FAA FORM 8130-6, APPLICATION FOR U.S. AIRWORTHINESS CERTIFICATE

Form Approved O.M.B. No. 2120-0018
09/30/2007

U.S. Department of Transportation
Federal Aviation Administration

APPLICATION FOR U.S. AIRWORTHINESS CERTIFICATE

INSTRUCTIONS - Print or type. Do not write in shaded areas; these are for FAA use only. Submit original only to an authorized FAA Representative. If additional space is required, use attachment. For special flight permits complete Sections II, VI and VII as applicable.

I. AIRCRAFT DESIGNATION

1. REGISTRATION MARK N305BX	2. AIRCRAFT BUILDER'S NAME *(Make)* TELFORD AVIATION SERV	3. AIRCRAFT MODEL DESIGNATION SKYBUS 30K	4. YR. MFR. 2007	FAA CODING 061001 0
5. AIRCRAFT SERIAL NO. MS001	6. ENGINE BUILDER'S NAME *(Make)* ROTAX	7. ENGINE MODEL DESIGNATION 912ULS		55572
8. NUMBER OF ENGINES 1	9. PROPELLER BUILDER'S NAME *(Make)* POWERFIN	10. PROPELLER MODEL DESIGNATION MODEL F 3-BLADE 72" DIA	11. AIRCRAFT IS *(Check if applicable)*	IMPORT

8

II. CERTIFICATION REQUESTED

APPLICATION IS HEREBY MADE FOR: *(Check applicable items)*

- A 1 [ ] STANDARD AIRWORTHINESS CERTIFICATE *(Indicate Category)*: NORMAL / UTILITY / ACROBATIC / TRANSPORT / COMMUTER / BALLOON / OTHER
- B [✓] SPECIAL AIRWORTHINESS CERTIFICATE *(Check appropriate items)*
  - 7 [ ] PRIMARY
  - 9 [ ] LIGHT-SPORT *(Indicate Class)*: AIRPLANE / POWER-PARACHUTE / WEIGHT-SHIFT-CONTROL / GLIDER / [✓] LIGHTER THAN AIR
  - 2 [ ] LIMITED
  - 5 [ ] PROVISIONAL *(Indicate Class)*: 1 CLASS I; 2 CLASS II
  - 3 [ ] RESTRICTED *(Indicate operation(s) to be conducted)*: 1 AGRICULTURE AND PEST CONTROL; 2 AERIAL SURVEY; 3 AERIAL ADVERTISING; 4 FOREST *(Wildlife Conservation)*; 5 PATROLLING; 6 WEATHER CONTROL; 0 OTHER *(Specify)*
  - 4 [✓] EXPERIMENTAL *(Indicate operation(s) to be conducted)*: 1 [✓] RESEARCH AND DEVELOPMENT; 2 AMATEUR BUILT; 3 EXHIBITION; 4 AIR RACING; 5 [✓] CREW TRAINING; 6 [✓] MARKET SURVEY; 0 TO SHOW COMPLIANCE WITH THE CFR; 7 OPERATING *(Primary Category)* KIT BUILT AIRCRAFT; 8 OPERATING LIGHT-SPORT: 8A Existing Aircraft without an airworthiness certificate & do not meet § 103.1; 8B Operating Light-Sport Kit-Built; 8C Operating light-sport previously issued special light-sport category airworthiness certificate under § 21.190
  - 8 [ ] SPECIAL FLIGHT PERMIT *(Indicate operation(s) to be conducted, then complete Section VI or VII as applicable on reverse side)*: 1 FERRY FLIGHT FOR REPAIRS, ALTERATIONS, MAINTENANCE, OR STORAGE; 2 EVACUATION FROM AREA OF IMPENDING DANGER; 3 OPERATION IN EXCESS OF MAXIMUM CERTIFICATED TAKE-OFF WEIGHT; 4 DELIVERING OR EXPORTING; 5 PRODUCTION FLIGHT TESTING; 6 CUSTOMER DEMONSTRATION FLIGHTS
- C 6 [ ] MULTIPLE AIRWORTHINESS CERTIFICATE *(check ABOVE "Restricted Operation" and "Standard" or "Limited" as applicable)*

III. OWNER'S CERTIFICATION

A. REGISTERED OWNER *(As shown on certificate of aircraft registration)* — IF DEALER, CHECK HERE →

NAME: TELFORD AVIATION INC
ADDRESS: 154 MAINE AVE, BANGOR, ME 04401

B. AIRCRAFT CERTIFICATION BASIS *(Check applicable blocks and complete items as indicated)*

AIRCRAFT SPECIFICATION OR TYPE CERTIFICATE DATA SHEET *(Give No. and Revision No.)* N/A	AIRWORTHINESS DIRECTIVES *(Check if all applicable AD's are complied with and give the number of the last AD SUPPLEMENT available in the biweekly series as of the date of application)* 2007-10
AIRCRAFT LISTING *(Give page number(s))* N/A	SUPPLEMENTAL TYPE CERTIFICATE *(List number of each STC incorporated)* N/A

C. AIRCRAFT OPERATION AND MAINTENANCE RECORDS

CHECK IF RECORDS IN COMPLIANCE WITH 14 CFR Section 91.417	TOTAL AIRFRAME HOURS 0.0	3 EXPERIMENTAL ONLY *(Enter hours flown since last certificate issued or renewed)* 0.0

D. CERTIFICATION - I hereby certify that I am the registered owner (or his agent) of the aircraft described above, that the aircraft is registered with the Federal Aviation Administration in accordance with Title 49 of the United States Code 44101 et seq. and applicable Federal Aviation Regulations, and that the aircraft has been inspected and is airworthy and eligible for the airworthiness certificate requested.

DATE OF APPLICATION	NAME AND TITLE *(Print or type)*	SIGNATURE
MAY 22, 2007	ROBERT C. KRUEGER, ENGINEERING MNGR	[signature]

IV. INSPECTION AGENCY VERIFICATION

A. THE AIRCRAFT DESCRIBED ABOVE HAS BEEN INSPECTED AND FOUND AIRWORTHY BY: *(Complete the section only if 14 CFR part 21.183(d) applies.)*

- 2 14 CFR part 121 CERTIFICATE HOLDER *(Give Certificate No.)*
- 3 CERTIFICATED MECHANIC *(Give Certificate No.)*
- 6 CERTIFICATED REPAIR STATION *(Give Certificate No.)*
- 5 AIRCRAFT MANUFACTURER *(Give name or firm)*

DATE	TITLE	SIGNATURE

V. FAA REPRESENTATIVE CERTIFICATION

(Check ALL applicable block items A and B)

A. I find that the aircraft described in Section I or VII meets requirements for — 4 THE CERTIFICATE REQUESTED / AMENDMENT OR MODIFICATION OF CURRENT AIRWORTHINESS CERTIFICATE

B. Inspection for a special permit under Section VII was conducted by: FAA INSPECTOR / FAA DESIGNEE / CERTIFICATE HOLDER UNDER / 14 CFR part 65 / 14 CFR part 121 OR 135 / 14 CFR part 145

DATE	DISTRICT OFFICE	4 DESIGNEE'S SIGNATURE AND NO.	1 FAA INSPECTOR'S SIGNATURE
5/22/07	ANE-MIDO-42		[signature]

VI. PRODUCTION FLIGHT TESTING

A. MANUFACTURER	
NAME	ADDRESS

B. PRODUCTION BASIS *(Check applicable item)*

☐	PRODUCTION CERTIFICATE *(Give production certificate number)* →
☐	TYPE CERTIFICATE ONLY
☐	APPROVED PRODUCTION INSPECTION SYSTEM

C. GIVE QUANTITY OF CERTIFICATES REQUIRED FOR OPERATING NEEDS

DATE OF APPLICATION	NAME AND TITLE *(Print or Type)*	SIGNATURE

VII. SPECIAL FLIGHT PERMIT PURPOSES OTHER THAN PRODUCTION FLIGHT TEST

A. DESCRIPTION OF AIRCRAFT

REGISTERED OWNER	ADDRESS
BUILDER *(Make)*	MODEL
SERIAL NUMBER	REGISTRATION MARK

B. DESCRIPTION OF FLIGHT — CUSTOMER DEMONSTRATION FLIGHTS ☐ *(Check if applicable)*

FROM	TO	
VIA	DEPARTURE DATE	DURATION

C. CREW REQUIRED TO OPERATE THE AIRCRAFT AND ITS EQUIPMENT

☐ PILOT ☐ CO-PILOT ☐ FLIGHT ENGINEER ☐ OTHER *(Specify)*

D. THE AIRCRAFT DOES NOT MEET THE APPLICABLE AIRWORTHINESS REQUIREMENTS AS FOLLOWS:

E. THE FOLLOWING RESTRICTIONS ARE CONSIDERED NECESSARY FOR SAFE OPERATION: *(Use attachment if necessary)*

F. CERTIFICATION – I hereby certify that I am the registered owner (or his agent) of the aircraft described above; that the aircraft is registered with the Federal Aviation Administration in accordance with Title 49 of the United States Code 44101 et seq. and applicable Federal Aviation Regulations; and that the aircraft has been inspected and is safe for the flight described.

DATE	NAME AND TITLE *(Print or Type)*	SIGNATURE

VIII. AIRWORTHINESS DOCUMENTATION (FAA/DESIGNEE use only)

✓	A. Operating Limitations and Markings in Compliance with 14 CFR Section 91.9, as applicable.		G. Statement of Conformity, FAA Form 8130-9 *(Attach when required)*
✓	B. Current Operating Limitations Attached		H. Foreign Airworthiness Certification for Import Aircraft *(Attach when required)*
✓	C. Data, Drawings, Photographs, etc. *(Attach when required)*		I. Previous Airworthiness Certificate Issued in Accordance with 14 CFR Section ______ CAR ______ (Original Attached)
✓	D. Current Weight and Balance information Available in Aircraft		
	E. Major Repair and Alteration, FAA Form 337 *(Attach when required)*	✓	J. Current Airworthiness Certificate Issued in Accordance with 14 CFR Section 21.191(a)(c)&(f) *(Copy Attached)*
✓	F. This inspection Recorded in Aircraft Records		K. Light-Sport Aircraft Statement of Compliance, FAA Form 8130-15 *(Attach when required)*

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION

SPECIAL AIRWORTHINESS CERTIFICATE

A	CATEGORY/DESIGNATION EXPERIMENTAL (UNMANNED AIRCRAFT)		
	PURPOSE Research and Development/Crew Training or Market Survey		
B	MANU-FACTURER	NAME N/A	
		ADDRESS N/A	
C	FLIGHT	FROM N/A	
		TO N/A	
D	N-305BX		SERIAL NO. MS001
	BUILDER Telford Aviation Services		MODEL Skybus 30K
E	DATE OF ISSUANCE May 22, 2007		EXPIRY May 21, 2008
	OPERATING LIMITATIONS DATED 5/22/07		ARE PART OF THIS CERTIFICATE
	SIGNATURE OF FAA REPRESENTATIVE William A. Burke		DESIGNATION OR OFFICE NO. ANE-MIDO-42

Any alteration, reproduction or misuse of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE TITLE 14, CODE OF FEDERAL REGULATIONS (CFR).

