

Goddard Space Flight Center Wallops Flight Facility UAS Flight Operations Manual

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A blue ink signature of Shane G. Dover, written over a horizontal line.

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Chief of Flight Operations

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Date

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Contents

1.	General.....	1
1.1.	Purpose of Document.....	1
1.2.	Procedure Scope and Applicability	1
1.3.	Authority	1
1.4.	Federal Aviation Regulations Compliance	1
1.5.	Relevant Documents	2
2.	UAS Flight and Flight Crew Authorization	2
2.1.	Approval to Fly UAS Vehicle.....	2
2.2.	Number of UAS Vehicles for which Pilots are Qualified.....	2
2.3.	Approval of UAS Flights	3
2.4.	UAS Flight Crew Designations.....	3
2.5.	Aircraft Lead	4
2.6.	UAS Project Pilots	4
3.	UAS Flight Crew Qualifications.....	4
3.1.	Qualifications	4
3.2.	UAS Pilot Qualifications	4
4.	UAS Flight Crew Training and Checkout.....	5
4.1.	UAS Aircraft Folders	5
4.2.	UAS Aircrew Training Records.....	5
4.3.	UAS Initial Flight Crew Training and Checkout	5
4.4.	UAS Instructor Pilot Training and Checkout.....	6
4.5.	UAS Mission Commander Training and Checkout	7
5.	UAS Flight Crew Currency and Proficiency	7
5.1.	Authority to establish currency requirements	7
5.2.	Logging of UAS Flight Time	7
5.3.	General UAS Pilot Currency Requirements	8
5.4.	Annual CRM Training Requirements for All UAS Flight Crew	9
5.5.	Recurrent Training Requirements for UAS Pilots	9
5.6.	Grounding of UAS Flight Crew	10
5.7.	Flight Status Review Board	10
6.	UAS Flight Scheduling and Planning	11
6.1.	UAS Primary Flight Crew Duty Time	11
6.2.	Minimum Required UAS Vehicle Flight Crew Compliment.....	11

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6.3.	Range Requirements	12
6.4.	Mission Planning	12
6.5.	Air Traffic Control Coordination	12
6.6.	Frequency Management	12
6.7.	Aircraft Configuration Summary	12
6.8.	Read and Initial (R&I) File	13
6.9.	Normal and Emergency Procedures	13
6.10.	UAS Vehicle Maintenance Records	13
6.11.	UAS Vehicle Weight and Balance Forms	13
6.12.	Required Documents for Each Flight	13
6.13.	UAS Preflight and Postflight Briefings	14
6.14.	UAS Functional Check Flights	15
7.	UAS Flight Execution and Supervision	16
7.1.	Minimum Essential Systems for UAS Vehicle Operations	16
7.2.	Chase and Formation Flights with UAS	16
7.3.	UAS Wind Limitations	16
7.4.	Weather Requirements	17
7.5.	UAS Minimum Fuel	17
7.6.	Abnormal UAS Vehicle Operations	17
8.	Small UAS Operations	18
8.1.	Hours of Operation	18
8.2.	Communications	18
8.3.	Airspace	18
8.4.	Frequency Management	18
8.5.	Security	18
8.6.	Weather	18
8.7.	Safety Equipment	18
8.8.	Rogue Aircraft (Fly Away)	19
8.9.	Mishap Plan	19
Appendix A	20
Acronyms	20
Appendix B	21
Definitions	21
Appendix C	24
NPR 7900.3C Appendix I: UAS Classification Matrix	24

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Appendix D.....	26
NPR 7900.3C Appendix J: UAS Pilot Matrix.....	26

CHANGE HISTORY LOG

Effective Date	Revision	Page(s) affected	Description of Changes
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1. General

1.1. Purpose of Document

This document describes the management of Goddard Space Flight Center's (GSFC) unmanned aircraft operations and related safety considerations. It is intended to supplement the Flight Operations Manual and provide further clarification for Unmanned Aircraft System (UAS) specific items such as flight crew qualifications, authorization, and training. For a complete discussion of operational procedures and considerations for UAS, both manuals shall be referenced.

1.2. Procedure Scope and Applicability

1.2.1. This document applies to all UAS operations conducted by GSFC, regardless of geographic location unless specifically excluded in this document or waived by the Chief of Flight Operations. Specific procedures for UAS operations hosted by GSFC or conducted for GSFC by other government or contractor organizations are typically detailed in contractual documents or Memoranda of Understanding.

1.3. Authority

1.3.1. In accordance with NPR 7900.3 paragraph 5.1.4, the Chief of Flight Operations has the authority to establish the policies defined in this document. Waiver authority also rests with the Chief of Flight Operations and is 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 folder. Permanent waivers are retained until incorporated into this document.

1.4. Federal Aviation Regulations Compliance

1.4.1. Unmanned aircraft project teams shall make every effort to comply with all applicable portions of Title 14 CFR Part 91 Federal Aviation Regulations (FAR) except where exemptions or authorizations issued to the National Aeronautics and Space Administration (NASA) by the Federal Aviation Administration (FAA) permit deviation from FAR, or where maintaining safety of flight takes precedence. UAS are currently unable to comply with all the provisions of Title 14 CFR, Part 91 (specifically the see and avoid requirements in Section 91.113).

1.4.2. Intentional deviation from a flight rule is authorized only when an in-flight emergency requires immediate action, safety of flight dictates (e.g., avoidance of an in-flight collision) or operational necessity is declared by competent authority. Intentional deviation from a flight rule is not authorized when the deviation will jeopardize the safety of manned aircraft or civilians.

1.4.3. The FAA Certificate of Authorization (COA) process establishes mandatory provisions when operating in the NAS outside of Restricted and Warning Areas to ensure that the level of safety for UAS flight operations is equivalent to that of manned aviation. A COA is unique to the intended mission, and specifies the time period, circumstances and conditions under which the UAS must be operated. All GSFC aircraft operating in the National Airspace must have a signed COA as outlined in UAS Interim Operational Approval Guidance 08-01 and NPR 7900.3 Chapter 5.

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1.5. Relevant Documents

1.5.1. General Maintenance Manual (GMM) - This document describes the maintenance and inspection policy, requirements and standards for GSFC aircraft and related support equipment. It includes information on the technical library, tool control program, aviation life support equipment, logistics, quality control/assurance, and aircraft line services.

1.5.2. Air Vehicle Flight Manuals - Each air vehicles flight manual contains specific operating information, procedures, instructions, and limitations for a particular air vehicle model. Supplements to flight manuals are issued by the Aircraft Office to provide information on update changes to air vehicle equipment and procedures.

1.5.3. Federal Aviation Regulations (FAR) - FARs pertaining to UAS and COAs applies to operations of GSFC UAS unless NASA regulations contain more stringent requirements or specifically authorize deviations, as applicable.

1.5.4. International Regulations - When operating in international or foreign national airspace, the rules and procedures established for that airspace shall apply.

1.5.5. GSFC Airport and Facilities Operations Handbook - The Airport and Facilities Operations Handbook contains course rules and procedures applicable to aircraft operating at the GSFC Airport and the Wallops Range.

1.5.6. GSFC Aviation Safety Program (ASP) – The GSFC Aviation Safety Program provides procedures and guidance relative to mishap prevention, planning, reporting, and investigations.

1.5.7. UAS Interim Operational Approval Guidance 08-01 – This document provides guidance used to determine if UAS may be allowed to conduct flight operations in the U. S. National Airspace System (NAS).

1.5.8. FAA Advisory Circular 91-57, Model Aircraft Operating Standards – Established criteria for the safe operations of model aircraft.

