LANGELY RESEARCH CENTER

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Aviation Operations & Safety Manual

National Aeronautics & Space Administration

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CANCELLATION

The issuance of this manual supersedes LPR 1710.16I, Aviation Operations and Safety Manual dated November 14, 2013.

Original signed on file

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Distribution:

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1. ADMINISTRATIVE RESPONSIBILITIES AND REQUIREMENTS

1.0.1 To ensure that Langley Research Center (LaRC) research and support aircraft operations are conducted in a safe, efficient, and productive manner, the Research Services Directorate Director, the Chief of Flight Operations (CFO), the Chief Pilot, the Aviation Safety Officer (ASO), and the Range Safety Officer (RSO) maintain direct oversight of the planning and implementation of these activities. Their responsibilities and those of other associated officials and organizations follow.

1.0.2 In addition to the continuous responsibilities delineated below, specific emergency/accident response and notification functions exist (on an as-needed basis) for various LaRC personnel as described in LMS-OP-0939, Aviation Accident Reporting, Investigation, and Site Management Plan.

1.1 DIRECTOR, RESEARCH SERVICES DIRECTORATE (RSD)

1.1.1 The RSD Director is the Organizational Unit Manager (OUM) responsible for oversight of RSD flight operations and aviation safety. The RSD Director formulates business policies and plans for aircraft management and ensures that appropriate procedures and policies exist to comply with government and Agency regulations. The RSD Director conforms with the definition of the "Aviation Program Manager," set forth by the Interagency Committee for Aviation Policy (ICAP) guidelines. RSD Director responsibilities include, but are not limited to:

a. Maintaining overall responsibility for LaRC aviation operations and their safe conduct.

b. Ensuring compliance with the LaRC Safety Program.

c. Ensuring that appropriate research systems development processes exist and are being used by employees.

d. Ensuring the establishment of operations and safety guidelines and procedures.

e. Providing resources and capabilities for implementation of research flight activities.

f. Preparing and implementing the aviation budget.

g. Developing and advocating staff hiring and training/certification strategies for RSD to implement LaRC research flight activities.

h. Reviewing and signing Flight Test Operations & Safety Reports (FTOSR) presented to the Airworthiness Review Board (ARB)/Flight Readiness Reviews, as well as Research Vehicle Work Order (RVWO) initiations and revisions.

i. Supervising all contract vendors, accounts, and services to ensure compliance with Federal purchasing and accounting procedures, as well as timely, uninterrupted service.

j. Ensuring compliance with Federal property acquisition and disposition regulations.

k. Establishing and maintaining communications and an effective relationship with NASA HQ personnel responsible for controlling aircraft operations.

l. Authorizing deviations/waivers of rules and maintenance procedures when necessary to provide for safe continuation of operations and with due regard to the impact on future maintenance requirements. These deviations shall not violate NASA policy or procedural requirements. Documentation of waivers and deviations shall be maintained in maintenance data logs and/or flight logs, as appropriate. These deviations are normally logged into the NAMIS database.

1.2 CHIEF OF FLIGHT OPERATIONS (CFO)

1.2.1 The CFO at NASA Langley performs the duties of the "Director of Operations," set forth by the Interagency Committee for Aviation Policy (ICAP) guidelines. He/she shall be knowledgeable concerning the contents of this document and the provisions of applicable regulations necessary for the proper performance of his/her duties and responsibilities. This person shall have the responsibility for ensuring the missions are conducted safely and in compliance with this document, Agency regulations, and applicable Federal Aviation Regulations. The CFO shall also:

a. Hold or have held either a commercial pilot certificate, airline transport pilot certificate, or military equivalent; or

b. Have at least 3 years of experience as a pilot-in-command of an aircraft operated under 14 CFR parts 121, 125, or 135, or equivalent military service; or

c. Have at least 3 years of experience as CFO or equivalent in the government, in the military, or with a civil certificate holder operating under 14 CFR parts 121, 125, or 135, and

d. Have at least 3 years of flight test/research operations experience.

1.2.2 As delineated in NPR 7900.3, the CFO "is the senior line manager with authority over flight activities operated or controlled by the Center and is directly responsible to the Center Director for the safe and effective conduct of those activities." The CFO's responsibilities include, but are not limited to:

a. Overall supervision and management of the Functional Areas of aircraft piloting, aircraft maintenance and modification, aircraft quality assurance, operations engineering, logistics and planning, and airworthiness and aircraft configuration control/management.

b. Establishing operational policies and standards, which are conducive to safe, efficient flight research and related support activities. Assuring compliance with policies, procedures, and practices described in governing documents.

c. Defining, proposing and implementing the management guidelines, processes, and procedures necessary to enable safe and effective operations of LaRC-assigned aircraft, including appropriate training/certification programs for all Functional Areas.

d. Developing and implementing flight following procedures to provide for timely notification of management and for initiating search-and-rescue operations in case of a lost or downed aircraft.

e. Developing and implementing a thorough and comprehensive training program to include initial and recurrent training appropriate for all aviation program personnel responsibilities and necessary operational skills relevant to the types of operations/missions conducted by the Center.

f. Defining and implementing an Aviation Safety and Mishap Prevention Program that meets Agency requirements and any additional Center guidelines, assisted by the Aviation Safety Officer (ASO) and the Functional Area managers.

g. Initial investigation of all incidents and accidents involving LaRC aviation personnel and/or aircraft, within the guidance and parameters set forth in NPR 8621.1.

NOTE: (Investigations may be conducted by the National Transportation Safety Board (NTSB) in which case a request shall be made to the NTSB to include a member of the Agency as a party to the investigation and to assist the NTSB as necessary.)

h. Ensure FTOSR limitations are followed.

i. Establishing and maintaining effective relationships with the local Flight Standards District Office (FSDO) of the Federal Aviation Administration (FAA) when "civil" aircraft are assigned.

j. Execute waiver authority over requirements set forth in this document. Waivers may be submitted in writing, verbally, or by e-mail. Waivers are typically applicable for the duration of the operation for which submitted. Landing and other aircrew currency and proficiency waivers are submitted in writing and are retained in the aircrew training record for one year. Permanent waivers are retained until incorporated into this document.

k. Providing management approval of Flight Requests to ensure that flights conducted in LaRC aircraft are in accordance with Flight Safety Releases (FSR), Boarding Authorizations (BA), or other management-approved activities.

l. Approving appropriate Boarding Authorizations (BA) for all personnel on LaRC and non-LaRC aircraft.

m. Serving as the Center interface to the Inter-center Aircraft Operations Panel (IAOP).

n. Generating flight operations guidelines, directives, and procedures associated with the operation of LaRC aircraft.

o. Establishing, monitoring, and enforcing safe operating practices, currency standards, and aircraft checkout policies.

p. Ensuring that monthly and annual aviation activity reports and other required reports are prepared properly and in a timely manner.

q. Assisting with budget preparation.

r. Preparing performance evaluations of first-line supervisors assigned to the aviation activity.

s. Designating pilots and aircrew for specific positions, such as Pilot-In-Command (PIC), Instructor Pilots (IP), Functional Check Pilots (FCF), Check Airman (CA), etc.

t. Determining the number and types of aircraft/UAS for which an individual aircrew member may maintain qualification at any given time and annually review that determination.

u. Recommending assignment of the ASO, with the concurrence of the Director of LaRC Safety and Mission Assurance Office, to the Center Director for approval.

v. Administering flight operations and/or flying as an aircrew member or observer on all assigned aircraft, where practicable and as necessary, to observe performance of assigned aircrew.

x. Establishing operational policies and standards, which are conducive to safe, efficient flight research and related support activities. Assuring compliance with policies, procedures, and practices described in governing documents.

y. Ensuring the currency, training, and proficiency of flying personnel is appropriate for the aircraft and mission assigned.

z. Establishing individual initial training, checkout, and currency requirements.

1.3 ASSOCIATE DIRECTOR FOR FLIGHT OPERATIONS (ADFO)

1.3.1 Background – The Associate Director for Flight Operations represents the CFO for flight related matters, excepting those that are not delegatable (e.g. MEL waivers). This position is normally filled by the Chief Pilot. Additionally, the ADFO may represent RSD when both the CFO and Deputy Director are absent.

1.3.2 ADFO responsibilities include, but are not limited to:

a. Engineering Reviews

b. Flight Configuration Reviews

c. Calendar/schedule Reviews

d. Flight Approval for medium/low risk flights including Operational Readiness Reviews

e. Representing RSD with the USAF/JBLE regarding flight related activities

f. Exceptional Flight Release

g. Assigning pilots to research and research support missions based on individual competency, experience, and currency.

h. Other duties other than those specifically precluded from delegation from the CFO in NPR 7900

1.4 AVIATION SAFETY OFFICER (ASO)

1.4.1 Background - The Aviation Safety Officer is the focal point for aviation safety matters for the Center Director, RSD Director, and the CFO. The ASO reports to the Center Director on all aviation safety matters. Qualification requirements for the ASO are set forth in NPR 7900.3. The

ASO is recommended by the CFO, approved by the RSD Director, appointed by the Chairperson of the Executive Safety Council (ESC), and acts on behalf of the Chairperson and the Center Director when discharging his/her responsibilities (LAPD 1700.2, Safety Assignments and Responsibilities). The ASO is a permanent member of the Executive Safety Council (ESC) and the Airworthiness Review Board (ARB).

1.4.2 ASO responsibilities include, but are not limited to:

a. Defining and implementing the Center Aviation Safety Program in conjunction with the Ground Safety Officer (GSO) and CFO to address all areas of flight and ground operations safety of aircraft.

b. Providing technical guidance on safety aspects of flight programs and operations.

c. Fostering an aviation safety climate, promoting mishap prevention, and developing and maintaining an aviation accident reporting and investigation plan.

d. Maintaining conformance with prescribing directives, standards, and procedures. Identifying or recommending corrective action, when required.

e. Facilitating the operation of the Aviation Safety Working Group (ASWG).

f. Reviewing and concurring with the FTOSR and hazard analyses/risk assessments presented to the ARB.

g. Providing liaison with the LaRC Safety Manager to identify and communicate aviation-related issues needing attention from other LaRC safety groups or committees.

h. Leading initial aircraft mishap investigations.

i. Maintaining a safety library to include all appropriate safety-related publications.

j. Maintaining a safety bulletin board to ensure timely crew awareness of safety issues.

k. Holding safety meetings quarterly, or more frequently as necessary, with regard to accident prevention measures, observed or reported hazards, and other safety-related issues.

l. Ensuring timely coordination with the CFO for review of safety preventive measures, safety-related problems, and recommendations for enhanced safety procedures.

m. Attending required NASA Safety Officer meetings, ESC meetings, and ARB meetings.

n. Participating in FAA-sponsored and other safety meetings/seminars, as may be deemed by policy or by the CFO, to enhance aviation safety.

o. Monitoring aviation operations and facilities to ensure timely detection and awareness of potential safety hazards and to ensure prompt preventive measures where appropriate.

p. Supporting the Inter-center Aviation Operations Panel (IAOP) reviews as an investigative panel member, when assigned.

q. Reporting hazards and events in the NASA Mishap Information System.

1.4.3 The ASO shall provide independent reports on aviation safety to the RSD Director, ESC Chairperson, and/or the Director of LaRC Safety and Mission Assurance Office (SMAO), as requested. In times of unavoidable absence from duty or of other conflicting time demands, the Aviation Safety Officer may appoint an assistant to execute the duties of the office.

1.5 AIRWORTHINESS & CONFIGURATION CONTROL/MANAGEMENT

1.5.1 Airworthiness (Research and Basic)

1.5.1.1 Research airworthiness engineering design and review are provided by RSD Airworthiness Engineers and/or contracted engineering support and are the focal points for aircraft and research systems modification and operational airworthiness assurance.

These research designs and systems are subject to airworthiness review by the ARB upon incorporation into a research vehicle or system prior to obtaining an FSR. Airworthiness responsibilities include, but are not limited to:

a. Reviewing engineering designs, aircraft modifications, and equipment installations.

b. Ensuring that engineering designs are in compliance with applicable FAR, military design specifications, or approved NASA airworthiness guidelines, as appropriate.

c. Documenting the design and any potential limitations or restrictions to normal flight manual usage and normal risk-of-flight.

d. Obtaining appropriate approvals prior to flight operations.

1.5.1.2 Continuous aircraft airworthiness is ensured through the oversight and monitoring by the Quality Assurance Office (QAO), as set forth in Section 1.10 of this document.

1.5.2 Configuration Control/Management

1.5.2.1 Configuration control is established through the initiation and completion of the Research Vehicle Work Order (RVWO) and Flight Configuration Review (FCR) processes.

1.5.2.2 Configuration Management is provided by the use of the NAMIS and is archived by the QAO. Additional documentation may be required to be provided to the ARB prior to issuance of a FSR. This may include design review minutes, engineering drawings, and flight manual changes, for example.

1.6 AVIATION GROUND SAFETY OFFICER (GSO)

1.6.1 The Research Systems Integration Branch (RSIB) shall provide an Aviation Ground Safety Officer (AGSO) which is an appointed position that functions as a safety advocate and consultant to the ASO and CFO on aviation safety matters unique to ground-based operations. The AGSO monitors general aircraft operations and provides recommendations for maintaining and improving ground safety to the CFO and the ASO. The AGSO conducts

safety meetings and provides other safety-related activities throughout the year. The AGSO is a member of the Aviation Safety Working Group (ASWG).

1.6.2 The AGSO shall institute mandatory safety indoctrination briefings for all personnel required to access and work within the hangar environs. As a minimum, the briefings shall include information on hangar general and aircraft-specific hazards, such as propeller arcs and jet blast, and on FOD, tool control, fire suppression systems, hearing protection and chemical hazard communication (Safety Data Sheets –SDS) considerations.

1.6.3 Qualifications for the AGSO are found in NPR 7900.3 Chapter 6.

1.7 CHIEF PILOT

1.7.1 Background - The Chief Pilot shall be an experienced pilot whose training and expertise provide the leadership and technical competence necessary to support the aeronautical research mission of the Center. The Chief Pilot shall also:

a. Hold an Airline Transport Pilot certificate or have equivalent military certification and have at least 3 years of experience as a pilot-in-command of an aircraft under 14 CFR parts 121, 125, 135, or military or civil government experience. Additional qualification requirements are set forth in NPR 7900.3.

b. Be a current NASA Research Pilot with designation as an Aerospace Technologist (AST).

c. Oversee the activities of the LaRC pilot staff to support flight experiments and piloted simulation requirements of the Center.

1.7.2 In functioning as technical and operational advisor to the CFO, the Chief Pilot's responsibilities include, but are not limited to, functioning as a technical and operational advisor to the CFO. He/she also:

a. Supervises the training and qualification of pilots and Qualified Non-Crewmembers (QNC) such as mechanics operations/instrumentation engineers and research systems operators.
b. Oversees flight operations activities, including processes and systems for planning, scheduling, and monitoring of flights in progress.

c. Shall be thoroughly familiar with the provisions of this document and the requirements of applicable regulations pertaining to flight operations and research.

d. Ensures that a flight schedule exists that meets flight crew currency, proficiency, experiment, and training requirements.

e. Ensures that research pilots have appropriate experience, training, demeanor, and expertise to perform satisfactorily in their project pilot roles (for both flight and simulation experiments).

f. Recommends appropriate pilot staffing levels and methods to meet projected research program objectives.

g. Ensures that the pilots' career development and training are defined and accomplished.

h. Assists the assigned Contracting Officer's Technical Representative (COTR) in the monitoring and oversight of any non-Civil Service pilots used in the operation of LaRC-assigned aircraft and flight projects.

i. Establishes, monitors, and enforces safe operating practices, currency standards, aircraft checkout policies, and training plans for the pilot staff.

j. Is responsible for the standardization of flight crews and aircraft operations.

k. Assists the CFO with the preparation of the budget, administrative and pilot duties.

l. Recommends designation of qualified pilots/crewmembers as Pilot in Command, Instructor Pilots, Check Airmen, Configuration Flight Profile Pilots, Formation Pilots and Functional Check Pilots.

m. Assigns training duties to ensure the Training Program is administered as outlined in this LPR. This may include delegation of Chief Pilot duties (i.e. check rides, record keeping, etc.) as required, to Training officers and/or Instructor pilots/Check Airmen.

n. Establishes and maintains a methodology for the dissemination of new policy and information.

o. Investigates deviations from regulations/policies and report findings to the CFO.

1.8 RANGE SAFETY OFFICER (RSO)

1.8.1 Background - All sUAS flight operations under NASA purview are subject to the requirements of NPR 8715.5, Range Safety Program.

1.8.2 The Range Safety Officer (RSO) is responsible to provide safety oversight for UAS operations. He/she shall provide liaison support with other range safety organizations when operating at their sites. The program/project manager shall limit the assessed collective risk associated with sUAS vehicle operation and ensure that the probability of doing harm to a member of the general public is not greater than the criteria established by NPR 8715.5, Range Safety Program.

1.8.3 The RSO will maintain safety training to be part of, or lead, an IRT or mishap investigation and be prepared to execute the aviation MPCP.

1.9 PILOT-IN-COMMAND (PIC)

1.9.1 Background - The PIC has the ultimate individual authority and responsibility for the safe and professional operation of an aircraft during the course of a specific flight and the resultant safety of the aircraft, passengers, crew, and/or payload.

1.9.2 PICs shall:

a. Maintain current awareness of all pertinent Agency requirements, FAA regulations, and other regulatory data bearing on the performance of their duties.

b. Obtain and maintain all FAA-required flight reviews, medical certification, and currency as set forth in the FARs prior to operation of civil certificated aircraft.

c. Exercise responsibility for the safe conduct of all aircraft, personnel, and equipment during flight operations including, but not limited to the following:

(1) Ensuring the airworthiness of the aircraft prior to flight.

(2) Ensuring that all appropriate safety policies and procedures are carried out during the flight.

(3) Accomplishing flight planning and preparation, including preflight inspections of aircraft and equipment.

(4) Obtaining an appropriate weather briefing.

(5) Ensuring Reduced Vertical Separation Minimum/Required Navigational Performance (RVSM/RNP) compliance, when required.

(6) Ensuring a safe landing zone selection.

(7) Making go/no-go and landing judgments with regard to weather minimums or other criteria.

(8) Ensuring all air-to-air, air-to-ground, and Air Traffic Control (ATC) communications are conducted professionally.

(9) Ensuring timely reporting of new or previously unknown hazards to safe flight encountered and anu unusual events reportable by CFO policy or NPR 8621.1.

(10) Conduct of post flight inspections.

d. Sign the documents required for final release of the flight once the flight is appropriately scheduled, approved by management, and released by maintenance.

e. Exercise final authority to delay or divert flights for reasons of weather, aircraft status, or other safety-related considerations.

f. Ensure that passengers and crew members are briefed on operational requirements, egress procedures, and safety and emergency procedures, as well as any other pertinent information.

g. Provide for the security of the aircraft when away from LaRC by coordination with fixed base operators/law enforcement/military security, as appropriate. Additional guidance is available in NPR 1620.3.

h. Perform additional duties, as assigned.

1.10 AIRCRAFT OPERATIONS AND ENGINEERING BRANCH (AOEB)

1.10.1 The Aircraft Operations and Engineering Branch (AOEB) is the focal point for aircraft research and support operations planning and implementation. AOEB performs the tactical planning, scheduling, implementation, and communications for aircraft research and support activities. The AOEB is supervised by a Branch Head, and is staffed with a branch Chief

Engineer, integration engineers (mechanical and electrical), operations engineers, structural engineers, airworthiness engineers and analysts, and pilots.

1.10.2 Branch responsibilities include, but are not limited to:

a. Providing research piloting services and corresponding research pilot project assistance.

b. Providing support piloting services, when necessary.

c. Providing design and integration engineering services for assigned projects.

d. Providing appropriate engineering and airworthiness analysis and reviews for assigned projects.

e. Managing RSD scheduling, resources, and communications relevant to missions as assigned.

f. Preparing and/or assuring that preparation of flight requests, flight manifests, flight cards, and other associated paperwork for research missions is accomplished.

g. Managing operational and ground logistics coordination for research missions as assigned.

h. Managing operational and logistical planning and coordination for all deployments as assigned.

i. Coordinating with aviation weather, flight planning, airfield and airspace management, and other dispatch-type services.

j. Assisting in preflight activities including route planning; clearances; egress briefings; ensuring aircraft, crew, and operational plan suitability for flight; and confirming release for flight.

k. Providing coordination with appropriate air traffic control (ATC) facilities to ensure efficient flight in the National Airspace System (NAS) and in special use airspace for both research and non-research flight activity.

l. Providing Flight Test Director services for research operations.

m. Working with Principal Investigators (PI) or lead researchers, the Aviation Safety Officer (ASO), and Hazard Analysis personnel to conduct and document hazard analyses and risk assessments.

n. Assisting Principal Investigators or lead researchers in preparation for ARB reviews and test plans for program flight missions.

o. Generating flight test cards for research missions that meet research and operational requirements by integrating researchers' plan-of-test with operational constraints.

p. Coordinating with the LaRC Flight Operations Support Center (FOSC) for research telemetry and tracking as needed.

q. Coordinating and conducting tour and demonstrational activity involving LaRC aircraft, as assigned.

1.11 AIRWORTHINESS PROCESS

1.11.1 Currently, the Airworthiness process is governed by the Airworthiness Review Process for the Eastern Region Airworthiness Review Board (ER-ARB) (chartered by the Executive Safety Council, as defined in LAPD 1150.2), Councils, Boards, Panels,

Committees, Teams, and Groups. It operates according to the objectives and procedure documented by NAII 7900.3, Airworthiness Review Process for the Eastern Region Airworthiness Review Board (ER-ARB). The ER-ARB is chartered to review all experimental modifications to aircraft and all research flight and ground scenarios developed to achieve programmatic objectives. The ER-ARB provides the airworthiness statement for specific research flight operations. These operations may include multiple aircraft coordination with both NASA and non-NASA assets. Coordination between NASA centers and participating entities is encouraged. For this document, ER-ARB and ARB are used interchangeably.

Operational risks and approval are governed by the ORR/FRR process covered later in this document.

1.12 AVIATION SAFETY WORKING GROUP (ASWG)

1.12.1 The Aviation Safety Working Group (ASWG) is chartered by the Executive Safety Council, as defined in LAPD 1150.2. The group operates as a grassroots organization to identify and address safety concerns at the lowest level. The ASWG is primarily focused on safety issues encountered in normal day-to-day hangar operations. It does not review research safety issues covered by ARB review processes.

Membership normally consists of representatives from each RSD flight discipline/expertise area and from other personnel directly involved in aircraft modification or flight activity.

1.13 OTHER SUPPORTING ORGANIZATIONS

1.13.1 The requirements of this LPR apply to all other organizations supporting the maintenance and modification of LaRC aircraft. Aviation operations utilizing LaRC assets (equipment, personnel, or funding) are subject to the requirements and provisions of this LPR.

1.14 DELEGATION OF AUTHORITY

1.14.1 In the absence of specific delegations issued from the RSD functional positions described in this chapter, authority and responsibility to execute these functions is delegated according to the Research Services Directorate Organizational Unit Plan, LMS-OUP-D1.

1.15 OPERATIONS SUPREMACY

1.15.1 When non-LaRC pilots are flying LaRC aircraft or LaRC pilots are flying non-LaRC aircraft, the more conservative limit of the operational limitations shall apply from each organization.

2. ADDITIONAL ADMINISTRATIVE POLICY

2.0 UNILATERAL STOP AUTHORITY

2.1.1 Although attempts should be made to resolve non-emergency issues through responsible management channels, Civil Servant and Contractor employees supporting aviation are vested with the right to exercise unilateral stop authority over any operation they consider unsafe, per LAPD 1710.1, Langley Research Center Aviation Safety Policy. This policy is implemented in accordance with LMS-CP-0902, Unilateral Stop Authority for Flight Operations and Related Activities. This unilateral stop authority is granted without retribution for all RSD facility, operational and aircraft-related activities. Exercise of the unilateral stop authority does not require formal initiation; either verbal or written communication is acceptable.

2.1 PILOT MEDICAL CLEARANCE

2.1.1 Aviation employees shall maintain a high state of mental and physical fitness. No employee shall accept a work assignment during a time wherein he/she suffers from a significant physical or mental deficiency. In such case, the employee shall inform his supervisor of the circumstances involved. Return-to-duty status shall only be permitted after consultation with a supervisor. In case of a serious illness or condition, an Aviation Medical Examiner/Flight Surgeon consultation shall be required for clearance to return to duty.

2.1.2 Aviation Medical Program - An aviation medical program exists at LaRC and is administered by the Center's Clinic. An Aviation Medical Examiner/Flight Surgeon is part of the resident LaRC staff, which gives all flight crewmembers, and qualified non-crewmembers the capability of receiving physicals and preventive measures at levels appropriate for the circumstances involved. Flight physicals and equivalent physical examinations are conducted for the furtherance of NASA Langley Research Center missions and to help ensure the safety and suitability of required crewmembers to perform airborne flight research missions.

2.2.2.1 The CFO/ADFO shall approve Center employee's requests to hold FAA physicals or equivalent certification of fitness to perform current or anticipated NASA missions. This policy does not supersede any requirement for other physical examinations required at Langley for industrial health purposes (i.e., audiograms, eye exams, etc.) or as established by other policy. In the event this local policy conflicts with another Center Procedure or Center or Agency policy, those policies shall augment or supersede the results of these criteria.

2.2.3 Required Examinations

2.2.3.1 RSD crewed aircraft pilots shall pass an FAA Class I medical examination or military equivalent administered annually.

2.2.3.2 RSD crewed aircraft pilots may continue to operate at Class II medical standard after the first 6 months without reexamination, except for pilots over the age of 55. Pilots over the age of 55 are required to complete the FAA Class I physical every 6 months.

2.2.3.3 The LaRC Clinic will administer Class I physicals for crewed aircraft pilots at no cost, or such pilots may choose another examiner at their own expense. If a non-LaRC examiner administers the physical, the results shall be forwarded to the LaRC Clinic for review and retention.

2.2.3.4 An equivalent military flight physical is acceptable for the operation of "public" aircraft. The results of the military physical shall be forwarded to the LaRC Clinic for

review and retention.

2.2.3.5 Pilots are responsible for ensuring that a copy of their current medical flight clearance is in their training jacket.

2.2.3.6 Crewed aircraft pilots failing a FAA Class I medical may request a review of their medical fitness for flight duties by the Aerospace Medicine Board at Johnson Space Center. Any request for fitness-for-flight review shall be made through management. Certification by the Aerospace Medicine Board may permit a pilot to continue operating NASA "public" aircraft.

2.2.3.7 LaRC aircraft (specifically the B-200 and HU-25) have been assessed with dosimeters for noise evaluation. LaRC aircraft exceed the noise exposure levels allowed by OSHA and require both noise protection and enrollment in the hearing conservation program. Individuals, supervisors, CFO and FSH who coordinate on the LF-66 shall ensure the HCP protocol is selected.

2.3 TOBACCO AND SMOKING

2.3.1 Any tobacco product use in NASA aircraft is not permitted. Smoking within 50 feet of any NASA aircraft is not permitted.

2.4 ALCOHOL AND DRUGS

2.4.1 Aviation personnel shall not use illegal or non-prescription controlled substances and shall at all times comply with the NASA drug and alcohol policy and FAR 91.17. No person may act as a crewmember for NASA:

a. Within 12 hours after the consumption of any alcoholic beverage.

b. While under the influence of alcohol.

c. While using any drug that would affect mental or physical faculties in any way.

2.4.2 Aviation personnel using prescription medications shall consult the NASA LaRC flight surgeon for concurrence with such use and shall at all times comply with the NASA drug and alcohol policy and FAR 91.17. Such prescription drug usage may have a potential for impairment of aircrew capabilities in a flight operation. Additionally, non-prescription over-the-counter drugs may also impair faculties and their use shall be approved by the flight surgeon prior to accepting flight duties.

2.5 WAIVER AUTHORITY

2.5.1 The CFO is the waiver authority for this document unless prohibited by higher authority (e.g. NPR 7900.3). The AFDO may exert waiver authority in the CFO's absence unless prohibited by higher authority (e.g. NPR 7900.3).

3. THE LaRC AVIATION SAFETY PROGRAM

3.0.1 Background - An effective safety program is vital to achieving the mission of the Center's aircraft/UAS flight programs. In recognition of this fact, RSD is committed to providing a safe and healthful working environment free of recognized hazards for its employees. In pursuit of this goal, an aggressive safety strategy shall be incorporated into all directorate activities. Safety is also an individual responsibility and shall exist in our thinking, planning, and actions.

3.0.2 Safety Management System (SMS) - NASA's Aviation Safety Program conforms to ICAO's SMS. NASA established ICAO SMS compliance through a phased SMS qualification process administered by the General Service Administration (GSA) from 2010 through 2017. These four audits achieved the maximum SMS Stage 3 certification using International Standard for Business Aircraft Operations (IS-BAO) SMS standards. The 2017 GSA IS-BAO audit was a Stage 3 re-certification used to also validate NASA's internal IAOP review process as a means of SMS self-auditing. Subsequent agency and center ICAO SMS audit compliance will be accomplished via the NASA NPR 7900.3 IAOP review process and be self-certified under public use authority. When the IAOP review process is continuously administered throughout the agency, NASA meets requirements of the Interagency Committee for Aviation Policy (ICAP) Federal Aviation Gold Standard Program for Aviation Safety Management as established by the Federal Management Regulation 102-33.180. This flows down to LaRC having met SMS Stage 3 certification when fulfilling the requirements of the IAOP review process. A GSA ICAP Gold Standard Certificate is produced for the agency that can be carried aboard LaRC aircraft for international operations as evidence of NASA's ICAO SMS compliance.

