brindza (SOTR) 11) Provision for schedule float: G. Young/H. Fenker 12) Maintain core staff: P. Brindza
Current Status: Oct 2012: Weekly phone calls established. Vendor visits planned. Joint technical testing plan developed and implemented. Nov 2012: D/Q2/Q3 magnet vendor, Sigma Phi (SP), is falling behind schedule. Rebaseline schedule requested. Vendor visit scheduled. Dec 2012: Details of magnet task force organization outlined including individual SOTR for each magnet vendor.		

Jan 2013: Magnet Task Force rolled out. Paul Brindza identified as SOTR for Q1 magnet.

Feb 2013: Consultant, Ettore Salpietro, develops common risk analysis and mitigation plan. Eight technical areas specified, with risk matrix tied to lower level risk elements. Lead engineers, design staff, and technical staff begin detailed risk analysis.

Feb 2013: Full bottoms-up ETC for D/Q2/Q3 magnet underway, lead by Hall C CAM and Physics APM.

Feb 2013: SP rebaseline plan developed. Iteration with JLab followed. Final result to be included in JLab 12 GeV rebaseline plan.

Feb 2013: Three of five contract mods are completed following resolution of technical and business issues. Contract mods 4 and 5 are under discussion.

Mar 2013: Vendor advances their linear FEA studies. Fabrication and procurement of conductor consolidation equipment underway.

Apr 2013: JLab engineer spends week at vendor consulting/assisting with FEA modelling. 80K properties of conductor were measured. Final Design Review for Dipole held on 23-24 April. Disagreement on acceptance criteria continues.

May 2013: Sigma Phi awards several small contracts to other vendors to improve their schedule performance. Discussion of acceptance criteria continues.

June 2013: Sigma Phi continues with consolidation of 2^{nd} reel of conductor. Decision taken to continue with hand consolidation apparatus and drop plan for automated machinery. JLab and Sigma Phi agree to grade conductor in order to use the best quality at the most critical points of the winding. Also reach agreement to perform non-linear FEA analyses. Conductor samples will be cold-tested at Saclay. These steps should bring us closer to convergence on acceptance criteria.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY1011-5</td><td>WBS: 1.5.1
(Hall D Solenoid)</td><td>Report Date: September 2013</td></tr>
<tr><td colspan="3">Description: Refurbishment and repair of Hall D Solenoid superconducting magnet encounters technical and/or schedule difficulties which are severe enough to compromise the ultimate performance or the ability to meet 12 GeV Project cost and schedule milestones.</td></tr>
<tr><td>Probability:
Technical: Mod
Cost: Mod
Schedule: Mod</td><td>Impact:
Technical: Mod
Cost: Mod
Schedule: High</td><td>Risk Rating: High

RETIRED</td></tr>
<tr><td colspan="3">First Indicator: Delays in the Hall D Solenoid refurbishment and test plan.</td></tr>
<tr><td colspan="3">Mitigation Approaches:
1) Modeling of magnetic forces with modified steel yoke as a function of excitation current in each of the 4 coils.
2) Thorough analysis of possible faults and resulting magnet current excursion and heating due to shorts, ground faults, or other problems.
3) Preparation of test stand to test each coil with yoke at full excitation current. Preparation of instrumentation readouts for all sensors, particularly current and stress/strain readouts, as well as standard JLab cryogenic controls. Refurbishment of cryogenic controls and supply lines and control reservoirs. Reconditioning of helium liquefier.
4) Addition of banding steel to yoke to minimize fringe field in external time-of-flight and forward calorimeter detectors.
5) Refurbishment of liquid nitrogen shields to address known corrosion issues; simultaneous investigation of condition of all internal elements of coils thus opened and thorough checking for leaks.
6) Addition of reinforcement to “overhanging” turns in Coil 2 to provide coil support during high-current operation.
7) Full program of cool-down, current excitation, and warm up for each coil individually in the JLab Test Lab, followed later in Hall D by full magnet cool-down, current excitation and warm up, prior to releasing magnet for use and thence for installation of Hall D detector components.
8) Monitor the progress of refurbishment and test plan through weekly meetings.
9) Monitor the progress of refurbishment and test plan through monthly EVMS meetings.
10) Evaluate options and impacts of operating magnet at lower current setting.
11) Evaluate options for acquiring a second solenoid as a back-up.
12) Convene a Director’s Review to evaluate risk mitigation plan.
13) Design a replacement solenoid coil.
14) Determine steel yoke cladding needed to control fringe fields.
15) Determine configuration of cryogenic support systems to satisfy operational safety needs.</td></tr>
<tr><td>Date Started:
June 2010</td><td>Date to Complete:
October 2013</td><td>Owner: Associate Project Manager for Physics - G. Young
Staff responsible for specific mitigation elements: T. Whitlatch - overall
1) Modeling : G. Biallas</td></tr>
</table>

