WBS	WBS Name	WBS Definition	WBS Leve
	SoLID Project	SoLID base equipment, including a solenoidal magnet, , EM calorimeter (including showere, preshower and SPD), light gas cherenkov, heavy gas cherenkov, DAQ system (including	1
1	Engineering, Design & Procedures	Project engineering, design and procedures	2
1.1	EM Calorimeter (EM)	This section includes EM calorimeter (Shower and Preshower), and Scintillator Pad Detectors	3
1.1.1		Detailed design of shower, preshower, and SPD modules, with a focus on feasibility of	4
	Shower, Preshower and SPD modules	mounting onto the module frame and integrating into SoLID, rouning of WLS and clear	-
1.1.1.2		Design of Preshower and SPD module frames, including holding the preshower lead sheets	4
	Preshower and SPD module frame		
1.1.1.3	Shower module frames	Design of Shower (shashlyk) module frames	4
1.1.1.4	PMT base design	Design of all PMT and MAPMT bases with pre-amps, prototyping and testing	4
1.2	Light Gas Cherenkov (LGC)		3
.1.2.1	Adjustable Mirror System	The primary mirror set will rotate about an inner joint when changing experimental configurations to configure the optics for different target-z locations. This system needs to	4
1.1.2.2	Tank and plumbing	The overall tank design requires a closed gas-tight pressure vessel. The design of the pump- and-dump gas system and how it integrates with the larger vessel will be coverd in this	4
1.1.2.3	Support and mounting	The tank will need to support it's own weight as well as the weight of the individual components. The support structures will need to affix to the mount points on the backside	4
.1.3	Heavy Gas Cherenkov (HGC)	The design of HGC	3
1.1.3.1	Tank and front thin window	The thin window needs to be designed with the lesser of 90% yield or 50 Ultimate strength	4
		(Note: 50% Ult will govern for aluminum). The thin window needs to be tested to 2X operational (design) pressure to qualify design and material batch. The tank needs to be designed to a safety factor of 3 using engineering analysis. The tank	•
1.1.3.2	Magnetic Shielding and reflection cone	The design of magnetic shielding and reflection cone needs to reach the goal of shielding with	4
1.1.3.3	Gas System	The gas system design will follow the existing JLab experience with heavy gas systems to fill,	4
1.1.3.4	Sum Readout	The sum readout includes both a set of electronic board to read out photonsensor (MAPMT) signal and the mechanic support to make the readout assembly to be mounted in the magnetic shielding and reflection cone. The design of summing board will depend on	4
1.4	GEM		3
1.1.4.1	GEM Modules	a cathode foil.	4
1.1.4.1.1	GEM Module component design	the specification of SoLID tracking. The CAD design of GEM foils holding frames and overall assembly design of GEM modules	5
1.1.4.2	GEM Readout	Assembly design of the electronics for reading out the GEM detectors meeting the high rate operation requirements and radiation hardness needs specified in the SoLID CDR.	4
1.1.4.2.1	VMM electronics design		5
	VMM electronics design	readout boards to match the requirements of SoLID.	