1.5.9. NASA Procedural Requirement 7900.3 – Establishes policies for the operation of unmanned aircraft systems

2. UAS Flight and Flight Crew Authorization

2.1. Approval to Fly UAS Vehicle

2.1.1. The Chief of Flight Operations will determine primary flight crew assignments and authorize flight via the daily flight schedule. To operate UAS vehicles, UAS pilots must meet the qualification, training, checkout, and currency requirements of this document. Records are kept in the pilot's aircrew training record maintained by the Training Manager. Non-GSFC UAS flight crew must be approved for flight by the Chief of Flight Operations.

2.2. Number of UAS Vehicles for which Pilots are Qualified

2.2.1. The Chief of Flight Operations will determine the number of UAS vehicles in which GSFC-assigned pilots are qualified based on overall pilot experience, UAS pilot experience, demonstrated

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performance, and research or operational requirements. Non-GSFC UAS pilots participating in GSFC research projects and flying GSFC UAS vehicles will typically fly only those aircraft directly assigned to the project.

2.3. Approval of UAS Flights

2.3.1. UAS research and test flights must be formally requested and approved by the Chief of Flight Operations. All UAS flights that terminate intentionally at an airfield other than GSFC's Wallops Flight Facility (WFF) require the approval of the FAA and the Airfield Manager. Prior coordination is required with all affected controlling agencies and organizations (FAA, airfield management, control tower, and emergency response teams). A UAS project team shall be prepositioned to receive the aircraft and coordinate local support requirements.

2.4. UAS Flight Crew Designations

2.4.1. UAS flight crew designations will be made based on flight crew overall experience, experience in similar types of UAS vehicles, experience in the actual UAS vehicle type, other training, and demonstrated performance.

2.4.1.1. **Initial Cadre (IC):** A pilot that has completed an approved training syllabus for a one-of-a-kind prototype or experimental vehicle for which no other pilots are qualified. Once each initial cadre member completes a "first flight" they will receive instructor designations and will be used to train other aircrew, as required.

2.4.1.2. **Instructor Pilot (IP):** The Chief of Flight Operations will designate UAS pilots with appropriate qualifications and experience as UAS Instructor Pilot for each UAS vehicle type. Instructor UAS pilots will evaluate initial qualification and annual proficiency check flights for UAS vehicles for which they are IP qualified. Instructor UAS pilots may perform Functional Check Flights (FCF) for UAS vehicles in which they are IP qualified.

2.4.1.3. **Pilot in Command (PIC):** PIC designation signifies full qualification in the appropriate vehicle, including acting as Mission Commander (MC). UAS pilots may perform FCFs if designated as FCF qualified for the UAS vehicle by the Chief of Flight Operations.

2.4.1.4. **Second in Command (SIC):** SIC designation signifies qualification to support UAS operations that require two UAS pilots, but not qualification to serve as the MC.

2.4.1.5. **Mission Commander (MC):** The pilot that has direct responsibility for the aircraft and mission execution.

2.4.1.6. **Remote Pilot:** The Remote Pilot is generally designated as the pilot in command of the UAS. The Remote Pilot typically controls the UAS autonomously by means of computer interface with an onboard flight management system (fly-by-mouse) through a command and control communication link.

2.4.1.7. **Pilot Operator** - An individual who operates a UAS by means of manual control in a remotely located ground control station and/or with a handheld external system to visually pilot the UAS. The External Pilot typically manages the air vehicle's flight path through a command and control communication link using manual stick-and-rudder inputs.

2.4.1.8. **Radio Control Pilot** - The RC Pilot is an individual who operates a UAS by means of a remotely located, manually operated radio-controlled flight management system (direct control by means

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of stick-to-surface interface). The flight controller is typically commercial off-the-shelf RC hobby equipment. Radio frequencies associated with the command and control function of the system are typically in the unlicensed spectrum suite (72 MHz, 900 MHz, or 2.4 GHz). The RC Pilot is the designated PIC of the unmanned aircraft. All flight operations are within visual line of sight of the controlling pilot

2.4.1.9. **Observer** - An individual who is a primary crew member for UAS operations. The observer serves as the flight safety monitor to ensure non-interference between the UAS vehicle and non-participating 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

2.5. Aircraft Lead

2.5.1. A highly qualified UAS Pilot will be identified by the Chief of Flight Operations as the Aircraft Lead for each UAS vehicle type.

2.5.1.1. UAS aircraft leads will serve as the primary point of contact with outside agencies for obtaining technical and operational information and ensuring distribution of relevant information to all assigned UAS flight crew. They will define, update, and administer the flight crew training syllabus for each UAS vehicle. UAS aircraft leads will conduct systems and emergency procedure reviews during training sessions and safety meetings.

2.6. UAS Project Pilots

2.6.1. A UAS Project Pilot will be assigned for each UAS research project conducted by GSFC. The project pilot is responsible for planning, executing and reporting on test flights for their specific aircraft. Additionally, they will identify risks and mitigation procedures for their assigned project. The Project Pilot is considered to be the link between the project team and the Aircraft Office for all operational considerations and must coordinate with the lead UAS Pilot. Each UAS science deployment must have an assigned lead Project Pilot for each type of UAS vehicle who will address operational concerns relative to the deployment.

3. UAS Flight Crew Qualifications

3.1. Qualifications

3.1.1. UAS research pilots at GSFC are engaged in aeronautical research flight programs that may involve the application of advanced and unconventional flying techniques. It is a GSFC requirement that each flight crew member shall be fully qualified to perform their duties safely and effectively in the conduct of the above mentioned flights, and that a systematic program of checkout, certification, training, and currency is maintained at all times. The qualifications listed below provide guidance on the minimum qualifications required for being hired as UAS flight crew. Flight crew hired as pilots for manned aircraft may be trained to perform duties associated with UAS flight crew positions as required to meet GSFC UAS vehicle and mission requirements.

3.2. UAS Pilot Qualifications

3.2.1. All candidates must meet the minimum qualification established in NPR 7900.3 Appendix J. In summary, the following qualifications apply.

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3.2.2. Candidates must possess an FAA commercial pilot certificate with instrument, single engine land rating, or possess a pilot and instrument rating from the armed services. At the time of initial appointment, candidates for all pilot positions must possess the appropriate medical certificate in accordance with NPR 7900.3 Appendix J.

3.2.3. Flight test positions also require completion of a flight test course such as a military flight test school, or the FAA flight test pilot course, or at least 1 year of experience either flight testing aircraft for engineering approval (civilian or military) or analyzing aircraft performance data. For flight test pilots, all candidates must possess a current first class medical certificate at the time of appointment.

3.2.4. At the discretion of the Chief of Flight Operations, GSFC research pilots without prior UAS experience may checkout in UAS vehicles to perform research or sensor platform flights using a prescribed training and checkout program.

4. UAS Flight Crew Training and Checkout

4.1. UAS Aircraft Folders

4.1.1. UAS Aircraft Folders are maintained in the Aircraft Office for each UAS vehicle type flown at GSFC. These folders will be updated by the aircraft Lead Pilot, Project Pilot or Senior Instructor. The Aircraft Folders shall contain the required UAS ground and flight training syllabus required for initial checkout, requalification, and instructor upgrade. It shall also contain currency requirements and a detailed description of the aircraft configuration including any unique test limitations (see Aircraft Configuration Summary).

4.2. UAS Aircrew Training Records

4.2.1. To ensure that all GSFC aircrew maintain the highest qualification and currency standards, the Chief of Flight Operations or designated representative will maintain a system of records, notices, and reports covering each individual UAS pilot. All activities accomplished in support of initial, requalification, instructor, and MC checkout in a UAS vehicle will be documented and kept on file in the pilot's aircrew training record. Additional pages used to document individual training events such as Crew Resource Management (CRM) or survival training will be attached, as applicable.

