Alpha CubeSat Technology Readiness Level (TRL)* & Overall Mission Readiness Review February 6, 2016

	System/Subsystem Name	TRL@GT-2	TRL@GT-3	TRL@GT-4	Rational for Stated TRL
		PDR	CDR	FRR	
0	**Alpha CubeSat Spacecraft**	**5**	6	7	Alpha CubeSat is a technology demonstration satellite
	Volume Budget Margin Status (S&Mech)	**Positive**			GT-2 calculations show positive margin - no extant unaddressed risks
	Mass Budget Margin Status (S&Mech)	**Positive**			GT-2 calculations show positive margin - no extant unaddressed risks
	Power Budget Margin Status (EPS)	**Positive**			GT-2 calculations show positive margin - no extant unaddressed risks
	Delta-V Budget Margin Status (PROP)	**Positive**			GT-2 calculations show positive margin - no extant unaddressed risks
	Communications Link Budget Margin Status (COMM)	**Positive**			GT-2 calculations show positive margin - no extant unaddressed risks
	Belbruno Ballistic Escape and Capture Trajectory (GN&C)	**Close**			Notional => 2nd order calculations close with lower Delta-V rqmts
1	**Communications System (COMM)**				
	Tethers Unlimited SWIFT-KTX Programmable K Band Transceiver (baselined)	5	6	7	COTS K band product being upgraded by vendor to Ka
	Clyde Space, Pumpkin, or equivalent 6U CubeSat Integrated Reflectarray Antenna	7	8	9	Reflectarray antennas are now a COTS product from multiple vendors
	NASA DSN 34m BWG Ka Band 32 GHz Downlink Standard Service (baselined)	9	9	9	Available DSN Standard Service
	NASA DSN 34m BWG X Band Uplink 7.145 MHz (baselined)	9	9	9	Available DSN Standard Service
	Corresponding alternate X Band Uplink ground station services	9	9	9	Alternate X Band Ground Stations are currently operational
2	**Electrical Power System (EPS)**				
	Blue Canyon technologies XB1 Module Battery	7	8	9	COTS product
	Clyde Space 6U CubeSat SIDE Solar Panels	7	8	9	COTS product
	Power Management And Distribution BCT XB1 Module	7	8	9	COTS product
3	**Data Management System (DMS)**				
	Bus Control Subsystem - Blue Canyon Technologies XB1 Module	7	8	9	COTS product
4	**Guidance, Navigation & Control (GN&C)**				
	Blue Canyon Technologies XACT Module	7	8	9	COTS product
	Blue Canyon Technologies XB1 Module	7	8	9	COTS product
5	**Structures & Mechanisms System (S&Mech)**				
	Solar Reflectarray Panel Hinge (Qty=4)	7	7	7	COTS products are now available from multiple vendors
	Solar Reflectarray Single Axis Articulation Servo (Qty=2)	7	7	7	COTS products are now available from multiple vendors
	Solar Reflectarray Deployment Mechanism (Qty=2)	7	7	7	COTS products are now available from multiple vendors
	Solar Reflectarray Mount (Qty=2)	7	7	7	COTS products are now available from multiple vendors
	TIB Spacecraft Deployment Mechanism Attach Point	7	7	7	COTS products are now available from multiple vendors
	Passive Power Source Inhibit Mechanism (EPS)	7	7	7	COTS products are now available from multiple vendors
	1U x 3U Ram/Forward Plate Structure	7	7	7	COTS products are now available from multiple vendors
	Mechanical Oxidizer Tank Seal	7	7	7	COTS products are now available from multiple vendors
	2U x 3U Core Structural Spars, Rails & Plate	7	7	7	COTS products are now available from multiple vendors
	Scar for Partial Aft Plate + Hybrid Rocket Ejection	2	TBD	TBD	Potential option to recover margin (not required)
6	**Propulsion System (PROP)**				
	Hybrid Motor Oxidizer Tank Subsystem (baselined)	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Hybrid (N20+40% Aluminized Paraffin) Motor Core Subsystem (baselined)	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Busek BIT-1 Ion Thrusters (using solid Iodine)(Qty=4) (baselined) (PDR elimination)	5	6	7	Multiple vendors have tested prototypes, integration challenge

	Phase 4 CAT (P4-50) Ambipolar Thruster (using Iodine) (PDR Addition)	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Tethers Unlimited HYDROS (using H20) (PDR Addition)	5	6	7	Multiple vendors have tested prototypes, integration challenge
7	**Thermal Control System (TCS)**				
	EPS Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	PROP Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	GN&C Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	COMM Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	S&Mech Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	DMS Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	PS Passive Dissipation	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Tools to Move Heat	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Tools for Mitigating and/or Rejecting Heat	5	6	7	Multiple vendors have tested prototypes, integration challenge
8	**Payload Systems (PS)**				
	CubeQuest Challenge Encoded BIT Stream Generator	5	6	7	Multiple vendors have tested prototypes, integration challenge
	System Performance Data Capture & Return	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Deep Space & Lunar Data Capture & Return	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Memorial Spaceflight Canisters	5	6	7	Multiple vendors have tested prototypes, integration challenge
9	**Ground Systems**				
	Spacecraft Control Center	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Spacecraft Near Real Time State Model Generator	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Capture & Store required navigation bits	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Payload(s) Operations Center	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Payload(S) Near Real Time State Model Generator	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Capture and Store Cube Quest Challenge Encoded BIT Stream	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Internet VLAN	5	6	7	Multiple vendors have tested prototypes, integration challenge
	Automated Command Sequence Generation and Verification Tool	5	6	7	Multiple vendors have tested prototypes, integration challenge
10	**Launch Service Provider (LSP) Systems**				
	Earth-to-LEO Launch Vehicle	9	9	9	COTS service is available from multiple vendors
	Upper Stage/Trajectory Insertion Bus (TIB)	5	6	7	COTS service is available or planned by multiple vendos
	TIB Fairing (if applicable)	5	6	7	COTS service is available or planned by multiple vendos
	ACS Transportation Packaging	9	9	9	Commerical Cargo is a COTS service
	NOTES:				
	*As defined in NASA/SP-2007-6105 Rev 1 pg 296. Include rational for stated TRL.				

	KEY:				
	No extant unaddressed technical risks				
	Elements of technical risk identified are well within established business norms				
	Material technical risk identified, tractable mitigation strategy defined and underway				
	Major technical risk identified, options to change baseline identified				
	Major technical risk identified, no mitigation strategy or change defined to date				