1.1.4.5	GEM mechanical support	The desgin of the mechanical supports system for the SoLID GEM tracker consisting support w	4
1.1.4.5.1	GEM mechanical support wheels design	The engineering design of the mechanical support wheels to hold the GEM modules, and associated components such as electronics, cables and gas lines, inside the SoLID magnet.	5
1.1.4.6	Transport and travel	technical staff. The transport and travel costs include trips to CERN to work on the GEM components design.	4
1.1.4.7	Management	Overall management and supervision of the GEM module and electronics engineering design.	4
1.5	DAQ/Electronics/Controls design		3
.1.5.1	DAQ/Electronics design		4
1.1.5.1.1	FADC specification	Document for specifications of Flash ADCs for SoLID	5
1.1.5.1.2			5
	Crate and support module design	Specifications for electronics including crates, trigger module and CODA specific modules	
1.1.5.1.3	GEM Readout specification	Specifications for GEM readout electronics and algorithm for data reduction on SSP and VTP	5
1.1.5.1.4	FADC VXS readout design	Specifications and design of fast readout of FADC using the VXS backplane	5
1.1.5.1.5	Calorimeter trigger design	Design of ECAL clustering trigger with FADC	5
1.1.5.1.6	Cherenkov readout design	Design of Cerenkov readout with FADC	5
1.1.5.1.7	PVDIS trigger design	Design of PVDIS trigger : coincidence between ECAL and LGC	5
1.1.5.1.8	SIDIS trigger design	Design of SIDIS trigger : coincidence between electron and hadron trigger	5
1.5.2	Detector Power and Cabling		4
1.1.5.2.1	HV and LV Power supply specification	Specification of LV and HV supplies	5
1.1.5.2.2	HV and LV cable/patch design	Design for patch panel and cabling for HV and LV	5
1.1.5.2.3	Signal cable/patch design	Design for patch panel and cabling signals	5
1.5.3	Slow Controls		4
1.1.5.3.1	Slow Controls specification	Specifications of slow controls	5
.1.5.4	Electronics Shielding		4
1.1.5.4.1	Shielding design	Design of shielding bunker to hold DAQ and slow controls electronics in hall	5
1.6	Magnet	Design requirements for retrofitting the CLEO II solenoid magnet for the SoLID experiments	3
1.1.6.1	Magnet Steel	Design of new magnet steel pieces and modification of existing pieces for SoLID configuration	g
1.1.6.1.1	Yoke	Design and engineer modifications to existing yoke pieces.	5
1.1.6.1.2	Upstream Endcap	Design and engineer modifications to existing upstream coil collar and new adjustable	5
1.1.6.1.3	Downstream Endcap	Design and engineer new cylindrical shell and back plates to include drawing packages ready	5
1.1.6.1.4	Nose Extension	for procurement.	5
1.1.6.1.5	Downstream Coil Collar	Design new downstream coil collar	5
1.1.6.2	Support and Alignment	Design of magnet and endcap supports and motion system for endcap	4
1.1.6.2.1	Magnet Support and Vertical Alignment System	Design new magnet support & vertical alignment system	5
1.1.6.2.2			5
1.1.6.2.2 1.1.6.3	Endcap Support and Motion System	Design endcap support and motion system	
	Control	Integration of magnet controls with Hall A and accelerator control systems.	4
	Power Supply	Specify power supply for SoLID solenoid	4
	Cruggania	Integration of magnet cryo system with existing hall cryo infrastructure.	4
1.1.6.4	Cryogenic	Full magnet systems checkout after final assembly.	4
1.1.6.4 1.1.6.5		Full magnet systems checkout alter iniai assembly.	(management of the second s
1.1.6.4 1.1.6.5 1.1.6.6	Magnet Testing		3
1.1.6.4 1.1.6.5 1.1.6.6 1.7	Magnet Testing <u>Infrastructure and Support Structure</u>		3
1.1.6.4 1.1.6.5 1.1.6.6 1.7 1.1.7.1	Magnet Testing Infrastructure and Support Structure Detector Support	Design of detector support systems in the magnet and endcap to include installation of	4
1.1.6.4 1.1.6.5 1.1.6.6 .1.7 1.1.7.1 1.1.7.1.1	Magnet Testing Infrastructure and Support Structure Detector Support Magnet Detector Support	Design of detector support systems in the magnet and endcap to include installation of Design internal detector support system for magnet	4 5
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13.26JankJank product on proceed proces on declarations of the section of the	1.1.7.3.2	Endcap Personnel Access	Design personnel access system for endcap detectors	5
