1.2.1.4 Landing System Overview

The landing system for the BlueSky vehicle consists of two main items—the parachute system and the landing gear.

The parachute system is housed in the nose cone structure, and is maintained at cabin temperature and pressure throughout the flight. The parachute system consists of a small drogue chute and a much larger main parachute. The pilot activates the deployment of both parachutes. The pilot deploys the drogue chute after atmospheric reentry to begin the initial deceleration of the vehicle as well as to rotate the vehicle to vertical. Once the vehicle reaches a vertical orientation, the pilot deploys the main parachute for the remainder of the descent.

The landing gear is housed in the aft structure of the vehicle. The landing gear consists of four landing struts that are extracted from four structural housings mounted inside the aft structure at four points of the circle. Figure 6 shows the location of the landing gear. The landing gear extends from the aft structure using high-tension springs. Once deployed, there is no on-board retraction capability for the landing gear. The pilot actuates the landing gear using a lever on the instrument panel on the left side of the center console after the parachute has fully deployed and the vehicle is in a stable descent. Though the normal operation of the vehicle calls for the main rocket engine to relight for a powered landing, the landing gear is designed to withstand the forces of an un-powered landing with just the parachutes.

The last phase of the landing occurs at an altitude of approximately 200 ft, when the main rocket engine relights for approximately 10 seconds to provide the final deceleration before touchdown.

1.2.1.5 Avionics and Guidance System Overview

The avionics and guidance system is composed of a central processor and a navigation box. The central processor, housed in the nose of the vehicle, controls the navigation and vehicle status functions. The navigation box houses the navigational sensors, including three-rate gyros, three accelerometers, two altitude-reporting systems, two Global Positioning System (GPS) receivers and antennas, and a telemetry transmitter and antenna. The two GPS antennas and the UHF telemetry antenna are mounted to the outer surface of the top of nose structure, flush with the surface. The information from the processor and the navigation unit is delivered to the pilot through two colored LCD monitors mounted on the center console in front of the pilot. The pilot can track important flight parameters such as altitude, position, velocity, vehicle orientation, projected instantaneous impact point (IIP), and propellant quantities. The fuel and oxidizer tank quantity gauges on the display are marked with a blue line that signifies the point at which the pilot should end the firing of the rocket engine during ascent. A warning system will provide the pilot with audible and visual signals when safe operating ranges of safety-critical flight parameters are exceeded. The central processor also contains a data storage unit that stores all of the vehicle parameters, such as position, velocity, attitude, accelerations, etc., for each flight. This data will be used to conduct the post-flight analysis, as well as to support any anomaly or mishap investigations.

The communication system consists of an audio panel on the right side of the center console controlling two communications transceiver radios. The antennas for both radios are mounted to the outer surface of the nose structure in separate positions to allow contact for all possible vehicle attitudes. Only the pilot is wired to the audio panel for radio transmit capabilities. A push-to-talk control for the pilot is located on the center control stick. Our communication system allows for real-time communication between our Ground Command Station and the pilot, as well as real-time communication between the Ground Command Station and ATC. Communications between ATC, Ground Command Station, and pilot that may affect the safety of the flight are recorded at our Ground Command Station.

1.2.1.6 Flight Control System Overview

The main flight controls for the pilot consist of the center control stick for pitch, roll, and yaw control. By moving the center control stick the pilot initiates electrical switches that control the firing of the correct combination of RCS thrusters. In addition to controlling the pitch, roll and yaw, the center control stick also has a push-to-talk control for the pilot to operate the radios as described in the Avionics and Guidance System Overview section and an engine on/off Fail-Safe Switch to control the fuel and oxidizer flow valves of the main engine. This Fail-Safe Switch is designed such that the rocket shuts down if the pilot releases the switch. The pilot holds down the engine on/off switch in order to fire the main rocket engine to begin the ascent, and releases the on/off switch once the vehicle has reached the target burnout conditions. The pilot also activates the engine on/off switch to fire the main rocket engine during landing. The pilot can release the engine on/off control at any time. At that point the rocket engine will stop firing. This capability allows for rocket engine shutoff during emergency conditions.

The instrument panel, located on the left side of the center console, contains the remaining flight controls. Most of these are on/off controls that are used during the various phases of flight. They are the:

- Engine Arm Switch,
- RCS Arm switch,
- Parachute Enable Switch,
- Drogue Chute Deploy Button,
- Main Chute Deploy Button,
- Landing Gear Deploy Lever,
- Battery Select Dial, and
- Oxidizer Dump Switch.

