803-GS-GSP-BPO-ANTARCTICA-2019-01

GROUND SAFETY PLAN

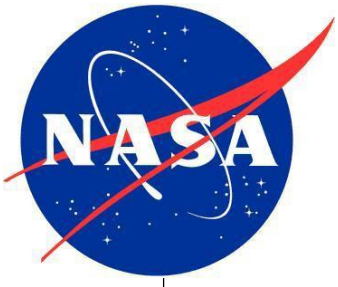
FOR

Balloon Program Office 2019 Antarctica Campaign

McMurdo, Antarctica

Effective Date
October 2019
Version 01

803/Safety Office



National Aeronautics and Space Administration

Goddard Space Flight Center
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CHANGE HISTORY LOG		
REVISION	**EFFECTIVE DATE**	**DESCRIPTION OF CHANGES**
-	October 21, 2019	

Ground / Instrument Safety Plans

SME Routing Receipt

Mission Name/ID#: BPO Campaign Antarctica 2019

Please sign upon the completion of your review

Review Routing	Name	Signature
GS Analyst	Robert Shute	Robert Shute Digitally signed by Robert Shute Date: 2019.09.30 12:15:37 -04'00'
Industrial Hygienist (IH) – to include chemicals	Bunting or Rabon (or Not Applicable)	MARVIN BUNTING Digitally signed by MARVIN BUNTING Date: 2019.10.04 13:52:56 -04'00'
Radio Frequency (RF) – to include HERP	Bunting or Rabon (or Not Applicable)	MARVIN BUNTING Digitally signed by MARVIN BUNTING Date: 2019.10.04 13:53:20 -04'00'
Laser	Bunting or Rabon (or Not Applicable)	N/A
Radioactive Materials (RA)	Bunting or Rabon (or Not Applicable)	N/A
Lifting Device Manager (LDM)	Julie Hurst (or Not Applicable)	N/A
*Cryo/Pressure Vessels/ Systems/Hypergolic	Nick Noparat (or Not Applicable)	Nirun Noparat Digitally signed by Nirun Noparat Date: 2019.09.30 12:28:36 -04'00'
Explosive Safety Officer (ESO) – to include HERO	Shad Combs (or Not Applicable)	Shad Combs Digitally signed by Shad Combs Date: 2019.10.16 10:31:09 -04'00'

Based on experience with prior missions with potential configuration changes, the mission that has Cryo/Pressure Systems/Hypergolic must be reviewed and approved by the PSM.

Table of Contents

1.0 GROUND SAFETY DATA SUMMARY

Principle Investigator/Payload:
Dr. Brian Rauch (SuperTIGER) – Washington University in St. Louis
Dr. David Fritts (PMC – TURBO) – GATS Inc
Dr. David Smith (E-MIST) – NASA Ames Research Center
Dr. James Buckley (APTLite) – Washington University
Dr. Alex Meshik (BAS) – Washington University
Mr. Mark Devlin (BLAST) – University of Pennsylvania

Hand Launches:
Mr. Robert Salter (TravalB) – Columbia Scientific Balloon Facility

Suspended Payload Weights: BLAST ~ 6910 lbs.
SuperTIGER ~ 6000 lbs.

Hand launch TravalB ~ 70 lbs.

Item	**Type**	**Hazard**
Collar Release	Guillotine Cutter	Moderate Fire/No Blast
Balloon Termination Fitting	Guillotine Cutter	Moderate Fire/No Blast
Payload/Parachute Separation	Guillotine Cutter	Moderate Fire/No Blast
Helium Tanks/Hoses	Pressure System	Rupture/Mass Projection
Balloon Restraining Spool	Stored Energy	Impact/Crushing
Launch Vehicle	Mobile Crane	Impact/Crushing

Launch Area:
Launch Location: McMurdo Station, Antarctica
Launch Site: LDB Launch Site, Ross Ice Shelf Launch
Launch Date: No earlier than November 2019

Launch Vehicle:

Pre-Launch Danger Area	96 m (315 ft.) radius circle about the Launch Vehicle (LV) plus a 96 m (315 ft.) radius circle about the Spool / Helium Truck with parallel (leg) lines connecting the outer edges of both circles at their centerlines, and running along either side of the Flight Train (up to 240 m (790 ft.) long)
Launch Danger Area	152 m (500 ft.) additional buffer area around the Launch Limit Area (LLA) provided in the Flight Safety Plan

Launch Hazard Area	See Flight Safety Plan

Subsystems:

Helium Truck	15 m (50 ft.) radius
Flight Train	46 m (150 ft.) minimum, to 96 m (315 ft.), maximum, along each side
Restraining Spool	30.5 m (100 ft.) radius
Launch Vehicle	96 m (315 ft.) radius
Balloon Inflation Hose	96 m (315 ft.) radius
Collar Release (Cat 2B)	3 m (10 ft.) radius

Personnel Restrictions:

Only mission essential personnel are permitted within the Launch Limit Area (LLA). Center essential personnel are permitted in the Launch Danger Area (LDA) provided they are sheltered. The LLA and LDA are provided by the Flight Safety Plan. Non-essential personnel are not permitted within any hazard area. The Mission Range Safety Officer (MRSO) will be apprised by Mission Manager (MM) or Campaign Manager (CM) to enact “CLEAR RANGE” status 10 minutes prior to the completion of inflation. The MRSO must be contacted prior to permitting non-essential personnel to enter the range area at the perimeter of the LDA (See Figure 1-1). For specific personnel restrictions regarding the Launch Hazard Area (LHA) please see the Flight Safety Plan (FSP).

2.0 SCOPE

This plan identifies the hazardous systems which exist on these NASA balloon vehicles and individual payloads, and defines the hazardous system classification for each hazardous system. Depending on the safety category during various launch operations, restrictions may be imposed on NASA personnel, NASA contractors, and experimenters, who will be referred to hereafter as the Mission Team (see 8.0 PERSONNEL RESTRICTIONS).

The Goddard Space Flight Center (GSFC), Wallops Flight Facility (WFF) and NASA Balloon Program Office (BPO) provide mission management, and the Columbia Scientific Balloon Facility (CSBF) provides engineering and operations support.

This Balloon Campaign will be conducted at LDB Launch Site, Ross Ice Shelf Launch, McMurdo Station, Antarctica, for BPO. It consists three primary missions.

Campaign Missions

1) BLAST (Balloon Borne Large Aperture Submillimeter Telescope) - Galactic magnetic fields can polarize submillimeter-emitting micron-sized dust

particles in star forming regions. The resulting emission is slightly polarized. By measuring the level of polarization, BLAST can help determine if magnetic fields are a dominant force over turbulence in regulating star formation in our Galaxy.