11.7.5.0. Initial Accordination Initial Construction of the Initial Construction of the Construction of	1.1.7.4	· ·		4
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11.7.2 Java the synthesis and explored pulsor is provide segmental colligation and according parameter and a semilar part of according parameter and according para and parameter and according parameter and parameter parameters and parameter parameters and parameter parameters and parameter paramater and paramater parameter and paramater parameter and paramet				
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12-1 Construction Pojes Construction, including wind to stating and commissioning. 2 12-1 Moderimeter fills) Dis Gover models action to the state of the state o	1.1.7.7	Layout	Design and engineering labor to provide experimental configuration data.	4
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12.1.1.7 Bee handing Cut and polish WLS fiber, insertion into the Shower module, and cots on efficient only the Site of President and Shower modules and cots on efficient only the Site of Site of President and Shower modules and cots on efficient only the Site of Site of President and Shower modules and cots and president modules and cots and president modules will appresent the Site of President and Shower and president modules will appresent the Site of President and Shower and president modules will appresent and president module initial testing 5 12.1.1.2 President and president and shower and president modules and shower modules will appresent and president and shower modules in the Site of President and Site President and Site of President and Site of President	1.2.1.1.5	stainless steel rods	Procure rods needed to assemble the shower modules, six rods per module	5
11.1.1.7 Box handling Cut and polish WLS There, insertion into the Shower module and cots on efficer and with 5 11.1.1.8 allower and prestower module same submiting To assemble parts into Prestower and due some assembled, but before 5 11.1.1.9 rhower and preshower module initial testing To assemble parts into Preshower and due some assembled, but before 5 11.1.1.0 rhower and preshower module initial testing To assemble parts into Preshower and due some assembled, but before 4 11.1.1.1 transporting to Liab. All modules needs a test functional test, a fraction of module sum and testing please are 4 11.1.1.1 transporting to Liab. All modules 7 11.1.1 transporting to Liab. All modules 7 11.1.1.2 transporting to Liab. All modules 7 11.1.1.2 transporting to Liab. All modules 7 11.1.1.2 transporting to Liab. All modules	1.2.1.1.6	assembling stands	Ten assembling stands needed to assemble and compress the Shower modules	5
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			array will consist of 9 Pivils arranged in a square, housed in an assembly that includes a	

1.2.2.3.1	Photosensors	Each photosensor array will need to cover a circular detection area with a radius of 7.5cm,	5	
	FILOLOSEIISOIS	defined by the optics of the detector and the focosing area of the reflective cone. A sensitive	5	
1.2.2.3.2	Photosensor Coating	The photosensors will be coated with the wave-length shifting chemical p-Terphyl to increase	5	
1.2.2.3.3	Summing Electronics	Many photosensors provide a multichannel pixel readout, but the trigger level electronics require one summed signal per photosensor. The summing electronics are designed at Jlab	5	
1 2 2 2 4	Mu Motal Shielding	PMT photosensors will require magnetic shielding to maintaining good efficiency. Each	5	
1.2.2.3.4	Mu-Metal Shielding	shield is a simple cylinder constructed of mu-metal that is designed to slide over a square	5	
		photosensor array of required detection size. Non-PMT photosensors may require less or no		
1.2.2.3.5	Reflective Cones	For reflections near the edges of mirrors, reflective cones are required to maintaining photon	5	
		collection efficiency. These cones are machined from aluminum and coated with reflective		
1.2.2.3.6	Array Assembly	The reflective film must be applied to the cones. The reflective cone, photosensors, magnetic	5	
