LCLS Risk Registry
September 2006

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1.1	**Management**									
R1.1-001	Change and Earned-Value Management Control Processes	5/52004	Mark Reichanadter	10/2/2006	Mark Reichanadter	If a baseline change control and earned-value management processes are not effective,	Then changes and earned-value could be reported incorrectly.	Design, Construction	1. Upload to LCLS Website all BCR's and CPR's (T. Mast) 2. Document minutes from monthly cost/schedule meetings with action items (M. Reichanadter, D. Schultz, J. Arthur, J. Albino) 3. Finalize Earned-Value Management Corrective Action Plan (M. Reichanadter) 4. Develop an understanding/process for possible civil construction claims settled late in the project (J. Albino)	
R1.1-002	Lack of documented Cost Estimate	5/52004	Mark Reichanadter	10/2/2006	Mark Reichanadter	IF project costs are not properly documented, and supported with accurate backup information	THEN the real costs of the scope of work is unknown, and the project may carry cost risks that cannot be covered by the estimated cost contingency.	Design, Construction	1. Update each L2 cost estimate (ETC) annually (POC: M. Reichanadter) 2. Each L2 system will document cost estimate in their Basis of Estimate (M. Reichanadter, D. Schultz, J. Arthur, J. Albino)	
R-1.1-003	Lack of well-understood project schedule	5/52004	Mark Reichanadter	10/2/2006	Mark Reichanadter	If the project schedule is inaccurate due to incomplete planning or logic errors/omissions,	Then the integrated project schedule may be inaccurate.	Design, Construction, Commissioning	1 Update project critical path and near critical paths each month (T. Mast) 2. Present Level 4 milestones in weekly management meeting (T. Mast)	
R1.1-008	LCLS Timing System	5/9/2004	Hamid Shoaee	10/10/2006	Hamid Shoaee	If there is a delay in implementation or technical deficiency in the following: • PNET receiver for EPICS • Master Pattern Generator for EPICS • Event Receiver for EPICS • Timing Distribution network	THEN, the existing SLC control system and the new LCLS controls will not be integrated, preventing operation of the LCLS from the MCC and rendering useless many essential SLC controls and many new LCLS devices such as the BPMs.	Construction, Commissioning	Timing system Design Review 11-15-2006	
R-1.1-009	Serious Accident on the SLAC Site	1/3/2005	Mark Reichanadter	10/2/2006	Mark Reichanadter	IF there is a serious accident on the SLAC site by SLAC employee, contractor or visitor	Then a work stoppage of all LCLS activities regardless of the accident cause or effect could occur. This is a low probability, high consequence risk.	Design, construction, commissioning, pre-operations	1. Weekly inspections of construction site (J. Galayda, M. Reichanadter, M. Scharfenstein, R. Hislop) 2. Perform and document Safe Observation Process (All, monitored by M. Scharfenstein) 3. Weekly safety minutes in OAC meeting and LCLS Mgmt meeting (M. Scharfenstein)	
R-1.1-011	Equipment Storage and Staging Area	1/3/2005	Mark Reichanadter	3/17/2006	Richard M. Boyce	IF the 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, pre-operations	detailed space planning memo that will allocate the necessary space for equipment staging by February 2006. Areas identified for LCLS to date are: B026 for magnets and equipment; B750 (104) for Undulator assy & storage by Dec '06; B750 (106) for X-ray/Far Hall hardware staging by Jan '07; storage trailers identified at MFD hub for LCLS fabricated parts. Asst. Manager for Undulator has been hired at SLAC and will coordinate the flow of materials for undulator installation.	
