LCLS Risk Registry
LCLS_risk_registry_Jan_05

No.	Risk Title	Date Submitted	Submitted By	Date Last Revised	Owner	If	Then	Risk Timeframe Which phase could this event occur? Design, Construction, and/or Commissioning	Probability of Event (percentage)	Current Cost Impact Estimates (use $k) O: Optimistic, ML: most likely, P: pessimistic			Schedule Impact (use time in months) O: Optimistic, ML: most likely, P: pessimistic			Overview of Risk Handling Plan	Risk Handling Approach: Avoid, Mitigation, Transfer, Accept	Steps for Handling the Plan	Risk Retired - Mark "X" for Yes
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1.1	**Management**																		
R1.1-001	Change Control	5/52004	Mark Reichanadter	5/52004	Mark Reichanadter	If change control is not effective,	Then change could get implemented without proper review and approval.	Design, Construction	**5**	**10**	**50**	**150**	**0**	**1**	**2**	Implement change control system and review cost, schedule and scope against baseline on a monthly basis.	Mitigate	7/04 - Set baseline. 8/04 thru 10/08 - Review cost status monthly.	
R1.1-002	Basis of Cost Estimate is not documented	5/52004	Mark Reichanadter	5/5/2004	Mark Reichanadter	If analysis supporting design decisions isn't documented, and supported by experts,	Then the real costs of the scope of work is unknown, and the project may be at risks that cannot be covered by the estimated cost and schedule contingency.	Design, Construction	**5**	**0**	**0**	**100**	**0**	**0.5**	**1**	Ensure that Basis of Estimate documentation is provided for all design decisions, procurements and subcontracts, ensure also that estimators are experienced in cost estimating and that they understand the full scope of work	Mitigate	Iterate on WBS Dictionary, use experienced estimators and/or vendors to provide estimates	
R-1.1-003	Project Schedule Validity	5/52004	Mark Reichanadter	5/52004	Mark Reichanadter	If the project schedule is invalid due to incomplete "subsystem" elements or schedule slips,	Then the comprehensive schedule may be invalid.	Design, Construction, Commissioning	**20**	**0**	**0**	**0**	**0**	**1**	**2**	Include schedule contingency and evaluate schedule.	Accept/Mitigate	Understand the critical path, optimize areas of float, use experts to 'value engineer' the overall construction schedule	
R1.1-006	Personnel	5/52004	Mark Reichanadter	5/52004	Mark Reichanadter	If there is a change in management personnel, or the project cannot draw high-quality personnel to key positions	Then project knowledge will be lost and the program may change.	Design, Construction, Commissioning	**20**	**0**	**>$1M**	**>$5M**	**0**	**3**	**12**	Communicate regularly with Lab managemen on the resource needs of the project, proactively recruit key personnel for upper management and engineering positions on the project	Mitigate	Constant communication and knowledge transfer to Lab management	
R1.1-007	Integration of SLC Control system Alpha to EPICS IOCs	5/9/2004	L.R. Dalesio	5/9/2004	L.R. Dalesio	IF we fail to implementAlpha functions 1-simple polled data transfer 2-Timed acquisition for beam synchronous data 3-Buffered acquisition of beam synchronous data	THEN the applications developed within the SLC controls system will not Function for linac sectors 20-30. This Will slow LCLS commissioning and Hinder or prevent operation of the linac in traditional modes.	Construction, Commissioning	**<5%**	**0**	**0**	**0**	**3**	**6**	**6**	Assign adequate manpower to assess the relevant tasks and carry them out. 3 FTE per year are assigned to mitigation of this risk.	Mitigate	1-identify all SLC-micro message types 2-write message emulators for EPICS IOCs	
R1.1-008	LCLS Timing System	5/9/2004	L.R. Dalesio	5/9/2004	L.R. Dalesio	IF there is a delay in implementation or technical deficiency in the following three new designs: PNET receiverfor EPICS Master Pattern Generator for EPICS Event Receiver for EPICS	Integration of the existing SLC Controls System and the LCLS EPICS controls Will not be integrated, preventing the Operation of LCLS from the MCC and Rendering useless many essential SLC controls functions in the LCLS	Construction, Commissioning	**<5%**	**400**	**1000**	**2000**	**3**	**4**	**6**	Adapt Timing pulse generator design from the Swiss Light Source For LCLS use. This module has 20 nsec resolution and at this time it is Not clear that the SLS design meets all LCLS specifications.	Accept	1-Develop and test three LCLS timing Modules in 2005-2006 2-Investigate alternative solutions in 2007 if necessary 3-Implement alternative solution in 2008, continue work on preferred solution	
R-1.1-009	Serious Accident on the SLAC Site	1/3/2005	Mark Reichanadter	1/3/2005	Mark Reichanadter	IF there is a serious accident on the SLAC site by SLAC employee, contractor or visitor	Then a work stappage of all LCLS activities regardless of the accident cause or effect could occur	design, construction, commissioning., operations	**< 5%**	**400K**	**4M**	**10M**	**3**	**4**	**6**	Implement an Integrated Safety Management System (ISMS) for the LCLS Division and Project. Ensure that LCLS upper-level management supports the ISMS and that ES&H issues are given the highest priority. Ensure that adequate ES&H resources (both technical and construction) are devoted to maintaining a safe working environment for LCLS staff.	Mitigate	Constant communication and regular training for LCLS staff that ES&H and ISMS is the highest priority for the LCLS.	

