EDM Project Risk Log (Major Item of Equipment)

Risk Analysis and Mitigation Form

Responsible Manager: Martin Cooper | Note: This is the DRAFT preliminary project consolidated risk log; some identification & analysis in progress.

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Risk Identification & Evaluation									Risk Disposition		
WBS Number	Subsystem Title	Work Pkg. Title	Risk Owner	Description of Risk	Likelihood of Occurrence	Impact: High Medium-Low	Overall Risk		Risk Approach	Mitigation Strategy (Required for High Level Risks)	Implement Date
1.0	**Project-Level**	N/A	Martin Cooper	Scope Creep - this is of particular concern to the EDM project, owing to the multiple number of key participants, who are also geographically dispersed throughout the US.	Likely	Medium	Medium		Control	The Project Office will employ formal change control at CD-1; MOU's will be executed with Universities that clearly define scope, schedule and cost baseline management expectations.	At CD-1
1.0	Project-Level	N/A	Martin Cooper	Project Technical, Schedule & Cost Integration - this is of particular concern to the EDM project, owing to the multiple number of key participants, who are also geographically dispersed throughout the US.	Very Likely	High	Medium		Control	Multiple part strategy: Pre CD-1, the Project Office convened a "Fast Start for Projects" integration planning workshop (industry best practice) with Subsystem Mgrs and key stakeholders; the Project Office has designated a formal integration manager; numerous Project Office mtgs. to integrate the design and to define a unified technical approach; Project Office will convene monthly mtgs to maintain integration; use of an overall project summary schedule with "horizontal integration" across all subsystems thru use of critical path, connecting logic and milestones. The Project Office also uses professional project controls staff and manages to the PPEP.	CD-0 thru CD-4
1.0	Project-Level	N/A	Martin Cooper	Cost Growth - this is of concern to the EDM project, owing to the multiple number of key participants/budgets, different internal costing rates, and who are also geographically dispersed throughout the US.	Unlikely	Medium	Medium		Control	Multiple part strategy: The Project Office designed a work package tool and requires its use by all participant organizations for the development of the cost baseline. This tool also uses the costing rates of the individual Universities. Costs and any variances are to be closely monitored (at least monthly) by the Project Office by comparing actuals to plan for each University. Cost contingency is "owned" by the Project manager and controlled thru formal change control. All funds and budget is controlled and allocated thru the Project Manager.	CD-0 thru CD-4
1.0	Project-Level	N/A	Martin Cooper	Research Results - certain EDM "downstream" activities are dependent on the findings and results of the research program. Reaching closure on research efforts are important to project progress. The risk is that research, relative to EDM design, must have an end point and not be open-ended.	Unlikely	Medium	Medium		Control	The Project Office has scheduled research to be be fully complete at CD-2a. In addition, Research and Development has been designated a WBS Level-1 element and is assigned to the EDM Project Manager, who also has responsibility for overall projject planning and execution. Research efforts are clearly defined in the scope and reserach "output milestones" will be linked in the schedule to those project activities that are dependent upon them.	CD-0 thru CD-2
1.0	Project-Level	N/A	Martin Cooper	Project Team/Organizational Cohesiveness - of concern to the EDM project, owing to the multiple number of key participants.	Unlikely	Medium	Low		Control	The PPEP provides that the EDM Project Manager at LANL direct the core project team. That team consists of Subsystem Managers (from Univerisites and ORNL) who are assigned to specific WBS Level 1 elements. Substem Managers designate Work Package managers. The Project Office will reinforce role responsibilities (defined in the PPEP) throughout the project thru mentoring and training.	CD-0 thru CD-4
1.0	Project-Level	N/A	Martin Cooper	Defining and employing the "right" amount of management, recognizing this is primarily a science project versus classical "brick and morter".	Unlikely	Low	Low		Avoid	Use of other Office of Science projects lessons learned and their project management processes. Use of professional project management advisors and graded approaches. Also, LANL initiative that requested an Internal Project Review.	CD-0 thru CD-4
1.0	Project-Level	N/A	Martin Cooper	Cost Risks: The neutron splitter-polarizer is a more than $1M item. Its procurement has been delayed to match the DOE funding profile. The change of the value of the dollar versus the euro presents a significant cost risk, and if the vendor will not accept prorated payments, the project cannot stay within the profile without significant project delay.	Likely	Low	Low		Control	Buy earlier rather than later.	
1.0	Project-Level	N/A	Martin Cooper	Cost Risks: The 4-layer conventional magnetic shield is a more than $1M item. Its procurement has been delayed to match the DOE funding profile. The unknown futures cost of nickel presents a significant cost risk, and if the vendor will not accept prorated payments, the project cannot stay within the profile without significant project delay.	Likely	Low	Low		Control	Buy earlier rather than later.	