R-1.1-013	Lack of formally approved specifications (PRD's, ESD's, ICD's)	4/18/2005	Mark Reichanadter	10/2/2006	Mark Reichanadter	IF the LCLS specifications are not well-defined and documented in a formal manner	THEN there is a potential for loss of project coordination/communication and a risk to the schedule and technical quality of the LCLS project.	PED, LLP, Construction	1. Document and present once per month # of PRD's/ESD's/ICD's/system. How many approved/week/month? Plot trends. (Darren Marsh)	
R-1.1-015	Linac Reliability	6/3/2005	Dave Schultz	3/2/2006	Dave Schultz	If the reliability of the Linear accelerator is not high	Then the experimental beam time will be impacted.	Operations	1) Estimate availability of existing SLAC magnet power supply systems. (July 2005) 2) Investigate availability options for magnet power supply systems. (Dec 2005) 3) Develop a availability budget for all Linac systems to identify and understand problem areas. (Mar 2006) 4) Develop plans to improve availability of identified critical areas. (May 2006)	
R-1.1-016	LCLS MPS System	6/6/2005	Patrick Krejcik	10/10/2006	Hamid Shoaee	If the Machine Protection System fails to respond and shut of the beam within one machine pulse of detecting a critical component failure or a beam loss	Then the sensitive components of the machine, in particular the undulator, will be put at considerable risk of being permanently damaged and will require replacement.	Design, Construction, Commissioning, Pre-Operations	MPS Design Review 11-09-2006	

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R1.1-018	Tracking Project Personnel	10/2/2006	Mark Reichanadter	10/2/2006	Mark Reichanadter	If the project cannot track actual FTE's against budgeted FTE's	Then there is the potential for budget overruns	Design, Construction, Commissioning	LCLS PMCS group to develop a spreadsheet comparing FTE's budgeted to FTE's worked (T. Mast, M. Abela)	
R1.1-019	Endgame Planning	10/2/2006	Mark Reichanadter	10/2/2006	Paul Emma	The project does not have a clear understanding of requirements for the end of commissioning	Then there is the potential for budget overruns as staff stay on the project into the operations phase	Commissioning	1. Establish physics commissioning goals for Injector, Linac, Undulator, FEL (P. Emma)	
R1.1-020	Contingency Analysis	10/2/2006	Mark Reichanadter	10/2/2006	Mark Reichanadter	The project does not have a clear understanding of its contingency requirements for the remainder of the project	Then there is the potential for committing to too much (or not enough) scope.	Desig, Construction	1. Do a semi-annual bottoms-up risk-based contingency analysis on remaining work (T. Mast) 2. Perform a Monte-Carlo assessment annually to validate the bottoms-up contingency analysis (T. Mast).	
R1.1-021	Control Account Mischarges leading to Variances	10/2/2006	Mark Reichanadter	10/2/2006	Mark Reichanadter	The project does not have well-documented process to ensure that costs are charged against the correct budgets	Then there is the potential for mischarges which lead to erroneous variances.	Desig, Construction, commissioning	1. Establish procedures to charge/purchase spares for the LCLS (M. Chang). 2. Establish procedures to correct mischages after the fact to avoid false variances (M. Chang).	
R1.1-022	Installation Schedule	10/19/2006	R.M. Boyce	10/19/2006	Mark Reichanadter	If the major installation period beginning November 2007, is not well-doumented and integrated throughout the project	Then there is a risk of not meeting the start of commissioning milestones	Construction, Installation	1. Establish high level management meetings to review installation schedule and milestones 2. Determine scheduling and reporting methods to be used for downtime 3. Integrate LCLS installation planning with other SLAC Operating programs to lessen impacts 4. Establish planning meetings to develop and integrate installation & checkout tasks at systems levels 5. Create, distribute and review the installation schedule to ensure total project wide agreement	
1.2	**Injector System**									
R-1.2-001	Laser Beam Temporal Shaping	5/4/2004	S. Gilevich	10/10/2006	Eric Bong	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 sh	commissioning	•Continue working with Thales on their scheme to produce flat-top profile that meets specifications. (Schedule October through January 2007). •When the gun is ready for UV, supply flat-top pulses or stacked pulses. (Schedule Early 2007) NOTE: Design and hardware for stacking is complete and in hand.	