		shielding and summing electronics must be assembled into a single unit which is the secured		
1.2.2.4	Transport, Travel, and Testing	Additional support for transport, travel, and testing is listed here.	4	
1.2.2.4.1	Transport	The tank will be assembled locally and specially shipped to Jefferson lab in an effort to	5	
1.2.2.4.2	Travel	Travel for prototyping, on-site testing, and various collaborative efforts with staff scientists	5	
1.2.2.4.3	Testing	Testing of procured and assembled components and materials to verify that construction is within design tolerances will be crucial at every stage of the total construction. Each and	5	
1.2.3	Heavy Gas Cherenkov (HGC)	The construction, testing and instillation of HGC	3	
1.2.3.1	Tank and front thin window	The tank with front thin windows encompasses all components of the detector and will be	4	
1.2.3.1		mounted from the outer radius to the rail system in the endcap. The tank has 30 identical	-	
		sectors and each sector includes a mirror, magnetic shielding and light collection cone, and		
		photosensor array. Every 3 sectors form a super sector with one front thin window and one		
		back window. Each supersector will be constructed separately. 5 super sectors will be		
1.2.3.2	Mirrors	mirrors to focus Cerenkov light onto photosensors	4	
1.2.3.2.1	Mirror Blanks	mirror blanks will use the same ones LGC uses.	5	
1.2.3.2.2	Mirror Coating	mirror coating will use the same coating LGC uses.	5	
1.2.3.2.3	Mirror Assembly	mirror assembly will be similar to how LGC mirrors assembly except HGC has only one mirror	5	
1.2.3.3	Magnetic Shielding and reflection cone	a combined structure to collect light and shield magnetic field around photosensor array	4	
1.2.3.3.1	Magnetic Shielding	shielding cone made with layers of low carbon iron and mu-metal	5	
1.2.3.3.2	Reflection cone	reflection layer such as coated reflective film and is attached to shielding layer	5	
1.2.3.4	Photon sensors and Coating	photosensors with WLS coating	4	
1.2.3.4.1	Photon sensors	photosensors (64 channel multi-anode PMTs with 2" square shape), the same ones LGC uses	5	
1.2.3.4.2	Photon sensor coating	the photosensors will be coated with the wave-length shifting chemical such as p-Terphenyl	5	
		to increase the detection efficiency of photoelectrons in the UV range. It will use the same		
1.2.3.5	Gas and Gas System	heavy gas and its gas system	4	
1.2.3.5.1	Gas System	gas system for filling, recovery and purification	5	
1.2.3.5.2	Gas for Testing, Commissioning and Initial Operation	Cherenkov gas medium to meet the requirement for pion detection. If C4F8 is used, for an entire volume of 20m3 at 1.7atm, 2000kg is needed for testing, commissioning and initial	5	
1.2.3.6	Sum Readout	The summing electronics to integrate analog signal from pixels of MAPMT into a total sum	4	
1121010		signal. It would share similar design that LGC uses, except it is not needed for trigger. The		
		mechanic support for photosensors assembly and short cables are included in the cost also.		
1.2.3.7	Testing and Installation	test individual components like mirrors, magnetic shielding and reflection cones, MAPMTs	4	
		and readerst as so as they are made available. One other tends is finished and shined to U.sh		
		and readout as soon as they are made available. Once the tank is finished and shiped to JLab,		
		install and align all optical components to verify that construction is within design		
1.2.4	GEM	install and align all optical components to verify that construction is within design The fabriation, testing and instllation of the Gas Electron Multiplier (GEM) tracker for SoLID	3	
1.2.4.1	GEM Modules	install and align all optical components to verify that construction is within design The fabriation, testing and instllation of the Gas Electron Multiplier (GEM) tracker for SoLID An individual GEM detector unit consisting of 3 GEM foils, a readout layer and a cathode foil.	4	