1.0	Project-Level	N/A	Martin Cooper	Technical Risks: If any of the R&D projects fails to resolve technical issues, the project may not be able to meet its technical specifications with the consequence that the eventual goal of the project will be compromised.	Unlikely	High	Medium		Control	Keep as many options open as long as possible.	
1.0	Project-Level	N/A	Martin Cooper	Technical Risks: On construction of one of the individual subsystems, one of the subsystems cannot live within the allocated heat budget. If the failing is sever, the project might not reach its operating temperature.	Unlikely	Medium	Low		Control	Conceptual Design.	
1.0	Project-Level	N/A	Martin Cooper	Schedule Risk: The number of cool-downs needed to debug the cryogenic systems is misestimated. Each cool-down advances or delays the project by 6-8 weeks.	Likely	Medium	Medium		Control	Careful workmanship/QA.	
1.0	Project-Level	N/A	Martin Cooper	Schedule Risk: R&D program is incomplete at the end of 2007.	Very Likely	Medium	Medium		Control	Proper Project Office Oversight.	
1.1.2.1.4	**R&D**	3He Relaxation	Doug Beck	Unknown physics causes the relaxation time of the 3He on the materials of the experiment to be less than 500 seconds	Unlikely	High	Medium		Control	Perform R&D to understand the physics of the relaxation and eliminate poorly performing materials	10/15/2005
1.1.1.2.5	R&D	n-storage time	Martin Cooper	The neutron storage time is significantly less than 300 sec	Unlikely	Medium	Low		Control	Measure the storage time and change the wall material if necessary	10/15/2005
1.1.2.2.3	R&D	Light Collection	Takeyasu Ito	The number of photoelectrons from the measurement cells is less than 25	Unlikely	Medium	Low		Control	Study a variety of light extraction schemes to optimize the number of photoelectrons	4/1/2006
1.1.2.3.8	R&D	Valves	Steve Williamson	No adequately reliable valve design is developed	Unlikely	High	Medium		Control	Perform R&D to develop adequate valves	10/15/2006
1.1.2.4.4	R&D	Geormetric Phase	Bob Golub	The 3He geometric phase systematic is larger than expected	Unlikely	Medium	Low		Control	Perform R&D to understand the 3He geometric phase effect	3/1/2006
1.1.2.5.2	R&D	Magnet Uniformity	Brad Filippone	The requirements for magnetic field uniformity cannot be achieved	Unlikely	Medium	Low		Control	Construct prototype magnets to measure their uniformity. Modify the design if necessary.	1/1/2006
1.1.2.6.6	R&D	HV Breakdown	Josh Long	The HV potential that can be withstood by Lhe at 500 mk is <10 keV/cm	Likely	High	High		Control	Pressurize the LHe to see if that improves the dielectric strength. If this method does not work, accept lesser sensitivity to the measurement with quite bad consequences. The method adds considerable complexity to the experiment.	10/15/2005
1.1.2.7.4	R&D	He Purification	Takeyasu Ito	The evaporative purification scheme does not work	Likely	High	High		Control	Prototype the purifier and optimize the design. If no satisfactory design is achievable, return to the heat flush technique with great cryogenic complexity.	6/1/2006
1.1.2.8.6	R&D	SQUID Signal	Steve Lamoreaux	The SQUID signal to noise is too poor to be workable	Unlikely	High	Medium		Control	Measure the SQUID S/N. If unfixably bad, revert to the dressed spin technique.	10/1/2006
1.1.2.9.7	R&D	3He Injection	Haiyan Gao	Either the 3He will not dissolve into the 4He or the polarization is lost	Unlikely	High	Medium		Control	Measure the injection properties. If bad, redesign the injection system.	4/1/2007
1.1.2.10.2	R&D	Laser Fluorescence	Dan McKinsey	Laser fluorescence is not applicable to EDM	Likely	Low	Low		Control	Develop laser fluorescence for EDM. If unusable, abandon it.	10/1/2007
1.2.4.1	**Polarized Neutron Beam Line & Shielding**		W. Korsch/ Rick Allen	If problems with contractor installation of guide.	Unlikely	Medium	Low		Accept	This problem has never occurred; the Guide Manufacturer will install the guide.	Q1 2010
1.2.4.2	Polarized Neutron Beam Line & Shielding		W. Korsch/ Rick Allen	If problems with installation of magnets	Unlikely	Medium	Low		Accept	Magnets will be tested before final installation. Potential Pring fields will be shielded as may be needed.	Q1 2010
1.2.4.3	Polarized Neutron Beam Line & Shielding		W. Korsch/ Rick Allen	If problems with installation of spin flipper	Unlikely	Medium	Low		Accept	Some additional time might be needed.	Q1 2010
1.2.4.4	Polarized Neutron Beam Line & Shielding		W. Korsch/ Rick Allen	If problems with installation of shielding	Unlikely	Medium	Low		Accept	There should not be any problem with beamline shielding. Additional shielding will be installed as needed.	Q1 2010
1.2.4.5	Polarized Neutron Beam Line & Shielding		W. Korsch/ Rick Allen	If problems with subsystem and tests.	Unlikely	Low	Low		Transfer	This is the debugging and testing phase. Expect problems like wrong cabling, load contacts, etc. These issues will be addressed as needed.	Q1 2010
1.3.2.3.2	**Cryovessel, Refrigerators & Related Equipment**	Construction of the volume and dummy endcap for testing	D.G. Haase/R. Golub	If the large scale tank built from composite material should fail during the construction or initial testing, then the schedule would be delayed and there might be a need to use other materials.	Unlikely	Low	Low		Control	The design of the volume will be checked against experiences of others using these materials. The vendor will be selected carefully and monitored during the construction process. We will work on ways to test specimens of the materials at low temperatures.	At beginning of design process.