FAA Form 8130-7 (07/04) *SEE REVERSE SIDE* *NSN: 0052-00-693-4000*

A	This airworthiness certificate is issued under the authority of Public Law 104-6, 49 United States Code (USC) 44704 and Title 14 Code of Federal Regulations (CFR).
B	The airworthiness certificate authorizes the manufacturer named on the reverse side to conduct production fight tests, and only production flight tests, of aircraft registered in his name. No person may conduct production flight tests under this certificate: (1) Carrying persons or property for compensation or hire: and/or (2) Carrying persons not essential to the purpose of the flight.
C	This airworthiness certificate authorizes the flight specified on the reverse side for the purpose shown in Block A.
D	This airworthiness certificate certifies that as of the date of issuance, the aircraft to which issued has been inspected and found to meet the requirements of the applicable CFR. The aircraft does not meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention On International Civil Aviation. No person may operate the aircraft described on the reverse side: (1) except in accordance with the applicable CFR and in accordance with conditions and limitations which may be prescribed by the Administrator as part of this certificate; (2) over any foreign country without the special permission of that country.
E	Unless sooner surrendered, suspended, or revoked, this airworthiness certificate is effective for the duration and under the conditions prescribed in 14 CFR, Part 21, Section 21.181 or 21.217.

U.S. Department
of Transportation

Federal Aviation Administration

Burlington Manufacturing Inspection District Office
12 New England Executive Park
Burlington, MA 01803

EXPERIMENTAL - OPERATING LIMITATIONS
RESEARCH AND DEVELOPMENT, CREW TRAINING, or MARKET SURVEY

REGISTERED OWNER NAME: TELFORD AVIATION INC.	**AIRCRAFT BUILDER:** TELFORD AVIATION INC.
REGISTERED OWNER ADDRESS: 154 MAINE AVE. BANGOR, ME 04401	**YEAR MANUFACTURED:** 2007
AIRCRAFT DESCRIPTION: UAS LIGHTER-THAN-AIR / AIRSHIP	**AIRCRAFT SERIAL NUMBER:** MS001
AIRCRAFT REGISTRATION: N305BX	**AIRCRAFT MODEL DESIGNATION:** SKYBUS 30K
	ENGINE MODEL: ROTAX 912 ULS
	PROPELLER MODEL: POWERFIN Model F 3-Bladed 72" Diameter

The following conditions and limitations apply to all Telford Aviation Skybus 30K flight operations while operating in the National Airspace System (NAS):

1. GENERAL

a. For the purposes of the **Special Airworthiness Certificate and Operating Limitations**, the Skybus 30K Unmanned Aircraft System (UAS), owned and operated by Telford Aviation, is considered to be an integrated system. The integrated system is composed of the Skybus aircraft, S/N: MS001, unmanned aircraft (UA) pilot, UA control station(s) (fixed or mobile), telemetry, navigation and communications equipment. This equipment includes ground, air, and space based equipment that is used for control of the Skybus 30K UA. The UAS also includes equipment on the ground and in the air that is used for communication with the chase aircraft and Air Traffic Control.

b. Unless otherwise specified in this document, the Pilot-in-Command (PIC) and Telford Aviation shall comply with all applicable sections and parts of 14 CFR including, but not limited to, parts 61 and 91. Alternative methods of compliance with specific regulations shall be annotated in this document as required.

c. No person may operate this UAS for other than the purpose of research and development (R&D), crew training, or market surveys, to accomplish the flight operation outlined in Telford Aviation Program Letter dated May 22, 2007, which describes compliance with §21.193(d), and has been made available to the pilot in command of the UAS. In addition, this UAS must be operated in accordance with applicable air traffic and general operating rules of part 91, and all additional limitations herein prescribed under the provisions of §91.319(e).

d. The PIC must determine that the UAS is in a condition for safe operation, and in a configuration appropriate for the intended purpose of the flight.

e. When changing between operating purposes of a multiple-purpose certificate, the operator must determine that the aircraft is in a condition for safe operation and appropriate for the purpose intended. A record entry will be made by an appropriately rated person to document that finding in the aircraft logbook.

f. No person may operate this UA to carry property for compensation or hire.

g. This UA must be marked with its U.S. Registration number in accordance with 14 CFR part 45.

h. This UA must display the word "EXPERIMENTAL" in accordance with §45.23(b).

i. Prior to conducting the initial Skybus 30K flight operations, Telford Aviation must forward a copy of the Skybus 30K, Special Airworthiness Certificate, and Operating Limitations to: Linda Otting, FAA Air Traffic Representative, Eastern Service Center, System Support, 1701 Columbia Ave, College Park, GA 30337, telephone (404) 305-5577, email Linda.Otting@faa.gov.

j. Section 47.45 requires that the FAA Aircraft Registry must be notified within 30 days of any change in the aircraft registrant's address. Such notification is to be made by submitting Form 8050-1 to AFS-750 in Oklahoma City, Oklahoma.

2. PROGRAM LETTER

The Telford Skybus 30K Program Letter, dated May 22, 2007, was used as a basis for the determining the operating limitations prescribed in this document. All flight operations must be conducted in accordance with the provisions contained in these operating limitations.

3. INITIAL FLIGHT TESTING

a. Flight operations shall be divided into 2 phases.

1) The following restrictions apply to Phase I flight-testing:

a) Shall be conducted within visual line of sight of the pilot/observer,

b) Shall be within a 3 statute mile radius of the airport,

c) Shall be conducted at an altitude no greater than 3000 ft. AGL,

d) The aircraft may not be controlled by satellite communications,

Initial Phase I flight-testing shall be completed upon accumulation of 25 flight hours. Following satisfactory completion of Phase I flight testing, the operations manager or chief pilot must certify in the records that the aircraft has been shown to comply with § 91.319(b). Compliance with § 91.319(b) must be recorded in the aircraft records with the following, or a similarly worded, statement:

"I certify that the prescribed flight test hours have been completed and the aircraft is controllable throughout its normal range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation. The following aircraft operating data has been demonstrated during the flight testing: speeds Vx ______, and Vy ______, and the weight ______ and CG location ______ at which they were obtained."

2) Phase 2 flight-testing authorizes flight in the Primary Containment Area within 6 statute miles of the airport at an altitude no greater than 3000 ft. AGL.

3) Aircraft operations for the purpose of market survey cannot be performed until after 50 flight hours have been accomplished. A logbook entry is required as evidence of compliance.

4. AUTHORIZED FLIGHT TEST OPERATIONS AREA

a. The base of operations for the Skybus 30K UAS shall be Loring International Airport (ME16) (former Loring AFB near Limestone, ME).

b. The flight test operations area authorized for the UA is depicted graphically below. This area shall be referred to as the "Primary Containment Area." Telford Aviation may be permitted to operate within restricted airspace per authorization of the using agency. Under these circumstances, should the UA venture beyond the boundaries of restricted airspace (e.g., spill out), provisions of this experimental certificate shall apply, including authorization to only operate within the boundaries of the Primary Containment Area. In these circumstances, Telford Aviation is responsible for notifying the FAA of the breach of any operations. The Skybus 30K is required to be operated in accordance with the conditions defined in these limitations and in compliance with FAA rules and regulations while operating in restricted airspace.

c. Flight operations in the Primary Containment Area shall be conducted below 3000 ft AGL within the boundaries defined below. When operating in a terminal environment, the UA must have line of sight communications.

	Latitude	Longitude
PT 1	N 46° 57' 02"	W 67° 49' 19"
PT 2	N 46° 59' 40"	W 67° 53' 09"
PT 3	N 46° 57' 02"	W 67° 56' 56"
PT 4	N 46° 54' 27"	W 67° 53' 09"

	Latitude	Longitude
PT 5	N 47° 00' 59"	W 67° 48' 08"
PT 6	N 47° 02' 16"	W 67° 53' 09"
PT 7	N 46° 57' 02"	W 68° 00' 45"
PT 8	N 46° 51' 50"	W 67° 53' 09"
PT 9	N 46° 53' 07"	W 67° 48' 08"

