

INSPYRE Project Participant Handbook

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Project Title	INjected Smoke and PYRocumulonimbus Experiment (INSPYRE)
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RAF Project Manager	Cory Wolff
Field Project Safety Officer (FPSO)	Stephen Jude
Field Project Station Chief	Kim Ward
Deployment Period	27 July - 10 September 2026

1. Project Specific Factors

Over Water Operations	N/A
Penetration of Strong Convective Systems	Not planned but flight operations will target areas near such systems
Operation under probable Icing Condition	Possible in warmer areas of anvil clouds - severe icing will be avoided
Hazards Associated with Foreign Bases of Operations	None expected - suitcase flights may land in Canada
Miscellaneous Hazards	Heat on tarmac, Severe weather, Smoke in cabin

A. Hazardous Material

Below is a list of hazardous material used in the project:

- Compressed gases: Nitrogen, Zero Air, Breathable calibration gas
- Liquid: Fluorinert
- Radioactive source: Soft x-ray (used only on ground, not in flight)
- Lasers: All are contained or captured



2. General Operation Guidelines

RAF Access & Personnel Safety Normal risks involved in working on or near both propeller and jet aircraft. (For example: noise, moving machine parts, blown dust or particles, equipment racks and other floor mounted hardware, etc.) Open toed shoes may not be worn on the aircraft during project cabin preparation or research flight operations due to the likely presence of various types of floor mounted hardware.

There will be no smoking within the RAF facility or within 50 feet of the aircraft on the ramp.

All personnel working around the aircraft must familiarize themselves with the location of fire extinguishers within the aircraft and in the vicinity of the aircraft. Consult with an RAF aircraft mechanic.

Field Project Safety Officer All RAF field deployments will have a designated *Field Project Safety Officer (FPSO)* – separate from the Project Manager – to oversee the implementation of these safety guidelines. Any safety related issues that come up during the course of the payload integration or field deployment should be raised directly with that individual.

Project Station Chief The PSC is responsible for overseeing on-site aircraft operations at deployment locations. ensuring that all maintenance, ground handling, and safety procedures are conducted effectively. They monitor weather conditions and halt operations when required for safety.

RAF hangar equipment & Machine Shop The RAF has an extensive sheet metal shop on site. Users are only allowed access to this equipment after they have been judged qualified for its use by the RAF Maintenance staff. Users are not allowed to operate any of the maintenance lifts at Rocky Mountain Metropolitan Airport (RMMA) or during field deployments. An RAF operator will be required to get access to this equipment.

Instrument Upload Period All ground operations, including the installation, testing and maintenance of scientific equipment, application of electrical power, aircraft maintenance, loading, fueling and aircraft movements will only be conducted by, or under the supervision of qualified RAF personnel.

The installations of all user-supplied equipment must be performed in compliance with the aircraft-specific Investigator Handbook. These documents set forth the procedures to be followed in the design, fabrication, and RAF approval of user-supplied equipment to be flown on board an NCAR aircraft.



System Acceptance Review (SAR) The entire research payload must undergo a complete safety inspection (SAR) by representatives of the three RAF technical groups (aeronautical engineering, technicians and quality assurance) prior to the first flight. One representative of each instrument must present at the SAR and each team is responsible for addressing the findings identified. This inspection must be documented using the *RAF SAR Record Sheet* (Form NCAR-F-007) and be accepted by the RAF's Chief Pilot. A copy of this form will be kept in the project file.

Rack Book Entry after SAR Once the SAR is completed, the project payload transitions into the “field phase” which indicates that all payload is required to be airworthy at all times. The Rack Book's function — tracking all removals/installations after the rack is built up (after SAR) and the aircraft weighed, to keep the aircraft within weight-and-balance limits (per GMM §3.13.37.1). Any change to interior/exterior components (installing/removing instruments, probes, plates, etc.) must be annotated on *RAF Rack Book* (Form NCAR-F-009) with date, component name, weight change, and location. Each group is responsible to document each temporary removal occurred in preparation for the airworthiness review prior to each flight.