The Engine Arm Switch is activated before launch and enables the engine on/off control on the center control stick. The RCS Arm Switch is also activated before launch and enables the RCS control by the center control stick. The Parachute Enable Switch is activated during atmospheric reentry to enable the drogue and main chute controls. The Drogue Chute Deploy Button is pushed after atmospheric reentry to deploy the drogue chute to initiate deceleration of the vehicle as well as to rotate the vehicle to vertical. The Main Chute Deploy Button is pushed once the vehicle is in a vertical orientation, deploying the main chute for the remainder of the descent. The Landing Gear Deploy Lever is used to lower the landing gear after the parachute has fully deployed and the vehicle is in a stable descent. Once deployed the landing gear cannot be retracted during the flight.

Using the Battery Select Dial, the pilot can manually select between the two batteries.

The Oxidizer Dump Switch is used to enable the pilot to dump the oxidizer under emergency flight conditions.

1.2.1.7 Environmental Control System Overview

The environmental control system provides environmental conditions that enable the crew to perform their functions properly. It also helps to defog the windows, as well as provides cooling for the vehicle's avionics. Two tanks filled with pressurized air at 5000 psi are located in the nose cone of the vehicle. Each tank can provide the required air and pressurization for the entire flight. The pressurized air tanks maintain the crew cabin at near sea level pressure and at room temperature during the entire flight. The conditioned air is also vented through the nose cone of the vehicle to maintain the temperature and pressure of the avionics, flight controls, RCS components, and the parachutes in the nose cone.

The air is circulated throughout the crew cabin using an air conditioning unit that consists of fans, a CO_2 scrubber, and a dehumidifier. A fan is used to draw air into the CO_2 scrubber (which captures CO_2 and removes it from the air) and then into the dehumidifier (which traps moisture to dry the air). This clean dried air is then vented back into the cabin. As stated previously in the Structural System Overview section, a second dehumidifier fan in the nose cone blows re-circulated cabin air between the two windowpanes so that they do not fog over.

The environment of the crew cabin is controlled from the environmental control panel located on the bulkhead to the right of the pilot. One dial controls the main air-conditioning fan, and a second dial controls the window defog fan. Also located on the environmental control panel is a dial for each of the pressurized air tanks. Each of these dials has three settings: off, on, and emergency. For a typical flight, only one of the tanks needs to be turned on. If there is a drop in cabin pressure (caused, for example, by a puncture of the structure), both tanks can be turned to the emergency setting. Air is then vented into the crew cabin to maintain cabin pressure.

The environmental control panel also contains environmental indicator gauges, including gauges for crew cabin pressure, temperature, and relative humidity, as well as gauges for CO_2 and O_2 concentration levels. A warning system will provide the pilot with audible and visual signals when safe operating ranges of these safety-critical flight parameters are exceeded.

1.2.1.8 Pneumatic/Hydraulic System Overview

N/A. The vehicle uses only electro-mechanical actuation, and does not contain any pneumatic or hydraulic systems.

1.2.1.9 Electrical System Overview

Two lithium-ion batteries housed in the nose structure provide the power for the avionics and guidance system, the flight control system, and the environmental control system. Each battery is capable of providing power for all systems for the duration of the flight, providing for dual redundancy. Using the Battery Select Dial, the pilot can manually select between the two batteries.

1.2.1.10 Software and Computing Systems Overview

A list of the functional systems that contain software is provided below. The software safety approaches used follow the FAA/AST *Guide to Reusable Launch and Reentry Vehicles Software and Computing System Safety*.

- Global Positioning System (GPS)
- Inertial Measurement Unit (IMU)
- Flight Display
- Propulsion System Health Monitoring
- Air Data Sensing
- Flight Control Systems
- Environmental Control System Health Monitoring

1.3 Vehicle Purpose [§437.23(b)(4)]

During the experimental phase of the program, the VS-1 will be flown for research and development to test a reusable vertical launch and landing design concept.

1.4 Payload Description [§437.23(b)(5)]

BlueSky plans to fly the Atmospheric CO_2 Sensor Instrument. The Atmospheric CO_2 Sensor Instrument is a scientific payload designed to measure the CO_2 levels at various altitudes during flight.

1.5 Foreign Ownership [§437.23(c)]

BlueSky Aerospace is a 70% American-owned corporation, with 30% foreign interests or participating entities. World Space Launch International, United Kingdom, controls a 30% stake in BlueSky Aerospace.

2. Flight Test Plan

2.1 Flight Test Plan Description [§437.25(a)]

This is an incremental testing program. Our flight test program is scheduled to begin in the fall of 2006. The locations of our tests are the Military Rocket Range and the New Frontier Spaceport. Initial tests will focus on the ground and flight tests of some key systems of our launch vehicle, such as the reaction control system, the parachute deployment system, and the landing system. These tests will provide the verification data to support the mitigation measures of our hazard analysis. Given that these tests do not include the launch of a launch vehicle, they will not require an FAA Experimental Permit. Later tests of our suborbital rocket, the VS-1, will require an Experimental Permit. Table 1 contains a summary of our testing program.