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R-1.1-010	Co-Location of Core LCLS Staff	1/3/2005	Mark Reichanadter	1/3/2005	Mark Reichanadter	If the core team of managers, scientists, engineers, and designers cannot be co-located at its three partner labs	Then, a loss of coordination and communication will be realized witin the LCLS project	Design, construction, commissioning, operations	20#	400K	2M	4M	3	4	6	Discuss regularly with Lab management the need for co-located space for the LCLS teams.	Avoid, mitigate	LCLS will communicate regularaly with Lab management at SLAC, ANL and LLNL to retain the necessary co-located office space to house its core staff	
R-1.1-011	Equipment Storage and Staging Area	1/3/2005	Mark Reichanadter	1/3/2005	Mark Reichanadter	IFthe LCLS cannot obtain secure storage space for equipment and deliverables prior to installation	THEN there is the potential for loss or damage to the LCLS deliverables	Construction, commissioning,operations	10%	400k	1m	4m	3	4	6	Develop staging plan with estimates on space needs and timing. Describe security and access requirements and any special equipment reauirements and work with SLAC to ensure adequate space is available when needed	Avoid, mitigate	LCLS will communicate regularly with SLAC management to obtain the necessary warehouse space to ensure LCLS deliverables are stored properly prior to installation in the LCLS conventional facilities	
1.2	**Injector System**																		
R-1.2-001	Laser Beam Temporal Shaping	5/4/2004	S. Gilevich	5/4/2004	S. Gilevich	If we are unable to procure or preserve the laser pulse flattop temporal shape (set by the pulse shaper) during amplification and UV conversion	Then the laser pulse on the cathode will not meet the temporal profile requirements and the emittance of the electron beam leaving the gun will be too large. And the optical components down the line could be damaged by the spikes in the amplified pulse shape	Design, Construction	3	50	100	100	3	3	6	Conduct R&D together with BNL and INFN. Develop alternative technologies of pulse shaping (spectral filtering)	Mitigate	Test the temporal shaper developed by INFN with the BNL laser Test the spectral filtering technology with the GTF laser	
R-1.2-002	Dual Feed L0-1 Structure	5/7/2004	Richard F. Boyce	5/7/2004	Lynn Bentson	If there are problems with the design or fabrication of the dual feed for the L0-1	Then the L0-1 structure will not be ready installation and commissioning	Design, Construction	20	0	50	100	3	3	6	Use a single feed L0-1 structure while waiting for the dual feed L0-1 structure.	Mitigate	Start the design early Fabricate ASAP	
R-1.2-003	'04 Linac Downtime Work	5/7/2004	Richard F. Boyce	5/7/2004	Lynn Bentson	If the shield wall is not complete during the Linac downtime	Then work in the Sector 20 Alcove to prepare for installation cannot proceed	Construction	30	0	50	100	6	6	12	Prepare the work in detail in advance. Work two shifts during the '04 downtime. Complete the work during the '04 winter 2 week break. Complete the work during the '05 linac downtime.	Mitigate	Schedule for the Steps: 04-06/2004 07-08/2004 12/2004	
R-1.2-004	'05 Linac Downtime Work	5/7/2004	Richard F. Boyce	5/7/2004	Lynn Bentson	If the waveguides in the Linac area are not installed before the Linac downtime is over	Then the beam cannot be accelerated in the injector	Construction	30	0	50	100	6	6	12	Prepare the work in detail in advance. Work two shifts during the '05 downtime. Complete the work during the '05 winter 2 week break. Complete the work during the '06 linac downtime.	Mitigate	04-06/2005 07-08/2005 12/2005 07-08/2006	

