For Office Use
Application #_____

Date Rec'd_____

CONVENTIONAL

BALLOON FLIGHT SUPPORT APPLICATION
FISCAL YEAR 2002

The following information is requested regarding your needs for NASA/NSBF balloon flight support. Please type or print legibly and return to the NSBF. Please contact NSBF for "LDB Flight Application Form" if you are submitting for Long Duration Balloon Flights.

PART I

1. Principal Scientific Investigator:_____

   Organization and Mailing Address: _____
   _____

   Telephone: _____ Telex or Telefax: _____

   E-Mail Address:_____

   Payload Name or Acronym: _____

2. I have plans for balloon launches within the periods specified on the attached letter: Yes_____; No_____.
   If no, complete Part III and date, sign, and return the questionnaire to the NSBF.
   If yes, complete entire questionnaire and return.

3. Project Officer or Delegate Familiar with Engineering Aspects of Experiment:
   _____

   Organization and Mailing Address: _____
   _____

   Telephone: _____ Telex or Telefax:_____

   E-Mail Address: _____

4. Source of Funding (Research Grant):_____

5. Number of Flights:_____

6. Flight Date(s):(1)_____(2)_____

7. Launch Site(s):(1)_____ _____(2)_____

8. Launch Site Arrival Date(s):(1)_____(2)_____

9. Dimensions of Scientific Payload:(1)_____(2)_____
(Enclose Drawings or Photo if available)

10. Estimated Weight of Scientific Payload (experimenter-supplied equipment only including batteries):
(1)_____(2)_____

11. Desired Float Altitude (feet):(1)_____(2)_____

12. Desired Time at Float Altitude:(1)_____(2)_____

13. Desired Launch Time (Time of Day):(1)_____(2)_____

14. Describe other than normal flight profile requirements - e.g., altitude variations, ascent/descent rates, valving, payload reel down, altitude stability:
_____
_____
_____

15. The NSBF normally provides steel shot as ballast. Non-magnetic ballast, e.g, glass shot or lead shot may be used if justified by science requirements. Please indicate your requirement.
Steel_____ Non-Magnetic_____.

16. Are there any restrictions on the proximity of the scientific payload to other equipment, electronics, ballast, or to the balloon? List any special balloon design requirements that you may be aware of e.g., no radar reflective tape, attached ducts, minimum poly powder lubrication, etc.
_____
_____
_____

17. A. Has this payload been flown before by the NSBF?

No_____ Yes_____Site_____Date_____
Last Flight Number:_____

B. Has this payload previously been certified for flight by NSBF?
No _____ Yes _____

C. Have any structural changes been made that affect your previous Mechanical Certification?
No _____ Yes _____

EXPLAIN (IF APPLICABLE)_____
_____
_____

18. Required work area and shop support?_____
_____
_____

19. Please indicate time required for use of [Environmental Test Chamber (Bemco)], if any _____.

20. Gases/Cryogens: List the quantity, type **and PURITY** of gases/cryogens that you wish the NSBF to order in support of your program. Refer to Enclosure 5 for specific instructions.
_____
_____

21. Other Requirements: Expendables, and services other than directly required by the NSBF for its flight support must be paid for directly by the experimenter's group or from monies transferred to NASA and made available to the NSBF as described in Enclosure 2.

    The NSBF will assist in determining whether these services are considered routine support. Please provide a listing of your requirements.
_____
_____

22. Payload Safety: The following is a list of hazards typically associated with balloon payloads. Please indicate which are applicable to your project.

	Yes	No
Radioactive Materials	____	____
Lasers	____	____
Cryogenic Materials	____	____
Pressure Vessels	____	____
High Voltage	____	____
Pyrotechnics	____	____

Attachment 9 is the NSBF Ground Safety Plan (GSP). It delineates NSBF policies regarding hazardous materials, systems, and equipment. Please verify that the appropriate documentation and procedures are in place to comply with these policies. You will be asked to sign a "Verification of Safety Compliance" form after your arrival at the launch site.

Please indicate any additional hazardous materials, systems, or equipment not falling into the above categories (i.e. toxic gases, superconducting magnets, etc). You will be required to generate a special ground and flight safety plan to address hazards associated with these items.

_____
_____
_____

Please attach any applicable safety documentation or plans that have been generated as part of your own institutional safety program as part of your project. Indicate below if you have or plan on submitting institutional safety documentation.

Yes_____ No_____

If you checked "yes" under radioactive materials, will you be using the sources in:

Flight_____? Ground Support Only_____?

List radioactive sources to be used along with maximum activity/wattage. (Identify materials in C_i, μC_i, and/or mC_i).

_____
_____
_____
_____

Each scientist is required to furnish NSBF with a Sealed Source Device Registry (SSDR) Safety Evaluation Sheet to be on file at NSBF before the source can be shipped to NSBF property or remote launch site. Refer to Enclosure 2 for instructions regarding radioactive sources.

If hazardous materials are used, you must furnish Material Safety Data Sheets (MSDS).

23. Are other experimenters participating with you in the flight(s) covered by this request?:
Yes_____ No_____
Names and Organizations:

_____
_____

24. Please identify all participants in your group that will be supporting your flight.*

NAME	CITIZENSHIP (a)
_____	_____
_____	_____
_____	_____

a. Non-U.S. citizens will not be allowed on any launch site without prior approval. Please provide the following for each non-U.S. citizen:

1. Birthplace
2. Date of Birth
3. Passport Number
4. Country of Citizenship

* This list must include all personnel at the launch site. In case of campaigns outside of the United States, the NSBF and NASA are required to inform the host country about the nationality of all campaign participants.

25. If this is a cooperative program, describe each party's degree of involvement:

_____
_____
_____

26. Briefly describe the scientific experiment and its objectives in layman language:

_____
_____
_____
_____
_____
_____
_____
_____

Note: The NSBF requires strict compliance with the established policy requiring all single-point failure threaded fasteners to be procured from an approved source or have a Certificate of Compliance from other sources. Single-point failure fasteners should be tested or a Certificate of Compliance provided to confirm that they are manufactured as specified. Refer to Enclosure 7 for a copy of the established policy and approved threaded fastener source list.

PART II

The following information is requested regarding your requirements for NSBF electronic support of flights from the Palestine Facility or other launch sites. Any additional pertinent information not specifically requested should be attached to the Flight Request.

NSBF TELECOMMAND SYSTEM

1. The NSBF telecommand system utilizes a computerized command management system at the ground station. Science commands are sent from the scientist provided remote computer to the NSBF Flight Computer COMMAND MANAGEMENT SYSTEM via RS-232 port. (See Enclosure 8 for Instructions for Command Integration.) The NSBF command system allows for a 16 bit parallel command word and a maximum of 80 discrete commands.

2. Do you plan to use your own command encoder and transmitter to meet science payload requirements? Yes___ No___ If Yes:

   Frequency_____ Power _____

   Authorization No._____ Area of Authorization_____

   Transmitter Antenna, omni or pointed?_____

AIRBORNE TELEMETRY REQUIREMENTS

1. Indicate the nature of telemetry signals from scientific instrumentation.

SIGNAL	FREQUENCY (BPS)	CODING (NRZ,Bi0,ETC)
_____	_____	_____
_____	_____	_____
_____	_____	_____

   NSBF normally furnishes telemetry transmitters. If you plan to utilize your own transmitter provide the following information.

2. Scientist Furnished Transmitter? _____

   Frequency _____; Authorization No. _____

   Area of authorization _____

3. Describe special or unusual electronic requirements, indicate constituent signals comprising science furnished composite video, indicate any TV video requiring NSBF supplied transmitters.

_____

_____

GROUND TELEMETRY REQUIREMENTS

NOTE: Analog tapes are routinely recorded on all flights and stored for a period of not less than six months.

4. Is digital tape logging required? _____Yes; _____No
If yes, please complete Digital Data Logging Requirement Form (Enclosure 4).

5. Indicate any special requirements (ground station equipment, test equipment, etc):

_____

_____

6. Downrange ground station support requirements:

_____

_____

BATTERIES (See Enclosure 5)

Do you want NSBF to purchase batteries for your scientific payload:
Yes:_____ No:_____

NOTE: Only lithium battery packs and cells of the type routinely used by the NSBF are available with this service. CIP power is not available for use by the scientist.

BATTERIES AVAILABLE
(Indicate desired per flight quantity)

Battery	Loaded Cells/Pack	Ampere Voltage	Quantity Hour *	Desired
B7901-10	10	26	30	_____
B7901-11	11	29	30	_____
B7901-12	12	32	30	_____
B9660	10	26	7	_____
B9525	5	14	7	_____
B9808	4	11.2	1	_____
G20-12	1	2.6	7	_____
G62-12	1	2.6	30	_____

* Ampere hour ratings should be derated for temperatures below -20 degrees Celsius.

Batteries ordered per this request will be held by NSBF only for the Fiscal Year the flight request is submitted. Should you be required to submit another Flight Application, even though you have not used the batteries originally requested, be sure to specify battery requirements.

Unless otherwise specified, batteries requested will be available at the requested launch site upon your arrival.

_____
_____
_____

PART III Future Requirements:

In an endeavor to meet the future needs of the scientific community, it is critical that you provide detailed information on any balloon flights planned for the next ***three (3) years*** to assist the NASA/NSBF in developing flight support services. Considerable advanced planning is required for complicated missions, e.g., Australia, Canada, Antarctica, etc. Even if your plans are not firm, identifying potential requirement facilitates the planning process. Include the anticipated number of flights through Calendar Year 2004 and their locations and seasonal requirements. Also note any special support requirements and any required services or capabilities that the NSBF does not presently offer.