4.3. UAS Initial Flight Crew Training and Checkout

4.3.1. UAS research pilots who support airborne science missions will receive qualification training under direction of a current UAS Instructor Pilot. Other NASA Center, military, or civilian UAS instructor resources will be used in the event a current GSFC UAS Instructor Pilot is not available. An initial UAS checkout training program will be developed for each UAS by either the lead UAS project pilot or the UAS Aircraft Lead. The training program will be documented in writing and filed in the UAS Aircraft Folder. The training program will include exposure to all UAS vehicle handling qualities that might be encountered during routine or emergency operations without violating flight manual restrictions or limitations. Qualification training will vary with the UAS vehicle involved, but may include:

- Ground training which may include a UAS ground control station checkout, handbook study, attendance at formal UAS vehicle training programs, emergency procedure training, and appropriate examinations.

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- Simulator training, if available, to include normal and emergency procedure training.
- UAS vehicle checkout flights, which will include a prescribed number of UAS flights and landings while under the supervision of a UAS IP or in accordance with a formal UAS training syllabus. Additional flights may be scheduled in order to meet training and proficiency for specific science mission requirements.
- A check ride in the UAS or approved simulator or surrogate vehicle prior to being cleared for solo flights.
- Solo flights, if applicable, in which a prescribed number of UAS flights in a given time are performed to complete initial checkout or gain proficiency, followed by UAS flights of a limited nature or complexity.
- A UAS IP monitored flight of a more complex nature to obtain full UAS mission qualification.

4.3.2. Prior to the first UAS flight of a newly assigned UAS pilot, the UAS pilot must complete the following items.

- Accomplish or provide documentation of a current and appropriate flight physical
- Ensure the training manager assembles UAS aircrew training record
- Complete applicable UAS vehicle examinations
- Complete a UAS vehicle emergency procedure review
- Complete required reading, UAS Flight Manual, UAS Checklist and Read and Initial File
- Receive safety briefing from the Aviation Safety Officer
- Ensure that an appropriate training syllabus is developed by the UAS monitor and documented in the UAS aircrew training record
- Complete required ground training in accordance with the approved UAS syllabus

4.3.3. UAS pilots who have not completed all specified ground training for a particular UAS vehicle, including attendance at ground school, may fly with a qualified UAS IP for familiarization. These flights shall not be counted as checkout flights for the purpose of obtaining qualification in the UAS vehicle.

4.3.4. In the case of prototype, experimental, or one-of-a-kind UAS vehicles for which no formal schools are available, the Chief of Flight Operations will select initial pilots (referred to as Initial Cadre) based upon overall test experience and experience with similar vehicles. An Initial Cadre training program will be incorporated into the applicable test plan using all means available including the services of the contractor and design engineers. Surrogate aircraft, vehicles with similar handling qualities and simulations may be used, if appropriate. When the training is complete, the Initial Cadre must complete one flight in the experimental vehicle prior to receiving an instructor designation. Once the IP designation is received, the Initial Cadre may train other aircrew.

4.3.5. UAS flight crew will not perform flight duties in a position for which a documented training program has not been completed unless approved by the Chief of Flight Operations, and under the supervision of a UAS IP.

4.4. UAS Instructor Pilot Training and Checkout

4.4.1. UAS pilots are designated to UAS instructor status by the Chief of Flight Operations, based on the following criteria:

- UAS experience
- Experience in type
- Experience in similar types of UAS vehicles

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- Training with engineers
- Training in simulators
- Previous UAS instructor qualifications
- Knowledge of the UAS vehicle mission
- Demonstrated performance.

4.4.2. Generally, an UAS Pilot should have a minimum of 500 hours of total flight instructor experience and 50 hours of flight experience in the particular type of UAS vehicle prior to being designated as an instructor. These requirements may be reduced at the discretion of the Chief of Flight Operations for Research Pilots flying prototype or one-of-a-kind experimental UAS vehicles based on the pilot's overall experience, experience in similar UAS vehicles, and familiarization with the particular UAS research vehicle.

4.4.2.1. GSFC qualified UAS instructors will normally conduct the training required for a new UAS instructor. In the absence of GSFC qualified UAS instructor flight crew, contractor or military UAS instructor flight crew may be used to checkout GSFC UAS instructors.

4.4.2.2. An instructor syllabus of instruction will be documented for each UAS and placed in the UAS Aircraft Folder. Individual UAS flight training will be documented using training forms for each UAS vehicle type and kept in the pilot's aircrew training record.

4.5. UAS Mission Commander Training and Checkout

4.6. UAS pilots are designated to MC status for multi-piloted aircraft by the Chief of Flight Operations. The decision to designate to MC status will be based on overall UAS experience, experience in the particular type of UAS vehicle, experience in similar types of UAS vehicles, extensive training with engineers or in simulators, previous UAS instructor experience, extensive knowledge of the UAS vehicle mission, and demonstrated performance.

4.7. For Category III UAS such as the Global Hawk, receiving a MC qualification will normally require 3 sorties as a copilot and 2 sorties as a pilot (MC) under instruction. These requirements may be reduced at the discretion of the Chief of Flight Operations for one-of-a-kind or prototype aircraft. For single piloted UAS, the Pilot in Command is the MC and no additional training is required.

5. UAS Flight Crew Currency and Proficiency

5.1. Authority to establish currency requirements

5.1.1. The Chief of Flight Operations has the authority to establish and approve all UAS flight currency requirements for all UAS flight crew assigned to GSFC or operating GSFC UAS vehicles. This includes specific requirements established for particular UAS flight research programs and UAS vehicles. Non-GSFC personnel operating non-GSFC aircraft will establish currency and proficiency requirements for their aircraft and aircrew which may include GSFC UAS pilots.

5.2. Logging of UAS Flight Time

5.2.1. UAS pilot qualifications for all GSFC assigned UAS vehicles are maintained by the Chief of Flight Operations. Designated UAS pilots shall log flight time as indicated in the paragraphs below.

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5.2.1.1. UAS PIC time is logged by the UAS pilot that is controlling movement of the vehicle's primary flight control surfaces.

5.2.1.2. UAS SIC time is logged by a pilot that is part of a multi-piloted aircraft that is not controlling the vehicle's primary flight control surface.

5.2.1.3. Mission Commander (MC) time will be logged by the aircraft Mission Commander.

5.2.1.4. UAS Instructor Pilot (IP) time may be logged by a UAS pilot when performing UAS IP duties during a UAS vehicle flight for which he is designated as a UAS instructor. In dual controlled UAS vehicles, a UAS pilot may log IP time when flying with a UAS pilot under instruction who is logging PIC or SIC time.

5.2.1.5. UAS flight time may not be used to meet NPR 7900.3 manned aircraft flight time requirements.

5.3. General UAS Pilot Currency Requirements

5.3.1. Once checked-out to fly a GSFC UAS vehicle, a flight crew member must maintain currency as defined in Table 1 below. These requirements have been established by the Chief of Flight Operations in accordance with NPR 7900.3 Chapter 5. The Chief of Flight Operations or a designated representative will monitor UAS flight crew currency.

Table 1: UAS Pilot Currency Requirements

	RC Pilot	Pilot Operator	Remote Pilot	Observer
Category I	3 Takeoffs and Landings per 90 days		3 hours per 90 days	No requirement exists
Category II		3 takeoffs and landings per 90 days	12 hours per 90 days	
Category III		5 takeoffs and landings per 90 days	15 hours per 90 days	

5.3.2. Due to the vast differences in controlling interfaces with unmanned aircraft systems and project requirements, the values listed in Table 1 may not be inadequate for all UAS. The Aircraft Lead or Project Pilot will establish currency, proficiency and requalification guidelines unique to a specific aircraft configuration or project. Surrogate UAS vehicles of similar performance and handling qualities and approved simulation devices may be used. In all cases, currency requirements may not decrease below the values listed above and all changes must be approved by the Chief of Flight Operations. The aircraft lead will ensure that all changes to currency requirements are documented in the UAS Aircraft Folder and acknowledged by all qualified pilots.

5.3.3. After 90 days, the UAS pilot must regain currency by reviewing normal and emergency procedures and UAS vehicle limitations with an IP. Letter documenting the required review above will be posted in the UAS pilot's flight jacket. The UAS pilot then must make a landing with a current IP monitoring the landing in order to regain currency.