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R-1.2-005	'06 Linac Downtime Work	5/7/2004	Richard F. Boyce	5/7/2004	Lynn Bentson	If the DL and SAB beamlines are not installed before the Linac downtime is over	Then the injector cannot inject the beam into the linac or complete commissioning to the SAB dump	Construction	**30**	**0**	**50**	**100**	**6**	**6**	**12**	Prepare the work in detail in advance. Work two shifts during the '06 downtime. Complete the work during the '06 winter 2 week break. Complete the work during the '07 linac downtime.	Mitigate	Prepare work in advance Work two shifts during '06 down Work during '06 winter break Work during '07 linac downtime	
R-1.2-006	RF Gun at 120 hertz	5/7/2004	Richard F. Boyce	5/7/2004	Richard F. Boyce	If the RF gun changes shape due the increased heat load of 120 hertz operations	Then the RF gun will not resonant with the klystron and will not accelerate the electron beam properly	Commissioning	**10**	**50**	**100**	**150**	**3**	**3**	**6**	Tune the RF gun manually so injector testing can proceed while the RF gun cooling is redesigned and a new RF gun in fabricated.	Mitigate	Manually tune the RF gun during injector testing Redesign the RF gun cooling Fabricate a new RF gun	
R-1.2-007	FY05 Shutdown	1/4/2005	Eric Bong	1/4/2005	Eric Bong	IF the FY05 shutdown signifcantly moes earlier in time, decreases in duration or is eliminated	THEN the components scheduled for installation during the FY05 shutdown will not be installed in the beamline during FY05.	Commissioning, operations	**> 25%**	**0**	**< $1M**	**< $1M**	**3**	**3**	**>3**	Mitigate risk of failure to install beamline components during FY05 downtime by establishing whether downtime will occur, and the duration if it occurs. Re-schedule installation work that will not happen in FY05 into FY06 and extend the FY06 downtime to accommodte work.	Accept	1. Define FY05 downtime existence and parameters with SLAC laboratory management. 2. Re-schedule downtime installation work. 3. Re-optimize engineering and fabricationschedules to new installation schedule.	
R-1.2-008	Insufficient Charge	1/5/2005	Eric Bong/Dave Dowell	1/5/2005	Cecile Limborg	IF the gun does not produce the specified charge	THEN the FEL will not produce the rquired 10^12 photons per pulse	Commissioning	**<25%**	**< $100K**	**< $1M**	**> $5m**	**0**	**3**	**0.3**	The beam charge is determined by the drive laser energy and the cathode quantum efficiency. The approach should be to first determine which of these subsystems is not meeting its specification, then correct that one. Mitigate using R&D on non linear conversion. Develop gun load lock as upgrade.	Mitigate	Drive laser energy is low: Put more resources into the non-linear conversion system via the LLNL SOW plan. Cathode QE is low: Implement the load lock and use plasma discharge cleaning to improve QE. Also, improve gun vacuum.	
R-1.2-009	Emmittance Specification	1/5/2005	Eric Bong/Dave Dowell	1/5/2005	Cecile Limborg	IF emittance from injector does not meet specification	THEN the FEL will not perform to its specifications	Commissioning	**< 25%**	**$100K**	**$500K**	**$1M**	**0**	**3**	**>3**	The injector emittance is determined by drive laser shaping and the cathode quality. The best approach to improving the emittance is to put more effort into the drive laser system and to implement better cathodes with the load lock.	Mitigate	1. Improve the drive laser by proceeding with the R&D at LLNL. 2. Build and imcorporate the load lock and the load lock room.	
R-1.2-010	Cabling Code Uncertainty	1/4/2005	Eric Bong	1/4/2005	Eric Bong	IF the cabling code requirement at SLAC changes before the cable plant is accepted and the incorrect cable is purchased or installed	THEN new cable will have to be purchased and/or installed to meet the new code requirement. Removing and reinstalling new cable would delay CD4.	Construction	**> 25%**	**< $1m**	**< $1m**	**> $5m**	**0**	**0**	**>3**	Accept risk of changing cable code requirements and purchase cable meeting or exceeding the standard that will certainly be adopted.	Accept	1. Purchase the cable appropriate to the new code. 2. Adjust the injector paln to reflect the increase in cable cost.	