The project Rack Book is located on a blue podium positioned next to each applicable NSF/NCAR research aircraft.

90 minutes prior to any flight, the RACK BOOK will be examined to determine which, if any, systems were affected. Those installations must be re-examined for adequate integration prior to proceeding with pre-flight preparations. If any system has not completed this examination by this deadline, the flight will be delayed to maintain the inspection timeline.

Activities Onboard the Aircraft While working onboard the aircraft, aircraft fuses or circuit breakers will be replaced or reset *only* with the consent of qualified RAF personnel. There will be no electrical power left on the aircraft without RAF supervision. At the completion of each day's activities, all liquids, refuse and litter must be removed from the aircraft and ramp areas.

Project Safety Briefing Prior to departing for the field site, all project personnel will receive a Project Safety Briefing. The briefing will be given by the project pilot and the assigned project manager on aircraft safety, hazardous materials onboard and possible local weather hazards. This briefing is required for all participants who are planning to work around the aircraft and flying as a QNC.



Qualified Non-Crewmembers QNCs are scientific personnel that have research duty to perform on NCAR/RAF aircraft. They may be NCAR employees or visiting scientists from universities associated with a particular research project. They are accountable to the pilot-in-command (PIC) at all times and will take direction from the NCAR/RAF Lead QNC (technicians). Participants who underwent the project safety briefing will be certified as qualified non-crewmembers (QNCs). Only members of the flight crew or QNCs necessary to complete the scientific mission may be carried on board.

Field Phase Tool Control Once the project payload passed the SAR, the project is officially in the "*field phase*". All tools, including specialty tools and equipment used by any person while performing work on any NSF/NCAR operated aircraft will be accounted for by the use of a comprehensive tool control list. The tool list will include a name and the institution of the responsible party for each tool listed created. All tool kits shall be configured for easy identification of all tools. The use of "tool shadowing" is highly recommended for easy comparison of the tool list and to aid in the identification of missing tools.

If any individual or user group declines to comply with this tool control policy, they may elect to utilize an RAF provided standard "red box" tool kit. These standard tool kits are available at the RAF during the project.

Visitors/user groups working on instrumentation onboard RAF aircraft are highly encouraged to create a small tool kit of minimal tools required for research project operations (if applicable). All tool kits shall have the group name identified on the exterior of the tool kit for easy identification. All groups or individuals utilizing tools onboard the aircraft shall provide the PM with a visual confirmation of each complete tool kit when requested prior to aircraft operations. User group tool kits may be reviewed by aircraft maintenance or instrumentation technicians at any time. The tool control program applies to all scientific local/field project flight operations.

Once the project enters the "*field phase*", the project manager (PM) will maintain a list of all groups subject to the RAF Tool Control program. During pre-flight operations, the PM will address each group to receive verification that all tools and equipment are accounted for 45 minutes prior to the scheduled takeoff time. In case of missing tools, flights will be delayed until all tools are accounted for, or a waiver is issued by the RAF flight operations.

Physical Fitness Flying research profiles onboard the RAF aircraft require a certain level of physical fitness – particularly for work around severe weather or for extended durations. Legal limitations prevent RAF from screening potential crew members directly so it is the responsibility of each individual participant to determine their fitness for inclusion in the list



of potential onboard observers. A summary of common issues that should be taken into account in your assessment of your fitness is appended to this document.

Hazardous Material Handling All compressed gas cylinders brought into the facility must be secured when not in use. Individual loose cylinders must be stored in the storage room in the old hangar. Groups of cylinders can be secured as blocks or on pallets in the open hangar. During the installation, removal or exchange of all cylinders on/from one of the aircraft, a safety cap must be in place protecting the valve.

Any hazardous material or chemical waste generated during ground operations will be identified, labeled, and disposed of in accordance with UCAR HESS policy and, where applicable, GMM §3.11.7 (Parts, Ground Support Equipment, Material Control, Calibrated Tooling and Hazardous Materials) requirements for marking, quarantine, and disposal of unserviceable or hazardous materials.