1.4.1.4	**3He Systems**		S.Williamson/ Steve Lamoreaux	*ABS Shutter (V7)* A detailed design of this item has not been produced. The cost is poorly determined. If it turns out that the shutter can not be at room temperature then the price will certainly go up	Unlikely	Medium	Low		Transfer	A final design will remove the cost uncertainty. If the cost is too high the collaboration could consider dropping this item from the experiment	
1.4.1.5	3He Systems		S.Williamson/ Steve Lamoreaux	*ABS Mechanical Support* The Mechanical support depends on the final design of the main cryostat which is unknown at the time of making this estimate	Unlikely	Medium	Low		Transfer	A final design will remove the cost uncertainty.	
1.4.2.2	3He Systems		S.Williamson/ Haiyan Gao	*ABS Interface Transport Tube/Bellows* Final design involves possibly conflicting requirements on materials (3He friendliness, thermal contraction, magnetic properties). If conventional materials can not be used, then more exotic materials and/or techniques may be required.	Likely	Medium	Medium		Avoid	1) Inovation in final design to overcome conflicting requirements 2) Compromise requirements to allow conventional materials and techniques to be used.	
1.4.2.3	3He Systems		S.Williamson/ Haiyan Gao	*ABS Interface Film Killer* If a conventional film burner is used, then the heat load to the Collection Volume may be excessive.	Likely	Low	Low		Transfer	Other techniques such as cesium coating, sharp edges, and reverse temperature gradient may overcome the heat-load issue with the film killer.	
1.4.2.4	3He Systems		S.Williamson/ Haiyan Gao	*ABS Interface Transport Coil* The ABS Interface Transport Coil must both re-direct the spins and reduce the magnetic field to the level inside the nEDM cryostat. The coil must be compatible with other constraints on the magnetic environment of the experiment (e.g. the field uniformity of the collection volume). If a single coil around the ABS Interface Transport Tube can not meet these demands, then additional magnetic shielding and coils may be needed	Likely	Low	Low		Transfer	A complete magnetic model of the experiment should determine whether a single coil can perform the required function.	
1.4.3.1	3He Systems		S.Williamson/ Haiyan Gao	*Prelim. Design Collection Apparatus* The collection of polarized 3He in purified 4He, and its maintenance without significant relaxation involves new techniques. If initial design concepts do not work out, then additional time will be required to develop alternatives	Likely	Medium	Medium		Accept	Additional time may be required to develop alternative designs	
1.4.3.2	3He Systems		S.Williamson/ Haiyan Gao	*Collection Volume* The volume will be made of pyrex using glass-blowing techniques. If the geometry of the volume proves difficult to produce, then time may be required to develop tooling and methods.	Likely	Low	Low		Accept	Spend additional resources to develop tooling and methods.	
1.4.3.3	3He Systems		S.Williamson/ Haiyan Gao	*Collection System Cesium Coating Apparatus* Techniques for in-situ coating (and re-coating) of the collection volume with cesium must be developed. If initial design concepts do not work out, then additional time will be required to develop alternatives	Likely	Medium	Medium		Accept	Additional time may be required to develop alternative designs	
1.4.3.4	3He Systems		S.Williamson/ Haiyan Gao	*Collection System Polarization Measurement Apparatus* The measurement of the polarization of the low density 3He may prove difficult. If initial design for the assumed SQUID-based NMR technique does not work out, then additional resources may be needed develop a new concep	Likely	Medium	Medium		Avoid	Ultimately this apparatus is not essential to the measurement since polarization is also measured in the measurement cell. The polarization measurement system could be dropped.	