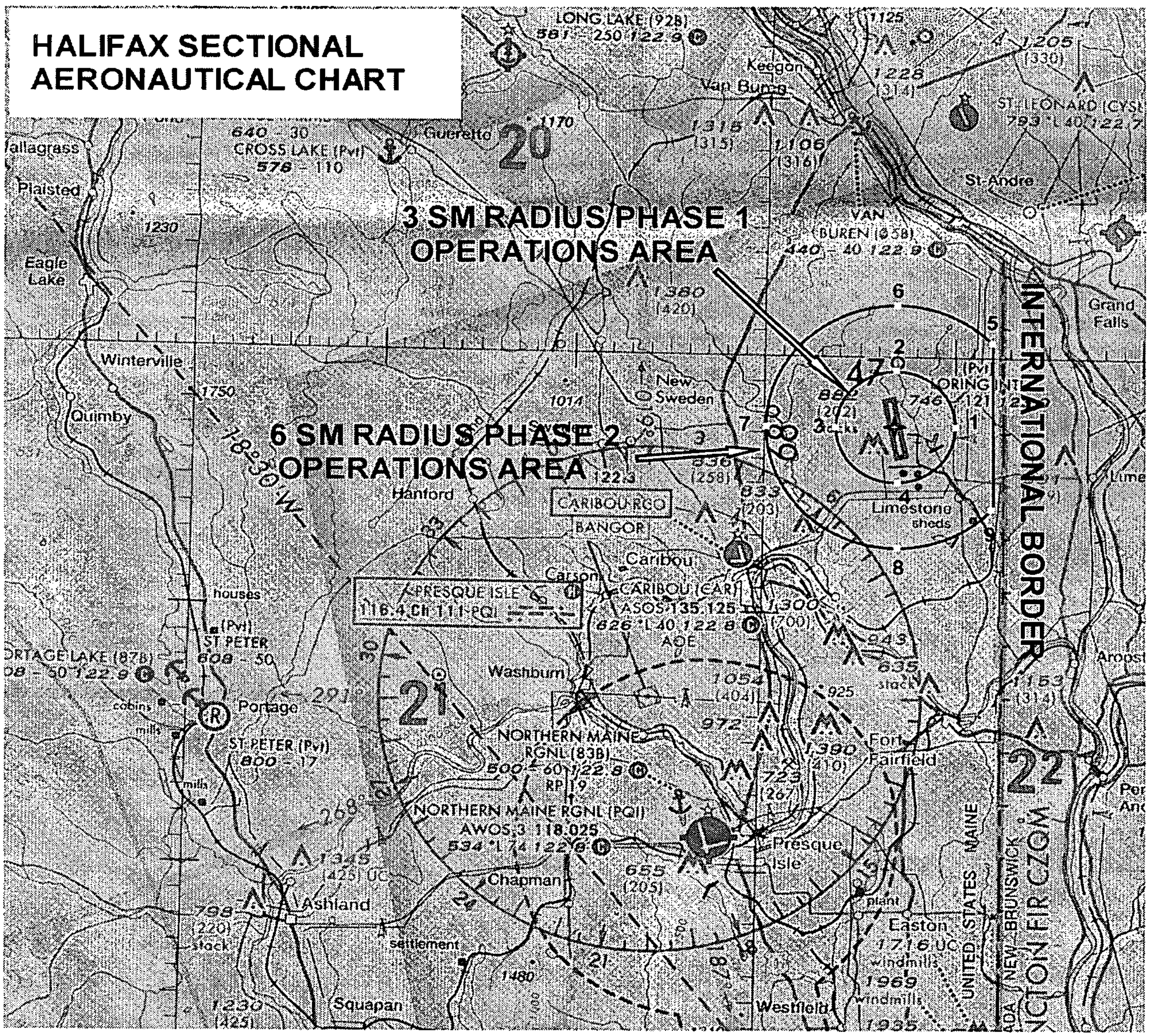


Figure 1: Primary Containment Area

e. The PIC shall ensure that all UA flight operations remain within the lateral and vertical boundaries of the Primary Containment Area or any restricted area approved by the using agency. Furthermore, the PIC shall take into account all factors that may affect the capability of remaining within the containment areas. This includes, but is not limited to, considerations for wind, gross weight, and glide distances.

f. Incident / Accident Reporting. Any incident / accident and any flight operation that transgresses the lateral or vertical boundaries of the Primary Containment Areas or any restricted airspace shall be reported to the FAA, Manager AIR-160, as soon as practicable, but always within 24 hours. Accidents shall be reported to the National Transportation Safety Board per the instructions contained on the NTSB website: www.ntsb.gov. The AIR-160 Manager, Mr. Doug Davis, can be reached at telephone number 202-385-4636, or by fax at 202-385-4651. The report may be provided by either phone, or e-mail to kenneth.d.davis@faa.gov. Further flight operations shall not be conducted until the incident / accident is reviewed by ATO, AFS, and AIR-160, and authorization to resume operations is received.

g. If the review reveals issues with the operating limitations, the FAA may revise/amend the operating limitations as part of the authorization to resume operations.

5. UA PILOT AND OBSERVER

a. All flight operations conducted in the Primary Containment Area shall have an observer to perform traffic avoidance and visual observation to fulfill the "see and avoid" requirement of §91.113.

b. The UA PIC shall hold, at a minimum, an FAA Private Pilot certificate, Instrument Rating, lighter-than-air category, with airship class rating, and have it in their possession.

c. All observers shall:

1) Hold at a minimum, an FAA Private Pilot certificate, or
2) Successfully completed specific observer training acceptable to the FAA.

d. The UA PIC shall maintain currency in manned aircraft per 14 CFR §61.57.

e. All UA pilots shall maintain currency in unmanned aircraft in accordance with Telford Aviation company procedures.

f. The UA PIC shall have a Flight Review in manned aircraft every 24 calendar months per 14 CFR §61.56.

g. All UA pilots shall have a Flight Review in unmanned aircraft every 24 calendar months in accordance with Telford Aviation company procedures.

h. The UA PIC shall have operational override capability over any Supplemental Pilot, regardless of position.

i. The Supplemental Pilot need not be a certificated pilot. If the supplemental pilot is not a certificated pilot, the supplemental pilot must have successfully completed a recognized Private Pilot ground school or successfully completed the private pilot written test within 90 days of the issuance of these limitations.

j. Pilots and observers shall have successfully completed applicable manufacturer training for high level systems and operational understanding of the UAS.

k. Pilots and observers must have in their possession a valid third class (or higher) airman medical certificate that has been issued under 14 CFR part 67.

l. A PIC must be designated at all times and be responsible for the safety of the UAS and persons and property along the UA flight path. This includes, but is not limited to, collision avoidance and the safety of persons and property in the air and on the ground. The PIC shall avoid densely populated areas (14 CFR § 91.319) and exercise increased vigilance when operating within published airway boundaries.

m. UA pilots and observers shall perform crew duties for only one UA at a time. When the observer is located in a chase aircraft, the observer's duties shall be dedicated to the task of observation only, concurrent duty as pilot is not authorized.

n. All observers must be thoroughly trained, familiar with, and possess, operational experience with the equipment being utilized for observation and detection of other aircraft for collision avoidance purposes as outlined in Telford Aviation Program Letter.

o. Visual Observer Responsibilities: The task of the observer is to provide the pilot of the UA with instructions to maneuver the UA clear of any potential collision with other traffic. Visual observer duties require continuous visual contact with the UA at all times in such a manner as to be able to discern UA attitude and trajectory. At no time shall the visual observer permit the UA to operate beyond line-of-sight necessary to ensure that maneuvering information can be reliably determined. At no time shall visual observers conduct their duties more than three (3) nautical miles laterally or 3000 feet vertically from the UA. Observers must maintain continuous visual contact with the UA. When a chase aircraft is utilized, it must maintain a reasonable proximity, and shall position itself relative to the UA in such a manner to reduce the hazard of collision per §91.111.

6. COMMUNICATIONS

a. Each UAS Flight operation must be coordinated by telephone with the Boston Air Route Traffic Control Center (ARTCC) at **(603) 879-6655** no less than 1 hour and no more than 2 hours prior to the start of the flight operation to receive assignment of a discreet transponder code.

b. Telford Aviation shall provide the Boston ARTCC with an on-site contact name and phone number (or frequency) for two-way communications with ATC for each flight.

c. The UA pilot shall have the capability of maneuvering the UAS or suspending operations as instructed by the Boston ARTCC.

d. The UAS shall transmit the assigned beacon code and altitude information (Mode-C) for the duration of the flight. Any failure of the transponder or inability to properly squawk an assigned code shall be reported to the Boston ARTCC and flight operations shall be concluded.

e. UAS operations shall be conducted only when Caribou Radar is functional. Telford Aviation shall verify the status of the radar with the Boston ARTCC prior to flight.

f. A distant (D) Notice to Airmen (NOTAM) shall be issued when UAS operations are being conducted. Telford Aviation shall contact the Automated Flight Service Station (FSS) no less than 48 hours prior to the operation and provide:

1) Name, address, and telephone number of the person giving notice.
2) Nature of the activity.
3) Date, time, and duration of the activity.
4) Size of the affected area in nautical mile radius and affected altitudes.
5) Location of center of affected area in relation to airport.
6) Location of center of affected area in relation to nearest VOR/DME or VORTAC.

g. Upon initial contact with ATC, the PIC must indicate the experimental nature in accordance with 14 CFR § 91.319.

h. The PIC must maintain two-way communication with ATC. If a chase aircraft is utilized, the chase aircraft pilot shall maintain two-way communications with ATC and with the PIC.

i. The PIC and observer(s) must maintain two-way communications with each other during all operations.

j. If communications cannot be maintained between the PIC, chase aircraft pilot, observer(s) and appropriate ATC facility, the UA will expeditiously return to its base of operations while remaining within the primary containment area, and conclude the flight operation.

k. Spectrum used for operation and control of the UA must be approved by the FCC or other appropriate government oversight agency prior to operations being conducted.

7. FLIGHT CONDITIONS

a. All flight operations must be conducted under visual flight rules (VFR) in visual meteorological conditions (VMC), including cloud clearance minimums as specified in 14 CFR § 91.155. Flight operations under instrument flight rules (IFR) or in instrument meteorological

conditions (IMC) are not authorized. Flight operations shall not be conducted under the Special VFR criteria specified in 14 CFR § 91.157, nor shall flight operations be conducted when flight visibility is less than three statute miles.

b. All flight operations within the Primary Containment Area as specified in Section 4d shall be conducted during daylight hours only.

c. The UA is prohibited from aerobatic flight, that is, an intentional maneuver involving an abrupt change in the UA's attitude, an abnormal acceleration, or other flight action not necessary for normal flight (§91.303).

d. Flight operations must not involve carrying hazardous material or the dropping of any objects or external stores, excluding water ballast.

e. The UA and chase aircraft shall be equipped with operable navigation, position, and strobe/anti-collision lights. Strobe/anti-collision lights shall be illuminated at all times.

f. The UA must operate an altitude encoding transponder (Mode C) in accordance with applicable guidelines and procedures.

g. The chase aircraft transponder must be on standby while performing chase operation flight with the UA. In the event of UA transponder failure, the chase aircraft will contact ATC and assume transponder operations.

h. In the event of transponder failure on either the UA or the chase aircraft, the UA must conclude all flight operations and expeditiously return to its base of operations within the prescribed limitations of this authorization.

8. FLIGHT TERMINATION & LOST LINK PROCEDURES

a. In accordance with Telford Program Letter, dated May 22, 2007 flight operations must be discontinued at any point when the approved flight containment area(s) is breached and/or the control of the UA is questionable. If it is determined that the UA is still under control of the PIC, the UA shall return to base (RTB).

b. In the event of lost link, the UA must provide a means of automatic recovery that ensures airborne operations are predictable and that the UA remains within the primary containment area. The UAS PIC will immediately notify ATC, chase aircraft/observer of the loss of link condition and what the expected UA response will be.