		2) Fault analysis: G. Biallas/E. Smith/E. Chudakov 3) Test Stand prep: T. Carstens/T. Whitlatch/E. Wolin 4) Addition of steel to yoke: T. Whitlatch 5) Refurbishment of internals: G. Biallas/T. Carstens 6) Addition of support bracs: G. Biallas/T. Carstens 7) Testing: G. Biallas/T. Carstens/E. Wolin/ T. Whitlatch 8) Weekly progress: E. Chudakov 9) Monthly progress: G. Young/W. Funk 10) Options lower current: E. Smith 11) Options new solenoid: E. Salpietro/E. Smith 12) Director's Review: H. Montgomery 13) Replacement design: E. Salpietro 14) Cladding: T. Whitlach/E. Chudakov/F. Martin 15) Cryogenics: T. Whitlatch

Current Status:

11/2009	Review of magnet force calculations, pressure vessel issues, test plans, repair status by internal JLab staff plus S. St. Laurent from SLAC.
12/2009-4/2010	Test stand layout, schedule, work plan, cryogenics design, and control system design all prepared.
2/2010-7/2010	Cryogenic control reservoir fabrication at vendor. Control system wiring design, module procurement, assembly, and control racks wiring and testing, followed by installment at Test Lab test site. Preparation of test stand rails and support, test platform, cryogenics design, layout and procurement.
4/2009-6/2010	Repair of Coil 1 internals and nitrogen shield, re-weldment closure of helium vessel and cryostat, vacuum tests and liquid-nitrogen operation checks.
6/2010	Opening of Coil 2 cryostat and helium vessel to survey state of magnet internals and prepare specific design for support system for overhanging coil layers.
11/2009-6/2010	Analysis of various magnet faults. Development of equivalent circuit model. Calculations of voltage and current transients and estimations of temperature rise for various fault scenarios.
6/2010	Analysis of technical options for acquiring a second solenoid as a back-up including cost and schedule implications.

7/2010-9/2010	Preparation of Coil 1 yoke steel, coil, cryogenics, controls and power supply for test stand operation.
10/2010	Convened Director's Review of Hall D Solenoid with external expert peer review panel. Resulted in numerous technical suggestions for proceeding with cooldown and testing of magnet coils. Recommendation to pursue data on cost and schedule of replacement solenoid in parallel with refurbishment activity.
10/2010-11/2010	Change Request 11-004 to re-plan installation schedule of solenoid in Hall D after completion of testing in Test Labs, re-planning of detector installation schedule to coordinate with solenoid while preserving overall installation completion date.
10/2010-12/2010	Coil 1 pumpdown, cooldown to liquid He temperature and operation at up to 1200 A excitation current. Measurement of cooling rates, I-V curves, internal stresses, magnetic field produced, and fast dump behavior.
12/2010	RFI for industry estimates of replacement coil cost and schedule. Cladding design prepared and costed.
1/2011	Coil 1 warmed up and removed from test stand. Coil 4 mounted in test stand preparation done for pumping down to check vacuum prior to cool down.
2/2011	Coil 4 cooled, operated up to 1500A, warmed, and removed from test stand. Tests similar to those for Coil 1 above.
3-4/2011	Coil 3 put in stand, cooled, issue encountered with temporary bellows spreader, coil warmed up to repair
5/2011	Coil 3 re-evacuated, cooled, tested to 1500A, and warmed up. Tests similar to those for Coil 1 above.
5/2011	Contract issued to MIT Plasma Science and Fusion Center for CDR on replacement solenoid. Seek to integrate existing steel yoke, refrigerator, power supply and cryogenic controls. Explore conductor and stabilizer choices, extrusion vs soldering for conductor, insulation, field shape vs winding pack design, structural design, cryogenics design, and quench detection and protection.
6/2011	Coil 3 removed and coil 2 inserted in test stand, evacuated and readied for cooldown.
12/2011	Coils and yokes mounted on concrete piers in Hall D. Platform installed. CDR report from MIT received and under evaluation. Significant progress made on the cryogenic system. Specification documents for the design/manufacture of a spare solenoid are complete, but procurement has been delayed in response to reduced FY12 funding allocation.
6/2012	Work is on track for magnet cooldown starting in Nov 2012. Assembly of the solenoid distribution can continued with the installation of the copper shield circuit. Mechanical piping installation of the Hall D refrigerator started. Fabrication and installation of the gas panel complete. Helium and nitrogen vessels, shield system, and instrumentation installed inside the vacuum vessel.
9/2012	Solenoid distribution can undergoing leak checks. Straight transfer line sections complete. Refrigerator warm helium piping installation continued. Cool-down delayed ~2 weeks to mid-December.