1.4.3.7	3He Systems		S.Williamson/ Haiyan Gao	*Collection System Sensor Instrumentation* A manufacturer of an instrument for measurment of the level of LHe in the collection volume at 0.3K has not been identified. If there is no commercially available level sensor that would work, then R&D must be carried out to develop one.	Likely	Low	Low		Avoid	We could forgo the measurement of LHe level in the collection volume. Concievably, measurement of temperature and pressure will be sufficient.	
1.4.5.1	3He Systems		S.Williamson/ Michael Hayden	*Prelim. Purifier Design* The purfication of 4He using the evaporation technique is untried. It will require R&D and may involve unanticipated design constraints. If initial design concepts do not work out, then additional time will be required to develop alternatives.	Likely	High	High		Accept	Additional time may be required to develop alternative designs.	
1.4.5.2	3He Systems		S.Williamson/ Michael Hayden	*Absorbtion Pumps* The greatest concern is excessive contamination by 4He of the absorbtion pump during purification. While examples of absobtion pump designs exist, if these do not prove adaptable to our needs, then addional design time will be required to develop an alternative.	Unlikely	Medium	Low		Accept	Additional time may be required to develop alternative designs.	
1.4.5.5	3He Systems		S.Williamson/ Michael Hayden	*Purifier Film Killers* A number of methods have been proposed to stop superfluid film flow in order to reduce contamination of the absorbtion pump. The choice of which method to pursue will require R&D and may involve unanticipated design issues. If initial design concepts do not work out, then additional time will be required to develop alternatives	Likely	Low	Low		Accept	Additional time may be required to develop alternative designs.	
1.4.5.6	3He Systems		S.Williamson/ Michael Hayden	*Purifier Film Killers* A number of methods have been proposed to measure or infer the purity of the pure product. The analysis by RGA of the exhaust gas from the absorbtion pump during regeneration is the method used for planning purposes. But if that method does not work out, then additional time will be required to develop alternatives.	Very Likely	Low	Medium		Avoid	We could forgo the independent measurement of purity in the purifier.	
1.4.5.10	3He Systems		S.Williamson/ Michael Hayden	*Purifier Sensor Instrumentation* A manufacturer of an instrument for measurement of the level of LHe in the purifier volumes at 0.3K has not been identified. If there is no commercially available level sensor that would work, then R&D must be carried out to develop one.	Likely	Low	Low		Avoid	We could forgo the measurement of LHe level in the purifier volumes. Concievably, measurement of temperature and pressure will be sufficient.	
1.4.6.1	3He Systems		S.Williamson/ Michael Hayden	*Prelim. Design Volume Displacement* The preliminary design must incorporate the volume displacement mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model, then the time required to finish this preliminary design could grow.	Unlikely	Low	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.6.3	3He Systems		S.Williamson/ Michael Hayden	*Volume Displacement Actuator* The concept for the actuator is a "heliomatic" system similar to what is contemplated for the vlaves. If that initial design concept does not work out, then additional time will be required to develop an alternative	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.8.1	3He Systems	Pressurizer	S.Williamson	*Prelim. Design Pressurizer* The preliminary design must incorporate the pressurizer mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model, then the time required to finish this preliminary design could grow.	Unlikely	Medium	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.8.2	3He Systems	Pressurizer	S.Williamson	*Pressurizer Bellows* The pressurizer bellows must be 3He friendly and remain ductile at 0.3K. Most conventional bellows materials will not meet these requirements. If an adequate bellows is not commercially available, then one must be fabricated possibly using new techniques and tooling and exotic materials	Very Likely	High	High		Accept	Devote additional resources required to fabricate pressurizer bellows.	
1.4.8.3	3He Systems	Pressurizer	S.Williamson	*Pressurizer Actuator* The concept for the actuator is a "heliomatic" system similar to what is contemplated for the vlaves. If that initial design concept does not work out, then additional time will be required to develop an alternative	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.1.1	3He Systems	Valves	S.Williamson/ Douglas Beck	*Prelim. Design Cell Isolation (V1) Valve Actuator and Interface* The preliminary design must incorporate the valve into the design of the insert and upper cryostat. If unanticipated problems arise in assembling the 3D model for the insert, then the time required to finish this preliminary design could grow.	Likely	Medium	Medium		Accept	Devote additional resources to solving problems which arise during the construction of the insert and upper cryostat 3D model.	
1.4.10.1.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Cell Isolation (V1) Valve Interface to body/stem* This interface must provide the double action required to seal the cell and provide a uniform ground plane. If that initial design concept does not work out, then additional time will be required to develop an alternative	Likely	Medium	Medium		Accept	Additional time may be required to develop an alternative design.	
1.4.10.1.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Cell Isolation (V1) Valve Actuators* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	High	High		Accept	Additional time may be required to develop an alternative design.	