9. MAINTENANCE

a. This UAS must not be operated unless it is inspected and maintained in accordance with the Telford Skybus 30K Maintenance Manual. Each inspection must be recorded in the UAS maintenance records.

b. No person may operate this UAS unless within the preceding 12 calendar months it has had a condition inspection performed in accordance with, FAA-accepted, Telford Skybus 30K Maintenance Manual and was found to be in a condition for safe operation. This inspection will be recorded in the UAS maintenance records.

c. Only those individuals authorized by Telford Aviation, and acceptable to the FAA, may perform inspections required by these operating limitations.

d. Inspections of the UAS must be recorded in the UAS maintenance records showing the following, or a similarly worded, statement: "I certify that this UAS has been inspected on [insert date] in accordance with the scope and detail of the Telford Skybus 30K Maintenance Manual, and was found to be in a condition for safe operation." The entry will include the UAS's total time-in-service, the name, signature, type of certificate and certificate number of the person performing the inspection.

e. UAS instruments and equipment installed must be inspected and maintained in accordance with the requirements of the Telford Skybus 30K Maintenance Manual. Any maintenance or inspection of this equipment must be recorded in the UAS maintenance records.

f. No person may operate this UAS unless the altimeter system and transponder have been tested within the preceding 24 calendar months in accordance with 14 CFR §91.411 and §91.413 respectively. These inspections will be recorded in the UA maintenance records.

10. EQUIPAGE

a. The UAS shall be equipped with an operable Mode-C transponder.

b. The GCS shall be equipped with two-way communications equipment allowing communications between the UAS pilot, chase aircraft, and ATC facilities.

11. INFORMATION REPORTING

Telford Aviation shall provide the following information to Kenneth.d.Davis@faa.gov on a monthly basis.

- **a.** Number of flights conducted under this certificate.
- **b.** Pilot duty time per flight.
- **c.** Unusual equipment malfunctions (hardware or software), if any.
- **d.** Deviations from ATC instructions.
- **e.** Unintended entry into lost link flight mode that results in a course change.

12. REVISIONS

a. The experimental certificate, Telford Aviation FAA-accepted program letter, and operating limitations cannot be reissued, renewed, or revised without application being made to the Burlington MIDO, and coordinated with the Production and Airworthiness Division,

AIR-200. AIR-200 will be responsible for headquarters internal coordination with the Aircraft Certification Service, Flight Standards Service, Air Traffic, Office of Chief Council, and Office of Rulemaking.

b. No Certificate of Authorization or Waiver may be issued in association with this Experimental Certificate unless coordinated with the Burlington MIDO and the Production and Airworthiness Division, AIR-200.

c. The provisions and limitations annotated in this operational approval may be amended or cancelled at any time as deemed necessary by the FAA.

d. All revisions to Telford FAA-accepted Telford Skybus 30K Maintenance Manual must be reviewed and accepted by the Portland Flight Standards District Office.

13. UA MODIFICATIONS

a. All software and system changes will be documented as part of the normal maintenance procedures and be available for inspection. All software and system changes shall be inspected and approved per Telford Aviation's maintenance procedures. All software changes to the aircraft and GCS are categorized as major changes, and shall be provided in summary form at the time they are incorporated.

b. All major modifications, whether performed under the experimental certificate, COA, or other authorizations, that could potentially effect the safe operation of the system, shall be documented and shall be provided to the FAA prior to operating the aircraft under this certificate. Major modifications incorporated under COA or other authorization need only be provided if the aircraft is flown under these authorizations during the effective period of the experimental certificate.

c. All information requested shall be provided to AIR-200.

End of Limitations.

William Burke
Aviation Safety Inspector (Mfg)
Burlington Manufacturing Inspection District Office
12 New England Executive Park
Burlington, MA 01803

Date: May 22, 2007

I certify that I have read and understand the operating limitations and conditions that are a part of the Special Airworthiness Certificate, FAA Form 8130-7 issued on May 22, 2007 for the purpose of Research and Development, Crew Training, or Market Survey.

This Airworthiness Certificate is issued for Telford Aviation UAS model Skybus 30K serial number MS001, registration number N305BX. This certification expires on May 21, 2008.

Note: If the so stated limitations or conditions cannot be complied with, Skybus 30K flight operations shall be terminated.

Applicant (signature)

Date: May 22, 2007

Name (Printed): Bob Ziegelaar

Title: President

Company: Telford Aviation Inc.

PROGRAM LETTER FOR UNMANNED AIRCRAFT SYSTEMS

REGISTERED OWNER NAME: **TELFORD AVIATION INC** **REGISTERED OWNER ADDRESS:** 154 MAINE AVE BANGOR, ME 04401 **AIRCRAFT DESCRIPTION:** **LTA UAS AIRSHIP** **AIRCRAFT REGISTRATION:** **N305BX**	**AIRCRAFT BUILDER:** **TELFORD AVIATION INC** **YEAR MANUFACTURED:** **2007** **AIRCRAFT SERIAL NUMBER:** **MS001** **AIRCRAFT MODEL DESIGNATION:** **SKYBUS 30K** **ENGINE MODEL:** **ROTAX 912 ULS** **PROPELLER MODEL:** **POWERFIN Model F 3-Bladed 72" Diameter**

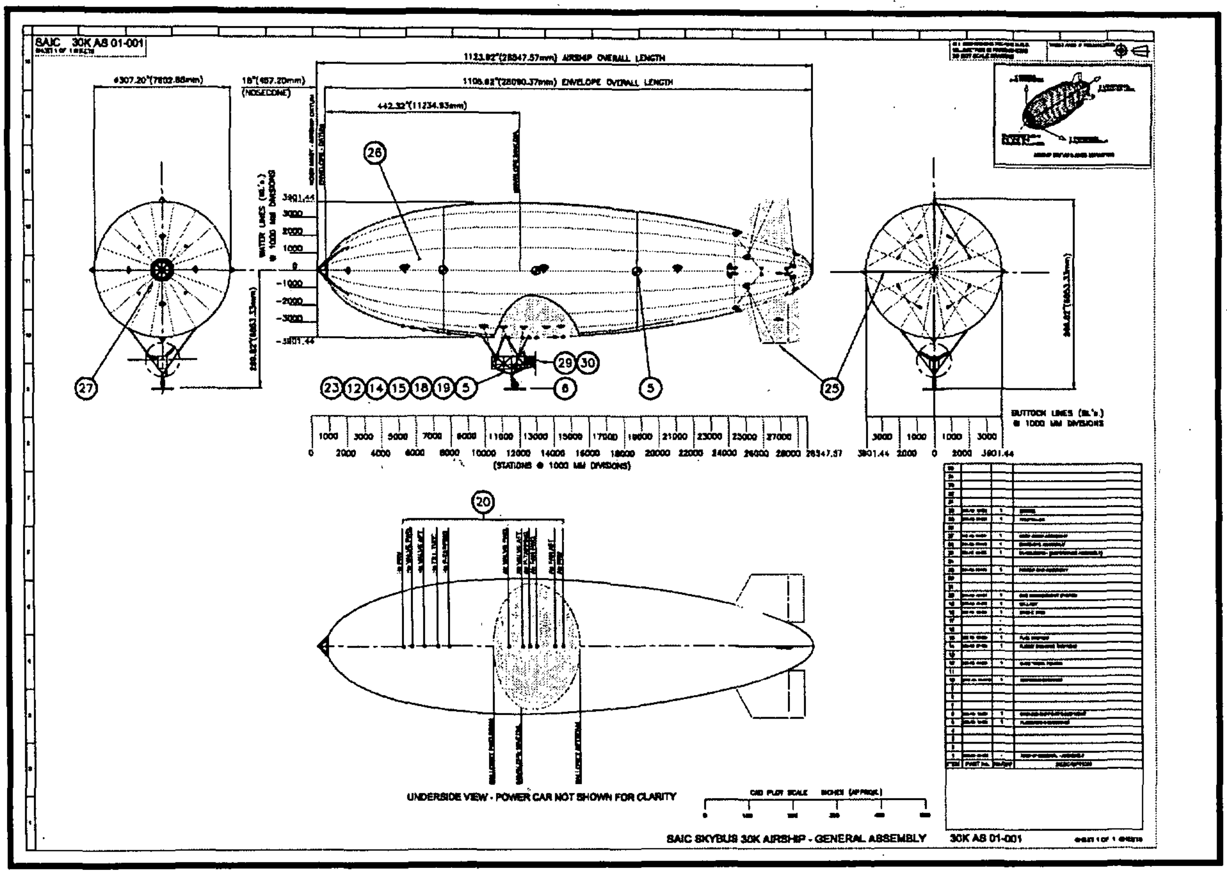
1. DEFINE THE EXPERIMENTAL PURPOSE(S) UNDER WHICH THE AIRCRAFT IS TO BE OPERATED (14 CFR § 21.191).