3.0.3 At LaRC, the ASO is the individual within RSD with the responsibility for managing the Center's aviation SMS to include, at a minimum, documentation control, training of personnel, and promotion of the program to ensure all aircraft operations personnel are aware of their responsibilities.

3.0.4. SMS non-conformances identified through either Agency internal or third-party audits shall be corrected or mitigated. Those not corrected or mitigated by NASA policy, shall be mitigated at Center or RSD level through aircraft design, policies or procedures based on the appropriate level of responsibility.

3.1 PURPOSE

3.1.1 Safety Culture

Safety culture or climate may be thought of as the collective beliefs, norms, standards, perceptions and assumptions that establish the unwritten rules and behaviors within and outside the organization. These shared values and beliefs form the "way an organization does things," and can be either good or bad. Fostering of a positive safety culture by management is critical to any effective safety program. The five characteristics of a safety culture are: a reporting culture, a just culture, a flexible culture and a learning culture all leading to an

informed culture. The following concepts and actions are elements of a positive safety culture:

a. Unqualified commitment to safety as a behavioral pattern and pervasive way of life by topmanagement.

b. Unambiguous expectations by each level of management, as well as each peer group, that safe life patterns and work habits are normal and shall be practiced off the job as well as on the job.

c. Availability of quality, standardized equipment with which to accomplish the assigned tasks.

d. Clear, easily understood operating procedures, followed without deviation.

e. Inclusive system of communications for collecting, analyzing, and exchanging incident data related to safety.

f. Non-retribution for submission of incident data.

g. Retraining without penalty or stigma when safety is involved.

h. System for tracking incident and accident data, analysis of trends, and feedback ofresults.

i. Peer acceptance that accidents are preventable, regardless of operations.

j. Peer acceptance that safety is a matter of lifestyle – a matter of culture.

k. Effectively implemented Operational Risk Management (ORM) techniques in each task evolution. See Appendix B.

3.1.2 Aviation Safety Procedures And Guidelines - Apply to the operation, maintenance and modification of aircraft, and the equipment utilized in support of LaRC flight operations. In the context applied herein, aviation is defined to include ground and support operations, facilities and equipment, as well as, actual sUAS and crewed aircraft flight. These procedures and guidelines form a closed loop to ensure that:

a. Aviation safety problems are detected and identified

b. Safe procedures for dealingwith problems are devised, specified, and implemented

c. Procedures are developed and enforced by the responsible individuals

3.2 SAFETY POLICY

3.2.1 It is the documented safety policy of LaRC to take all reasonable steps to avoid loss of life, personal injury, property damage and mission failure. Aviation safety policy for the Center is established in LAPD 1710.1, *LaRC Aviation Safety Policy*.

3.2.2 Aviation safety is a line management function; however, assuring the highest practical level of safety is also the responsibility of every employee associated with flight operations. Due to the unique nature of operations, LaRC aviation safety procedures are specified in broad terms to allow the flexibility of application that is needed for the variable conditions associated with research flight operations. Appropriate, specific safety procedures are formulated for research programs. Each flight activity includes a mechanism to ensure that safety is given special consideration. This provides a chain of responsibility with a continuing check and documentation of safety elements throughout a given research activity. This system complies with the requirements of all applicable aviation and basic safety documents.

3.2.3 The civil servant and contractor staff with functional responsibilities pertaining to aviation as implemented at LaRC is vested with the right to exercise the Unilateral Stop Authority, as described in Section 2.0 and LMS-CP-0902. Unilateral Stop authority allows anyone the right and responsibility to call a halt to any activity that is perceived to be hazardous.

3.2.4 Mishap Preparedness and Contingency Plans are outlined in LPR-8621.1, LMS-CP-0939 and project-specific pre-deployment mishap plans for missions exceeding three days away from LaRC.

3.3 AIRCRAFT MISHAP PREVENTION SURVEY

3.3.1 The aviation program and flight operations at LaRC are subjected to biennial safety reviews conducted by the Headquarters Aircraft Management Division (AMD) and the Inter-center Aircraft Operations Panel (IAOP), with independent oversight by NASA Headquarters. These reviews are based on the extensive checklist maintained by the Headquarters AMD, covering all phases of aviation at the Center, and include all functions and organizations that support these aviation activities. These reviews produce formal recommendations or action requests to which the Center shall respond to NASA Headquarters as part of a continuous improvement initiative. Any initiative that results in a change or supplement to the Aviation Safety Program is documented and incorporated into a revised program.

3.4 AIRCRAFT MISHAP PREVENTION, REPORTING, AND INVESTIGATION

3.4.1. Specific responsibilities and the process for aviation mishap and accident reporting are documented in NPR 8621.1. LPR 8621.1, LMS-OP-0939, project-specific pre-deployment mishap plans for missions exceeding three days away from LaRC. These constitute a fundamental element of the Center Aviation Safety Program. These elements lead directly to

the accident investigation process of NPR 8621.1, *NASA Mishap and Close-Call Reporting, Investigation, and Record-Keeping Policy*. Additionally, processes exist for the identification and reporting of operational incidents and near misses in order to track, analyze and apply corrective measures to situations that have caused, or may cause, unsafe situations. These include Incident/Hazard/Close Call reports that allow employees to communicate with management and the ASO about any safety issue or concern, including the identification and resolution of unsafe situations. ICAO Annex 13 addresses international incident investigations.

3.4.1 Mishap Prevention Themes - As part of the operational element of the Aviation Safety Program, the Aviation Safety Officer conducts regular, periodic briefings (both formal and informal) to pilots and other aviation personnel focused on specific safety and prevention themes. The themes addressed include:

a. historical data and analysis of LaRC aviation operations and functions, trends and noteworthy events from the military, industry and other NASA Centers,

b. specific manufacturers' safety-related information, and

c. future areas of emphasis of particular importance to LaRC operations.

3.4.2 The Aviation Ground Safety Officer conducts ground safety forums addressing themes comparable to those mentioned above on a regular basis. These supplement the periodic forums of the Aviation Safety Officer.

3.4.3 Aviation Mishap Prevention Bulletin Board - Aviation safety/mishap prevention information is posted on several bulletin boards located in public areas accessible to each functional element of the LaRC flight organization. On these boards are posted timely, aviation safety-related and mishap prevention data and announcements relevant to specific LaRC operations, as well as universal information (such as safety posters) that communicate state-of-the-art advances, significant trends, and common-sense practices of merit to all aviation organizations and efforts.

3.4.3 Branch supervisors are still required to conduct employee safety training IAW LaRC general safety program but may take credit for any month an ASO-led safety training occurs.

3.4.4 Mishap, "Close Call" and Hazard Reporting (Hazards and Anomalies)--The Center's Aviation Safety Program encourages reporting of mishap, hazards, anomalies, and close calls from personnel. This is normally documented through the NMIS database. Personnel desiring anonymous reporting can do so within NMIS. SMAO assists the ASO in entering and processing data entered into the system. The NMIS documents and informs potential and actual hazards to the appropriate management level for investigation and resolution. "Close Calls" are documented, trended, and disseminated to internal personnel and other NASA flight organizations for educational and awareness purposes. Additionally, cognizant safety personnel at LaRC follow the reporting requirements contained in NPR 8621.1. Events that

are not mishaps or Close Calls, but are relevant to capturing safety trend data should be input into NMIS as a "Non 8621 reportable" event. The can include, but are not limited to, non-damaging bird strikes, non-repairable UAS vehicle loss below the Type D thresholds, system failures necessitating diverts or early mission terminations, and other unusual events.

3.4. 5 Aircraft Mishap and Close Call Investigation--The principles of mishap reporting, investigation and identification of root causes, and corrective action are central to an effective aviation safety program, which shall be conducted in accordance with NPR 8621.1. "Close Call" reporting, investigation, and dissemination of lessons learned are essential elements of mishap prevention. Initial response guidance to mishap occurrences can be found in LMS-OP-0939 and LPR 8621.1.

3.5 AVIATION SAFETY COUNCIL

3.5.1 The concept of the Aviation Safety Council is fulfilled at LaRC through the joint efforts of the Center Executive Safety Council (ESC), the Aviation Safety Working Group, and the Airworthiness & Safety Review Board.

3.6 AVIATION SAFETY MEETINGS

3.6.1 Safety stand-downs are called periodically at a Center level and within the RSD for communication of safety and mishap prevention information and, as needed, on a corrective basis to address specific occurrences or observations of concern. The forums and activities of the stand-down cause all other operations within the flight organization to cease while they are in progress and are open to all personnel from organizations that support LaRC aviation activities, not just those within the flight organization. Safety requirements, including meetings, are also addressed in contracts supporting the flight organization, as well as, within roles and responsibilities of management and specific functional leads. The Aviation Safety Working Group (ASWG) provides a forum for identification and methods of resolution for safety issues in daily hangar and aircraft operations.

3.7 SAFETY INCENTIVES & AWARDS

3.7.1 The Center has several means by which individuals are rewarded for safe accomplishment of functional tasks supporting aviation missions. This recognition may be in the form of both a plaque/certificate and/or cash. The RSD management receives an annual award budget for allocation to its staff or to any other individual at the Center whose performance in support of the Center aviation activity has been exemplary. Letters of recognition and non-monetary awards are provided by the Center to contractor staff, taking advantage of opportunities to recognize and award outstanding effort through the contractor. Other forms of safety acknowledgement include certificates for accident-free operation from outside organizations, such as the National Business Aviation Association (NBAA).

3.8 PERSONAL PROTECTIVE EQUIPMENT

3.8.1 Aviation Protective Equipment & Clothing - In accordance with NPR 7900.3, LaRC maintains an inventory of system-level and personal protective equipment, which is issued to aircraft and flight crewmembers as applicable to the duties associated with given missions.

3.8.1.1 Protective equipment is defined as a device or item worn, used, or located for the safety and protection of LaRC personnel and official Center visitors. Protective clothing is also defined as an article of clothing furnished to an employee at Government expense.

3.8.1.2 Protective equipment shall be worn or carried for personal safety and protection when performing work assignments. Government issue protective equipment for loan may include: oxygen masks, aviator flashlights (with batteries), aviator watches, kneeboards, manual/electronic navigation computers, personal equipment storage bags, earplugs, nasal spray, watch caps, and any other equipment necessary to accomplish flight objectives.

3.8.1.3 Protective clothing for loan may include Nomex Flight Suits, Nomex Flight Jackets, flight boots, fitted anti-exposure suits, anti-G suits, Nomex gloves, custom-fitted helmets, undergarments, socks, and any other equipment necessary to accomplish flight objectives.

3.8.1.4 All LaRC flight research personnel shall wear the following uniform items and equipment while on research flight duty, unless otherwise approved by the CFO/ADFO:

a. Nomex flight suit (underwear shall be cotton, wool, or Nomex only) or Drysuits

b. Appropriate shoes (boots, leather, no open toes, etc).

c. Headset

d. Approved nametags

3.8.1.5 When operational life support equipment is a required element of a flight mission, preflight training and orientation to the equipment is accomplished before the mission. Operational life support equipment shall be managed in accordance with NPD 4200.1, *Equipment Management*, and NPR 4200.1, *NASA Equipment Management Manual*. The Research Systems Integration Branch oversees the issuance and control of aviation protective equipment and protective clothing in accordance with the above guidelines. The issuance of all LaRC equipment shall meet the following criteria:

a. The issuance is not permanent.

b. It will benefit the Federal Government.

c. The equipment is not modified

d. Appropriate officials review and concur with purchase, inventory, and issuance.

3.8.2 Wear of Civilian Attire - Appropriate civilian attire may be worn on program support flights, as well as pilot proficiency flights, at the discretion of the assigned pilot-in-command, if such attire is not prohibited by other regulations or Center-published guidance.

3.9 CARGO SAFETY

3.9.1 All cargo shall be inspected for hazardous material content prior to loading aboard aircraft. Refer to Section 14 for hazardous material handling procedures.

3.9.2 All other cargo shall be properly secured and documentation of weights and volumes be made available for the calculation of aircraft weight-and-balance.

3.10 DISSEMINATION OF AVIATION SAFETY INFORMATION

3.10.1 All formal LaRC aviation safety documents (numbered and configuration controlled) are maintained and "published" in the Langley Management System (LMS). These documents are also made available to all regular users and potential "outside" users of aviation services at LaRC who may not be familiar with aviation safety practices and operations, or who may work within the LaRC safety framework on a regular basis. Less formal (unnumbered) documents, such as the Aircraft Crash Rescue Handbook, are made available to potential users, inspectors and Agency safety and operations managers, as well as, to organizations from which support is needed or with which activities are conducted. The Aviation Safety Officer and Chief Pilot are empowered to disseminate aviation safety information electronically and when required formally entered into the Pilot Information File.

3.11 FACILITIES SAFETY

3.11.1 The physical plants of both LaRC and Joint Base Langley-Eustis (JBLE) are integral elements of the Center Aviation Safety Program. The Facility 1244 Hangar complex, including taxiways and ramps, are designed to support safety and security for both the surrounding environment and personnel/equipment involved in aviation operations. Hazard barriers and controls exist for both people and equipment throughout the LaRC facilities to minimize the probability of unexpected or unmanaged exposure to risk. Only authorized (trained and/or oriented) personnel are allowed in critical areas of the facilities, and operations permitted or prohibited are documented throughout the aviation policy manuals of the Center. Specific facility safety guidance is available in LPR 1740.3.

3.11.2 This document, the Intra-Governmental Support Agreement between JBLE and LaRC, LMS-TD-0940, the Facility 1244 Security Plan, and all applicable Center institutional/occupational health and safety policies and regulations address facilities safety issues. Included are: routine preventive services for day-to-day operations and participation

with LaRC aviation personnel in training exercises, education programs developed by the Chief of Flight Operations, the Aviation Safety Officer, and/or the Research Systems Integration Branch Head.

3.11.3 In addition to the Facility 1244 complex, the LaRC Fire Station (staffed by the Hampton Fire Department) and the JBLE Fire Station provide facilities and equipment for crash/fire/rescue emergency situations. They are on call 24 hours per day, and can use the *Aircraft Crash Fire Rescue Handbook*, created and maintained by the Aviation Safety Officer, as the primary source of technical and emergency data for each aircraft assigned to LaRC.

3.12 PHYSICAL SECURITY OF AIRCRAFT

3.12.1 Aircraft shall be provided physical security at all times.

3.12.1.1 When at NASA facilities, the aircraft shall normally be hangared. NASA security personnel shall monitor aircraft on a routine basis when the aircraft is not inside a hangar.

3.12.1.2 When away from LaRC, the aircraft pilot-in-command shall coordinate with the local fixed base operator/local law enforcement/military security, as appropriate, for the physical security of the aircraft to minimize opportunities for damage, sabotage, or theft of equipment. Additional guidance is available in NPR 1620.3.

3.12.1.3 International operations require extra vigilance and pre-planning to ensure adequate physical security for NASA aircraft. Consultation with HQ, embassy/consulate, NASA Counter Intelligence office, Foreign Clearance Guide, State Department advisories, and /or military authorities shall be pursued prior to embarking on an international assignment.

4. FLIGHT OPERATIONS

4.0.1 General Operating Rules - All aircraft operations, including sUAS, shall be conducted in accordance with all applicable FAR, local and national laws, manufacturer's aircraft manuals, TOs and NATOPS manuals, NASA regulations and policies, and the requirements of this document. Aircraft shall be operated in an airworthy condition at all times, in accordance with NPR 7900.3 and this document. Aviation personnel are expected to utilize sound conservative judgment in their approach to their duties. Safe, effective research flight operations is the primary objective of RSD.

4.0.2 The flight operations at LaRC are to be conducted in the following categories as set forth in NPR 7900.3:

a. Research Operations

(1) Flight research

(2) Simulator support

b. Program Support operations

(1) Transportation of support equipment &personnel

(2) Aerial photography

(3) Safety & photo chase

(4) Currency/proficiency/training

(5) Maintenance test/ Functional Check Flights (FCF)

(6) Miscellaneous flight activities

c. Emergency and humanitarian operations

4.0.3 Equipage

All LaRC aircraft shall be equipped with the radio navigation and communications equipment required for the airspace and types of flights being conducted. In most cases, such equipment shall be the minimum required by the Federal Aviation Regulations for operation in the National Airspace System. Appropriate FCC aircraft radio licenses shall be obtained for the operations anticipated. International operations require compliance with ICAO regulations and the requirements of the host country.

TCAS/GPWS/TAWS equipment is to be installed in all aircraft, if feasible.

When commercial aircraft services (CAS) are utilized, TCAS/GPWS/TAWS shall be installed in such aircraft. Waivers to this requirement shall be referred to NASA HQ.

4.1 **MISSION CLASSIFICATION**

All aircraft assigned to LaRC may be used for either research or program support missions. Normally configuration as a research aircraft does not preclude additional assignment of the aircraft in a support mission capacity.

4.1.1 Additionally, LaRC missions are classified as research or program support.

Generally, these aircraft are operated as "public use aircraft" according to 14 CFR Parts 1 and 91. When operations are conducted under the "Public Aircraft" classification, no passengers may be carried. The only persons authorized to fly aboard an aircraft when in "Public Aircraft" status, are qualified crew members and qualified non-crewmembers. Qualified crewmembers are those required for the operation and safe conduct of the flight. Normally qualified non-crewmembers consist of research or other technical personnel flying in support of a project or program.

4.1.2 Research Missions – Research missions primarily use the aircraft for research purposes directly related to data collection. These aircraft may have modifications to the primary structure, control systems, engines, and/or basic aerodynamics subject to airworthiness process approval.

4.1.3 Program Support Missions - Program support missions use the aircraft to carry personnel or equipment, proficiency flying, or other similar role.

a. Program support aircraft may have research modifications, provided these modifications are documented and are airworthy.

b. Program support aircraft may be used to support any program and may carry research personnel who are qualified non-crewmembers. When a program support aircraft is used in connection with a pilot's official travel, the incidental carriage of qualified non-crewmembers who have a need to travel on official business for a research program to the same or nearby locations is permitted.

4.1.4 Commercial Aircraft Services (CAS) - Use of commercially provided aircraft is authorized with required oversight by RSD. Non-NASA owned aircraft evolutions are also considered to be in a "Public Use" status during NASA operations and, therefore, are subject to NASA airworthiness guidelines. All such operations shall be coordinated with the applicable contracting officer for compliance with this requirement for NASA aviation oversight. NPR 7900.3 provides additional guidance.

4.2 **GENERAL FLIGHT OPERATIONS, CLEARANCE, AND SCHEDULING**

4.2.1 The applicable portions of the general operating and flight rules of Federal Aviation Regulation Part 91 shall apply to the operation of LaRC aircraft. Other federal regulations and guidelines concerning the operation of public aircraft shall also apply, as appropriate. When operating in military airspace or at military installations, applicable military regulations shall be followed. All aircraft entering or departing LaRC, whether transient or assigned, are bound by the requirements of LAFB Instruction 11-250, Airfield Base Operations and Base Flying Procedures. When aircraft are operated internationally, operations shall be conducted in

compliance with FAA, ICAO, and host country guidance. NASA aircraft are designated by the U.S. State Department as "State Aircraft" for ICAO purposes. This is equivalent to military aircraft for operational purposes. Appropriate guidance for international operations is available in the USAF Foreign Clearance Guide (FCG). See Appendix A.

4.2.2 LaRC aircraft shall be operated in compliance with approved Airplane Flight Manuals/Pilots Operating Handbooks/Technical Orders/NATOPS manuals, as appropriate. Aircraft modified for research shall be operated within the approved flight envelope determined by the formal review process, including ER-ARB Flight Safety Release constraints. Performance calculations and limitations shall be taken into consideration, along with meteorological and air density performance factors, prior to flight.

4.2.3 Responsibilities - Organizations requiring the use of RSD personnel or facilities, including research and support aircraft and research pilots, shall schedule their use through appropriate RSD processes.

a. Prior to implementation, the RSD Director shall approve all programmatic schedule commitments and any significant changes to commitments.

b. RSD employees are encouraged to participate fully in project planning and coordination, including the determination of windows of opportunities for flights. However, individual employees are not authorized to schedule, reschedule, postpone, or cancel flights without appropriate concurrence.

4.2.4 Scheduling - The Research Services Directorate Aircraft Operations and Engineering Branch shall publish flight schedules. Currency and qualifications shall be consulted prior to assignment of flight crew personnel to particular missions.

4.2.5 Communications

4.2.5.1 Aircraft shall maintain communications with ground stations as required by the FARs, ICAO, and other competent authority.

4.2.5.2 "Sterile cockpit" procedures shall be in effect below 10,000 feet AGL. Only essential conversation shall be used below 10,000 feet AGL. These essential conversations are normally required only during maintenance functional check flights, research, and for approach briefings.

For missions that collect data below 10,000', the sterile cockpit procedures are in effect within 10 NM of the landing airfield or conclusion of the research portion whichever occurs first.

4.3 **FLIGHT APPROVALS**

4.3.1 General - All flights of LaRC aircraft shall be approved by the CFO, Chief Pilot, or designee. Pilots shall only be assigned to flights for which they are properly designated for their assigned crew position and who meet the currency requirements for the scheduled flight operation. NAMIS and other flight currency data shall be consulted prior to assignment of flight crew personnel to particular missions.

4.3.2 Manifesting and Boarding Authority - Boarding authorization is required for every person flying on a LaRC aircraft. In addition, LaRC personnel traveling aboard non-LaRC (non-commercial) aircraft shall have a boarding authorization. This may be accomplished by CFO approval of travel orders. However, in the absence of CFO-approved travel orders, a normal boarding authorization shall be accomplished. A manifest shall be kept of all QNCs aboard an aircraft.

b. The CFO (or designee) is responsible for ensuring that each person listed on the manifest has appropriate boarding authority. The PIC is responsible for assuring that all persons boarding LaRC aircraft are listed on the manifest.

c. It is the responsibility of each PIC to ensure that a safety briefing is provided to personnel flying on LaRC aircraft prior to takeoff on all flights. For research operations with the same personnel as previous flights, any changes to routine operations shall be briefed.

d. The CFO shall ensure records are maintained for all crewmembers with documentation of boarding authority issuance.

4.3.3 Publication of the flight schedule from the AOEB BH or Chief Pilot constitutes flight approval. Certain flights require higher approval authority. The AOEB BH shall seek approval and annotate that permission via the flight schedule.

Flight Type	Approver
CFP	CFO
FCF	CFO, ADFO
Initial Training Flight	CFO, ADFO, Chief Pilot
ICF	CFO, ADFO, Chief Pilot, AOEB Branch Head
Project Flight	CFO, ADFO, Chief Pilot, AOEB Branch Head
Proficiency Flight	CFO, ADFO, Chief Pilot, AOEB Branch Head

FRR/ORR signature is direct approval to conduct those research flights. Additional approval is not required for multiple flights during the duration of the approval.

In addition to the flight approvals described above, LMS-CP-0905 requires that any person boarding a LaRC aircraft have approval from their supervisor for that specific flight. An email or other documentation from the supervisor suffices for this requirement.

NOTE: The issuance of supervisory-approved, trip-specific travel orders covering flight by LaRC civil servants or affiliated contractors aboard LaRC aircraft shall be recognized as meeting this supervisory approval requirement.

NOTE: In any event that would normally meet approval criteria, where compliance with these procedures may unusually delay a response in such a way as to risk loss of life or extensive injury, the PIC shall exercise his/her judgment and proceed accordingly. In this event, every

effort shall be made, as expeditiously as the situation permits, to obtain the required approvals and make the required notifications.

4.3.4.1 Changes to Flight Approvals - Non-substantive changes to requested flights, such as changes in the date and time, may be made without renewal of supervisory approvals.

4.3.4.2 Changes during Flight - Mission requests received while in flight by senior staff individuals shall be complied with by the PIC using his/her best judgment. When crews receive requests for missions or a change to a mission requiring approval beyond the PIC's authority and original mission approval, while in flight, and mission circumstances do not render landing advisable, the appropriate approvals and notifications shall be accomplished by radio or via satellite phone. If this is not possible, the PIC shall notify the CFO, ADFO or Chief Pilot as soon as feasible. Any deviation shall conform with approved ORR/FRR permissions and within the approved envelope of the aircraft.

4.3.5 Mission Support Flights – Mission support flights are normally approved flight by flight.

4.4 RELEASE OF AIRCRAFT

4.4.1 General - LaRC aircraft shall be flown only after being released by authorized personnel in maintenance. Discrepancy corrective action shall be exercised only by persons designated by the RSIB Branch Head. The discrepancy clearing official shall have had at least six months maintenance experience within the last 24 months in order to clear an aircraft discrepancy. Releasing officials shall receive recurrent training, which may include on-the-job training, at least once every 24 months on the aircraft for which they are authorized to perform maintenance. The PIC accepts responsibility for the aircraft after release by initialing the LF 115, Aircraft Operational Report or the NAMIS Flight Preparedness Report, as applicable.

4.4.2 Required Documents – If NAMIS internet access is unavailable for flight release, an LF 115 shall be signed and dated, releasing the aircraft for flight in accordance with LMS-TD-0940, General Aircraft Maintenance Manual procedures and this document. Additionally, all completed LF 781 forms or equivalent NAMIS documentation for the aircraft shall be available for pilot review prior to flight. When NAMIS access becomes available, the data contained in the hard copy forms shall be transcribed and entered into the NAMIS database.

4.4.3 Pilot Review - Pilots shall review the discrepancies listed on the Flight Preparedness Report, or other available documents, prior to acceptance of the aircraft for flight. When possible, the crew chief or other knowledgeable supervisor shall review the form with the pilot. When the pilot is satisfied that he or she fully understands the condition and status of the aircraft, acceptance of the aircraft is accomplished by initialing the Flight Preparedness Report, or if not available, on the Form LF 115.

4.4.4 Aircrew members shall evaluate the conditions expected with regard to the execution of a flight evolution through an active Operational Risk Management/Safety Risk Management process. A go/no-go decision by the PIC shall be the outcome of this review process. All aircrew shall be familiar with applying ORM. See Appendix B for more detail.

4.4.5 AIRCRAFT MINIMUM EQUIPMENT LIST

Each aircraft shall have an MEL. RSD shall follow Part 91 rules which removes the Time To Repair constraint. However, Time To Repair listed in the MEL may lend credence to repairing as rapidly as possible, but is not the determination whether the aircraft is up or down. If the aircraft cannot be repaired in a timely manner because of the nature of on-going flight operations (e.g. remote location), the RSIB BH (or designee) shall present the repair plan to the CFO. When multiple discrepancies are present, the PIC shall present a mitigation plan to the ADFO/CFO for approval prior to subsequent flight activity. An open discrepancy review shall be accomplished during the FRR/ORR process pertaining to germane discrepancies that may affect aircraft performance or rule compliance.

4.5 FLIGHT PLANNING

4.5.1 General - The Pilot in Command (PIC) of each LaRC aircraft flight is responsible for assuring that all appropriate authorities are notified concerning planned operations of LaRC aircraft. The PIC is also responsible for the operation of LaRC aircraft in accordance with clearances received from these authorities.

4.5.2 Weather - The PIC is responsible for obtaining a thorough weather briefing prior to flight. Determination of forecasted hindrances to flight along the proposed route shall be utilized to optimize the operation with avoidance of severe weather as the main priority. Such information as the location of frontal weather activity, tornadic or hurricane locations, wind forecasts, turbulence, areas of IFR visibility and ceilings, and icing associated with altitude selection and cold weather shall be obtained. Aircraft are to be operated into known icing conditions only if they are so equipped and certified for the operation. Selection of alternate airports requires adequate fuel reserves in the event of unexpected weather activity, including reduction in visibility and ceilings while enroute. Pilots are encouraged to utilize Flight Service, Flight Watch, and military Metro services. PICs shall remain focused on the impact of weather conditions throughout the flight on the safety and security of the aircraft and its occupants. Additionally, weather conditions shall be considered in order to provide for safe ground operations and adequate overnight security of the aircraft. Hangar usage is recommended if available.

4.5.3 WEATHER MINIMUMS

4.5.3.1 Basic weather minima apply for all flights. FRR/ORR may designate higher weather minima based on configuration or other criteria. Careful attention needs to be paid when specifying VMC criteria for research, such as 3,000 feet of clear air and a defined horizon. Currency requirements listed in NPR 7900 may increase approach minima based on flight hours.

4.5.3.2 Special Minimums – The Chief Pilot, (or the CFO or the ASO in the case of aircraft operated by the Chief Pilot) may specify temporary higher minimums for pilots transitioning to new aircraft when deemed necessary for safe flight operations. When such special minimums apply, they shall be documented on the pilot's checkout form for that aircraft along with conditions for their removal.

4.5.3.3 RVR only approaches – When an approach only lists RVR for weather minima, the approach shall be NLT 2400 RVR (or approach minimum, whichever is higher) unless operative touchdown zone and centerline lights are available. If these are available, the approach may be flown down to 1800 RVR (or approach minimum, whichever is higher).

4.5.3.4 Alternate weather Minima

Normally the FAA minima of 600 foot ceiling/2 miles visibility for precision approaches or 800 foot ceiling/2 miles visibility for non-precision approaches apply. In the event that the approach minima in use are above the FAA minima, precision minima plus 200/½ or non-precision minima plus 300/1 shall be applied. For LaRC aircraft operations, LPV approaches may be considered a precision approach for weather minima determination and flight logging.

4.5.4 Local flights

4.5.4.1 IFR Operations – IFR operations are to be used to the maximum extent practical.

4.5.4.2 VFR Operations – VFR operations may be used at the discretion of the PIC. The use of VFR flight following is strongly recommended. LAFB/JBLE anti-hijacking procedures are to be followed.

4.5.4.3 Flight Monitoring – The FRR or ORR may specify mandatory flight monitoring. When the PIC determine flight monitoring is necessary, FOSC or alternate means (ADS-B out) tracking shall be performed.