R-1.2-006	RF Gun at 120 hertz	5/7/2004	Richard F. Boyce	5/9/2006	Eric Bong	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	• Design gun. (Schedule for steps: June thru December 2006) • Fabricate gun. (January thru June 2006) • Test gun (August 2006) NOTE: PDR complete; FDR complete; design complete and fabrication in progress	
R-1.2-012	Laser Beam Spatial Shaping	3/8/2005	Sasha Gilevich	4/12/2006	Sasha Gilevich	IF we are unable to produce and preserve the UV laser pulse round flattop spatial shape (set by the reshape) during the transport of the beam to the cathode	THEN only small transverse fraction of the beam will have small enough emission to lase. And the tuning for emittance preservation will be very difficult.	Design, Construction	• Testing of the UV conversion process of the spatially shaped pulses (Schedule for steps: DONE) • Imaging of the spatially shaped UV pulses and optimization of the optical system (Schedule for steps: 90% complete as of 4-12-06)	
1.3	**Linac System**									
R-1.3-001	Linac RF Stability	5/6/2004	Eric Bong	4/12/2006	Eric Bong	If the RF stability physics requirements are not met,	Then 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, Pre-Operations	1. Model feedback - Done 2. Develop Bunch Length Monitor inhouse (Jan 2006 - October 2006) 3. Design pick-off downstream of BC1 and design BLM integration (March 2006-July 2006) 4. Fabricate BC1 pickoff & BLM integration (April 2006 - July 2006) 5. Install LLRF incorporate BLM feedback (December 2006 - July 2007)	
1.4	**Undulator System**									
R-1.4-012	Undulator Component Motion	12/1/2004	Josh Stein	3/16/2006	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.	Design	• Test motors for damage in SRing environment (Mar. 06) • Characterize the threshold for motor resistance (Apr. 06) • Plan on installation of "worst case" motor choice to minimize impact on replacing existing motors as necessary.	

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R1.4-025	Vacuum Chamber Development Schedule	3/8/2006	S. Milton	3/8/2006	S. Milton	IF the schedule for the vacuum chamber cannot be improved	Then the vacuum chambers will delay the assembly in the MMF and subsequently delay the turn on for the beam through the complete undulator system.	Design, Commissioning	• Query the engineers about needs (Mar. 2006) • Provide additional support people as needed to accelerate the schedule (Mar. 2006) • Finalize all testing require to go forward with the full length prototype (April 2006) • Build a full length prototype (July 2006) • Review risk again in detail (July 2006)	
R1.4-026	RF BPM Schedule	3/8/2006	S. Milton	3/8/2006	S. Milton	If the schedule for the rf bpms cannot be improved	Then the rf bpms will delay the assembly in the MMF and subsequently delay the turn on for the beam through the complete undulator system.	Design, Commissioining	• Query the engineers about needs (Mar. 2006) • Provide additional support people as needed to accelerate the schedule (Mar. 2006) • Get the RF BPM into the injector test stand as soon as possible (April 2006) • Review risk again in detail (May 2006)	
R1.4-029	Quadrupole Temperature Impacts	3/8/2006	S. Milton	3/8/2006	S, Milton	If the adjacent RF BPM is not shielded from the heat of the adjacent quadrupole	Then the RF BPM will detune and stop them from functioning correctly.	Design	• Study the impact on the RF BPM of an adjacent heat source (Apr. 2006) • Design a heat shield (May. 2006) • Build and test the effectiveness of the heat shield (June 2006) • Iterate if necessary until a suitable design is found (July 2006)	
R1.4-030	Beam Loss Monitor	3/8/2006	S. Milton	3-8-206	S. Milton	If we do not clearly define soon the entire beam loss monitor system	Then we run the risk of becoming later than we already are.	Design	• Get the engineer in charge to focus more on this project (Mar. 2006) • Insist on a complete design plan by end of April 2006 • Rework the schedule to reflect the work that is foreseen from the design plan (April 2006)	
r1.4-032	Beam Finder Wire Scanning Algorithm	3/8/2006	S. Milton	3/8/2006	S. Milton	If we do not have the capability to rapidly move and record the position of the beam finder wire in a manner useful for beam physics studies	Then we will need to make modifications to the existing cam mover strategy to allow for this request for beam physics capability	Design	• Get better specifications from the physicists as to what is an acceptable way to move the BFW for beam size determination (April 2006) • Determine if we can satisfy this motion with what we already have (April 2006) • Reassess this risk in May 2006	
1.5	**X-Ray, Transport, Optics & Diagnostics System**									
R-1 .5-001	Solid Attenuator Performance	5/8/2004	R. Bionta	1/2/2006	R. Bionta	IF solid 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	1) Design low-z solids - Solid attenuator has been designed to be made of Be 2) Develop high pressure / high z gas capabilities in gas attenuator - Ar at 60 Torr will subsitute for solids at 9 keV. We will test prototype operation at 60 Torr with Ar in summer 2006. There remains the concern about how we delever Ar to the attenuator in the FEE as 60% plan calls for only a single N2 line. 3) Locate solid attenuators in low pressure region of gas attenuator to avoid corrosion by N2 gas.	