12/2012	Cool-down underway.
1/2013	Compressor repair required. Cool-down stopped. Two –four week delay.
2/2013	Compressor repair completed. Cool-down re-starts.
5/2013:	Low power (5A – 100A) and high power (100A – 1500A) testing complete. Frequent refrigerator clean-out of carbon dust required. Quench occurs at 1500A. Testing stopped.
6/2013:	Investigation team led by Physics Division formed to study quench with W. Schneider and R. Flora as external experts. Engineers from Hall B and Hall C assisted as well. Safety procedures re-visited and reviewed prior to re-start of cool-down and test program.
7/2013:	Quench analyzed, no direct cause determined but several possibilities have been ruled out. Approved procedures in place to re-start cool-down and power-up to carry out test program.
8/2013:	Decision made not to attempt full current of 1500A at this time due to reduced refrigerator capacity. Magnet ramped successfully to 1350A, testing and field maps done at 1300A. Test program complete. Magnet warmed up.
9/2013:	Further analysis of quench done. Results and conclusions presented to Director's Magnet Advisory Group.
	High risk retired. Overall LOW risk at this time.
	Closed.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY1112-2**	**WBS:** 1.4.2.4 **(Hall B Electronics)**	**Report Date: January 2012**
Description: Increased cost in fabricating the Hall B Electronics.		
Probability: Technical: Low Cost: Mod Schedule: Low	**Impact:** Technical: Low Cost: Mod Schedule: Low	**Risk Rating:** Moderate – Cost **RETIRED.**
First Indicator: Revisit the manufacturing and testing cost estimates for ADCs, TDCs, and trigger modules as part of the annual ETC update process.		
Mitigation Approaches: 1) Obtain vendor cost estimates in response to full board construction information and components lists. 2) Testing program for ADC, TDC and trigger modules, both singly and at crate level. 3) Check of support component counts to instrument full as-built detector. 4) Check of subsystem needs, including HV, LV, crates, cabling.		
Date Started: December 2010	**Date to Complete:** 1QFY2012	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: 1) Vendor estimates: F. Barbosa/C. Cuevas 2) Testing program: F. Barbosa/C.Cuevas 3) Design review: S. Boiarinov/L. Elouadrhiri 4) Subsystem needs: S. Boiarinov
Current Status: 12/2010: Initial check of channel and component counts, and total subsystem needs complete. 1/2011: Estimates of component and board costs for FADCs checked in light of first article actual costs. 2/2011: Check of module counts for all eight types of planned trigger modules and check of system architecture. Estimate of testing manpower for FADCs and trigger modules.		
3-6/2011: First small production run (40 unites) of FADC250 produced. Full crate tests performed of thse together with prototype trigger modules. Results under analysis but look good. Procurement for 600 modules (combining Halls A,B,C,D and physics) was started.		
6/2011: Review of all modules and crate counts for CLAS12		
4-6/2011: Prototype of discriminator tested; cost estimate revised in advance of main procurement.		
1-6/2011: Work continued on all needed types of trigger modules. Those needed for the full crate tests of FADC250 were produced and sdo function. Fabrication estimate to be refined in 1QFY2012 and procurements started thereafter.		

7-12/2011: Estimate of fabrication resources was finalized and included in an approved Change Request.