4.5.5 International Flight Planning – Refer to Section 4.18 and Appendix A.

4.5.6 Fuel Planning

Normally, 5% is added to fuel calculations from the performance charts or known fuel flows (e.g. G-III with doors) for determining fuel burn in flight during flight planning.

Fuel minimums for each aircraft (which meet or exceed 45 minute holding at 10,000 feet) are as follows:

Aircraft	Fuel Minimum
SR-22 / LC-40	10 gal
B-200 / UC-12	350 lbs
HU-25	1500 lbs
G-III / G-IV	3000 lbs

These fuel minima are the no less than expected land fuel amounts, including if diverting to a planned alternate.

4.5.7 Crosswind Limitations

Aircraft	Crosswind Limitation*
SR-22 / LC-40	20 knots
B-200 / UC-12	25 knots
HU-25	25 knots
G-III	21/30 knots#
G-IV	24 knots

*Crosswind limitations are absolute limits. PIC/SIC designations may result in reduced crosswind limits. Aircraft POH may also introduce additional limits based on runway condition.

Crosswind limitation is 21 knots until 100 hours of non-simulator flight time and 20 non-simulator landings are achieved.

4.5.8 Remote Fuel and Weather Minima

During remote operations where flight to a divert airfield is not feasible, additional fuel and weather limits are in effect. These additional limits are in case the weather deteriorates or, in the event of an accident that closes the runway for a period of time.

Fuel Minima

	Single Runway	Dual Runway
Weather > 2000’ and 3 NM	1+15 fuel reserve	1+00 fuel reserve
Weather between 600/2 (800/2 if non precision only approach) and 2000/3	1+30 fuel reserve	1+15 fuel reserve
Weather below 600/2 (800/2 if non precision only approach available)	Departures to another airfield authorized if takeoff field is above approach minima	Departures to another airfield authorized if takeoff field is above approach minima

Additional requirements of the remote airfield are: destination must have TAF forecasts and valid from 1 hour before to 2 hours after the planned time of arrival; approach NAVAIDs that are monitored or more than one approach must exist (e.g. ILS and VOR, VOR and GPS, etc.); destination IAP does not specify RADAR REQUIRED; destination IAP cannot have ANA as an icon on approach plate.

In the event the approach minima are higher than those listed above, refer to paragraph 4.5.3.5.

4.5.9 Minimum Runway Length/Width

For normal operations, the following minimum runway lengths and widths are in effect:

Aircraft	Min Runway Length*	Min Runway Width*
C-206B	2500’	50’
LC-40/SR-22	3000’	50’
UC-12/B-200	4500’	75’
HU-25	6000’	100’
G-III / G-IV	6000’	150’

*Even though the POH may indicate a shorter runway may be used, a waiver from the ADFO is necessary to land on or takeoff from a runway that is shorter or narrower than listed above. Performance charts/calculations may indicate a longer runway is necessary.

4.6 FLIGHT LOCATING ACTIONS

4.6.1 Flight Crew Actions - The PIC shall ensure that during critical local flight operations (designated during FRR/ORR process) the FOSC is kept aware of the location of the aircraft by monitoring local metro frequency when possible and in range. AOEB is chartered with staffing the FOSC during critical local flight operations.

4.6.2 Operations Action/Late or Missing Aircraft.

4.6.2.1 These flight locating procedures are to ensure the safety of the crews. If an aircraft is late or missing, the Chief Pilot is responsible to ensure that appropriate aircraft search and rescue procedures are initiated.

4.6.2.2 A flight shall be considered overdue when a planned landing is not made at the destination airport and communications with the flight crew are lost. In the event of an overdue aircraft, the Chief Pilot or person delegated that responsibility shall notify the following:

a. CFO

b. RSIB Head

c. ASO

d. ATC/FSS

e. Local airports where the aircraft may be expected to land.

4.6.2.3 If the aircraft or crew is not located following the above notifications, personnel shall institute the appropriate Missing Aircraft actions.

4.7 EMERGENCIES

4.7.1 Under any flight emergency condition, the PIC is responsible for the successful completion of the flight. He/she is in full and complete command and all personnel shall execute his/her orders precisely. The PIC is the final authority in any decisions concerning actions to be taken, however, consideration shall be given to recommendations given by ATC and/or other sources.

4.7.2 In an emergency involving the safety of persons or property, the PIC may deviate from prescribed procedures, methods, weather minimums, and regulations in the interest of safety.

4.7.3 If a PIC decides that an emergency condition exists during the flight, when appropriate, he/she shall contact an Air Traffic Facility and advise them of the problem and request any needed assistance. Declaration of an emergency is advised when the aircraft or crew is in potential jeopardy. PICs shall ensure that assistance from emergency sources is requested and that communication is maintained with ATC facilities concerning the emergency status, if possible.

4.7.4 The PIC is the final authority regarding the sequence and manner in which crewmembers accomplish procedures. All crew members shall be thoroughly familiar with all emergency procedures and their specific duty assignments. Crew members shall accomplish from memory the specific immediate action items specified for their station and shall be familiar with other crewmembers assigned duties. Each crewmember shall be prepared to perform their assigned emergency duties including possible evacuation duties

4.7.5 Each PIC who deviates from a rule during an in-flight emergency requiring immediate action shall communicate the circumstances to the Chief Pilot and CFO. If a request is issued through official channels concerning the incident, the PIC shall, with the consent of the CFO, send a written report of that deviation to the FAA Administrator or designated FAA offices. It is also important that an exact account of the problem be stated and relayed to the ASO for proper report generation.

4.7.6. The PIC shall have responsibility to respond to an inflight medical emergency or incapacitation in an expeditious manner. Assistance from ATC facilities for flight diversion to a location with emergency medical services shall be requested, if appropriate. A request for ambulance service to meet the aircraft on arrival is highly recommended. Declaration of an emergency in order to receive expeditious handling is also recommended.

4.7.7 No employee, regardless of involvement in an emergency situation, is authorized to make statements to the general public or to newsgathering agencies without the knowledge and consent of the Agency. Public Affairs personnel shall be consulted for further guidance.

4.7.8 Pilots are advised to take advantage of the NASA Aviation Safety Reporting System (ASRS) and Incident Reporting Identification System (IRIS), as appropriate. The Aviation Safety Officer can provide further guidance and information.

4.8 FLYING AREAS

4.8.1 Research flights and aerobatic flights shall be conducted, to the extent possible, in light traffic areas away from federal airways. When the flight plan requires high speed maneuvering or significant pilot attention inside the cockpit, the use of special use airspace or safety chase or both is encouraged. Where available, and when consistent with mission objectives, radar advisories shall be utilized.

4.9 FORMATION FLYING

4.9.1 Some research support missions, such as safety/photo chase and paced airspeed calibrations, require formation flying. Formation flying practice by qualified pilots in compatible aircraft is permitted.

a. Formation flying shall be planned in advance, including a thorough preflight briefing between the pilots involved.

b. Impromptu formation flying only for flight test or safety purposes also shall be permitted when both pilots agree and coordination of the flight can be accomplished via radio prior to join up. Under no circumstances shall a LaRC pilot join up with another aircraft without the other pilot's knowledge and consent. Which aircraft is the formation lead shall be specified.

c. Formation takeoffs and landings are authorized for no more than two compatible aircraft. Pilots shall have documented formation experience prior to being considered for formation flight clearance. Documented experience may be from previous training or may be obtained in-house from a qualified IP. Section takeoffs (i.e. simultaneous takeoff) with LaRC aircraft are prohibited unless allowed via ORR/FRR process.

d. Qualification for formation flying, along with any limitations, shall be determined by the Chief Pilot and documented in the pilot's training folder.

4.10 AEROBATIC FLYING

4.10.1 Aerobatic flying is authorized for qualified pilots in aircraft approved for aerobatics by their type certificate or approved flight manual.

a. All limitations set forth in the flight manual, or those established by the ER-ARB, in the case of particular research missions, shall be strictly obeyed.

b. All aerobatic flying shall be accomplished in low-density airspace outside federal airways.

c. Flight visibility shall be at least 5 statute miles.

d. Parachutes shall be available for all occupants.

e. Qualification may be obtained from prior military service or approved training curricula. Aerobatics qualification shall be documented and retained on record.

4.11 ROTARY WING OPERATIONS

N/A

4.12 OVERWATER OPERATIONS

4.12.1 All occupants of aircraft shall carry personal flotation devices.

a. Life rafts shall be placed onboard aircraft operating out of gliding distance of land.

b. For surface sea temperatures at or below 50 deg F or surface air temperature at or below 32 deg F (wind chill corrected):

- If operating below 10,000 feet and out of gliding distance to land, drysuits shall be worn by aircrew. Quick donning drysuits shall be readily available for all QNCs on aircraft.
- If operating above 10,000 feet and outside of gliding distance to land, drysuits shall be available for all aircrew and QNCs.
    - If the aircraft is considered too cramped (as determined by PIC) as to prevent the donning of the drysuits, aircrew shall wear drysuits.
- Gliding distance to land is for research or transit operations. Lower altitudes, such as those flown during an approach to land, do not violate the above policy.

4.12.2 Extended overwater operations require thorough preflight planning with regard to weather, contingencies, equal-time-point calculations, and required navigation and communication equipment for the mission. PICs shall ensure that alternates are planned as necessary with regard to weather, fuel, runway length, customs, and other support facilities.

4.13 INSTRUMENT OPERATIONS

4.13.1 Approach and Landing Minimums under IFR

Each pilot making an IFR takeoff, approach, or landing at an airport (domestic or foreign) shall comply with the applicable instrument approach and weather minimums published for that facility. If during an instrument approach that utilizes Runway Visual Range (RVR) for landing visibility and the RVR is reported to be below the required minimums before the aircraft has passed the final approach fix (FAF), the approach shall be abandoned and a missed approach shall be executed. If the aircraft is inside of the final approach fix (FAF) when the RVR is reported to have gone below minimum conditions, the pilot may continue the approach to decision height (DH), decision altitude (DA) or minimum descent altitude (MDA). At airports where weather services are not available, the approach may be initiated and a landing executed if, when reaching the MDA, DA or DH, the weather is found to be at or greater than that specified for the approach. Continuation of an approach to landing shall be in compliance with FAR Part 91 regulations.

4.13.2 Circling Approaches

Extra care shall be exercised in the execution of circling approaches in IFR conditions. Consideration shall be given to other options, such as straight-in approaches to other runways, if available. If a circling approach is required, utilization of higher category minimums may be used if the visibility and ceiling support such use. Circling categories are based on the certificated maximum gross landing weight of the aircraft, not on the current gross weight of the aircraft at the time of the approach. Utilization of minima of categories lower than the certificated category are not authorized. However, higher Categories may be used if deemed prudent by the PIC. Circling approaches in the vicinity of high terrain or other obstacles shall be avoided. Some international airports' circling minimums are ill-defined and are not recommended to be used. It is recommended that operations into such locations be thoroughly pre-briefed prior to flight and all contingencies considered.

4.13.3 Braking Action Requirements

A braking action report shall be evaluated with regard to its source, timeliness and changes to be expected with fluctuations in temperature. The reported braking action shall be better than nil. Braking action reports of "fair or poor" are acceptable if the runway is into the wind and equals or exceeds the landing field requirement or the balanced field length requirement as defined in the AFM/POH. Extreme caution shall be exercised under these conditions. The PIC's judgment shall always be the determining factor.

4.14 FLIGHT PROFILES

4.14.1 Functional Check Flights (FCF)

When maintenance parameters require a particular aircraft to be flown on a Functional Check Flight (FCF), the pilot-in-command (PIC) shall be designated in writing as a Functional Check Flight (FCF) pilot for the type of aircraft involved. Normally, FCFs are conducted with the minimum crew complement necessary to properly conduct and document the check flight.

4.14.1.1. Conduct of FCF. FCFs shall be conducted in VMC conditions for any items requiring engine shutdown, propeller feathering, stalls, unusual flight maneuvers, high speed descent, or effects of installation of electronics equipment that could interfere with flight instruments. Also prior to the use of unchecked or unproven flight instruments or similar situations in IMC conditions, the instruments shall have been checked in VMC conditions. Once all flight checks requiring VMC conditions are completed and all flight instruments are cleared for proper operation while operating under VMC, IMC flight may be utilized, if necessary, to proceed to an area allowing for additional checks of ancillary equipment. Normally, functional check flights shall be conducted utilizing published approved checklists for the type aircraft. These may be provided from manufacturers, military sources, or locally developed and approved by the Chief Pilot.

4.14.2 Instrument Check Flights (ICF)

Instrument Check Flights are conducted in support of research missions upon upload and integration of research equipment to an aircraft in order to confirm proper operation of research equipment, as installed. Before an ICF may be conducted, airworthiness approval and a signed FRR/ORR shall be obtained. ICFs are classified as research flights and, therefore, shall be flown in compliance with the applicable configuration and research limitations.

ICFs may be flown by a properly designated PIC, qualified in the particular type of aircraft. Qualified non-crewmembers may participate in these flights, as necessary.

4.14.3 Compatibility Flight Profile (CFP) Flights

CFPs are flown in the event that changes made during the install or de-install of a research system may affect the flying qualities, performance, pitot-static or airworthiness of aircraft. These flights are normally considered test flights in the purest sense and require test point approval from the CFO. Care must be taken to conduct these flights using standard build up techniques and higher risk mindset. An FRR is normally required to conduct a CFP. CFPs may

be flown by a properly designated PIC, qualified in that particular type of aircraft. QNCs are not permitted on a CFP unless specifically authorized by the CFO. Day VMC is normally required for CFPs. Transit through a layer to conduct the CFP is authorized if chased or the modification to the aircraft is not assessed to affect flying qualities (Chief Pilot approval).

4.14.4 Electromagnetic Interference (EMI)/Electromagnetic Compatibility (EMC) Flights

EMI/EMC flights are normally conducted in conjunction with an ICF to determine that the installed research system does not affect aircraft systems and, conversely, that the aircraft systems do not affect the installed research equipment. Day VMC is normally required until the equipment used for an instrument approach is fully checked out. If the first flight is schedule to be at night, night VMC is acceptable. If GPS approach equipped, an ILS/VOR checkout is desired, but not required for entry into IMC provided GPS if functioning correctly.

4.15 RECORDS AND LOGS

4.15.1 At the completion of each flight in a LaRC aircraft, the PIC shall log all flight time for each pilot for each duty condition, including numbers and types of landings and approaches. NAMIS Form 1672A "Aircrew Flight Form" shall be used for this purpose. Form 1672A shall be completed in accordance with the following procedures:

a. A separate Form 1672A shall be completed for each day for each aircraft.

b. A separate form 1672A shall be completed for the originating date of operation. Time zones shall be based on the location of the originating flight.

c. Pilot and QNC names shall be entered on the form.

d. The sum of all time in each pilot category (PIC, Second-in-command (SIC), Instructor Pilot (IP)) shall equal the total flight time for each leg (i.e., the sum of all PIC times for all pilots flying on a leg shall equal the total flight time for that leg). Flight time as a Check Airman shall be logged as IP time in NAMIS.

e. SIC time may be logged anytime when flying as a copilot when a SIC is required by the aircraft's type certification, or when a SIC is required by the rules under which the flight is operated. SIC time may be logged in LaRC B-200 and UC-12 aircraft.

f. Instrument approaches shall be accompanied by the logging of actual or simulated instrument time.

g. Complementary duty conditions shall add up to the total flight time for each leg (i.e., day plus night times shall add up to total leg time).

h. Duty conditions that are not complementary, such as instrument or simulated instrument times, cannot exceed the total leg time.

i. If an individual log is not kept, pilots are encouraged to record supplementary data, such as specific approaches flown, emergency procedures practiced, etc. in the "Remarks" column.

j. Flight time logged in FAA- approved training simulators shall be reported on a Form 1672A in order for any of the time or maneuvers to be credited against currency requirements of NAMIS.

k. Flight time in simulators not approved by the FAA, or training devices such as desktop simulators, may not be credited against any of the currency requirements of this part.

l. In the event that access to NAMIS is unavailable, flight time may be logged in a hard copy format for transcription into the NAMIS database as soon as practical.

m. Aircraft discrepancies are to be entered on Form 1672A. FCF and Ops Check sign offs are also required.

4.16 AIRCRAFT SERVICING

4.16.1 Fueling of aircraft with persons on board is not normally performed, but is allowed IAW NPR 7900. Additional restrictions from the airworthiness approval or FRR/ORR may be in effect.

4.16.2 An aircraft shall be serviced only with approved fuels, fluids, oxygen, and other consumables as prescribed by the manufacturer or the AFM/POH. Exceptions are to be approved for research purposes through ER-ARB and/or RSD processes prior to use of experimental substances, such as new fuel types, in aircraft. Consideration shall be given to the long-term impact of the use of such materials on the safety and continued operational life of the aircraft and its associated components.

4.17 INTERNATIONAL OPERATIONS

4.17.1 Advanced planning is the key to successful foreign operations, and lead times of at least three to six months may be required of some flights. It is the joint responsibility of RSD management and the Pilot in Command to ensure the success of the trip. The Aircraft Operations and Engineering Branch shall provide coordination for planning and conduct of all international operations.

4.17.2 Items to be taken into account before an international flight include, but are not limited to:

a. Route planning and flight information documents, including charts.

b. Personal documentation, including passports, visas, medical certificates, immunization records, and pilot certificates.

c. Foreign travel briefings.

d. Air crew training and certification for the airspace types (i.e., MNPS, RVSM, RNP, etc.) and for the anticipated countries of operation.

e. Communications equipment availability for theater of operation.

f. Foreign Clearance Guide (FCG) compliance.

g. Aircraft documentation, including certificates of airworthiness, registration, aircraft radio license, and noise certificates. Also included are MNPS, RVSM, RNP, CPDLC, ADS-B, etc. required certifications for the aircraft in the areas of operation.

h. Landing and overflight permits coordinated through NASA HQ.

i. Customs arrangements, including eAPIS reports (if required).

j. Aircraft handling agents, if desired.

k. Foreign user charges/fees.

l. Fuel and other consumables availability and quality.

m. Payment methods available

n. Aircraft incident/mishap preparation per LMS-OP-0939, ICAO Annex 13, and the FCG.

o. Special survival equipment requirements for the area of operation.

p. Coordination with the Export Control Office (researchers are required to achieve export control permissions for their equipment)

4.17.3 NASA aircraft are operated as ICAO "State Aircraft" per NPR 7900.3 during international operations. This is the same status under which military aircraft operate. Therefore, all international operations of LaRC aircraft shall comply with the Foreign Clearance Guide and appropriate DoD Flight Information Publication (FLIP) guidance. This status has been granted by the U.S. State Department, but is not universally recognized by foreign entities. Therefore, NASA aircraft and crews may be categorized as "civil" or "private" aircraft in some foreign locations. This may subject the crews to ramp checks for compliance with local or ICAO regulations, leading potentially to fines and mission delays. Crews shall make appropriate contingency plans for such possible mission impacts. Additional details regarding international flight operations can be found in Appendix A.

4.17.3.1 Diplomatic clearances shall be obtained prior to operations into foreign controlled airspace. NASA HQ shall arrange for all diplomatic clearances.

4.17.3.2 Current Reduced Vertical Separation Minimums (RVSM), Minimum Navigation Performance Standards (MNPS), and Required Navigation Performance (RNP) procedures and standards shall be reviewed prior to flight. If these standards cannot be maintained during a proposed flight operation, then prior coordination and permission shall be obtained for operation in RVSM airspace with non-compliant equipment before initiating flight into that area.

4.17.4 Customs and Border Protection (CBP) designates non-military aircraft entering the United States as either "Commercial" or "Private" aircraft for customs purposes. NASA aircraft are considered to be "Private" aircraft for these purposes, since they are not operated or owned by a licensed air carrier. Therefore, CBP entry requirements for customs, eAPIS, immigration, and agriculture apply to all NASA aircraft and air crew. Information concerning compliance is

summarized in Appendix B. It is essential that these procedures are rigorously followed. Additional information and clarification of these rules are available at www.cbp.gov.

4.18 FAA ENFORCEMENT ACTIONS AND REGULATORY VIOLATIONS

4.18.1 Any employee who is informed of an FAA violation, potential violation, or investigation being opened on an action in which they have been involved shall report the circumstances to the Chief Pilot as soon as possible. This notification shall include a detailed written record of the circumstances. The Chief Pilot and CFO shall investigate the incident to determine the facts associated with the event. Legal assistance may be provided to an employee who has acted in good faith and in the best interest of the Agency.

4.18.2 The Chief Pilot shall coordinate with the FAA, military, and NASA HQ, as necessary, to resolve such issues. The Aviation Safety Officer shall be informed as to the resolution of the issue.

4.18.3 Pilots are advised to take advantage of the NASA Aviation Safety Reporting System (ASRS) and IRIS, as appropriate. The Aviation Safety Officer can provide further guidance and information.

4.19 NOISE ABATEMENTPOLICY AND PROCEDURES

4.19.1 Policy. The objective of NASA is to minimize community-perceived noise caused by aircraft by emphasizing crew awareness and exercising noise-abatement operating techniques. Benefits of an effective noise abatement policy include:

a. Improved community relations.

b. Eased operational approvals.

c. Self-regulation.

d. Compliance with noise abatement ordinances and regulations.

4.19.2 Noise Abatement Implementation. The policy is to minimize noise disturbance as a result of LaRC flight operations. Noise Abatement Implementation includes:

a. Altitude - Fly the highest practical altitude, increase at night.

b. When possible, fly over the least populated areas.

c. Avoid sharp maneuvers.

d. Use high takeoff and approach profiles.

e. Vary yourroute - avoid repetition.

f. Avoid known noise sensitive areas where possible.

g. Follow published noise abatement procedures, if available, consistent with safety, including airport curfews.

h. Comply with host country noise abatement regulations when in international airspace.

4.19.3 Citizen Complaints. Each pilot shall be familiar with the noise abatement policy. This will assist in dealing with citizen inquiries and complaints. A significant number can be prevented if given sensitivity, foresight and commitment.

a. Upon receiving a noise complaint from a citizen, the employee shall refer the complainant to the CFO.

4.19.4 Noise certificates.

Large and turbojet-powered aircraft are issued noise certificates as part of their type certification. Availability of a copy of a noise certificate issued by the FAA is a requirement for operation in some jurisdictions, especially in Europe.

4.19.5 Gulfstream Operations

Operations out of LAFB do not require the use of the noise-reduced departure. Operations outside of LAFB need to be aware of airport restrictions and may require implementation of the noise-reduced takeoff procedure. The Flaps 0 takeoff procedure shall not be conducted unless approved by the Chief Pilot.

4.20 AIRCREW QUALIFICATIONS

4.20.1 The Chief Pilot shall recommend flight qualifications of the assigned pilots to the CFO for approval.

4.20.2 Only NASA LaRC pilots may serve as the PIC on board LaRC aircraft. This does not restrict SICs from left seat operations provided they are not restricted from occupying the left seat.

4.20.3 SIC designation. Aircrew may be designated as SICs in LaRC aircraft provided they have demonstrated basic aircraft systems knowledge, completed initial aircraft training (waiverable by CFO), and have three landings in type.

4.20.4 SICs may upgrade to PIC status when they have achieved the minimum requirements for the position and demonstrate the ability to operate as PIC of the aircraft. This may involve a PIC upgrade check ride.

4.20 CURRENCY

Aircrew who have lapsed currency in one aircraft may perform a landing with QNCs on board provided an instructor pilot is on board. For currency purposes, LC-40, SR-22 and C206 landings and approaches are interchangeable, as are the B-200 and UC-12.

Minimum Pilot Currency Requirements in Previous 90 Days

	All Types	In Type					
		SR-22/LC-40/C206	UC-12/ B-200	UC-12/ B-200*	HU-25	G-III / G-IV**	HU-25/ G-III/G-IV**
Flight Hours	25	3	5	3	3	3	3
Landings	6	3	2	1	2	2	2
Approaches	3	2	2	1	2	2	2
Night Landings***	3	2	2	1	1	1	1

*If total flight time in NASA King Airs is >400 hours and PIC time is >200.

** For pilots qualified in both the HU-25 and G-III/G-IV, the landing and approach currency may come from either aircraft. For pilots who have not flown the aircraft > 60 days but are current in multi-engine jet aircraft, an instructor pilot is required to be in the cockpit. For pilots qualified in both G-III and G-IV aircraft, landings and approaches shall count for both aircraft when flown in either aircraft.

***Night landing currency need only be met for night missions.

IAW NPR 7900 series, aircrew that do not meet the 90 day all-type flight hour minimum of 25 hours or number of approaches shall increase their approach minima by 200’ and 1/2 mile visibility until the flight hour currency is met. In multi-crewed aircraft, if one pilot is current, the approach minima increase is not required.

4.21 OVERWEIGHT OPERATIONS OF KING AIR AIRCRAFT

When operating above 12,500 pounds in the UC-12 or B-200, the UC-12 limitations of overweight operations (found in NATOPS) apply to the B-200. In all cases, flight time above 12,500 pounds for either aircraft shall be documented in FDC. Additionally, level flight below 10,000 feet MSL should not be planned when overweight.

4.22 STABILIZED APPROACH CRITERIA

During instrument approaches, the following stabilized approach criteria shall be used:

IMC

At the Final Approach Fix (FAF), the aircraft shall be configured to be in a landing configuration (i.e. gear down and flaps set for an approved landing configuration:

Aircraft	FAF Flap setting
SR-22	0, 50%, 100%*
LC-40	12, 40*
UC-12/B-200	0, 40, 100

HU-25	20, 40
G-III / G-IV	20, 39

*Flaps 100% in the SR-22 and flaps 40 in the LC-40 aircraft is not recommended until landing is assured due to missed approach performance and associated configuration changes necessary in IMC.

By 200’ AGL, the aircraft shall be configured in its final landing configuration. Careful attention must be paid when executing a configuration change at low altitude. Flaps shall not be changed below 500’ AGL unless increased stopping distance is absolutely necessary.

VMC

At 500’ AGL the aircraft shall be configured to be in a landing configuration (i.e. gear down and flaps set for a normal landing configuration:

Aircraft	500’ AGL Flap setting
SR-22	0, 50%, 100%
LC-40	12, 40
UC-12/B-200	0, 40, 100
HU-25	20, 40
G-III / G-IV	20, 39

By 200’ AGL, the aircraft shall be configured in its final landing configuration. Careful attention must be paid when executing a configuration change at low altitude.

If the above requirements are not met, a missed approach shall be executed.

4.23 **FLIGHT READINESS REVIEW (FRR)/OPERATIONAL READINESS REVIEW (ORR)**

In addition to the NPR 7900 series requirements, LaRC FRR/ORR shall also contain the following information:

Aircraft status including discrepancies that may affect mission/deployment

Fatigue management plan (if required)

List of QNCs to be flown

Decision to include Flight Operations Engineer (if required)

Additional Emergency/Survival Equipment

Additional qualifications necessary

An FRR is required when conducting a CFP or higher risk research/test points. An ORR is required when participating in any research or test activity. The Chief Pilot or ADFO is the decision authority for higher risk research/test points. An FRR and ORR can occur simultaneously.

4.24 **MINIMUM CREW**

Aircraft	Minimum Crew	Notes
C-206	1	
SR-22	1	
LC-40	1	
UC-12/B-200	2	See 4.26.1. The minimum crew may be met by a qualified PIC and any NASA pilot. ORR/FRR may drive increased qualifications.
HU-25	2	Requires PIC and PIC/SIC.
G-III / G-IV	2	Requires PIC and PIC/SIC. Flight Operations Engineer may be required for research flights in accordance with paragraph 8.1.4.

4.25.1 UC-12/B200 (King Air) Single pilot operation requirements are as follows:

1) Approval for King Air single pilot flight operations shall be provided by the Chief Pilot (CP) or Associate Director for Flight Operations (ADFO) for any non-research flights and by the Chief of Flight Operations (CFO) for research flights.
2) Pilots shall be designated by the (CFO) as "single pilot qualified" for any flight operation. This requirement does not apply to ground engine runs as they can be performed as a single pilot operation by a King Air qualified pilot.
3) Single Pilot Qualification shall require a minimum of 200 flight hours as Pilot in Command of a B200 series aircraft and successful completion of an Initial or Recurrent training simulator syllabus as a single pilot.
4) Single pilot operation pilot proficiency requirements shall be a minimum of 3 landings and two approaches in the King Air within the previous 30 days, or 1 landing and one approach in model within the preceding 7 days.

Single pilot operation limitations are as follows:

1) Simulated engine out training or practice is prohibited. Required single engine maneuvers on Functional Check Flights (FCF) are allowed.
2) Full stop and Stop and Go landings are preferred but if runway length precludes a Stop and Go, a Touch and Go may be performed. Flap configuration shall not be changed while moving on the runway. (i.e. only no flap and approach flap Touch and Go landings are allowed.)
3) Provided the pilot meets all currency requirements, no additional buffer to approach minima are necessary.

5. UNCREWED AIRCRAFT SYSTEMS OPERATIONS

5.1 Policy

5.1.1 Background. This chapter provides LaRC policy clarifications for UAS operations captured in NPR 7900.3D, NPR 8715.5B, NASA-STD-8719.25, OCHMO-STD-1880.1, LPR 1710.18 and LMS-TD-0903.

5.1.1.1 Technological Advances. Technological advances continue to provide unprecedented leaps in Uncrewed Aircraft Systems (UAS) capability. LaRC is currently focused on UAS applications supporting research objectives that include aeronautics, space science, and earth science. Technology that permits the rapid dissemination of remote sensing data acquisition products will play an important role in this effort. Most importantly, UAS shall be responsive to the needs of scientists and researchers by providing data-gathering capabilities through the use of user-configurable test bed design and modular payloads.