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1.2.4.1 1.2.4.1.1 1.2.4.1.2 1.2.4.1.2 1.2.4.1.2 1.2.4.1.4 1.2.4.1.5 1.2.4.1.5 1.2.4.1.7 1.2.4.2 1.2.4.2 1.2.4.2 1.2.4.2 1.2.4.3 1.2.4.3.1 1.2.4.3.2 1.2.4.3.1 1.2.4.3.2 1.2.4.3.2 1.2.4.3.2 1.2.4.3.2 1.2.4.3.2	GEM Modules GEM foils GEM readout planes GEM cathode foils GEM module frames GEM module supplies GEM module tooling GEM module assembly GEM Readout VMM electronics channels VMM electronics cables GEM high voltage HV power supplies HV power cabling GEM Gas plumbing GEM Gas plumbing GEM mechanical support	install and align all optical components to verify that construction is within designThe fabriation, testing and instillation of the Gas Electron Multiplier (GEM) tracker for SoLIDAn individual GEM detector unit consisting of 3 GEM foils, a readout layer and a cathode foil.A GEM (Gas Electron Multiplier) foil has small holes (on a scale of 100 µm), etched in aA GEM readout foil is a 2-dimensional readout strip structure with a readout strip pitch of400 microns or 600 microns. The readout foil is located after the 3 GEM foils in the GEMThe GEM cathode foil is located before the 3 GEM foils in the module. It is a Kapton foil withThe GEM module frames hold the different foils in a GEM module; they also have built inspacer grids to keep the foils from touching each other under electrostatic forces. The foilsThe supplies for GEM module construction include specialized epoxy glue, specializedThe supplies for GEM module construction include specialized poxy glue, specializedThe GEM module assembly includes testing and validation of all components, ultra-soniccleaning and varnish coating of frames, stretching and gluing offoils on to frames, gluingtogether stretched frames on the assembly jig to form the module, gas sealing of the module,GEM readout system is used for reading out the signals from the individual GEM channels,amplifying and digitizing the signals and then transmit this information to the DAQ systemfor GEM modules to the DAQ system located outside the SoLID magnet.Utra low nois	4 5 5 5 5 5 5 4 5 5 4 5 5 4 5 5 4 5 4	
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1.2.4.8	Management	Overall management and supervision of the GEM module design, manufacture and	4
1.2.5	DAQ/Electronics/Controls		3
1.2.5.1	DAQ Electronics		4
1.2.5.1.1	FADC	Flash ADC Trigger and readout electronics	5
1.2.5.1.2	Crates and DAQ support modules	VME Crates and VME DAQ support modules - VTP, SSP, CPUs,	5
1.2.5.1.3	FADC VXS readout	Fast readout of the FADC using the unused VXS line from backplane. Needed for PVDIS to	5
1.2.5.1.4	GEM Readout	VTP and SSP firmware for GEM background suppession and GEM readout computer	5
1.2.5.1.5	Calorimeter trigger	Reuse HPS trigger scheme as base for 6+1 calorimeter trigger, include transfer of adjacent	5
1.2.5.1.6	Cherenkov readout and trigger	Readout of FADC for Cherenkov, transfer of blocks at interface, trigger on digital sum of 9	5
1.2.5.1.7	PVDIS trigger	Coincidence between ECAL and Light Gas Cherenkov	5
1.2.5.1.8	SIDIS trigger	Coincidence between ECAL and Light Gas Cherenkov and pion trigger (SPD + ECAL (+MRPC if	5
1.2.5.2	Detector Power and cabling	Power supplies for detector and front end. Cabling for high voltage, low voltage and signals.	3
1.2.5.2.1	High and Low voltage power supplies	High voltage for photomultiplier bases. Low voltage for active component Crenkov summing and ECAL active bases. LV power supplies needed for Cerenkov summing circuit and ECAL amplified bases. Power was evaluated to be 10 mA at 10V of base current plus 1 mA per MHz of rate in Cerenkov. 60 summing circuits are needed giving about 9 W of power. For ECal is	4
	12 also and 1 and a line and 12 also and a state state	Procurement of new cabling and patch panels for 682 HV channels and modification of	5
1.2.5.2.2	High and Low voltage cabling and patch panels	existing cabling and patch panels for 2000 channels. Cabling for low voltage supplies.	-
1.2.5.2.3	Signal Cables and Patch Panels	Signal cables for detectors	5
<u>1.2.5.3</u>	Slow Controls	EDICC Insult Outsuit Constralling and hast computer for CIII display	4
1.2.5.3.1	Slow controls IOCs and host	EPICS Input Output Controllers and host computer for GUI display.	5
12522	Slow controls programming	Slow controls software and graphical interface. For control and monitoring of HV, LV, gas systems, and detector environment. Includes general purpose input output controlers and a	5