Personal Life Insurance While the aircraft are maintained and operated within rigorous guidelines, all NCAR aircraft are officially designated as “PUBLIC AIRCRAFT” and are not subject to the same certification requirements as civil aircraft. Certain life insurance policies have coverage exemptions for flying on non-airline flights. RAF recommends that all flight participants check with your individual insurance companies to see if you are covered. NCAR also maintains blanket liability coverage for all crew members. See the Disclosure Statement for Government Aircraft for details.

3. Flight Crew and Qualified Non-crewmembers (QNCs)

The cabin will normally be pressurized to cabin altitudes below 10,000 feet. Research flight operations with cabin pressures above 12,000 feet will not be conducted unless this requirement has been stated at the time of the original project request. Specialized training and more restrictive physical requirements for flight crews and observers are needed for such operations.

The project manager has the responsibility to ascertain that everyone onboard is familiar with normal and emergency procedures, and the use of the following equipment as pertinent to the flight: oxygen system and masks; the interphone system; emergency exits; and emergency survival equipment. This is accomplished through the project safety briefing, which must be documented prior to participation in a flight as a Qualified non-crewmember. The flight crew includes the pilots, flight engineer and the Lead QNC (technician onboard each research flight).

Supplemental emergency oxygen requirements are as follows:



- Cabin pressure altitude above 10,000 ft MSL but not exceeding 13,000 ft MSL: each flight crewmember (pilots, flight engineer, and Lead QNC) shall wear an oxygen mask and use supplemental oxygen for any portion of the flight at that altitude exceeding 30 minutes in duration.
- Cabin pressure altitude above 13,000 ft MSL: every person onboard shall wear an oxygen mask and use supplemental oxygen for the duration of the flight.
- Unpressurized flight from 18,000 to 25,000 ft MSL: requires 30 minutes of preflight denitrogenation breathing; crew members breathe 100% oxygen from the start of prebreathing until the aircraft has descended back below 18,000 ft MSL.
- Unpressurized flight above 25,000 ft MSL will not be conducted.

4. Research Flight Operations

All flight operations will be conducted in accordance with Federal Aviation Administration Regulations Part 91 Subpart B. The pilot-in-command (PIC) is responsible for the safe conduct of all flight operations. Safety belts will be worn by all personnel during taxi, takeoff and landing and at such times as instructed by the flight crew. There will be no smoking on any NCAR aircraft. No smoking is permitted within 50 feet of parked aircraft, or flammable liquid storage points.

In the event of fire, the crew member observing the fire will warn the other crew members by shouting, "FIRE-FIRE" and reporting the location of the fire. If smoke, fumes or fire are present within the personnel compartment, all occupants regardless of altitude will don pressure demand oxygen masks and select "100% OXYGEN" on his/her respective oxygen regulators. All available means will be used to extinguish the fire. The RAF technician has the primary responsibility for fighting the fire and directing the actions of other personnel.

Scientific Instrument & HazMat The operation of user-supplied research equipment onboard the aircraft will only be permitted under the supervision of, or with the approval of the RAF and the scientist concerned. It will be the duty of the scientific crew aboard to properly adjust or secure research and related equipment prior to takeoff and landing. However, it is the responsibility of the PIC to specifically check and ascertain that such duties have been satisfactorily completed.

Research electrical power will normally be available at all times. All power changes will be coordinated between the scientific observer and flight crew. Any fuse replacement or circuit breaker reset in the primary power supply system will be performed only by or with the consent of the pilot-in-command. Whenever an engine or the Auxiliary Power Unit is in



operation, hearing protection will be worn near the aircraft. (Hearing protection is required within the C-130 aircraft).

Any malfunction in scientific equipment, mechanical or electrical, will be immediately reported to the pilot-in-command. No in-flight repairs will be permitted without permission from the pilot-in-command. No in-flight handling of toxic chemicals or gases, or other hazardous materials, will take place until specifically authorized by the pilot in command. The written procedure will need to be followed when performing the tasks. The pilot shall assess the current flight conditions prior to authorizing such activities.