_____

_____

_____

_____

I have read and agree with all requirements and conditions set forth in the Balloon Flight Support Application and Enclosures.

_____
Name (Type or Print)

_____
Organization

_____
Signature

_____
Date

PRE-FLIGHT SUCCESS CRITERIA

Notes:

1. The NSBF always strives to meet the comprehensive success criterion as established by the experimenter. Therefore, unless a reasonable chance exists of meeting that criterion as stated, the flight application will be deemed unacceptable.

2. At the launch site, the NSBF will make every effort to meet the comprehensive success criterion. Under no circumstances will the NSBF attempt to launch your experiment unless the minimum success criterion can be met.

Please type or print legibly.

1. Briefly state the minimum scientific objective which must be met to achieve a mission success.

   _____

   _____

   _____

2. Balloon Performance Requirements:

   Float Duration (Hrs) - Desired_____; Minimum Acceptable_____

   Float Altitude (Ft) - Desired_____; Minimum Acceptable_____

   Altitude Stability - Desired_____; Minimum Acceptable_____

   Describe other than normal flight profile requirements - e.g., altitude variations, ascent/descent rate, valving, payload reel down, altitude stability):

   _____

   _____

   _____

3. Define any NSBF support systems (telemetry, commanding, recovery, etc.) performance requirements with desired and minimum criteria.

   _____

   _____

   _____

4. Experiment Performance - Detectors, Pointing Systems, etc. (Give a summary of the desired and required performance for the experiment.

_____

_____

_____

5. Provide details on any other data source or support element separate from the balloon flight but necessary to achieve mission success (e.g., instrumented sounding balloons, instrumented aircraft, satellite overpass, independent ground station measurements, National Weather Service Radiosonde Data).

_____

_____

_____

6. Proposed Data of Flight_____

   Launch Site_____

_____
Name (Type or Print)

_____
Organization

_____
Signature

_____
Date

WAIVER OF CLAIMS
AGAINST THE PHYSICAL SCIENCE LABORATORY
NEW MEXICO STATE UNIVERSITY

With regard to Balloon Flight Services provided by New Mexico State University/Physical Laboratory, the operators of the National Scientific Balloon Facility (NSBF), under contract with the National Aeronautics and Space Administration (NASA), the requiring institution identified below, agrees not to assert any claim or claims against the New Mexico State University/Physical Science Laboratory, the National Aeronautics and Space Administration, or their employees or agents, for loss or damages to any instrument or scientific equipment (including loss of or damage to the balloon) provided by the requiring institution and carried on a Balloon Flight provided by the National Scientific Balloon Facility, or consequential damages resulting from such loss or damages, except with respect to any such loss or damages resulting solely from the fault or negligence of the New Mexico State University/Physical Science Laboratory. This waiver shall be in effect from:

_____ to _____ inclusive.

(Date) **(Date)**

Institution: _____

(e.g., Agency Name, University Name, etc.)

_____

(Department, Section, etc.)

Name: _____

(Official with authority to legally bind institution)

Title: _____

(Title of above official)

Date: _____

(Date official signs this document)

Enclosure 2

HOLD HARMLESS AND INDEMNIFICATION

The _____

(Name of Institution, e.g., NASA Center, NOAA, NRL, University Name etc.)

_____

agrees to Indemnify and Hold Harmless the Physical Science Laboratory of New Mexico State University (PSL/NMSU), its Regents, Officers, and employees from any liability whatsoever (including legal costs) associated with damages or death resulting from a radioactive substance provided by

_____

(Name of Scientific User at NSBF)

and carried on a balloon flight launched, flown, and recovered by PSL/NMSU National Scientific Balloon Facility (NSBF) for the

_____

(Name of Subgroup, e.g., Department, Section, etc., at Institution)

_____

whose address is _____

_____

Name: _____

(Official with Authority to Legally Bind Institution)

Title: _____

(Official's Title at Institution)

Date: _____

(Date Official Signs this Document)

DIGITAL DATA LOGGING REQUIREMENTS

NSBF has available some data logging applications software which can be tailored to many logging and real-time display requirements. Currently, this support is provided only for flights launched at Palestine, Texas. This form provides preliminary information necessary to ensure that digital logging and display requirements can be met.

If you would like post flight digitized data from analog tapes for flights launched from any site, please identify in the **Other Special Requirements Section**.

1. Recording: (800 BPI/1600 BPI)

2. Tapes Provided by Scientist: (Yes/No)

3. Can Scientist Provide assistance with changing tapes? (Yes/No)

4. Is real-time display required? (Yes/No)

5. PCM Information:
   Data Rate (BPS) _____
   Bits/Word _____
   Words/Frame _____
   Frames/Major Frame _____
   Frame Sync = _____
   Sub Frame Sync = _____
   (Please attach copy of PCM format)

6. Other Special Requirements: _____

_____

_____

_____

_____

_____

The undersigned verifies that above requirements have been tested to meet stated requirements.

_____ _____

(Scientist's Signature) **(Date)**

Enclosure 4

GENERAL POLICY/PROCEDURAL INFORMATION

EFFECTIVE FY 1993

1. BALLOON FLIGHT SUPPORT APPLICATION

All scientific groups requesting NASA/NSBF support must submit a Balloon Flight Application of each year. The form is issued from, and must be returned to the NSBF by 15 August 2001. Initial point of contact with the NSBF is Darla Cook (telephone number, 903-723-8010 or email address: Darla.Cook@master.nsbf.nasa.gov). Normally, the application is valid only for the next fiscal year.

Science groups requesting Long Duration Balloon (LDB) support involving transcontinental flights or launches from the Arctic or Antarctic must submit an LDB Balloon Flight Support Application at least two years in advance of the requested support. The advance application for LDB flights is due to the long lead time required for logistics in addition to operational planning with associated support organizations. Bernice A. Merritt (telephone 757-824-1353) is the NASA LDB Program Manager and should be contacted directly regarding LDB flight support applications. Specific details regarding LDB flight requirements not addressed in the Balloon Flight Support Application forms will be covered through direct contact with the science group.

Science groups that are submitting a Balloon Flight Support Application for the first time, or groups that are submitting an application for a new gondola that has not been launched by NSBF before, must also contact the NASA Balloon Projects Branch. The point of contact is Bernice A. Merritt. This contact is to inform NASA of the new project and enable planning to begin prior to the time that NSBF submits the proposed flight program to NASA. Contact should be made about the same time that the Balloon Flight Support Application is submitted to NSBF.

Bernice A. Merritt
NASA/Goddard Space Flight Facility
Wallops Flight Facility
Balloon Projects Branch
Wallops Island, Virginia 23337
Telephone: (757) 824-1353
Fax: (757) 824-2149
Email: Bernice.A.Merritt@gsfc.nasa.gov

2. PRE-FLIGHT MINIMUM SUCCESS CRITERIA

All scientific groups requesting NASA/NSBF flight support must submit the Pre-Flight Minimum Success Criteria form, along with the Balloon Support Application. This form provides insight into the science performance requirements, and it is used to assess the scientists needs. The launch support group will use the requirements for flight planning. A launch will not be attempted without assurance that the minimum scientific requirements can be met. Therefore, the experimenters should be realistic in specifying criteria.

The NSBF should be informed of any changes in requirements or schedule as they may effect costs and program plans.

3. NOTIFICATION

The scientific group will be notified within three weeks of the application receipt and informed of any problems associated with flight requirements. Subsequent notification will be made upon receipt of NASA flight program approval.

4. NON-NASA-SPONSORED PROGRAMS

All funding for non-NASA sponsored users must be provided through fund transfers from the sponsoring agency to NASA. Upon receipt of the funds, NASA approves the NSBF to establish an account for the user. (A users fee is not assessed to national users.)

Foreign users are required to have a Memorandum of Understanding (MOU) with NASA Headquarters. Additionally, foreign users will be assessed a users fee for each flight. All funding, including the users fee must be provided to NASA as per the established MOU.

No direct procurement can be made by the NSBF for services until the necessary agreements are in place and monies have been received from the user.

Information regarding cost estimates, contractual agreements, MOU's with NASA and instructions pertinent to the transfer of funds may be obtained by contacting:

Ms. Bernice Merritt
NASA/Goddard Space Flight Center
Wallops Flight Facility
Balloon Projects Branch
Wallops Island, Virginia 23337
Telephone - (757) 824-1353

5. CAMPAIGN REQUIREMENTS MEETING

Every major remote campaign on large projects requiring operational support will include a Campaign Requirement Meeting (CRM). Each science group is required to participate in a scheduled CRM to review NSBF support plans as well as science requirements once the project or campaign has been approved.

6. USER-PURCHASED BALLOONS

The NSBF normally provides the balloons, but will launch balloons purchased directly by the users, as long as they comply with NSBF design and QC/QA requirements. The balloon design must be reviewed by the NSBF to assure compliance with NASA/NSBF balloon specifications prior to production. The normal NSBF QA and manufacturer QC procedures must be in force during production.

7. BATTERIES

The NSBF provides batteries to NASA programs and upon request, will act as a battery purchasing agent for non-NASA funded experimenters. Batteries cannot be purchased until funds are received by NASA and authorization is received by NSBF. However, only lithium cells and/or packs of the type routinely used by the NSBF will be available. The user should detail battery requirements in Part II of the Balloon Flight Support Application (Enclosure 1) and ensure that the necessary funds are made available.