Table 1 Planned Flight Test Summary

Flight Test	Location	Maximum Altitude	Number of Tests	With Pilot	Exp. Permit Required
1. Helicopter drop test, dummy weight	Military Rocket Range	10,000 ft	4	No	No
2. Helicopter drop test, no main engine	Military Rocket Range	10,000 ft	8	No	No
3. Helicopter drop test, with main engine	Military Rocket Range	10,000 ft	6	Yes	No
4. Vertical launch to 40,000 ft	New Frontier Spaceport	40,000 ft	5	Yes	Yes
5. Vertical launch to 328,000 ft	New Frontier Spaceport	328,000 ft	3	Yes	Yes

Flight Test #1: The first set of tests will focus on the parachute deployment system. A dummy weight will represent the vehicle during these tests. We will drop the dummy weight and the attached parachute deployment system from a helicopter at an altitude of 10,000 ft. Once clear of the helicopter, the drogue parachute will deploy, followed by the main parachute. Our ground-based remote control will initiate the parachute deployment sequence.

Flight Test #2: The second set of tests will demonstrate the un-powered landing sequence of our vehicle with a dummy weight in place of the main rocket engine. The helicopter will carry the vehicle aloft to an altitude of 10,000 ft. The helicopter will drop the vehicle with its landing gear fully deployed and locked in place. The pilot will control the RCS thrusters and the parachute deployment from the ground. The vehicle will land un-powered using its main parachute.

Flight Test #3: The third set of tests will demonstrate the powered landing sequence. Our testing helicopter will carry the vehicle to 10,000 ft. The helicopter will then drop the vehicle, with its landing gear fully deployed and locked in place to simulate a typical descent. The pilot will control the RCS thrusters and the parachute deploy from within the vehicle. When the vehicle has descended to an altitude of approximately 200 ft above the ground, the pilot will ignite the main rocket engine to provide the final deceleration until touchdown. As our program progresses the helicopter will drop the vehicle with the landing gear retracted. The pilot will then deploy the landing gear prior to landing.

Flight Test #4: The fourth series of tests requires an FAA Experimental Permit. These tests will originate at the New Frontier Spaceport. The vehicle will be mounted onto its launch stand with enough propellant to carry it to an altitude of 40,000 ft, as well as enough propellant for a powered landing. An altitude of 40,000 ft will provide sufficient margin for the pilot to deploy the parachutes. The pilot will then deploy the landing gear while using the RCS thrusters to vertically stabilize the vehicle. At approximately 200 ft, the pilot will ignite the main rocket engine to decelerate the vehicle until touchdown.

Flight Test #5: The fifth series of tests requires an FAA Experimental Permit. These tests will originate at the New Frontier Spaceport. The vehicle will be mounted on its launch stand with the propellant tanks fully loaded. The pilot will initiate the firing of the main rocket engine carrying the vehicle to an altitude of 328,000 ft. As the vehicle passes back through 30,000 ft, the pilot will initiate the deployment of the drogue parachute, followed by the main parachute. The pilot will then deploy the landing gear and ignite the main rocket engine at approximately 200 ft above the ground for final deceleration and touchdown.

List of Key Flight-Safety Events: For the flights originating at the New Frontier Spaceport, the key flight-safety events are the:

- Main rocket engine ignition,
- Parachute deployment,
- RCS attitude control ignition sequence,
- Powered landing, and
- Envelope expansion flight(s) from 40,000 ft to 328,000 ft.

2.2 Description of Proposed Operating Area(s) [§437.25(b-c)]

The New Frontier Spaceport is located near SpaceCity, MyState. This location lies along the western boundary of the Military Rocket Range, and will benefit from the controlled airspace around the Military Range. The Spaceport encompasses a 27 square mile site consisting of open land with an average elevation of 4,700 ft. The Spaceport facilities include a launch complex, a 12,000 ft runway and aviation complex, a payload assembly complex, a support facilities complex, and a system development complex.

The location of the Spaceport, and its proximity to the Military Rocket Range, are presented in Figure 7. The proposed operating areas for our test program are shown in Figure 8.