5.3.4. If all UAS pilots are noncurrent for a particular UAS vehicle, the senior IP available for that UAS vehicle will review normal and emergency procedures and UAS vehicle limitations with another instructor pilot or a pilot designated by the Chief, Flight Crew Branch. A letter documenting the required review above will be posted in the UAS pilot's flight jacket. The senior UAS instructor pilot then regains landing currency while being monitored by the designated IP monitoring the landing. Based on the appropriate fidelity of a flight simulator, consideration may be given for using a simulator to obtain currency.

5.3.5. If 180 days has elapsed since currency expiration, the UAS pilot must complete a recurrency checkout program as documented in the aircraft folder.

5.3.6. The Chief of Flight Operations may designate surrogate UAS vehicles of similar performance and handling qualities to meet the landing currency requirement for specific UAS vehicle.

5.3.6.1. If the UAS vehicle is certified for instrument flight rules (IFR) or night operations (including flight on an IFR flight plan), all qualified pilots must complete 6 instrument approaches every 6 months to maintain currency. This requirement is in accordance with the FAA's UAS Interim Operational Approval Guidance 08-01. The approaches may be completed in any type of aircraft for which the pilot is qualified and half of the instrument approaches may be obtained in an approved simulator. Instrument approaches should be divided equally between non-precision approaches and precision approaches.

5.4. Annual CRM Training Requirements for All UAS Flight Crew

5.4.1. Crew Resource Management (CRM) training is required annually for all GSFC UAS flight crew. This training shall include all aircrew, test conductors, test directors and engineers with control room responsibilities (monitoring safety of flight / safety of test parameters). Documentation for this training must be contained within each aircrew training record.

5.5. Recurrent Training Requirements for UAS Pilots

5.5.1. Each pilot will complete an annual instrument review and refresher class every 12 months to ensure instrument proficiency. An approved instrument examination may be taken in lieu of attendance at a formal instrument refresher course.

5.5.2. Every 12 months, each pilot will complete an annual checkride for each type UAS vehicle in which they are qualified. A surrogate aircraft or approved simulation device may be used, if deemed appropriate by the Chief of Flight Operations. The recurrency training date is based on the last day of the month in which the proficiency check ride is accomplished. Recurrent training requirements will be determined by each UAS Aircraft Lead or lead Project Pilot, approved by the Chief of Flight Operations and documented in the UAS Aircraft Folder. At a minimum, it shall include an open book, closed book and boldface exam along with a check ride that must be administered by a qualified instructor.

5.5.3. A proficiency check ride requires the following items as a minimum: Flight planning, mission briefing, ground procedures, takeoff, normal and emergency landing patterns normally practiced in flight, post landing procedures, mission debriefing, and other maneuvers deemed appropriate by the UAS aircraft lead.

5.5.4. Any refresher training accomplished at an approved commercial training establishment or through the military may be used to fulfill the above requirements. Check rides completed under the

supervision of a qualified military or civil UAS check pilot may be used to fulfill the proficiency check ride requirement for a particular aircraft, if properly documented.

5.6. Grounding of UAS Flight Crew

5.6.1. Mandatory temporary grounding of UAS flight crew will occur for the following reasons until the specified corrective action is completed:

5.6.1.1. Flight physical overdue. UAS flight crew must complete the appropriate flight physical to resume flight duties.

5.6.1.2. Check ride overdue. The Chief of Flight Operations may use discretion and waive this requirement if a UAS vehicle is unavailable or for other unforeseen circumstances, but the check ride must be completed expeditiously.

5.6.2. Mandatory administrative grounding: UAS flight crew involved in a Class A or B mishap while flying a UAS, or a lower severity mishap or close call that created a high possibility for death or serious injury, will be suspended from all UAS flight activities pending a review by the Chief of Flight Operations. A UAS mishap due to technical problems beyond the control of the flight crew (such as vehicle loss due to a lost link, vehicle loss due to a planned and briefed hazardous test, or vehicle loss due to a software design problem) may not necessarily result in a mandatory flight crew grounding for UAS operations. The duration of and release from grounding will not exceed 30 days without referral to the Center Director for recommended further action.

5.6.3. The Chief of Flight Operations has the authority and responsibility to temporarily ground UAS flight crew, in writing, for a period of up to 30 days for flight discipline or flight safety violations or for other reasons as deemed appropriate. He/she also has the authority and responsibility to recommend permanent grounding of flight crew.

5.6.4. Upon concurrence of the next level supervisor on the recommended permanent grounding, the Center Director will be notified immediately so that he/she may appoint a Flight Status Review Board.

5.6.5. In all cases of a permanent grounding of UAS flight crew, the immediate supervisor will, within 30 calendar days of the permanent grounding action:

5.6.5.1. Conduct a performance appraisal review with the grounded flight crew that will include a discussion of reasons for the grounding action and annotate the performance appraisal to reflect the situation.

5.6.5.2. Coordinate with management and the GSFC Office of Human Capital Management to effect the timely and appropriate reassignment of position duties of the affected flight crew.

5.7. Flight Status Review Board

5.7.1. Whenever a GSFC flight crew is removed from UAS flight status by the authority vested in relevant supervisors, that situation will be reviewed by a third party board (which may include flight crew members from other NASA Centers). This board will be appointed by the Center Director and will be disbanded after presenting their findings and recommendations to the Center Director. The grounded flight crew may waive his/her right to this review in writing at any time during the process, and in such cases, the board will terminate at that time.

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5.7.2. The Board's scope includes all elements pertinent to the grounding that are necessary to arrive at their conclusions and recommendations. However, their scope does not include personnel assignment options beyond the flight status issue. The board should feel free to call upon any center resources required in the course of their review.

5.7.3. All testimony, deliberations, findings, and recommendations occurring in the course of the review shall be deemed confidential and distributed only on a need-to-know basis.

5.7.4. Relevant supervisors may also request of the Center Director that a Flight Status Review Board be appointed "before the fact" to aid that supervisor in his/her decision making process regarding a contemplated removal from flight status. In this case, the candidate for grounding may not waive his/her right to the review.

6. UAS Flight Scheduling and Planning

6.1. UAS Primary Flight Crew Duty Time

6.1.1. Maximum UAS primary flight crew (UAS pilots, flight engineers, and technicians) duty times are shown below. UAS crew duty time is the total time a crew is on duty before the final termination of a flight. UAS crew duty time accrues consecutively and begins when a crewmember reports to his/her designated place of duty, including nonlocal travel time to the duty location (travel time that exceeds approximately 90 minutes in duration), and ends when the UAS vehicle is parked and shut down. Each UAS crewmember must have at least 12 hours off duty after completing all UAS postflight activities prior to being required for a subsequent flight (either ground or flight duties). These requirements can be waived by the Chief of Flight Operations or a designated representative on an individual basis.

6.1.1.1. Single piloted UAS vehicle with one pilot – 12 hours

6.1.1.2. UAS vehicle with two qualified UAS pilots (FP and CP) – 14 hours

6.1.1.3. Each UAS operation must be evaluated to consider the type and tempo of operations when considering maximum shift periods for flight crew. Shorter UAS crew duty times should be used to support very high or very low workload conditions. UAS operation should be staffed to allow for periodic breaks for all required flight crew.

6.1.1.4. Other personnel who have critical decision-making duties with respect to a UAS flight (such as mission UAS pilots, senior operations representatives, flight monitors, critical data monitors, flight test engineers, and others designated by the Project Manager or Chief of Flight Operations) have a maximum crew duty day of 12 hours unless waived by the Chief of Flight Operations.

6.2. Minimum Required UAS Vehicle Flight Crew Compliment

6.2.1. Each UAS Project Pilot will determine the minimum required flight crew necessary to support basic UAS flight operations and research requirements. Each UAS vehicle will be operated with all required flight crew positions fully staffed for the intended mission requirements and scheduled to avoid duty time limitations.