8. GONDOLA DESIGN CERTIFICATION

All range users must provide NSBF with gondola and suspension structural design information, material specifications, load test information, etc., **60 days** prior to arrival at the launch site. Final gondola design certification shall be performed by the NSBF using the NASA/NSBF accepted criteria . NASA-sponsored experimenters requesting balloon flights at launch sites other than Palestine, Texas and not requiring NSBF services shall forward this information to the Balloon Projects Branch at Wallops Flight Facility. Any further distribution will be made from that office. Details of these criteria are included in Enclosure 6.

9. PRESSURE VESSEL CERTIFICATION

All scientists flying pressure vessels of any type on their payload must submit a brief treatise on the vessels for review and approval by NASA/WFF engineers. The description need not be overly elaborate. A few paragraphs will suffice. The statement should contain general information on:

1. Design specifications of the vessel(s)
2. Description of any ground testing performed on the vessel(s)
3. Any flight history of the vessel(s).

10. RADIOACTIVE SOURCES

All range users must submit the following documentation to the NSBF Radiological Safety Officer at least four weeks prior to the arrival of the science group to a launch site:

a. Copy of the Radioactive Material License for their institution.

b. Current leak test documentation for all radioactive material. License and laws of the State of Texas require that Alpha-emitting sources be tested every three months.

   Other sealed sources must be tested every six months. Any source arriving without a current test certificate will be impounded until it is leak tested, even if it requires gondola disassembly. The scientific investigator will be responsible for all costs incurred for leak tests at the NSBF.

c. A list of the individuals in the science group who are authorized to handle radioactive sources.

In addition, range users who intend to bring radioactive sources to the NSBF or other launch site are required to complete the Radioactive Material Hold Harmless and Indemnification (Enclosure #3). This form is to be submitted with the Balloon Flight Support Application.

11. WAIVER OF CLAIMS

All user institutions and users are required to complete the NSBF Waiver of Claims Form (Enclosure # 2).

The person signing for the user institutions and users must be someone who can "bind" the organization, e.g., Contracting Officer, Contracting Manager, Principal Investigator, Division Head.

The NSBF will retain the waivers on file by institution name, through the effective date on the claim form. This form will cover all scientists from their respective institution for that time period.

The waiver form should be sent by the user institution or user, with the other data that is provided when a scientist makes a request for NSBF services.

The scientist must understand that both the scientist and his/her employer have to sign the waiver and return it to the NSBF before flights will be authorized.

If a scientist or institution has questions concerning the waiver form, they should contact Ms. Bettie Furman Administrator, NSBF Site Manager's Office.

12. GASES/CRYOGENS

In order to assure timely delivery of cryogens and specialty gases, the following procedure must be followed:

FOR DOMESTIC FLIGHTS:

> **No less than fourteen (14) days** prior to arrival at launch site, each science group is requested to notify Ms. Bettie Furman of their cryogen/specialty gas requirement. This may be accomplished by letter, via telephone at NSBF, (903) 723-8002 or by E-Mail: Bettie.Furman@master.nsbf.nasa.gov.

FOR REMOTE CAMPAIGNS:

> **No less than forty-five (45) days** prior to arrival at launch site, each science group is requested to notify Ms. Bettie Furman of their cryogen/specialty gas requirement. This may be accomplished by letter or via telephone at NSBF, (903) 723-8002.

The Administrator in the NSBF Site Manager's Office will ensure the gases/cryogens are ordered, only after notification as outlined above. Even if such gases were identified on the flight request, you must still notify Ms. Furman at the NSBF.

Liquid nitrogen, liquid helium, dry oxygen, argon, nitrogen and helium can be readily obtained. Any other type of gas is considered a specialty gas. **Please allow thirty (30) days for delivery of specialty gases for domestic flights and forty-five (45) days for remote campaigns.**

Hospital grade and industrial grade dry nitrogen is readily available.

Orders will be placed only for those flights which have been approved. Each flight that has been approved, has an established funding level based upon the information you provided in the flight request. Should your gas requirement exceed this level, NASA will have to provide approval for any dollar amounts exceeding the established funding level.

13. POST FLIGHT SCIENCE ASSESSMENT

A post flight assessment of the preliminary science results is required. A form is available from NSBF, and it will be given to the Principal Investigator at the post flight critique held by the NSBF Operations Department. The completed form should be mailed to Bernice A. Merritt, NASA-WFF, at the address on the form. NASA-WFF will not establish the NASA-reported mission performance until a post flight assessment form is received. Significant delay in receipt of the form could impact future flight support.

14. POINT OF CONTACT

Ms. Bettie Furman is the point of contact at the NSBF for information regarding users

services. She coordinates with the proper NSBF activity to assure timely response to the users' questions. She should be informed immediately of any changes in requirements or schedule as they may affect costs and program plans. Ms. Furman can be contacted at (903) 723-8002 or email address: Bettie.Furman@master.nsbf.nasa.gov.

NATIONAL SCIENTIFIC BALLOON FACILITIES

STRUCTURAL REQUIREMENTS FOR BALLOON GONDOLAS

The gondola certification program helps to ensure that containment frames and suspension systems supplied by scientists are mechanically capable of withstanding the stresses placed on them by launch, flight, termination, and impact.

The NSBF Engineering Department uses the scientist's design information and stress analysis to assess a gondola's suitability and to certify the structure. The scientist is responsible for the design and analysis of the gondola. The gondola stress analysis must be performed by an engineer whose qualifications must be provided to the NSBF in the form of a brief resume. Primary point of contact is the Manager of NSBF Engineering contacted through Ms. Bettie Furman at (903) 723-8002 or E-Mail Address: Bettie.Furman@master.nsbf.nasa.gov.*

Although NSBF engineers are available to answer questions on design problems or unusual projects, the NSBF certifying engineer's primary role is to identify critical structures, determine whether the analysis has examined these structures and spot-check pertinent calculations. Based on the stress analysis provided, the engineer gives the gondola an overall rating and determines how much weight the entire structure can handle. The scientist is then notified of the certification based on his design and stress analysis.

Using the following guidelines, the scientist must provide design specifications and a stress analysis of the gondola to the NSBF at least 60 days prior to the anticipated flight date.

1. Drawings showing the relative locations and dimensions of all structural and load-bearing gondola members. Materials identification shall be included in all drawings.

2. At least one complete assembly drawing.

3. Working drawings and specifications for all purchased and fabricated mechanical components and assemblies that are part of the flight train (e.g., rotators, swivels, turnbuckles, clevises, rings, and universal joints).

4. A stress analysis of all major structural members, including decks and ballast attachment points. Identify the components, equipment, and weights comprising the loads.

---

*Manager of Engineering will assign a staff engineer to interface with each payload group.

5. A statement certifying that the aforementioned requirements have been met. This statement must be signed by the principal investigator and the engineer responsible for the gondola structure.

The documentation for a certified gondola design is filed by the NSBF Engineering Department, and gondolas need not be re-analyzed for subsequent flights unless design changes are made. However, NSBF engineers visually reinspect the assembled gondola before each flight, and the principal investigator is required to sign a Science Gondola Modification Certification Form verifying that the previously certified design was not changed.

The following design criteria should be used in planning gondola structures and suspension. Gondolas must be designed so that all load-carrying structural members, joints, connectors, decks, and suspension systems are capable of withstanding the conditions listed below without ultimate structural failure.

1. A load 10 times the weight of the payload applied vertically at the suspension point.

2. For multiple-cable suspension systems, each cable must have an ultimate strength greater than five times the weight of the payload divided by the sine of the angle that the cable makes with horizontal (should be >30 degrees) in a normal flight configuration. Cable terminations, cable attachments, and gondola structural members must be capable of withstanding the load described above. Some exceptions to this criterion may be allowed for gondolas with more than four suspension points at the discretion of the NSBF certifying engineer.

3. A load five times the weight of the payload applied at the suspension point and 45 degrees to the vertical. This load factor must be accounted for in the direction perpendicular to the gondola's short side, perpendicular to the gondola's long side, and in the direction of the major rigid support members at the top of the gondola structure. If flexible cable suspension systems are used, they must be able to withstand uneven loading caused by cable buckling.

4. A side acceleration of 5 g applied to all components and equipment attached to and/or onboard the gondola structure or any portion of the flight system below the balloon.

5. The effects of stress concentration factors must be considered in the analyses of all critical mechanical structures and assemblies. The ultimate strength of the element should be derated proportionately to the applicable stress concentration factor. The stress concentration factors shall be based upon the specific load case and standard mechanical engineering design practices. A specific example of a structural element in which stress

concentrations are to be considered is the shaft and housing of a swivel or rotator assembly.

If a particular element does not pass when derated by the full effects of the stress concentration factor, the stress analyst must demonstrate that other factors such as material ductility offset the effects of stress concentrations. For instance, a tensile/pull test of an assembly can be used to demonstrate that it has an ultimate strength greater that the above criteria will allow. The NSBF recommends that proof tests be conducted by the science group as a standard practice to ensure that their hardware has adequate strength.

6. The ductility of all materials used for critical mechanical elements shall be considered in the analysis of the gondola structure. Specifically, the NSBF does not encourage the use of materials that are determined to be brittle or that are not recommended for use in shock loading applications. Close examination of all materials that have a percent elongation less than or equal to 10% at an ambient temperature of -60 degrees Celsius shall be made to determine if the material is to be considered brittle.

   If a material is determined to be brittle, the certification criteria listed in paragraphs 1, 3 and 4 must be multiplied by a factor of 1.5. That is, the particular element that is fabricated using a brittle material must be able to sustain a 15 g vertical load, a 7.5 g load at 45 degrees, and a 7.5 g horizontal load without failure.