1.4.10.2.1	3He Systems	Valves	S.Williamson/ Douglas Beck	*Prelim. Design Pressurizer Isolation (V2) Valve* The preliminary design must incorporate the valve mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model then the time required to finish this preliminary design could grow	Unlikely	Medium	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.10.2.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Pressurizer Isolation (V2) Valve Body and Seat* This valve must make a reasonable seal with materials that are helium friendly. If simple solutions are not adequate, then more complicated, exotic, and expensive solutions may be needed	Likely	Low	Low		Avoid	It may be possible to eliminate this valve if the pressurizer volume is not too large. R&D may provide alternative materials and techniques. It is possible that this valve could be replaced by a superleak.	
1.4.10.2.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Pressurizer Isolation (V2) Valve Actuator* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.3.1	3He Systems	Valves	S.Williamson/ Douglas Beck	*Prelim. Design Pressurizer Standoff (V3) Valve* The preliminary design must incorporate the valve mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model then the time required to finish this preliminary design could grow	Likely	Low	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.10.3.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Pressurizer Standoff (V3) Valve Body and Seat* This valve must remain superfluid LHe tight with a pressure differential of 1 atm while being constructed of materials that are helium friendly. If simple solutions are not adequate, then more complicated, exotic, and expensive solutions may be needed.	Very Likely	Medium	High		Accept	Additional time may be required to develop an alternative design.	
1.4.10.3.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Pressurizer Standoff (V3) Valve Actuator* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.4.1	3He Systems	Valves	S.Williamson/ Douglas Beck	*Prelim. Design Collection Isolation (V4) Valve* The preliminary design must incorporate the valve mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model then the time required to finish this preliminary design could grow	Unlikely	Low	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.10.4.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Collection Isolation (V4) Valve Body and Seat* This valve must make a reasonable seal with materials that are helium friendly. If simple solutions are not adequate, then more complicated, exotic, and expensive solutions may be needed.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.4.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Collection Isolation (V4) Valve Actuator* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.5.1	3He Systems	Valves	S.Williamson/ Douglas Beck	*Prelim. Design Purifier Control (V5) Valve* The preliminary design must incorporate the valve mechanism into the intricate upper cryostat 3D model. If unanticipated problems arise in assembling that model then the time required to finish this preliminary design could grow	Unlikely	Low	Low		Accept	Devote additional resources to solving problems which arise during the construction of the upper cryostat 3D model.	
1.4.10.5.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Purifier Control (V5) Valve Body and Seat* This valve must make a reasonable seal with materials that are helium friendly. If simple solutions are not adequate, then more complicated, exotic, and expensive solutions may be needed.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.5.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Purifier Control (V5) Valve Actuator* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.6.2	3He Systems	Valves	S.Williamson/ Douglas Beck	*Purifier isolation (V6) Valve Body and Seat* This valve must make a reasonable seal at 0.3K. If simple solutions are not adequate, then more complicated, exotic, and expensive solutions may be needed.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.10.6.3	3He Systems	Valves	S.Williamson/ Douglas Beck	*Purifier isolation (V6) Valve Actuator* The concept for the actuator involves a pneumatic system with helium as the working fluid for the transmission of force from 300K to 4K. If that initial design concept does not work out, then additional time will be required to develop an alternative.	Likely	Low	Low		Accept	Additional time may be required to develop an alternative design.	
1.4.11.1.2	3He Systems	Interconnect Plumbing	S.Williamson/ Jen-Chieh Peng	*Volume Displacement Transport Tube* The details of the interconnect network are not firm. If changes are made, then design time and manufacturing cost may increase	Very Likely	Low	Medium		Accept	Devote additional resources to re-design and increased manufacturing costs if interconnection model changes.	
1.4.11.2.2	3He Systems	Interconnect Plumbing	S.Williamson/ Jen-Chieh Peng	*Collection/Purifier Interconnect Transport Tube* The details of the interconnect network are not firm. Furthermore, the material and design for connections have yet to be worked out. If exotic materials are required or if connections are more complicated than expected, then design and manufacturing cost will increase	Very Likely	Low	Medium		Accept	Devote additional resources to the design effort and construction as needed.	
1.4.11.2.3	3He Systems	Interconnect Plumbing	S.Williamson/ Jen-Chieh Peng	*Collection/Purifier Interconnect Transport Coils* The details of the interconnect network are not firm. The coil design is extremely sensitive to these details. If the design and manufacturing is more complicated than estimated then costs will increase	Very Likely	Low	Medium		Accept	Devote additional resources to the design effort and construction as needed.	