6.3. Range Requirements

6.3.1. Category II and III unmanned aircraft must operate within the Wallops Class D airspace, R-6604A or be on an approved COA. Additionally, aircraft in these categories may only takeoff and depart from existing airports with prepared surface runways or other approved means of vehicle launch (catapult or sling launched). Category I UAS range requirements are listed in paragraph 8.3 of this manual.

6.4. Mission Planning

6.4.1. The PIC of a GSFC UAS vehicle will ensure that a flight plan is prepared prior to every flight. The flight plan will be independently verified by a qualified aircrew member and so noted at the preflight briefing. The form used will be one of the following:

- Military Flight Plan (DD Form 175)
- ICAO Flight Plan (DD Form 1801)
- FAA Flight Plan (FAA 7233-1)
- A certificate of waiver or authorization (COA) is required for flights conducted in FAA-controlled air space (NAS)

6.4.2. Highly autonomous systems such as the Global Hawk require a thorough mission plan validation and verification process. A complete discussion on autonomous mission planning is outside the scope of this document, but all baseline mission plans and subsequent changes shall be verified and validated by a minimum of two qualified pilots. A record of the mission plan validation and verification process will be maintained with all other aircraft configuration changes.

6.5. Air Traffic Control Coordination

6.5.1. Project teams will submit a Memorandum of Understanding and/or Letter of Agreement with local air traffic control facilities to ensure that they have a complete understanding of and agree upon the air traffic control procedures that will be used to ensure safe UAS operations. This shall include a discussion of exclusive use airspace requirements, lost command and control datalink procedures, emergency procedures, de-confliction plan with other manned assets, and flight termination procedures.

6.6. Frequency Management

6.6.1. UAS will operate on assigned frequencies only. All command and control frequencies and electromagnetic radiation emissions from unmanned aircraft must be assigned and de-conflicted with the GSFC WFF Spectrum Manager.

6.7. Aircraft Configuration Summary

6.7.1. UAS research vehicles are frequently modified to accomplish test and research objectives. It is critical to document all modifications that affect the operation of the UAS vehicle, including normal and emergency procedures, instrumentation system operating procedures, and flight limitations. The Project Pilot for each platform will document these items on an Aircraft Configuration Summary which will be maintained in the UAS Aircraft Folder. This documentation must be in place and accurately reflect the aircraft configuration prior to brief time.

6.8. Read and Initial (R&I) File

6.8.1. A R&I file will be established to maintain continuity and pass along important platform-specific information that is not formally documented elsewhere. A general R&I File is maintained by the Aircraft Operations Department while platform specific items will be contained within the Aircraft Folder. The Training Manager and aircraft Lead Pilot will be responsible for maintaining the general R&I File and platform specific files respectively. All aircrew must acknowledge the general file along with any platform specific files for which they are qualified prior to flying in GSFC aircraft.

6.9. Normal and Emergency Procedures

6.9.1. Normal and emergency procedures shall be in accordance with the manufacture's Pilots Operating Handbook (POH), if one exists. Test article emergency procedures will be documented on the Aircraft Configuration Summary. Normal and emergency procedure checklists will be maintained and kept up-to-date by the aircraft Lead Pilot.

6.9.2. In the case of experimental or prototype aircraft where no checklist exists, the Project Pilot will be responsible for establishing and maintaining these documents. The initial checklists and any subsequent changes must be approved by the Chief of Flight Operations via a Technical Safety Review Board (TSRB).

6.10. UAS Vehicle Maintenance Records

6.10.1. Each UAS vehicle will have a GSFC Aircraft Maintenance Record and will be entered into the NASA Aircraft Management Information System (NAMIS) noting the readiness of the aircraft, including status and fuel service. The Flight Preparedness Form, contained in NAMIS, will be printed, completed and signed by the designated maintenance representative and submitted to the UAS airworthiness engineer and the UAS Pilot scheduled to fly the mission. The UAS pilot will accept the vehicle as ready by inspecting the Flight Preparedness Form and signing in the appropriate place. The UAS pilot may sign-off an open nongrounding maintenance item. An open grounding maintenance item may be downgraded to an open nongrounding item by approval of the Chief of Flight Operations before flight.

6.11. UAS Vehicle Weight and Balance Forms

6.11.1. A copy of current UAS weight and balance forms for all category II and III UAS vehicles operated at GSFC will be maintained in maintenance control as documented in the GSFC GMM. These may be computed on a flight-by-flight basis or may be computed to cover standard operating configurations for a single UAS vehicle. A copy of the applicable weight and balance forms will be available at the UAS control station during flight for all category II and III UAS.

6.12. Required Documents for Each Flight

6.12.1. A copy of the following documents must be maintained in the UAS aircraft folder and UAS control station.

- NASA Airworthiness certificate (if applicable)
- NASA GSFC Safety of Flight Release
- Weight and balance form
- Normal Operating Procedures

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- Emergency Procedures
- Aircraft Configuration Summary

6.13. UAS Preflight and Postflight Briefings

6.13.1. Flight planning is an essential part of the process for conducting UAS flights in a safe and efficient manner. All UAS flights conducted by GSFC UAS vehicles will be planned and briefed appropriately to ensure thorough preparation.

6.13.2. The crew briefing is also an essential part of the process for conducting UAS research flights. The crew briefing is normally the last formal briefing and presentation prior to the actual UAS research flight. This briefing should be conducted by the UAS PIC flying the mission for each mission segment. The intent is to cover all operational aspects of the mission and to promote full understanding among participants. The guidelines for conducting crew briefings are listed below.

6.13.2.1. For missions of duration less than or equal to 8 hours, the crew brief is normally conducted the day of the flight prior to the start of operations. However, the crew brief may be conducted up to 24 hours prior to the flight.

6.13.2.2. For missions of duration greater than 8 hours involving multiple crews, the crew brief is conducted 24 to 36 hours prior to the start of operations in order to facilitate attendance by all participants and to comply with crew rest requirements.

6.13.3. The following personnel shall attend UAS research flight crew briefings:

- All required UAS flight crew members, including chase aircraft support pilots
- Senior flight operations representative
- Airworthiness engineer
- Control room subsystem monitors
- Appropriate systems engineers
- Project scientists
- Other personnel deemed necessary for proper mission planning and execution

6.13.4. For long duration flights where multiple UAS flight crews are required during the course of the mission, a hand-over UAS flight crew briefing is conducted to ensure that the UAS flight crew assuming flight duties is aware of all pertinent information regarding the status of the UAS vehicle and mission prior to assuming UAS flight crew duties. This hand-over briefing is typically conducted by the departing mission UAS Pilot and UAS PIC. Additional duty station specific hand-over briefings, including significant flight events or data, are conducted by discipline engineers or scientists as appropriate for each duty station.

6.13.5. Combined Systems Tests and other ground tests in support of UAS research programs will be crew briefed. The UAS project pilot, airworthiness engineer, or project chief engineer will determine who is required prior to attending the crew briefing.

6.13.6. A generic flight briefing checklist is available in the Aircraft Office for projects to use in mission briefings. UAS project personnel may modify the briefing checklist to meet specific project and mission requirements. Briefing formats for different project flights may vary, but should cover the following areas.

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- AFSRB follow up and open items
- Weather
- Test plan/flight profile
- Test cards/chase requirements
- Mission rules/limitations/Go and No-Go Criteria
- Aircraft status
- Crew coordination items
- Emergency procedures
- Bingo and landing fuel

6.13.7. Postflight debriefings will be conducted to discuss general flight conduct, mission accomplishments and areas for improvement. The postflight briefing may be broken in two parts based on crew rest requirements: (1) an initial debrief conducted by the landing UAS flight crew to discuss UAS vehicle maintenance status and mission success and (2) a debrief conducted when all participating UAS flight crew are available to discuss overall mission conduct and lessons learned. The guidelines for conducting crew debriefings are listed below:

6.13.7.1. For missions of duration less than or equal to 8 hours, the mission debrief is conducted immediately following the flight, if practical, or the following day.