2) Super-TIGER (Super Trans-Iron Galactic Element Recorder) is a large-area instrument for measurement of the abundances of elements. It will test and clarify the emerging model of cosmic-ray origin in OB associations and will measure the energy spectra of the more abundant elements. Super-TIGER will accommodate Missions of Opportunity: Exposing Microorganisms in the Stratosphere (EMIST), PMC-Turbo Instrumentation, Balloon Air Sampling (BAS) and APTLite (Advanced Particle-astrophysics Telescope). BAS and APTLite do not pose any safety hazards.

3) TravalB (Trajectory Validation Mission – Barrel), formerly GUSTO PATHFINDER (Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory), will provide stratospheric SPB trajectory verification for a simulated GUSTO mission.

3.0 SAFETY RESPONSIBILITIES

All personnel in the performance of their duties, working directly with or in support of this project, shall comply with Federal, State, and NASA health, safety, and environmental regulations and procedures applicable to the operation being performed.

The NASA MRSO, the BPO MM, the CSBF CM, CSBF Crew Chief (CC), and the Operations Safety Specialist (OSS) share responsibility (within the limits of their jurisdiction) for implementing this Ground Safety Plan (GSP) and for the safe performance of operations associated with this campaign.

The MRSO and OSS have the authority to make real-time decisions concerning safety for the mission as long as there are no violations of the safety requirements stated in GSFC-STD-8009. The MRSO has the authority to make changes to this GSP as long there are no violations of GSFC-STD-8009.

The BPO MM will provide project oversight and facilitate a working relationship with the OSS and CSBF personnel on behalf of the BPO Contracting Officer Representative and WFF Safety Office. The BPO MM will complete the Mission Manager Launch Procedure and provide clearance per the launch commit criteria to the CSBF CM to proceed for launch. The BPO MM shall serve as the Chair of the Interim Response Team (IRT) in the case of a contingency and will identify and brief the roles of the IRT at the Flight Readiness Review.

The CSBF CC will direct the movement and operation of all heavy equipment used in balloon launch operations in such a way as to ensure safe conduct of launch operations. The CSBF CC shall verify that all launch equipment is configured in accordance with the approved mechanical certification provided by the CSBF

Engineering Department.

The Experimenter is responsible for supplying documentation to CSBF and BPO identifying hazards and control methods. The typical payload hazards are identified in the Balloon Flight Support Application and the Ground Safety Data Request Form. Hazards will be identified in the user request for support, and reviewed and approved by CSBF and Safety Office personnel. Mission specific payload hazards will be covered separately in Section 11.

3.1 Personal Exposure Limits

NASA Balloon Program personnel hazard restrictions apply to operational staff, scientific payload staff, and visitors/spectators. Potential exposure restrictions vary according to operational phase and operational locations. The cardinal rule observed during any hazardous operation (fire risk, explosive systems, high pressure systems, toxic materials, radioactive materials, RF radiation, high energy impacts, heavy equipment operation, electrical shock, and laser systems) will be to limit the exposure to a minimum number of personnel consistent with safe and efficient operations. Operations will be structured such that, should an incident occur, it will cause the least possible injury to personnel and damage to facilities and property.

Mission essential personnel will be excluded from exposure to ground operational hazards except where they are required to perform specific operations and procedures to a payload during a launch operation. Nonessential personnel will not be permitted in ground and launch operational hazard areas.

4.0 HAZARDOUS SYSTEMS

Refer to Section 1.0 for a list of the hazardous systems onboard the Balloon Vehicle. Approximate locations of hazardous systems are shown on Figures 1-2 and 1-3. Details of the hazardous systems and inhibits used to decrease those hazards are delineated in the Risk Analysis Report (RAR) Balloon Launch Vehicles, 803-GS-RAR-BPO-BALLOONS-01H, published under a separate cover and located at \\Wff-lynx\Code803NEW\Documents\Approved Safety Documents/Risk Analysis Reports\Ground Safety RARs.

A description of the hazards and safety precautions for the other payload instruments are included in the payload hazard summaries in Section 11. These hazard summaries include hazardous systems, requirements, hazardous systems classification, danger areas, personnel restrictions and operational procedures.

5.0 EXPLOSIVES STORAGE INFORMATION

Storage Hazard Classifications

The following list includes all flight pyrotechnics on this mission and indicates their hazard classifications/divisions and compatibility groups per NASA-STD-8719.12A.

Item Nomenclature	DoT EX #	Hazard Classification (1)		
		Class	Div.	Comp. Grp
Collar Release: PacSci 6800-X (Qty. 2)	EX1993050092	1	4	S
Balloon Termination: PacSci 6803-X (Qty. 2)	EX2011011822	1	4	S
Parachute/Payload Sep.: PacSci 6802-X (Qty. 1)	EX2011011822	1	4	S

Notes

(1) Hazard classifications were taken from the Department of Transportation's Competent Authority memorandum, or the manufacturer's Safety Data Sheets.

6.0 HAZARDOUS SYSTEMS CLASSIFICATION

The systems listed below are always Category 2 B-State hazards because premature actuation poses no danger to personnel nor damage to property:

- The Collar Release system
- The Balloon Terminate system
- The Parachute/Payload Separation system

7.0 DANGER AREAS

The **PLDA** for the balloon launch vehicle is defined by a 96 m (315 ft.) radius circle about the Launch Vehicle (LV) plus a 96 m (315 ft.) radius circle about the Spool / Helium Truck with parallel (leg) lines connecting the outer edges of both circles at their centerlines, and running along either side of the Flight Train (up to 240 m (790 ft.) long) (Figure 1-4). The PLDA for hand launches is similar to that of a LV except with a shorted Flight Train distance of 63 m (207 ft.) (Figure 1-5).

The **LDA** for the balloon launch vehicle is defined as a 152 m (500 ft.) Buffer Area around the LLA (Figure 1-1). The LDA is established when the CSBF Balloon Terminate System (BTS) is armed at the end of inflation. Access controls will be established to exclude **ALL** personnel from the LDA with the exception of the vehicle operators and mission essential personnel. The LDA remains in effect until the MRSO releases the area after a successful balloon launch event or not until helium is released from the balloon envelope while still restrained by the spool in the event of a captive abort. In the event of an active abort, the LDA will remain in effect until the MRSO has deemed the event is complete and there are no further hazards associated with the event. The LLA restricts the LV's travel and is an area agreed upon by the Safety Office and the BPO.

