



U.S. ATLAS Maintenance Plan

Silicon 1.1

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.1.1.1	Pixel Mechanics	Disk structures (sectors, rings, and mounts)	X			X	<u>When system is removed for module replacement, we have responsibility for the mechanics.</u>
1.1.1.2	Pixel Sensors	Tiles					
1.1.1.3	Pixel Electronics	IBM wafers					
		Optical IC wafers					
		Test systems					
1.1.1.4	Pixel Hybrids	Flex hybrids					
		Disk pigtails					
		Optical hybrids	X			X	Can be removed and replaced at CERN using spares.
1.1.1.5	Pixel Modules	Wafers	X		X	X	Will replace failing units. Removal at CERN, repairs or production and test of new units in U.S.
		Modules					
1.1.2.1	IC Electronics	39,975 chips					
1.1.2.3	Modules	Barrel modules	X		X	X	Removal of any defective modules that were made in U.S. at CERN. Tests and production of any spares in the U.S.
1.1.3	Read Out Drivers	Production RODs	X		X	X	Two maintenance activities. Repair of board defects due to mortality. Removal and replacement at CERN, check of spares in U.S. Fix software problems in both C code and VHDL (continuous process).
		DSP VME boards					
		Multimodule VME boards					



U.S. ATLAS Maintenance Plan

TRT 1.2

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.2.1.1	TRT Barrel Module	Module Mechanics	X			X	HV, gas in SR building repair stand
1.2.1.1.	Cables	Cables		X			
1.2.5	TRT Electronics						
1.2.5.1	ASDBLR	425,000 channels	X		X		Chip testing at Penn
1.2.5.3	PCB	Front-end PCBs 106,000 channels	X			X	PCB testing in SR building at CERN



U.S. ATLAS Maintenance Plan

Liquid Argon 1.3

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.3.1	Barrel Cryostat	Barrel Cryostat	X			X	The cryostat will be accessed for maintenance approximately every ten years
1.3.2.1	Signal Feedthrough	Signal Feedthrough	X			X	For suspected feedthrough failures, troubleshooting, repair, calibration and replacement of parts if necessary. Purchase of spare parts to support maintenance and scheduled part replacements. Maintenance of the feedthrough repair facility, and equipment.
		Heater Plate and thermocouples	X			X	Trouble shooting and repair of suspected Heater Plate, and thermocouple failures. Purchase of spare parts to support maintenance.
1.3.2.2	HV Feedthrough	Cables	X			X	Trouble shooting of suspected cable failures for continuity, shorts, TDR etc. Cable repair or replacement if required.
		Filter modules			X	X	For suspected filter module failures, troubleshooting, repair, and replacement of parts if necessary. Purchase of spare parts to support maintenance and scheduled part replacements.
		Heater Plate and thermocouples	X			X	Trouble shooting and repair of suspected Heater Plate, and thermocouple failures. Purchase of spare parts to support maintenance.
1.3.3	Cryogenics	Refrigerator.	X			X	Performance scheduled checks and calibration of the refrigeration system. Purchase of spare parts to support maintenance and scheduled part replacements.
		15kl N ₂ Storage dewar	X			X	Performance scheduled checks and calibration of the storage dewar. Purchase of spare parts to support maintenance and scheduled part replacements.
		Cryogenic liquid transfer lines	X			X	Performance scheduled checks and calibration of the cryogenic liquid transfer lines . Purchase of spare parts to support maintenance and scheduled part replacements.
		Liquid quality meter	X			X	Performance scheduled checks and calibration of the liquid quality meter. Purchase of spare parts to support maintenance and scheduled part replacements.



U.S. ATLAS Maintenance Plan

Liquid Argon 1.3 (Continued)

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.3.4.1	Readout Electrodes		X			X	Performance scheduled checks, calibration, troubleshooting and repair of suspected readout electrode failures. Purchase of spare parts to support maintenance and scheduled part replacements.
1.3.4.2	Motherboard System		X		X	X	Performance scheduled checks, calibration, troubleshooting and simple repair of suspected motherboard system modules at CERN. Modules with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.4.2.3.1		Summing Boards	X		X	X	Troubleshooting and simple repair of suspected summing boards at CERN. Boards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.4.2.3.2		Motherboards	X		X	X	Troubleshooting down to the failed component , and simple repair of suspected Motherboards at CERN. Motherboards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.4.2.3.3		Alignment Boards		X			
1.3.4.2.3.4		HV Boards	X		X	X	Troubleshooting and simple repair of suspected HV boards at CERN. HV boards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.5.1		Preamps	X			X	Troubleshooting and simple replacement of suspected preamps at CERN. Purchase of spare parts to support maintenance at CERN.