R-1.2-011	Reliability of the Injector Drive Laser System	6/4/2004	Sasha Gilevich	6/4/2004	Sasha Gilevich	IF any of the dirve laser system components fails (for example, due to optics damage or due to diode laser failure)	THEN the whole LCLS will be shut down for a certain period of time required to find and fix the problem and realign and check the laser system. This downtime period can be significant due to the complexity of the system and to the fact that the main components will be built by the outside vendor and could be fixed only by its manufacturer.	Operations	**30%**	**$350K**	**$500K**	**$1000 K**	**0.5**	**0.5**	**1**	Plan the laser bay to have the space and utilities to accommodate the second laser system. Request the Project Office to allocate FY07 funds towards procurement of the second laser system	Accept	Order the system. Integrate the system.	
1.3	**Linac System**																		

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R-1.3-001	Linac RF Stability	5/6/2004	Eric Bong	5/6/2004	Eric Bong	If the following RF stability is not achieved… L1: φ1: 0.1° S; ΔV1/V1: 0.10% LX: φX: 0.1° X; ΔVX/VX: 0.25% L2: φ2: 0.1° X; ΔV2/V2: 0.25% L3: φ3: 0.1° X; ΔV3/V3: 0.25%	The electron bunch length will vary with phase instability and the electron energy will vary with the amplitude instability. This will cause fluctuations in the SASE FEL pulse length and peak brightness.	Commissioning, Operations	>25%	0	0	750	0	3	>3	Mitigate risk of failure to achieve RF stability requirements by instituting R&D efforts to develop an appropriate signal to use as feedback to establish RF stability. Investigate multiple feedback signal sources in case one source fails to meet criteria. Model feedback effectiveness. Test feedback on Linac klystron using EPICS control mockup in Linac Sector 21.	Mitigate	1. Perform bunch length measurements w/ EO and OTR/THz signals with test beam. 2. Build LLRF prototype and install in Linac. 3. Build EPICS test stand in Linac. 4. Write RF feedback software. 5. Instrument Linac klystron and rest feedback.	
R1.3-002	FY05 Shutdown	1/4/2005	Eric Bong	1/4/2005	Eric Bong	IF the FY05 shutdown signifcantly moes earlier in time, decreases in duration or is eliminated	THEN the components scheduled for installation during the FY05 shutdown will not be installed in the beamline during FY05.	Commissioning, operations	> 25%	0	< $1M	< $1M	3	3	>3	Mitigate risk of failure to install beamline components during FY05 downtime by establishing whether downtime will occur, and the duration if it occurs. Re-schedule installation work that will not happen in FY05 into FY06 and extend the FY06 downtime to accommodte work.	Accept	1. Define FY05 downtime existence and parameters with SLAC laboratory management. 2. Re-schedule downtime installation work. 3. Re-optimize engineering and fabricationschedules to new installation schedule.	
R-1.3-003	Sector 20 Beneficial Occupancy	1/4/2005	Eric Bong	1/4/2005	Eric Bong	If the beneficial occupancy of Linac Sector 20 is delayed	THEN the components scheduled for installation in the laser alcove and the injector vault will be delayed	Construction	< 25%	0	0	< $1M	0	1	3	Accept risk of delay to install beamline components due to Li20 Beneficial Occupancy delay and minimize impact by regular inquiry into LI20 construction progress and revising installation schedule to accommodate	Accept	1. Regularly review Li20 conventional construction progress. 2. RE-schedule installation work.	
R-1.3-004	Linac Legacy Issues	1/5/2005	Eric Bong	1/5/2005	Eric Bong	IF the condition of the existing SLAC Linac infrastructure does not support LCLS requirements	THEN the LCLS will not be able to operate the new beamlie components required to meet electron beam delivery parameters	Design, Construction	> 25%	< $5M	< $5m	> $5m	0	0	3	Mitigate risk by upgrading SLAC Linac infrastrucure prior to commissioning Linac	Mitigate	1. Specify utilities requirements to conventional facilities. 2. Check conventional facilities plan to veerify utilities requirements will be met. 3. Monitor implementaiton of CF plan. 4. Verify utilities capacities prior to component installation.	