The **LHA** shall be defined by the WFF Safety Office and published in the Flight Safety

Plan (FSP), 803-FS-FSP-BPO-ANT2018/19-01A, which is published under a separate cover on file at WFF Safety Office, Code 803, Public Directory, \\Wff-lynx\Code803NEW\Documents\Approved Safety Documents\Flight Safety Plans\Balloons. The LHA must be in place prior giving the GO to start inflation.

Information regarding transmitters can be found in the payload hazards summaries located in Section 11.

Additional information can be found at the following link: \\Wff-lynx\Code803NEW\Documents\Approved Safety Documents/Risk Analysis Reports\Ground Safety RARs then go to latest revision of Balloon RAR.

8.0 PERSONNEL RESTRICTIONS

Prior to balloon release from spool, the MRSO and/or their designee will ensure the PLDA and LDA are clear as defined in this GSP (Reference Figures 1-4 and 1-1), of all personnel not actively participating in launch operations, privately owned vehicles (POVs), superfluous equipment and other impedimenta.

Only mission essential personnel will be permitted in the **LDA** when the CSBF Balloon Terminate System (BTS) is armed at the end of inflation until the “ALL CLEAR” is given by the MRSO after launch or a launch abort.

8.1 Pyrotechnic Systems

Personnel are permitted to be in the area during operations such as power switching, power ON and RF radiation as these systems are inherently safe. Section 6.0 HAZARDOUS SYSTEMS CLASSIFICATION defines those conditions, which make potentially hazardous systems Category 2B.

Active essential personnel performing specific tasks may be permitted in the hazardous system's Danger Areas when the above conditions are not in effect and with the OSS’s permission.

Cell Phones and other personal communication devices shall not be allowed in danger areas during the mission. Personal communication devices create an unnecessary distraction during hazardous operations. It is required that all personal communication devices be left in personal vehicles, or left in the care of someone not involved in or around the hazardous operations.

8.2 High Pressure Systems

There are no high pressure systems contained onboard the Balloon LV. A Helium Truck Inflation System is used at the launch site prior to launch. This system is composed of a truck loaded with helium tanks (isopacks) and the inflation hose(s)/diffuser(s). The hazard area for the Helium Truck Inflation

Vehicle is 15 meters (50 feet) centered on the vehicle. There also exists an Inflation Hose/Diffuser set up. The hazard area for this is 96 meters (315 feet) centered on the connection to helium tanks.

If not DOT approved tube bank trailer, notify NASA Safety Office before use for evaluation by the NASA Pressure Systems Manager (PSM).

8.3 Personal Protective Equipment

Personnel shall wear/use:

- Static dissipative outer garments (e.g., labcoats or overalls) when working around electro-explosive devices, or any other device that contains an energetic material.
- Grounded wrist straps when handling electro-explosive devices or exposed energetic materials. After the hazardous operation is completed, the wrist straps are removed.
- Appropriate footwear and hard hats during lifting and launch operations.
- Hearing protection during inflating/venting or high noise environments.
- An oxygen meter during indoor nitrogen purges.
- Employees shall wear a reflective vest meeting the requirements of ANSI/ISEA 107-2015, American National Standard for High-Visibility at all hours (day or night). This includes CSBF, BPO, RSO, Science Team, and any other personnel working anywhere near the balloon equipment (this would include ALL operation involving the use of the Launch Vehicle, and/or Spool Vehicle, and/or Helium Trucks). This includes hang tests, compatibility tests and any other movement of the vehicles in or out of the storage facilities and hangars. Static dissipative outer garment shall not be worn under reflective vests during hazardous operations. The OSS shall wear the reflective vest in this circumstance since he/she is only observing this operation.
- Eye protection and cold insulating gloves shall be worn when exposure to cryogenics is possible. Appropriate articles of clothing shall be worn to ensure no exposed skin, including closed-toe shoes and pants.
  For further information please refer to the 800-PG-1700.1.1, Wallops Flight Facility Personal Protective Equipment Program.

8.4 Operations Under Threat of Electrical Storm:

800-WI-8715.2.1B, Severe Weather Notification and GSFC-STD-8009 provide instructions for personnel concerning impending serve weather conditions during hazardous operations that impact mission operations at McMurdo Station.

An early warning system for electrical storms is not available at McMurdo Station, therefore outdoor hazardous operations shall cease and be cleared whenever thunder is heard. In general, thunder can be heard up to 13 km (8

miles depending on winds, weather, etc.) away.

9.0 HAZARDOUS CIRCUITS APPROVAL

Hazardous circuits are contained in the balloon vehicle. A Safety Review of the vehicle electro-explosive circuits has been conducted by WFF Safety Office personnel; the results are documented in the Risk Analysis Report (RAR) for Balloon Launch Vehicles, 803-GS-RAR-BPO-BALLOONS-01H. A copy of that report can be obtained from the NASA WFF Code 803 Safety Office and is located at \\Wff-lynx\Code803NEW\Documents\Approved Safety Documents/Risk Analysis Reports\Ground Safety RARs. Wallops Safety Office personnel have determined that all hazardous event initiation circuits employed on these missions comply with the requirements of GSFC-STD- 8009.

10.0 OPERATIONAL PROCEDURES

Prelaunch and launch operations will be conducted in accordance with the procedures listed below.

10.1 Balloon Launch Vehicle Procedures

OF-603-02-P, Rev B	Launch Equipment Configuration Certification (LECC)
ES-100-20-P, Rev E	CSBF Ordnance Preflight/Flight Line/Post Flight Procedures
OF-322-15-C, Rev A	Balloon Inflation (BI) Operations Procedure
OF-434-00-C, Rev A	Helium Compression Hazardous Procedure
820-FORM-2013-1, Rev H	BPO Mission Manager Launch Procedure

10.2 Experiment/Payload Procedures

820-PROC-2018-09	BLAST Cryogen Transfer Operations SuperTIGER LN2 Dewar Handling Procedure

10.3 NASA / WFF Policy Guidelines

NPR 1800.1D Chapter 2	NASA Operational Health Program Procedures Section 2.14 Shift Work
820-MPCP-2019-01	Mishap Preparedness and Contingency Plan
800-PG-1700.1.1	Wallops Flight Facility Personal Protective Equipment Program
800-PG-8715.5.1	Range Safety Process for Programs and Projects
GSFC-STD-8009	Goddard Space Flight Center (GSFC) Wallops Flight Facility Range Safety Manual (RSM)
800-WI-8715.2.1B	Severe Weather Notification
GSFC-STD-8715.1	GSFC Safety Standard for Explosive Safety