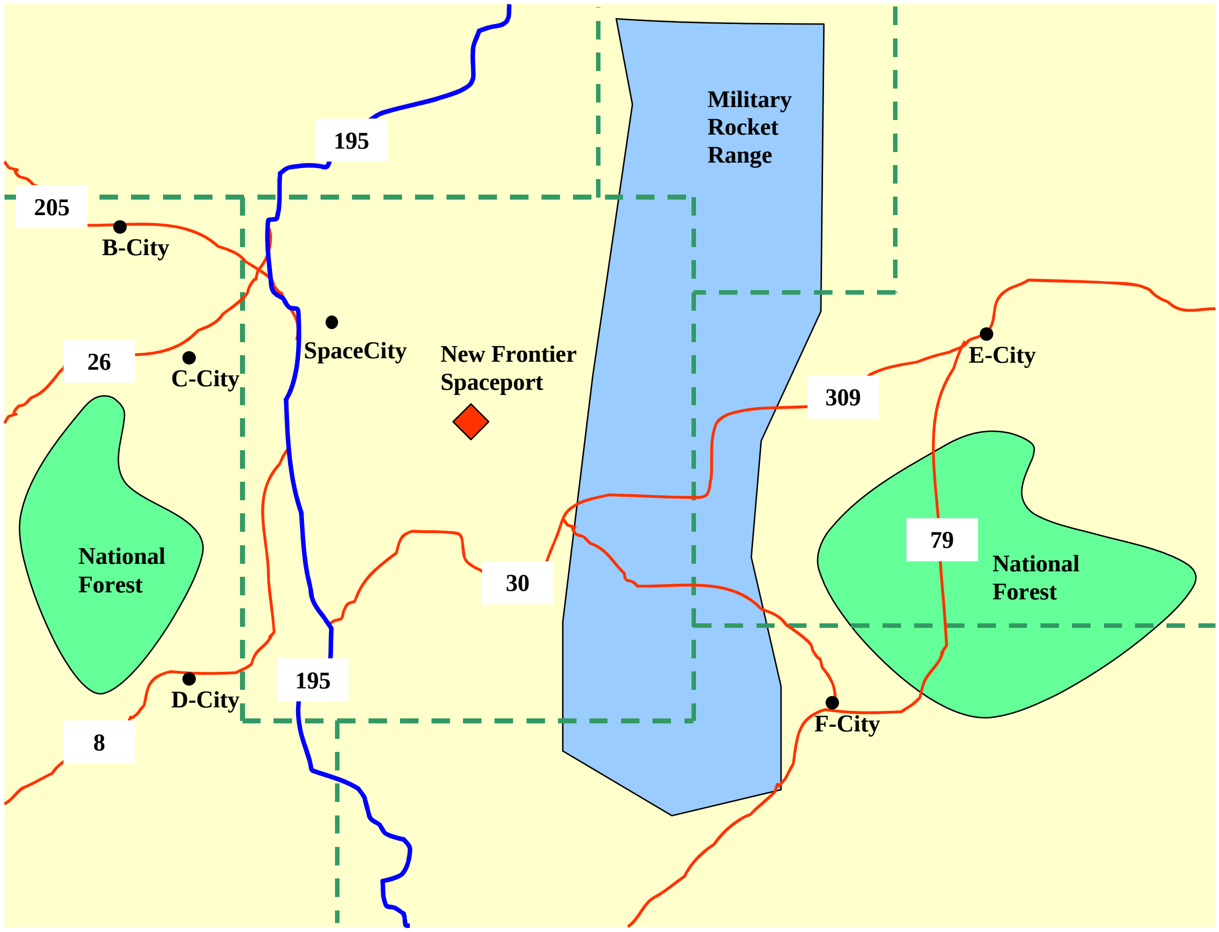

Figure 7: Location of New Frontier Spaceport

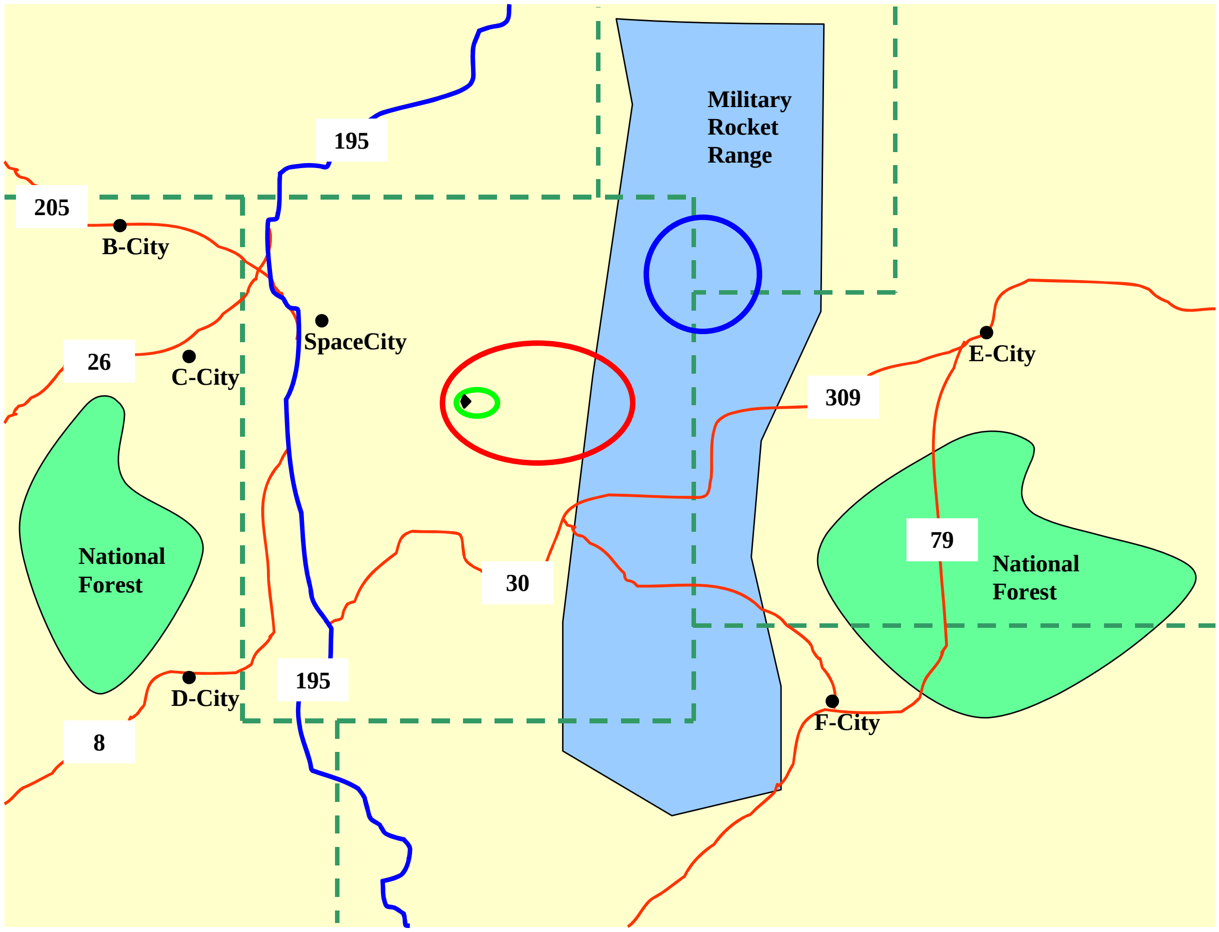

Figure 8: Operating Areas for Test Flights

Initial Test Operating Area: The blue circle in Figure 8 shows the 6 nm radius operating area on the Military Rocket Range that will be used for the helicopter drop tests. These are flight test series 1 through 3.

Primary Flight Test Operating Area (Flights to 40,000 ft): The green oval in Figure 8 shows the proposed operating area for our permitted flight tests. It is a volume defined by an ellipse that is 4 nm long by 3 nm wide and extends upward to 50,000 ft. The black diamond is the location of our launch site. The boundary of the operating area is an ellipse defined by the equation: $(x/a)^2 + (y/b)^2 = 1$, where b = 1.5 nm (width) and a = 2 nm (length). The boundary of this operating area is defined by the following:

- Longitude: 106° 53’ 00” W and 106° 58’ 00” W
- Latitude: 32° 54’ 00” N and 32° 57’ 00” N
- Maximum height of 50,000 ft

- Axes of the ellipse: 106° 55’ 30” W longitude and 32° 55’ 30” N latitude

Primary Flight Test Operating Area (Flights to 328,000 ft): The red solid-lined oval in Figure 8 shows the operating area for our permitted flight tests. It is a volume defined by an ellipse that is 20 nm long by 13 nm wide and extends upward to 350,000 ft. The black diamond is the location of our launch site. The boundary of the operating area is an ellipse defined by the equation: $(x/a)^2 + (y/b)^2 = 1$, where b = 6.5 nm (width) and a = 10 nm (length). The boundary of this operating area is defined by the following:

- Longitude: 106° 38’ 00” W and 107° 02’ 00” W

- Latitude: 32° 48’ 30” N and 33° 01’00” N

- Maximum height of 350,000 ft

- Axes of the ellipse: 106° 50’ 00” W longitude and 32° 55’ 30” N latitude

3. Operational Safety Documentation

3.1 Pre-Flight and Post-Flight Operations [§437.27 & §437.53(a-b)]

On the day of flight, the VS-1 vehicle will be transported to the launch site from a vehicle processing facility using a flatbed truck. Only launch processing crews and the flight crew will be allowed at the launch site while performing operations under the experimental permit. The justification and method used to determine our safety clear zone is described below.

A 1,250-feet radius circle defines our “safety clear zone.” This is our acceptable minimum safe distance during pre-flight and post-flight operations. Greater distances will be used whenever practicable to maximize public safety and minimize potential damage to nearby facilities and equipment. In addition, at T-30 minutes and T-5 minutes prior to each flight test, BlueSky will conduct helicopter surveillance of the operating area to clear the operating area of all uninvolved personnel. If anyone is detected in the operating area, the countdown to launch will be stopped (i.e., “No-Go” status). Our safety official will be dispatched to confirm that the operating area is cleared of all personnel.