5.1.1.2 Levels of Complexity. UAS vary in size and complexity from vehicles weighing less than a pound to vehicles weighing over 30,000 pounds. Typically, sUAS (small UAS) vehicles weigh less than 55 lbs and are designed as single fault tolerant systems, with little or no redundancy. This is primarily done as a trade-off between performance requirements against weight and available volume. The lack of redundancy in UAS drive additional risk considerations for operations occurring in and around populated areas. As the Center's operational infrastructure, procedures, and equipment are developed and expanded to support these program-funded flight activities, the need for trained pilots, observers, and system operators with unique UAS-related skill sets is recognized. The skills required to support such research programs are beyond the typical hobby level for recreational Radio Control (RC) enthusiasts. Precision maneuvering of UAS configurations with complex multi-layered control systems utilizing sophisticated ground stations and displays are becoming the norm. Levels of complexity and autonomy will continue to increase as efforts are made to show that a single pilot/ground station control operator can control multiple UAS aircraft beyond visual line of site (BVLOS) in the National Airspace (NAS). Eventually, automation will completely remove the pilot/ground station operator requirements for flights in the NAS.

5.1.2 LaRC Policy. The LaRC RSD UAS Operations Office (UASOO), Airworthiness Review Board (ARB) and UAS Flight Readiness Review (FRR)/Operational Readiness Review (ORR) ensures that all UAS flight projects are properly reviewed, documented and approved in accordance with LPR1710.18, LMS TD-0903, NPR 7900.3 and this LPR. Prior to the issuance of a Flight Authorization (FA), the review process may include the review and approval of a UASOO Questionnaire, approval of a flight test plan, a risk assessment, an engineering/project-level design review, an Airworthiness review and a Flight Readiness/Operational Readiness Review.

5.1.2.1 As designated by the Center Director, the LaRC RSD Chief of Flight Operations (CFO) shall ensure that UAS flight crews and operations receive direct oversight and comply

with the guidance within this document.

5.1.2.2 The RSD UAS pilot in charge of training shall provide independent oversight over all aspects of UAS flight crew qualifications and training in accordance with NPR 7900.3 and this LPR.

5.1.2.3 The LaRC Center Range Flight Safety Lead (CRFSL) shall be responsible for overseeing, monitoring, and evaluating Center and project implementation of this LPR, NPR 8715.5, and NASA-STD-8719.25.

5.1.2.4 All LaRC UAS operations shall be conducted within the requirements of this LPR. The CFO/ADFO has the authority to determine the appropriate level of oversight as described in this document.

5.1.2.5 All project managers will be made aware of this policy prior to any UAS flight activity.

5.1.3 UAS Definition. Defined IAW NPR 7900.3.

5.1.4 UAS Classifications. Defined IAW NPR 7900.3. Additions to 7900.3 are listed below. Note: if a vehicle's weight and operating airspeed fall under two different categories, the higher category shall be used.

Category I UAS general characteristics:

Cat I	
Configuration Management	sUAS aircraft in this category typically operate on a fly to failure maintenance schedule. Flight-critical parts will be inspected at least once per day, prior to flight activities—normally accomplished during the first preflight of the day. An appropriate maintenance inspection schedule will be developed for critical components and all manufacturer's maintenance procedures shall be followed (i.e. torque settings, inspection intervals IAW LMS-TD-0903, etc).

Category II UAS general characteristics:

Cat II	
Airworthiness	Aircraft are required to have an airworthiness statement provided by the NASA Airworthiness Review Process.
Configuration Management	Flight-critical parts will be inspected at least once per day, prior to flight activities—normally accomplished during the first preflight of the day. An appropriate maintenance inspection schedule will be developed for critical components and all manufacturer's maintenance procedures shall be followed (i.e. torque settings, inspection intervals IAW LMS TD 09-03, etc).
Safety	Only requirements levied by the airworthiness review process and ORR will be required for this category of aircraft.

5.1.5 UAS Flight Crew Definition and Responsibilities: The crew may consist of Mission Commander (MC), Flight Test Lead (FTL), Project Manager (PM), Pilot(s) in Command (PIC), Ground Control Station Operator(s) (GCSO), observers, spotters, engineers, Range Safety Officer(s) (RSO) and other individuals who are required to operate a UAS and are authorized by position descriptions, letters of appointment, memoranda of understanding, memoranda of agreement (MOA), or contracts to perform UAS flight operations. The MC, FTL, PM or PIC shall be involved in all mission planning to include test plan development and approval; complete prelaunch, mission, and recovery checklists; and assist in evaluating and disseminating in-flight data. NASA Langley utilizes the definitions in NPR 7900.3 to define the human-vehicle interface for piloting positions and responsibilities for safe UAS operations. Additional clarification of these positions is identified below:

5.1.5.1 Mission Commander (MC). Responsible for all phases of the flight activity except those related to the physical control of the UAS aircraft (the PIC's responsibility) and those aspects of range and flight safety (the RSO's responsibility) per NPR 7900.3. The MC is required for MQS II and III operations per NPR 7900.3 and optional at other times
based on the direction of the FRR/ORR. The qualifications for MC are specified in NPR 7900.3 and this LPR (Section 5.6).

5.1.5.2 Flight Test Lead (FTL). Responsible for (1) defining the flight activity for the day, (2) ensuring the test conditions flown will achieve mission assurance, and (3) ensuring the flight activity is flown in accordance with the test plan reviewed and approved by the FRR/ORR.

This person is not required to be PIC or MC qualified, however, may perform those roles if qualified and current to do so.

5.1.5.3 Pilot-in-Command (PIC). Responsible for the safe operation of the UAS vehicle(s) in the National Airspace System (NAS). The person acting as PIC may change by phase of flight (MC to GCSO PIC for beyond visual line-of-sight operations) or when the vehicle(s) are handed off to another pilot (PIC to PIC in daisy-chain operations). The PIC shall be certified by the RSD Chief of Flight Operations to act as a PIC (for additional information on certification, Reference Section 5.6 of this LPR). The PIC shall have a current medical renewed annually unless conducting operations of size/complexity defined under 14 CFR Part 107 as per OCHMO 1880.1. PIC methods per NPR 7900.3 that are frequently used at LaRC include:

a. Radio Control Pilot. Controls the UAS with a manually operated radio-controlled transmitter.

b. Remote Pilot. Operates the UAS from a remotely located Ground Control Station (GCS) via a command and control communication link using keyboard and mouse, other computer input devices or manual stick-and-rudder inputs. Note: when the person at the GCS is acting at the direction of the PIC and are not qualified as a PIC, they are referred to as a Ground Control Station Operator.

c. Safety Pilot (SP). A safety pilot role is fulfilled by a qualified NASA PIC who, for a specified period of time, allows (1) the automated software, (2) the GSCO, (3) another NASA PIC, (4) pilot-in-training or (5) the non-NASA Evaluation Pilot to manipulate the aircraft controls. The SP shall have the ability to take control from any of the options listed above at any time. The PIC remains responsible for the safe conduct of the flight.

d. UAS Instrument Rated Pilot (IRP). A pilot qualified to operate a NASA UAS under IFR. An IRP shall understand the sections of 14 CFR Subpart F 61.125 and 61.127 that apply to instrument flight operations in the NAS. A Federal Aviation Administration (FAA) instrument rating, military pilot rating, or completion of a formal UAS training course where the UAS pilot has demonstrated and understanding of instrument flight is required for this certification.

e. UAS Instructor Pilot (IP). A pilot certified to conduct initial UAS Pilot training and UAS flight crew annual reviews. In general, the IP shall be considered a subject matter expert on the particular type of aircraft.

5.1.5.4 Ground Control Station Operator (GCSO). Manages the operation of an uncrewed aircraft by means of a ground control station (GCS), typically by means of computer interface with an onboard flight management system through a command and control communications link. This person typically acts at the direction of the PIC, and is not required to be a qualified PIC. LaRC operations frequently co-locate the GCSO with the PIC so the GCSO can provide the PIC with vehicle health status and request a manual takeover when needed. Note: If the GCSO is PIC qualified and the flight activity has been approved for that person to be the PIC from the GCS, they are referred to as a Remote Pilot.

5.1.5.5 Observer. The observer serves as the flight safety monitor to ensure noninterference between the uncrewed aircraft and nonparticipating aircraft by means of see and avoid. The observer may perform these duties either on the ground or in a chase aircraft while in direct communication with the controlling pilot. The observer is required to have a FAA Class III medical and complete annual RSD training, which qualifies them to participate in MQS I, II, and III operations. An observer is required for MQS II or III operations.

5.1.5.6 Spotter. Performs the same duties as an observer, but is limited to conduct Part 107-like operations or provide additional observer duties when working with a qualified observer. The spotter is not required to have an FAA medical, but is required to complete annual RSD training and possess unaided vision (except for glasses) capable of maintaining sight of the UAS at all times.

5.1.5.7 Range Safety Officer (RSO). Performs duties as assigned by the CRFSL in accordance with NPR 8715.5 and ensures compliance with FRR/ORR issued operating instructions levied on UAS operations. The RSOs are responsible for the safe conduct of the mission and for ensuring compliance with approved airspace authorizations. The RSO must give the final approval prior to each flight operation in the NAS. In the event of a mishap,

the RSO takes control of the situation to ensure safety, preserve evidence, collect preliminary details and notify required personnel. RSOs are only required for unconstrained flights in the NAS. Other UAS flight activities, such as those indoors, in a cage or net, or tethered operations below 150 feet (as documented in the NASA-FAA MOA), will have a designated individual responsible for safety but that person is not required to be a trained RSO.

5.1.5.8 Evaluation Pilot (EP). A pilot participating as a "human subject" in a research activity. Depending on the type aircraft and intended flight activities, the EP may be required by RSD to obtain medical clearance and complete training. The EP is expected to be competent in their assigned duties, however they are not required to be current or qualified as PIC of that aircraft. Ultimate responsibility for the safe conduct of the flight resides with the PIC.

5.1.6 UAS Flight Crew Requirements

5.1.6.1 UAS Flight Crew. UAS flight crew are responsible for the safe control and operation of the UAS and shall ensure that appropriate communications with Air Traffic Control are maintained in accordance with the approved airspace authorization.

5.1.6.2 For unconstrained flights in the NAS, the minimum crew is two individuals; a PIC and an RSO.

5.1.6.3 UAS flight crew can serve multiple roles/functions during flight operations (e.g., the RSO can also serve as a spotter, the PIC and GCO can exchange duties between flights). The change in duties/roles shall be verified prior to every flight.

5.1.6.4 All test team members report to the MC (if a MC is required or designated), otherwise, the crew reports to the FTL or PIC as defined in the test plan for that flight activity.

a. The MC (FTL or PIC) is responsible for ensuring the flight activity complies with the FRR/ORR approved flight test plan.

5.1.6.5 The RSO provides independent safety oversight, to include giving the final GO/NO-GO before every flight and has the ultimate authority to terminate flight operations.

a. When multiple UAS flight crews are operating simultaneously, the ORR will clearly describe how many RSOs and visual observers/spotters are required as well as defining their location and assigned tasks.

5.1.7 UAS Command and Control Systems. UAS flight crews shall have the capability to command, control, and manage the UAS and to coordinate access and integration into the NAS to complete the mission. These systems include aircraft control and airspace control.

5.1.7.1 Aircraft Control. Aircraft control is the authority to direct the physical maneuvers of a

UAS in flight or to direct a UAS to gather data or operate in a specific area defined within an approved flight test plan. Test Plans may include Visual Line of Sight (VLOS), Beyond Visual Line of Sight (BVLOS) and/or Beyond control link Line of Sight (BLOS) concepts of operations (CONOPS). These CONOPS may also include multi-vehicle control through a single GCSO. CONOPS for all these operations shall detail risk mitigations essential to the safe operation as it pertains to FAA, NASA, LaRC and range specific policy guidelines. Additionally, risk assessments and risk mitigation procedures for CONOPS shall include the following:

a. Procedures to keep the UAS within the boundaries of the predetermined area of operation (AO) during nominal and emergency operating conditions.

b. Procedures to minimize risk to people, infrastructure and personal property.

c. Procedures to manage loss of communications with equipment, flight crew and ATC.

d. When transferring from one control mode to another (i.e., GCSO to RC Pilot) during VLOS operations, a new PIC may be declared and PIC responsibilities may be transferred from one operator to another. When transferring from one control mode to another during BVLOS operations, a new PIC shall be declared and PIC responsibilities shall be transferred (i.e., control room to another MC or GCSO PIC to RC Pilot). In all cases, a positive three-way change of control is required.

5.1.7.2 Airspace Control. Airspace control provides for the coordination, integration, and regulation of the use of a defined airspace and identification of all airspace users. Any airborne object that may interfere with the flight path or trajectory of any other object within the NAS is of concern and requires airspace coordination and integration. Airspace control is the authority to direct the maneuvers of a UAS (along with other aircraft and airspace users) for the best use of the airspace. Airspace control is accomplished through established procedures for coordination of airspace by Air Traffic Control or range authorities.

a. The PIC and the RSO have the responsibility to ensure appropriate communications with ATC. LaRC UAS control transfers shall ensure three-way handoffs occur between all UAS operators. In the event of lost voice communications, all voice transfer communications must have a backup communication method.

b. The UASOO is the single POC for coordination with JBLE for Letter of Procedure (LOP) agreements and with the FAA on Certificates of Waiver or Authorization (COAs).

5.2 UAS Planning

5.2.1 Before any deployment or local UAS operation, considerable planning takes place well in advance of the operation. UAS operations often include unique requirements pertaining to integration in CONUS or overseas localities. Coordination with appropriate agencies or countries shall occur as soon as the decision is made to deploy a UAS. The LaRC Uncrewed Aircraft System (UAS) Flight Operations Request form (LF 435) provides the

UASOO with the required data to begin the review process for a UAS project and is required by LPR 1710.16 (see 5.7 for more information). The LF 435 shall be completed, submitted, and approved prior to scheduling the FRR/ORR. The LF 435 shall include all information associated with the requested UAS project. All UAS project specific records and documents shall be maintained at the project level and subject to the review of the UASOO.

5.2.2 Prior to every FRR/ORR and subsequent flight operation, the UASOO shall ensure that the flight crew assigned to the sUAS/mission meets the minimum defined requirements for qualification, currency, and proficiency found within this LPR. The UASOO shall
maintain a data base which tracks data/metrics-at-a-glance that includes but is not limited to: UAS Flight Authorizations, important dates, vehicle status (number of flights, number of landings, etc.), pilot qualifications, currency, and Proficiency information.

5.2.3 LaRC UAS operations are conducted under a variety of airspace authorizations. Some authorizations are managed at the NASA HQ level and others are managed by the LaRC UASOO. The following types of authorizations are available for use to support LaRC UAS operations:

a. Certificate of Waiver or Authorization (COA) – an authorization issued by the FAA to a public operator or agency for a specific location and UAS activity. COAs may be obtained by the UASOO, the controlling agency, NASA HQ or another organization (ex. NASA/FAA Blanket Class G COA).

b. NASA-FAA Memorandum of Understanding (MOU)– an agreement between NASA and the FAA for certain UAS operations in uncontrolled airspace.

c. Special Use Airspace (i.e., Restricted Airspace) – operations allowed with permission of the Controlling Authority.

d. International Airspace – airspace outside the 12-nautical-mile limit of the United States and its territories under NASA's State Authority.

e. 14 CFR 107 – FAA regulation for the operation of sUAS in the National Airspace System (NAS).

5.2.3.1 Each of these five options have varying operating requirements, restrictions, and limitations. Regardless of the operating authority a NASA UAS operates under, compliance with NASA and LaRC policies is required.

5.2.3.2 The FAA is responsible for airspace management within the National Airspace System, commonly referred to as the NAS. The NAS consists of controlled, uncontrolled and special-use airspace. A UAS cannot fly beyond the boundaries of special-use airspace without specific authorization of the FAA. If a UAS will be flown outside the boundaries of special-use airspace, sufficient time (minimum of six weeks) shall be allowed for the UASOO to process a COA request with the FAA using the COA Application Processing System (CAPS) Online Process. If approval is obtained from the FAA, a COA will be issued approving UAS flight operations for the requested airspace.

It is important to note that the approved COA will not cover all operational information submitted via the CAPS online process. Operators must be aware of the submissions to ensure full compliance with the approved COA.

5.2.3.3 An MOU or Letter of Procedure (LOP) with the local air traffic control facility may be required to ensure the UAS flight crews have a complete understanding of the air traffic control procedures used and to ensure safe UAS operations under the controlling agency.

5.2.3.4 Letter of Agreement (LOA). An LOA with local air facilities shall be completed to ensure that proper coordination of support requirements is understood and agreed upon. It will address:

a. Fuel and hazardous material storage.

b. Hangar facilities.

c. Runway use.

d. Any other logistical and support requirements.

5.2.3.5 The option to utilize 14 CFR 107 (Part 107), still requires the applicable UAS oversight IAW NPR 7900.3, OCHMO 1880.1 and this LPR.

5.2.4 Scheduling Meeting. A monthly UASOO flight scheduling meeting will occur to schedule UAS training and UAS project test missions in desired airspace, schedule UASOO personnel, schedule tethered flight activity and verify Flight Authorization approvals for all flights in the NAS.

5.2.4.1 Scheduling usage of the CERTAIN range should include desired operating area/areas (CERTAIN I, II, III, IV).

5.2.4.2 Drone Cage Flight Operations Scheduling. Use of the drone cages shall be scheduled through the assigned facility coordinator. The facility coordinator is responsible for ensuring operations are conducted IAW the associated drone Standard Operating Procedure (SOP).

a. UASOO RSO/CRFSL – CERTAIN Range I – 98’ x 50’ x 36’ grass cage

b. B1230 Facility Coordinator – B1230 – 60’ x 60’ x 50’ paved cage and indoor flight facility

c. Gantry Facility Coordinator – Gantry – 150’ Radius x 120’ high paved cage

5.2.5 International Operations. Foreign governments are sensitive to the capabilities and valuable information that could be collected by UAS, as well as the inherent risks associated with uncrewed flight operations. NASA UAS have State Aircraft status.

5.2.5.1 UAS planners shall ensure that UAS operations are included at the outset of integration planning within host nation (HN) airspace.

5.2.5.2 Planners shall have a firm understanding of the UAS to be employed so that they can satisfy any protests or concerns from the HN.

5.2.5.3 The UAS planner shall work via the Office of International and Interagency Relations (OIIR) to gain diplomatic clearances prior to any UAS operations within their represented country.

5.3 UAS Preflight Planning

5.3.1 Operations Site. Flight crews shall ensure particular consideration is given to the location of the UAS operations site. Considerations shall include ease of access to the operations site, availability of a runway or other landing surface, availability of emergency landing sites, surrounding obstacles, potential causes of electromagnetic interference (EMI), location and density of nonparticipants, proximity of emergency responders, availability of fuel and/or electricity, availability of potable water, availability of restroom facilities and personnel access controls. An environmental assessment and an emergency response plan must be conducted for each UAS operating range unless a similarly acceptable assessment has been conducted by the range owner/manager. The environmental assessment is accomplished by filing an LF 461 and receiving the associated Record of Environmental Consideration (REC). The emergency response plan shall be coordinated through and approved by the CRFSL. Both the environmental assessment and the emergency response plan for each site will be the responsibility of the UASOO.

5.3.2 Weather. Flight crews shall consider the expected weather conditions at the operation site for the entire duration of each mission. Should weather approach minimums required to conduct a safe UAS operation, the RSO, with input from the PIC/MC will make the final decision on whether or not to proceed. The RSO and PIC will consider all aspects of the environment, including wind speed/direction, visibility, required cloud clearances, heat index, wind chill, temperature, precipitation and their impacts on the entire flight crew. The ultimate authority for terminating flight operations resides with the RSO.

5.3.2.1 Operations approved under VLOS rules shall maintain a minimum of 3 statute miles visibility and cloud clearances of 500' below and 2000' horizontally.

5.3.2.2 Maximum surface wind condition limits: steady $\leq$20 knots, maximum gusts 20 knots, 90º crosswinds $\leq$ 12 knots (fixed wing UAS during takeoff and landing). The ARB/FRR/ORR may modify these requirements to define an envelope that meets the capabilities of the vehicle and/or needs of the project.

5.3.2.3 Personnel should dress appropriately for the weather and the RSO shall monitor weather conditions and personnel to ensure nominal performance. Personnel shall hydrate and rest when needed.

5.3.2.4 Hot weather operations: UAS operations will cease when the Heat Index reaches 105 degrees F. Additional mitigations are identified below for Heat Indexes between 90-95

degrees F, 96-100 degrees F and 101-104 degrees F.

a. Heat Index 90-95 degrees F: Workers should receive shade from direct sunlight whenever possible during work and breaks. Additionally, RSOs and/or Supervisors should provide awnings, tents or canopies. A cool, air-conditioned place for individuals that may require attention is desired but not required.

b. Heat Index 96-100 degrees F: Operations are allowed with 5-10 minute water and rest breaks every hour. A cool, air-conditioned place for those individuals that may require additional attention is required. The maximum length of an operational day shall be eight hours.

c. Heat Index 101-104 degrees F: Operations are allowed with 5-10 minute water and rest breaks every 30 minutes. An air-conditioned shelter shall be available in close proximity for personnel to take a break from the elements. The frequency and duration of the breaks shall be at the RSO's discretion but not to exceed 30 minutes of continuous operation. Any team member may request a shelter break at any time. The RSO shall monitor all team members throughout the operation and be attuned to effects of hot weather on personnel and equipment. The decision to halt or delay operations shall reside with the RSO on-site. Operations shall take advantage of shady areas when locating personnel on the ground. (note: clear, sunny days with no wind can feel up to 15 degrees F warmer than overcast days or areas in the shade due to the radiant effects of the sun). The maximum length of an operational day shall be six hours.

d. At a heat Index of 105 and above, all operations will cease until a Heat Index of 104 or below is reached. Should temperatures reach any of the listed temperature categories above, the associated operational time limits will be used.

5.3.2.5 Cold weather operations: UAS operations with windchills above 40 degrees F are allowed without required mitigations. UAS operations will terminate when the windchill is below 32 degrees F. At windchills between 32 and 40 degrees F, the following mitigations are required:

a. A heated shelter shall be available in close proximity for personnel to take a break from the elements and warm up.

b. The frequency and duration of the breaks shall be at the RSO's discretion; however any team member may request a shelter break at any time.

c. The maximum length of an operational day shall be six hours.

d. The team shall take advantage of sunny areas when locating personnel on the ground. Note: that clear, sunny days with no wind can feel up to 15F warmer than overcast days or areas in the shade due to radiant effects of the sun. While this is not reflected in a temperature or windchill measurement, it does affect the heat loss from one's body. Therefore, relying solely on a temperature or windchill measurement is not necessarily indicative of how cold it may 'feel' to a person.

e. The RSO shall monitor all team members throughout the operation and be attuned to effects of cold weather on personnel and equipment.

f. The RSO shall rely on timely and relevant weather information for awareness of changing weather.

g. Effects of cold weather on equipment, especially batteries, shall be discussed during the pre-flight briefing.

h. The decision to halt or delay operations shall reside with the RSO on-site.

5.3.2.6 Requests for operations above/below the maximum/minimum temperature limits and appropriate mitigations shall be discussed in advance with the UASOO and approved by the ARB or FRR/ORR. The ARB shall only be involved if outside of aircraft minimum/maximum temperature limits. These exceptions to the nominal hot/cold weather operations shall be documented in the Flight Authorization.

5.3.3 Communications. UAS operations are communication intensive operations that require a detailed communication architecture plan that includes voice, command/control and data/telemetry communications. Types of communication interfaces may include ground-to-vehicle, vehicle-to-ground, vehicle-to-vehicle, RSO-to-ATC, ATC-to-RSO, RSO-to-PIC, PIC-to-RSO, Observer/Spotter-to-PIC PIC-to-Observer/Spotter, GCSO-to-PIC, PIC-to-GCSO, GCSO-to-RSO, RSO-to-GCSO, GCSO-to-Observer and Observer-to-GCSO. The communication plan shall be structured to support the needs of the operation.

5.3.3.1 UAS flight crew shall ensure an effective/robust command and control architecture is built into the UAS operation. All research missions shall include a communication architecture plan as part of the approved test plan. The communication plan shall identify and mitigate potential EMI issues by obtaining Radio Frequency Authorizations (RFAs) from the LaRC Spectrum Management Office for all transmitting devices. The communications plan shall also include mapping the frequency spectrum for all equipment used during operations and identify EMI contingency plans for all types of communications.

5.3.4 Mission Planning. UAS operations require detailed planning to safely and efficiently execute missions and still meet mission objectives. Mission planning starts with well-defined operations in an approved test plan. The test plan should include communications plans, minimum-risk flight planned routes with emergency landing sites, fuel/battery management plans, procedures to handle in-flight-emergencies, methods of range containment, defined Lost Link procedures that are IAW with approved airspace authorizations and LaRC UAS mishap notification procedures

5.3.4.1 Route Planning. UAS missions shall be planned by the UAS flight crew in close coordination with the CRFSL and the Range Safety Officer. This is necessary to ensure there is no conflict with other flight activities and to identify other potential operational

risks, including route-related risks addressed during the FRR/ORR process.

5.3.4.2 In-flight Emergencies. During planning, sufficient attention shall be given to the possibility that an in-flight emergency may occur. Particular attention should be given to the selection of emergency landing sites for use during a "land immediately" emergency situations. Consideration shall also be given to the location of potential impact sites if the UAS exits controlled flight and impacts the ground. All hazards shall be considered within the safety analysis to minimize risk to the public, personal property, flight crew, and equipment.

5.3.4.3 Flight paths, minimum-risk routes, and other air management tools shall be included in the UAS operational plan.

5.3.4.4 Loss of Link Procedures. In general, all C2 and data links to the vehicle and to the ground station that are present at takeoff are expected to be operational during the entire flight. Should a flight test plan include scenarios where a link may be inoperable but the flight continue as nominal, those scenarios shall be documented and briefed to the ARB/ORR for approval or rejection. When a UAS senses an appreciable delay or loss of the command uplink or other link, the predetermined loss-of-link procedures shall be invoked to contain the vehicle within the confines of the approved airspace and terminate the flight as safely as possible. Lost link instructions vary but should allow for a return to launch profile or divert via a suitable alternate route and recovery location. The UAS return home or alternate profile shall be verified by two people to ensure proper programming. During lost link recoveries, the UAS pilot will attempt to reestablish communication with the UAS.

a. All loss of link occurrences shall be reported to the CRFSL.

b. Loss of Link Procedures shall be reviewed at the FRR/ORR.

5.3.4.5 Range Containment. UAS operators shall ensure that all vehicles have properly functioning flight termination and/or range containment systems to ensure operations occur only within the airspace boundary limits.

a. If the vehicle attempts to depart the confines of the approved airspace and no other control methods are available to recover the vehicle, vehicle power shall be removed to prevent a significant airspace deviation. Pilot judgment should be used to determine the best time to remove power and bring the vehicle down to minimize injury to personnel and avoid damage to property.

5.3.4.6 Agency Mishap Notification. In the event of a mishap where the UAS impacts the ground (other than a hard landing), causes damage to property and/or results in an injury the RSO shall be the Interim Response Team, and perform duties in accordance with NPR 8621.1C and the Center Mishap response plan or project specific mishap response plan.

5.4 UAS Flight Operations

5.4.1 Flight Brief. Includes all personnel actively and passively participating in the flight operations. The RSO and PIC/FTL/MC will run the brief. The RSO covers all safety related topics via the NASA LaRC Range Safety Commit Criteria and the PIC/FTL/MC will address test execution emphasis items. As a minimum the flight brief will include:

a. Mission objectives.

b. Verification of flight authorizations.

c. Review of test hazards.

d. Flight crew currencies, qualifications and assigned tasks.

e. Test site specifics: to include safety items and airspace agreements.

f. Checklist Review.

g. Weather and NOTAMs.

h. Communication plan.

i. Proper personal protection (PPE).

j. Mission specific limits and knock-it-off criteria.

k. System/Vehicle updates and configuration changes.

l. Emergency divert airfields/locations and/or ditch sites.

m. Emergency procedures, terminology and "emergency of the day" discussion.

n. Unilateral stop authority.

o. Safety barriers.

p. Mission profiles and specific test execution risk mitigations.

5.4.2 Preflight Vehicle Inspection. The RSO shall accomplish a review of the vehicle logbook and inspect the vehicle for compliance. At a minimum, the logbook shall include the airworthiness statement/certificate, the Flight Authorization and any maintenance performed since the last UASOO vehicle inspection (see LMS-TD 0903 for more information). Any minor modifications (for example, rerouting a wire, moving an antenna, making single gain adjustments that are part of a test plan, repairing a broken wire etc.) made to a Cat I/II vehicle shall be assessed by the RSO. If the RSO determines that the modifications have no material effect on the airworthiness of the vehicle, the operation may continue with no action needed by the ARB. Any modifications not considered minor (modifications external to the test plan that temporarily or permanently change the flight characteristics/airworthiness of the vehicle) shall be reviewed by the

ARB Chair for assessment on vehicle airworthiness and if necessary, receive a new vehicle inspection from the UASOO (see LMS-TD 0903 for more information).

5.4.3 Takeoff Method. The UAS flight crew readies the UAS for launch and performs systems checks to ensure that systems perform in accordance with operating checklists.

5.4.3.1 Prior to takeoff, systems checks shall include an independent means to verify waypoints entered into a navigational system that cover both nominal and lost link operations.

5.4.3.2 Takeoff methods may vary based on vehicle type and flight location.

5.4.4 Recovery and landing. An adequate surface area shall be available for a nominal landing of the UAS. The landing site shall be accessible to the UAS flight crew and allow for adequate stand-off distance to ensure crew safety.

5.4.4.1 Emergency landing/ditch sites shall be identified and used for off-nominal landings when the PIC determines that their use is required. These sites shall be chosen to minimize injury and damage to personnel and property. Emergency/Ditch sites shall not be overflown when a land as soon as possible situation arises.