1.2.5.3.2	Slow controls programming	Cables connecting Cherenkov, ECAL, SPD PMTs to readout cards, including patch panels.	4
<u>1.2.5.4</u>	Setup and Testing	Installation and testing of HV cables and patches	4
1.2.5.4.1	HV cables and patches		5
1.2.5.4.2	Ecal	Cabling to DAQ and testing with pulser and cosmics	5
1.2.5.4.3	SPD	Cabling to DAQ and testing with pulser and cosmics	5
1.2.5.4.4	Light Gas Cerenkov	Cabling to DAQ and testing with pulser and cosmics	
1.2.5.4.5	Heavy Gas Cerenkov	Cabling to DAQ and testing with pulser and cosmics	5
1.2.5.4.6	Full sytem testing	Cabling to DAQ and testing with pulser and cosmics	5
1.2.5.5	Shielding hut		4
1.2.5.5.1	Shielding hut	Procurement and assembly of bunker to hold DAQ and controls electronics in the Hall	3
1.2.6	Magnet	alignment, magnet utilities and magnet testing	4
	Magnet Steel	Procure new steel or modifications to existing steel	
1.2.6.1.1	Yoke	Modify the 24 existing yoke pieces. Procure machining services and provide engineering	5
1.2.6.1.2	Upstream Endcap	Procure modifications to existing upstream coil collar and new adjustable endcup	5
1.2.6.1.3	Downstream Endcap	Procure new material and fabricate cylindrical shell including support mounting	5
1.2.6.1.4	Nose Extension Downstream Coil Collar	Procure new two piece cast nose extension including finish machining. Provide engineering Procure new downstream coil collar complete with machined details.	5
1.2.6.1 .5	Support and Alignment	Procure support and alignment system for magnet and endcap	4
1.2.6.2.1	Magnet Support and Vertical Alignment System	Procure new magnet support & vertical alignment system	5
1.2.6.2.2	Endcap Support and Motion System	Procure endcap support structure and endcap motion system.	5
1.2.6.3	Control	Integration of magnet controls with Hall A and accelerator control systems.	4
1.2.6.4	Power Supply	Procure and installation of power supply	4
1.2.6.5	Cryogenic	Integration of magnet cryo system with existing hall cryo infrastructure.	4
1.2.6.6	Magnet Testing	Full magnet systems checkout after final assembly.	4
1.2.7			3
1.2.7	Infrastructure and Support Structure	Procurement of support structures, personnel access, infrastructure modifications and	4
	Detector Support	Procurement of detector support system	
1.2.7.1.1	Magnet Detector Support	Procure internal detector support system for magnet	5
1.2.7.1.2	Endcap Detector Support	Procure internal detector support system for endcap	5
1.2.7.1.3	Detector Support Integration	Integration of individual detectors into support system	5
1.2.7.1.4	Detector Installation Fixtures	Procure detector installation fixtures	5
1.2.7.2	Baffles	Procurement of baffle system	4
1.2.7.2.1	Baffle Layers	Due sure metanial and finish meable in the of haffle layous	
1 1 7 2 2		Procure material and finish machining of baffle layers.	5
1.2.7.2.2	Baffle Support System	Procure baffle mounting system that will integrate into detector mounting system inside of	5
1.2.7.3	Baffle Support System Access	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access	5 5
1.2.7.3 1.2.7.3.1	Baffle Support System Access Magnet Personnel Access	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet	5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors	5 5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID.	5 5 5 5 4
1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.5	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID	5 5 5 5 4 4
1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.5	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation	5 5 5 4 4 4 4
1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.5 1.2.7.6	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the	5 5 5 4 4 4 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.5 1.2.7.6 1.2.7.6.2	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the	5 5 5 4 4 4 4 5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.5 1.2.7.6 1.2.7.6.1 1.2.7.6.2 1.2.7.7	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout.	5 5 5 4 4 4 4 5 5 5 4
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1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6.1 1.2.7.6.2 1.2.7.7 1.2.7.8 1.2.7.8	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A	5 5 4 4 4 5 5 5 4 4 3