1.4.11.3.2	3He Systems	Interconnect Plumbing	S.Williamson/ Jen-Chieh Peng	*Pressurizer/Cell Interconnect Transport Tube* The details of the interconnect network are not firm. Furthermore, the material and design for connections have yet to be worked out. If exotic materials are required or if connections are more complicated than expected, then design and manufacturing cost will increase	Very Likely	Low	Medium		Accept	Devote additional resources to the design effort and construction as needed.	
1.4.11.3.3	3He Systems	Interconnect Plumbing	S.Williamson/ Jen-Chieh Peng	*Pressurizer/Cell Interconnect Transport Coils* The details of the interconnect network are not firm. The coil design is extremely sensitive to these details. If the design and manufacturing is more complicated than estimated then costs will increase	Very Likely	Low	Medium		Accept	Devote additional resources to the design effort and construction as needed.	
1.4.12.3	3He Systems	3He (Full Subsystem) Test	S.Williamson	*He3S Test Cell Polarization Measurement Apparatus* The measurement of the polarization of the low density 3He may prove difficult. If initial design for the assumed SQUID-based NMR technique does not work out, then additional resources may be needed develop a new concep	Likely	Low	Low		Accept	One of the key specifications that must be confirmed by this test is the final cell polarization. If initially the SQUID NMR technique does not work out, then additional resources must be devoted to fixing problems or finding another method.	
1.5.1.5	**Magnets & Magnetic Shielding**	Prelim. Design of Conventional Shield	Brad Filippone	If the world commodity prices of nickel-based alloys, molybdenum, and other metals used in the production of mu-metal continue to rise dramatically, then the cost of the four-layer conventional shield will scale accordingly.	Likely	High	High		Accept	The contingency for this task is needed because of recent large fluctuations/increases in the costs for materials used in the production of mu-metal. The final cost for the shield will not be known until the PO is placed with the vendor. The design of the four-layer conventional shield cannot be compromised and will not be modified in response to large increases in production material costs.	
1.5.3.4	Magnets & Magnetic Shielding	Constant Field Coil Ferromagnetic Shield	Brad Filippone	If the world commodity prices of nickel-based alloys, molybdenum, and other metals used in the production of mu-metal continue to rise dramatically, then the cost of the four-layer conventional shield will scale accordingly.	Likely	High	High		Accept	The contingency for this task is needed because of recent large fluctuations/increases in the costs for materials used in the production of mu-metal. The final cost for the shield will not be known until the PO is placed with the vendor. The design of the four-layer conventional shield cannot be compromised and will not be modified in response to large increases in production material costs.	
1.5.8.4	Magnets & Magnetic Shielding	3He Spin-holding Coil Ferromagnetic Shield	Brad Filippone	If the world commodity prices of nickel-based alloys, molybdenum, and other metals used in the production of mu-metal continue to rise dramatically, then the cost of the four-layer conventional shield will scale accordingly.	Likely	High	High		Accept	The contingency for this task is needed because of recent large fluctuations/increases in the costs for materials used in the production of mu-metal. The final cost for the shield will not be known until the PO is placed with the vendor. The design of the four-layer conventional shield cannot be compromised and will not be modified in response to large increases in production material costs.	
1.6.3.1	**Central Detector Systems**	P-design HV monitor	Ito	If lase-port windows indtroduce excessive spurious ellipticity into the light beam, then it could be ncessary to alter te HV monitor design to eliminate these spurious signals.	Likely	Low	Low		Accept	Alter the design of the Kerr HV monitor. Review cost and schedule changes	At beginning of design process.
1.6.3.2	Central Detector Systems	F-design HV monitor	Ito	If it is technically impossible to install windows and a clear light path inside the EDM measurement cells, then it could be necessary to alter the HV monitor design so that it is placed in a technically feasible location, such as the HV capacitor.	Unlikely	Medium	Low		Accept	Alterh the design of the Kerr HV minitor. Review cost and schedule	
1.6.6.1.5	Central Detector Systems	Procure optics	Ito	If it turns out that the assumed design does not work or is not the optimum, we will need to alter the design and that will change the schedule and cost	Likely	Medium	Medium		Control	Control the risk by performing appropreate R&D and prototyping. Then accept the risk	
1.6.6.2.4	Central Detector Systems	Procure cryogenic feedthroughs	Ito	the uncertainty associated with what is needed is dominating the contingency	Likely	Low	Low		Control	As we continue to refine the design of the experiment, the uncertainty will be reduced.	
1.6.7.3	Central Detector Systems	Procure insert end cap	Ito	the detailed design of this item depends on design of other things	Likely	Medium	Medium		Control	As we continue to refine the design of the experiment, the uncertainty will be reduced.	