The gondola design also must ensure that all scientific equipment, NSBF equipment, and ballast remain contained when subjected to the loads described above and that the gondola is capable of supporting the weight of NSBF equipment. The NSBF Engineering Department should be contacted during the design stage for information on equipment and ballast weight for the flight.

The following assumptions are made by the NSBF certifying engineer in reviewing gondola design analyses:

1. The suspension point is defined as the point where the scientist-furnished gondola suspension equipment interfaces with the NSBF-furnished flight system hardware.

2. The payload weight includes the gondola structure, all scientific equipment and components, and all NSBF equipment (including ballast) affixed to the structure below the gondola suspension point.

3. For analysis purposes, the base of the gondola may be assumed to be rigidly fixed (i.e., in a static condition). Other boundary conditions may be used upon prior approval of the NSBF.

The final stage of gondola certification is a visual inspection by an NSBF engineer. The gondola is checked for adequate suspension and crush pad cushioning. In addition, the certifying engineer checks welds and verifies that the construction matches the description submitted by the user.

GSFC FASTENER INTEGRITY REQUIREMENTS

The Suborbital Projects and Operations Directorate (SPOD) is requesting exclusion for SPOD programs except as noted herein.

The sounding rocket and balloon programs are established efforts that share the relatively low cost, high risk, rapid response philosophy of obtaining a maximum in scientific return at a minimum cost. The programs have relied on comprehensive testing structural analysis, and inspection to serve as the check and balance for flight reliability.

To ensure the integrity of fasteners used in Code 800 flight programs, but in keeping with the nature of these programs, Code 800 will implement a new policy. This requires all future procurements of structural threaded fasteners intended to be used for flight hardware and safety critical (where a single failure could result in injury to personnel or damage to property or flight hardware by dropping or losing control of the load) nuts and bolts and GSE hardware to be procured from one of the following, or to include a requirement to meet a tensile load specification.

a. Defense Industrial Supply center

b. Vendors that appear on the approved sources list (Appendix I of GSFC Spec. S-313-100)

c. Vendors supplying traceable certifications

A minimum sample of three items from each procurement will be tested to demonstrate compliance with the procurement specification, unless procured from sources a, b, or c above. Items exceeding the tensile test capability or which for other reasons are not suitable for tensile test may be hardness tested to determine equivalent strength. Organizations not having testing capabilities may send sample test items to the Experimental Mechanical Construction Section (Code 821.2) for testing.

Threaded fasteners which are single-point failure items on flight hardware or which have single-point failure with personnel safety implications on ground support equipment will be load tested and visually inspected in all cases.

This same policy will be imposed on the contractors for hardware provided in support of these programs. The flight experimenters, however, would be considered exempt from these policies although they would be informed of the concerns and the approved sources and would be offered the use of services of Code 821.2 for sample testing of threaded fasteners. Successful comprehensive testing of integrated systems will still provide the basis for final flight approval, except for the balloon program. The balloon program will continue to rely on structural analysis, inspection, and in the case of single-point failure fasteners, tensile or hardness testing will be performed. Safety critical items, in all cases, will continue to be emphasized.
If you have any questions about the implementation of this policy, contact the NSBF

Engineering Manager through Bettie Furman at (903) 723-8002 or E-Mail address: Bettie.Furman@master.nsbf.nasa.gov.

LIST OF GSFC-APPROVED MANUFACTURERS

(Appendix I, GSFC S-313-100)

Safe life or single-point fasteners must be made by these manufacturers or by manufacturers that are audited by the developer. Fasteners may be purchased directly from the manufacturer or from any distributor.

Air Industries Corp.
12570 Knotted St.
Garden City, CA 92641
(714) 892-5571
Aerospace bolts

Bristol Industries
630 E. Lambert Rd.
Area, CA 92622
(714) 990-4121
12-point bolts, hex and double-hex, self-locking nuts, channel nuts

California Screw Products
14957 Gwenchris Ave.
Paramount, CA 90723
(213) 633-6626
AN, MS, NAS bolts

Cherry Aerospace
1224 Warner Ave.
Santa Ana, CA 92707
(714) 545-5511
Blind Fasteners, self-locking nuts

Crescent Mfg. Co.
700 Geo. Washington Tpk.
Burlington, CT 06013
(203) 673-2591
Bolts and screws, rivets

Monogram Aerospace Fasteners
3423 S. Garfield Ave.
P.O. Box 6847
Los Angeles, CA 90040
(213) 722-6740
Blind fasteners

Federal Manufacturing Co.
9825 Dazed Ave.
Chatsworth, CA 91311
(818) 341-9825
Limited NAS bolts

GC Aerospace
1307 Winemaker Ave.
Ontario, CA 91761
(714) 988-0053
Aerospace bolts, non-locking nuts

Hi-Shear Corp.
2600-T Skypark Dr.
Torrance, CA 90509
(213) 326-8110
Aerospace bolts, blind fasteners, inserts, fastening systems

Kaynar Mfg. Division
800 S. State College Blvd.
Fullerton, CA 92634
(714) 871-1550
Locknuts, special nuts, inserts

Beutsch Fastener Corp.
3969 Paramount Blvd.
Lakewood, CA 90712
(213) 421-3711
Aerospace bolts, nutplates rivets, captive screws

Enclosure 8 - Instructions for User Command Interface

The document outlines a new interface format for the NSBF command management system, which will go into effect on 1/1/2000. The modifications to the interface involve using a hex representation for addresses and commands rather than using a combination of octal and hex.

> **Note**
> The VHF (Larse Encoder/Decoder) command system will not be supported after 1/1/2000.

User Interface Port Configuration

Default is 1200 baud, no parity, 8 bits, 1 stop bit.
Available baud rates include 1200, 2400, 4800, 9600.
(Baud rate does NOT affect rate of outgoing commands.)

User Command Request Packet

This packet format should be used to request that user commands be sent to the CIP/payload. This packet is sent from the user computer to the NSBF GSE computer. *(Users are not allowed to command NSBF balloon control systems.)*

Syyyy(SP)xxqSyyyy(SP)xxqSyyyy(SP)xxq(CR)(LF)

S (ASCII 53_h)
yyyy - four character command (hex for dataword and discrete)
space (ASCII 20_h)
xx - address in hex
space (ASCII 20_h)
q - either W (ASCII 57_h) for data word or K (ASCII $4B_h$) for discrete

repeat above twice

carriage return (ASCII 13_h)
line feed (ASCII 10_h)

Discrete Command Example for Address 12_h, Command 13_h
S0013 12KS0013 12KS0013 12(CR)(LF)

Dataword Command Example for Address 12_h, Command $AB03_h$
SAB03 12WSAB03 12WSAB03 12W(CR)(LF)

User Command Verification Packet

The NSBF command management system will return this packet to the user to verify that a user command request packet has been received AND that the command has been sent. Receipt of this packet does not verify that the command was received by the CIP, only that the command was sent to the transmitter.

XX/YYYY/00:00:00(CR)(LF)

XX - address in hex
/ (ASCII $2F_h$)
YYYY - command in hex
/ (ASCII $2F_h$)
00:00:00 - time command was sent (GMT)
carriage return (ASCII 13_h)
line feed (ASCII 10_h)

Error messages will be returned if the command is not formatted properly. The error messages are formatted as follows:

S -ERROR(SP)00:00:00(CR)(LF)	general error
C -ERROR(SP)00:00:00(CR)(LF)	address greater than $1F_h$
1 -ERROR(SP)00:00:00(CR)(LF)	repetitions not equal

Example for Properly Formatted Command from Science GSE
Address 12_h, Command 13_h - 12/0013/12:20:45(CR)(LF)
Address 12_h, Command $AB03_h$ - 12/AB03/12:20:46(CR)(LF)

Example for repetitions not equal
S-ERROR 12:20:50(CR)(LF)

User Single Line Interface

The following outlines the format for an optional single line interface which passes balloon location and command echo information to the user. The information is sent on the same serial line used by the user command interface and does not interfere with this capability. The normal user command verification packet is still provided to the user, in addition to the command echo data.

CIP Location Interface

If the single line interface is enabled, this information is sent to the user at 5 or 10 second intervals. If the selected GPS is updating, a packet will be sent every time a GPS packet is received (roughly every 5 seconds.) If the selected GPS is not updating, a packet will be sent every 10 seconds with the last data received from the CIP.

The packet format is defined below:

HH:MM:SSLLLLLmmm.mLLLLLmmm.maaaaaaaapppppp.pppprrrrrrssssshhhhttttttt.t(CR)(LF)

HH:MM:SS	Time (GMT)	(00:00:00)
LLLLLmmmm.m	Latitude (degrees minutes.decimal_seconds)	(%5d%5.1f)
LLLLLmmmm.m	Longitude (degrees minutes.decimal_seconds)	(%5d%5.1f)
aaaaaaa	GPS Altitude (ft)	(%8d)
ppppp.p	Pressure Altitude (millibars)	(%10.3f)
rrrrrr	GPS Ascent Rate (ft/min)	(%6d)
ssss	GPS Speed (knots)	(%4d)
hhhh	GPS Heading (degrees)	(%4d)
tttttt.t	Air Temperature (C)	(%8.1f)
carriage return (ASCII 13_h)		
line feed (ASCII 10_h)		

Example of CIP Location Interface

```
HH:MM:SS   deg min.decimal_sec
|          |         deg min.decimal_sec
|          |         |             GPS alt (ft)
|          |         |             |     Pressure Alt (mb)
|          |         |             |     |           Ascent rate (ft/min)
|          |         |             |     |           |   Speed (knots)
|          |         |             |     |           |   |   Heading (deg)
|          |         |             |     |           |   |   |   Air Temp (C)
|          |         |             |     |           |   |   |   |    <CR><lf>
|          |         |             |     |           |   |   |   |    |
19:56:06   56 51.5  101  3.9     924   929.044   200  20 120   0.0
19:56:11   56 51.5  101  3.9     924   929.044   210  21 121   0.0
20:20:16   56 51.5  101  3.9     924   929.044   211  20 120   0.0
```

CIP Command Echo

If the single line interface is enabled, every command echo received from the CIP will be sent to the user in the format described below. The command echo indicates the last command received by the CIP.