5.4.5 Mishap Response. The RSO takes control of the situation to ensure safety, preserve evidence, collect preliminary details and notify required personnel in accordance with NPR 8621 and the relevant range Emergency Response Plan. The RSO shall notify the Aviation Safety Officer (ASO) and provide the pertinent information to relay and coordinate with the appropriate agencies (e.g., ER-ARB, NASA HQ, FAA, and NTSB). The Research Services Directorate shall ensure that appropriate agencies have been notified of the UAS mishap and the course of action.

5.5 UAS Airworthiness, Information Technology ATO and Operational Review Process.

5.5.1 Unconstrained flight operations in the NAS shall have an Airworthiness Statement/Certificate, Information Technology Authority to Operate and a Flight Authorization (FA). Indoor, caged and tethered flights below 150 feet do not require an FA or an Airworthiness Statement/Certificate. Depending on the risk level of the operation, FAs may require some or all of the following operations reviews: Flight Readiness Review (FRR), Operational Reediness Review (ORR) and/or Mission Readiness Review (MRR). Required operational reviews shall be determined by the chair of the ORR. The Flight Readiness Review and Operational Readiness Review may be combined and held as a single review for issuance of a Flight Authorization. The MRR and ORR may also be combined into one review.

5.5.2 Airworthiness Review Board (ARB). See LPR 1710.18.

5.5.3 Information Technology (IT) Authority to Operate (ATO). Required for every UAS vehicle/component capable of transmitting/receiving information. The approved System Security Plan (SSP) IT ATO shall be issued by the Langley UASOO Head. Operators shall complete the Langley UAS Project Memorandum of Understanding (CD-9999-M-LRC-4500) and receive approval prior to powering up for the first time. Components

covered under a different security plan are not subject to the requirements of the SSP (ex. laptop that is being used as a ground station that resides on a different security plan (ACES, RD, ED, etc… SSP)). Items requiring approval are listed below:

a. Uncrewed Aircraft Vehicles (UAV)

b. Ground-based controllers

c. Ground stations

d. Mobile devices, such as iPads, Phones

e. Laptops

f. Any other system used to configure, load an executable, create an executable, modify, or directly control a UAV

5.5.4 UAS Flight Readiness Review (FRR). The FRR (if required) occurs after the aircraft has a valid Limited Airworthiness Statement/Certificate and is to ensure the aircraft is safe to conduct flights. This is done f or aircraft first flights (prototype vehicles) and to validate major aircraft modifications that affect the airworthiness of the vehicle (e.g., compatibility flight profiles, envelope expansion and major adjustments made to the flight control laws of a commercial off-the-shelf (COTS) flight control system/autopilot). Representatives of all organizations involved with the development, design, fabrication, maintenance, inspection, operations of the vehicle and test plan development shall attend the review.

5.5.4.1 Process. The risk level assigned by the UASOO Head (or designee) determines the level of the FRR process used. The UASOO Head shall use information from the preliminary ARB meeting (see LPR 1710.18 for additional information), the UASOO Operations Questionnaire and information from the project to determine the expected FRR risk level.

5.5.4.2 Risk Assessment. The expected risk level (Low, Medium, High) assigned by the UASOO Head shall be reviewed at the FRR. There are different procedures required to complete the FRR depending upon the assigned risk level. If a change is made to the risk level, an increase or decrease in the assigned risk level shall drive the level of oversight required to complete the FRR.

a. Low Risk FRR. The chair/approving official is the UASOO Head. A flight test plan shall be submitted to the chair six working days prior to the scheduled FRR. The chair shall distribute to all members of the review committee. At a minimum, the committee shall include an RSO, UASOO Pilot (or independent UAS Pilot if project is run by UASOO), and UASOO Chief Engineer. Based on the nature of the material, the Chair may add members to the review committee. A designated substitute may be appointed for any of the individuals on the committee.

b. Medium Risk FRR. The chair/approving official is the Assistant Director of Flight

Operations (ADFO). A flight test plan shall be submitted to the chair six working days prior to the scheduled FRR. The chair shall distribute to all members of the review committee. Nominally, the committee shall include the CRFSL, ARB Chair, UASOO Pilot (or independent UAS Pilot if project is run by UASOO), SMAO, Software Subject Matter Expert (SME), Aviation Safety Officer and UASOO Head and Chief Engineer.
Based on the nature of the material, the Chair may add or subtract members to the review committee. A designated substitute may be appointed for any of the individuals on the committee.

c. High Risk FRR. The chair/approving official is the CFO. A flight test plan shall be submitted to the chair six working days prior to the scheduled FRR. The chair shall distribute to all members of the review committee. At a minimum, the committee shall include the CRFSL, ARB Chair, UASOO Pilot (or independent UAS Pilot if project is run by UASOO), SMAO representative, Software Subject Matter Expert (SME), Aviation Safety Officer, UASOO Head and Chief Engineer, RSD Chief Engineer. Based on the nature of the material, the Chair may add members to the review committee. Two members on the board must be Test Pilot School Graduates. A designated substitute may not be appointed for any of the individuals on the committee.

5.5.4.3 At the completion of the FRR, a Limited Flight Authorization shall be issued. Results of the flight/flights conducted under the Limited FA shall be submitted to the FRR chair for review. When satisfied that the vehicle is safe to conduct normal research flight operations (vehicle no longer requires flight envelope expansion or flight envelope verification), the FRR chair shall advise the ORR chair that the FRR test results are satisfactory. A normal Flight Authorization shall come from the ORR chair for follow-on research flight activities.

5.5.5 UAS Operational Readiness Review (ORR). The ORR certifies that a UAS test flight operation is ready to deploy and the vehicle operations are safe to fly the intended mission. The ORR also verifies that the logistics, scheduling, and resources for its intended mission are properly allocated and scheduled. Representatives of all organizations involved with the development, design, fabrication, maintenance, inspection, operations of the vehicle and test plan development shall attend the review.

5.5.5.1 Process. The risk level assigned by the UASOO Head (or designee) determines the ORR process used. The UASOO Head shall use information from the preliminary ARB meeting (see LPR 1710.18 for additional information), the UASOO Operations Questionnaire and information from the project to determine the expected ORR risk level.

5.5.5.2 Risk Assessment. The expected risk level (Low, Medium, High) assigned by the UASOO Brach Head shall be reviewed at the ORR. There are different procedures required to complete the ORR depending upon the assigned risk level. If a change is made to the risk level, an increase or decrease in the assigned risk level shall drive the level of oversight required to complete the ORR.

a. Low Risk ORR. The chair/approving official is the UASOO Branch Head. A formal ORR may or may not be required depending on the complexity of the operations identified in the UASOO Operations Questionnaire. Examples of missions that may not require a formal ORR include training/proficiency flights, camera flights not over people and simple test flights that involve the control of UAS of size/complexity defined under 14 CFR Part 107. A flight test plan may be required depending upon the information in the UASOO questionnaire. If required, a test plans shall be submitted to the chair 6 working days prior to the scheduled ORR. The chair shall distribute to all members of the review committee. At a minimum, the committee for a formal ORR shall include an RSO, UASOO Pilot (or independent UAS Pilot if project is run by UASOO) and UASOO Chief Engineer. Based on the nature of the material, the Chair may add members to the review committee. A designated substitute may be appointed for any of the individuals on the committee.

b. Medium Risk ORR. The chair/approving official is any long course Test Pilot School Graduate. A flight test plan shall be submitted to the chair 6 working days prior to the scheduled ORR. The chair shall distribute to all members of the review committee. At a minimum, the committee shall include the CRFSL, ARB Chair,
UASOO Pilot (or independent UAS Pilot if project is run by UASOO), SMAO representative, Software Subject Matter Expert (SME), Aviation Safety Officer and UASOO Head and Chief Engineer. Based on the nature of the material, the Chair may add members to the review committee. A designated substitute may be appointed for any of the individuals on the committee.

c. High Risk ORR. The chair/approving official is the ADFO. A flight test plan shall be submitted to the chair 6 working days prior to the scheduled ORR. The chair shall distribute to all members of the review committee. At a minimum, the committee shall include the CRFSL, ARB Chair, UASOO Pilot (or independent UAS Pilot if project is run by UASOO), SMAO representative, Software Subject Matter Expert (SME), Aviation Safety Officer and UASOO Head and Chief Engineer. Based on the nature of the material, the Chair may add members to the review committee. Two members on the board must be Test Pilot School Graduates. A designated substitute may not be
appointed for any of the individuals on the committee.

5556 Hazard Analysis. The project lead/PIC is responsible for initiating a hazard analysis for each mission/project. Projects and missions shall follow the UASOO best practices/normal safety of flight procedures (identified in a-i below) to drive the risk down to a "normal risk of flight." Missions that cannot attain a normal risk of flight status (as determined by the ARB/FRR/ORR) shall accomplish additional hazard analyses to adequately identify and mitigate hazards associated with the planned flight activities. Additional hazards shall be identified using the LaRC RSD Hazard and Risk Template. UASOO normal safety of flight procedures are as follows:

a. Proficiency training will be conducted prior to the start of a research campaign to facilitate safe operations throughout the campaign.

b. Flight test cards shall be designed and drafted with the flight crew to insure facilitating a safe test environment. Flight test cards shall be executed with the build-up approach in mind (low risk/sub-system performance verification to high risk/full system performance verification).

c. Response to fire on the ground and in the air are reviewed and briefed during daily safety brief IAW "NASA LaRC Range Safety Commit Criteria"

d. Flight crew has been trained regarding the use of fire extinguishers with respect to the types of fires associated with UAS flight operations

e. Flight crew is trained and familiar with the use, and maintenance of various battery types and various other batteries in use for UAS operations

f. Proper personal protection equipment to be worn when in the vicinity of UAS operations.

g. Personnel shall be briefed on location of barriers and crews in close proximity to UAS operations shall be kept at a minimum to minimize chances of injury or death.

h. Observers or Spotters are required for all LaRC UAS flights in the NAS.

i. Range Departure/Flyaway Mitigations. Flight termination failsafe for RC control shall remove power to the vehicle. Flight termination failsafe with autopilots shall consist of preprogrammed autopilot control response with a transmitter override for safety pilot (if available). Failure of both autopilot and transmitter override link shall result in removal of power to the vehicle. All lost link/return to launch programmed procedures shall be verified by two individuals. PIC/GCSO training and annual reviews shall include emergency training for loss of command link.

5.5.7 UAS Mission Readiness Review (MRR). Shall focus on mission operational safety for UAS operations that involve using multiple aircraft in a BVLOS operation where multiple activities and operations are occurring simultaneously.

5.5.7.1 The requirement to hold and conduct an MRR shall be determined by the UASOO Branch Head.

5.5.7.2 Missions requiring an MRR shall have a Mission Commander designated to lead the mission.

5.5.8 Results of the reviews shall be documented and reflected in the approved Flight Test Plan (if required) and subsequent Flight/Limited Fight Authorization and stored on the UASOO digital repository.

5.5.9 Flight Approval Process. With a valid FA/Limited FA, flight approvals for Low/Medium risk missions shall be issued by the UASOO Head. High risk mission flight approvals shall be issued by the CFO no more than 48 hours prior to the mission.

5.6 UAS Flight Crew Requirements

5.6.1 Qualifications and Designation. UAS flight crew members shall be in compliance with the minimum qualifications for all LaRC UAS missions as defined in this LPR. The LaRC CFO shall ensure that each UAS crewmember is qualified to perform duties of their assigned position.

5.6.1.1 The UAS Chief of Training shall establish, maintain and administer an initial/annual refresher training program for all mission commanders, UAS pilots, flight test leads, observers, spotters and ground control station operators.

5.6.1.2 The CRFSL shall establish annual refresher training requirements for all RSOs.

5.6.1.3 UAS flight crew can hold multiple qualifications and switch between those designated positions during flight operations (e.g., the RSO can also serve as a spotter, the PIC and GCSO can exchange duties between flights).

5.6.1.4 Initial UAS qualifications shall be documented and approved by the CFO.

5.6.2 UAS Pilot Qualifications. As designated by the Center Director, the LaRC CFO, shall designate UAS pilots for the specific type of UAS and the Mission Qualification Standards level achieved.

5.6.2.1 All UAS pilot qualifications shall be documented and approved by the CFO.

5.6.2.2 Unconstrained UAS flights in the NAS operated on behalf of NASA shall be piloted by an individual who is either a NASA pilot or is designated as a UAS pilot by the CFO. The CFO shall provide a letter designating each LaRC UAS pilot PIC providing that person can meet the minimum NASA LaRC UAS Pilot training standards. Typically, there is no expiration date on the designation letter but the UAS Chief of Training shall monitor currency requirements to ensure proficiency.

5.6.3 UAS Flight Crew Training: The LaRC UAS Flight Crew Continuous Training Program shall be completed by all UAS Flight Crew members to include: Mission Commanders, Flight Test Leads, Observers, Spotters, and all various types of UAS Pilots, for initial training/certification and thereafter annually for maintaining minimum UAS training/certification requirements for the Center.

5.6.3.1 The training program may be tailored to consider previous experience with UAS aircraft, currency in similar types of UAS aircraft, previous training background, and availability of other resources to ensure an adequate level of training. Depending on the category of the UAS flight crew member, qualification training may be conducted under the direction of a military, civilian, or NASA qualified MC, UAS PIC, UAS IP, RSO, and/or GCSO. The following guidelines establish minimum supervision for

qualification and re-currency training missions.

a. Mission Commanders and Flight Test Leads in training shall have a qualified MC conduct supervisory duties during training operations.

b. UAS Pilots in training shall have a qualified UAS IP conduct supervisory duties during training flights in the NAS. UAS IPs shall notify the UAS Chief of Training that the pilot is training is ready for solo certification. Upon solo certification, UAS Pilots in training may have a qualified UAS PIC or RSO conduct supervisory duties during training flights in the NAS.

c. Observers and spotters in training shall have a qualified RSO conduct supervisory duties during training.

d. Ground Control Station Operators in training shall have a qualified GCSO conduct supervisory duties during training operations.

5.6.3.2 Initial certifications and annual reviews shall be witnessed by the UAS Chief of Training, CRFSL or a UAS IP.

5.6.3.3 UAS Ground Control Station Operator training shall be the responsibility of the UAS Chief of Training and the UAS project. Since there are many variations of ground control station configurations, system specific training requirements for this position shall be the responsibility of the project. General GCSO training shall be taught by the UASOO. GCSOs will be recommended for certification upon completion of both the UASOO general GCSO training and the project's system specific GCSO training.

a. Documentation from the project for the system specific GCSO training is required.

5.6.3.4 Simulators training for Pilots and GCSOs is highly encouraged for normal and emergency procedures. Some simulators are acceptable substitutes for field training and may, if approved by the UAS Chief of Training, be used as a substitute for initial or annual training.

All UAS flight crew members shall have completed Crew Resource Management (CRM) training within the past 24 months.

5.6.4 UAS Mission Qualification Standards (MQS). Each UAS crew shall have the knowledge and knowledge-based skills needed to safely conduct flight in the required airspace and flight conditions. It is important to note that MQS are independent of vehicle type/class and only depend on the airspace and flight profiles required for the mission.

5.6.4.1 MQS Level I. VFR conditions below 1200 feet AGL in COA approved airspace authorizations, Class E, G airspace, or special use airspace (or international equivalents). UAS Pilots shall complete the LaRC UAS Flight Crew Continuous Training Program. IAW NPR 7900, operations are restricted to VLOS/daisy chain operations. BVLOS operations below 1200 feet may require a waiver to NPR 7900 in addition to a COA or Part 107 waiver.

5.6.4.2 MQS Level II. VFR conditions above 1200 feet AGL and below 18,000 feet MSL (or applicable international transition altitude) in all applicable classes of airspace or in special use airspace at any altitude. UAS Pilots at this level require a designated MC assigned to the flight. It is permissible f or UAS Pilots not MQS Level II certified to conduct flight in MQS Level II conditions under the authority of the UAS MC.

5.6.4.3 MQS Level III. Any flight conducted under IFR. UAS Operations at this level requires a designated MC assigned to the flight with a NASA UAS instrument rating. It is permissible for UAS pilots to operate under the authority of the instrument rated MC.

5.6.4.4 Flight time for MQS level II and III operations shall be kept separate from NASA crewed aircraft flight time, by type, in NAMIS.

5.6.5 Training/Proficiency Evaluation. UAS Pilots are required to demonstrate their skills, knowledge, and understanding of how to safely operate and fly each type of UAS. UAS Pilots shall receive type and MQS Level certification in the following categories (multi-rotor, fixed-wing and turbine). UAS GCSO training and certification shall be good for all UAS types. Each proficiency evaluation (initial or annual) flight shall include the following skill elements, provided they are in the approved flight envelope for the aircraft. Elements from multiple flights can be grouped to qualify as a proficiency evaluation event.

5.6.5.1 All LaRC Mission Commanders, Pilots, Observers, Spotters and GCSOs shall demonstrate the following prior to certification by the CFO:

a. The UAS Crew Continuous Training Plan Completed

b. An understanding of the various limitations and requirements for the Airspace the UAS is to be operated within.

c. An understanding of the Currency and Proficiency requirements, as well as the reporting requirements to the UASOO Chief Pilot.

d. An understanding of Battery Charging, Battery Capacity Checks, and Minimum Operational Voltage f or the UAS being operated

e. An understanding of the minimum Pilot/Crew interface requirements for the type of UAS Operated.

f. An understanding of the Flight Modes in which the UAS can operate in, and the benefit/limiting factors of each flight mode.

g. An understanding the Preflight/ Post Flight/ and Continuous Airworthiness Requirements.

h. An understanding of required vehicle maintenance entries IAW LMS-TD-0903.

5.6.5.2 UAS Pilot Fixed Wing Proficiency Events: All turns shall be smooth and coordinated to

avoid stall departure. The pilot shall demonstrate reasonable accuracy in maintaining airspeed, glide slope, and runway centerline on the final approach, with smooth transition to flare and touchdown without damaging the vehicle.

a. Takeoff, to be held within 10 ft. either direction of centerline, with smooth, controlled corrections as necessary.

b. Horizontal figure-8 or UAS procedure turns. This element demonstrates skills at both left- and right-hand patterns and the ability to control the model's flight path.

c. Perform two aerobatic maneuvers with combined looping and rolling elements (if vehicle is capable). Examples include Half Cuban-8, loop and Immelmann, split S, or similar maneuvers. This element demonstrates the general pilot flying skills.

d. High-speed circuit of the field performed at a safe high rate of speed. This element demonstrates the ability to control a model aircraft at speed.

e. Traffic pattern including a missed approach/go-around. This element demonstrates the ability to control a model aircraft in the landing approach configuration.

f. Three full-stop landings. Smooth, controlled corrections to maintain the aircraft's airspeed and flight path through touchdown, within 10 ft. either direction of centerline are required. The landing shall be completed on the runway with no damage to the vehicle through touchdown and rollout.

g. One additional flight maneuver, which may include: looping maneuvers, rolling maneuvers, inverted flight, spins, stalls, trim shots, axis doublets, and touch- and-go landings.

h. One simulated emergency, which may include: engine out (dead-stick), extinguishing an on-board fire, disorientation maneuver and recovery, missed approach, and traffic collision avoidance maneuver.

5653 Multirotor/VTOL Proficiency Flight Events. The Multirotor/VTOL UAS Pilot Shall Demonstrate for Proficiency the Following Basic Flight Maneuvers (flights may be flown in any order and are at the discretion of the PIC):

a. Flight #1: Takeoff in "Alt Hold" and climb to 20M, execute 360-degree rotations about the UAS' vertical Axis. Change to "Stabilize" using RC controller and execute 360-degree rotations about the UAS' vertical axis, maintaining altitude and position. Change back to "Alt Hold" using the RC controller, then land.

b. Flight #2: Takeoff in "PosHold" and climb to 20M, fly box pattern keeping the forward position of the UAS oriented in the direction of travel while maintaining altitude. Change to "Alt Hold" from the RC controller and fly box pattern in the opposite direction keeping the forward position of the UAS oriented in the direction of travel, then land.

c. Flight #3: Takeoff in "PosHold" and climb to 30M, fly a large figure eight pattern while holding altitude. Change to "Alt Hold" and fly a large figure eight pattern while holding altitude. Change to "Stabilize" then land.

d. Flight #4: Takeoff in "PosHold" and climb to 30M. Activate "Auto Mode" from GCS and have the aircraft fly an autonomous box pattern. During the box pattern, take RC command, switch to Alt Hold and continue to fly the box pattern. Reengage "Auto Mode" during the box pattern. GCS commands RTL due to simulated situation. Pilot takes over and lands manually.

e. Flight #5: Takeoff in "PosHold" and climb to 30M. Activate "Auto Mode" from GCS and have aircraft fly an autonomous box pattern. Create/simulate a lost link failure, requiring the RC pilot to take control of the vehicle and safely land. Monitor RTL and decide if a manual landing is required.

5654 UAS Ground Control Station Operator Proficiency Evaluation. The GCSO shall demonstrate proficiency in communicating with the vehicle and the crew. They shall demonstrate vehicle control mode switches, manipulation of an autonomous routing, issuance of direct control commands and initiating return to launch/recovery commands. The GCSO shall understand the necessary actions to take during an emergency and communicate the essential information to the PIC.

a. UAS GCSO PIC/Remote Pilot Proficiency Requirements. In addition to the requirements listed in 5.6.8 below, the GCSO PIC must demonstrate the
programming and execution of an autonomous flight from takeoff to landing (assuming the system is capable of autonomous takeoff and landings). A LaRC certified UAS PIC may act as a GCSO PIC provided they have demonstrated knowledge of the ground control station commands. UAS GCSO PIC is required for BVLOS and M to N operations. Note M to N operations are defined as operations where a single GCSO simultaneously controls more than one UAS.

566 Holders of a NASA UAS instrument rating shall pass the LaRC UAS instrument rating exam, maintain an FAA pilot certificate and have a First Class medical certificate (for more information see OCHMO-STD-1880.1).

5.6.6.1 BVLOS operations under LaRC supervision require that PICs and/or GCSO PICs have completed a NASA developed BVLOS training plan.

567 Medical. UAS MCs, Pilots, GCSOs and observers shall meet the specified medical standards in NPR 7900.3 and OCHMO-STD-1880.1. Operators and spotters whose duties involve the control of UAS of a size/complexity defined under 14 CFR Part 107 do not require a medical, provided they self-assess and ensure they are physically and mentally capable of participating in the mission.

568 UAS PIC Currency. Currency is dependent on the category of UAS pilot. A review of UAS pilot and crew qualifications shall be made prior to flight assignment to ensure that prerequisites for the intended mission are met.

a. All UAS Pilots shall have completed three flights within the preceding 90 days. UAS Pilots out of flight currency shall accomplish three flights minimum to re-establish flight currency. UAS Pilots whose currency has expired for 90 days shall accomplish annual refresher training to regain currency.

b. Flights shall be in same type and MQS level. Flights from same type but different MQS level may be used to update currency requirements. The type of UAS utilized for currency events shall be equivalent in category and type to the UAS being flown for research or mission operations.

c. Instrument Currency. UAS Pilots with an instrument rating must conduct six BVLOS flights every 180 days.

d. For turbine currency, pilots shall meet the UAS currency requirements. Initial or recurrent training may require a lengthier program to achieve desired level of proficiency.

e. Ground Control Station Operator PIC (Remote Pilot) shall have logged a minimum of one hour simulation, and completed three takeoffs and landings to a full stop in addition to the requirements listed in 5.6.5.4. UAS GCSO PICs out of currency shall accomplish 3 flights minimum to re-establish currency. UAS GCSO Pilots whose currency has expired for 90 days shall accomplish annual refresher training to regain currency.

5.6.9 Records: All flight crew qualifications, training, currency, re-currency, evaluations and proficiency records shall be kept on file and maintained by the UAS Chief of Training. Records shall be kept in a training folder or equivalent electronic database. The LaRC CFO may request audit of such records at any time.

5.6.10 The UAS Chief of Training shall review UAS flight crew qualifications prior to flight assignment to ensure that prerequisites for the intended mission are met. This typically occurs at an ORR.

5.7 LaRC UAS Mission Request Process

5.7.1 An initial meeting with the project team and UASOO personnel is encouraged if there is any uncertainty in the planning of the flight activities.

5.7.2 Once a flight experiment is formulated, fill out the LF-435 LaRC Uninhabited Aerial System (UAS) Flight Operations Request. Provide:

a. Project name

b. Requestor

c. WBS (for charging of entire project)

d. CONOPs

e. Planned number of flight days

f. Location f or flight activities

g. Personnel and logistics support needed from UASOO

5.7.3 Return initial LF-435 to UASOO Chief Engineer to obtain an estimate for support for the intended flight activities f or activities in a given Fiscal Year.

5.7.4 Once the UASOO Estimate has been provided, look for the Procurement dollar value and FTE. If this value is acceptable, provide this electronic form to the project Program Analyst or Project Manager for concurrence via electronic signature. If the values are not acceptable, contact the UASOO Chief Engineer for clarification.

5.7.5 The UASOO will then route the project office signed LF-435 through the RSD management for final concurrence and signatures.

5.7.6 The project Program Analyst or Project Manager shall coordinate with the UASOO Program Analyst for transfer of funds and FTE.

5.7.7 The UASOO shall coordinate any engineering reviews as needed or direct the project to perform an Operational Safety Review and Airworthiness Review via the respective boards.

5.7.8 Upon completion of these activities the project shall perform an FRR/ORR to finalize planning and coordination with UASOO team members.

5.8 LaRC Range Flight Safety Program

5.8.1 The LaRC UAS Range Flight Safety Program provides for protection of the public, workforce, and property during range operations associated with the flight operations of UAS in the national airspace (NAS) and in restricted airspace (as controlled by NASA or other government entities). This section describes the NASA LaRC range flight safety policy, roles and responsibilities, requirements, and procedures tailored to UAS operations as defined and described in NPR 7900.3 Aircraft Operations Management, Chapter 5, and is in accordance with NPR 8715.5B and NASA-STD-8719.25.

5.8.2 Roles and Responsibilities

5.8.2.1 The Center Director or Designee is responsible for:

a. Protecting the public, NASA workforce and property (high-value equipment and facilities), and the environment from potential harm resulting from NASA range flight activities and operations at their Center or by vehicles assigned to their Center, and to limit their exposure to risk to acceptable levels.

b. Providing resources - e.g., personnel qualified to perform range flight safety functions appropriate to the types of vehicles and range flight operations.

c. Overseeing the implementation of requirements in this LPR and applicable standards, including the establishment of Center-specific standards and adjudication of requests for relief.

d. Informing the Chief, SMA of non-compliances with Agency range flight safety requirements, and of other unsafe activities and practices.

e. Designating a qualified CRFSL.

5.8.2.2 NASA LaRC Center Range Flight Safety Lead (CRFSL). The CRFSL is part of the Institutional Mission Support Authority defined in NPD 1000.0.

The LaRC CRFSL is responsible for:

a. Overseeing, monitoring, and evaluating Center and project Range Safety Requirement implementation of NPR 8715.5B, NASA-STD-8719.25 and applicable laws and regulations.

b. Performing risk assessments and analyses on behalf of the Center.

c. Providing concurrence on waivers and Equivalent Level of Safety (ELS) determinations.

d. Informing the Center Director and SMA Director of non-compliances with Agency range flight safety requirements and of other unsafe activities and practices.

e. Determining the need to monitor range flight operations and to include flight termination capabilities/requirements.

f. Designating Range Safety Officers (RSOs) or Flight Safety Officers (FSOs) to monitor range flight operations and make real-time decisions concerning flight initiation and termination Center Range Flight Safety Lead

g. The CRFSL is an AST position, requiring an engineering or appropriate related degree.

5.8.2.3 LaRC Range Safety Officer (RSO): A person primarily responsible for safety and oversight during range operations involving UAS. The LaRC Flight/Range Safety Officer has the authority to hold or abort the operation, or take a risk mitigation action, which includes terminating the flight. RSO is synonymous with the term "Mission Flight Control Officer" used at some DoD ranges. The RSO takes direction from the LaRC CFRSL.

5.8.2.4 Flight/Range Safety Officer (F/RSO) responsibilities:

a. Coordinates with the FAA on range operations that use the National Airspace System (NAS).

b. Provides interface with the FAA with regard to national airspace (NAS) usage for the development of UAS procedures, policy, and recommendations.

c. Provides interface with other government ranges to ensure flight operation in restricted airspace is consistent with NASA Range Safety Program risk mitigation requirements.

d. Implements policy and procedures in accordance with NPR 8715.5, Range Safety Program, tailored for this LPR.

e. Has the authority to hold or abort the operation, or take a risk mitigation action, which includes terminating the vehicle.

f. Verifies that all UAS Operation commit criteria have been met prior to a range and flight mission operation.

g. Responsible and accountable for the safe conduct of range flight operations (including aircraft and UAS flight operations) under their cognizance in accordance with applicable requirements.

h. Monitor the vehicle flight trajectory, vehicle systems, Flight Safety Systems, and the performance of the FTS and CMS if applicable to determine if there are any deviations which would require action by the R/FSO.

i. Terminate a flight when any aspect of the flight (including, but not limited to, vehicle or support system performance) violates preplanned termination criteria.

j. Serves as Interim Response Team in the event of a UAS mishap in accordance with NPR 8621.1C

k. The RSO is an inherently governmental position, in accordance with NPR 8715.5

5.8.3 Range Safety Personnel Training Program Requirements

5.8.3.1 In addition to the Flight Crew Training Requirements listed within this LPR, the training program for range safety personnel that support NASA range flight operations shall:

a. Provide qualified personnel to support nominal and contingency range flight operations

b. Include a recurring training process to ensure personnel retain their qualifications

c. Include a requalification process for personnel who lose qualification status, such as someone who exhibits substandard performance or has health problems.

