Applicable Safety Requirements

1. The Alpha CubeSat (ACS) spacecraft must meet or exceed the International Space Station (ISS) safety requirements for pressurized cargo from the delivery to the applicable ground cargo processing facility (Kennedy Space Center or the Mid-Atlantic Regional Spaceport) until the Launch Service Provider (LSP) Trajectory Insertion Bus (TIB)passes outside the ISS Keep Out Sphere (KOS) with the ACS attached.

2. The ACS must meet or exceed the LSP TIB safety and interface requirements from the point of integration (TBD: ground or ISS depending on cargo vehicle accommodations) until the TIB executes the equivalent of a Planetary Services Deployment Mechanism release of the ACS spacecraft.

3. The following ISS Safety Requirements Documents are applicable:

- **SSP 50021 – ISS Safety Requirements Document**
- **SSP 50021 DCN 001**
- **SSP 50021 DCN 002**
- **SSP 30599 Revision E – Safety Review Process**
- **SSP 30559 Revision D – ISS Structural Design and Verification Requirements**
- **SSP 52005 Revision D – Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures**
- **SSP 41172 Revision U – Qualification and Acceptance Environmental Test Requirements**
- **SSP 30558 Revision C – Fracture Control Requirements for Space Station**

4. The ISS SSP 30599 Revision E – Safety Review Process Document begins with a Phase I Safety Review which typically occurs after the preliminary design is complete. In anticipation of the need to meet the requirements of the Phase I Safety Review after CubeQuest Challenge GT-2 the ACS Team has developed the following annotated abstract of the Phase I Safety Review process to document our readiness to comply with the applicable requirements.

5.1 PHASE I SAFETY REVIEW

The phase I safety review is the first safety meeting among the appropriate safety and engineering personnel representing NASA, IPs, contractors, and the ISS safety review panels in which safety of the ISS equipment and associated operations are addressed. The objective of the meeting is to identify all hazards and hazard causes inherent in the preliminary design, evaluate the means of eliminating, reducing, or controlling the risk, and establish a preliminary method for safety verification.

5.1.1 PHASE I DATA REQUIREMENTS

The following data is required for the phase I safety reviews:

A. GSE and Flight Hardware Ground Operations at KSC

> *1. Flight Element description based on subject mission.*
>
> *2. Descriptions of GSE and flight hardware subsystems that present a potential hazard during ground processing, and the ground operations involving these items. Schematics and block diagrams with safety features and inhibits identified shall be included. Design data for hazardous*

systems (pressure, lifting, etc.) shall be summarized in a matrix. Contact the GSRP Chair for sample formats.

3. Ground operations scenarios including post-flight ground operations at the primary, alternate, and contingency landing sites. The scenarios shall highlight unique requirements, such as continuous power through a T-0 umbilical.

4. Ground HRs and appropriate support data.

5. Ordnance data required by KHB 1700.7

6. Demonstration that the preliminary design is in compliance with design requirements of KHB 1700.7. The following are basic hazard groups applicable to ground operations: structural failure of support structures and handling equipment; collision during handling; inadvertent release of corrosive, toxic, flammable, or cryogenic fluids; loss of habitable/breathable atmosphere; inadvertent activation of ordnance devices; ignition of flammable atmosphere/material; electrical shock/burns; personnel exposure to excessive levels of ionizing or nonionizing radiation; use of hazardous/incompatible GSE materials; inadvertent deployment of appendages; working under suspended loads; and rupture of composite epoxy overwrap pressure vessels. SSP 30599 Revision E 5-2

7. Planned on-dock arrival date at KSC.

B. Flight System Design and Operations

1. An overview description of the design and flight operations of the hardware being addressed in the review. This includes descriptions of: hardware elements; flight and ground systems related to ISS on-orbit manned and unmanned operations; airborne support equipment; operational scenarios related to assembly, start-up sequences, and orbital operations; and LP, assembly, and stage configurations of the hardware. Briefly describe the hardware and operations in terms of significant characteristics and functions. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.

2. Detailed descriptions and schematics/block diagrams (at a PDR level of detail) for safety-critical systems and subsystems and their operations. In lieu of uniquely generated safety descriptive data, and with prior coordination with the SRP, references can be made to other ISS descriptive documentation made available to the SRP.

a. The schematics and block diagrams should be prepared with safety features, inhibits, etc., identified. Describe the major elements of the end item or segment with the information organized by technical disciplines (See below).

b. Describe the design, function, planned operation, and safety features of each system/subsystem.

c. The following list of technical disciplines may be used to organize the data: structures, materials, mechanical systems, pyrotechnics and ordnance systems, pressure systems, propulsion and propellant systems, avionics systems (including electrical power distribution, computer-controlled systems), command and control systems, optical and

laser systems, human factors, hazardous materials, thermal control systems, and interfaces and provided services.