R-1 .5-002	Gas Attenuator Performance	5/5/2004	R. Bionta	1/2/2006	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	1) Include low-z solid attenuators in the baseline 2) Construct and operate prototype in spring 2006	
R-1 .5-003	Imager noise and backgrounds	5/5/2004	R. Bionta	1/2/2006	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	1) Provide an indirect imager which can be withdrawn in a direction transverse to the beam to lessen Compton background. 2) Provide capability to run cameras at slower readout speeds. 3) Provide a gas ion chamber and total energy detector for alternative means of measuring beam intensity. 4) Locate detectors downstream of thick slit, muon shield, and attenuators. 5) Investigate electrical grounding in FEE.	
R-1.5-004	Small apertures may hinder commissioning	1/6/2005	Richard Bionta	1/6/2006	Richard Bionta	IF the small apertures located upstream of the Commissioning Diagnostics limit our view of the spontaneous radiation or reflections from the undulator vacuum chamber seriously distrots the spontaneous radiation pattern…	THEN, we will possible miss important information in the spontaneous beam that could aid in commissioning, and it may be difficult to convince ourselves that we are looking for the FEL in the correct place in the event that we do not see the FEL signal initially.	Commissioning	1) Simulations of spontaneous radiation patterns have been performed (LCLS note LCLS-TN-05-26.) 2) Stay-clear zone has been established ("X-Ray Stay-Clear Apertures from Undulator to FEE", LCLS PRD 1.3-016.) 3) This risk can be retired when the beam line is fully designed from the end-of-undulator to the FEE diagnostics package.	

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R-1 .5-005	Design Immaturity	1/6/2005	Richard Bionta	1/6/2005	Richard Bionta	IF, due to the relative design immaturity of the XTOD instrumentation, large changes in scope are necessary in order for instrumentation to meet requirements…	THEN, it will be difficult to meet the schedule and budget as specified in P3.	Design, Construction	1) Prioritize Instrumentation development schedule 2) Early front-end Design 3) Provide adequate contingency for immature designs	
R-1.5-006	Late changes to design due to evolving user requirements	1/6/2005	Richard Bionta	10/10/2006	John Arthur	If there are major changes in the scope, performance, existence or placement of XTOD instrumentation due to evolving user requirements…	Then, it will be difficult to meet the schedule and budget as specified in P3.	Design, Construction, Commissioning	1) Adhere to BCR process. 2) Maintain cost estimates and low-level R&D efforts on possible user instrumentation such as lenses, mirrors, and pulse length/synchronization schemes. 3) Provide adequate R&D as well as management resources to consider ramifications to Commissioning strategy, risks, and safety of proposed changes before initiating BCR process. 4) Develop computer beam and instrumentation tools to allow accurate assessment of proposed changes.	