R-1.3-005	Cabling Code Uncertainty	1/4/2005	Eric Bong	1/4/2005	Eric Bong	IF the cabling code requirement at SLAC changes before the cable plant is accepted and the incorrect cable is purchased or installed	THEN new cable will have to be purchased and/or installed to meet the new code requirement. Removing and reinstalling new cable would delay CD4.	Construction	> 25%	< $1m	< $1m	> $5m	0	0	>3	Accept risk of changing cable code requirements and purchase cable meeting or exceeding the standard that will certainly be adopted.	Accept	1. Purchase the cable appropriate to the new code. 2. Adjust the linac paln to reflect the increase in cable cost.	
1.4	**Undulator System**																		
R-1.4-002	Magnetic Measurements	5/7/2004	Robert Ruland	5/7/2004	Robert Ruland	Measurement time estimates are based on measurements performed on the undulator segment prototype at APS. The tuning of the production undulator segments might take longer than estimated based on the prototype.	Presently, we are only scheduling work during day shift. We would add additional personnel allowing us to staff swing or even night shifts.	Construction	<25%	<1000	<1000	<1000	0	0	0	Time estimates are based on measurements on the undulator prototype at APS. If production undulator segments are more difficult and more time consuming to tune, we can add additional staff to run swing or even night shifts	Mitigate	Loan from other departments or hire additional staff	
R-1.4-003	Fixed Support Design Specification	5/9/2004	Steve Milton	5/9/2004	Steve Milton	If the fixed supports are not stable over time	Then beam-based alignment need to be performed too often to achieve availability and stability functional goals	Design	<25%	50	100	100	3	5	6	Get more design and engineering support on this.	Avoid	Cost of an additional engineer and designer for 3 months.	
R.1-4-004	Chamber Roughness Specification	5/9/2004	Dean Walters	5/9/2004	Steve Milton	If the surface roughness of the chambers is too high	Then it is very likely that there will be significant reduction in total power delivered or no lasing at all.	Commissioning, Operations	?	50	100	120	3	5	6	Prototyping of various chamber configurations will be performed and the results of the prototype chambers measured roughness will be given to a theorist to determine if it meets the performance specifications. Methods of reducing the surface roughness of the chambers will also be tested.	Avoid		

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R-1.4-005	Machine Protection System	5/9/2004	Josh Stein	5/9/2004	Steve Milton	If beam strikes the undulators do to unwitnessed steering errors,	Then the magnet blocks in the undulator may be damaged.	Design, Commissioning, Operations	<25%	20	25	50	<1	1	2	The Machine Protection System within the undulator section will be designed with different system inputs in mind, but will be based on beam loss monitors. If it is determined at a later date that the beam position information is a required input into the system, that capability will be added as another system input to the global MPS.	Avoid	The beam position may be monitored via: 1) The existing RFBPM systems – this requires active EPICS participation, but reduces the impact on new electronics designs (see below) and adds minimal software effort 2) Some type of Beam Position Limit Detectors may be designed to signal when the beam has exceeded vertical or horizontal limits.	
R-1.4-006	RFBPM – Timing Interface	5/9/2004	Josh Stein	5/9/2004	Steve Milton	If the timing interface to the existing SLAC timing system is not correlated with the RF BPM's	Without accurate and reliable timing information, the data acquired from the RFBPM, a system critical component, becomes meaningless.	Design, Commissioning, Operations	>25%	20	25	50	<1	1	2	The design of the EPICS aware timing module will depend almost directly on the amount of effort expended – with this in mind, the primary method of handling this risk is by assigning multiple and redundant engineers to the design effort.	Avoid		
R-1.4-007	Magnet Block Radiation Damage	5/9/2004	Marion White	5/9/2004	Stephen V. Milton	If the high-energy electron beam strikes any of the undulator magnet blocks,	Then it is very likely that some amount of radiation damage will occur, resulting in partial demagnetization of individual magnets within the undulator.	Commissioning, Operations	>25%	20	25	50	<1	1	2	There is risk that one or more undulators will be damaged in part or in total by radiation as a result of commissioning or operational beam strikes.	Mitigate, Accept	The risk handling plan is: 1) Collimators are installed to protect the undulators 2) Equipment protection devices, including radiation sensors will not allow beam operation under conditions known to be dangerous to the undulators. 3) Seven (7) spare undulators are being purchased. 4) All undulator magnets are made of a new higher coercivity material which is less sensitive to radiation damage. 5) ANL-APS is carrying out studies with the intent of better understanding the actual damage mechanism and helping to determine safe operating dose levels. 6) Undulators can be rolled out of the beam to do beam tuneup studies. 7) Commissioning procedures developed with undulator protection as one of the prime goals.	