1.6.8.1	Central Detector Systems	P-design V1 valve	Ito	there is a large uncertainty in the design of the item	Very Likely	Low	Low		Accept	Alter the design as needed	
1.6.8.3	Central Detector Systems	F-design V1 valve	Ito	there is a large uncertainty in the design of the item	Very Likely	Low	Low		Accept	Alther the design as needed	
1.6.8.4	Central Detector Systems	Procure V1 valve	Ito	there is a large uncertainty in the design of the item	Very Likely	Medium	Medium		Control	As we continue to refine the design of the experiment, the uncertainty will be reduced.	
1.6.8.5	Central Detector Systems	Install V1 valve	Ito	there is a large uncertainty in the design of the item	Very Likely	Low	Low		Control	As we continue to refine the design of the experiment, the uncertainty will be reduced.	
1.6.11.1	Central Detector Systems	Light system warm test	Ito	This acticity is a warm test of the light system. There is a change that the system does not work	Unlikely	High	Medium		Control	Control the risk by performing appropreate R&D and prototyping. Then accept the risk	
1.6.11.7	Central Detector Systems	test entire CDS	Ito	this is a test of the entire subsystem. Therefore there is a large uncertainty in estimating how long and what it will take. For example, depending on what does not work , we may have to cool down many more times.	Very Likely	High	High		Control	Control the risk by performing appropreate R&D and prototyping. Then accept the risk	
1.6	Central Detector Systems	WBS 1.6 Dependency on R&D Outcomes	Ito	The overall subsystem is considered high risk at this point in time (CD-1) due largely to the high dependency on the outcomes of the EDM R&D program, and the associated uncertainty.	Likely	High	High		Control	R&D is scheduled to finish within 18 months, prior to CD-2. During this period, specific technical solutions will be developed and/or verified through the R&D program that will be incorporated into the proposed final design of the central detector system.	CD1 thru CD2
1.7.1.2	**Electronics, Simulations, Computers & Data Analysis**	Subsystem Controls	Chris Gould	Most VME hardware comes from Euoropean manufacturers, so costs are subject to changes in the dollar-euro exchange rate	Likely	Low	Low		Transfer		At beginning of design process.
1.7.2.2	Electronics, Simulations, Computers & Data Analysis	Data acquisition system	Chris Gould	if light output from cells is too low (significantly less than 10 pe's per primary event), particle ID based on after pulsing will likely not be possible.	Unlikely	High	Medium		Avoid	As of this moment, there is uncertainty in the technical approac	At beginning of design process.
1.7.2.3.4	Electronics, Simulations, Computers & Data Analysis	Testing of cosmic ray suppression system	Chris Gould	neutron and gamma ray induced backgrounds due to cosmic rays and other surrounding radiation sources may be higher than expected.	Unlikely	Medium	Low		Control	A plastic paddle cosmic ray suppression system can be implemented retroactively if needed; it is not included in the initial project scope.	At integration & commissioning step
1.8.2	**Infrastructure**	Electrical Plant	W. Sondheim	Design and install the electrical services for the EDM experiment at the SNS	Likely	Low	Low		Control	Requre feedback from sub-sytems prior to layout. Possible cost control problem with electricians as will be negotiated through the SNS.	Q2, 2010
1.8.3	Infrastructure	Plumbing	W. Sondheim	Design and install the plumbing services required by the EDM experiment in the SNS exeperimental hall, including power, grounding, communication and signals	Likely	Low	Low		Control	All information on the plumbing requirements will be needed prior to initial layout. Negotiations with the SNS for plumbers - either SNS craft or outside will be the source of variable costs.	Q4, 2010
1.8.4	Infrastructure	Mechanical Supports	W. Sondheim	Design and fabricate the necessary mechanical structures needed to support the experiment, as well as the structures that allow for the assembly and maintainance	Likely	Low	Low		Control	This will have the longest engineering time associated with it because information will be coming as other sub-system components start to be assembled. This could add delays or engineering changes.	Q1, 2010
1.8.5	Infrastructure	Counting House	W. Sondheim	Design the counting house to meet the expected needs, consult with a vendor to design a stan alone pre-fab structure that may be supported off the floor	Unlikely	Low	Low		Control	Once a general size has been decided on, negotiations will begin with an outside vendor who has demonstrated the capability needed. GE Modular is such a vendor. They also have the capability of providing the support structure needed. Variable costs associated with rigging in the hall	Q3, 2010