R-1 .5-008	Solid attenuator corrosion from ionized nitrogen	5/10/2006	R. Bionta	10/10/2006	John Arthur	If the reaction of ionized nitrogen with Be to form Be3N2 occurs at a sufficiently high rate…	Then the solid attenuators and/or gas attenuator apertures will be sufficiently damaged to affect their performance or may create a safety hazard..	Commissioning, Operations	Consult with experts. Test coated and uncoated Be in plasma chamber. Prepare back-up plan using materials other than Be.	
R-1.5-009	Gas attenuator aperture corrosion from ionized nitrogen	5/10/2006	Richard Bionta	5/10/2006	Richard Bionta	If the reaction of ionized nitrogen with Be to form Be3N2 occurs at a sufficiently high rate…	Then the gas attenuator windows will be sufficiently damaged to affect their performance and may create a safety hazard..	Commissioning, Operations	Consult with experts. Prepare experimental plan. Test coated and uncoated Be in plasma chamber. Select a different window material.	
R-1.5-0010	No gas attenuator gas lines in current CF plans	5/10/2006	Richard Bionta	5/10/2006	Richard Bionta	If detailed plans for the gas attenuator gas lines are not included in the CV package ...	Then, it may be difficult to install a sufficiently clean and safe supply of gas to the attenuator resulting in delays in commisioning and inflexibility in choice of gas.	Design, Construction, Commissioning		
R-1 .5-0011	Scintillator saturation	5/10/2006	Richard Bionta	10/10/2006	John Arthur	IF the scintillators saturate at levels below the saturated FEL level ...	THEN, it will be difficult to measure FEL parameters with the direct imager.	Commissioning	1) Plan for the operation of direct imager with upstream attenuators. 2) Study data from TTF and elseware to better estimage the onset of scintillator saturation. 3) Perform experiments at TTF and other facilities to measure the onset of scintillator saturation.	
R-1.5-0012	Radiation Physics ok of offset mirror / collimator configuration	5/10/2006	Richard Bionta	5/10/2006	Richard Bionta	If there are major changes in the scope, performance, existence or placement of XTOD instrumentation after the project is baselined due to evolving user requirements…	Then, it will be difficult to meet the schedule and budget as specified in P3, and the Commissioning and risk mitigation strategies will be ineffective.	Design, Construction, Commissioning	1) Adhere to BCR process. 2) Place facility and Commissioning instrumentation upstream of potential users to allow Commissioning activities to proceed during installation of user instrumentation. 3) Delay design of user instrumentation. 4) Maintain cost estimates and low-level R&D efforts on possible user instrumentation such as lenses, mirrors, and	
R-1.5-013		10/10/2006	John Arthur	10/10/2006	IF there are major delays or difficulties with procuring x-ray mirrors that meet technical requirements	THEN mirror installation may be delayed and/or mirror cost may rise.			1) Develop mirror specs, begin discussions with vendors early. 2) Consider back-up plans such as ordering mirror spares, oredering spares from different vendors, etc. 3) Procure mirrors with sufficient schedule float to activate backup plan if necessary.	
R-1.5-014		10/10/2006	John Arthur	10/10/2006	IF it proves difficult to meet technical specs for mirror mounting	THEN the mirror mounting schedule and/or cost plans may be exceeded.			1) Develop mirror mount specs, begin engineering early. 2) Consider both procurement from outside vendors and internal fabrication. 3) Consider building small prototype to prove design. 4) Allow schedule for evaluation of prototype.	
1.6	**X-Ray Endstations System**									

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R-1.6-001	Laser Timing Failure	5/7/2004	J. Arthur	3/6/2006	S. Moeller	If the desired level of synchronization is not achieved	Then the precision of experiments and diagnostics will be compromised	Operations	1. Study recent results at SPPS (End of 06). 2. Continue to monitor progress at SPPS (06/07). 3. Assign appropriate resources (e.g., control and laser engineer) to focus on laser timing and identify risks related to LCLS (planned during FY07).	