The flight vehicle is initially loaded with RP-1 and GN2. When oxidizer is added, the status of the area around the vehicle changes to Hazard Class 1, Division 1.1 (HC/D 1.1). It is important to minimize the timeline of a vehicle when it is in this state and to minimize the number of people who are exposed to it. Explosive siting for Hazard Class 1 is based on the quantity of explosive material and separation distance relationships (QD) that provide defined types of protection. Explosive siting criteria for the BlueSky vehicle were selected to satisfy, as a minimum, the requirements found in Appendix D of 14 CFR Part 420.63 and DOD 6055.9, “DOD Ammunition And Explosives Safety Standards.” Additional guidance is taken from Department of Transportation, Federal Aviation Administration, Commercial Space Transportation; “Waiver of Liquid Propellant Storage and Handling Requirements for Operation of a Launch Site at the Mojave Airport in CA” (Federal Register / Vol. 69, No. 130 / Thursday, July 8, 2004 / Notices).

The vehicle is subject to appropriate QD criteria based on type and weight of the fuel and oxidizer on board. For the purpose of explosive siting, the total weight of the flight vehicle fuel and oxidizer plus the weight of the oxidizer in the servicing tanker are considered in establishing the appropriate QD area for the loading area. In accordance with DOD 6055.9-STD, Rev 5, Tables C9-T18 and C9-T1, the vehicle loading area will be located a minimum of 1,250 feet from any inhabited building.

Post-flight operations begin upon landing. Any oxidizer remaining in the vehicle is removed through the oxidizer dump port, at which point the vehicle's status is downgraded to "non-explosive." Any remaining fuel is then removed through the fuel dump port. The vehicle is then rotated onto our flatbed truck to a horizontal orientation and transported to a vehicle processing facility to prepare for the next flight.

3.2 Hazard Analysis [§437.29 & §437.55(a)]

BlueSky's hazard analysis process consists of four parts:

1) Identifying and describing the hazards,

2) Determining and assessing the risk for each hazard,

3) Identifying and describing risk elimination and mitigation measures, and

4) Validating and verifying risk elimination and mitigation measures.

Our assessment of the risks is a qualitative process. Risk accounts for both the likelihood of occurrence of a hazard and the severity of that hazard. The levels for the likelihood of occurrence of a hazard, presented in Table 3, and the categories for the severity of a hazard, presented in Table 2, were used in combination with the four-step hazard analysis process to develop our list of hazards. The severity and likelihood are combined and compared to criteria in a risk acceptability matrix, as shown in Table 4. BlueSky used the following FAA/AST guidance document to perform its hazard analysis: *AC 437.55-1, Hazard Analysis for the Launch or Reentry of a Reusable Suborbital Rocket Under an Experimental Permit.*

As our flight test program progresses, there will be anomalies that will be credited to component, subsystem, or system failures or faults; software errors; environmental conditions; human errors; design inadequacies; and/or procedural deficiencies. As these anomalies occur during our program, a risk elimination/mitigation plan will be developed. In addition, BlueSky will provide verification evidence (i.e., test data, demonstration data, inspection results, and analyses) in support of our risk elimination/mitigation measures. Our hazard analysis will be continually updated as our test program progresses. See Appendix D for a list of the identified hazards. Appendix E provides a description of our verification schedule.

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
7C	Propulsion System	Fuel leak from line rupture or fitting failure leading to possible fire or explosion of the vehicle.	The consequence is the possible death or serious injury to the public.	I	D	8	- The fuel lines have been designed to a safety factor of 4.0. - Incorporate a Fail-Safe Switch. Allows the pilot manually to abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- The fuel lines have been tested to a safety factor of 1.5. The following FAA/AST guidance document has been used to determine the appropriate verification safety factors for all structures: *FAA/AST Guide to Verifying Safety-Critical Structures for Reusable Launch and Reentry Vehicles.* - See Appendix E for a description of our verification schedule. - A copy of our training program has been included with this application (Appendix C).
7D	Propulsion System	LOX leak from line rupture or fitting failure leading to possible fire or explosion of the vehicle.	The consequence is the possible death or serious injury to the public.	I	D	8	- The LOX lines have been designed to a safety factor of 4.0. - Incorporate a Fail-Safe Switch. Allows the pilot to manually abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- The LOX lines have been tested to a safety factor of 1.5. The following FAA/AST guidance document has been used to determine the appropriate verification safety factors for all structures: *FAA/AST Guide to Verifying Safety-Critical Structures for Reusable Launch and Reentry Vehicles.* - See Appendix E for a description of our verification schedule. - A copy of our training program has been included with this application (Appendix C).