(a) Research and Development

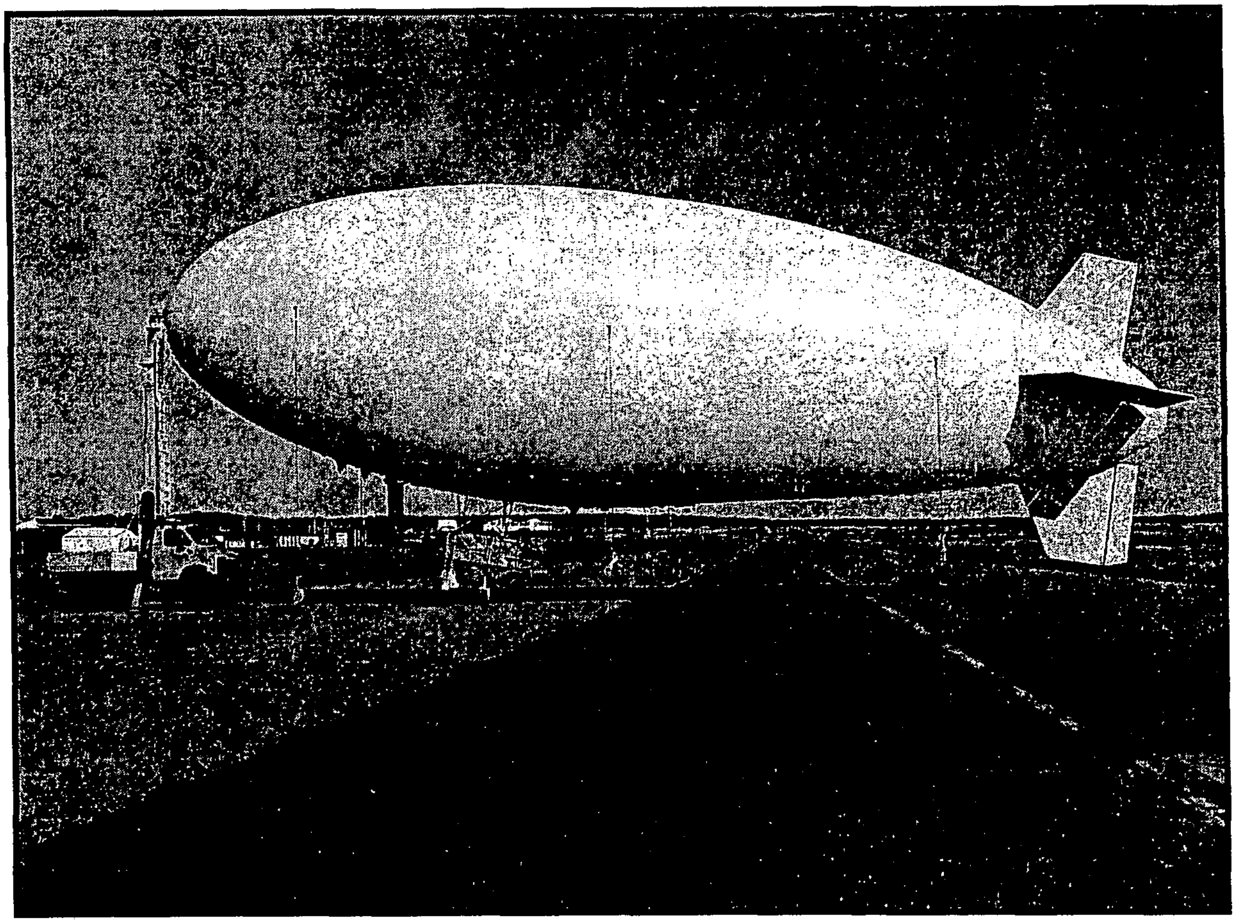
(b) Market Survey

(c) Crew Training – Pilot Crew and Ground Crew

2. DESCRIBE THE PURPOSE/SCOPE OF THE EXPERIMENTAL PROGRAM FOR EACH 14 CFR § 21.191 EXPERIMENTAL PURPOSE SOUGHT (14 CFR §§ 21.193(b)(d)).



Three View GA of the SKYBUS 30K Airship



Photograph of the SKYBUS 30K on the mast truck

1) Scope of the Experiments

(A) The scope of the Research and Development Program is to collect, process, analyse and assess the flight test data and design for optimization of the existing SKYBUS 30K Airship before migrating the proven technologies to the larger sister SKYBUS 80K Airship for ultimate payload operations. Comparison with Flight Simulation and actual flight is sought. The Flight Test program has been developed such that after successful flights in Radio controlled mode, transition to a pre-programmed flight mode can commence.

(B) The scope of the Market Survey program is to determine if a suitable market exists for a LTA UAS aircraft and to demonstrate to prospective customers the advantages associated with a LTA UAS. Prospective customers, both civilian and government will have the opportunity to see actual flight characteristics and be afforded the opportunity to attach different payloads to the LTA UAS aircraft for evaluation.

(C) The scope of the Pilot and Ground Crew training program is to build up a competent team that can safely operate the UA Airship for initially the R&D program by developing appropriate procedures from the experience gained. Training manuals for new Pilots and Ground Crew will be developed for the subsequent operation of other LTA UAS's of this type. Flight Simulation for pilots has been initiated and an assessment of the success of this will be made.

3. DEFINE THE AREA(S) IN WHICH THE EXPERIMENTAL FLIGHTS WILL BE CONDUCTED.

a. Describe the areas over which the flights are to be conducted and address of base operation (14 CFR § 21.193(d)(3)).

AIRSPACE REQUIREMENTS

Datum: Loring International Airport
Midpoint of Runway Centerline
Limestone, ME

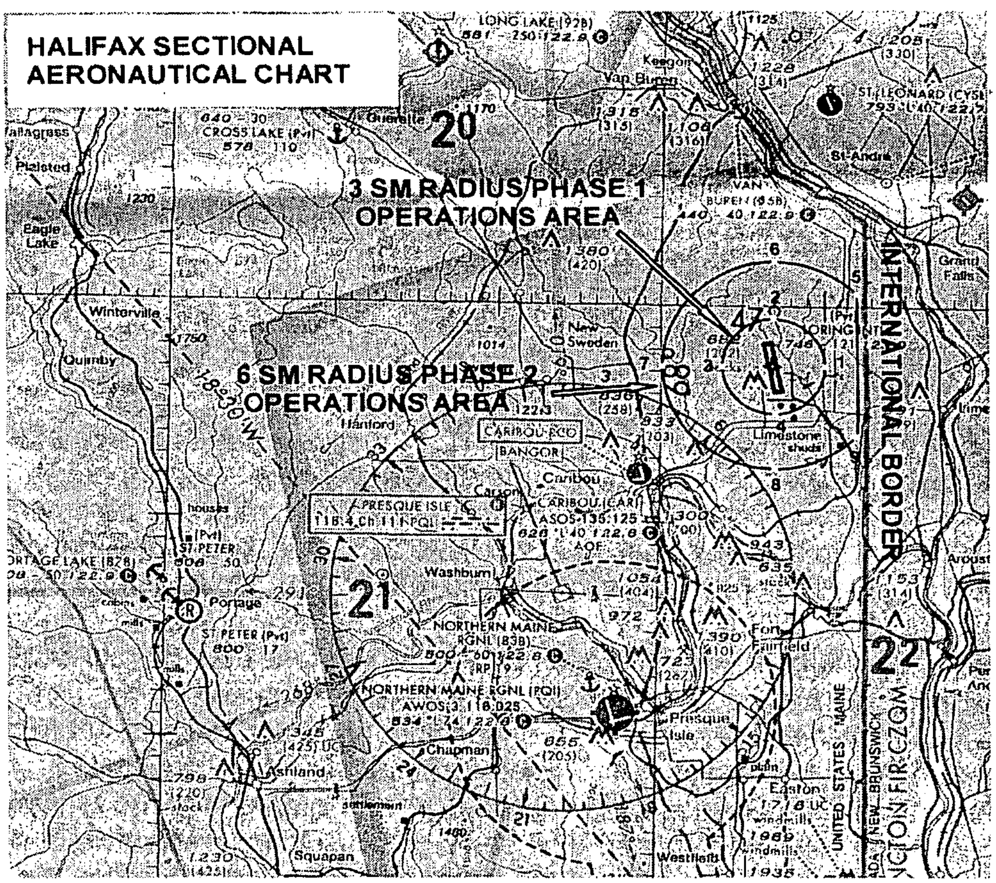
	Latitude	Longitude
Datum Location:	46° 57' 02" N	67° 53' 09" W

Phase 1 - Boundary of Flight Operations
3SM Radius Circle, center located at Datum

	Latitude	Longitude
PT 1	46° 57' 02" N	67° 49' 19" W
PT 2	46° 59' 40" N	67° 53' 09" W
PT 3	46° 57' 02" N	67° 56' 56" W
PT 4	46° 54' 27" N	67° 53' 09" W

Phase 2 - Boundary of Flight Operations
6SM Radius Semi Circle, center located at Datum
(East boundary is North/South line 1/2 mile West from international border)

	Latitude	Longitude
PT 5	47° 00' 59" N	67° 48' 08" W
PT 6	47° 02' 16" N	67° 53' 09" W
PT 7	46° 57' 02" N	68° 00' 45" W
PT 8	46° 51' 50" N	67° 53' 09" W
PT 9	46° 53' 07" N	67° 48' 08" W



b. Identify all proposed flight areas using latitude and longitude on aeronautical maps.

See previous item, 3(a).

c. Include information on airspeed, altitude, number of flight hours, number of flights and program duration for each test flight area.

There are six proposed phases to the R&D flight test program.

Phase 1: Shakedown and familiarization

Phase 2: UAS flight performance

Phase 3: Pre-programmed flight

Phase 4: Payload Integration

Phase 5: Crew advanced training

Phase 6: Endurance demonstrations

It is anticipated that the entire flight test program including crew advanced training will be conducted over a period of 6 to 12 calendar months and all tests conducted at the nominated flight test area. The culmination of the flight test program is intended to demonstrate that the UAS can be controlled and operate safely for a continuous 30 hour pre-programmed flight period with an operational payload.

Phase 1 ensures that the pilot has the correct feel for the flight characteristics of the UAS before attempting specific performance manoeuvres. Telemetry data will be interrogated and analyzed post flight before the next flight is permitted to commence. Any safety issues arising from the analyzed telemetry data must be resolved prior to the next flight. The pilot shall be made aware of the results from the telemetry data so that enhancements in control and operations can be potentially realized. Phase 1 shall consist of at least 6 hours flight time for a period of not less than 30 minutes or more than 60 minutes. The pilot may land sooner if there are issues with the flight. The ground crew including observers will be enhancing their basic skills learnt from the ground taxi phase of operations. All Phase 1 flight testing will be conducted within a 3 mile radius of the Ground Station located at the South end of the runway. All flights in this phase will be conducted VFR below 500ft AGL in forecast winds below 5kts for the duration 2 hours beyond the intended landing time. Speeds for straight and level flight and descent will be limited to 50% power or 40 knots whichever is the least unless corrective action is required. A Maximum static heaviness of 75lb shall be limit of heaviness for this phase of testing. It is not intended to fly the UAS in a statically light configuration during Phase 1.

Phase 2 is the major body of the R&D flight test program that will identify the flight characteristics of the UAS. During this phase the Crew will be further enhancing their skill sets in operating the UAS. It is intended to conduct all tests in this phase below 3000ft AGL within a 6 mile radius of the centre of the main runway in the eastern segment. Speeds up to the maximum possible (circa 70kts) at full throttle will be conducted. On average each flight test is expected to take an hour from Take-Off to touchdown. No flight in this phase is anticipated to last longer than 2 hours but certainly no longer than is comfortable for the pilot and crew concentration.

A Maximum static heaviness of 150lb and a maximum static lightness of 50lb are the expected operational norms and hence for flight test purposes the limits shall be investigated up to 20% in excess of the expected operational norms.

Flight tests conducted at the various heaviness/lightness configurations shall include; Climb/descent performance, straight and level and turn performance, acceleration / deceleration tests and pressure height tests.

It is anticipated that to cover all aspects of this phase of the flight test program including flight testing any modifications, approximately 50 flight hours will have been accumulated.