U.S. ATLAS Maintenance Plan

Liquid Argon 1.3 (Continued)

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.3.6	System Crate including the Detector Control System (DCS)		X		X	X	Performance scheduled checks, calibration, troubleshooting down to the failed board and or module, and simple repair of suspected system crates and or the (DCS) at CERN. System crates with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions. Maintenance of the electronics facility and equipment
1.3.6.1		Pedestals		X			
1.3.6.2		Warm Cables & Base Plane	X			X	Troubleshooting and simple repair of suspected Base Planes and warm cables at CERN. Base Planes boards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare Base planes and piece parts to support maintenance at CERN, and at the home institutions.
1.3.6.3		Crates (includes the power bus)	X		X	X	Troubleshooting and simple repair of suspected power bus's at CERN. Power bus's with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.6.4		Power Supplies	X		X	X	Troubleshooting and simple repair of suspected power supplies at CERN. Power supplies with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions
1.3.6.5		Cooling System	X		X	X	Performance scheduled checks, calibration, troubleshooting down to the failed cooling component, and simple repair of the cooling system at CERN. Cooling components with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.



U.S. ATLAS Maintenance Plan

Liquid Argon 1.3 (Continued)

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.3.7	FEB		X		X	X	Troubleshooting down to the failed component , and simple repair of suspected FEBs at CERN. FEBs with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
		Associated FEB Components	X			X	Purchase of spare parts to support maintenance at CERN.
1.3.7.4.3		Optical Links	X		X	X	Troubleshooting down to the failed component , and simple repair of suspected Optical Links at CERN. Optical Links with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.8	Level I Trigger Interface		X		X	X	Troubleshooting down to the failed component , and simple repair of suspected Level 1 Trigger Interface at CERN. Level 1 Trigger Interfaces with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.8.1		Layer Sum Boards	X		X	X	Troubleshooting and simple repair of suspected Layer Sum boards at CERN. Layer Sum boards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.8.2		Level I Interface Boards	X		X	X	Troubleshooting and simple repair of suspected Level 1 interface boards at CERN. Level 1 Interface boards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, repair and calibration. Purchase of spare parts to support maintenance at CERN, and at the home institutions.



U.S. ATLAS Maintenance Plan

Liquid Argon 1.3 (Continued)

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.3.9	ROD		X		X	X	Troubleshooting down to the failed component , and simple repair of suspected RODs at CERN. RODs with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.9.2		Remapping Boards	X		X	X	Troubleshooting down to the failed component , and simple repair of suspected RODs at CERN. RODs with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
1.3.10	Forward Calorimeter		X			X	Performance scheduled checks, calibration, troubleshooting down to the failed board and or module, and simple repair of the failed Forward Calorimeter at CERN. Purchase of spare parts to support maintenance at CERN Maintenance of the FCAL repair facility and equipment
1.3.10.1		EM Section	X		X	X	Troubleshooting and simple repair of the EM Section at CERN. Purchase of spare parts to support maintenance at CERN.
1.3.10.2		Cold electronics	X		X	X	Troubleshooting and simple repair of the suspected cold electronics at CERN. The cold electronics with more difficult problems, is to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
		Cables	X			X	Trouble shooting of suspected cable failures for continuity, shorts, TDR etc. Cable repair or replacement if required.
		Motherboards	X		X	X	Troubleshooting down to the failed component , and simple repair of suspected Motherboards at CERN. Motherboards with more difficult problems, are to be shipped back to the home institutions for troubleshooting, and repair. Purchase of spare parts to support maintenance at CERN, and at the home institutions.
		Decoupling capacitors	X			X	Troubleshooting to the failed component , and simple repair at CERN. Purchase of spare parts to support maintenance at CERN, and at the home institutions.