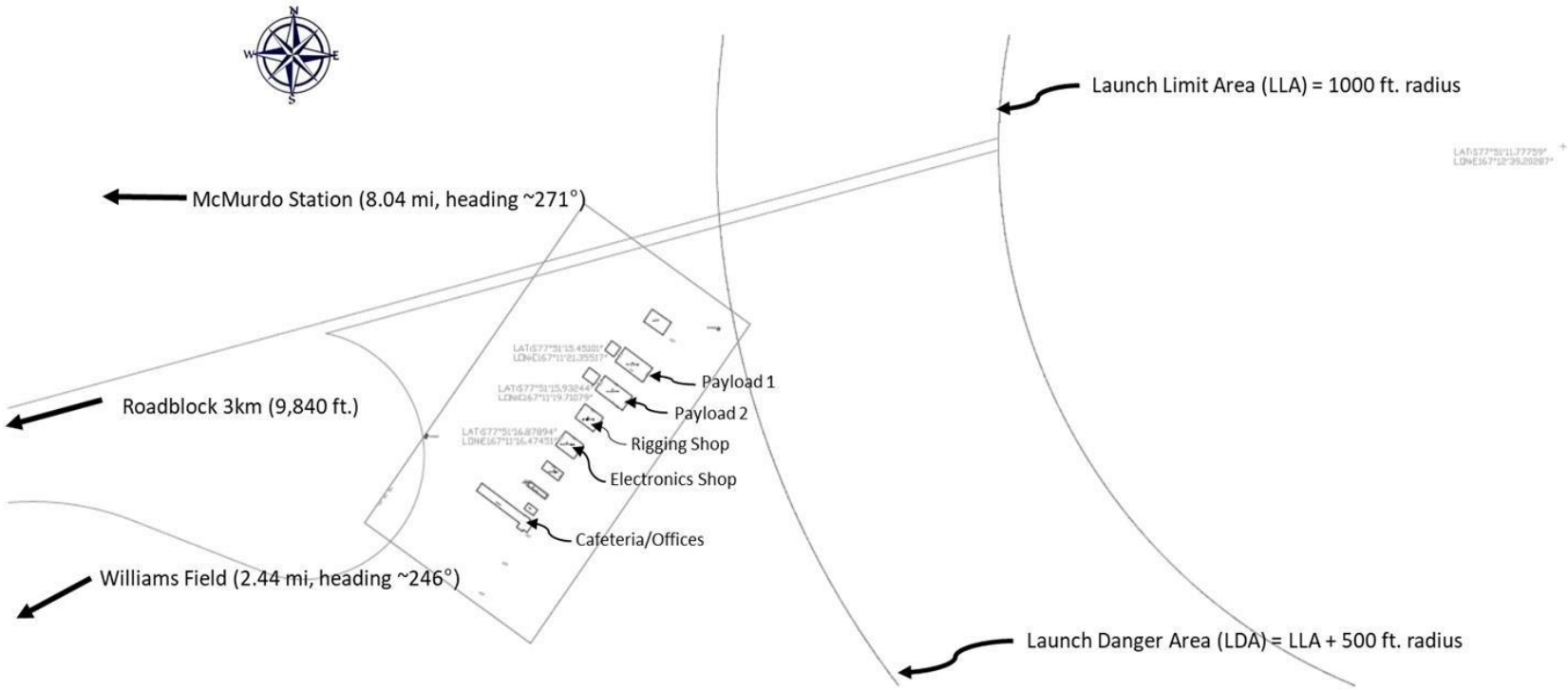

Figure 1-1 Launch Limit Area & Launch Danger Area (LLA and LDA)