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
7E	Propulsion System	Over pressurization of fuel tank due to improper pressurization (design inadequacies, pressurization system failure) leading to tank bursting and loss of vehicle.	The consequence is the possible death or serious injury to the public.	I	D	8	- The tank has been designed to a safety factor (burst) of 1.5. - Incorporate a Fail-Safe Switch. Allows the pilot manually to abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- The tank has been proof tested to a safety factor of 1.25. The following FAA/AST guidance document has been used to determine the appropriate verification safety factors for all structures: *FAA/AST Guide to Verifying Safety-Critical Structures for Reusable Launch and Reentry Vehicles.* - See Appendix E for a description of our verification schedule. - A copy of our training program has been included with this application (Appendix C).
7F	Propulsion System	Over pressurization of LOX tank due to improper pressurization (design inadequacies, pressurization system failure) leading to tank bursting and loss of vehicle.	The consequence is the possible death or serious injury to the public.	I	D	8	- The tank has been designed to a safety factor (burst) of 1.5. - Incorporate a Fail-Safe Switch. Allows the pilot to manually abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- The tank has been proof tested to a safety factor of 1.25. The following FAA/AST guidance document has been used to determine the appropriate verification safety factors for all structures: *FAA/AST Guide to Verifying Safety-Critical Structures for Reusable Launch and Reentry Vehicles.* - See Appendix E for a description of our verification schedule. - A copy of our training program has been included with this application (Appendix C).

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
7G	Propulsion System	Failure of engine to re-ignite during landing due to inadequate design or excessive environments resulting in lost of vehicle.	The consequence is not serious enough to cause injury to the public.	IV	C	18	N/A → → → Risk is acceptable				
7H	Propulsion System	Loss of reaction control system due to line failure resulting in the crashing inside or outside operating area.	The consequence is the possible death or serious injury to the public.	I	D	8	- Incorporate a Fail-Safe Switch. Allows the pilot manually to abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- A copy of our training program has been included with this application (Appendix C).
7I	Propulsion System	Excessive use or loss of RCS gaseous N2 due to inadequate design or excessive environments resulting in the vehicle crashing inside or outside operating area.	The consequence is the possible death or serious injury to the public.	I	D	8	- Incorporate a Fail-Safe Switch. Allows the pilot manually to abort flight by cutting off the main engine. - Abort procedures training for the pilot and ground crew.	I	E	12	- A copy of our training program has been included with this application (Appendix C).
7J	Propulsion System	Propellant dump valve fails to open leading to possible fire and explosion if hard landing and fuel on board.	The consequence is not serious enough to cause injury to the public.	IV	D	19	N/A → → → Risk is acceptable				

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
8A	Landing System	Partial or full failure of parachute due to inadequate design or excessive environments resulting in the vehicle crashing inside or outside operating area.	The consequence is the possible death or serious injury to the public.	I	C	4	- Redundant release mechanisms. - Extensive pilot training for this emergency situation will be conducted before the piloted test flights begin. - Abort procedures training for the pilot and ground crew.	I	E	12	- A copy of our training program has been included with this application (Appendix C).
8B	Landing System	Partial or full failure of landing gear leads to vehicle crashing.	The consequence is not serious enough to cause injury to the public.	IV	D	19	N/A → → → Risk is acceptable				
9A	Vehicle Environmental Control	Loss of cabin pressure due to explosion, overpressure, puncture, or gradual leak results in pilot incapacitation and an uncontrolled crash.	The consequence is the possible death or serious injury to the public.	I	D	8	- Gauge for cabin pressure in crew cabin. - Dual pressurized tanks. The pilot can manually switch between tanks in an emergency. This system will be tested and inspected prior to each flight. - Extensive pilot training for this emergency situation will be conducted	I	E	12	- A copy of our training program has been included with this application (Appendix C). - See Appendix E for a description of our verification schedule.

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
							before the piloted test flights begin. - Incorporate a Fail-Safe Switch. Allows for an automated abort by cutting off the main engine if pilot is incapacitated.				
9B	Vehicle Environmental Control	Failure of the CO2 scrubber systems due to design inadequacies leading to pilot incapacitation and probable crash of the vehicle inside or outside the operating area.	The consequence is the possible death or serious injury to the public.	I	D	8	- Redundant CO2 scrubbing systems. - Dual pressurized tanks. The pilot can manually switch between tanks in an emergency. This system will be tested and inspected prior to each flight. - Incorporate a Fail-Safe Switch. Allows for an automated abort by cutting off the main engine if pilot is incapacitated.	I	E	12	- See Appendix E for a description of our verification schedule.
9C	Vehicle Environmental Control	Failure of one or more fans to circulate cabin air due to design inadequacies leads CO2 buildup	The consequence is the possible death or serious injury to the public.	I	D	8	- Redundant dehumidifier fan. - Dual pressurized tanks. The pilot can manually switch between tanks in an	I	E	12	- See Appendix E for a description of our verification schedule.