Dataword commands are sent in two stages with the lower byte being sent before the upper byte. This will cause two command echoes to be returned for every dataword sent.

ECHO/XX/YYYY/00:00:00*(CR)(LF)

ECHO - ascii text to denote echo of command received by CIP
XX - address in hex
/ (ASCII $2F_h$)
YYYY - command in hex
/ (ASCII $2F_h$)
00:00:00 - time command echo was received by GSE (GMT)
asterisk (ASCII $2A_h$)
carriage return (ASCII 13_h)
line feed (ASCII 10_h)

Example for Address 12_h, Command 13_h

ECHO/12/0013/13:54:34*(CR)(LF)

Example for Address 12_h, Command $AB03_h$

ECHO/12/0103/13:54:35*(CR)(LF) lower byte of dataword + 100_h
ECHO/12/02AB/13:54:36*(CR)(LF) upper byte of dataword + 200_h

NASA BALLOON PROGRAM
NATIONAL SCIENTIFIC BALLOON FACILITY
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ENCLOSURE 9

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GROUND SAFETY PLAN

1.0 Introduction of the NSBF Balloon Ground Safety Plan

1.11 General

1.1.1 This document is the Balloon Ground Safety Plan (BGSP) for operations performed by the National Scientific Balloon Facility (NSBF). The BGSP is a subsection of the Range Safety Manual for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF) identified as RSM-93.

1.1.2 The NSBF BGSP applies to all balloon operations performed by the NSBF Department personnel at Palestine, TX, Fort Sumner, NM, or any remote launch site.

1.1.3 The ground safety goal of the NSBF BGSP is to minimize risks of injury or death to personnel and damage to property caused by NSBF in conducting operations, and to prevent mishaps that might result in embarrassment to NSBF, NASA, and the United States Government.

1.1.4 It is the policy of the GSFC/WFF and NSBF that all systems be designed such that a minimum of two independent unlikely failures must occur in order to expose personnel to a hazard.

1.2 Responsibilities

1.2.1 It is the responsibility of the NSBF Operations Department Head (Campaign Manager, at remote sites) to insure compliance with the provisions of the BGSP for NSBF operations and for science user operations. The NSBF Recovery Leader is responsible for safety during recovery operations.

1.2.2 It is the responsibility of the NSBF science user to supply NSBF with documentation identifying hazards and control methods to rate the severity (catastrophic, critical, marginal, or negligible); to specify the probability (frequent, probable, occasional, remote); and to supply operational procedures which minimize the risk of injury to personnel. Hazards will be identified in the science user flight request and reviewed at the NSBF Flight Requirements Meeting. This meeting occurs when the science user arrives at the launch site staging area.

2.0 Hazard Control

2.1 Hazard Categories

2.1.1 Hazard categories used in the BGSP correspond to the definitions in RSM-93 paragraphs 5.2.5.1 (Category A) and 5.2.5.2 (Category B).

2.1.2 The NSBF balloon flight system contains no inherent Category A hardware, equipment, or systems. The only explosive or pyrotechnics in the NSBF flight systems are totally contained pyrotechnic wire cutters or pyrotechnic separation devices, which are considered to be Category B devices.

2.1.3 Conditions exist during various phases of balloon operations for configurations of nonhazardous systems or nonhazardous systems plus Category B systems to create a situation resulting in a Category A hazard condition.

2.1.4 All Category A hazard conditions will be directly addressed within the NSBF BGSP identifying the steps taken to mitigate risk to personnel and property.

2.2 Hazard Control Methods

2.2.1 The methods employed by NSBF to protect personnel and to minimize risk while conducting potentially hazardous operations will be to:

- **S** Implement safety design criteria
- **S** Identify all the known hazards associated with the program
- **S** Minimize exposure of personnel to potentially hazardous systems
- **S** Establish safe operating procedures
- **S** Plan for contingencies.

2.2.2 Exposure Limits

2.2.2.1 The principle used in conducting balloon launch operations and exposing personnel to a hazardous situation is to limit the exposure to a minimum number of personnel for a minimum time a to minimum number of potential hazards consistent with safe and efficient operations.

2.2.2.2 Operations will be configured that, should an incident occur, ti will cause the least possible injury to personnel and property.

2.2.2.3 Operations will be conducted in such a manner that the exposure of personnel to a potential hazard decreases as the probability of an incident increases.

2.2.3 **Personnel Limits**

2.2.3.1 The designated NSBF Launch Crew Chief is responsible for determining that only active essential personnel are permitted within potentially hazardous areas during a balloon launch operation.

2.2.3.2 The normal limit of operational personnel within the hazard area prescribed for the balloon launch area is 12. The number of personnel at any given time within the hazard area will be kept to a minimum. The Flight Director for NSBF Operations or the NSBF Campaign Manager at remote sites may grant exceptions as requests are presented.

2.2.3.3 Requirements regarding official visitors, guests, tours, etc., are as follows:

No guests, tours, or visitors will be allowed within any hazardous area after a hazardous operation has been initiated.

All guests, tours, or visitors observing any part of the launch operation will be escorted by an NSBF employee as approved by the Flight Director for operations at the NSBF, or the Campaign Manager for operations at all other locations. The escort will assure that all non-operational personnel remain outside hazardous areas when hazardous operations are underway.

3.0 **Specific Policies**

3.1 Operational Phases

3.1.1 Operational activities associated with balloon launches are divided in four phases. These phases are not necessarily continuous in time. Specific hazards may occur in each phase. The following paragraphs define the four phases and identify the specific procedures required in each phase to mitigate risk.

3.1.2 Phase I - General Operations Support

This phase is associated with receipt, inspection, storage, and shipment of materials to and from NSBF or remote sites; moving about the launch site; pre-flight preparation, assembly, and testing; and recovery operations to include transportation systems back to the launch site.

3.1.3 Phase II - Payload Pickup Through Start of Inflation

This phase extends from the time that the payload is physically attached to the balloon launch vehicle prior to leaving the assembly area to the point that inflation of the balloon commences.

3.1.4 Phase III - Balloon Inflation

This phase starts when lifting gas is applied to the balloon, after it is connected to the complete flight system. The phase is complete when all lifting gas has been transferred to the balloon and all pre-flight preparations are complete.

3.1.5 Phase IV - Launch

This phase starts from the time the balloon is released from the spool and ends when the payload is released from the launch vehicle.

3.2 **Specific Policies and Criteria**

3.2.1 Phase I - General Hazards

3.2.1.1 Ionizing Radiation Controls

3.2.1.1.1 All operations involving the use of radioactive sources must conform to the standard of the Nuclear Regulatory Commission, 10CFR, and applicable regulations for the state or country in which the operation takes place.

3.2.1.1.2 The NSBF Radiological Safety Officer (RSO) shall be responsible for receiving and providing appropriate storage for all radioactive sources brought to NSBF and remote sites. Procedures for the use, handling, and storage of radioactive sources shall be designed to minimize the exposure of personnel. All activities will comply with the specific procedures and policies identified in the NSBF Health and Safety Plan.

3.2.1.1.3 The scientific user is responsible for obtaining all licenses for radioactive material, and for supplying the NSBF RSO with copies of the licenses.

3.2.1.1.4 Range users will provide the NSBF RSO with Material Safety Data Sheets for each source being used.

3.2.1.1.5 For operations conducted from Alice Springs, Australia, the University of New South Wales will maintain a set of calibration sources for use by scientific users of the facility. The University of New South Wales will be responsible for maintaining the appropriate licenses and documentation, as well as for storage of the sources.

3.2.1.1.6 For operations conducted from Antarctica, the National Science Foundation will provide the necessary licenses, documentation, and storage for all radioactive sources transported to Antarctica.

3.2.1.1.7 Removal of ionizing radiation sources from NSBF or remote launch sites is the responsibility of the range user, except for special cases specified in 3.2.1.1.5 and 3.2.1.1.6.

3.2.2 **Laser Hazards Control**

3.2.2.1 All operations involving the use of lasers must comply with the standards and regulations of ANSI Z136.1-1096 and GHB 1860.3

3.2.2.2 Access and laser illumination must be controlled to insure that no personnel are present within the ocular hazard area unless suitable protection is provided per NASA/GSFC Handbook for Radiation Safety-Laser GHB 1860.3A (May 1978) and ANSI Z-136.1-1986.

3.2.3 **Chemical Hazards**

3.2.1.1 Chemical Hazards can almost exclusively be categorized into those associated with handling of cryogenic materials, gases, and lithium used in batteries. Chemical hazard control is largely the responsibility of the scientific user with NSBF oversight responsibility per paragraph 1.2.