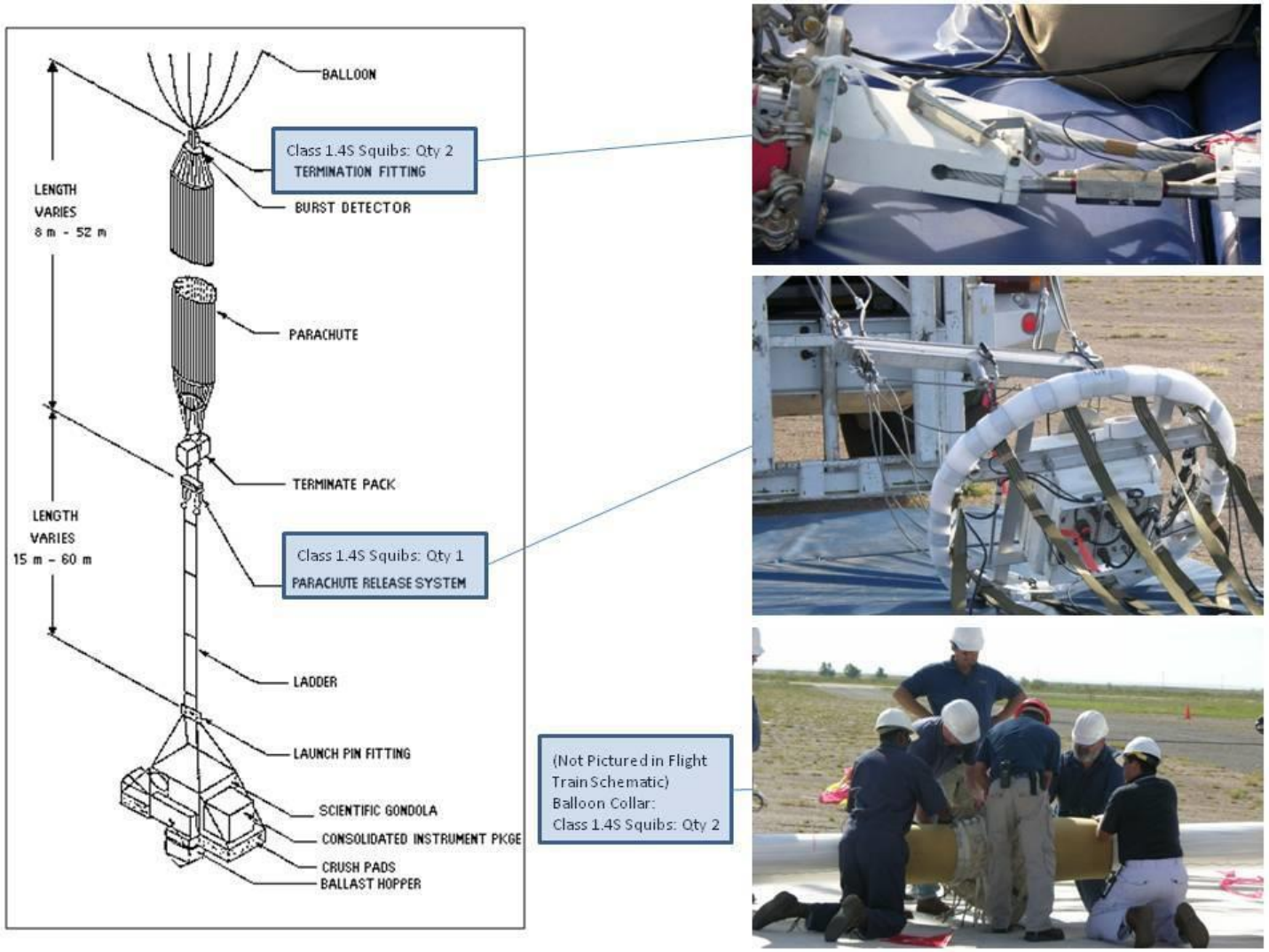

Figure 1-2 Location of Hazardous Systems

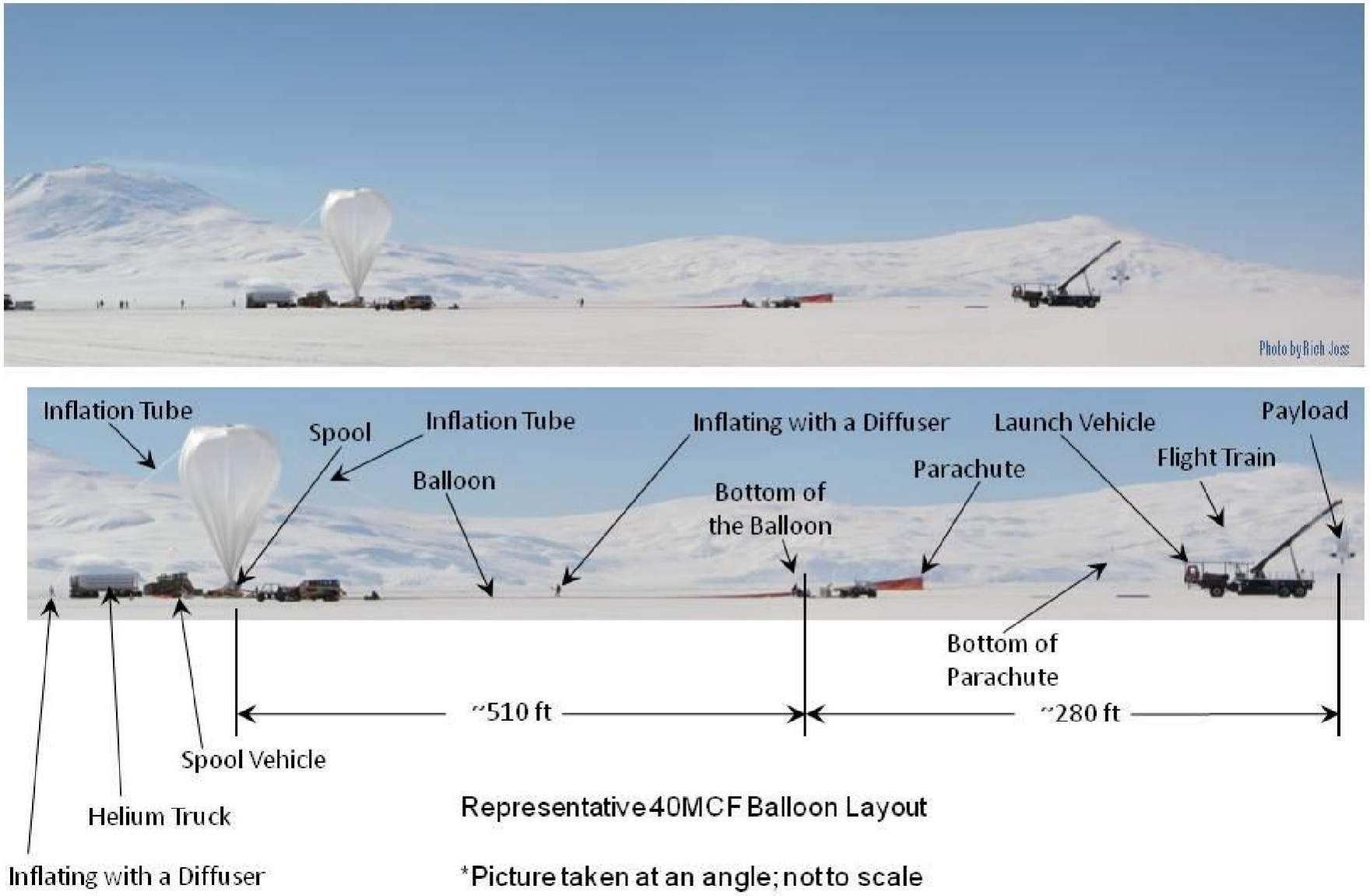

Figure 1-3 Location of Hazardous Systems with Vehicles

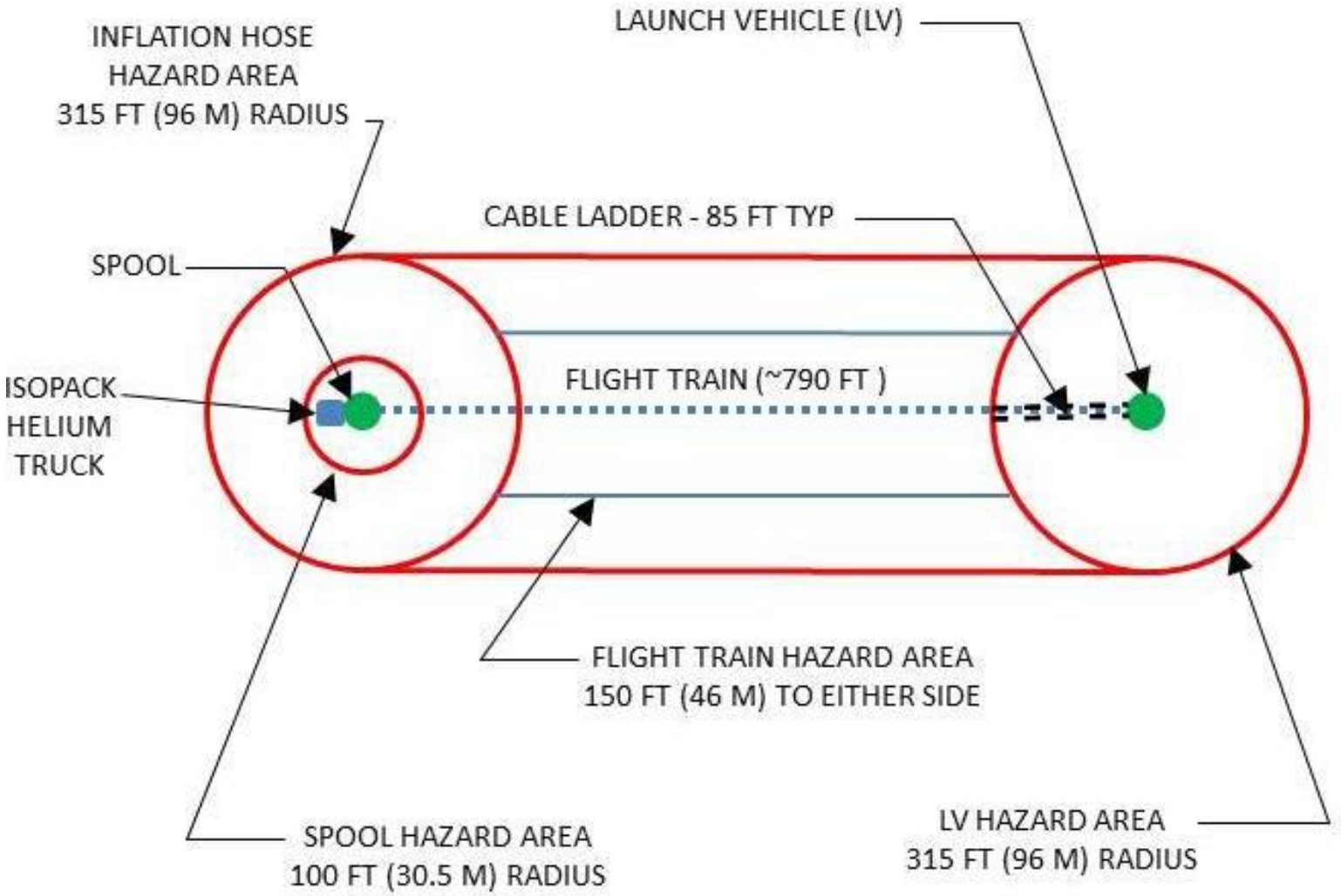

Figure 1-4: Pre-Launch Danger Area (PLDA)

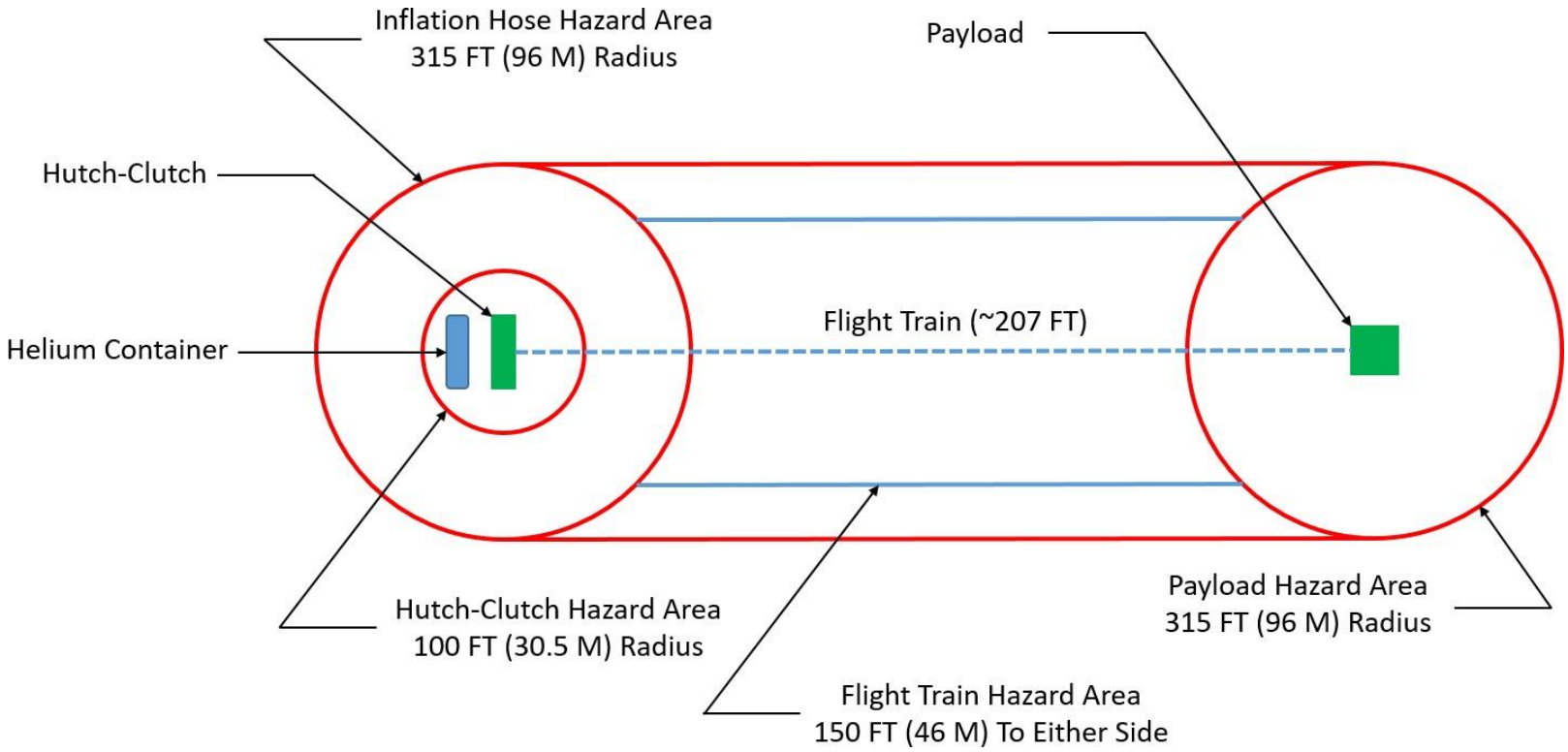

Figure 1-5: Hand Launch Pre-Launch Danger Area (PLDA)

11.0 MISSION SPECIFIC PAYLOAD HAZARD SUMMARIES

The payload safety hazard summaries and safety data sheets listed below are included on the following pages:

1) Super-TIGER Hazard Summary
2) BLAST Hazard Summary
3) TravalB 1 & 2 Hand Launch Hazard Summary

Hazard Summary 1: SuperTIGER (Super Trans-Iron Galactic Element Recorder)

The following missions of opportunity pose safety hazards:
- EMIST
- PMC Turbo

Chemical

The SuperTIGER experiment does not contain any chemicals.