Closed.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY1112-5</td><td>WBS: 1.3.3
(Cryomodules)</td><td>Report Date: June 2013</td></tr>
<tr><td colspan="3">Description: Anomalously large microphonics data has been seen during testing of the R100 cryomodule in the Cryomodule Test Facility (CMTF). If it holds true for C100 performance in the tunnel, maximum accelerating gradients could be compromised.</td></tr>
<tr><td>Probability:
Technical: Mod
Cost: Mod
Schedule: Low</td><td>Impact:
Technical: Low
Cost: Mod
Schedule: Low</td><td>Risk Rating: Moderate</td></tr>
<tr><td colspan="3">First Indicator: Analysis of data from testing of R100 cryomodule.</td></tr>
<tr><td colspan="3">Mitigation Approaches:
1. Suspend welding cavities into helium vessels
2. Suspend assembly of cryomodules 5-10
3. Get data on R100 in the tunnel
4. Based on those results:
a. Evaluate whether to restart welding cavities into helium vessels and/or cryomodule assembly
b. Adjust priorities in item 6 below based on analysis of the R100 data
5. Get data on C100-1 in the tunnel
a. Evaluate whether to restart welding cavities into helium vessels and/or cryomodule assembly
b. Adjust priorities in item 6 below based on analysis of the C100-1 data
6. In parallel with 1 and 2:
a. Develop potential mechanical design adjustment
b. Develop potential corrective algorithms using the RF controls
c. Develop methods for reliable testing of the solutions
7. The following may be needed. Need will be evaluated based on R100 and C100-1 data
a. Test corrective RF control algorithms on C100-1 in CMTF
b. Test mechanical corrections
c. Implement corrective items as needed</td></tr>
<tr><td>Date Started:
May 2011</td><td>Date to Complete:
June 2013</td><td>Owner: Associate Project Manager for Accelerator - L. Harwood
Staff responsible for specific mitigation elements:
1) Data acquisition and analysis: J. Hogan
2) Final review and approval of mitigations: C Rode</td></tr>
<tr><td colspan="3">Current Status:
5/18/2011: Welding of cavities into helium vessels suspended. Cryomodule assembly suspended. In-tunnel measurement plan for R100 and C100 is underway. Mechanical design and RF control algorithm development are underway.
6/2011: In-tunnel measurement of C100-1 confirms microphonic response for some cavities is higher than specification. Analysis of possible mechanical design modification continues for multiple cryomodule components. Additional cold microphonic measurements are being taken on C100-1 during standard acceptance testing. Some external damping solutions will also be investigated. Benchtop measurements of the cavity/helium vessel/tuner interface are ongoing to determine the optimal design for reducing the</td></tr>
</table>

microphonic response.

11/2011: C100-1 and C100-2 modules have been installed and tested in the tunnel, and confirm the earlier conclusions. Mitigation strategies, such as weighted bags and stiffer tuning arms, are still under investigation pending testing in the final tunnel location under accelerator operating conditions.

1/2012: Both C100-1 and C100-2 have been successfully operated, and C100-1 is being used for beam delivery to the 6 GeV program.

2/2012: C100-5 was built with a stiffer tuning arm, and tested in the Test Lab exhibiting microphonics performance similar to earlier data. Data is inconclusive regarding benefits of the stiffer tuning arm, but no deterioration was seen.

4/2012: The performance of a full zone with the C100-2 cryomodule was demonstrated this month by operating at an energy gain of 104 MV with the full beam loading (465 microAmps) planned for 12 GeV research operations. 108 MV was also achieved without beam loading.

5/2012: The performance of a full zone with the C100-2 cryomodule was demonstrated again this month by operating at an energy gain of 108 MV with the full beam loading (465 microAmps) planned for 12 GeV research operations for more than an hour. This promising result indicates that large microphonics do not limit the performance of one cryomodule. However this risk will continue to be tracked until testing is complete on multiple cryomodules in the tunnel operating with beam loading in 2013.

6/2013: Cryomodule assembly and VTA testing continues. Tunnel installation on schedule with expectations for all 10 cryomodules to be complete by September 2013. Testing with beam will begin in 1QFY14.