Phase 3 will build on the flight characteristics established in the previous phases and transition from a fully RC mode to an RC Take off and Landing with pre-programmed flight. These tests will permit the fine tuning of the autopilot and the GCS. Maximum duration of these flights is not scheduled to be longer than daylight hours so that flight is always VFR

Phase 4 will only be undertaken if there is sufficient payload capability in terms of weight margin. Testing may be reduced to tethered tests only as the current SKYBUS 30K has marginal free lift capability for payloads exceeding 50lbs. Dependant upon the outcome of the first three phases of the R&D Flight Test Program (FTP) and the progress of the in build larger sister SKYBUS 80K airship, Phase 4 may be deferred until the SKYBUS 80K is progressing through Experimental Category flight tests so that both ships can be flown at the same time (each individually piloted) and communication trials between the ships conducted for research. It is conceivable that Phase 4 could be conducted after Phase 5 or 6 but if the lift capability is insufficient then it is further conceivable that the Phase 4 for the SKYBUS 30K is cancelled.

Phase 5 is primarily for the benefit of developing pilot and crew skills to enhance the quality of both training and operating procedures and manuals for future customers. Procedures for crew changes in anticipation of endurance flights in Phase 6 need to be established before conducting endurance trials.

Phase 6 will consist of a series of flights building up from the longest flight conducted in the previous phases to ultimately an endurance target of 30 hours. Clearly VFR flights could not be conducted on such continuous flights.

d. What class of airspace will be used?

Loring International Airport is located in Class G airspace (uncontrolled airspace).

e. Will minimum fuel requirements of 14 CFR § 91.151 be met?

Yes. All R&D test flights will take-off and land at the same airfield and the Airship will be fuelled equivalent to the total flight test duration plus one hour all conducted at Maximum Continuous Power fuel consumption.

f. Will flight-testing include payload testing?

Only if Phase 4 of the R&D flight test program is reached and desired.

g. What considerations need to be taken with regard to payloads?

None at present. See (f) above.

h. Will the aircraft perform any aerobatic maneuvers?

No. Nor will it be capable of doing so.

i. Flight Conditions (e.g., VFR, IFR, VMS, etc.)

Only VFR up to and including Phase 5 of the R&D Flight Test Program.

4. AIRCRAFT CONFIGURATION. Attach three-view drawings or three-view dimensioned photographs of the aircraft (14 CFR § 21.193(b)(4)). Describe Unmanned Aircraft System configuration including ground control station. Include a description of aircraft/system performance characteristics including:

See section (2) of this document for a 3-view dimensioned drawing of the SKYBUS 30K Airship and the accompanying photograph.

a. Wing span Envelope Diameter = 25 ft (Volume = 30,500 cuft)

b. Length Envelope Length = 92 ft

c. Powerplant Single engine Rotax 912ULS 100hp

Single Engine - Rotax 912ULS (Non-Certified) 4-stroke, 4 cylinder horizontally opposed, spark ignition engine with push rods, Over Head Valves and one central camshaft. The cylinder heads are liquid cooled whilst the cylinders are ram air cooled. The engine has a dry sump forced lubrication system. Other features include Dual breakerless capacitor discharge ignition, 2 constant depression carburettors, mechanical fuel pump, propeller drive via a reduction gear with integrated shock absorber and overload clutch, 12V Electric Start, Integrated AC Generator with External rectifier-regulator (12V 20A DC) and a custom External 24VDC Generator.

Cylinder Bore = 3.31in, Stroke = 2.4in, Displacement = 82.5in^3, Compression Ratio 10.5:1

Crankshaft to Propeller shaft reduction ratio = 2.43:1

Propeller: 3-bladed 72" diameter Powerfin Composite construction

ISA Performance: Take Off 5800 rpm 98.5hp, Max Continuous Speed 5500 rpm 92.5hp

d. Max gross take off weight 2205lb

e. Fuel capacity 80 Gallons

f. Payload capacity 150lb as a dummy payload

g. Max altitude 7000 ft

h. Endurance Potential for 12.5 hours with 0.5 hours reserve based on 6.15gph at 5500rpm Maximum Continuous Power for the 80 gallon fuel tank. At 50% continuous power the fuel burn is 3 gallons per hour at 4000 rpm giving 26 hours with 0.5 hours reserve. At 55% maximum continuous rpm (3000 rpm) the engine generates 45hp and consumes 1.75 gph giving 45 hours endurance.

i. Max airspeed Estimated to be up to 70 knots. The maximum airspeed attainable is expected to be not less than 40 knots

j. Control/data frequencies 900 MHz and 2.4 GHz

k. Guidance and navigation control VFR RC mode for all R&D flight tests in phases 1 through 5 inclusive.

5. INSPECTION AND MAINTENANCE (14 CFR 91.7).

a. Describe the inspection and maintenance program that will be used to maintain the aircraft and related systems (includes ground stations and/or other support systems).

Skybus 30K Maintenance Manual Issue B 20070522

Rotax 9122 ULS engine manufacturers inspection and maintenance program.

DRS Technologies *Skybus GCS Maintenance Procedures*, Document number 9040-00053.

b. Provide copy of flight manual, if applicable, current weight and balance report, equipment list. Flight manual is currently a working document but will be available for inspection during FAA visit

6. PILOT QUALIFICATION (14 CFR §§ 61.3, 61.5).

a. Describe the qualifications for each pilot.

Airship Licensed Pilot – Mike Fitzpatrick (Airship Management Services Inc) an who has 21,000 hours of Lighter-Than-Air time.. FAA pilot certificate number is: 39266966

Steve Ouellette – Telford Aviation supplemental pilot of fixed wing models, trained under John McHugh on the Skyship 600 manned airship, Flight simulator training (Realplanes G3 flight simulator adapted by SAIC as documented in simulator file "SKYBUS 30K Trainer 01.plnG3" dated June 14th 2006 and time stamped 10:01)

John Trask – Telford Aviation – PPL and Fixed wing flight instructor.

b. Pilots must be qualified/certificated in the appropriate type of aircraft, i.e., rotorcraft, powered lift, fixed wing, etc.

Our proposal is to have Mike Fitzpatrick (Licensed Airship Pilot) be with (immediately adjacent to) the supplemental pilot with simulator training who will actually have the command of the flight control box. The supplemental pilot has more experience in flying RC models than the formally qualified Airship Pilot.

b. Describe internal training program to qualify pilots.

Any Pilot wishing to fly the Airship in RC mode must have gained some flight time in an airship and have completed a minimum of 50 hours flight simulator training on the SKYBUS flight simulator in RC mode from a fixed ground perspective position.

c. Describe the qualifications and training of observers.

All observers will have or be trained in basic air law to the level required for a PPL license.

7. AIRCRAFT MARKING (14 CFR Part 45). All Unmanned Aircraft System (UAS) are required to be registered and identified with the registration number. Aircraft must be marked in accordance with part 45. The Airship will carry N-Marks in accordance with part 45.

8. ATC TRANSPONDER AND ALTITUDE REPORTING SYSTEM EQUIPMENT AND USE (14 CFR § 91.215). Describe the aircraft altitude reporting system.

The Skybus 30K is fitted with an ATCRBS Transponder – Mode 3/A, 4096 code with altitude reporting (Mode C). The transponder code cannot though be changed dynamically (that is: whilst the UAS Airship is airborne).

9. METHOD FOR SEE AND AVOID (14 CFR § 91.113a). In what manner, or by what means, will the requirement to "see and avoid" other aircraft be met? What performance will the chase plane have?

The UAS Airship operation shall employ a see-and-avoid capability that achieves an equivalent level of safety, comparable to the see-and-avoid requirements for manned aircraft. See-and-avoid will be accomplished through the use of visual observers. As a minimum there will be sufficient visual observers on the surface to continuously observe the UAS in flight. If there is any possibility the ground visual observers cannot ensure an equivalent level of see-and-avoid safety, a visual observer on board a chase aircraft will be employed to meet the see-and-avoid responsibilities. Visual observers shall maintain direct communication with the SKYBUS 30K UAS Airship Pilot. Visual observers are responsible for seeing other aircraft and providing the MS001 ROA pilot with a change of course and/or altitude to prevent a collision. The SKYBUS 30K UAS Airship Pilot and the visual observers shall have no other duties or responsibilities when performing their function and maintaining aviation safety shall be more paramount than achieving mission objectives.

10. SAFETY RISK MANAGEMENT. An applicant must provide a safety checklist that identifies and analyzes the hazards of UAS operations that are described in the program letter. Additional information is available by contacting *the FAA ASI.*

Refer to enclosed response to Safety Checklist guide issued by FAA in Draft format dated 8/18/2006

11. SYSTEM CONFIGURATION. Provide a description of aircraft system configuration and all on-board and ground-based equipment.

11.1 Flight Control System

Pitch control of the LTA UAS Airship is provided by electric actuator driven control surfaces on the horizontal port and starboard stabilizers. Similarly Yaw control is provided by an electric actuator driven control surfaces on the lower vertical stabilizer. A 48Vdc supply provides power to the electric actuator motors and a separate 24Vdc supply provides the power for the fail safe brake motor such that in the event of loss of power, the actuators do not back drive. Power is also supplied to proximity limit switches attached to the actuators to prevent bottoming on full extension/retraction. In addition to proximity limit switches, software limits are imposed on the actuators within the proximity limit switches to provide a level of redundancy in the system. Actuator rates are software controlled.

Signals to the flight controls initiate from the Pilots Flight Control Box (PFCB) to the Ground Control Station(GCS) via a 50ft length of shielded cable. The Ground Control Station then transmits the appropriate signals through the wireless "Freewave" architecture to the UAS on board Flight Control Computer (FCC) where after signal verification and processing is transmitted to the actuators.

11.2 Envelope Pressurization Control System

The autonomous Envelope Pressurization Control System is a dedicated microcontroller based system designed to maintain air and helium pressure within specified limits of the SKYBUS 30K LTA UAS. The system consists of a Master controller, display unit, and two sensor units. One sensor unit is used to measure the ballonet air pressure, while the other is used to measure helium pressure. The Master controller collects the data from the sensor units, and uses a voting scheme to filter the air and helium pressure readings. The master controller uses the air and helium pressures to provide autonomous control of the ballonet fans. The Master controller communicates with the display unit to provide pressure, and temperature data to the user and provide override switches for each of the 8 relays. For the SKYBUS 30K LTA UAS, only 6 of the relays are used (2 fans, 2 air valves, and 2 helium valves).