R-1.6-006	2-D Detector Failure	5/7/2004	J. Arthur	3/11/2005	S. Moeller	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	1. R+D work starts early FY05 2. Review after 1st and 2nd year 3. Decision about continuation of program after 2nd year review (end of FY06) 4. In case R+D program is stopped: 5. Start with procurement of alternative detector (specifications will be determined earlier).	
R-1.6-008	Pricing fluctuations for procurement items	4/1/2005	S. Moeller	10/10/2006	John Arthur	IF the prices for procurement items or the exchange rate for foreign procurements increases rapidly in the next years	THEN the actual cost for procurements will be higher than our current cost estimates	Construction	Monitor prices of items that will be procured in the later years and especially from vendors that are the only suppliers of the items. Allow for sufficient contingency. Present changes to Project Office for possible BCRs. SCHEDULE FOR STEPS: Monitor prices beginning of FY06; For start of procurements at the end of FY06 thru mid of FY08.	
R-1.6-009	Scope uncertainties due to evolving requirements early in the design phase of the Atomic Physics Instrument	3/16/2006	S. Moeller	10/10/2006	John Arthur	IF there are major scope changes for the atomic physics instrument	THEN the actual cost for this instrument may be higher than our current cost estimates, and the schedule may be delayed.	Construction	1. Adhere to the BCR process. 2. Notify Project Office early via a preliminary BCR for any changes	
1.9	**Conventional Facilities**									
R-1.9-004	Tunnel Schedule	5/7/2004	David Saenz	9/28/2006	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	1 - Increase working hours. 2 - Add additional equipment. 3 - Work multiple hedings	
R-1.9-008	Seismic activity during construction	5/7/2004	David Saenz	9/28/2006	David Saenz	If a moderate earthquake occurs during tunneling operations	Then a life/safety issue may cause possible accidents or schedule delays	Construction	1 - SLAC SSC review	
R-1.9-024	UH Tunnel Geology	8/9/2005	Dick McDonald	9/28/2006	David Saenz	IF insufficient ground cover at E. End UH tunnel for normal excavation	THEN, additional ground support will be installed to facilitate tunnel excavation	Construction	Install additional ground support as tunnel is excavated (Schedule for the steps: during excavation)	
R-1.9-025	Linac Legacy Issues	1/5/2005	Dick McDonald	9/28/2006	David Saenz	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	1. Specified utilities requirements provided to Conventional Facilities. 2. Generate plan to upgrade utilities to requirements. 3. Perform upgrades during 2006 shutdown	
R-1.9-028	In place Utility Protection	1/23/2006	Dick McDonald	9/28/2006	Bob Law	IF SLAC operational utilities are disrupted during construction	THEN, SLAC Operations will be impacted and construction schedule will be delayed for repairs and costs will increase	Construction	1 - Potholing 2 - Gound Penetrating radar 3 - Excavation permits	
R-1.9-031	Title III Services	2/24/2005	Dick McDonald	9/28/2006	David Saenz	If level of support is inadequate to support construction activities.	THEN project will encounter schedule delays and cost increases due to insufficient timley support.	Construction	1 - Negociate Title III services with Jacobs prior to mobilization to provide support. 2 - Monitor Support to ensure adequate for needs. 3 - On site support	
R-1.9-032	CF Staff Support	2/24/2005	Dick McDonald	9/28/2006	David Saenz	IF additional staff are not hired in a timley manner	THEN staff will not be suficient to support project needs.	Construction	Fill current opening with individual that has heavy civil exerience. Backfill as position becomes available with individual that has heavy civil experience.	
R-1.9-033	UTR Support	3/13/2006	Dick McDonald	3/13/2006	David Saenz	IF UTR staff are not available a timley manner	THEN UTR staff will not be suficient to support project needs.	Construction	Discuss with CEF and implement plan to insure needed support.	
R1-9-035	Constructed Facility doesn't meet requirements	6/12/2006	Dick McDonald	6/12/2006	David Saenz	IF Jacobs design doesn't meet science requirements	THEN facility will not operate as expected	Construction	THEN redesign and additional construction will be required	