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6.1 1.2.7.6.2 1.2.7.7 1.2.7.8 1.2.8 1.2.8	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for	5 5 4 4 4 5 5 5 4 4 4 3 4
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1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.7 1.2.7.8 1.2.8.1 1.2.8.1 1.2.8.1.2	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations Physics generators Geometry definitions	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for Implement physics event generators relevant for the planned experimental program Choose a suitable geometry storage format. Describe geometry of target, spectrometer, detectors and detector components in sufficient detail for design study simulations and	5 5 4 4 4 5 5 5 4 4 3 4 5 5 5 5
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1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6.1 1.2.7.6.2 1.2.7.7 1.2.7.8 1.2.8.1 1.2.8.1 1.2.8.1.2 1.2.8.1.2 1.2.8.1.2 1.2.8.1.4 1.2.8.1.5 1.2.8.1.6	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations Physics generators Geometry definitions Digitization DAQ/trigger emulation Framework integration Testing/QA	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for Implement physics event generators relevant for the planned experimental program Choose a suitable geometry storage format. Describe geometry of target, spectrometer, detectors and detector components in sufficient detail for design study simulations and Implement algorithms for simulating the detector responses, including readout electronics. Develop simulation of the data acquisition and trigger system including handling of pile-up Integrate simulation algorithms into overall end-to-end software framework	5 5 4 4 4 5 5 5 4 4 4 3 4 3 4 5 5 5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.7 1.2.7.8 1.2.8 1.2.8.1 1.2.8.1.1 1.2.8.1.2 1.2.8.1.2 1.2.8.1.4 1.2.8.1.5 1.2.8.1.5 1.2.8.1.5 1.2.8.1.7	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations Physics generators Geometry definitions Digitization DAQ/trigger emulation Framework integration Testing/QA Coordination	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for Implement physics event generators relevant for the planned experimental program Choose a suitable geometry storage format. Describe geometry of target, spectrometer, detectors and detector components in sufficient detail for design study simulations and Implement algorithms for simulating the detector responses, including handling of pile-up Integrate simulation algorithms into overall end-to-end software framework Assess performance of chosen simulation algorithms (generators, particle transport, Coordinate simulation efforts via periodic group/subgroup meetings, issue tracking, forum <td>5 5 4 4 4 5 5 5 4 4 4 3 4 4 3 5 5 5 5 5</td>	5 5 4 4 4 5 5 5 4 4 4 3 4 4 3 5 5 5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.7 1.2.7.8 1.2.8.1 1.2.8.1.1 1.2.8.1.2 1.2.8.1.2 1.2.8.1.4 1.2.8.1.5 1.2.8.1.7 1.2.8.2 1.2.8.1.7 1.2.8.2 1.2.8.1.7 1.2.8.2 1	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations Physics generators Geometry definitions Digitization Framework integration Francework integration Testing/QA Coordination Online Analysis Infrastructure	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procurements and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for Implement physics event generators relevant for the planned experimental program Choose a suitable geometry storage format. Describe geometry of target, spectrometer, detectors and detector components in sufficient detail for design study simulations and Implement algorithms for simulation and rigger system including handling of pile-up Integrate simulation algorithms into overall end-to-end software framework Assess performance of chosen simulation algorithms (generators, particle transport, Coordinate simulation efforts via periodic group/subgroup meetings, issue tracking, forum Develop software infrastructure and reconstruction algorithms suitable	5 5 5 4 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5