Cryogens

The SuperTIGER payload utilizes low pressure gaseous nitrogen purge generated by vaporization of the liquid nitrogen (LN2) Dewar. To prevent inadvertent open of LN2 dewar liquid supply valve and cryogen spraying to personnel, this valve shall be covered, locked and tagged out at close position per SuperTIGER LN2 Dewar Handling Procedure. This procedure has been reviewed and concurred upon by the PI, BPO, and Code 803 Safety Office.

The mission of opportunity PMC-Turbo contains pressure systems that are exempt from pressure systems certification and inspection due to low pressure (0 psig.) and small volume. Filling of this pressure system must be done by using CSBF's certified pressure regulator assembly. This system has been reviewed and approved by the Pressure Systems Manager.

Laser

The SuperTIGER experiment does not contain any lasers.

Pressure Systems

The SuperTIGER payload contains the following pressure vessel system hazards that have been reviewed and approved by the Pressure Systems Manager.
Super-TIGER contains pressure systems that are exempt from pressure systems certification and inspection due to low pressure (0 psig.) and small volume.
Filling of this pressure vessel must be done by using CSBF's certified pressure regulator assembly.

Radioactive Materials

The SuperTIGER does not contain any radioactive materials.

Batteries

The SuperTIGER payload is powered by lead acid batteries. The mission of opportunity

E-MIST is powered by sealed lead acid batteries. These batteries are potted and enclosed such that there is no leak path for stray voltage to contact any personnel, ordnance or flammable items. No modifications will be made to these batteries. These batteries have been reviewed and approved by the Code 803 Safety Office.

Radio Frequency Emitters

The SuperTIGER Payload uses standard supplied air and ground transmitters. These transmitters have been analyzed for Hazards of Electromagnetic Radiation to Personnel (HERP) and Hazards of Electromagnetic Radiation to Ordnance (HERO) safe standoff distances (SSD). The Radio Frequency Safety Officer approves CSBF transmitters which is documented in docket number RF19-223-00 form GSFC 23-6 RF and the RF Safety Plan for the SuperTIGER mission. Hazards of Electromagnetic Radiation to Ordnance (HERO) Safe Separation Distance (SSD) calculations were performed following the process outlined in GSFC Safety Standard for Explosive Safety, GSFC-STD-8715.1 revision A.

The SuperTIGER poses an RF hazard. Results of the HERP and HERO calculations are listed and safety precautions are described below. There is the potential to have multiples of the RF transmitters listed below.

Table 1-1 HERO & HERP SSDs for the SuperTIGER Payload

Docket Number / ID / Location	Safe Separation Distance (SSD)	
	HERO	HERP
	Minimum Required	Minimum Required
RF17-142-00 Upper L-Band Emitters - Mobile	10 ft.	0.5 ft.
RF17-143-00 S-Band 15 ft. Mhz Emitters - Mobile	10 ft.	0.5 ft.
RF17-148-00 L-Band Emitters - Mobile	10 ft.	0.3 ft.
RF17-151-00 CSBF TDRSS - Mobile	10 ft.	0.3 ft.
RF17-152-00 CSBF Iridium SBD - Mobile	10 ft.	0.2 ft.
RF17-153-00 CSBF Iridium Pilot - Mobile	10 ft.	N/A
RF17-154-00 CSBF Command UpLink - Mobile	10 ft.	N/A

Docket Number / ID / Location	Safe Separation Distance (SSD)	
	HERO	HERP
	Minimum Required	Minimum Required
RF18-274-00 ACER Collar - Mobile	10 ft.	0.1 ft.

The user of the transmitter can present an operational need for the transmitter to be closer than HERO SSD identified above to the GSFC Explosive Safety Officer (ESO). The ESO may grant a temporary exception to the identified minimum SSD.

High Voltage

The SuperTIGER component has a high voltage system, which supports a COTS photomultiplier tube operating at voltages up to 1250V. These power supplies are distributed among 24 electronics boxes. All high voltage is potted or within high voltage and low pressure-rated coaxial cables and connectors.

Biological Hazards

The EMIST mission of opportunity contains bacteria that have a biological hazard rating of 1. These bacteria are safely contained inside the payload and have been reviewed and approved by the National Science Foundation and the NASA WFF Industrial Hygienist.

Safety Data Sheets

Safety Data Sheets for all hazardous chemicals, batteries, gases and cryogens are required to be posted in the immediate workspace where the hazard is being operated on and stored.

HAZARDOUS SYSTEMS CLASSIFICATION

The SuperTIGER experiment's hazardous systems are considered Category 2 B-State.

DANGER AREAS

With the exception of the Pre-Launch Danger Area (PLDA), Launch Danger Area (LDA) and Launch Limit Area (LLA), there may be other danger areas established for certain hazardous systems (other experiments as discussed in the GSP) which require coordination by the OSS.

PERSONNEL RESTRICTIONS

Personnel shall always be kept at the absolute minimum when dealing with hazardous systems.

OPERATIONAL PROCEDURES

SuperTIGER LN_2 Dewar Handling Procedure

Hazard Summary 2: BLAST (Balloon Borne Large Aperture Submillimeter Telescope)

Chemical

The BLAST payload does not contain any chemicals.

Cryogens

The BLAST payload utilizes liquid nitrogen (LN2) for pre-chilling flight cryostat prior to filling with liquid helium (LHE). BLAST will use a Cryogen Transfer Operations procedure that is approved by NASA WFF Pressure Systems Manager prior to any hazardous operations Safety precaution and PPE use as stated in the procedure must be adhered.

Laser

The BLAST payload does not contain any lasers.

Pressure Systems

The BLAST payload contains pressure system (pressure regulator assembly) that has been reviewed and approved by the Pressure Systems Manager. BLAST contains a flight cryostat. Pressurization of this cryostat assembly must be done by using BLAST-TNG pressure regulator assembly which has been reviewed and approved by the PSM or using CSBF's certified pressure regulator assembly.