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY1112-6</td><td>WBS: 1.3.2
Power</td><td>Report Date: June 2013</td></tr>
<tr><td colspan="3">Description: Design partner of Magnet Power Supply prime contractor is experiencing financial difficulties and reorganization. Design work slowed significantly and the first article power supply delivery is expected to be six months late. The second first article supply is now projected to be later still. Final deliveries of all units may not support accelerator commissioning milestones if schedule delay mitigation is not forthcoming.</td></tr>
<tr><td>Probability:
Technical: Low
Cost: Low
Schedule: Mod</td><td>Impact:
Technical: Low
Cost: Low
Schedule: Mod</td><td>Risk Rating: Moderate</td></tr>
<tr><td colspan="3">First Indicator: Design, Testing and Delivery of First Articles – 2 Power Supplies</td></tr>
<tr><td colspan="3">Mitigation Approaches:
1. Requiring current vendor to generate a revised schedule with detailed listing of remaining First Article (FA) tasks and resource assignments needed to complete the FA. Schedule to include measureable milestones to be able to determine if weekly goals are achieved
2. Monitor completion of first article power supplies (2 units) in accordance with revised schedule.
3. Vendor instructed to supply a revised production schedule for all remaining work.
4. Released a new RFI to alternate vendors (responses to be received in July 2011) in the event the contract must be re-bid. The RFI contains a desired schedule which will support accelerator commissioning.
5. Consideration is given to breaking the current contract into two pieces; one remaining with current vendor and; one going to a new vendor.
6. Setting a Must Act Date of Sept 15, 2011, beyond which we cannot continue with present vendor and must pursue alternate sources.</td></tr>
<tr><td>Date Started:
June 2011</td><td>Date to Complete:
CD-4A</td><td>Owner: Associate Project Manager for Accelerator - L. Harwood
Staff responsible for specific mitigation elements:
1) Technical Contract Management: W. Merz
2) Final review and approval of mitigations: C Rode</td></tr>
<tr><td colspan="3">Current Status:
6/2011: Communicating frequently with vendor. RFI’s have been requested from potential alternate vendors.

7-11/2011: JLab personnel traveled to vendor site to witness first article testing. First article shipment was authorized pending completion of punch list. Discussions continue regarding revised delivery schedule. Significant delays are expected.

12/2011: Vendor proposed an additional one year delay in delivery schedule and increased funding. JLab issued a cure notice to vendor. Work continues to locate alternate vendors.

2/2012: Contract termination with original vendor is underway. Plan is to procure two units which have more stringent specifications via sole source, and do a competitive bid for the</td></tr>
</table>

remaining units.

5/2012: Contract termination complete. The two units with tighter specs have been ordered. Bids have been received for remaining units and are being evaluated.

8/2012: Proposal evaluation is complete, and discussions held to negotiate improvements to the 22-24 month delivery schedule. Contract awarded for remaining units; schedule meets project milestones with some float. Design review held for the two units with tighter specs; vendor is moving ahead with the final manufacturing design work.

9/2012: Change Request processed to capture contract award including cost impact, so cost risk has been mitigated. Based on past experience, schedule risk remains. Risk has been reduced from High for cost and schedule to Moderate for schedule.

9/2012: Overall Risk Reduced to Moderate for Schedule.

2/2013: The Box Power Supply detailed design review for the 15 large supplies was held the first week of February. Following the resolution of a few minor issues, production approval for the first article power supply was given.

6/2013: Power testing of the Arc 1 power supply by the vendor was completed in June. The power supply is being prepared for shipment. Assembly of the first-article Box Power Supply (Arc 2) for the second contract (50 PPM supplies) was completed and testing was begun.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY1112-7**	**WBS:** 1.3.1 **(Cryomodules)**	**Report Date: September 2012**
Description: The Test Lab is scheduled to be renovated as part of the TEDF project. The cavity string assembly activities need to be completed before the cavity work centers are decommissioned for renovation. The delay of completion of the cavity string assembly (due to holds arising from concern about the anomalously high µ-phonics) is now very close to the projected date for removal of the requisite work centers.		
Probability: Technical: Low Cost: Mod Schedule: Mod	**Impact:** Technical: Low Cost: Mod Schedule: Mod	**Risk Rating:** Moderate **RETIRED.**
First Indicator: Review of cryomodule production & TEDF activity schedules.		
Mitigation Approaches: 1) Coordinate closely with TEDF project management. 2) Establish TEDF interface dates in WBS 1.3.1 baseline and track float accordingly. 3) Review cavity string assembly resources to improve schedule and reduce schedule conflict risk. Adjust resources where appropriate.		
Date Started: June 2011	**Date to Complete:** June 2013	**Owner:** J. Hogan