R-1.4-008	Undulator Vacuum Chamber AC Conductivity	12/4/2004	Dean R. Walters	12/1/2004	Stephen Milton	IF the Undulator Vacuum Chamber necessitates a change in material due to the AC Conductivity of the chamber wall material.	THEN there will have to be a redesign to the Undulator Vacuum chamber design. With a change of chamber design also brings about a change in construction method.	Design, construction, commissioning	> 25%	$300K	$500K	$800K	3	6	12	Analyze impact of material and cross section choice on performance. Change vacuum chamber design to use better suited material (Cu -> Al) and chamber cross section (circular -> oblong). Optimize FEL gain through micro-tapering. Reduce bunch charge in combination with increased linac bunch compression.	Mitigate, Accept	Technical stucy of AC conductivity. Complete construction methodologies study.	

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R-1.4-009	Lack of final performance specificiations of focusing and corrector magnets: schedule, and cost implications of delayed decision on specs	12/1/2004	Marion White	12/1/2004	Stephen V. Milton	IF there is a delay in finalizing the strength specificiation and alignment tolerance of the quadrupole and/or corrector magnets	THEN it is very likely that there will be schedule and cost implecations; design and integration effort are delayed	Design, construction, commissioning, operations	> 25%	$100K	$100K	$100k	< 1	<1	2	There is a risk that the present quadrupole and corrector magnet strength and alignment tolerance will be changed again due to incompletely developed commissioning and oeprating plans. There is also risk in that a prolonged delay in making the required decisions on magnet strengths and alignments tolerance will cause significant schedule delay and thus cost growth. The magnet is an integrated part of the undulator line, and changing it requires changes or perhaps loss of nearby components. The risk handling plan is: 1. The new PRD will be sidned off by 18 Feb 2005.	Mitigate, Accept	See handling plan	
R-1.4-010	Undulator period and aperture change due to AC impedance issues; performance, schedule, and cost implications, including delayed decision	12/1/2004	Marion M. White	12/1/2004	Stephen V. Milton	IF the undulator period, aperture, and quantity change due to mitigation of AC impedance issues, and if there is a delay in deciding on a course of action	THEN it is very likely that there could be performance, schedule, and/or cost implications.	Design, construction, commissioning, operations	> 25%	< 100K	< 1M	> 10M	< 1	>1	6	There is risk that the present undulator design will cause degraded FEL performance due to possible wakefield enhancement by AC contributions to the impedance. There is risk that a prolonged delay in making a decision on the required undulator gap and period will cuase significant schedule delay and thus cost growth.	Mitigate, Accept	1. A task force was set up t o make calculations, simulations, and measurements, and to propose a solution to Project Management by mid-January 2005. 2. The decision will be made and a revised PRD will be ;issued by 18 February 2005. If there are no or only minor design changes to the undulator, the baseline schedule can be met. 4. If significant design changes are required to miitgate the wakefield problems and ensure FEL performance, a redesign will be done as rapidly as possible. 5. If additional undultaors are qrequired to compensate for increased gap, the production schedule and plan may need adjustment.	
R-1.4-011	End of Undulator Diagnostics Suite	12/1/2004	Dean R. Walters	12/1/2004	Stephen V. Milton	IF the goals and rose of the End of Undulator Diagnostics are not detailed	THEN the organization and schedule of the End of Undulator will be in flux	Design, construction, commissioning	> 25%	<1M	<1M	5M	0	3	6	Conduct discussions and R&D together with SLAC and LLNL. Develop plan for technical study followed by a listing of responsibility of equipment design, construction, and installation.	Mitigate	Complete Technical Study of End of Undulator Diagnostics. Assignment of responsibility.	