3.2.3.2 It will be the responsibility of the scientist to develop procedures for the safe storage, handling, transfer, and uses of hazardous cryogenic materials, gases, and solids brought to NSBF or any remote launch site on behalf of the scientist or for use in balloon payloads. Hazards, hazard areas, and procedures for safe operations will be reviewed and approved by the NSBF Facility Safety Officer (FSO).

3.2.3.3 Hardware (tanks, transfer lines, etc.) shall conform to applicable ASME and DOT regulations.

3.2.3.4 Science users will supply the NSBF Officer or Campaign Manager with Material Safety Data Sheets (MSDS) for all hazardous material. The NSBF Safety Officer or Campaign Manager will have knowledge of physical and health hazards, as well as first aid techniques relevant to the hazardous material operation. MSDS's will be posted in applicable work areas at the primary work place facility. When NSBF employees are at remote locations, required information can immediately be obtained by voice communication with the NSBF FSO.

3.2.3.5 The NSBF Safety Officer or Campaign Manager will develop a special ground safety plan if danger to personnel associated with the hazardous material falls outside the normal controls associated with materials used in balloon operations.

3.2.3.6 Handling and storage of lithium batteries will be performed in compliance with NSBF Operations Department policies to include protective clothing and equipment requirements.

3.2.3.7 Disposal of lithium batteries shall be coordinated with the NSBF Facility Safety Officer and comply with local codes and regulations.

3.2.3.8 All work areas are carefully inspected for unrecognized hazards. OSHA 1910.146, “Permit Required Confined Spaces” will be a guide in all NSBF operations associated with confined spaces.

3.2.3.9 When handling chemicals, gases and lithium batteries, adequate personnel protective equipment will be worn to reduce the risk of personal injury. When chemical spills occur, trained personnel will respond in compliance with NSBF “Chemical Spill Procedure” as described in NSBF Safety and Health Plan.

3.2.4 **Pressure Vessels**

3.2.4.1 All ground support pressure systems shall meet ASME Boiler and Pressure Vessel Codes or GMI 1710.4.

3.2.4.2 All helium trailers and isopaks used in balloon operations shall comply with applicable DOT regulations.

3.2.4.3 Unrestricted access will be granted to all pressure systems that are certified to the ASME Boiler and Pressure Vessel Cases or have stored energy levels less than 100 K Joules (75K ft-lbs) and operating pressure less than 150 psi for gases and 1500 psi for liquids.

3.2.4.4 Airborne systems will be identified per 1.2.2 by the NSBF science user. The NSBF FSO will review the systems and hazards identified by the science user. Of airborne pressure systems do not comply with ASME Boiler and Pressure Vessel Codes or GMI 1710.4, the NSBF FSO will coordinate with the science user to determine compliance within NASA GSFC safety guidelines.

3.2.4.5 A special Ground Safety Plan and data package will be prepared for operations involving pressure vessels or systems which do not meet criteria specified 3.2.4.1. This Ground Safety Plan will identify hazard areas and include provisions for separating personnel from the pressure vessels by a barrier designed to protect against blast and fragmentation within the hazard area.

3.2.5. **High Voltage**

3.2.5.1 NSBF systems do not utilize high voltage electronics.

3.2.5.2 Any science user creating high voltage hazards will be identified under Paragraph 1.2.2. The NSBF FSO and NSBF Operations Manager will review any identified high voltage hazards and determine that the scientist complies with NASA GSFC safety requirements.

3.2.6 **Pyrotechnics**

3.2.6.1 NSBF does not utilized high energy pyrotechnics. NSBF does utilize Electro-Explosive Device (EED) cable cutters and separation devices (explosive1.45 DOT 172.101, CFR 49) on NSBF flight and payload systems. NSBF technicians, responsible for wiring and assembly of equipment using EED cable cutters, receive training and orientation by the NSBF FSO on proper handling and assembly of these devices in NSBF flight systems.

3.2.6.2 Any pyrotechnic hazards identified in science user systems will be identified under 1.2.2. The NSBF FSO and NSBF Operations Manager will review any identified pyrotechnic hazards and determine that the scientist complies with NASA GSFC safety requirements.

3.2.7 **Packaging and Shipment of Hazardous Material**

3.2.7.1 All shipments of hazardous material shall be packaged and transported in compliance with DOT regulations, transportation regulations for the appropriate foreign country, if applicable, and relevant instructions listed on the materials safety data sheets.

3.2.7.2 The NSBF Safety Officer, shipping/receiving clerk, and NSBF Property Officer shall be responsible for compliance with applicable regulations.

3.2.8 **Moving About and Working at the Launch Site**

3.2.8.1 NSBF employees, visitors, and scientific users shall comply with all posted speed limits and cautionary signs while at NSBF and remote sites.

3.2.8.2 It shall be the responsibility of the NSBF Safety Officer to identify potential hazards associated with everyday activities at NSBF facilities, and post the appropriate warnings appropriately. At remote sites this function will be the responsibility of the NSBF Campaign Manager.

3.2.8.3 Heavy equipment, i.e., launch vehicles, spool vehicles, etc., will be limited to a maximum speed of 5 mph while moving about NSBF facilities.

3.2.8.4 NSBF employees, scientific uses, or visitors shall not operate machine shop equipment, the BEMCO chamber, or Tenney Chamber without express approval from the respective area supervisors. Permission to operate this equipment shall be granted after the user demonstrates proficiency with the equipment, and knowledge of applicable safety procedures.

3.2.9 **Recovery Operations (reference NSBF Policy # 4-74-2, "Balloon Tracking and Recovery")**

3.2.9.1 All NSBF recovery trucks and trailer assemblies shall comply with applicable DOT regulations, as well as state and local codes pertaining to operation of motor vehicles.

3.2.9.2 Prior to each balloon operation, an NSBF recovery form shall be completed by the scientific user delineating specific hazards and safety procedures associated with pickup, disassembly, and transportation of the instrument back to the launch site. It shall be the responsibility of the NSBF Safety Officer or his designee to insure that information on the form is complete. This form will be reviewed in detail prior to departure so that NSBF recovery personnel are familiar with any hazards that may be associated with recovery. In the area of unusually hazardous recoveries, a special recovery plan will be prepared.

3.2.9.3 Whenever possible, a representative of the scientific group will accompany the NSBF recovery crew to aid in preparing the payload for safe transport back to the launch site. The NSBF Safety Officer or is designee will require scientific participation in recoveries deemed unusually hazardous.

3.2.9.4 Lithium batteries will be disconnected and stored in approved shipping containers prior to transport. Batteries will not be disposed of in the field by burial, but will be transported back to the launch site for proper disposal.

3.2.9.5 Pressure vessels and cryogenic dewars shall have pressure relieved and be rendered safe prior to transport according to instructions on the recovery form.

3.2.9.6 Protective clothing and equipment will be worn by recovery personnel consistent with the hazards associated with each recovery.

3.3 Phase II - Payload Pickup to Start of Inflation

3.3.1 **Heavy Equipment Operation**

3.3.1.1 It will be the responsibility of the Crew Chief to direct the movement and operation of all heavy equipment used in balloon launch operations in such a way as to insure safety and minimize the number of personnel exposed to hazards associated with this equipment.

3.3.1.2 All NSBF lifting devices, fixtures, and equipment must conform to NSS/G01740.9B as a NASA facility under GSFC/WFF management.

3.3.1.3 All crane type launch heads using pins to suspend the payload, will have two rated safety cables attached between the launch head and the truck plate to restrain the truck plate.

3.3.1.4 Tiny Tim Launch Vehicle

3.3.1.4.1 While attaching the “Tim” fitting to Tiny Tim, the vehicle’s engine will be shut off. The generator attached to the engine is the only energy source to the motors used to activate the jaws holding the payload or controlling the launch boom.

3.3.1.4.2 No personnel will be permitted to walk out onto the jaws of Tiny Tim (painted red area) while the engine is running.

3.3.1.4.3 The hydraulic operated safety column will be used as a secondary support for the launch boom at all times when a payload is suspended from the jaws of Tiny Tim.

3.3.1.4.4 Regular inspections of Tiny Tim will be performed according to procedures outlined in NSBF Operations Policy #08-92-31, “Inspection of Tiny Tim.”

3.3.1.4.5 A Category A condition occurs when the balloon payload is suspended from Tiny Tim jaws and the Tiny Tim engine is running.

3.3.1.4.5.1 The hazard area for this Category A condition is defined as the ground footprint of the science payload.

3.3.1.4.5.2 No personnel will be allowed in this hazard area for any reason when the Category A condition exists.

3.4 Phase III - Hazards-Balloon Inflation

3.4.1 Mechanical Constraint of Flight Train

3.4.1.1 The NSBF Support Engineering Department will be responsible for providing mechanical certification of the spool, spool restraining vehicle, flight train, and launch vehicle for each launch configuration used at NSBF and remote sites. Guidelines for certification will be to insure mechanical integrity of the entire system at the maximum planned gross inflation should the system be exposed to a 20 knot wind directly behind the balloon bubble at the completion of inflation.

3.4.1.2 NSBF Launch Crew Chief is responsible to configure all launch equipment in accordance with the approved mechanical certification provided by the NSBF Engineering Department.

3.4.2 Electro-mechanical Constraint of Flight Train

3.4.2.1 Category A hazard condition results when the NSBF Flight Terminate System is made “hot” by insertion of the continuity plug and balloon inflation begins. This Category A hazard continues through balloon launch or until helium is released from the balloon envelope or until the continuity plug is removed the NSBF Flight Terminate System.