Potential hazards from pressure systems are projectile and fragmentation from failed components and whipping from flexible hose. Asphyxiation is also a hazard from gaseous nitrogen if it is vented or leaked in areas with no ventilation.

- Gases shall not be utilized in a confined space.
- Inspect cylinders, fittings, gauges, and hoses.
- Confirm currency of cylinder hydrostatic testing.
- Inspect cylinder installation for protection of valve end damage.
- Restrict cylinder handling, with regard to movement on and off the gondola, to trained personnel.

Radioactive Materials

The BLAST payload experiment does not contain any radioactive materials.

Batteries

The BLAST payload is powered by lead acid batteries. These batteries are potted and enclosed such that there is no leak path for stray voltage to contact any personnel, ordnance or flammable items. No modifications will be made to these batteries. These batteries have been reviewed and approved by the Code 803 Safety Office.

Radio Frequency Emitters

The BLAST payload uses standard supplied air and ground transmitters. These transmitters have been analyzed for Hazards of Electromagnetic Radiation to Personnel (HERP) and Hazards of Electromagnetic Radiation to Ordnance (HERO) safe standoff distances (SSD). The Radio Frequency Safety Officer approves CSBF transmitters which is documented in docket number RF19-222-00 form GSFC 23-6 RF and the RF Safety Plan for the BLAST mission. Hazards of Electromagnetic Radiation to Ordnance (HERO) Safe Separation Distance (SSD) calculations were performed following the process outlined in GSFC Safety Standard for Explosive Safety, GSFC-STD-8715.1 revision A. The BLAST payload poses an RF hazard. Results of the HERP and HERO calculations are listed and safety precautions are described below. There is the potential to have multiples of the RF transmitters listed below.

Table 2-1 HERO & HERP SSDs for the BLAST Payload

Docket Number / ID / Location	Safe Separation Distance (SSD)	
	HERO	HERP
	Minimum Required	Minimum Required
RF17-142-00 Upper L-Band Emitters - Mobile	10 ft.	0.5 ft.
RF17-143-00 S-Band 15 ft. Mhz Emitters - Mobile	10 ft.	0.5 ft.
RF17-148-00 L-Band Emitters - Mobile	10 ft.	0.3 ft.
RF17-151-00 CSBF TDRSS - Mobile	10 ft.	0.3 ft.
RF17-152-00 CSBF Iridium SBD - Mobile	10 ft.	0.2 ft.
RF17-153-00 CSBF Iridium Pilot - Mobile	10 ft.	N/A
RF17-154-00 CSBF Command UpLink - Mobile	10 ft.	N/A
RF18-274-00 ACER Collar - Mobile	10 ft.	0.1 ft.

The user of the transmitter can present an operational need for the transmitter to be closer than HERO SSD identified above to the GSFC ESO. The ESO may grant a temporary exception to the identified minimum SSD.

High Voltage

The BLAST payload does not contain high voltage sources.

Safety Data Sheets

Safety Data Sheets for all hazardous chemicals, batteries, gases and cryogens are required to be posted in the immediate workspace where the hazard is being operated on and stored.

HAZARDOUS SYSTEMS CLASSIFICATION

The BLAST payload hazardous systems are considered Category 2 B-State.

DANGER AREAS

With the exception of the Pre-Launch Danger Area (PLDA), Launch Danger Area (LDA) and Launch Limit Area (LLA), there may be other danger areas established for certain hazardous systems (other experiments as discussed in the GSP) which require coordination by the OSS.

PERSONNEL RESTRICTIONS

Personnel shall always be kept at the absolute minimum when dealing with hazardous systems.

OPERATIONAL PROCEDURES

820-PROC-2018-09 BLAST Cryogen Transfer Operations

Hazard Summary 3: TravalB 1 & 2 (Trajectory Validation Mission – Barrel)

Chemical

The TravalB mission does not contain any chemicals.

Cryogens

The TravalB experiment does not contain any cryogens.

Laser

The TravalB experiment does not contain any lasers.

Pressure Systems

The TravalB experiment does not contain any pressure systems.

Radioactive Materials

The TravalB experiment does not contain any radioactive materials.

Batteries

The TravalB experiment is powered by lead acid batteries. These batteries are potted and enclosed such that there is no leak path for stray voltage to contact any personnel, ordnance or flammable items. No modifications will be made to these batteries. These batteries have been reviewed and approved by the Code 803 Safety Office.

Radio Frequency Emitters

The TravalB experiment uses standard supplied air and ground transmitters. These transmitters have been analyzed for HERP and HERO SSD. The Radio Frequency Safety Officer approves CSBF transmitters which is documented in docket number RF19-224-00 and RF19-225-00 form GSFC 23-6 RF and the RF Safety Plan for the TravalB missions. Hazards of Electromagnetic Radiation to Ordnance (HERO) Safe Separation Distance (SSD) calculations were performed following the process outlined in GSFC Safety Standard for Explosive Safety, GSFC-STD-8715.1 revision A.

The TravalB poses an RF hazard. Results of the HERO and HERP calculations are listed and safety precautions are described below. There is the potential to have multiples of the RF transmitters listed below.

Table 3-1 HERO and HERP SSDs for the TravalB Experiment

Docket Number / ID / Location	Safe Separation Distance (SSD)	
	HERO	HERP
	Minimum Required	Minimum Required
RF19-297-00 CSBF Iridium SBD - Mobile	10 ft.	0.1 ft.

The user of the transmitter can present an operational need for the transmitter to be closer than HERO SSD identified above to the GSFC ESO. The ESO may grant a temporary exception to the identified minimum SSD.

High Voltage

The TravalB X-Ray Detector component has a high voltage system, operating at voltages up to 800V. All high voltage is enclosed in potting material inside detector casing.

Safety Data Sheets

Safety Data Sheets for all hazardous chemicals, batteries, gases and cryogens are required to be posted in the immediate workspace where the hazard is being operated on and stored.

HAZARDOUS SYSTEMS CLASSIFICATION

The TravalB experiment's hazardous systems are considered Category 2 B-State.

DANGER AREAS

With the exception of the Pre-Launch Danger Area (PLDA), Launch Danger Area (LDA) and Launch Limit Area (LLA), there may be other danger areas established for certain hazardous systems (other experiments as discussed in the GSP) which require coordination by the Operations Safety Specialist, OSS.

PERSONNEL RESTRICTIONS

Personnel shall always be kept at the absolute minimum when dealing with hazardous systems.

OPERATIONAL PROCEDURES

820-FORM-HANDLAUNCH-2019-4, Mission Manager Hand Launch Procedure