R-1.4-012	Undulator Component Motion	12/1/2004	Josh Stein	12/1/2004	Stephen V. Milton	IF radiation strikes the motors used to move devices within the undulator hall.	THEN the motors may become damaged to the point where they cease to function, or function in an inappropriate manner.	Commissioning, Operations	30%	50K	500K	500K	1	1	3	Determine radiation susceptibility of pertinent motors. Develop alternative motor choices and anticipate backup installation.	Mitigate	Test motors for damage in SR environment. Characterize the threshold for motor resistance. Plan on installation of "worst case" motorr choices to minimize impacet on replacint existing motors if necessary.	
1.5	**X-Ray, Transport, Optics & Diagnostics System**																		
R-1.5-001	Solid Attenuator Performance	5/8/2004	R. Bionta	5/8/2004	R. Bionta	IFsolid attenuators fail to achieve sufficient or linear attenuation due to damage or physics effects.	THEN at high photon energies, we will be unable to cross calibrate the diagnostic detectors, and we will be unable to operate the direct imagers and the spectrometer.	Commissioning	10	500	1000	2000	3	6	12	Make solid attenuators of the lowest Z materials. Develop plans to raise pressure in the gas attenuator and to run it with higher z gases. Plan for moving solid attenuators and detectors downstream.	Mitigate	1) Design low-z solids 2) Develop high pressure / high z gas capabilities in gas attenuator 3) Provide space for solid attenuators downstream.	

No.	Risk Title	Date Submitted	Submitted By	Date Last Revised	Owner	If	Then	Risk Timeframe Which phase could this event occur? Design, Construction, and/or Commissioning	Probability of Event (percentage)	Current Cost Impact Estimates (use $k) O: Optimistic, ML: most likely, P: pessimistic			Schedule Impact (use time in months) O: Optimistic, ML: most likely, P: pessimistic			Overview of Risk Handling Plan	Risk Handling Approach: Avoid, Mitigation, Transfer, Accept	Steps for Handling the Plan	Risk Retired - Mark "X" for Yes
										O	ML	P	O	ML	P				
R-1.5-002	Gas Attenuator Performance	5/5/2004	R. Bionta	5/5/2004	R. Bionta	If gas attenuator fails to achieve sufficient or linear attenuation due to insufficient pressure with an opening large enough to pass the required beam footprint.	Then, at low photon energies, we will be unable to cross calibrate the diagnostic detectors, and we will be unable to operate the direct imagers and the spectrometer.	Commissioning	**10**	**500**	**1000**	**2000**	**3**	**6**	**12**	The risk of poor gas attenuator performance is handled in a 3 pronged approach. First we are investigating window technologies that allow higher pressures across bigger openings, and have provided access shafts for external gas piping into the FEE. Secondly, we have increased the length of the gas attenuator to 10 m, considerably lowering the pressure requirements and have positioned the gas attenuator so that it can be expanded into the muon shield and into the flex space if necessary. Thirdly, we have the option of moving the solid attenuator's and detectors further downstream if necessary.	Mitigate	1) Design low-z solids 2) Develop high pressure / high z gas capabilities in gas attenuator 3) Provide space for solid attenuators downstream.	
R-1.5-003	Imager noise and backgrounds	5/5/2004	R. Bionta	5/5/2004	R. Bionta	If imager noise levels are too high due to high radiation backgrounds, EMP, or high readout rates..	Then we will be limited in our abilities to measure the FEL at low intensities during commissioning.	Commissioning	**10**	**500**	**1000**	**2000**	**3**	**6**	**12**	Provide an indirect imager which can be withdrawn in a direction transverse to the beam to lessen Compton background. Run cameras at slower readout speeds. Provide a gas ion chamber and total energy detector for alternative means of measuring beam intensity. Locate detectors in first hutch during commissioning, downstream of electron dump and muon shields.	Mitigate		
1.6	**X-Ray Endstations System**																		
R-1.6-001	Laser Timing Failure	5/7/2004	J. Arthur	5/7/2004	J. Arthur	If the desired level of synchronization is not achieved	The the precision of experiments and diagnostics will be compromised	Operations	**10**	**100**	**100**	**100**	**3**	**3**	**3**	Allow plenty of time for design	Mitigate		