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
		resulting in pilot incapacitation probable crash of the vehicle inside or outside the operating area.					emergency. This system will be tested and inspected prior to each flight. - Incorporate a Fail-Safe Switch. Allows for an automated abort by cutting off the main engine if pilot is incapacitated.				
9D	Vehicle Environmental Control	Loss of pressurized air for crew breathing due to design inadequacies leads to pilot incapacitation and probable crash of the vehicle inside or outside the operating area.	The consequence is the possible death or serious injury to the public.	I	D	8	- Dual pressurized tanks. The pilot can manually switch between tanks in an emergency. This system will be tested and inspected prior to each flight. - Incorporate a Fail-Safe Switch. Allows for an automated abort by cutting off the main engine if pilot is incapacitated.	I	E	12	- See Appendix E for a description of our verification schedule.
9E	Vehicle Environmental Control	Fire/smoke in crew cabin resulting in pilot incapacitation and probable crash of the vehicle inside or outside the	The consequence is the possible death or serious injury to the public.	I	D	8	- Redundant CO2 scrubbing systems. - Dual pressurized tanks. The pilot can manually switch between tanks in an	I	E	12	- A copy of our training program has been included with this application (Appendix C). - See Appendix E for a description of our verification schedule.

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
		operating area.					emergency. This system will be tested and inspected prior to each flight. - Abort procedures training for pilot and ground crew. - CO2-based suppression system. - Incorporate a Fail-Safe Switch. Allows for an automated abort by cutting off the main engine if pilot is incapacitated.				
10A	Natural Environments	The vehicle experiences wind gusts exceeding 200 ft/sec. This results in the pilot and the flight control system inability to control the vehicle. Probable crash of the vehicle inside or outside the operating area.	The consequence is the possible death or serious injury to the public.	I	C	4	- Wind limits on launch commit criteria.	I	E	12	- Description of abort rules are included in the following: “BlueSky Checklist and Flight Rules.”
10B	Natural Environments	Natural or triggered lightning strikes the vehicle in flight leading to flight -	The consequence is the possible crash of the	II	C	6	- Monitor and report meteorological conditions to the mission conductor	II	E	15	- Description of abort rules are included in the following: “BlueSky Checklist and Flight Rules.”

No.	System	Hazard Description	Results	**Risk Before Mitigation Measures			Risk Elimination or Mitigation Measures	**Risk After Mitigation Measures			Verification Evidence
				S	L	R		S	L	R	
		safety system malfunction.	vehicle outside operating area.				prior to launch. - Vehicle will not launch if lightning producing meteorological conditions exist.				

Appendix E: BlueSky Verification Schedule

No.	System	Purpose	Test Description	Test Dates	Available Products for Delivery
1	Avionics & Guidance	To verify the operation of the central processor/ navigation system under a range of conditions: _ Due to excessive load environments – Loss of data from the GPS, gyro, accelerometer, altitude sensor, antenna, or telemetry system	Ground Tests: 10 Attach central processor/navigation system to shaker and vibrate system at expected flight conditions. Perform functionality tests before and after each test.	Nov 2006 – Jan 2007	- Avionics and Guidance test data and results - Flight Test #1 results document
			Flight Tests: 4 Central processor/ navigation system will be integrated into test vehicle and dropped from a helicopter during non-permitted flights to test its functionality. These tests will be performed during Flight Test #1 as described in Table 1.		
2	Flight Control Systems	To verify the ability of the pilot to use the flight control systems and displays to control the vehicle during normal operations and emergency situations	Ground Tests Without Pilot: 10 Vehicle will be mounted on a special sled that can move laterally in both the x- and y-direction. The sled also contains sensors to measure forces in the z-direction. With the vehicle mounted on the sled and the various RCS thrusters firing, the vehicle will either move in the x-y plane or will register the level of force in the z-plane. To ensure safety to the pilot, this first set of tests will be conducted using the remote control to control the movement of the sled and vehicle.	Jan – Apr 2007	- Flight Control Systems test data and results - Video of multiple Ground Tests
			Ground Tests With Pilot: 10 Same as above ground tests, but with the pilot inside the vehicle controlling the sled and vehicle.		
			Flight Tests: 6 Vehicle will be dropped from 10,000 ft from a helicopter during non-permitted flights, with the pilot controlling the vehicle from inside the vehicle. These tests will be performed during Flight Test #3 as described in Table 1.	Apr – May 2007	- Flight Control Systems tests data and results from Flight Test #3 - Video of multiple tests during Flight Test #3