11.3 Electrical System

11.3.1 ELECTRICAL SYSTEM

Primary engine system power is 12VDC. The engine's internal AC alternator has a 20 amp capacity. The AC power is converted to DC by a remotely mounted rectifier. A single lead-acid battery is charged by the alternator, and provides approximately 45 minutes of backup power supply if the alternator is off-line. This system provides power for all engine related subsystems including the Starter, Fuel Pumps and Engine Instrumentation System (EIS). It also provides power for the Strobe light, Transponder, Precision Pressure Transducers (PPT), and Control Surface Actuator Limit Switches and Potentiometers. A manually switched contactor disconnects the battery from the 12V power bus, and allows the battery to be charged with the bus offline. An external charge port is provided for charging the 12V battery.

Primary aircraft flight system power is 24VDC. A 28V electronically controlled alternator, with up to 130 amps capacity, is powered via V-belt from a pulley mounted on the prop shaft. Dual 12V lead-acid batteries wired in series are charged by the alternator, and provide approximately 45 minutes of backup power supply if the alternator is off-line. This system provides power for the Avionics Rack, Com & Flight Control Hardware, Flight Sensors, and Ballonet Pressurization System. Payload power, separate from aircraft bus, is also available from the alternator. A manually switched contactor disconnects the battery from the 28V power and payload buses, and allows the battery to be charged with the bus offline. An external charge port is provided for charging the 24V battery stack.

28V and 12V Power is distributed via a circuit breaker panel through shielded wiring. The bus voltages are monitored and relayed to the Ground Station. The external charge port located on the nose of the power car powers the bus and charges the batteries while not in flight. An EU2000i generator rated at 110v and 13.3 amps is used for auxiliary power when the airship is not in proximity to an AC outlet in the hangar. The generator is hung from the power car on the left side, forward. The generator is removed prior to flight.

Figure 11.3.1 shows a diagram of the overall electrical system.

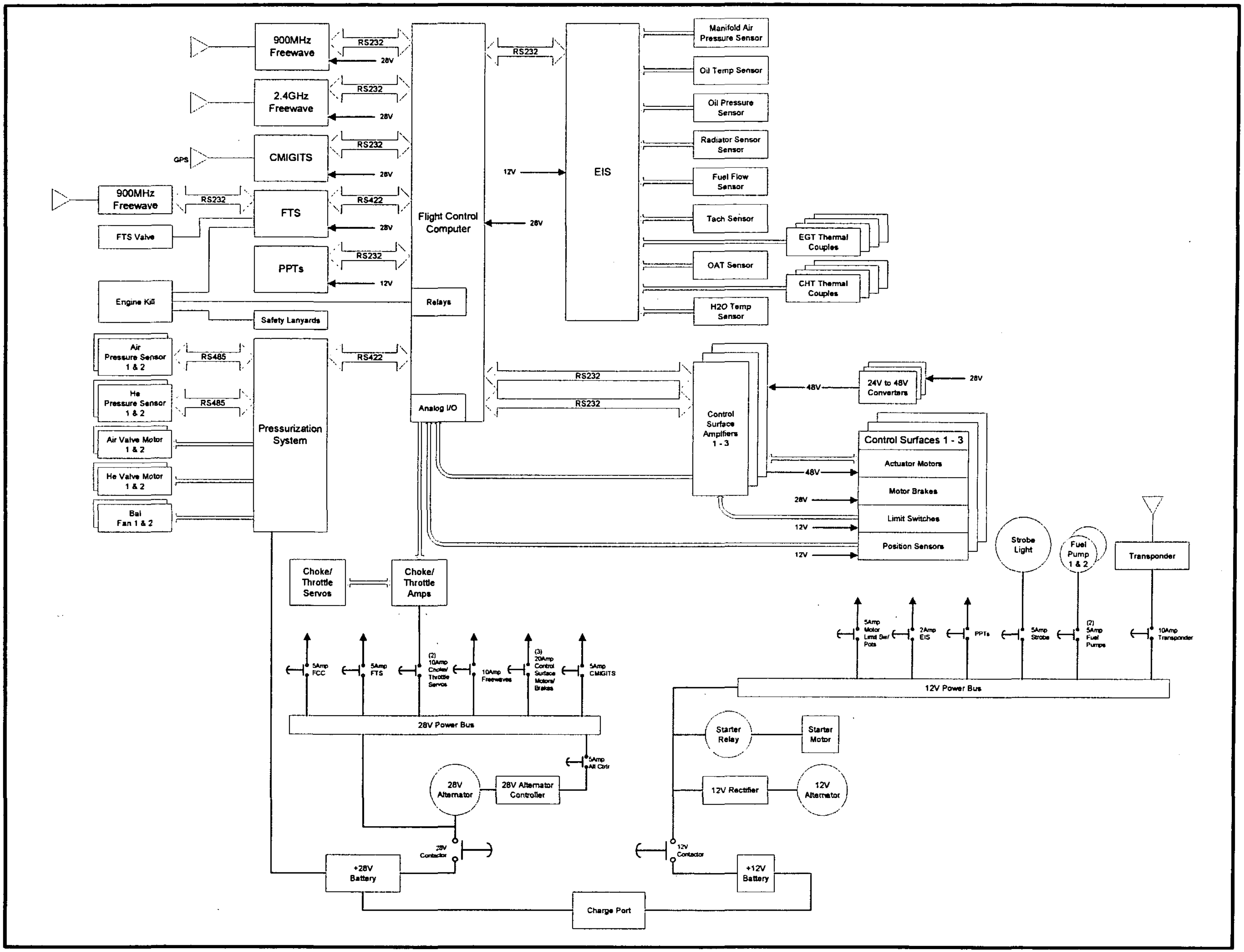


Figure 11.3.1: Skybus30K Electrical Architecture Diagram

11.3.1.1 ELECTRICAL SYSTEM COMPONENTS

A full list of all electrical system components are as follows:

11.3.1.1.1 ENGINE HARDWARE COMPONENTS:

- Rotax Engine/12V Alternator
- 28V Alternator
- 28V Alternator Controller
- 28V Power Contactor
- 12V Power Contactor
- 12V Rectifier
- Fuel Pumps
- Throttle and Choke Amplifiers
- Throttle and Choke Servos
- Engine Instrumentation System (EIS)
- Engine Ignition Box
- Ignition and Starter Relay
- Flight Batteries

11.3.1.1.2 FLIGHT CONTROL & COMMUNICATION HARDWARE:

- Flight Control Computer (FCC)
- Ballonet Pressurization System
- Ballonet Fans
- Ballonet Valves
- Flight Termination System (FTS)
- FTS Valve
- 24V to 48V Power Converters
- Accelnet Actuator Amplifiers
- Control Surface Actuators
- CMIGITS
- Transponder
- Strobe Light
- 900MHz Freewave
- 2.4GHz Freewave
- 900MHz FTS Freewave

11.3.1.1.3 FLIGHT SENSORS COMPONENTS:

- Manifold Air Pressure Sensor (MAP)
- Precision Pressure Transducers (PPTs)
- Fuel Flow Sensor
- Tack Sensor
- Outside Air Temp Sensor
- Radiator Sensor
- H2O Temp Sensor
- Oil Temp Sensor

- Oil Pressure Sensor
- Type K Thermocouples
- Type J Thermocouples

11.3.2 PRE-PROGRAMMED FLIGHT CONTROL SYSTEM

The Pre-Programmed Flight Control System (PFCS) performs primary flight control functions that stabilize the vehicle and provide the ability to control the vehicle. The PFCS provides continuous data exchange with the Ground Control System (GCS) and manages system response when communication is lost. A 900 MHz Freewave modem and a 2.4 GHz Freewave modem provide redundant communications between the AFCS and GCS. Its control functions sense the current aircraft state and compute the required control motions in response to various commands. The PFCS is essentially a non-redundant system except for the data links.

The PFCS can fly preplanned missions carried on-board or follow manual flight director commands. In the event of loss of communication, a programmable auto recovery plan is included that sequences the subsequent actions of the airship until communications is reestablished. If communications cannot be reestablished, the vehicle will return on its own to a predefined site and land (or perform whatever substitute sequence is programmed by the operator prior to the mission).

11.3.2.1 AVIONICS RACK

Many of the Engine Hardware Components, Flight Control Components, and Communication Components are located within the Avionics Rack. Locating these components in a single enclosure keeps space usage to a minimum while also adding additional protection from the outside environment. In addition, the Avionics Rack allows for a means by which the Ground Crew can easily interface with the air vehicle's controls and displays. The following is a list of all components contained within the Avionics Rack:

- Flight Control Computer (FCC)
- 12V and 28V Power Control/Conditioning
- Control Surface Actuator Amplifiers
- Choke and Throttle Actuator Amplifiers
- Actuator 24V to 48V Power Converters
- Engine Instrumentation System (EIS)
- Flight Termination System (FTS)
- Precision Pressure Transducers (PPTs)
- Transponder
- 900 MHz Freewave
- 2.4 GHz Freewave
- 900 MHz FTS Freewave
- Ignition Control

11.3.2.2 FLIGHT CONTROL COMPUTER

The main component of Flight Control System is the Flight Control Computer (FCC) which resides inside the Avionics Rack. It receives inputs from flight sensors via serial ports that include a full-state vector including attitude and attitude rate, position, velocity, acceleration, air data, and a host of other information. In addition, it acquires information from the engine sensors that determine flight state and system health through analog inputs, thermal couples, or serial ports. With this information the FCC calculates control positions that are used by the servo-amplifiers in order to close the position loop around the actuator motor to achieve control.

The FCC is a PC/104 computer stack that has the following board set:

- Processor (166 MHz Pentium) with two on-board serial ports, Ethernet port, keyboard and video interfaces, and parallel.
- Power Relay Output Module (16 channels)
- Multi I/O board with Discrete I/O and Analog I/O
- Two 4-port serial I/O boards for additional serial communications
- 28 VDC 50W high-efficiency power converter
- Environmental Fan Card

The FCC and resides in a rugged enclosure made of extruded aluminum that provides rubber corner supports which provide tolerance against g-loading as well as providing a limited degree of vibration isolation. It uses a single front interface panel for all I/O, including ten serial ports, 16 channels of analog input, 8 channels of analog output, 8 channels of discrete output, and five channels of discrete input. The stack employs an environmental fan card to assure positive cooling at all times. Recommended operating limits are ambient cabin temperatures less than 120 degrees Fahrenheit and operating altitudes less than 10000 ft.