R-1.6-006	2-D Detector Failure	5/7/2004	J. Arthur	5/7/2004	J. Arthur	If the 2-D X-Ray Detector fails to meet its technical requirements by 9/28/08	Then the goal of developing this useful instrument will not have been met	Operations	**30**	**1,000**	**1,000**	**1000**	**0**	**0**	**0**	Begin detector R&D immediately. If R&D results are not promising, pursue acquisition of alternative detector, with less aggressive specifications, in FY07.	Mitigate		
1.9	**Conventional Facilities**																		
R-1.9-002	Bay Area Labor Construction Cost	5/7/2004	David Saenz	5/7/2004	David Saenz	If the Bay area economy experiences rapid economic growth, to levels see 5-10 years ago.	Then Bay area labor force may experience an increase in demand that can result in a greater labor cost than currently estimated.	Construction	**<5%**	**>$5M**	**>$5M**	**>$5M**	**0**	**0**	**0**	Monitor trends for bay area construction activities	Avoid, Accept	Review and track various resources for bay area construction activities, specifically labor costs. Develop quarterly reports and present economic trends to the LCLS Project Office	
R-1.9-004	Construction Schedule	5/7/2004	David Saenz	5/7/2004	David Saenz	If the average tunneling rate, using road header boring, is not maintained	Then the minimal tunneling advances will experience a schedule delay and impact the overall schedule of beneficial occupancy milestones	Construction, Commissioning, Operations	**<25%**	**<$5M**	**<$5M**	**<$5M**	**3**	**3**	**3**	Closely monitor all major activities and proactively seek improvements to the CF schedule. Call an early review with outside experts to optimize the LCLS construction schedule.	Avoid, Accept	Review all critical patch activities, place all tunneling and excavation operations onto the critical path, increase of necessary manpower, and make provisions for additional equipment (road headers)	
R-1.9-005	Undulator Hall HVAC	5/7/2004	David Saenz	5/7/2004	David Saenz	If the environmental parameters of the tightly controlled Undulator Hall thermal requirements are not realized,	Then the specified technical requirements will not allow the 33 undulators to function properly	Commissioning, Operations	**<25%**	**<$1M**	**<$1M**	**<$1M**	**>3**	**>3**	**>3**	Review and validate the design by Jacobs Engineering for the Undulator Hall HVAC system	Mitigate	Provide peer review of mechanical systems, provide adequate review of the HVAC system during upcoming VE session in Title II	
R-1.9-006	Tunneling	5/7/2004	David Saenz	5/7/2004	David Saenz	If the subsurface material is to soft	Then voids and soft surfaces will require additional reinforcement and potentially cause additional cost and potential schedule delays	Construction	**<25%**	**<$1M**	**<$1M**	**<$1M**	**<3**	**<3**	**<3**	Provide additional detailed geotechnical analysis of subsurface to approximately 10' below inverted tunnel floor elevation	Mitigate	Provide additional borings, develop geotechnical investigation	

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										O	ML	P	O	ML	P				
R-1.9-008	Seismic activity during construction	5/7/2004	David Saenz	5/7/2004	David Saenz	If a moderate earthquake occurs during tunneling operations	Then a life/safety issue may cause possible accidents or schedule delays	Design, Construction	**<25%**	**<$1M**	**<$1M**	**<$1M**	**<3**	**<3**	**<3**		Mitigate	Provide construction design to peer review, submit final design to SLAC Seismic Safety committee for review and approval	
R-1.9-012	RSY Pile Locations	5/7/2004	David Saenz	5/7/2004	David Saenz	If excavation of piles results in contact with active/inactive utilities	Then major modifications to the construction plan, cost and schedule may be impacted	Construction	**<25%**	**<$1M**	**<$1M**	**<$1M**	**<3**	**<3**	**<3**	Manage CF scope of design effort to ensure completion within scheduled parameters.	Mitigate	Manage CF scope for requirements, manage Jacobs Engineering effort to assure timeliness of final deliverable, validate all scope changes	
R-1.9-014	**Delta Between Jacobs Engineering and WDWC Cost Estimates**	1/5/2005	David Saenz	1/5/2005	David Saenz	IF the WDWC report cost estimate is correct	THEN the CF budget will need to be readjusted to increase by ~ $7M	Construction	**2%**		**> $5m**		**0**	**0**	**0**	Continually review and validate the cost etimage against local contractor conditions.	Mitigate	Increased contingency assessment for the RY-CLOC construction Phase. Will RE-evaluate the estimated constrcutino cost at the o 30% and 60% T2 phase with JE as well as the CM/GC	