5.8.3.2 Qualifications for Range Safety Position include demonstrated knowledge, experience, and decision making involved with safety at the Center, which may have included

operation of various labs, projects, crewed flight, simulators, and wind tunnels. Qualifications for personnel who perform range safety functions for a NASA range flight operations (including RSOs, FSOs, and personnel responsible for Flight Safety Systems and range safety analysis) shall include the training requirements listed within NASA-STD-8719.25 Appendix C and the below:

a. Successful completion of knowledge-based training (self-study and/or classroom) applicable to the range safety function.

b. Successful completion of instructor-led, hands-on training on how to perform the range safety function followed by satisfactory on-the-job performance as a trainee, as applicable.

c. Proficiency demonstrated to a qualified range safety professional during simulation scenarios that exercise hands-on operations of Flight Safety Systems and use of safety decision-making tools or processes, as applicable.

d. Proficiency demonstrated to a qualified range safety professional during exercises of nominal and contingency actions, as applicable.

e. F/RSOs shall perform real-time decision-making responsibilities during operations at a minimum of once per year per vehicle type.

f. F/RSOs with real-time safety decision-making responsibility shall meet the safety certification requirements of NPR 8715.3 and shall maintain an FAA Class III medical certificate if acting as both an observer and RSO.

g. In addition to the previous experience and knowledge, the F/RSO is required to complete the series of NASA Range Safety training courses, listed in NASA-STD-8719.25, Table A-3. The required courses are on SATERN as follows:

i. Flight Safety Systems (SMA-AS-WBT-335)

ii. Range Safety Orientation (SMA-AS-WBT-410)

iii. Range Safety Operations (Instructor Led)(SMA-SAFE-NSTC-0097)

iv. Risk Management Overview (SMA-OV-WBT-111)

v. Basics of Aviation Safety (SMA-SA-WBT-100)

Note: these courses may be taught during the Wallops Flight Facility Range Safety Course.

5.8.4 Range Flight Safety Standards Applicability

5.8.4.1 NASA Program Managers shall notify the CRFSL of planned range flight operations as soon as the possibility for the operation is identified.

5.8.4.2 NASA Program Managers, with concurrence from the CRFSL, shall determine the applicability of NASA-STD 8719.25 to the specific project and operations in accordance with Table 3-1.

5.8.4.3 NASA Program Managers shall document and implement a Range Safety Risk Management Process plan consistent with this LPR, NASA-STD-8719.25 when applicable, and requirements imposed by the range.

5.8.4.4 NASA Program Managers shall obtain concurrences and approval of the Range Safety Risk Management Process plan, and for any future changes, from the authorities defined in this NPR.

5.8.4.5 Requirements for the implementation of a Range Safety Risk Management Process are contained in paragraph 5.8.5.

5.8.4.6 NASA Program Managers shall notify the CRFSL of potential requests for ELS determinations or waivers as soon as the potential need for one is identified.

5.8.4.7 NASA Program Managers shall obtain ELS determinations and waiver approvals from CRFSL

5.8.4.8 NASA Program Managers shall ensure that each NASA range flight operation undergoes a range safety risk analysis to establish any design or operational constraints needed to control risk to the public, NASA workforce, and property, in accordance with NASA-STD-8719.25.

5.8.4.9 NASA Program Managers shall ensure that the range safety risk analysis incorporates the applicable requirements of any range, launch site, or landing site that supports the range flight operations.

5.8.4.10 NASA Program Managers shall obtain concurrence on the range safety risk analysis from the CRFSL.

5.8.5 UAS Range Flight Safety. Range flight safety considerations include three basic elements: range safety analysis, range safety systems, and operational requirements. The following section provides a description of these elements and related concepts tailored specifically to LaRC UAS safety of flight.

5.8.5.1 Range Safety Analysis. A range safety risk analysis shall be completed in accordance with NASA-STD-8719.25 incorporate the elements of risk management; i.e., risk assessment, risk mitigation, containment (a), and risk acceptance. UAS Programs shall present the Langley RSD UAS Operations Hazards Analysis (LF 580) before the ARB for review and final approval to address containment, fight termination, severity and probability of identified hazards along with control measures for mitigating risk down to acceptable levels for final approval and signature by the UASOO, Aviation Safety Officer (ASO) and the ER-ARB chairperson.

a Containment: A range safety technique that precludes hazards from reaching the

public, the workforce, or property that requires protection duringnormaland malfunctioning vehicle flight.

b. Risk Criteria: Each range operation shall satisfy the following criteria f or assessed risk unless higher risk levels are specifically authorized for the operation. For range operations managed by other government agencies, the RSO shall verify that the equivalent level of risk is aligned with NASA policy and then shall accept those conclusions or document in a separate Hazard Analysis Report generated for that particular location and operation.

c. Property Risk:

The Probability of Impact (Pi) for any property and damage of concern shall be $Pi \leq 1 \times 10^{-3}$ for any property within the containment (operations / hazard) area.

d. Individual Risk:

Probability of Casualty (Pc)

$Pc \leq 1 \times 10^{-6}$ for individual people who are not mission essential or critical operations personnel.

$Pc \leq 10 \times 10^{-6}$ for mission essential or critical operations personnel.

e. Collective Risk:

Collective Risk Criterion for the combination of Mission Essential Personnel and Critical Operations Personnel: Expectation of Casualty $(Ec) \leq 300 \times 10^{-6}$.

Collective Public Risk Criteria: $Ec \leq 100 \times 10^{-6}$.

5.8.5.2 Utilizing the results of the range safety risk analysis, the cognizant Range Flight Safety personnel, the authority responsible for the range, launch site, or landing site, and any other range users/tenants and public or private entities in the flight vicinity, shall:

a. Identify any NASA or non-NASA property in the vicinity of the flight that requires protection from potential debris impact and/or other hazards.

b. Local authorities and Programs are responsible for determining what property requires protection. Local authorities may have risk management requirements that apply to certain high-value equipment, assets, or other property. There may be specific property for which the Project requires risk management due to its proximity to the flight and the consequences associated with potential hazards.

c. Ensure decisions to accept risks associated with range flight operations consider risk to the public, NASA workforce, to any property identified in paragraph a. above,

mission, including the safety of any flight crew, and mission constraints.

d. Make operational decisions needed to control risk prior to initiation of flight or each phase of flight to an acceptable level.

5.8.5.3 The UASOO shall develop and maintain formal documentation that provides the details of the Range Safety Risk Management Process.

5.8.6 Range Flight Safety Systems: NASA Program Managers subject to NASA-STD-8719.25 shall obtain a determination from the CRFSL as to whether flight safety systems, such as a Flight Termination System (FTS) or a Contingency Management System (CMS), are required. In other cases, range authorities may separately require the implementation of such systems.

5.8.6.1 If the use of a FTS or CMS is required based on a determination by the CRFSL, the NASA Program Manager responsible for range flight operations shall request the designation of a qualified civil service personnel RSO/FSO from the CRFSL to operate or direct the use of those systems in accordance with NASA-STD-8719.25.

5.8.6.2 If the use of a FTS or CMS is required, the NASA Program Manager responsible for range flight operations shall obtain activation criteria from the RSO/FSO.

5.8.6.3 NASA Program Managers shall develop and obtain concurrence from the CRFSL or designated RSO/FSO on launch and flight commit criteria to be used during range flight operations.

5.8.6.4 Each flight operation shall have a contingency plan in the event the vehicle experiences momentary or permanent loss of command communication of the control link with the ground station where the pilot in command is operating. This plan may have one or all of the following features as part of the strategy.

5.8.6.5 Flight Termination System (FTS): The FTS is an independent system specifically designed to terminate the flight of the vehicle in the event of a system failure in which the vehicle no longer responds nominally to control commands from the ground station / PIC. In such a case, the F/RSO shall initiate the termination-of-flight command to bring the vehicle down to the ground in a safe location.

5.8.6.6 Failsafe System: The failsafe system is an integral part of the flight control system and program logic that will be initiated automatically or by the PIC. In this case, the on-board control system will initiate a pre-programmed series of maneuvers to either bring the vehicle down in a controlled manner or, in the case of autonomous flight operations, direct the vehicle to a predetermined specific GPS waypoint or “home” location. If communication is not reestablished, then the vehicle can linger, circling the waypoint until all fuel is consumed, or an auto-land may be initiated. In either case, the vehicle will be brought down to the ground in a way that will minimize property damage and optimize containment measures.

5.8.6.7 Safety Critical Software: Vehicle programs and range safety organizations shall identify

safety-critical software in range safety systems owned by NASA or used to support NASA missions and ensure it satisfies project/mission requirements, and ensure it satisfies NPR 7150.2, NASA Software Engineering Requirements, and NASA-STD - 8739.8, Software Assurance and Software Safety Standard.

5.8.6.8 Implementation of the launch/flight commit criteria shall include documenting the actual conditions at the time of flight or time of each phase of flight where applicable to verify that the launch/flight commit criteria have been met.

6. CREWED AIRCRAFT FLIGHT TRAINING

6.0 GENERAL

6.0.1 Pilots shall receive the following training annually:

a. Emergency egress training.
b. Crew resource management (CRM) training.
c. Pilot recurrent aircraft training, as appropriate.
d. Additional emergency procedures training, as required by the Safety Management System requirements of NPR 7900.3.
e. Single-pilot crew operations training (by type), if available.
f. RVSM/RNP/International training, as appropriate.
g. Instrument Refresher training

6.1.2. Individual Training Plan - Prior to the start of each calendar year, the Chief Pilot shall evaluate each pilot to determine their individual training needs.

a. These training plans shall contain quantitative goals for obtaining or maintaining proficiency in specific aircraft types, in specific flight conditions, and in specific maneuvers necessary to support assigned flight projects and aircraft.

b. Recurrent formal training shall be included and will normally include simulator training in an FAA-approved facility. This should include single-pilot operations training, if available, dependent upon the aircraft type certification allowing single-pilot operation.

6.2 EGRESS TRAINING

6.2.1 The Research Services Directorate shall establish a formal egress training program for all personnel who have official flight duties.

a. Egress training is required annually for all crewmembers and qualified non-crewmembers in each aircraft in which they fly and shall be documented on LF123.

b. Qualified pilots are the primary egress briefers.

c. Medical emergency situations, depressurization, ditching and inflight aircrew incapacitation shall be addressed.

6.3 PHYSIOLOGICAL AND HYPOXIA TRAINING

6.3.1 LaRC pilots and crewmembers operating aircraft above 10,000 ft pressure altitude are required to attend initial physiological training. This may be achieved by previous qualification (i.e. previous military training).

a. All crewmembers should attend physiological refresher training at least every five years.

b. ROBD trainers may be used except in the case of initial training for pilots.

6.4 EJECTION/HELICOPTER SEAT TRAINING

6.4.1 Flight in ejection seat/helicopter aircraft of LaRC pilots shall be allowed provided they meet other center's requirements for flight in those aircraft.

6.5 WATER SURVIVAL TRAINING

6.5.1 Annual academic refresher shall be conducted over LaRC centric survival gear. In the event a LaRC pilot does not have previous water survival training, a personalized syllabus shall be affected for qualification.

6.6 COLD WEATHER SURVIVAL TRAINING

6.6.1 Cold-weather survival training should be considered for deployments in cold environments.

6.7 AED/CPR TRAINING

6.7.1 AED/CPR training shall be conducted biennially for all pilots.

6.8 RECURRENT PILOT TRAINING

6.8.1 The table below highlights recurrent pilot training

Aircraft	Initial Qualification	Recurrent Qualification	Notes
G-III	In a G-III initial class	Annual recurrent in an approved flight simulator	Only one recurrent (G-III or G-IV) is necessary for both G-III and G-IV aircraft. SIC designation with training, 100 hours in G-IV aircraft and designated PIC in G-IV aircraft.
G-IV	In a G-IV initial class for PIC.	Annual recurrent in an approved flight simulator	Only one recurrent (G-III or G-IV) is necessary for both G-III and G-IV aircraft. SIC designation with training, 100 hours in G-III aircraft and designated PIC in G-III aircraft.
HU-25	In an FA-20 initial class	Annual check ride in aircraft	
B-200/ UC-12	In a King Air initial or recurrent class	Annual recurrent in an approved flight simulator or check ride in aircraft	Annual check ride in King Air aircraft may replace or be in addition to recurrent simulator
LC-40/ SR-22	Locally with a safe for solo check ride	Annual check ride	Annual check ride may be in one aircraft to qualify for both aircraft

If research schedule or other time constraints exist, the CFO may delay recurrent training. Proficiency goals may include more frequent training as resources permit.

6.8.2 Emergency procedures training shall normally be conducted during annual recurrent training at an approved simulator facility. If emergency procedure training is conducted on an actual aircraft, no QNC personnel or passengers shall be on board.

6.9 TRAINING RECORDS

6.9.1 The Chief Pilot, UAS Branch Head, and RSIB Branch Head shall be responsible for maintaining complete training records for crew members, qualified non-crewmembers, and maintenance personnel. UAS projects shall document and maintain training records pertinent to the requirements of the project FTOSR/ORR and the requirements of Chapter 5 of this document.

6.9.2 The CFO/ADFO shall ensure that training records are maintained for all other personnel routinely involved in crewed aircraft operations. This information is normally tracked in FDC/NAMIS.

6.9.3 Crewed aircraft training records shall include the following:

a. Name
b. Crew position, if applicable
c. Flight physical date
d. Certificate type
e. Number of certificates
f. Date of indoctrination training completion
g. Date of initial equipment training completion
h. Dates of completion for the following recurrent training:
    i. Ground school
    ii. Annual check ride/recurrent training
    iii. Special training (any agency-specific training deemed necessary i.e., windshear, seat dependent task training, project-specific training requirements, international procedures, crew resource management (CRM), single-pilot checkout, etc.)
        a. Handbook exams, if required by type of aircraft.
    iv. Training records may be maintained in conjunction with SATERN, NAMIS, and hard copy documentation, as appropriate. Reference in the hard copy file shall make reference to the applicable links to SATERN, NAMIS, or other electronic filing systems.
    v. Records of the completion of all required and optional training shall be kept in these files for a minimum of 5 years.

7.0 CREWED AIRCRAFT PILOT QUALIFICATIONS & RESPONSIBILITIES

7.1 GENERAL

7.1.1 Crewed aircraft pilot staff shall be capable of skillfully and safely operating the range of aircraft types, as assigned, for which the Center is responsible. Therefore, pilots are required to maintain qualifications over a number of different aircraft, as required to support assigned projects. sUAS pilot qualifications are addressed in Chapter 5.

7.1.2 LaRC pilots may be qualified LaRC civil service employees, qualified contractor employees hired in accordance with a contract providing piloting services, or qualified military or civilian detailees from other government organizations. The Chief Pilot, with concurrence of the CFO, may approve waivers to these requirements where appropriate and justified. Research pilots shall possess at least a bachelor's degree in engineering or an equivalent scientific degree from an accredited college/university. A degree in Aeronautical or Aerospace Engineering is desirable.

7.1.3 Pilots shall be designated in writing by the CFO as Pilot-in-Command (PIC) or as Second-in-Command (SIC) for a particular type aircraft. Additional designations that may be granted include Instructor Pilot (IP), Check Airman (CA), and Functional Check Flight (FCF) Pilot.

7.1.4 In this section, use of the term “management” shall mean the CFO and the RSD Director, unless otherwise noted.

7.1.5 All pilots are considered to be in safety critical positions and are subject to the provisions of the LaRC Random Drug Testing Program.

7.2 PILOT OCCUPATIONAL CATEGORIES

7.2.1 Crewed Aircraft Research Pilots – Crewed aircraft research pilots shall be designated as an "Aerospace Engineer and Pilot - AST Research Pilot" and shall meet the hiring and academic qualification requirements for an Aerospace Technologist (AST) position, in addition to the pilot requirements listed in this document. In general, research pilots are expected to have engineering or similar scientific backgrounds, documented flight test experience, and a broad background of flying experience. Military pilots detailed to NASA who have similar qualifications may also be designated as “Research Pilots.” Research pilots are expected to participate in the scientific aspects of the programs to which they are assigned and to publish the results of their efforts, as appropriate. Research pilots may fly research, program support, and mission management aircraft, provided they are properly qualified and current in the aircraft identified for the mission.

7.3 CREWED AIRCRAFT PILOT DESIGNATION

7.3.1 Flight Experience - LaRC crewed aircraft pilots are expected to have achieved minimum experience requirements prior to being employed as a pilot, as outlined in the following table. In individual cases, management may waive or amend these requirements.

a. Research PIC

Category	Minimum Flight Hours*
First pilot/PIC	2000
Turbine Aircraft	500
Instrument (Actual or Simulated)	250
Night	100
Cross-country	500
Aerobatic	15
Formation	15

*Waiverable by CFO/ADFO.

b. Research SIC

Category	Minimum Flight Hours
First pilot/PIC	1000
Turbine Aircraft	250
Instrument (Actual or Simulated)	150
Night	50

c. LaRC Research Pilots shall meet the following minimum experience levels to be designated as PIC in each category of aircraft:

Aircraft	Minimum Hours in Type
Propeller Aircraft	20
Jet Aircraft	50
Multi-engine, weight> 12,500 lbs	50

d. LaRC Research Pilots shall meet the following minimum experience levels to be designated as SIC in each category of aircraft:

Aircraft Type	Minimum Hours in Type
Propeller Aircraft	15
Jet Aircraft	25
Multi-engine, weight> 12,500 lbs	50

7.3.2 Pilot-in-Command - A PIC designation requires demonstrated airmanship, maturity, and aircraft systems knowledge for a particular type of aircraft. The individual shall be recommended by the Chief Pilot, approved by the CFO and designated in writing. A PIC is responsible for the safe conduct of the flight and for the safety of all embarked personnel. The PIC shall use Crew Resource Management (CRM) techniques in the conduct of assigned flight operations. The PIC shall comply with all mandated FAA pilot certifications, including current medical certification and applicable ratings, if a NASA-owned aircraft is operated as a civil aircraft under an FAA

Airworthiness Certificate. Specific LaRC PIC responsibilities are listed in section 1.8. PIC requirements for Mission Management operations are addressed in NPR 7900.3.

7.3.3 Second-in-Command – An SIC designation requires demonstrated airmanship, maturity, and aircraft systems knowledge for a particular type aircraft at a level of expertise that provides for professional cockpit assistance to the PIC. This shall include the implementation of Crew Resource Management (CRM) techniques. Designation shall be in writing and shall be approved by the CFO upon the recommendation of the Chief Pilot. Some aircraft may require an SIC to be assigned based on aircraft type certification or on specific research requirements. SIC requirements for Mission Management operations are addressed in NPR 7900.3. Most international operations require the SIC to hold a valid type rating, if a type rating is available for a particular aircraft. Alternatively, for domestic operations in the United States, an SIC without a type rating may operate an aircraft as SIC if they meet the following requirements:

a. Complete an appropriate ground school/systems training in accordance with FAR Part 61 SIC requirements.

b. Be landing current in type as set forth in FAR Part 61.

c. Meet additional flight training requirements established by the Chief Pilot and be evaluated by an IP.

d. For G-IV operations, an SIC may be designated if previously qualified as a PIC in G-III aircraft with 100 hours in G-III and has accomplished a G-IV ground school locally developed by the Chief Pilot.

7.3.4 Instructor Pilots, Check Airmen, and Functional Check Flight Pilots – Special designations of pilots are required for the following positions:

a. Instructor Pilot (IP)

(1) To be designated as an instructor pilot in crewed NASA LaRC aircraft, a pilot shall have demonstrated superior systems knowledge and piloting skills in the type of aircraft in which designation is sought. The pilot shall be recommended by the Chief Pilot and designated in writing by type aircraft.

(2) In general, the IP shall be considered a subject matter expert on the particular type of aircraft. The Chief Pilot shall determine the training syllabus to be used to provide for IP designation. The syllabus may utilize the aircraft manufacturer's or military guidance, as appropriate.

(3) NASA crewed aircraft instructor pilots shall have a previous or current designation as an FAA Certified Flight Instructor (CFI) or military instructor pilot before obtaining designation as a NASA Instructor Pilot.

(4) Minimum IP qualifications are:

Aircraft	Hours in Type (waiverable by CFO)
SR-22 / LC-40	25 (plus 100 hours in similar aircraft (e.g. T-34, T-6)
B-200/UC-12	200 (PIC time in turbine aircraft)
HU-25	50 + 500 hours PIC time in multi-engine jet aircraft
G-III / G-IV	50 + 500 hours PIC time in multi-engine jet aircraft

d. Check Airman (CA)

Check Airmen are senior IPs who have been designated to not only provide training, but also to provide check rides for the aircraft in which this designation has been granted. This designation is granted through the evaluation by the CFO and the Chief Pilot of the experience and knowledge of the instructor pilot to perform check ride signoffs in the appropriate aircraft. These pilots shall be designated in writing and shall familiarize themselves with appropriate flight training syllabi and check flight procedures for the type aircraft that they are authorized to check.

Check Airman minimum qualifications are designation as an IP and PIC in the aircraft. The CA shall be qualified, designated, and current in the model aircraft that the check is being performed in.

c. Functional Check Flight (FCF) Pilot

(1) Functional check flight pilots are to be chosen and recommended by the Chief Pilot, based on their superior systems knowledge. These pilots shall be designated in writing and shall familiarize themselves with appropriate maintenance functional check flight procedures for the type aircraft that they are authorized to check.

(2) Maintenance functional check flights (FCFs) normally require such checks as engine shutdown and restart, propeller feathering, pressurization checks, and electrical system checks in flight. Therefore, all FCF pilots shall obtain a briefing from appropriate maintenance/QA personnel prior to flight, concerning the maintenance checks that need to be performed.

No research mission shall be combined with an FCF. At the completion of the FCF, the pilot shall debrief QA and appropriate maintenance personnel on all aspects of the flight and discrepancies that were noted.

(3) Minimum FCF qualifications are:

Aircraft	Minimum Hours in Aircraft (may be waived by CFO)
SR-22 / LC-40	25 (and 100 hours in single engine propeller)
B-200 / UC-12	100 (and 500 hours multi engine)
HU-25	100 (and 1000 hours multi engine)
G-III / G-IV	100 (and 1000 hours multi engine)

7.3.5 Multiple Aircraft Designations - Given the need for pilots with a broad base of experience and the highly structured flight environment at LaRC, there is no prescribed limit to the number of aircraft types in which a pilot can maintain designation.

Maintenance of currency and proficiency, and provision for retraining and/or requalification in a particular type aircraft, shall be coordinated with the Chief Pilot or AOEB for appropriate scheduling.

7.3.6 Visiting, Guest, and Subject Pilots - Pilots required or invited to fly LaRC aircraft to meet LaRC mission requirements shall meet LaRC qualification and currency requirements or as specified by the FRR/ORR or CFO. Pilot designations shall be documented and signed by the CFO. Pilots shall fly subject to the authority of the CFO.

a. The Chief Pilot shall maintain pilot training and qualification records on pilots operating LaRC aircraft as PIC. As a minimum, documentation shall include a copy of their pilot and medical certificates, and pertinent training records or logbook documentation.

b. For research missions, ORR/FRR shall establish qualification requirements for the aircrew involved in the research, if required.

7.4 REQUIREMENTS FOR CREWED AIRCRAFT PILOT CERTIFICATION

7.4.1 General - Due to the nature of research aircraft operations, special arrangements may be necessary for pilots and other crewmembers to obtain training prior to operating some LaRC aircraft. Normally if a formal outside training syllabus is unavailable, an in-house training syllabus shall be adopted to provide for safe initial operations, utilizing qualified IPs and CAs. Approved FAA and/or military training facilities may be utilized as an alternative method of obtaining type-specific training and checkout.

7.4.2 In Type

a. For initial certification and operation of LaRC aircraft operated as civil aircraft with a FAA certificate of airworthiness, crewed aircraft pilots shall be required to have appropriate FAA certificates and ratings.

b. Pilots shall receive initial training in individual aircraft types from the appropriate flight instructor for that aircraft or from a formal FAA training provider. Use of formal ground school and simulator facilities are encouraged, if available.

c. All RSD syllabus flights shall be documented on an LF 277, NASA/Langley Research Center Flight Evaluation and Training Record.

d. All check flights shall be conducted by a NASA CA or FAA Designated Examiner, as appropriate, and shall be documented on a LF 277, or equivalent FAA training record form, such as a logbook entry or completion certificate.

e. Initial checkouts in aircraft shall include a completed locally-developed handbook exam on aircraft systems and emergency procedures, unless the initial qualification was through the use of an FAA-approved training course.

Handbook exams for research aircraft shall be tailored to the aircraft configuration and mission equipment installation, with emphasis on unique inflight emergency procedures required.

f. When an established school is not available, as in the case of a one-of-a kind research aircraft or other type of flying device, the Chief Pilot shall establish checkout requirements with the concurrence of the ASO and the CFO. Approvals for operation of these aircraft shall be guided by engineering and design reviews and appropriate test plan approvals.

7.4.2.1 Type Ratings - For LaRC aircraft operated as public aircraft in domestic airspace, FAA type ratings are not required, but are recommended, if available.

a. Pilots who do not already have the requisite type rating for a particular aircraft shall obtain type ratings through NASA-funded training for aircraft requiring type ratings in civil operations. For LaRC aircraft that carry an FAA civil airworthiness certificate requiring a type rating, type rating training and certification is required if the aircraft is being operated in accordance with the FAA civil airworthiness certificate.

7.5 CREWED AIRCRAFT PILOT RESPONSIBILITIES

7.5.1 Upon acceptance of the aircraft for flight, the PIC is responsible for the safe operation of the aircraft and the safety of the passengers and crew. A list of PIC responsibilities is included in Section 1.8.

a. The PIC shall ensure that passenger briefings are conducted for normal and emergency egress and other safety-related matters.

b. Although scheduling personnel shall monitor currency and qualification of pilots prior to flight assignment, it is ultimately the responsibility of each pilot to ensure that he or she is qualified and current in accordance with the provisions of this document and NPR 7900.3 prior to undertaking flight operations in a LaRC aircraft.

7.5.2 SICs, when assigned, shall provide assistance and CRM support to the PIC while in flight and during ground operations. Especially important is the support from the SIC while providing copiloting duties during IFR conditions, congested airport operations, and research non-standard operations.

7.5.3 No emergency or non-normal procedures shall be practiced in aircraft while in flight with passengers or non-qualified crew members on board. Documented FCF procedures are considered normal for the purposes of this section.

7.6 FLIGHT TEST REPORTS

7.6.1 If required by the Principal Investigator (PI) or lead researcher, or other entity, designated research aircrew shall complete a Flight Test Report in a format appropriate to the activity.

7.6.2 If multiple flights are required to complete an experiment card, the flights may be combined on a single report. If other documents are referenced, such as experiment plans, copies shall be attached.

a. When multiple air crew are involved in a mission, only one report is required. However, all other air crewmembers having opinions, evaluations, or information that could be important to the project or to future operations, shall submit separate inputs or combined reports.

b. Any reports that require internal distribution shall be reviewed by the Chief Pilot and Principal Investigator or lead researcher prior to distribution.

c. Such reports are not considered publications and may not be disseminated to non-LaRC entities without management approval.

7.7 ASSIGNMENT OF PROJECT AIRCREW

7.7.1 The Chief Pilot shall make project pilot assignments, based upon pilot workload, related experience, short and long-term availability, costs of training and checkouts, demonstrated professionalism, and other factors. Assignment may be on the LF444 or in another format, but:

a. Assignment as project aircrew does not preclude later changes to this designation or the use of other aircrew on the project.

b. The Aviation Safety Officer shall not normally be assigned as a Project Pilot. However, the ASO may participate in research project flying as a PIC or

SIC, but may not be assigned directly to the project.

7.8 PILOT FLIGHT CURRENCY REQUIREMENTS

7.8.1 General - LaRC pilots shall meet minimum currency requirements listed in this section in order to carry personnel in LaRC aircraft. However, pilots are not expected to meet all minimum currency requirements at all times.

a. If maintaining currency in a particular category or type is not required to meet mission requirements, currency may be allowed to lapse provided it is not one of the minimum currency requirements of NPR 7900.3.

b. In addition to these requirements, the Chief Pilot or the CFO may establish special requirements if warranted by safety considerations.

c. Conversely, the CFO may waive compliance with these requirements in special cases, where justified.

7.8.1.1 The currency requirements of this guideline are minimum requirements, and meeting them shall not be construed as constituting proficiency. Depending on individual pilot backgrounds and experience levels, aircraft complexity, and mission requirements, proficiency flying beyond that necessary to meet the minimum currency levels of this guideline may be approved and/or required. LaRC pilots shall use the standards for currency found in FAR Part 61 as the minimum basis for assessing pilot flight currency. For LaRC aircraft operated as civil aircraft, the currency requirements of FAR Part 61 are mandatory.

7.8.2 Individual Training Plan - Prior to the start of each calendar year, each pilot shall develop and submit an individual training plan for Chief Pilot approval. This plan shall guide the scheduling and assignment of pilots to regularly scheduled flights in support of approved projects, with the goal being to continuously meet currency requirements, as a minimum, and meet proficiency plans as a goal.

7.8.3 Currency Requirements for Research Pilots

Research pilots shall meet the currency requirements (landings, approaches, and hours) in NPR 7900.3 series.

a. Failure to meet any night currency requirement in this category shall result in restriction to operations not carrying personnel at night until the appropriate requirement is met or a waiver is obtained.

b. If a pilot fails to meet currency requirements, the Chief Pilot shall take action to ensure currency is met, unless it has been waived as set forth in para. 7.8.3 a.

7.8.4 Other Currency Requirements

7.8.4.1 Instrument Proficiency Check (IPC)

a. LaRC pilots may meet the IPC requirement by attending formal initial or recurrent training. Failure to meet this IPC currency requirement shall result in restriction to Visual Flight Rules (VFR) conditions as a PIC. They may continue to serve as an SIC in instrument conditions, provided they previously conducted an IPC.

b. A local instrument check ride may serve as an IPC, but is not the preferred method.