3.4.2.1.1 The Category A hazard area is defined as extending from the NSBF parachute cut-away device to the launch spool. This area extends 10 feet on either side of the package and balloon up to the launch spool and a 50 foot radius around the center of the launch spool.

3.4.2.1.2 Personnel will not straddle or remain under any portion of the parachute or balloon at any time when this Category A hazard exists.

3.4.2.1.3 The only personnel allowed within this Category A hazard area are NSBF launch personnel trained to perform the following operations:

- **S** stripping of protective wrap from the balloon at a position behind the launch spool
- **S** stripping of protective wrap from the balloon from the balloon base fitting to the spool from a position on either side of the balloon
- **S** inspection and documentation of the balloon and associated flight hardware from either side of the parachute and balloon
- **S** installation of the balloon collar by the launch crew chief and support technicians
- **S** deploying the terminate box assembly as slack is taken out of the system during inflation

3.4.2.2 All EED's used for flight critical systems shall meet a 1 amp/1 watt NO FIRE requirement and be 100% qualified with a 500 VDC megohm-meter test for 5 seconds from bridgewire to case (and bridgewire to bridgewire if dual bridgewires are used).

3.4.2.2.1 Electrical wiring and power source shall be completely independent and isolated from all other systems; they will not share common cables, terminals, power sources, tie points, connectors, or ground returns with any other systems.

3.4.2.2.2 All EED's will be connected with approved shorting devices until the flight system is assembled on the launch pad. At no time will any flight system EED's be left in an open circuit condition.

3.4.2.2.3 All EED's will be specified to not give off shrapnel in operation and may be fired without danger of fragmentation.

3.4.2.2.4 All EED's used in balloon operations will be specified as .4S as per CFR 49 for shipment and handling.

3.4.2.2.5 Receiving, shipping, handling, and storage of EED's shall be performed in accordance with NSBF Operations Policy # 04-86-28, "Procedures for Storage, Safe Handling, and Installation of Ordnance Devices".

3.4.2.2.6 All NSBF staff utilized to assemble and install EED's will receive training and orientation by the NSBF FSO.

3.4.3 Non-ionizing Radio Frequency (RF) Radiation Controls

3.4.3.1 RF-radiation sources brought to the NSBF or remote sites must pass a compatibility test with NSBF flight systems as performed by the NSBF

Electronics Section. Scientific uses will supply the NSBF Electronics Section with specific descriptions of all non-NSBF transmitters or significant RF emitters located on the scientific payload. A Safety Factor (Cs) will be determined based on the calculation in the appendix regarding hazard distance for pyrotechnics.

3.4.3.2 All Operations involving the use of RF transmitters must conform to the standards and regulations specified in ANSI C95.1-1982, and use frequencies approved by the NASA GSFC/WFF Frequency Coordinator, and the designated area frequency coordinator for each launch site.

3.4.4 Electrostatic Discharge (ESD) Hazards

Precautions must be taken to eliminate or reduce the risk of electrostatic discharge during inflation which could result in actuation of the terminate fitting squibs.

3.4.4.1 The exclusive use of Series 5800 Holex squibs on NSBF terminate fittings greatly reduces or eliminates the potential for inadvertent actuation of the terminate squibs in normal balloon operations.

3.4.4.2 Personnel handling of the terminate box, parachute, and terminate fitting will be minimized after balloon inflation has begun.

3.4.4.3 In extremely dry environmental conditions, the Campaign Manager may opt to apply static dissipating fluid to the ground cloth prior to laying out the balloon.

3.4.4.4 The launch vehicle will incorporate a drag chain to eliminate static charge on the launch vehicle.

3.4.5 Electrical Storm Criteria (Reference NSBF Operations Policy #8-74-5, “Thunderstorm and Launch Restrictions”)

3.4.5.1 Inflation of a balloon will not be started if an electrical storm is detected within 10 nm of the launch site.

3.4.5.1.1 If no equipment is available to detect electrical storms, inflation will be halted and the hazardous areas cleared upon hearing thunder or observing weather conditions which have an immediate potential of producing an electrical storm.

3.4.6 High Pressure Gas Equipment

3.4.6.1 All inflation tubes, fittings, and helium diffusers shall be certified under the GSFC/WFF NSBF Pressure Vessel Certification Program.

3.4.6.2 Hydrogen gas will not be used for balloon inflation except under special procedures that have been specifically reviewed and approved by the NSBF Operations Manager, NSBF Facility Safety Officer, and NSBF Site Manager.

3.5 Phase IV - Balloon Launch

3.5.1 Balloon Release

3.5.1.1 The Crew Chief shall be solely responsible for signaling the spool operator to release the balloon from the spool. An approved communication mechanism (handy talkie, launch vehicle light system, etc.) shall be employed by the Crew Chief to signal the spool operator to release the balloon.

3.5.1.2 The spool mechanism will be designed such that two actions are necessary to activate the spool and release the balloon.

3.5.2 Launch Vehicle Safety

3.5.2.1 The number of personnel riding on the launch vehicle during an operation will be minimized to reduce hazards during launch. A minimum crew will consist of the Crew Chief, Driver, one or two mechanical technicians to push the payload off at launch, and an electronics technician.

3.5.2.2 An electronics technician will ride on the launch vehicle with an approved portable command system capable of terminating the flight upon command from the Crew Chief.

3.5.2.3 An electronic intercom system will be installed on the launch vehicle such that, at a minimum, the Crew Chief, driver and electronics technician have voice communication. This system will be independent from other voice communication systems to eliminate the possibility of interference from other sources.

3.5.2.4 For crane-head launches two safety cables will attach the truck plate to the crane head. The cable release mechanism to launch the balloon will be an NSBF Support Engineering Department approved mechanical lever arm.

3.5.2.5 For Tiny Tim launches, the jaw release mechanism requires two actions to arm the Crew Chief ‘s launch button. On Tiny Tim, a separate jaw release switch will be located in the driver’s cab should the Crew Chief’s release button malfunction. This switch shall be protected from inadvertent actuation by a hinged cover until immediately prior to balloon releases.

3.5.2.6 The Crew Chief shall be responsible for deciding whether to initiate spool release and balloon launch. If at any point during an operation, the Crew Chief observes conditions that could result in danger to personnel, the decision will be made to destroy the balloon in the spool or terminate the

flight prior to payload release.

3.5.2.7 Balloon collar release will be initiated by command of the Campaign Manager or his designee. The person issuing the command will be located in a safe area off to the side of the operation where the entire flight train is visible. Collar release will take place such that there is no danger of the collar, collar receiver or protective foam striking personnel riding on the launch vehicle.

3.5.2.8 Category A hazard condition exists from the time that the balloon is released from the spool until the payload is released from the launch vehicle.

3.5.2.8.1 The Category A hazard area is defined as a rectangular area on the ground from the payload on the launch vehicle to the launch spool and extending one half of this distance to either side of line between the payload and launch spool. The area also consists of a semicircle in front of the launch vehicle with a radius equal to one-half the length of the total flight system.

3.5.2.8.2 All personnel and vehicles are excluded from this area except for NSBF launch crew personnel assigned to duties on the NSBF payload launch vehicle.

3.6 HAZARDOUS AREAS

3.6.1 Category A Hazard Areas

3.6.1.1 Operational Phase II - Payload on Tiny Tim and Engine On

3.6.1.1.1 A radius on the ground from the center of the science payload equal to the height of the Tiny Tim Pin in the jaws of Tiny Tim.

3.6.1.1.2 Operation Phase III - Hot Terminate and Inflation

3.6.1.2.1 The area from the parachute cut-away device to the launch spool extending one foot either side of the parachute and balloon.

3.6.1.3.1 A rectangular area on the ground from the payload on the launch vehicle to the launch spool and extending one half of this distance to either side of the line between the payload and launch spool. The area also consists of a semicircle in front of the launch vehicle with a radius equal to one-half the length of the total flight system.

3.6.2 General Restrictions

3.6.2.1 Operational phases II, III, and IV tend to draw attention from the general public. Since balloon launch operations rarely occur from locations where access is tightly controlled or limited, crowd control always becomes an issue.

3.6.2.2 The NSBF Operations Manager or his designee will monitor the situation with the general public and insure that vehicles and people are always outside of the launch area in front of the launch vehicle and one-half the distance from the payload to the spool on either side of the parachute and balloon.

3.6.2.3 Visitors may be escorted within these restricted areas by NSBF staff as long as no Category A conditions exist during the operation.

3.7 Personal Protective Equipment

3.7.1 Safety glasses or face shields are required for operations that present an ocular hazard, particularly working with lithium batteries and high pressure helium cylinders.

3.7.2 Hard hats are required for operations where personnel work on multiple levels.

3.7.3 Ear plugs are required for all personnel working with 75 meters of the balloon bubble during inflation.

3.7.4 Personnel working with cryogenic liquids shall wear proper protective equipment as necessary including hand and foot protection, face protection, and appropriate outer garments. Pants will be worn outside of boots or shoes while working with cryogenic liquids.

3.7.5 Personnel working with lithium batteries are required to wear appropriate face, body and hand protection. They will also have immediate access to an approved respirator and eyewash station.

3.7.6 Operations involving materials or procedures identified in special Ground Safety Plans (identified on a case by case basis for especially hazardous operations) will wear personal protective gear as indicated in the Ground Safety Plan.

4.0 OPERATIONAL CONTROLS AND SECURITY

For all launch operations at NSBF, Ft. Sumner and remote sites, the designated Campaign Manager, or at NSBF the Flight Director, exercises control over personnel associated with the operation.