Minimum operating altitudes RAF flight operations conform to the minimum altitudes established in the applicable FARs (14 CFR §91.119). Because INSPYRE involves no over-water operations (Section 1.A), the following overland minimums apply absent a specific altitude waiver:

- Anywhere (except takeoff/landing): an altitude allowing an emergency landing without undue hazard to persons or property on the surface if a power unit fails.
- Over congested areas (city, town, settlement, or open-air assembly of persons): 1,000 ft above the highest obstacle within a 2,000 ft horizontal radius of the aircraft.
- Over other than congested areas: 1,000 ft above the surface (except over water, which does not apply to this project).
- Night VFR overland: the more restrictive of 14 CFR/AIM or the operating location's Civil Aviation Authority minimum.

Project Crew Duty Adequate rest for onboard personnel, both flight crew and scientific observers, is essential to the safe and efficient operations of NCAR aircraft in support of research programs. RAF has established the following crew duty/rest limits (AOM §2.3.2.1, Rev. 12):

Time Period	Operating Limit
Any 24-hour period	10 flight hours
Any consecutive 7 days	40 flight hours or 60 duty hours
Any 30-day period	120 flight hours
Maximum crew duty period	14 hours
Minimum crew rest period	12 consecutive hours



Maximum consecutive duty days (10~14-hour days)	2 days
Maximum consecutive working days	6 days (mandatory day off with greater than 36 duty-free hours after the 6th day)
Daytime takeoff-time scheduling window	6 hours
Nighttime takeoff-time scheduling window	3 hours
Advance notice required for day/night operation changeover	36 hours (24 hours circadian adjustment and 12 hours preflight crew rest)

- Any project flight crew member — not the PIC alone — always has the option of calling a no-flight day when consecutive flights are scheduled and crew fatigue is a factor, or at any time when safe performance is in jeopardy.
- No one may assign flight times that exceed the limits above.
- Night duty is defined as a show time earlier than 0500 local or a landing after 2400 local (the Chief Pilot may approve modification of this definition based on recent flight/duty schedules).
- A duty day between 10 and 14 hours is considered a maximum duty day.
- Daytime takeoff times should be scheduled within a 6-hour window and nighttime takeoff times within a 3-hour window to preserve circadian rhythm; when this cannot be maintained, the crew must be notified at least 48 hours in advance, or the flight length should be shortened (to 7 hours or less by day, and below 7 hours by night without 48-hour notice).
- Waivers to the above limits require approval of the RAF Aviation Operations Manager (coordinated with the PIC, flight crew, and Chief Pilot) and are capped at: a maximum 3-hour Crew Duty Day extension, a minimum 10-hour crew rest reduction, and no more than two waivers per crewmember in any 30-day period.

5. Hazardous Materials, Energies and Toxic Gases

Hazardous materials, non-eye safe lasers, compressed inert gases or toxic gases will not be carried aboard NCAR aircraft without review and permission from the RAF Safety Committee. Applicable Federal and OSHA regulations regarding both onboard and ground support activities will be adhered to in each case. Provisions for dealing with said materials or gases will be defined by the RAF Safety Committee in coordination with the NCAR Health Environment and Safety Office (HESS) and applicable regulations.



At the project level, all hazards must be declared and listed by each participant on the RAF's *Hazard Identification Form*. This form details the potential hazards associated with each instrument and includes handling procedures to be followed to limit the dangers associated with the various hazards. The Safety Data Sheets (SDS) associated with the hazard must also be submitted. UCAR's HESS group, together with the RAF Safety Committee, reviews each submitted form and identifies issues and risks. Three copies of the appropriate Safety Data Sheets (SDS) for each chemical hazard will be generated by HESS and placed in three locations: aboard the aircraft, in the project Operations Center, and at RAF.