7.8.4.2 Annual Instrument Refresher - Each LaRC pilot shall attend a classroom instrument refresher course annually. Taking an open book instrument exam approved by the Chief Pilot may be substituted if an instrument course is not available. An FAA approved aircraft syllabus that also provides an instrument sign off qualifies for this instrument refresher.

7.8.4.3 Annual Handbook Review - Each pilot is required to review the pilots operating handbook annually for each aircraft in which he/she is qualified. Retaking or reviewing the aircraft handbook exam, as applicable, may document this review.

a. If a formal systems refresher course for a particular type of aircraft is accomplished during the year, a handbook exam is not required.

b. Each pilot jacket shall contain documentation indicating the date each handbook review was conducted.

c. Failure to meet this requirement shall result in restriction from operating the aircraft until the review is completed.

7.9 REMEDIAL RE-EXAMINATION PROCEDURES

7.9.1 Upon identification of deficiency during a training event or check flight, a check airman/instructor may retrain and recheck or identify the deficiency and recommend remedial training to the Chief Pilot.

a. If additional flight or simulator retraining is required, the check airman/instructor shall request a reexamination check, in writing, to the Chief Pilot.

b. The request shall include a verification statement that remedial training has been completed and the crewmember has reached a performance level that warrants re-examination.

c. Re-examination flight checks shall be accomplished as directed by the Chief Pilot.

d. The Chief Pilot shall document any limitations placed on the crewmember until the reexamination has been satisfactorily completed.

e. Documentation of the recheck shall be made using LF 277, NASA/Langley Research Center Flight Evaluation and Training Record.

7.9.2 Requalification - If any currency requirement is not met, requalification may be accomplished by demonstrating proficiency in flight to an IP. If an IP is not available, recurrency shall be accomplished with another pilot current in the aircraft.

a. If all pilots are noncurrent, the least noncurrent pilot shall act as the safety pilot to re-qualify the other pilots.

b. If two pilots are not available, currency then may be obtained by solo or minimum crew operations at the discretion of the CFO, as appropriate.

c. Other aircrew or research personnel shall not be carried until currency requirements have been achieved for the crew position and type of operation required.

7.10 REMOVAL PROCEDURES

7.10.1 Any flight crewmember who does not meet the recent flight experience requirements stated in this Operations Manual shall have his position reviewed by the RSD Director.

a. After thorough review of training and qualification difficulties, a decision shall be made concerning continuation in flight status or whether a waiver action is appropriate.

b. Additional guidance is available in NPR 7900.3.

7.11 PILOT RELEASE FROM FLIGHT STATUS

7.11.1 Pilots may be released from flight status under the following conditions:

a. Failure to meet the minimum pilot requirements of this document (including medical).

b. Failure to operate LaRC aircraft in a safe and professional manner, or the gross or consistent use of poor judgment (Additional guidance is available in NPR 7900.3).

c. If their piloting services are no longer required to meet organizational commitments.

7.12 RECORDS AND LOGS

7.12.1 An automated pilot flight time logging system shall be provided for documenting pilot currency status with regard to flight time, instrument approach, and landing currency requirements. This is normally provided through the use of the NAMIS system.

a. The Chief Pilot, in conjunction with the CFO, is responsible for maintaining and documenting pilot currency status with regard to all other currency requirements.

b. Pilots shall not be required to maintain individual logbooks, provided an automated logging system is in operation to document compliance with currency requirements.

c. The automated logging system shall be maintained on a daily basis so that a ready reference is available to assist in properly assigning crews based on currency and training accomplished.

8. REQUIREMENTS FOR CREWED AIRCRAFT QUALIFIED NON-CREWMEMBERS (QNCs)

8.0.1 QNC Overview

8.0.1 A Qualified Non-Crewmember (QNC) is an individual, other than a member of the flight crew, aboard an aircraft whose presence is required to perform, or is associated with the performance of the research being conducted on that flight.

This section applies to LaRC sponsored flight research activity on both LaRC and non-LaRC aircraft. (Note: NASA LaRC is not authorized to conduct passenger operations, therefore all non-pilots onboard LaRC aircraft must be classified as a QNC, and must satisfy the requirements listed below.)

8.1.1 RSD QNCs

8.1.1. Maintenance technicians are approved on flights as required (maintenance evaluation flights or transit to/from deployment location) provided they have met QNC requirements. Maintenance technicians, when a single pilot is authorized, may sit in the right seat of the aircraft during flight. Engineering personnel or other RSD personnel may also fly as QNCs. RSD will issue an authorization to RSD QNCs to fly on the aircraft as long as required. The status and supporting documentation for each RSD QNC is maintained in the 'QNC Currencies' folder on the RSD 'AOEB-FltOps' SharePoint site.

RSD QNCs are considered to be in safety critical positions. Employees in these positions are subject to the provisions of the LaRC Random Drug Testing Program.

Flight Operations Engineer (FOE). The participation of a FOE may be required depending on the complexity of the research operations and/or the number of researchers on board, typically on larger aircraft such as the HU-25 and GIII. The FOE is normally the primary conduit for communications between the flight crew and research personnel. The decision to use a FOE is made by the CP or ADFO after consultation with AOEB and the ASO. To be assigned as FOE, individuals must be a qualified QNC and demonstrate knowledge of aircraft and associated safety systems, research equipment, communication systems (internal and external as applicable), door open/closing, and egress/evacuation procedures. This position is normally staffed through AOEB.

8.1.2 Non-RSD QNCs

Non-RSD QNCs (e.g., researchers, subject matter experts, human test subjects, public outreach, etc.) required to fly onboard aircraft are classified as QNCs, and will receive authorization to fly on the specific aircraft for the duration of the research flight activity.

8.1.3 Records Management for QNCs

Information required for a QNC to fly on an aircraft does not meet the NPR 1441.1 (Section 1.1.2) definition of a 'record' of RSD operations.

In accordance with NRRS 1141.1, 'information copies' (AFS # 1000, Item 5) may be destroyed when no longer needed or when one year old, whichever is sooner.

8.2 REQUIREMENTS FOR NON-RSD QNCS

8.2.0 For a non-RSD QNC to fly on LaRC aircraft or on non-LaRC aircraft, four requirements must be met: medical certification, project designation, RSD authorization, and egress training. (Note: egress training requirements for non-LaRC aircraft is determined by organization operating that aircraft, and is not tracked by RSD.)
The status and supporting documentation for each non-RSD QNC is maintained in the 'QNC Currencies' folder on the RSD 'AOEB-FltOps' SharePoint site.

8.2.1 Medical Certification
This process requires the QNC complete a Basic Medical Course from the Mayo Clinic or AOPA, and the QNC provides evidence of completion to the NASA Clinic. (Contact the NASA Clinic for alternative means to obtain a medical clearance, such as a current FAA or military flight physical.)
After successful completion of the medical review, the LaRC Flight Surgeon signs the Appendix B of OCHMO-STD-1880.1, and the Clinic sends it to AOEB Branch Head.
The medical certificate is valid for up to the end of the 12th month or the date specified by the Flight Surgeon, whichever occurs first.
For purposes of verifying the QNC's medical certification, only the Flight Surgeon signature on Appendix B is needed; the signature by the QNC is desired but not required.

8.2.2 Project Designation
The Principal Investigator of the research flight activity will submit a list of all non-RSD QNCs to AOEB Branch Head that includes the person's name, organization, cell phone, person's e-mail address, supervisor's name, supervisor's phone number, and supervisor's e-mail address. The e-mail will also include the name of the research activity, intended aircraft, and projected flight window.
This document provides evidence that the QNC's participation in a research flight test activity is acknowledged by the Project, and that they are performing their duties in accordance with their position description or contract.
This approval is valid until the end of the research flight test activity or until the date specified by the supervisor, whichever occurs first.

8.2.3 RSD Authorization
The RSD Project Manager will present the list of non-RSD and RSD QNCs during the Operational Readiness Review (ORR). Acceptance of the research flight test activity (i.e., signing the ORR) is the RSD authorization for that QNC to fly on-board the specified aircraft. Alternate means of authorization include NAMS request (future capability) or sending a request to add individuals after the ORR to the AOEB Branch Head.
This authorization is valid until the end of the research flight test activity.

8.2.4 Egress Training
For non-LaRC aircraft operations, QNCs will meet the training requirements and comply with the procedures of the operator of that aircraft. This training is not tracked in the 'QNC Currencies' database.

For LaRC aircraft operations, RSD pilots will provide egress training prior to the QNC's first flight, to include the understanding and acceptance of flying on a Public Use aircraft.
The pilot giving the training will e-mail AOEB flight operations distribution with the type training given, including acceptance of the Public Use Disclosure, and the QNCs name and organization.
Egress is valid for up to the end of the 12th month from when the training was given.

8.3 FLIGHT OPERATIONS

The name of each QNC shall be listed on the flight manifest.
The PIC shall use the 'QNC Currency' database on the AOEB-FltOps SharePoint site to verify each person is current and authorized as a QNC on that aircraft for that mission.
The aircraft PIC (Pilot In Command) retains final authority for all actions pertaining to the safe operation of the aircraft, to include who is authorized to board the aircraft, if the mission should be flown, and if the mission should be terminated early. A partial list of items the PIC considers includes the QNC's ability to egress the aircraft in normal and emergency conditions (weight, size, mobility, etc.), the QNC's physical and emotional state (under the influence of medication or alcohol, distressed or distracted, fatigued, etc.), and the internal configuration of the aircraft (trip hazards, confined spaces, etc.).

9. CREW DUTY LIMITATIONS

9.0 GENERAL

9.0.1 Definitions for *critical job* and *critical person* from LAPD 1700.5, *NASA Langley Research Center Maximum Work Time Policy*, apply to all who fly, operate or prepare aircraft or research systems, and generally to those who conduct research aboard aircraft. LaRC aviation operations are conducted in accordance with the policies/limits established by LAPD 1700.5, with additional restrictions as noted in the table below.

9.0.2 The normal crew duty time limit is 12 hours. Each crew duty period of 12 hours or greater shall be followed by a minimum rest period of 10 hours. Crew duty time begins when a crewmember arrives at his duty station, whether for the purpose of flight or non-flight activities. Crew duty time ends when a crewmember has completed official duties for the day. Crew duty hour maxima are:

Work/Flight Time Maximum*	Hours
Maximum workday without CFO approval	12
Maximum workday with CFO approval	16
Maximum flight time in single piloted operations per day	8
Maximum flight time in dual piloted operations per day	10
Maximum flight time with CFO approval per day	12

9.2 CREW REST

9.2.1 Crew rest is required for all aircraft crewmembers and QNCs with in flight responsibilities. During research flying, all QNCs shall be considered to have in flight responsibilities. During non-research flying QNCs are not considered to have in flight responsibilities unless they have an active role in the flight (e.g. FCF or maintenance check flight).

a. Crew rest is the time period prior to the time the crew reports for flight, during which the crewmembers are assigned no official duties. During this time the crew is expected to obtain sufficient rest prior to the flight. There must be an opportunity for 8 hours of uninterrupted rest within the overall crew rest period.

b. Minimum crew rest time shall be 10 hours beginning at the time the crewmember completes official duties for the day and ending when the crewmember reports for duty.

c. A crewmember or QNC may accept an assignment for flight time only when the applicable requirements are met.

d. No crewmember or QNC may be made to accept a mission during any required rest period.

e. Time spent in transportation, not local in character, that is required of flight crewmembers is not considered part of a rest period.

f. A flight crewmember is not considered to be assigned flight time in excess of flight time limitations if the flights to which he/she is assigned are expected to terminate within the published time limitations. In the case where circumstances beyond the control of the flight crewmember (such as adverse weather conditions) cause an unexpected delay in landing, the PIC shall exercise good judgment concerning the continuation of the flight. If it is deemed to be safer to continue to the intended destination within a short period of time, rather than to divert to another location based on weather, landing conditions at the alternate, or other factors, then the PIC may continue, but shall provide a debrief on the situation to the ADFO/Chief Pilot upon landing.

g. Violations of the above limitations shall be reported immediately to the Chief Pilot

9.2.2 **FLIGHT TIME LIMITATIONS AND REST REQUIREMENTS.**

9.2.2.1 A pilot may not be assigned or accept an assignment for flight time as a member of a crew if that crewmember's total flight time in all government flying will exceed:

a. 200 hours in any calendar quarter

b. 350 hours in any two consecutive calendar quarters

c. 500 hours in any calendar year.

9.2.2.2 When a flight crewmember has exceeded the daily flight time limitations in this section, because of an emergency response or circumstances beyond the control of the agency or flight crewmember (such as adverse weather conditions), that flight crew member shall have a rest period as determined by the ADFO, but not less than 12 hours before being assigned or accepting an additional flight assignment.

9.23 **MULTIPLE TIME ZONE CROSSING**

9.2.3.1 For flights or travel when multiple time zones are crossed (measured from takeoff to landing destination), a down day is required if more than 4 time zones are crossed and an additional down day is required for every additional 4 time zones crossed (e.g. crossing 12 time zones in a single day requires 3 down days). If on a deployment flight or return flight across multiple time zones, a down day is not required if the same circadian rhythm as the origination airfield is maintained. Whenever crossing more than 5 time zones, a fatigue management plan must be approved by the Chief Pilot or during the FRR/ORR process.

10. CREWED AIRCRAFT RESEARCH EXPERIMENTS

10.1 GENERAL

10.1.1 The functional implementation of LaRC aircraft research experiments is guided by policies and procedures described in this chapter. The specific, chronological activities of the personnel and organizations involved in planning and carrying out aircraft research experiments are detailed herein. Although specified in a chronological order, the order may be changed or some of the activities may be conducted in a parallel manner to expedite the aircraft research process (as authorized by the ER-ARB or CFO).

10.2 AIRCRAFT RESEARCH EXPERIMENT INITIATION

10.2.1 The implementation and/or safety assessment of aircraft research experiments are initiated in accordance with LMS-CP-0960, with the submittal of an Aircraft Flight Research Project Initiation Request (LF434, for experiments involving non-LaRC aircraft) or a Simulation and Flight Work Request (LF444, for experiments involving LaRC aircraft), as appropriate.

a. The request defines the scope of the research and has a specific routing for approvals.
b. The submission of these requests also serves to inform the ER-ARB of the new requirement and initiates the process of determining and planning the requisite ER-ARB reviews (ref. NAII 7900.3)

10.3 SYSTEM SAFETY

10.3.1 General - Safety procedures are formulated for each program as appropriate to the application. Each program includes measures to ensure that safety is given special consideration and that a chain of responsibility is established and maintained throughout. From a system safety standpoint, this document provides information on hazard identification, hazard analysis, and risk management requirements for LaRC flight research projects.

a) An Airworthiness Engineer, an Operations Engineer, designated system safety professionals from OSMA, Research Pilot, and any other experts deemed appropriate, shall consult with the Principal Investigator or lead researcher in developing safety procedures for both installation and research operations.
b) The project pilot, ASO and an Airworthiness Engineer serve as consultants and final reviewers of the hazard analyses prior to presentation to the airworthiness process.
c) The flight release for research activities is made by the airworthiness approval process and FRR/ORR process. For higher than normal risk operations, Center management may provide flight release for research activity. (For more information on system safety, see NPR 8715.3, NASA Safety Manual.)

10.3.2 System Safety Implementation - The goal of system safety is to ensure that the safety requirements of each aircraft research experiment are understood by each participant and that the

tasks, products, and methods of implementation are clearly defined. This risk reduction process is applied as a fundamental risk management tenet.

a. The following information is presented to the airworthiness approval process:

(1) Hazard reporting and resolution

(2) Assignment of safety responsibilities

(3) System safety milestones and schedules

(4) System safety interface with other engineering disciplines

(5) System safety tasks to be performed, such as:

a) Testing

b) Hazard analysis and risk assessment

c) Configuration management

b. The fundamental premise of system safety and the Aviation Safety Program is that hazards shall be reduced to the lowest practical risk level.

(1) The first goal is to affect a design that eliminates hazards.

(2) If this is not possible, safety devices shall be incorporated to prevent or ameliorate consequences of hazardous situations.

(3) If safety devices cannot adequately accomplish the objective, warning devices shall be incorporated

10.4 RSD SAFETY REVIEWS

10.4.1 RSD flight approval processes ensure that aircraft experiments are evaluated for appropriate safety considerations. These can be conducted as a formal review meeting or as a continuous review process. Those considerations determined and evaluated during the safety review processes include, but are not limited to:

a. Procedures
b. Chase
c. Photography
d. Airworthiness
e. Communications
f. Minimum crew
g. Documentation of tested flight envelope
h. Emergency equipment (parachutes, flotation devices, helmets, etc.)

These reviews normally utilize the expertise of the RSD Chief Engineer, Airworthiness Engineer, Hazards Engineer, Chief Pilot, ASO, and other necessary technical personnel.

10.5 CHANGES TO AIRCRAFT RESEARCH EXPERIMENT DEFINITION

10.5.1 Changes to approved aircraft research experiments are accomplished according to LMS-CP-0960. This encompasses planning, implementation and functional/safety review(s).

10.6 HAZARD ANALYSIS AND DOCUMENTATION

10.6.1 Identification - A hazard, or hazardous condition, exists when any research related component, subsystem, or system has the potential to cause injury, illness, death, or equipment damage through its normal performance, performance degradation, functional failure, or inadvertent functioning. Formal hazard identification methods (such as the development of fault trees, failure modes and effects analysis, etc.) are utilized to identify potential hazards that result from aircraft modifications, research systems, operational requirements, human factors, environmental conditions or any other source of hazard due to the experiment requirements that are above the normal risk of flight for that aircraft.

10.6.2 Hazard Analysis Process - It is a Principal Investigator's or lead researcher's responsibility to ensure that hazard analyses are conducted and documented in the airworthiness review process (system safety hazards) and FRR/ORR (operational hazards).
a. Flight operations personnel shall provide technical expertise, and SMAO may provide system safety experts to identify and apply specific analysis techniques (fault tree, failure modes /effects, etc.). These analyses are best accomplished by a group effort, including the Principal Investigator or lead researcher, RSD personnel, and all other sources of technical expertise, as required.
b. These analyses examine hazards or hazardous conditions systematically to
(1) Evaluate the risks associated with those hazards, and
(2) Eliminate or abate those hazards to acceptable levels.
c. The "Flight Research Hazard Analysis," LF273, is the recommended minimum format for documenting the analysis.

10.6.3 Risk Assessments - An assessment of each undesired event is conducted as to the type of risk involved and the effectiveness of any countermeasures that exist.
a. The risks associated with death or injury to personnel or damage to equipment are managed so that the desired level of safety is maintained.
b. Project managers are required to provide a project-specific risk assessment plan when Center risk assessment plans do not adequately address specific project risks. Additional guidance is available in NPR 7120.8.

10.7 CREWED AIRCRAFT MODIFICATION AND DOCUMENTATION

10.7.1 General - This section describes responsibilities and procedures for implementing aircraft research experiments and modifying LaRC aircraft for research purposes.

10.7.2 When a new experiment has been approved by RSD, any modification to LaRC aircraft, aircraft systems, aircraft research systems, or software requires the submittal of the appropriate request for implementation, review, approval, and documentation.

a. LaRC aircraft research experiments that involve aircraft, aircraft modifications, and airborne equipment provided under contract or grant, or which may require LaRC

personnel to fly, are reviewed in accordance with LMS-CP-0960 and NAII 7900.3 as appropriate.

b. Aircraft owned, leased, or controlled by LaRC are maintained and modified in accordance with the LaRC General Aircraft Maintenance Manual, LMS-OP-0940.

c. Research equipment modifications and/or installations are documented by drawings and approved by the Langley Management System (LMS) process. The Research Vehicle Work Order (RVWO) process, as defined in the LMS-OP-0940, is used to document and authorize modifications that affect aircraft configuration or interfaces with the basic aircraft systems.

d. Procedures for assuring the safety of the aircraft and flight operations with nonstandard modifications to the aircraft or with nonstandard research equipment are established by the CFO.

10.7.3 Aircraft Classification - All NASA aircraft are defined as "public use" aircraft and are operated as defined in 49 USC 40102. The type of use of public aircraft determines the rules and regulations under which these aircraft shall operate.

a. Those aircraft used for passenger transport are required to be operated as "civil" aircraft, with a valid FAA Certificate of Airworthiness when doing so.
    a. When operating as "civil" aircraft, the provisions for relaxed operating requirements as set forth for aircraft used as "public" aircraft are not available to government agencies.
    b. The civil aircraft shall be operated and maintained under applicable Federal Aviation Regulations (Parts 91, 23 or 25, etc.). Use of certificated personnel is required for maintenance signoff and flight operations.
    c. LaRC aircraft operated under a civil certificate are subject to both the LaRC work order processes and the FAA processes for configuration changes, equipment certification, etc.
    d. FAA regulations shall govern if there is a conflict between NASA and FAA processes for aircraft operating under a civil certificate.

b. The same aircraft and crew can operate as "public" and as "civil" based strictly on the intended use for a particular flight.
    (1) If the aircraft is operated as a "civil" aircraft, the pilot(s) shall meet all Federal Air Regulations requirements pertaining to qualification, certification, and currency applicable to the operation.
    (2) The aircraft shall meet all the requirements of its FAA type certificate including having a valid FAA Certificate of Airworthiness when returned to service as a "civil" aircraft. This requirement includes compliance with all inspections, ADs, and maintenance logbook entries required by regulation.
    (3) Any civil certificated aircraft modified for purposes that deviate from the civil type certification shall report such changes to the local FAA Flight Standards District Office (FSDO). Once such modifications are removed, coordination shall be made with the FSDO for return to proper civil airworthiness certification status, including compliance with appropriate inspections.

10.8 RESEARCH VEHICLE WORK ORDER REQUEST AND APPROVAL

10.8.1 Modifications to aircraft and aircraft systems under the control of RSD are initiated by the submission of an Aircraft Configuration Change Request (LF443) or Simulation and Flight Work Request (LF444), along with supporting documentation, to the RSD Quality Assurance Office, for creation of a Research Vehicle Work Order. Additional information regarding the Research Vehicle Work Order process can be found in the LMS-OP-0940.

10.9 EXPERIMENTAL SYSTEMS WORK REQUEST

10.9.1 Changes to the aircraft research systems software are accomplished with an Experimental Systems Work Request (ESWR), LF436.

a. This process is applicable to software applications and incorporates the concept of verification and validation by encompassing checkout facilities, such as the Flight System Integration Lab (FSIL).
b. This process may require the use of Research Vehicle Work Order process if the requested changes require aircraft modifications.
c. ESWR tracking numbers are assigned by the originating organizations and are filed with QAO. Additionally, ESWRs are logged and tracked by QAO to prevent duplication of identification numbers and to ensure closure.

10.10 SOFTWARE

10.10.1 Software delivery specifics are contained in LMS-CP-0960. Installation and modification of flight software is accomplished according to the processes and procedures of the preceding sections. Software is delivered to aircraft in one of two phases: pre-lockdown and lockdown. The purpose of lockdown is to maintain a configuration record of software while in aircraft research experiment activities.

a. Lockdown is established when developmental activity is coming to an end and the research experiment is about to commence. Research flights may include developmental activity and do not necessarily indicate the software phase.
b. Before lockdown, software may be delivered to the aircraft without tracking or approval.
c. After lockdown, software is delivered with the Software Delivery form, LF 238.
d. Lockdown ends upon the completion of the aircraft research experiment, RSD development of any software required for flight or control of flight processes, or for research systems.

10.11 STRESS ANALYSIS

10.11.1 Any structural research modification to LaRC aircraft or installed research system shall require stress analysis to establish that applicable design criteria have been met or maintained.

a. The required stress analysis and any drawings referenced by the analysis shall be submitted to the QAO and the airworthiness engineers prior to, or concurrent with, the submittal of the associated Research Vehicle Work Order.
b. When scheduling modification activities, up to two weeks shall be allowed for the review and approval of submitted analysis and the subsequent approval of the associated RVWO.
c. Any analysis shall be complete and sufficiently comprehensive as to require no further explanation.
d. Analyses may be handwritten, but shall be legible and easily reproducible by photocopier and mass storage technology.
e. The first several pages of a stress analysis shall follow the recommended general format outlined below:
   (1) Cover Sheet
   (2) NASA Signature Sheet
   (3) Revision Sheet (if applicable)
   (4) Contractor Signature Sheet (if applicable)
   (5) Table of Contents
   (6) Introduction
   (7) Summary of Critical Factors of Safety
   (8) Drawing List
   (9) General Diagram(s)
   (10) General Loading Description
f. Each analysis shall contain free body diagrams, statements of assumptions, and section and material properties.
g. General equations and their sources are to be given before substitution of numerical values.
h. It is preferred that all material specifications and vendor items be grouped together in one section, either in the body of the analysis or as an appendix.

10.12 PUBLIC AIRCRAFT AIRWORTHINESS GUIDELINES

10.12.1 This section provides a set of general guidelines and procedures to be used in the design, fabrication, and installation of aircraft modifications to public-use aircraft, i.e. airborne research equipment and/or modification of an aircraft for research purposes. It is intended to scope the requirements for airworthiness definition and certification for flight and operation of hardware and systems aboard LaRC aircraft. Airworthiness of civil certificated aircraft is subject to the FARS and appropriate FAA oversight and compliance.

a. The RSD Chief Engineer, Airworthiness Engineers, the ASO, and the QAO shall establish airworthiness guidelines in response to requirements formulation per LMS-CP-0960 and LMS-CP-0910.

b. Applicable manufacturer, military or FAA standards or guidelines shall be utilized to ensure adequacy of installations and designs.
c. Not all standards are applicable to every platform or design.
    1. In normal situations, manufacturer's guidelines shall be followed with additional reference to appropriate FAA regulations for airworthiness.
    2. Military requirements shall normally be followed when the aircraft or equipment was or is being developed for military, non-civil use.
d. Non-standard detailed guidelines are determined only after definitions are made of experiment requirements and system/component functions and operational characteristics in conjunction with existing aircraft and research systems configurations and operational limitations, through a formal NASA design review process.
e. Questions concerning the standards to be utilized for a particular design shall be referred to the Airworthiness Engineers.

10.13 MODIFICATION, OPERATION, AND SYSTEM CLASSIFICATIONS

10.13.1 Modifications shall be classified as to function and purpose in order to establish safety guidelines. This determination shall take into account:

a. Both the equipment and operation immediately being addressed.
b. The integration of the equipment into the existing configuration and the operation of systems within an envelope of limitations that may exist for the configuration.

10.13.2 Classifications result from the assessment of specific aircraft modification, operation, or system integration requests in conjunction with other concurrent configuration and operational limitations (the "envelope").

a. Consultations with technical experts within all elements of RSD, other LaRC organizational units, other NASA centers, DoD, and private industry may be made for these determinations.
b. Early consultation with the airworthiness engineers or the Aviation Safety Officer to determine the appropriate airworthiness guidelines is imperative for each activity undertaken.
c. These guidelines are classified in three broad categories:
    (1) Flight Critical: Any aircraft modification, system installation, or operation which, if incurring a failure during use, would place the aircraft, primary aircraft systems, or personnel at significantly greater risk than the normal "assumed risk" of flying. This category shall require the most stringent guidelines for equipment certification, installation, and operation. All airborne research hardware and software shall be subject to formal design reviews, testing or verification, full shop quality assurance and additional flight quality assurance, as required, to ensure airworthiness and safety compliance. Equipment that has not been flight qualified for flight critical applications shall be considered for use in such applications only after consultation with and inspection by airworthiness engineers, the Operations and Engineering Branch, and QAO.

(2) Mission Critical: Any aircraft modification (hardware or software), system installation, or operation which, if incurring a failure during use, would prevent the accomplishment of the research mission or operational objectives, but not affect any flight critical systems. Elements defined within this category may be long-term, shall use more standardized guidelines for equipment certification, installation and operation, and shall focus predominantly on product and mission assurance. Mission Critical assessments are conducted with the cooperation of SMAO, the ER-ARB, and RSD.

(3) System Critical: Any aircraft modification, system installation, or operation which, if incurring a failure during use, would prevent the accomplishment of only a portion of a research mission or operational objectives, and not affect any other component, system or operation. Elements defined within this category shall be short-term, and shall use the least stringent guidelines for equipment certification, installation, and operation. System Critical assessments are conducted with the cooperation of SMAO, the ER-ARB, and RSD.

10.14 AIRWORTHINESS PROCESSSAFETY REVIEWS

10.14.1 The Airworthiness Process is derived from the Executive Safety Council (ESC) as established by LAPD 1150.2, which also establishes its charter and membership.

a. Safety is achieved through the cumulative knowledge and diverse skills of the individual engineers, scientists, and technicians selected for Airworthiness Review duty because of their unique experience relevant to particular systems and functions associated with flight research and aviation safety.

b. Board members are experts or have access to other experts in the various technology disciplines needed to determine the safety requirements for aircraft modifications, equipment design, and flight operations, and assigned by the Chairperson of the Executive Safety Council (ESC)

c. The Chairperson of the Airworthiness Process schedules reviews as required commensurate with the degree of risk involved.

1) After all required reviews have been completed successfully, the Chairperson has the responsibility to issue an airworthiness approval.

2) This approval is required prior to the initiation of research flights.

APPENDIX A: INTERNATIONAL FLIGHT OPERATIONS

A.1 ADVANCED PLANNING

A.1.1 Advanced planning is the key to uneventful foreign operations. It is the joint responsibility of RSD management and the PIC to ensure the success of the trip. International and oceanic flight preparations are thoroughly addressed in FAA AC 91-70A. Typical considerations include:

A.1.1.1 Route Planning and Flight Information Documents – It is recommended that flight planning services be used, whenever possible, for every international flight for route, weather, and NOTAM services. Most countries will bill operators for Air Traffic Control services within their boundaries. If such bills are received, they are to be forwarded to headquarters for State Department adjudication.