Current Status:

June 2011:	Change request being developed to include TEDF activity coordination dates in 12 GeV cryomodule baseline schedule. Developing detailed decommissioning plan for cryomodule production work centers.
Nov 2011:	The assembly of the cavity strings must be completed before the cavity/work centers are relocated to avoid risk of schedule interruptions and related cost/technical issues. Schedules are being closely monitored, and detailed planning for the relocation is underway.
Feb 2012:	Relocation of the work centers has been delayed to mid-March. Some cost and schedule impact is expected.
May 2012:	Detailed coordination of the move continues. The current renovation schedule will require final assembly of cryomodules #8, #9, and #10 to be completed in the new work area after several months of downtime.
Aug 2012:	Final assembly of C100-8 and C100-9 is underway in the new work area in the Test Lab Addition. The transition of work space is complete.
Sep 2012:	Assembly of C100-10 has started in the new TLA. Relocation complete.

Closed.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY1112-8**	**WBS:** 1.4.3.1.5 **(Hall C Magnets)**	**Report Date: January 2012**
Description: Cost of steel yokes for Hall C Q2, Q3 and Dipole magnets		
Probability: High	**Impact:** Low	**Risk Rating:** Moderate **RETIRED.**
First Indicator: Increases in the Hall C Magnet Yoke cost		
Mitigation Approaches: 1) TOSCA analysis of various magnet yoke designs. Comparison of predicted field quality with requirements for SHMS 2) Contacts with vendors concerning steel properties, pricing, delivery schedules for various fabrication and machining options		
Date Started: June 2011	**Date to Complete:** July 2013	**Owner:** Associate Project Manager for Physics - G. Young Staff responsible for specific mitigation elements: H. Fenker - overall 1) Magnet lead – P. Brindza 2) Field quality calcuations – S. Lassiter 3) Yoke design and vendor contacts – R. Wines 4) Analysis of permissible yoke gaps – R. Wines

Current Status:

3-6/2011 TOSCA analysis of field quality from various yoke design options. Harmonic analysis of calculated field and comparison to SHMS requirements. Study of machined steel vs stacked plate configurations. Study of cast vs forged/rolled steel. Study of horizontal vs vertical plate orientation with respect to dipole field axis. Study of magnet assembly sequence and possible work restrictions. Consultation with vendors about major price and schedule drivers for magnet quality steel, including casting vs. forging/rolling, availability of various carbon-steel grades, requirements for void detection. Determination of cost of stacked cast plate with minimal machining and of rolled plate alternative.

11/2011 The yokes have been redesigned using casting to lower the manufacturing costs. The revised procurement package has been sent out and bids received.

1/2012 Bids on the procurement package have been received and reviewed. A contract is placed.

Closed.

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY 1112-10**	**WBS:** 1.6.3 **(Hall D Civil)**	**Report Date: January 2012**
Description: Cost increase due to construction contractor's claim that Jefferson Lab directed acceleration which caused them to incur additional costs by providing additional manpower and supervision.		
Probability: High	**Impact:** Moderate (> $300K and < $1 M)	**Risk Rating:** High **RETIRED.**
First Indicator: Construction contractor's request for compensation for directed acceleration.		
Mitigation Approaches: 1) Evaluate the weather impacts to the project to ensure the construction contractor has been awarded time for excusable delays. 2) Hire outside counsel to evaluate the construction contractor's claim and provide support in resolution of the claim. 3) Work cooperatively with the contractor to help minimize costs. 4) Add time to contract in a timely manner for any future excusable delays.		
Date Started: September 2011	**Date to Complete:** March 2012	**Owner:** Associate Project Manager for Civil – R. Yasky
Current Status: 08/2011: Jefferson Lab denied the Construction Contractor's request for a 50-day time extension. The basis of the time extension request is a differing site condition associated with the location of an electrical ductbank in the vicinity of the Phase III excavation. 08/2011: Jefferson Lab denied the Construction Contractor's request for equitable adjustment to provide shoring for the Phase III excavation. Construction Contractor claims the shoring is required due to the differing site condition of the electrical ductbank location. 08/2011: Construction Contractor requests resolution of claims for over $1 million related to acceleration, differing site condition, and assessment of liquidated damages and safety fines. 09/2011: Jefferson Lab Legal Counsel reviews the Construction Contractor's claims and the Subcontracting Officer provides the legal basis for denial to the Construction Contractor. 09/2011: Construction Contractor files suit in the Circuit Court of Newport News, Virginia. 09/2011: DOE provides approval for Jefferson Lab to hire outside counsel. 11/2011: Outside legal counsel prepared a response to the contractor's claim. A meeting with the contractor was held on November 30, 2011 to review the details of the claim. A resolution was reached. 1/2012: Change Request approved and implemented to capture the resolution of the dispute. **Closed.**		