U.S. ATLAS Maintenance Plan

Tile Calorimeter 1.4

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.4.1.2.3	Tile Cal Modules		X		X	X	Primarily calibration with Cs ¹³⁷ source. Analysis of data at home institutions.
1.4.3.1	PMT block		X			X	Calibration, testing and replacement/repair as needed
1.4.3.2.3	Tile Cal Electronics	3-in-1 Cards	X		X	X	Calibration, testing, and replacement/repair as needed. Repair may be done in US.
		Motherboard	X		X	X	Calibration, testing, and replacement/repair as needed. Repair may be done in US.
1.4.3.4.3		Interface Board	X		X	X	Calibration, testing, and replacement/repair as needed. Repair may be done in US.
1.4.3.5.3	System control	Module		X			
1.4.4.1	Gap submodules	Gap submodules	X		X	X	Primarily calibration with Cs ¹³⁷ source. Analysis of data at home institutions.
1.4.4.2.3	Cryostat Scintillaor Mechanics	Mechanics only		X			



U.S. ATLAS Maintenance Plan

Muon 1.5

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.5.4.4.1	CSC	CSC Chambers	X			X	Short term access will be limited. Extensive repairs can be made when wheels opened or come to surface.
1.5.7	MDT	MDT Chambers	X			X	Chamber have to be repaired at CERN – during access to pit.
1.5.8.2.1		MDT Kinematic Mounts	X			X	Some small adjustments may be required to position chamber
1.5.8.2.2		MDT Chamber Connectors		X			
1.5.9.1.1		MDT-ASD Chip		X			Chips will be replaced by replacing Mezz card.
1.5.9.1.2		MDT Mezzanine PCB	X		X		Cards will be repaired in the US – but replacement will be made with hot spares at CERN.
1.5.9.1.2		Signal HH Boards	X			X	Hot spares for quick replacement – repair at CERN since boards are European made
1.5.9.2.2		HV HH Boards	X			X	Hot spares for quick replacement – repair at CERN since boards are European made
1.5.9.3		Mezz-CSM Cables	X			X	Cables will be fixed by substituting hot spares.
1.5.9.4		CSM	X		X		CSMs will be repaired at University of Michigan – a few hot spares will be at CERN.



U.S. ATLAS Maintenance Plan

Muon 1.5
(Continued)

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.5.11	CSC Electronics	ASM I Electronics	X		X		Hot spares at CERN – long term fix at BNL.
1.5.11.2.1		ASM II Electronics	X		X		Hot spares at CERN – long term fix at BNL.
1.5.11.1.2		LV Power, Cooling & Cabling	X			X	Power supplies fixed at CERN.
1.5.11.3.1		Sparsifiers	X		X		Hot spares at CERN – long term repair at UCI.
1.5.11.4		Readout Drivers					
1.5.11.6	Support electronics	VME crates w/ CPU & timing module	X			X	Fixed at CERN
1.5.11.7		Readout Software	X			X	Developed in US but fixed at CERN
1.5.11.8		HV Supplies	X			X	Fixed at CERN
1.5.11.4.2.2		DCS Modules	X			X	NIKHEF
1.5.12.3.1	Alignment System	Alignment Bar Instrumentation	X		X		Hot spares at CERN – long term fix at Brandeis.
1.5.12.3.2		Proximity Monitors	X		X		Hot spares at CERN – long term fix at Brandeis.
1.5.12.3.3		Multi-Point System (BCAM)	X		X		Hot spares at CERN – long term fix at Brandeis.
1.5.12.3.4		DAQ	X		X		Hot spares at CERN – long term fix at Brandeis.
1.5.12.4		In-plane System	X		X		Hot spares at CERN – long term fix at Brandeis.



U.S. ATLAS Maintenance Plan

Trigger/DAQ 1.6

WBS #	Subsystem	Deliverable	Maintenance Required		Location of Maintenance		Description of Maintenance
			Yes	No	US	CERN	
1.6.1	LVL2 Supervisor & RoI Builder	LVL2 Supervisor & RoI Builder	X		X	X	Custom electronics solely the responsibility of US groups. Computers (supervisors) will likely be maintained along with other level 2 farm machines.
1.6.2	LVL2 Calorim. Trigger	LVL2 Calorim. Trigger	X		X	X	Software will need to be adapted to OS upgrades and the evolution of physics requirements.
1.6.2		Readout Buffers					
1.6.3	LVL2 SCT Trigger	LVL2 SCT Trigger	X		X	X	see above
1.6.3		Readout Buffers					
1.6.4	LVL2 Global Trigger Equipment	LVL2 Global Trigger Equipment	X		X	X	see above