3. Flight HRs and appropriate support data (see paragraph 5.1.2).

4. A summary listing in the description section, of safety-critical services provided by other ISS segments or the Orbiter.

5.1.2 PHASE I HAZARD REPORTS

A phase I HR shall be prepared for each hazard identified as a result of the safety analysis on the preliminary design and operations. The focus shall be on cause description and controls. Instructions for completion of phase I HR forms are contained in Appendix D.

5.1.3 SUPPORT DATA - PHASE I HAZARD REPORTS (FLIGHT ONLY)

Critical procedures/processes, which require special monitored verification, shall be identified in preliminary fashion. Also, for those hazards controlled by "design for minimum risk," rather than failure tolerance requirements, a minimum set of support SSP 30599 Revision E 5-3 data, defined herein for phase I are required. (Appendix D contains the complete list of data elements for design for minimum risk hazards.) For COTS and non-complex hardware, ISS subsystem manager and SRP with appropriate discipline expert (EEE, material, battery, etc) will provide guidance to the appropriate level of detail required for HR generation. (Note 1: Reference to submitted and approved document by number and title is sufficient unless given specific request.)

A. Unpressurized Structures:

1. Preliminary plan for structural verification in accordance with SSP 30559, Structural Design and Verification Requirements, (including beryllium, glass [in accordance with SSP 30560, Glass, Window, and Ceramic Structural Design and Verification Requirements], and composite/bonded structure) (Note 1)

2. Fracture Control Plan in accordance with SSP 30558, Fracture Control Requirements for Space Station (Note 1)

B. Pressurized Systems:

1. Fracture Control Plan (Note 1)

2. Summary of design conditions for each pressurized system and certification approach

C. Pyrotechnic Devices:

1. Identification of pyrotechnic devices and functions performed

D. Ionizing Radiation:

1. Ionizing radiation data sheet for each source (JSC Form 44 Ionizing Radiation Source Data Sheet - Space Flight Hardware and Applications, See Appendix G)

E. Electrical Systems:

1. Top level wiring diagrams illustrating the approach to wire sizing and circuit protection

F. Components and Elements of Mechanisms in Critical Applications:

1. Mechanical Systems Verification Plan (MSVP) – Preliminary Version (Note 1). Include in the MSVP a summary of critical procedures and processes to meet safety requirements using either a) failure tolerant approach or b) Design For Minimum Risk (DFMR) approach that required compliance with JSC letter MA2- 00-057, Mechanical Systems Safety, September 28, 2000. A fault tolerant approach that combines a) and b) above will be accepted. A link to the MSWG website and the MA2-00-057 letter is available on the ISS SRP web page at http://srp-sma.jsc.nasa.gov/default.cfm.

5. The following Space Launch System (SLS) safety requirements while not specified as applicable are included as a reference:

Hazard Analysis Verification

Reference SLS-SPIE-RQMT–018 IDRD Sect 4.0 and App B VCRM

Submit analysis method of verification of safety hazard mitigations as defined in SLS-SPIE-RQMT–018 IDRD Sect 4.0 and App B VCRM

1-lists analysis w/plans of when performed;

3-all above & provides some initial analysis

5-all of the above plus some detailed analyses

Hazard Analysis Test/Demonstration

Reference SLS-SPIE-RQMT–018 IDRD Sect 4.0 and App B VCRM

Submit test or demonstration method of verification of safety hazard mitigations as defined in SLS-SPIE–RQMT–018 IDRD Sect 4.0 and App B VCRM

1 - lists tests w/plans for development;

3 - all above & plans for verification testing

5 - all above & draft test procedures available

Inspection

Reference SLS-SPIE-RQMT–018 IDRD Sect 4.0 and App B VCRM

N/A

Safety Data Package (SDP)

Reference: SLS-RQMT-216 SLSP EM-1 Safety Requirements for Secondary Payload Hardware & SLS-PLAN-217 EM-1 Secondary Payload Safety Review Process or equivalent for selected launch vehicle

Initial Safety Data Package with hazards identified

1 - completed Phase 0 submission material, but no material for Phase I review

3 - completed Phase 0 submission material, & draft SDP for Phase I with hazards identified

5 - all of the above, plus methods to close hazards

Schedule

Submit your development schedule, showing milestones relative to phased safety review milestones, demonstrating compliance with SLSPLAN-217 SLS Secondary Payload Safety Review Process, Sect. 4. Detail plan to GT3 w/milestone events to other GTs

1 - low confidence that SDP and payload development will be sufficiently mature for phased payload safety review;

3-adequate confidence that SDP and payload development will be mature as required for phased payload safety review milestones

5-excellent progress in SDP; excellent payload development progress relative to required phased safety review milestones