12 GeV CEBAF Upgrade Risk Document Form		
Risk ID: **FY 1213-1**	**WBS:** NA **Programmatic**	**Report Date:** **September 2013**
Description: FY12 funding allocation was $50M, a reduction of $16M from the baseline plan. This directed change will require a re-baseline of the Project.		
Probability: Technical: Low Cost: High Schedule: High	**Impact:** Technical: Low Cost: High Schedule: High	**Risk Rating:** High **RETIRED.**
First Indicator: Federal budget passed, and reduction to JLab 12 GeV Project funding level known.		
Mitigation Approaches: 1. Carefully plan the procurement profile, approving only moderate risk and time critical elements. 2. Shift scope out of FY12 into FY13. 3. Extend the installation shutdown from 12 months to 16 months. 4. Delay beam delivery to experimental Hall by ~2 to ~6 months. 5. Evaluate with DOE need to re-baseline Project.		
Date Started: January 2012	**Date to Complete:** June 2013	**Owner:** Project Manager - C. Rode
Current Status: 01/2012: FY2012 budget released. Cut of $16M for 12 GeV Upgrade Project. Begin Change Request process for shifting scope later in time. 02-5/2012: Extend planned long installation shutdown from 12 months duration to 16 months. Approve and implement multiple Change Requests to delay scope into FY13 and FY14. 06/2012: Lehman Mini-Review to discuss project status and preliminary plans for rebaselining. 09/2012: Lehman Mini-Review of Project's proposal for rebaselining to include increased TPC and delay in CD-4B. Rebaseline review scheduled for November 27-29, 2012. 12/2012: Lehman Review of Project's proposal for rebaselining held Nov 27-29, 2012. 02/2013: Director's Temple Review of Project's proposal for rebaselining scheduled for April 8-10, 2013. Lehman Review scheduled for May 7-9, 2013. 05/2013: Lehman Review was held at JLab on May 7-9, 2013. Review committee recommended that the Project be rebaselined following substantial implementation of their recommendations. 06/2013: A Mini-Independent (Lehman) Review of the 12 GeV Upgrade is scheduled for August 9, 2013 in Germantown, MD.		

<table>
<tr><td colspan="3">12 GeV CEBAF Upgrade
Risk Document Form</td></tr>
<tr><td>Risk ID:
FY 1213-1</td><td>WBS: NA
Programmatic</td><td>Report Date: September 2013</td></tr>
<tr><td colspan="3">Description: FY12 funding allocation was $50M, a reduction of $16M from the baseline plan. This directed change will require a re-baseline of the Project.</td></tr>
<tr><td>Probability:
Technical: Low
Cost: High
Schedule: High</td><td>Impact:
Technical: Low
Cost: High
Schedule: High</td><td>Risk Rating: High

RETIRED.</td></tr>
<tr><td colspan="3">08/2013: A Mini-Independent Project (Lehman) Review of the 12 GeV Upgrade was held on August 9, 2013 in Germantown, MD. Rebaseline to be approved following implementation of Recommendations including additional risk mitigation for the superconducting magnets.

09/2013: An ESAAB meeting for the 12 GeV Upgrade rebaseline was held on September 4, 2013 in Germantown, MD. The rebaseline was approved. Implementation was complete by the end of the month with an effective start date of September 1, 2013.

High risk retired.

Closed.</td></tr>
</table>