The FCC operates on a 28 VDC power source taken from the aircraft power. Typical power dissipation is approximately 20W, but during initialization peak loads can be as high as 40W.

11.3.2.3 FREEWAVE MODEMS

The FCC communicates with the Ground Control Station through a pair of redundant data links that transport identical information for comparison and detection of data dropouts. This feature allows the system to function normally even when the data link performance becomes somewhat sporadic. The particular selection of data link is unimportant as long as approximately 36Kbps rate is available for the down link and 15Kbps is available for uplink. (These bandwidth requirements may be adjusted by reallocating variables and sample rates within the telemetry stream.) The standard data link uses frequency-hopping spread-spectrum RF modems from Freewave that operate in either the 900 MHz or 2.4 GHz ISM frequency bands. These modems are programmed to only accept data from designated counterparts identified by equipment serial number. This feature provides a degree of security against interference or unauthorized insertion of commands. The modems are mounted in weather-tight enclosures for added environmental protection.

11.3.2.4 C-MIGITS

The Miniature Integrated GPS/INS Tactical System (C-MIGITS) is a self-contained, self-initializing unit that provides turnkey navigation functionality. It provides 50 Hz updates of all inertial related states to the FCC. The C-MIGITS contains fiberoptic rate gyros, solid-state accelerometers, and a GPS receiver that is capable of DGPS operation. The primary

CMIGITS function is to sense inertial and GPS states and merge them in a Kalman filter to provide the best possible total aircraft flight state estimate to the FCC. The data is then output from the CMIGITS in a serial data message stream on an RS232 port.

11.3.2.5 BALLONET PRESSURIZATION SYSTEM

Pressure Monitor System is a dedicated microcontroller based system designed to maintain air and helium pressure within specified limits. A Master Controller uses air and helium pressure data, collected from the pressure sensor units, to provide autonomous control of the ballonet fans. One Pressure Sensor Unit is used to measure the ballonet air pressure, while the other is used to measure helium pressure. A Display Unit shows pressure and temperature data from the master controller, and provides push button control for selecting limit sets, and providing user override switches for each relay control (2 fans, 2 air valves, and 2 helium valves). The data is output from the Master Controller in a RS422 serial data message stream to the FCC.

11.3.2.5.1 AIRSPACE CONTROL COMPLIANCE SYSTEM

This system enhances safe flight operations with other aircraft, but is not required to operate the air vehicle. It consists of a Flight Termination System (FTS) and a Transponder with altitude encoding capability.

The flight termination transmitter sends commands from the Ground Station via a 900MHz Freewave Modem to an independent receiver on the air vehicle. Subsequent actions control the FTS Helium Valve and the engine ignition (left and right) via relays, thereby terminating the flight in short order. The FTS is a dedicated microcontroller based system that is isolated from other onboard systems, and has a dedicated back-up power supply.

The transponder is turned on and off manually prior to flight. The squawk code is set manually prior to takeoff and cannot be changed in-flight.

11.3.2.5.2 CONTROLS / DISPLAYS

Ground crew interface with the air vehicle is done via controls and displays summarized in table 1.4.1.10-1.

Table 1.4.1.10-1 Airvehicle Controls and Displays

Name	Function	Location	Operation
Door Panel	Cover access to avionics rack	Lower aft corner of each door	Lift latch and twist
24V Breakers	On/ Off for power, protect equipment from short circuits	Inside main panel on front of avionics rack	Per label: Out = OFF In = ON
12V Breakers	On/ Off for power, protect equipment from short circuits	Inside main panel on front of avionics rack	Per label: Out = OFF In = ON
Engine	Display engine	Inside main panel on	See EIS Operator

Name	Function	Location	Operation
Instrument System (EIS)	status, fuel flow, OAT, drivetrain operation hours, 12V bus voltage	front of avionics rack	Manual
Ignition Key	Control engine ignition ON / OFF	Inside main panel on front of avionics rack	Twist key per label
Flight Termination Lanyards	Controls L/R Ignition	Inside main panel inside avionics rack	See Operator Manual
Flight Safety Plug	Enables FTS for Flight / Disables Ignition for Hangar	Inside main panel mounted on power car in front of avionics rack	Flight Plug: Enables FTS Ground Plug: Disables Ignition
28V Contactor Switch	Isolate 28V battery from electrical system	Inside main panel on front of avionics rack	Per label: Out = OFF In = ON
12V Contactor Switch	Isolate 12V battery from electrical system	Inside main panel on front of avionics rack	Per label: Out = OFF In = ON
24V External Power Jack	Interface for 24V external power	Nose of power car	Click polarized connectors together / apart
Gascolator	Fuel filter, water separator, fuel sample point, fuel drain port	Lower left corner of firewall	Push spigot in for sample / drain
Engine Oil Reservoir	Engine Oil Reservoir	Left hand side of tube frame	Remove twist cap, check level per dipstick markings
Engine Coolant Bottle	Engine coolant overflow bottle	Right hand side of tube frame	Check level per markings on bottle. Use twist cap to fill
Fuel Fill Port	Fuel Fill Port	Top of fuel tank	Lift locking tab, twist tab to remove

11.4 Fuel and Cooling systems

Both the Fuel System and Coolant system are essentially based on those documented in the Rotax 912ULS Manuals. The major alteration made to the engine that affects the coolant system is that a heater block positioned between the carburetor and the air intake manifold fed by the engines own oil supply provides heat to the carburetor when the engine is warm to help reduce carburetor icing especially when flying at altitude.

12. SYSTEM SAFETY - FLIGHT TERMINATION AND LOST LINK. What is the expectation of aircraft "Flight" if fuel is starved? Describe/explain aircraft lost link and emergency recovery procedures. Provide an explanation of the flight termination system (FTS) in detail.

If fuel is starved the SKYBUS 30K UAS Airship can still be flown real-time by the RC pilot for a period of time as determined by the battery status at the time of the fuel starvation. Unlike conventional heavier than air aircraft the LTA UAS Airship could be in either a statically heavy or statically light condition. If the Airship were statically light then the Airship would rise in altitude rather than descend. In a statically heavy configuration the rate of descent will be proportional to the static heaviness. Contingency planning is accomplished in advance to determine the safest locations to bring the SKYBUS 30K UAS Airship to the surface that is generally uninhabited.

In the event of an emergency the SKYBUS 30K UAS Airship can be brought down like a free balloon into one of the designated areas.

The SKYBUS 30K UAS Airship possesses an independent flight termination system (FTS). The FTS operates on a different frequency than the control data link and has its own redundant battery system. The FTS has been proven on the ground to be effective for a range of 20 miles, which is in excess of the distance the SKYBUS 30K UAS Airship will be flown. The FTS consists of two separate functions the first being to just kill the engine and the second to release the kift gas from the envelope at a controlled rate. If either or both of these functions are activated then the engine can be restarted and or the Flight termination Valve (FTV) can be closed to prevent further lift loss and potentially a full recovery to normal flight could be made.

The protocol for a loss of control link is to shut down the engine first so that it is not running when the SKYBUS 30K UAS Airship reaches the ground. thereby reducing the risk of fire and injury from the propeller to ground personnel. This feature is considered an additional safety benefit that other classes of UAS probably do not have the luxury of since such aircraft effectively are in the position of irrecoverable flight.

Any static heaviness of the SKYBUS 30K UAS Airship at the time of shutting down the engine will permit the SKYBUS 30K UAS Airship to gradually descend. If the rate of descent is too slow or the airship rises due to static lightness the pilot will open the FTS valve which gradually releases helium from the envelope. Once the rate of descent is to the satisfaction of the pilot he can close the FTS valve to arrest the rate of descent or elect to keep it open to increase the rate of descent.

13. COMMAND AND CONTROL. Provide a description of the system and/or procedures for command and control of the UAS.

The pilot operates the Pilots Flight Control Box (PFCB) linked to the Ground Control Station (GCS). The Flight Control Computer (FCC) communicates with the GCS through a pair of redundant data links that transport identical information for comparison and detection of data dropouts. This feature allows the system to function normally even when the data link performance becomes somewhat sporadic. The particular selection of data link is unimportant as long as approximately 36Kbps rate is available for the down link and 15Kbps is available for uplink. (These bandwidth requirements may be adjusted by reallocating variables and sample rates within the telemetry stream.)

Control Authority:

- Dynamic real-time control
- Real-time flight director style commands
- Supervised waypoint-based navigation
- Pre-programmed flight (for hand-off or recovery after lost link)
- Hands-off (not including takeoff, landing)
- Waypoint inputs (from A to B at C speed at D altitude)
- Flight Plan upload, drop and drag or keyed
- Futaba RC type controls (i.e. separate controls and trim for most functions)
- Pre-programmed lost link recovery

Situational awareness:

- Maps ADRG,CADG, CIB, GEOTIFF, NITF 2.0 (i.e. FalconView)
- Air vehicle health displays
- Mission Planning & storage

14. CONTROL STATIONS. Provide a description of the ground/airborne stations used to control the UAS.

Primary Ground Station:

- Integrated Multiple Display Operator Station.
- Moving Map Window
  - Multiple Map formats (GEOTIF, CADRG, DNC, >20 formats both raster image, and vector based)
  - Automatic and manually placed icons
  - Mission plan display
  - Real Time mission status display

- Actual flight path (bread crumb) overlay.
- Payload geo-location overlay.
- Automatic Line of sight, and obstacle avoidance mission analysis.
- Lat / Lon or UTM units

- Platform Status Window
  - Detailed mission status (waypoint data)
  - Platform status
    - Subsystems (engine, INS, control surfaces, etc)
    - Environment (baro pressure, humidity, temperature)
    - Real Time system and subsystem Go / NoGo Status

Portable Shock Mounted Hardigg Case, STD 19" IEA
Zmicro Dual Displays
Zmicro Expander II Keyboard Tray
MDI 4u rack mount Computer

2 Removable SCSI drive
DVD/CD RW+-
USB 2.0
Firewire
Windows 2000 or XP
Dual Pentium
4 Gig of ram Minimum
Nvidia or ATI Radeon series graphics card DVI-D or SXGA

15. CONTROL FREQUENCIES. Provide a description/listing of the frequencies used to control the UAS.

The standard data link uses frequency-hopping spread-spectrum RF modems from Freewave that operate in either the 900 MHz or 2.4 GHz ISM frequency bands. These modems can be programmed to only accept data from designated counterparts identified by equipment serial number. This feature provides a degree of security against interference or unauthorized insertion of commands. The modems are mounted in weather-tight enclosures for added environmental protection.

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