A.1.1.2 Personal Documentation - Requirements for most countries likely to be visited are contained in the International Flight Information Manual (IFIM) and USAF Foreign Clearance Guide (FCG). Passengers and crew members shall be notified of these requirements sufficiently far in advance of the trip. Foreign Travel Briefings are required prior to commencement of foreign travel.

A.1.1.3 Aircraft Documentation - Aircraft and engine log books, noise certificate, MNPS/RVSM approval letters and operations manuals, and insurance certification, if required, shall be carried in addition to all the normal documentation, such as airworthiness certificates, registration certificates, and aircraft radio station licenses. Airplane Flight Manuals or equivalent are required. NOTE: RVSM certification and approval allows operation in any RVSM airspace worldwide. However, there may be specific theater-based requirements for each area of operation which shall be considered.

A.1.1.4 Landing and Overflight Permits - Aircraft entry requirements are shown in the IFIM and FCG. These permits often require several weeks to obtain and may require extensive NASA Headquarters coordination with embassies.

A.1.1.5 Aircraft Handling Agents - The use of a handling agent for all but the most routine international destinations is highly recommended.

A.1.1.6 Foreign User Charges/Fees - These charges may require cash or letters of credit; the handling agent or foreign location Point-of-Contact (POC) shall be consulted for details concerning payment.

A-2 Verify the correct revision before use by checking the LMS Web site.

A.2 RESPONSIBILITIES FOR INTERNATIONAL DEPLOYMENT

A.2.1 OPERATIONS AND ENGINEERING BRANCH - Obtain or confirm:

A.2.1.1 Applicable flight information publications (FLIPS)/Jeppesen Charts

A.2.1.2 Diplomatic clearances for entry and overflight through HQ

A.2.1.3 U.S. military base use permission/PPR numbers

A.2.1.4 IFIM, FCG, and ICAO rules and procedures

A.2.1.5 Certificate of aircraft ownership/FAA registration/FAA or NASA airworthiness certificates (as appropriate)/noise certificates

A.2.1.6 Insurance certificates (If required). Normally a letter on NASA letterhead stating that the U.S. government is a self-insurer shall suffice to meet this requirement.

A.2.1.7 Customs, immigration and agricultural forms

A.2.1.8 eAPIS message submissions

A.2.1.9 Credit cards, carnets, letters of credit, SF-44s, travelers checks and cash, as appropriate

A.2.1.10 Trip itinerary and passenger manifest

A.2.1.11 MNPS/RVSM Certification (aircraft and crew)

A.2.1.12 Ground handling services

A.2.1.13 NASA and U.S. State Department security briefings, as appropriate

A.2.1.14 Immunizations and records

A.2.1.15 Passports, visas, and personnel documentation

A.2.1.16 Coordination with the Export Control Office

A.2.2 RESEARCH SYSTEMS INTEGRATION BRANCH - Ensure the aircraft has enough time/cycles remaining to complete the deployment prior to any required inspections that may come due or have plans to accomplish the inspection with certified personnel. An aircraft pack-up kit shall be prepared to include the following:

A.2.2.1 Aircraft and engine logbook information

A-3 Verify the correct revision before use by checking the LMS Web site.

A.2.2.2 Inspection and life limited items status

A.2.2.3 Spare parts appropriate for the route/destinations anticipated

A.2.2.4 Maintenance reference manuals

A.2.2.5 Survival equipment - FAR/ICAO and NASA required items

A.2.2.6 Aircraft Radio Station License

A.2.3 CREWMEMBERS - Ensure they have the following:

A.2.3.1 FAA Airman certificates with appropriate type ratings and current medical certificates (required outside of the U.S.) (Temporary pilot certificates are not valid outside of the U.S.)

A.2.3.2 FCC Radiotelephone Permit (required outside of the U.S.)

A.2.3.3 Passport and visas for countries to be visited

A.2.3.4 Credit cards, cash or travelers checks

A.2.3.5 Travel orders

A.2.3.6 Operations Manual (including RVSM section) on-board (LPR 1710.16)

A.2.3.7 Aircraft Flight Manual (AFM) on-board

A.2.3.8 Immunization records ("yellow card")

A.2.4 INTERNATIONAL SAFETY AND SECURITY

A.2.4.1 Increased security awareness is important on international flights. When traveling into countries where stability might be questionable, timely review of newspaper articles and magazine reports are of value. The FAA Security Office and the U.S. Department of State country desk are aware of potential problems and can be consulted prior to departure for questionable countries. The PIC shall ensure that destination airports and surroundings for a planned flight do not present a threat to safety or security. This is particularly true of international flights to destinations that have a poor reputation for safety and security. NASA security shall be contacted prior to any international flight to check for unusual or hazardous situations that may impact the security of a planned flight.

A.2.4.2 The flight crew shall be responsible for ensuring aircraft security by adhering to the following procedures:

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A.2.4.2.1 When away from home base, close and lock the entrance door when leaving the vicinity of the aircraft.

A.2.4.2.2 No visitors shall be allowed on board the aircraft without a crewmember present.

A.2.4.2.3 If possible, overnight parking away from home base shall be in a well-lighted area, or, preferably, in a hangar. All plugs and covers shall be installed when parked outside. Gust locks shall be installed, as appropriate. Wheels shall be chocked.

A.2.4.2.4 Crews shall be particularly alert when the aircraft is being serviced. One crewmember shall supervise all fueling and require that a fuel sample be taken if there is any doubt as to the quality of the fuel. The aircraft shall be properly grounded during all fueling operations.

A.2.4.2.5 In the event a situation arises that raises the crew's suspicions, report the facts to the nearest police or government authority.

A.2.4.2.6 All aviation personnel shall challenge anyone in the hangar bay or on the ramp who cannot be identified, is not wearing an appropriate ID badge, or behaves suspiciously.

A.2.4.2.7 Do not fly any aircraft where its safety is in question.

A.2.4.2.8. In the event of illness by persons aboard the flight, the PIC shall determine the location where such a person shall be transported for medical care. Due regard shall be given for the types of facilities that are available. If necessary, the local US embassy or consulate shall be consulted for recommendations for appropriate care.

A.3 REQUIREMENTS FOR OPERATION IN MNPS/RVSM/RNP AIRSPACE (North Atlantic/Europe/Pacific) A.3.1 Requirements shall be kept up to date in accordance with current federal regulations in effect at the time of any planned international flight. Current regulations for civil aircraft operation include:

A.3.2 UNRESTRICTED OPERATION IN THE NORTH ATLANTIC ROUTE SYSTEM

A.3.2.1 Minimum Navigation Performance Standard (MNPS) certification of aircraft and crew for operation between FL285 and FL420 in MNPS airspace:

A.3.2.1.1 Aircraft MNPS certification requires navigation performance to meet RNP-12.6 standard (2-IRSs or 2-GPSs)

A.3.2.1.2 Crew shall receive training in MNPS procedures November 14, 2013 LPR 1710.16 I-1 A-5 Verify the correct revision before use by checking the LMS Web site.

A.3.2.1.3 Letter of Authorization (normally combined with RVSM certification letter)

A.3.2.1.4 Notification of MNPS qualification to authorities

A.3.2.2 Reduced Vertical Separation Minimum (RVSM) certification of aircraft and crew for operation between FL290 and FL410.

A.3.2.2.1 Aircraft RVSM certification (RVSM monitoring per ICAO Doc. 9574)

A.3.2.2.2 RVSM/MNPS manual approved by FAA for civil aircraft operations

A.3.2.2.3 Crew shall receive training in RVSM procedures

A.3.2.2.4 FAA Letter of Authorization (renewed every two years), if aircraft is operated as a "civil" aircraft. An equivalent NASA letter of authorization for State aircraft operation is recommended.

A.3.2.2.5 Notification of RVSM qualification to authorities for insertion into FAA/ICAO database

A.3.2.3 One HF radio and one VHF radio (two HFs if on random route)

A.3.2.4 Adequate maritime survival equipment per FARs

A.3.2.5 Traffic Collision Avoidance System (TCAS) II with Version 7 equipment required

A.3.2.6 Recommended - Two HF radios with SELCAL

A.3.2.7 Recommended - Upgrades for ETOPS operation (extended range, not required for FAR Part 91 operations)

A.3.3 LIMITED OPERATION IN THE NORTH ATLANTIC AREA

A.3.3.1 MNPS certification if operating between FL285 and FL420. (Can operate below FL285 without MNPS certification on random routes)

A.3.3.2 Notification of MNPS qualification to authorities

A.3.3.3 RVSM certification for operations FL290-FL410

A.3.3.4 Other Considerations

A.3.3.4.1 May utilize random routes well clear of NAT tracks.

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A.3.3.4.2 Some routes do not require HF radios if transiting above certain altitudes and in certain areas. (VERY RESTRICTIVE)

A.3.3.4.3 May be restricted below FL350 in Reykjavik FIR.

A.3.3.4.4 Adequate maritime/polar survival equipment per FARs

A.3.4 UNRESTRICTED OPERATION IN EUROPE

A.3.4.1 Shall meet BRNAV (RNP-5) (Normally accomplished with 2 IRSs with Navaid updates, DME/DME or 2 GPSs) {Effective altitudes vary by country. Consult Eurocontrol for details.}

A.3.4.2 8.33 KHz spacing VHF radios (FM immunity interference shielded with documentation of compliance)

A.3.4.3 Noise Certificate (Stage III or approved waiver for airport used)

A.3.4.4 Airworthiness Certificate

A.3.4.5 Current FAA Registration Certificate

A.3.4.6 RVSM in effect from FL290 to FL410

A.3.4.7 FAA Letter of Authorization (renewed every two years, if using RVSM airspace), if aircraft is operated as a “civil” aircraft An equivalent NASA letter of authorization for State aircraft operation is recommended.

A.3.4.8 Notification of RVSM qualification to authorities (FAA/ICAO)

A.3.4.9. Traffic Collision Avoidance System (TCAS) II with Version 7 equipment required (Also known in Europe as ACAS II)

A.3.5 UNRESTRICTED OPERATION IN THE PACIFIC

A.3.5.1 RNP-10 Navigation performance

A.3.5.2 RVSM certification from FL290-FL410 (FL410 is available to non-RVSM)

A.3.5.3 HF radio

A.3.5.4 Adequate maritime survival equipment per FARs

A.3.5.5 FAA Letter of Authorization (if in RVSM airspace), if aircraft is operated as a "civil" aircraft

A-7 Verify the correct revision before use by checking the LMS Web site.

A.3.5.6 Notification of RVSM qualification to authorities (FAA/ICAO)

A.3.5.7 Recommended - Two HF radios with SELCAL

A.3.5.8 Recommended - ER upgrades for extended ETOPS range (Not required for FAR Part 91 Operations) A.3.6 UNRESTRICTED OPERATION IN THE WESTERN ATLANTIC TRACK ROUTE SYSTEM (WATRS) AND DOMESTIC AIRSPACE (DRVSM):

A.3.6.1 FAA Letter of Authorization (if in RVSM airspace), if aircraft is operated as a "civil" aircraft. An equivalent NASA letter of authorization for State aircraft operation outside of domestic airspace is recommended.

A.3.6.2 Notification of RVSM qualification to authorities (FAA/ICAO)

A.3.6.3 RVSM in effect for FL290 to FL 410

A.3.6.4 RNP-10 Navigation performance

A.3.6.5 If TCAS is installed, it shall comply with TCAS II, Version 7, when operating in RVSM airspace

A.3.7 RESTRICTED OPERATION IN THE WESTERN ATLANTIC TRACK ROUTE SYSTEM (WATRS) AND UNRESTRICTED OPERATION IN DOMESTIC AIRSPACE (DRVSM):

A.3.7.1 Letter of Authorization for RVSM

A.3.7.2 Notification of RVSM qualification to authorities (FAA/ICAO)

A.3.7.3 RVSM in effect from FL290 to FL 410

A.3.7.4 If TCAS is installed it shall comply with TCAS II, Version 7, when operating in RVSM airspace

A.3.7.5 Prior Coordination – Operation in RVSM/RNP airspace with non-equipped aircraft requires prior ATC coordination and approval

A.3.7.6 RNP-10 Navigation performance or approved deviation/waiver or operation outside of RVSM or RNP tracks

A-8 Verify the correct revision before use by checking the LMS Web site.

A.4 RECOMMENDED PROCEDURES AND FLIGHT PREPARATION

A.4.1 FAA GUIDANCE - FAA guidance on international and oceanic flight operations is found in AC 91-70A. FAA guidance on the use of RVSM/RNP airspace is found in AC 91-85.

A.4.2 RVSM DISPATCH CHECKLIST

A.4.2.1 Determine flight level (FL) floor, FL ceiling and horizontal boundaries of RVSM airspace.

A.4.2.2 Determine if RVSM approval is specifically required to file for flight into a specified airspace. With limited exceptions, RVSM approval is required to file for flight at FL290-FL410 throughout most of the world.

A.4.2.3 Verify that the airframe is RVSM approved.

A.4.2.4 Determine if any operating restrictions apply to the aircraft for RVSM operations (e.g., speed or altitude limitations).

A.4.2.5 Check the MEL for system requirements related to RVSM.

A.4.2.6 Check block 10 a. & b. of the ICAO flight plan to ensure that it correctly reflects RVSM/Equipment status.

A.4.2.7 Review reported and forecast weather conditions enroute, with specific emphasis on conditions such as turbulence greater than moderate, which may affect aircraft ability to maintain level flight.

A.4.2.8 Determine if TCAS is operational.

A.4.2.9 Review enroute RVSM theater-specific contingency procedures.

A.4.2.10. RVSM operations manual/instructions aboard.

A.4.3 RVSM FLIGHT PLANNING

A.4.3.1 RVSM Airspace - RVSM airspace is defined as any airspace between FL 290- 410 where 1,000-foot vertical separation is applied.

A.4.3.2 Minimum Equipment List - When planning and filing into RVSM airspace, aircraft shall meet certain Minimum Equipment Lists (MEL) provisions for RVSM operation.

A.4.3.3 Weather - The PIC shall review reported and forecast weather conditions with specific emphasis on conditions such as greater than moderate turbulence that may affect the aircraft's capability to maintain level flight

A-9 Verify the correct revision before use by checking the LMS Web site.

A.4.3.4 TCAS – For TCAS equipped aircraft , use of TCAS is highly encouraged. TCAS enhances operational safety by enhancing pilot situational awareness and by providing a system

for collision avoidance. Note: Aircraft are required to be equipped with TCAS II, V.7, if TCAS-equipped, in order to operate in most RVSM airspace, however, there are provisions for MEL relief. The aircraft shall be dispatched in accordance with MEL provisions for flight into the specific area of operations and prior coordination with ATC.

A.4.3.5 Maintenance Flights - ATC providers have established policy to enable aircraft that are temporarily non-RVSM compliant to fly in RVSM airspace for the purpose of repositioning the aircraft to a maintenance facility. This policy requires prior coordination with appropriate ATC centers so that 2000-foot separation can be applied between the non-compliant aircraft and other aircraft. Compliance requirements and policy for such operations are published in NOTAMS, Aeronautical Information Publications (AIP), and other appropriate documents.

A.4.3.6 Delivery and Humanitarian Flights - Provision for limited flights by aircraft not approved for RVSM for delivery and humanitarian flights is available. Compliance requirements and policy for such operations are published in NOTAMS, AIPs, and other appropriate documents.

A.4.4 OCEANIC ENROUTE CONTINGENCIES

A.4.4.1 Prior to entry into RVSM Airspace - The following equipment is required to be operational at entry into RVSM airspace:

A.4.4.1.1 Two independent primary altimetry systems

A.4.4.1.2 One automatic altitude control system

A.4.4.1.3 One altitude alerting device

A.4.4.2 If any required equipment fails prior to entering RVSM airspace, the PIC shall notify ATC and obtain a new oceanic clearance above or below the RVSM stratum.

A.4.4.3 The PIC shall evaluate the new clearance with due consideration for the effect on fuel consumption, time enroute any MEL/CDL issues or any other operational factors. The PIC shall evaluate the ability to continue to destination, or whether to proceed to an intermediate airport, or to return to the departure airport. The pilot shall then either confirm the new clearance with ATC or request a new clearance to another airport. The final decision rests with the PIC.

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A.4.4.4 After Entry into RVSM Airspace – AC 91-85 provides guidance for pilot and controller actions if RVSM required aircraft equipment fails after entry into RVSM airspace or the aircraft encounters turbulence that affects the aircraft's ability to maintain level. If any required RVSM equipment fails or turbulence greater than moderate is encountered, the PIC is expected to notify ATC of the intended course of action. The PIC has the following options:

A.4.4.4.1 Continue with original ATC clearance if ATC can apply an alternate form of separation (i.e., lateral, longitudinal or 2,000 ft vertical separation).

A.4.4.4.2 Request ATC clearance to climb above or descend below RVSM airspace if ATC cannot provide adequate separation from other aircraft.

A.4.4.4.3 Execute ICAO contingency procedures to offset from track and FL, if ATC cannot provide adequate separation from other aircraft. The PIC shall maintain the offsets until a revised ATC clearance can be obtained.

A.4.4.4.4 These contingency procedures are subject to change by the FIR/UIR controlling agency. Current procedures shall be obtained and thoroughly understood by the aircrew prior to entry into a particular RVSM/RNP region.

A.4.5 NON-RVSM COMPLIANT AIRCRAFT

A.4.5.1 The PIC shall comply with ATC requirements for flight of non-RVSM compliant aircraft for research, maintenance, aircraft delivery or humanitarian flights.

A.4.5.2 Flight in certain portions of the WATRS region can be approved for non-RNP aircraft. Operators of Non-RNP10 aircraft shall annotate ICAO flight plan Item 18 as follows:

A.4.5.2.1 "STS/NONRNP10" (no space between letters and numbers).

A.5 CUSTOMS AND BORDER PROTECTION (CBP) REQUIREMENTS

A.5.0 Due to changing requirements refer to the latest CBP guidance for proper compliance with CBP rules and implementation.

A.5.I eAPIS MANIFEST REQUIREMENTS

A.5.1.1 NASA aircraft are considered "private aircraft" for the purposes of customs, immigration, and agriculture. Pilots of all private aircraft arriving in the U.S. from a foreign port or place or departing the U.S. for a foreign port or place, are required to submit manifest information electronically to CBP for each individual traveling onboard the aircraft. APIS manifest submissions can be transmitted through the CBP Electronic Advance Passenger Information System (eAPIS) web portal or another CBP-approved electronic data interchange system. eAPIS has a web portal (https://eapis.cbp.dhs.gov)

A-11 Verify the correct revision before use by checking the LMS Web site. that enables users to create, manage, and submit APIS manifests. A notice of arrival or notice of departure is required in the same transmission as the corresponding arrival or departure traveler manifest information. This complete transmission will hereafter be referred to as an "APIS manifest." NOTE: Notices of arrival or departure submitted outside the eAPIS web portal or other CBP approved electronic data interchange system do not satisfy electronic manifest submission requirements. Telephone calls, ADCUS messages, faxes, e-mails, etc., do not meet electronic manifest submission (APIS) requirements (unless expressly authorized by CBP in a particular case). However, these types of informational communication are always encouraged and may be required by the CBP port of entry in addition to the electronic APIS manifest requirements discussed in this document.

A.5.1.2 APIS regulations do not apply to flights between the United States and the U.S. Virgin Islands, Puerto Rico, Guam, or the Commonwealth of the Northern Mariana Islands, as these

locations are considered part of the United States for APIS purposes. However, notice of arrival requirements for flights from the U.S. Virgin Islands still apply. Additionally, private aircraft APIS regulations do not apply to overflights of foreign airspace, provided the private aircraft departs and arrives in the U.S. and does not land at a foreign port (or overflights of U.S. airspace that do not include a U.S. arrival or departure). The private aircraft pilot is responsible for ensuring that the APIS manifest is transmitted to CBP. Crews are advised to consult the www.cbp.gov web site for complete information.

A.5.1.3 Airports of Entry - Pilots may arrive only at approved CBP airports of entry (from the table provided in eAPIS) unless permission has been otherwise granted by CBP to arrive at another port or place (Fixed Base Operator (FBO), landing strip, etc.). CBP, based on security or other risk assessments, may limit the locations where aircraft entering the United States from a foreign port or place may land. Pilots seeking to arrive at an unlisted location shall contact the CBP port of entry closest to the proposed landing site. If an arrival has been approved at an unlisted location: Normally aircraft shall land and clear customs at the first customs airport in U.S. territory along their route of flight when arriving from Mexico, Central or South America, or the Caribbean. Overflight to other locations requires a formal request procedure with written approval from CBP prior to flight.

A.5.1.4 Agricultural Inspection – Crews shall ensure that prior coordination has been made for required agricultural inspections, including trash/garbage handling, at the port of entry. Substantial fines can be assessed if garbage is improperly disposed of. Additionally, disinsectation procedures are required at many locations, requiring proof of insecticide application.

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A.5.2 FOREIGN DEPARTURE

A.5.2.1 Departures from a foreign port or place can originate from almost anywhere. However, eAPIS reports shall be initiated electronically unless CBP grants a waiver. Internet service is required to initiate the eAPIS report. Telephone calls to CBP do not alleviate the eAPIS requirement.

A.5.3 CHANGES TO MANIFESTS A.5.3.1 The private aircraft pilot is obligated to make necessary changes to the APIS manifest after it has been transmitted to CBP. If changes to an already submitted manifest are necessary, an updated and amended manifest shall be resubmitted to CBP. If additional travelers are added to an already-submitted manifest, an updated manifest submission with the new traveler information is required. When a traveler on an already submitted manifest does not travel on the flight, current CBP policy does not require submission of an updated manifest. Certain changes to an already-submitted manifest do not require electronic resubmission. Flight cancellations, changes in expected time of arrival (ETA)/departure (ETD), or changes in arrival/departure location may be submitted telephonically, by radio, or through existing processes and procedures. On a limited case-by-case basis, CBP may permit a pilot to submit or update notice of arrival or departure and arrival/departure manifest information telephonically when unforeseen circumstances preclude

submission of the information via eAPIS. Under such circumstances, CBP will manually process the notice of arrival/departure and traveler manifest information provided by the pilot; the pilot is required to wait for CBP screening and approval to depart. In these cases, the pilot shall contact the CBP airport of arrival/departure for assistance. Changes in ETA and arrival location shall be coordinated with the CBP arrival location to ensure that resources are available to inspect the arriving aircraft. If an updated manifest is submitted, any approval to depart previously granted by CBP is invalid. The private aircraft pilot is required to receive approval from CBP for the amended manifest before the aircraft may depart. A.5.3.2 Failure to follow DHS instructions: Prior to departure to or from the United States, the pilot of a private aircraft shall receive a message from DHS approving departure and follow any instructions contained therein prior to departure. The pilot is ultimately responsible for the validity, accuracy, completeness, and timeliness of the APIS manifest even if submitted through a third party. In the event of an APIS deficiency, CBP will consider the circumstances surrounding the alleged infraction before any APIS penalty case initiation occurs. Pilots are encouraged to describe any and all mitigating factors when APIS deficiencies are identified. As explained in the comments section of the "Advance Information on Private Aircraft Arriving and Departing the United States" final rule, APIS penalty cases are assessed against the aircraft pilot in the amount of $5,000 for the first violation and $10,000 for each subsequent violation.

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APPENDIX B: ORM DECISION MAKING

B.1 Operational Risk Management.

B1.1 The operational risk management process is a simple five-step process. The concept of applying a standard, systematic approach to minimizing risk was originally developed to improve safety in the development of weapons, aircraft, space vehicles and nuclear power. It has been embraced by many civilian corporations and the Army, and is now being implemented in the Navy, Air Force and Coast Guard. Although a risk management process like this has been part of the NAVOSH program for years, it has traditionally been applied primarily to workplace hazards. However, this process is also effective when applied to planning, operations, training and procedures.

B.1.1 The five steps of ORM are:

B.1.1.1 Identify potential causes of injury, damage, or mission degradation.

B.1.1.2 For each hazard identified, determine the associated risk in terms of severity and probability.

B.1.1.3 Develop risk control options, then decide if benefit outweighs risk. Seek further controls or guidance from CoC, if necessary.

B.1.1.4 Once risk decision is made, implement selected controls.

B.1.1.5 Follow up to ensure controls are working and watch for changes.

B.2 Decision Making (DM)

B.2.1 What is Decision Making? Effective decision making refers to the ability to use logical and sound judgment to make decisions based on available information.

B.2.2 This includes:

a. Assessing the problem.

b. Verifying information.

c. Identifying solutions.

d. Anticipating consequences of decisions.

e. Informing others of decision and rationale.

f. Evaluating decisions.

B.2.3 Factors That Promote Good Decision Making:

a. Teamwork.

b. Extra time to make a decision.

c. Alert crew members.

d. Decision strategies and experience.

B.2.4 A Decision Making Strategy for Troubleshooting:

a. Identify all the symptoms.

b. Make a hypothesis as to the possible cause.

c. Test your hypothesis.

d. Apply appropriate remedies.

B.2.5 Barriers to Good Decision Making:

Barrier	**How to Overcome**
Time	Use SOPs and select the best decision using available information.
Inaccurate or ambiguous information	Cross-check information.
Pressure to perform	Evaluate the rationale for making a decision.
Rank Difference	Use assertive behaviors.

B.3 Decision Strategy for Risk Assessment:

B.3.1 AESOP Model: Once a hazard has been detected, evaluate it to determine its potential effect on the planned flight by considering its impact on the:

a. Aircraft

b. Environment

c. Situation

d. Operations

e. People

B.3.2 The analysis shall consider the crew's relative ability to cope with changes in each of the five basic elements listed in the AESOP model.

Remember:
Good decisions optimize risk management and minimize errors, while poor decisions can increase them. Poor judgment or decision making is a leading cause of failure to complete missions and of mishaps. Each decision affects your future options.

APPENDIX C: ACRONYMS

ACAS Airborne Collision Avoidance System

ACCM Aircraft Configuration Control/Management

AD Airworthiness Directive

AE Airworthiness Engineer

AFM Aircraft Flight Manual

AMA Academy of Model Aeronautics

AMO Aircraft Management Office

AO Area of Operations

AOA Annual Operating Agreement

APIS Advance Passenger Information System

ASO Aviation Safety Officer

ASRS Aviation Safety Reporting System

ASWG Aviation Safety Working Group

ATC Air Traffic Control BA Boarding Authorization

BRNAV Basic Area Navigation CA Check Airman

CBP Customs and Border Protection

CDL Considered Discrepancy List

CRFO Chief of Research Flight Operations

CFR Code of Federal Regulations

COA Certificate of Authorization

CoC Chain of Command

DA Decision Altitude

DH Decision Height

DHS Department of Health and Human Services

DOD Department of Defense

DOT Department of Transportation
DRVSM Domestic Reduced Vertical Separation Minimum

eAPIS Electronic Advance Passenger Information System

ER Extended Range

ER-ARB Airworthiness Review Process for the Eastern Region Airworthiness Review Board

ESC Executive Safety Council

ESWR Experimental Systems Work Request

ETA Estimated Time of Arrival

ETD Estimated Time of Departure

FAA Federal Aviation Administration

FAR Federal Aviation Regulation

FCF Functional Check Flight

FCG USAF Foreign Clearance Guide

FL Flight Level

FLIP Flight Information Publication

FOSC Flight Operations Support Center

FRR Flight Readiness

FSDO Flight Standards District Office

FSIB Flight Systems Integration Branch

FSR Flight Safety Release

FTOSR Flight Test Operations and Safety Report

GCS Ground Control Station

GPS Global Positioning Satellite

GSO Ground Safety Officer

HM Hazardous Materials

HN Host Nation

IAOP Inter-center Aviation Operations Panel

ICAO International Civil Aviation Organization

ICAP Interagency Committee for Aviation Policy

ICF Instrument Check Flight

IFIM International Flight Information Manual

IMC Instrument Meteorological Conditions

IMO International Maritime Organization

IFR Instrument Flight Rules

ILS Instrument Landing System

IP Instructor Pilot

IRIS Incident Reporting Information System

IS-BAO International Standard for Business Aircraft Operations

LAFB Langley Air Force Base

LAPD Langley Research Center Policy Document

LPR Langley Research Center Procedures and Requirements

LaRC Langley Research Center

LMS Langley Management System

MDA Minimum Decision Altitude

MEL Minimum Equipment List

MMEL Master Minimum Equipment List

MNPS Minimum Navigation Performance Standard

NAMIS NASA Aircraft Management Information System

NAS National Airspace System

NASA National Aeronautics and Space Administration

NAVOSH Navy Occupational Safety and Health

NEMS NASA Equipment Management System

NOTAM Notices to Airmen

OEB Operations and Engineering Branch

ORM Operational Risk Management

OUM Organizational Unit Manager

PCS Portable Control Station

PIC Pilot-in-Command

POH Pilot's Operating Handbook

PL Public Law

QA Quality Assurance

QAO Quality Assurance Office/Officer

RFA Radio Frequency

RNP Required Navigational Performance

RSD Research Services Directorate

RSIB Research Systems Integration Branch

RVR Runway Visual Range

RVSM Reduced Vertical Separation Minimum

RVWO Research Vehicle Work Order

SAR Search and Rescue

SDAB Simulator Development and Analysis Branch

SED Systems Engineering Directorate

SIC Second-in-Command

SMAO Safety and Mission Assurance Office

SMS Safety Management System

SOP Standard Operating Procedure

sUAS Small Uncrewed Aircraft Systems

UAS Uncrewed Aircraft Systems

UAV Uncrewed Aerial Vehicle UN United Nations

VFR Visual Flight Rules

VMC Visual Meteorological Conditions