6.13.7.2. For missions of duration greater than 8 hours involving multiple crews, in order to comply with crew rest requirements the mission debrief is conducted 24 to 36 hours following the flight to facilitate attendance by all participants.

6.14. UAS Functional Check Flights

6.14.1. Functional Check Flights (FCF) are accomplished when significant maintenance or modifications have been performed to a UAS vehicle involving flight critical systems such as engines, electrical systems, hydraulics, flight controls, pitot static systems, environmental systems, and other essential systems for safe operation. Functional check flights are normally not required for instrumentation system checkouts if the integrity of flight critical systems is not affected. Flights dedicated to instrumentation or experiment system checkout are accomplished as mission support flights.

6.14.2. The following considerations will be used to determine if a FCF is required for UAS research vehicle:

- Applicable NATOPS or Production Flight Procedures Manual requirements
- Length of time since the aircraft last flew
- Types of modifications made to the aircraft since it last flew
- Amount and type of maintenance performed on the aircraft since it last flew

6.14.3. FCFs on a UAS research vehicles will be conducted at the discretion of the airworthiness engineer and Project Pilot. The Chief of Flight Operations or designated representative may also direct FCFs.

6.14.4. FCFs on a UAS research vehicle may be full or partial profiles. Full profiles will normally be flown if the UAS vehicle has not flown for an extended period of time or if extensive modification or maintenance has been accomplished since it last flew. Partial profiles may be flown to check specific UAS vehicle systems affected by maintenance or modifications.

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6.14.5. FCF procedures for each UAS research vehicle will be reviewed in light of vehicle limitations and modifications. Where appropriate, modified FCF procedures will be written. These modified procedures will be documented in the UAS vehicle flight manual or in a dedicated FCF checklist.

6.14.6. When a partial FCF profile is flown on a UAS research test vehicle, it may be combined with a test mission. The mission may integrate test maneuvers and functional check requirements only if the test maneuvers are performed after all required functional checks are completed.

6.14.7. All UAS FCF tests will be accomplished in day VMC. Additionally, the airfield weather must be no lower than 1500-3 and suitable for all planned FCF maneuvers for the UAS vehicle. This does not preclude flying through IMC to an area where VMC exists.

6.14.8. UAS pilots are designated by the Chief of Flight Operations as FCF qualified in specific UAS vehicles. Generally, UAS IPs are FCF qualified for UAS vehicles for which they are instructor qualified. FCF qualifications are documented in the UAS aircrew training record.

7. UAS Flight Execution and Supervision

7.1. Minimum Essential Systems for UAS Vehicle Operations

7.1.1. A minimum Essential Equipment list will be maintained in the Aircraft Folder for each UAS. Prior to research flights, UAS pilots and aircraft lead shall establish a test specific go-no go list indicating which systems are required for safety and mission accomplishment and adhere to those standards when deciding whether to continue or abort a mission.

7.2. Chase and Formation Flights with UAS

7.2.1. Formation flights of GSFC aircraft must take place only by prior arrangements between the pilots of the aircraft involved. Normally, such arrangements must be thoroughly briefed prior to the flight. When an emergency or special circumstance exists or for the protection of lives, a deviation from the prior arrangement is permitted with the following precaution: The decision to operate near another aircraft in flight must be carefully weighed, considering the capabilities of the aircraft and understanding the intentions of the crews involved. In no case should the action increase the overall hazard.

7.3. UAS Wind Limitations

7.3.1. UAS projects shall establish wind limitations appropriate for the intended UAS operations. These limitations should consider maximum winds for flight, maximum crosswind conditions for takeoff and landing, and maximum gust or turbulence conditions for adequate flight control. Actual wind limitations will be evaluated as part of the AFSRB process and documented in the Aircraft Configuration Summary. If no limitations exist, the following limitations shall be adhered to:

- Category I aircraft 15 knot headwind, 5 knot crosswind, 5 knot tailwind
- Category II aircraft 20 knot headwind, 7 knot crosswind, 7 knot tailwind
- Category III aircraft 25 knot headwind, 10 knot crosswind, 10 knot tailwind

7.4. Weather Requirements

7.4.1. Weather limitations and alternate requirements for each project will be formulated and approved during the Mission Operation Readiness Assessment Panel (MORAP) process. If no other limitations exists, the following criteria apply:

7.4.1.1. For remotely piloted unmanned aircraft that have an operator in the control loop during launch and recovery, the weather conditions at scheduled launch time and plus or minus one hour of scheduled recovery time shall be no lower than 1500-3. While en route, the operator shall maintain VFR conditions at all times.

7.4.1.2. For highly autonomous vehicles with a keyboard and mouse interface that are certified for IFR operations, the weather conditions at scheduled launch time and plus or minus one hour of scheduled recovery time shall be no lower than 1000-3. While en route, the operator may proceed on an IFR flight plan.

7.4.1.3. No alternate is required if the vehicle has fuel reserves to allow for 1 hour of holding at 2000 feet over the field at maximum endurance airspeed. If an alternate is required, a ground crew shall be positioned to recover the vehicle.

7.4.1.4. Icing conditions shall be avoided at all times.

7.5. UAS Minimum Fuel

7.5.1. UAS projects will establish minimum and emergency fuel remaining requirements for each UAS vehicle operated at GSFC. UAS pilots will plan and execute each mission to allow completion above the minimum fuel remaining requirements for the respective UAS. UAS pilots will declare minimum fuel when it becomes apparent that traffic sequencing will result in landing at or below the minimum fuel. Pilots will declare emergency fuel when it becomes apparent that a landing will occur at or below the emergency fuel unless traffic priority is obtained. Bingo and landing fuels should be planned to allow landing in normal traffic sequence prior to reaching the minimum fuel.

7.5.2. Minimum on-deck fuel will be formulated and approved during the MORAP process and documented in the Aircraft Configuration Summary. If no limitation exists, the aircraft must have sufficient fuel to hold for 30 minutes over the intended point of landing.

7.6. Abnormal UAS Vehicle Operations

7.6.1. The practice of in-flight emergency procedures to include intentionally activating degraded or backup modes of any flight control or aircraft subsystem is strictly prohibited unless the flight is operating on an approved FCF, ECF or other test plan.

7.6.2. Per NPR 8715.5, paragraph 1.3.7.3a, the Range Safety Officer will undergo a simulation exercise/scenario that provides hands-on operations of the range safety system and safety decision making process in conjunction with the UAS once a year.

8. Small UAS Operations

8.1. Hours of Operation

8.1.1. Small UAS (sUAS) operations will normally take place between the hours of 0700 local until 25 minutes after official sunset. After hours operations may be scheduled if coordinated through the responsible GSFC Project Manager or designated oversight representative. sUAS operations will normally take place Monday-Friday. Operations during weekends may also be scheduled through the responsible GSFC Project Manager or designated oversight representative.

8.2. Communications

8.2.1. The pilot is responsible for maintaining communications with the control tower at all times during flight operations. Normally, two-way VHF/UHF radio or land mobile radio is required as primary means of communication, with cellular phone as back-up.

8.3. Airspace

8.3.1. sUAS may operate from any suitable location as long as the aircraft remains below 400 feet AGL and away from populated or sensitive areas as defined in FAA Advisory Circular 91-57, Model Aircraft Operating Standards. If mission objectives require a deviation from this Circular, the vehicle must remain within Wallops class D airspace, R-6604A or have an approved COA from the FAA. Category I aircraft may takeoff or land on unprepared surfaces.

8.4. Frequency Management

8.4.1. All operating RF equipment and frequencies utilized in the conduct of sUAS flight operations must be approved by the GSFC Spectrum Manager. The test team may only operate on the assigned frequencies.