Company Material (COMAT) and NOTOC process (per Dangerous Goods Manual, Rev. 0, 1 Sep 2025): NCAR RAF operates as a Will-Not-Carry hazardous materials operator and does not transport dangerous goods for hire. The INSPYRE project-specific hazardous materials listed in Section 1.A (compressed gas cylinders) are carried exclusively in support of the scientific mission and, under the Dangerous Goods Manual, are managed and documented as Company Material (COMAT) rather than as shipped dangerous goods.

- Prior to the deployment (and prior to any subsequent change in instrument loadout), the Project Manager will review all instrument components and materials intended for carriage aboard the aircraft — including each compressed gas cylinder listed in Section 1.A — to determine whether they are regulated under 49 CFR and must be handled as Hazardous COMAT.
- For each item of Hazardous COMAT, the Project Manager will complete a COMAT – Notice to Captain (NOTOC) form identifying the item, its proper shipping name and UN/ID number (if applicable), hazard class/division and packing group, quantity and location aboard the aircraft, and any special handling or stowage precautions.
- The completed NOTOC will be submitted to the Pilot-in-Command (PIC) at least 24 hours prior to scheduled departure, or as soon as practical for mission-critical changes. The PIC's review and signed acknowledgment constitute acceptance of the COMAT for carriage on that flight; the PIC retains final authority to accept or reject any item.
- A copy of each NOTOC will be retained in the project flight file and maintained by RAF Operations for a minimum of 90 days after mission completion.
- All COMAT items identified on the NOTOC must be secured within instrument racks, payload bays, or other approved mounting systems; protected from heat, vibration, and contamination as applicable; and accessible only to trained personnel.



- All project personnel (mission scientists, technicians, and other observers) will be briefed by the PIC on RAF's Will-Not-Carry status and the prohibition on personal hazardous materials aboard the aircraft, including restrictions on personal compressed-gas cylinders, chemicals, or lithium-battery-powered devices exceeding the allowances in 49 CFR §175.10.
- In the event of an in-flight or ground incident involving hazardous COMAT, the PIC will reference the corresponding NOTOC to identify affected materials and initiate response procedures, consulting the Emergency Response Guidebook (ERG) as needed.

6. Emergency Equipment and Personal Safety

Emergency equipment and protective clothing will be carried aboard NCAR aircraft to cope with air and ground emergencies; and to sustain crew members' lives in case of forced landings.

Emergency equipment is divided into two categories as listed below. Emergency equipment is considered a part of the aircraft and will not be carried by individual crew members. Scientific crew may carry tools necessary for airborne maintenance and specialized research equipment. Crew judgment is the paramount factor deciding emergency equipment needs.

A. Category I Equipment

Category I equipment is a part of the basic aircraft inventory and will be carried aboard NCAR aircraft at all times.

- Fire Extinguishers
- Axe
- First Aid Kit
- Tool Kit: Pliers, screw drivers, wrenches, fuses, tape, allen set, and knife
- Flashlight
- Personal breathing equipment (one unit located at each cabin seat)

B. Category II Equipment

Category II equipment is primarily crew survival equipment and will be carried during specialized operations, over water, desert, mountains, arctic areas, etc. This category is not expected to apply to INSPYRE given the project's operating profile (Section I & I.A).



Category II A

Category II A equipment will be aboard NCAR aircraft for all operations conducted over desert and over water beyond gliding distance of land.

- One life preserver for each crew member
- Enough life rafts to safely carry all crew members
- Water in addition to that carried in the survival kit
- Emergency radio
- Survival kit

Category II B

Category II B equipment will be carried on all flights where operations are to be conducted over mountainous terrain and arctic areas.

- Emergency radio
- Survival kit
- Exposure suits, sleeping bags, or blankets, as appropriate

C. Protective Clothing

Prior to any deployment, local conditions will be examined to determine whether or not protective clothing will be required appropriate to conditions which may be encountered. This issue will be discussed in the mandatory "Project Safety Briefing" discussed above. It will be the responsibility of the project manager & the pilot-in-command to ensure that all crew members wear appropriate clothing.