1.2.7.3 1.2.7.3.1 1.2.7.3.2 1.2.7.4 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.6 1.2.7.7 1.2.7.8 1.2.8 1.2.8.1 1.2.8.1.1 1.2.8.1.2 1.2.8.1.2 1.2.8.1.4 1.2.8.1.5 1.2.8.1.5 1.2.8.1.5 1.2.8.1.7	Baffle Support System Access Magnet Personnel Access Endcap Personnel Access Power Beamline Hall A Modifications Ramp Hall Layout Assembly/Installation Software Simulations Physics generators Geometry definitions Digitization DAQ/trigger emulation Framework integration Testing/QA Coordination	Procure baffle mounting system that will integrate into detector mounting system inside of Procurement of personnel access Procure access platform for cyro/controls on top of magnet Procure access system for endcap detectors Procurement and installation of power utility components required for SoLID. Procurement and installation of new or modified beamline components for all SoLID Modifications of hall infrastructure for SoLID installation Procurement of low ground clearance cryostat transport frame or modifications to the Perform modifications and preparations of Hall A for the installation and operation of the Labor for installation support related to experimental layout. Manpower for the assembly of experimental components and installation within Hall A Develop simulation software infrastructure and implementation to the level required for Implement physics event generators relevant for the planned experimental program Choose a suitable geometry storage format. Describe geometry of target, spectrometer, detectors and detector components in sufficient detail for design study simulations and Implement algorithms for simulating the detector responses, including handling of pile-up Integrate simulation algorithms into overall end-to-end software framework Assess performance of chosen simulation algorithms (generators, particle transport, Coordinate simulation efforts via periodic group/subgroup meetings, issue tracking, forum <td>5 5 4 4 4 5 5 5 4 4 4 3 4 4 3 5 5 5 5 5</td>	5 5 4 4 4 5 5 5 4 4 4 3 4 4 3 5 5 5 5 5

1.2.8.2.2	Data model	Develop a preliminary data model (data structures) compatible with desired granularity of	5
		reconstruction algorithms and matched to anticipated experimental configurations.	
1.2.8.2.3	Raw data decoder	Develop an input module for the sofwtare framework capable of decoding/mapping the	5
1.2.8.2.4	Track reconstruction	Implement algorithms for track reconstruction for the anticipated experimental	5
1.2.8.2.5	Detector analysis	Develop basic detector analysis algorithms, such as calorimeter clustering and Cherenkov	5
		amplitude summation, suitable for performance evaluation. This may include particle	
1.2.8.2.6	Event display	Implement an event visualization system capable of showing raw and aggregated detector	5
1.2.8.2.7	Testing/QA	Evaluate the performance of the online analysis software using simulated and test beam data,	5
1.2.8.2.8	Coordination	Coordinate development efforts via meetings, issue tracking, discussion groups and source	5
1.2.9	Oversight/Project Management	Oversight and project management for the project and for all subsystems	3
1.2.9.1	Project Management	Oversight and project management for the project	4
1.2.9.1.1	Project Management-Scientist	Scientific oversight and project management for the project	5
1.2.9.1.2	Project Management-Engineer	Engineering oversight and project management for the project	5
1.2.9.1.3	Safety	Oversight on safety aspects for the project	5
1.2.9.1.4	Project Office Support	Support from the JLab project office	5
1.2.9.2	PMO Support	Oversight and project management for all subsystems	4
1.2.9.2.1	PMO-Magnet	Project management and oversight for magnet subsystem	5
1.2.9.2.2	PMO-DAQ/Electronics	Project management and oversight for DAQ/Electronics subsystem	5
1.2.9.2.3	PMO-Infrastructure/Support Structure	Project management and oversight for infrastructure, support structure, baffles, assembling	5
1.2.9.2.4	PMO-Calorimeters	Project management and oversight for calorimeters	5
1.2.9.2.5	PMO-Tracking	Project management and oversight for tracking detectors	5
1.2.9.2.6	PMO-Cherenkovs	Project management and oversight for Cherenkov detectors	5