8.5. Security

8.5.1. All personnel present at the test area must obtain and display their GSFC or Visitor Badge at all times while in the test area.

8.5.2. All personnel present at a designated sUAS test area will comply with GSFC security personnel directives for entry/exit, and guidance provided by the GSFC designated oversight representative.

8.6. Weather

8.6.1. VFR flight rules apply. Test teams will ensure the UAS is operated within the defined wind limitations for that air vehicle and is operated within the environmental condition limitations as prescribed by the UAS operating manual or similar documentation.

8.7. Safety Equipment

8.7.1. An operable fire extinguisher must be present at all times during test activities. An operable flashlight must be available to crews operating before sunrise and after sunset.

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8.8. Rogue Aircraft (Fly Away)

8.8.1. The pilot and test team shall make every effort to re-establish control of the UAS and land immediately.

8.8.2. In the event that the air vehicle exits the designated test area under a fly-away condition, the pilot is responsible to notify Wallops Control Tower operators or the nearest ATC facility immediately. Provide as much information on location, direction of travel, altitude, and expected vehicle behavior as possible.

8.8.3. In accordance with NPR 7900.3 Appendix I, a Flight Termination System is not required for Category I aircraft as long as a reliable commercial RC system is being utilized.

8.9. Mishap Plan

8.9.1. Test Area Mishap – No Collateral Damage

8.9.1.1. The aircrew and control room personnel will comply with the approved mishap plan or 830-MAMC-001 if no test specific document exists. The aircrew and control room personnel will notify GSFC designated oversight representative immediately. The GSFC designated oversight representative will notify appropriate NASA government personnel (GSFC management) as time permits.

8.9.2. Test Area Mishap – Collateral Damage

8.9.2.1. If a fire exists as a result of an air vehicle crash landing, first responders will attempt to extinguish the fire and dial 911 to report the incident. If injuries occur as a result of an air vehicle crash landing, first responders shall dial 911 to report the incident.

8.9.2.2. First responders shall Notify Wallops Tower or appropriate ATC agency. Provide information on the location of the incident as well as the current status of the air vehicle, fire, personnel injuries, damage to ground vehicles/structures, etc. First responders shall notify GSFC designated oversight representative (as time permits).

8.9.3. Outside Test Area Mishap

8.9.3.1. If the air vehicle becomes a rogue aircraft (fly away) and/or crash lands outside of the designated test area, the aircrew and control room personnel will comply with the approved mishap plan. The aircrew and control room personnel will notify Wallops Control Tower operators or nearest ATC agency and provide as much information on location, direction of travel, altitude, expected vehicle behavior, and mishap location as possible.

8.9.3.2. The aircrew and control room personnel will notify GSFC designated oversight representative (as time permits).

Appendix A

Acronyms

AFSRB	Airworthiness and Flight Safety Review Board
AGL	Above Ground Level
AV	Air Vehicle
COB	Close of Business
COTS	Commercial Off The Shelf
CTO	Control Tower Operator
ETA	Estimated Time of Arrival
ETR	Estimated Time of Return
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FOM	Flight Operations Manual
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HAZMAT	Hazardous Materials
HQ	Headquarters
IAOP	Inter-Center Aircraft Operations Panel
IAW	In Accordance With
IMTE	Inspection, Measuring, Test Equipment
ISO	International Standards Organization
NA	Not Applicable
NASA	National Aeronautics and Space Administration
NCR	Nonconformance Report
NCW	Not Complied With
OJT	On-Job Training
OPS	Operations
PG	Procedures and Guidance
PIC	Pilot in Command
PSO	Pilot Sensor Operator
SIC	Second in Command
SOFR	Safety of Flight Release
sUAS	Small UAS
TDY	Temporary Duty
UAS	Unmanned Aircraft System
WFF	Wallops Flight Facility

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Appendix B

Definitions

All NASA UAS and remotely piloted vehicles fall into one of three groups. These groups are defined in NPR 7900.3C and are also listed in Table 2:

Table 2: Definition of UAS Groups

Category	I	II	III
Weight (lb)	≤ 55	55-330	> 330
Airspeed (kt)	≤ 70	≤ 200	> 200
Type	Model or sUAS	sUAS	UAS

Air Vehicle Maintenance – The scheduled or unscheduled work on an air vehicle that is required to attain and to sustain a state of airworthiness, and work that meets all required standards, practices, and guidelines for airworthiness.

Air Vehicle Modification – Any alteration, addition, or removal of air vehicle structure, components, equipment, computer software, or primary instrumentation. Routine maintenance is exempt from this definition.

Air Vehicle Operations – A general term used to describe the operational phase of an air vehicle’s activity that normally commences with an air vehicle’s release for flight and terminates with its return to maintenance status. Aircrew training, functional check flights, and mission operations are considered subsets of air vehicle operations. “Air vehicle maintenance operations” is a general term used to describe non-flight maintenance activity.

Airworthiness – The capability of an air vehicle to be operated within a prescribed flight envelope in a safe manner.

Airworthiness and Flight Safety Review Board (AFSRB) – The AFSRB is a board responsible for approving aircraft modifications and configuration changes. Flight approvals are presented in the form of a Safety of Flight Release (SOFR). The Board is composed of the GSFC Aviation Safety Officer, mechanical, electrical, and aeronautical engineers. One of these individuals is designated as the Chairman.

Beyond Line of Sight (BLOS) - Beyond line of sight (BLOS) typically refers to communication link protocols that enable unmanned air vehicle command and control outside of a direct link between a transmitter and a receiver.

Certificate of Authorization (COA) - COA is an authorization issued by the Air Traffic Organization to a public operator for a specific Unmanned Air Vehicle activity. After a complete application is submitted, FAA conducts a comprehensive operational and technical review. If necessary, provisions or limitations may be imposed as part of the approval to ensure the unmanned aircraft can operate safely with other airspace users.

Configuration Control – A process that ensures changes to an UAS configuration are controlled and in conformance with design drawings and specifications. Configuration changes to a UAS with an

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airworthiness certificate must be in compliance with NASA airworthiness policies. Configuration changes to NASA research or program support UAS must be in compliance with NASA specific directives of the NASA entity operating the UAS.

Contracting Officer's Representative (COR) – An individual who serves as the primary technical representative for the contracting officer relative to a Government contract.

Engineering Check Flight (ECF) – A flight authorized by a NASA operations and safety directive for the purpose of validating engineering modifications to a NASA research or program support UAS. The ECF is usually required following installation of project equipment for a particular mission.

8.9.4. Pilot Operator - An individual who operates a UAS by means of manual control in a remotely located ground control station and/or with a handheld external system to visually pilot the UAS. The Pilot Operator typically manages the air vehicle's flight path through a command and control communication link using manual stick-and-rudder inputs.

Flight Readiness Review (FRR) – The FRR is a review conducted prior to any flight operations to ensure compliance with all airworthiness and flight safety requirements as outlined in this document.

Functional Check Flight (FCF) – An FCF is synonymous with a post-maintenance check flight and has the expressed purpose of flight checking altered UAS systems as required by the GSFC GMM or another applicable maintenance manual.

Goddard Procedural Requirements (GPR) – A GPR is a GSFC-approved publication that provides procedures and guidelines on a particular subject. A GPR is issued in conformance with the Center's quality management system.

Intercenter Aircraft Operations Panel (IAOP) – The IAOP is composed of members from NASA centers that operate aircraft, representatives from the Aircraft Management Team (AMT), advisors from appropriate NASA centers, advisors from the Office of Safety and Mission Quality, and points of contact from the NASA Headquarters program offices. The IAOP provides NASA with aircraft advisory information and a standardized, functional peer review process for aircraft operations and maintenance.

External Pilot - The Internal Pilot is generally designated as the pilot in command of the UAS. The Remote Pilot typically controls the UAS autonomously by means of computer interface with an onboard flight management system (fly-by-mouse) through a command and control communication link.