1.9.1	**Assembly and Commissioning**	Coil Package Assembly/Commissioning at NCSU	D. Haase, B. Fillipone	This task primarily involves debugging a system, which is always difficult to estimate. The consequences of an error are significant because each cooldown, test and warm up cycle is estimated to take 6-8 weeks. The risk is that the cycle time may be even longer, or more cycles than expected will be required. Since the bulk of the labor is off project this is primarily a schedule risk.	Likely	Medium	Medium		Control	Care will be taken in the cryogenic design to reduce the cycle time. Subsystems to be assembled into the cryovessel will be first required to undergo stringent tests. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.9.2	Assembly and Commissioning	Insert Assembly/Commissioning at NCSU	D. Haase, T. Ito	This task primarily involves debugging a system, which is always difficult to estimate. The consequences of an error are significant because each cooldown, test and warm up cycle is estimated to take 6-8 weeks. The risk is that the cycle time may be even longer, or more cycles than expected will be required. Since the bulk of the labor is off project this is primarily a schedule risk.	Likely	Medium	Medium		Control	Care will be taken in the cryogenic design to reduce the cycle time. Subsystems to be assembled into the cryovessel will be first required to undergo stringent tests. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.9.3	Assembly and Commissioning	3He Component Assembly/Commissioning at NCSU	D. Haase, S. Williamson	This task primarily involves debugging a system, which is always difficult to estimate. The consequences of an error are significant because each cooldown, test and warm up cycle is estimated to take 6-8 weeks. The risk is that the cycle time may be even longer, or more cycles than expected will be required. Since the bulk of the labor is off project this is primarily a schedule risk.	Likely	Medium	Medium		Control	Care will be taken in the cryogenic design to reduce the cycle time. Subsystems to be assembled into the cryovessel will be first required to undergo stringent tests. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.9.4	Assembly and Commissioning	Transfer Apparatus to the FNPB	P. Huffman	Equipment could be damaged en route.	Unlikely	High	Medium		Control	Care will be taken in the design of shipping containers. The equipment value will be communicated to the shipper. The government cannot self-insure and accidents are possible, so we are accepting some level of risk. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.9.4	Assembly and Commissioning	Transfer Apparatus to the FNPB	P. Huffman	Shipping prices could exceed expectations	Likely	Low	Medium		Control	More thorough cost estimates will be developed when the equipment-to-ship list is more completely developed. The total cost is relatively low, so even a rather gross underestimate will not strongly impact the bottom line.	When the equipment-to-ship list is more thoroughly developed.
1.9.5	Assembly and Commissioning	B-shield Assembly/Commissioning at the FNPB	B. Fillipone	This task primarily involves debugging a system, which is always difficult to estimate. The consequences of an error are significant because each cooldown, test and warm up cycle is estimated to take 6-8 weeks. The risk is that the cycle time may be even longer, or more cycles than expected will be required. Since the bulk of the labor is off project this is primarily a schedule risk.	Likely	Medium	Medium		Control	Care will be taken in the cryogenic design to reduce the cycle time. Subsystems to be assembled into the cryovessel will be first required to undergo stringent tests. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.9.6	Assembly and Commissioning	Cryostat Assembly/Commissioning at the FNPB	V. Cianciolo, D. Haase, B. Fillipone, T. Ito, S. Williamson, P. Huffman, C. Gould	This task primarily involves debugging a system, which is always difficult to estimate. The consequences of an error are significant because each cooldown, test and warm up cycle is estimated to take 6-8 weeks. The risk is that the cycle time may be even longer, or more cycles than expected will be required. Since the bulk of the labor is off project this is primarily a schedule risk.	Likely	Medium	Medium		Control	Care will be taken in the cryogenic design to reduce the cycle time. Subsystems to be assembled into the cryovessel will be first required to undergo stringent tests. Design optimizations will take place during the design phase of the project. Acceptance criteria will be defined prior to acceptance of subsystems at the cryovessel assembly site.	Design Phase
1.10	**Project Mgmt.**	N/A	J. Tapia	The potential risk is associated with the multiple collaborators to the project. IF the schedule is not adeqaultely integrated, THEN difficulty in tracking variances could result.	Likely	Medium	Medium		Control	The Project Office will compile & maintain the overall project schedule; schedule planning at the subsystem level will be to a level of detail sufficient to develop the schedule logic across the subsystems.	CD-1thru 3
1.10	Project Mgmt.	N/A	J. Tapia	The potential risk involves the reality of having to work with multiple accounting systems at the major participants home campuses. In particular, the collection of actual costs on a timely basis. IF costs are not collected monthly and accurately, THEN false variances result and the liklihood of cost increases results.	Likely	High	High		Control	Special measures are required to control this situation. The Project Office will work with each University to understand its accounting system and to implement a monthly cost reporrting approach. This may necessitate the submittal of a monthly cost accrual by a University(s).	CD-1thru 4
1.10	Project Mgmt.	N/A	J. Tapia	The potential risk is associated with how to distribute funds to participating organizations without the Project manager losing control of the budget.	Likely	Medium	Medium		Control	The Project Manager will authorize the expenditure of funds through a formal work authorization system.	CD-1thru 4
Total Schedule and Budget Exposure:											