4.1 All NASA personnel, NSBF personnel, experimenters, scientists, and associated contractors are responsible for:

, Adhering to the requirements established in this document.

, Adhering to the directions issued by the NSBF designated Flight Director or Campaign Manager.

- Reviewing vehicle, payload, support systems, and support operations with the Flight Director or Campaign Manager.

- Obtaining permission from the Flight Director or Campaign Manager before conducting any operations in hazard areas.

- Identifying active essential personnel for such operation to assure maximum personnel limits are not exceeded.

- Controlling all RF radiation sources in coordination with the Campaign Manager or Flight Director.

4.2 The designated Launch Crew Chief is responsible for all personnel access to the hazard areas defined for balloon operations.

4.2.1 Due to the extended distances involved with balloon launch operations, all NSBF personnel are expected to be alert to the presence of unauthorized and/or unescorted personnel in operational hazard areas and ensure that notification is provided to the Launch Crew Chief and that they are asked to leave the area.

4.2.2 NSBF Operations personnel will either be approved to work independently in the hazard areas or will be under direct supervision by senior personnel.

4.3.3 NSBF Operations personnel will utilize individual handi-talkie radios for direct communication with the Launch Crew Chief.

NATIONAL SCIENTIFIC BALLOON FACILITY

PAYLOAD SAFETY PROCESS

General

This document will outline NSBF's process of certifying and documenting that a balloon payload is in compliance with applicable safety requirements during integration and launch. It addresses the tasks, responsibilities, submittals, safety reviews/meetings, and schedules associated with the process. The philosophy of the NSBF payload safety process is that the NSBF scientific user is responsible for insuring that the payload is in compliance with NSBF policy. NSBF is responsible for checking, monitoring, and documenting compliance.

From a safety standpoint, payloads flown by NASA's Balloon Program pose reduced risks in comparison to other NASA Expendable Launch Vehicles. Hazards associated with balloon payloads fall into a somewhat limited and generic set of safety considerations. Standard safety hazards in ballooning can be categorized as follows.

- Radioactive Sources
- Lasers
- Chemical Hazards
- Pressure Vessels
- High Voltage
- Contained Pyrotechnics

Safety compliance requirements for the above hazards are addressed in the "NASA Balloon Program Ground Safety Plan (attached). Identified safety hazards that fall outside these areas are handled through separate safety plans and reviews. The following paragraphs describe the process. Table 1 is an abbreviated depiction of the NSBF Payload Safety Process.

1. Initiate Project and Document Safety Assessment

1.1 Identify Hazards Falling Within NSBF Ground Safety Plan. The NSBF Flight Application Form is sent out to prospective users in July of each year. The form includes a safety questionnaire covering hazards normally associated with balloon payloads. The NSBF Ground Safety Plan is attached to the Flight Application so the prospective user can identify safety issues and determine whether the payload is in compliance with NSBF Policy.

1.2 Identify Hazards Falling Outside NSBF Ground Safety Plan. The Flight Application also contains questions about safety hazards not covered in the Ground Safety Plan. This is the means whereby special cases are identified and flagged. The Flight Application requests that the user forward all home institution safety documentation to NSBF. Most balloon payloads originate at NASA centers or universities. Users are usually required to undergo rigorous safety processes at their home institutions while building up their instrumentation. This documentation is used by NSBF as a further check of compliance with safety requirements.

1.3 User Verification of Compliance with NSBF Ground Safety Plan. The principle investigator is required to submit signed documentation indicating that the payload is in compliance with NSBF safety standards delineated in the Ground Safety Plan. This form is sent to NSBF prior to shipment of the payload to the launch site.

1.4 User Prepared Special Safety Plans. When the user identifies a safety issue falling outside those covered in the NSBF Ground Safety Plan (i.e. superconducting magnet, toxic gas, etc), a separate safety plan must be prepared by the user and submitted to NSBF for review. The NSBF Safety Officer is responsible for review of these plans for compliance with established industry safety standards.

2. Conduct Safety Reviews

2.1 Review Standard and Special Payload Safety Issues and Plans. Program Review Meetings are held monthly at NSBF to discuss support of upcoming campaigns and operations. Flight Applications and project files are reviewed in some detail. Safety related status, concerns, and issues are discussed. Action items on safety compliance are documented and tracked.

2.2 Resolve Open Safety Concerns, Action Items, and Discrepancies. Response and close of safety related action items for each upcoming operation are discussed at the monthly Program Review Meetings. Closer of action items are the responsibility of the Operations Manager or the assigned Campaign Manager. Emphasis is placed on insuring that applicable safety documentation is at NSBF prior to shipping the instrumentation to the launch site.

3. Finalize and Approve Safety Assessments/Plans

3.1 Prepare Balloon System Pre-Launch Safety Package (BSPSP). Immediately following the scientist's arrival at the launch site, a Flight Requirements Meeting is held. The Flight Application Form is reviewed for compliance with standard and special safety issues prior to beginning of payload integration. The signed Payload Safety Compliance form, special safety plans for non-standard hazards, and user institution safety documentation is reviewed, discussed, and assembled into the Balloon System Pre-Launch Safety Package (BSPSP). Unresolved issues, if any are referred to the NSBF Safety Officer. The completed BSPSP package serves as a formal approval of the project from a safety standpoint.

4. Periodic Compliance Checks

4.1 Verify Compliance with Safety Procedures/Plans. The NSBF Operations Manager or Campaign Manager is responsible for periodic inspection of integration areas for compliance with routine and special safety procedures and plans. These inspections will typically take place on at least a bi-weekly basis.

5. Pre-Launch Review

5.1 Review Applicable Safety Plans with Flight Line Personnel. Flight Readiness Review meetings are held once the science payload is flight ready and no sooner than 72 hours prior to a scheduled launch. Standard flight line payload safety procedures and special safety plans, if any, are reviewed with cognizant personnel. Checklists are used to insure safety compliance. These meetings are rescheduled every 72 hours should a launch delay occur.

5.2 Recovery Plan. A completed form indicating step by step instructions for safe payload handling during recovery operations is submitted by the principle investigator at the Flight Readiness Review meeting. This form is reviewed and approved by the Flight Director. Should extraordinary safety measures be necessary during recovery, a formal plan is written, reviewed, and discussed with recovery personnel.

6. Documentation

Table 2 lists documentation generated during the Payload Safety Process, who is responsible for generating it, and required signatures on the accompanying documentation. At the conclusion of each flight, all payload safety documentation will be archived in the flight folder.

Document(s)	Responsible Party	Required Signatures
Flight Application Form	Science P.I.	Science P.I.
Special Safety Plans	Science P.I.	Science P.I.
User Institution Safety Documentation	Science P.I.	User Institutional Safety Office Representative
Verification of Safety Compliance Form	Science P.I.	Science P.I./NSBF Ops Manager
Program Review Meeting Action Item and Closure	NSBF Operations Manager	NSBF Operations Manager
BSPSP	NSBF Campaign Manager	NSBF Campaign Manager
Pre-Flight Readiness Meeting Checklist	NSBF Flight Director	NSBF Flight Director
NSBF Recovery Form	Science P.I.	Science P.I./NSBF Operations Manager

Table 2
Payload Safety Process Documentation

Attachment: NSBF Ground Safety Plan

Table 2
NSBF Payload Safety Process

Task #	Safety Task Description	Responsibility	Product or Meeting	Schedule
	INITIATE PROJECT AND DOCUMENT SAFETY ASSESSMENT			
1.1	Identify safety hazards falling within NSBF Ground Safety Plan.	NSBF Operations Manager	Flight Application document delineating standard safety issues.	3-9 months prior to payload shipment to launch site.
1.2	Identify safety hazards falling outside of standard NSBF Ground Safety Plan.	NSBF Operations Manager	Flight Application document delineating special safety considerations.	3-9 months prior to payload shipment to launch site.
1.3	User prepared special safety plan for hazards not covered in NSBF Ground Safety Plan.	Science Principle Investigator	Written Safety Plan for special hazards.	1 month prior to shipment to launch site.
	CONDUCT SAFETY REVIEWS			
2.1	Review Standard and Special Payload Safety Issues and Plans	NSBF Site Manager/Operations Manager	Program Review Meetings. Safety-related concerns/issues and action items documented in meeting minutes	At least monthly beginning 3 months prior to shipment to launch site.
2.2	Resolve open safety concerns, action items and discrepancies	NSBF Operations Manager	Program review Meetings-Response and closure of concerns and action items.	As assigned.

	FINALIZE AND APPROVE SAFETY ASSESSMENTS/PLANS			
3.1	Prepare final Balloon System Prelaunch Safety Package (BSPSP).	NSBF Operations Manager/Campaign Manager	Flight Requirements Meeting. Assemble Payload Safety Compliance Form, safety plans for non-standard hazards, and user institution safety documentation.	Immediately following arrival at launch site.
	PERIODIC COMPLIANCE CHECKS			
4.1	Verify that procedures/plans are being followed.	NSBF Operations Manager/Campaign	Verbal warning of science users or written discrepancy reports (depending on severity)	Periodic from payload arrival at launch site through launch.
	PRELAUNCH REVIEW			
5.1	Review applicable routine and special safety issues and plans with flight line personnel	NSBF Flight Director	Flight Readiness Meeting. Completed pre-flight checklists.	<72 hrs prior to launch
5.2	Recovery Plan	NSBF Flight Director	Flight Readiness Meeting. Completed Recovery Form or plan	<72 hrs prior to launch

Table 2 (cont)

NSBF Payload Safety Process