Line of Sight (LOS) - Line of sight (LOS) typically associated with RF communication direct link limitation between a transmitter and receiver. May also refer to visual line of sight (VLOS) between the controlling pilot and an air vehicle.

NASA-Controlled Aircraft – Aircraft that are bought, borrowed, leased, bailed or otherwise procured or acquired, regardless of cost, from any source for the purpose of conducting NASA science, research, and/or other missions, and which are operated by NASA and/or whose operation is managed by NASA. Aircraft loaned by NASA to another agency/organization are not considered as NASA-controlled aircraft unless so stated by agreement.

Observer - An individual who is a primary crew member for UAS operations. The observer serves as the flight safety monitor to ensure non-interference between the unmanned air vehicle and non-participating aircraft by means of see and avoid. The observer may perform these duties either on the ground on in a chase aircraft while in direct communication with the controlling pilot.

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Pilot in Command – A NASA pilot who holds the appropriate category, class, and, if appropriate, type rating or military qualification for the aircraft and is qualified in its operation by appropriate center or mission management directives. The PIC has final authority and responsibility for the operation and safety of the flight.

Project Check Flight (PCF) – A PCF is an initial project-related flight in a program support UAS that is flown to check the functionality of project equipment. This flight is authorized in an OSD and is staffed with project personnel who operate and check project equipment.

Radio Control Pilot – The RC Pilot is an individual who operates a UAS by means of a remotely located, manually operated radio-controlled flight management system (direct control by means of stick-to-surface interface). The flight controller is typically commercial off-the-shelf (COTS) RC hobby equipment. Radio frequencies associated with the command and control function of the system are typically in the unlicensed spectrum suite (72 MHz, 900 MHz, or 2.4 GHz). The RC Pilot is the designated PIC of the unmanned aircraft. All flight operations are within visual line of sight of the controlling pilot

Unmanned Aircraft System (UAS) – A UAS is any airborne vehicle system without a pilot onboard that is controlled autonomously by an onboard guidance and control system and is operated from a remote ground control station. A UAS is defined as an aircraft by the FAA. Unmanned aircraft systems can be operated via a remotely located, manually operated flight control system or ground control system.

Appendix C

NPR 7900.3C Appendix I: UAS Classification Matrix

Category	I	II	III
Weight (lb)	≤ 55	55-330	> 330
Airspeed (kt)	≤ 70	≤ 200	> 200
Type	Model or sUAS	sUAS	UAS
Airworthiness & Flight Safety Review	Ops in NAS: Must comply with NASA and FAA requirements.		
	Ops in special use airspace (SUA): Commercial off-the-shelf models and sUAS receive flight approval via NASA Center airworthiness and flight safety review process. All NASA and NASA hosted aircraft must have an airworthiness statement and flight release.	Ops in special use airspace (SUA): NASA Center airworthiness and flight safety review and a flight readiness review are required. Subsequent system modifications requires technical review and FRR/AFSRB in accordance with (IAW) Center requirements. All NASA and NASA hosted aircraft must have an airworthiness certificate and flight release.	
Maintenance	Only requirements levied by the FRR/AFSRB to correct deficiencies will be required for this category of aircraft.	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. Individual aircraft log books will be maintained for each aircraft.	Aircraft maintenance will be accomplished, IAW NPR 7900 and applicable NASA guidance.
Range Operations	Ops in NAS: Must comply with NASA and FAA requirements.		
	All operations are visual line of sight (LOS) and will be conducted under approved local range safety authority or FAA model aircraft rules.	LOS flight operations at any authorized operations area or as identified and approved by local range safety authority. Beyond LOS flight operations IAW Center approved requirements. BLOS daisy chain flight operations are authorized if observer qualifications meet NASA requirements.	LOS and BLOS flight operations will be accomplished IAW Center-approved requirements. Range safety review and approval required.

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	Ops in NAS: Must comply with NASA and FAA requirements		
Mishap Reporting	Only requirements levied by the FRR/AFSRB will be required for this category of aircraft, except for cases in which the aircraft caused injury to people or property reaching NPR 8621.1 cost thresholds.	System safety analysis will be an integral part of system operation. A hazard analysis and accepted risk list will be developed. The Center flight safety office will review and approve the analyses. Mishap reporting, IAW NPR 8621.1.	Accomplished IAW NPR 7900, NPR 8621.1 and applicable NASA and Center-developed reporting procedures.
Flight Termination System	Not required with reliable commercial RC controller.	Required unless the command and control system has proven reliability using actual flight data or a proven, regularly exercised lost link capability. Commercial RC controllers do not require an FTS.	
Waiver Authority	IAW NPR 7900 and applicable NASA HQ-approved Center guidelines.		
Oversight Responsibilities	IAW NPR 7900		

Appendix D

NPR 7900.3C Appendix J: UAS Pilot Matrix

Category	RC Pilot	Pilot-Operator	Remote Pilot	Observer
Crew Qualifications	Ops in NAS: Must comply with NASA and FAA requirements.			Ops in NAS: Must comply with NASA and FAA requirements.
	NASA (Civil Servant and NASA contractor) certificate of qualification identifying completion of an appropriate Center, company, or military-developed and Center-approved flight training course. Must complete a flight check (in accordance with Center-developed guidelines) demonstrating competency in similar-type aircraft (rotorcraft and fixed-wing aircraft apply to this requirement).	NASA (Civil Servant and NASA contractor) Pilot-Operator requires a certificate of qualification identifying completion of a Center-developed/HQ approved, company or military flight training course.	NASA (Civil Servant and NASA contractor) Remote Pilots must meet the minimum qualifications for a NASA pilot based on NPR 7900 and IAW Center-established processes and procedures.	NASA (Civil Servant and NASA contractor) observers require a certificate of qualification identifying completion of an appropriate Center, company, or military-developed and Center-approved flight training course and must have an FAA observer requirements. Hosted observers must satisfactorily identify qualifications in a questionnaire for the Center hosting. Partnerships present a subset of hosted mode.
Medical Qualifications	Ops in NAS: Must comply with NASA and FAA requirements.			Ops in NAS: Must comply with NASA and FAA requirements.
	RC pilots require a current FAA Third Class Pilot Medical Certificate or a NASA Third Class Medical Exam.	Pilot-Operators require a current FAA Third Class Pilot Medical Certificate or a NASA Third Class Medical Exam.	Remote Pilots require a current FAA First Class Pilot Medical Certificate, a NASA First Class Medical Exam, or a military flight physical exam.	Observers require a current FAA Second Class Pilot Medical Certificate or a NASA Second Class Medical Exam.
Training	Ops in NAS: Must comply with NASA and FAA requirements.			Ops in NAS: Must comply with NASA and FAA requirements.
	Initial pilot training must include either completion of FAA private pilot written exam or completion of a Center-developed and Chief of Flight Ops-approved based on NPR 7900. Continuing training plan is Center-	Initial pilot training must meet minimum NASA Pilot-Operator training requirements. Continuing training plan is Center developed and Chief of Flight Ops approved based on	Initial pilot training must meet minimum NASA Remote Pilot training requirements. Continuing training plan is Center developed and Chief of Flight Ops approved based	Initial observer training must include either completion of FAA private pilot written exam or completion of a Center-developed and Chief of Flight Ops-approved IAW NPR 7900. Continuing training plan is

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	developed and Chief of Flight Ops approved. Training will be documented and maintained IAW NPR 7900.	NPR 7900. Training will be documented and maintained IAW NPR 7900.	on NPR 7900. Training will be documented and maintained IAW NPR 7900.	Center-developed and Chief of Flight Ops approved. Training will be documented and maintained IAW NPR 7900.
Currency	Ops in NAS: Must comply with NASA and FAA requirements.			Ops in NAS: Must comply with NASA and FAA requirements.
	NASA RC Pilots are not required to maintain currency in a manned aircraft, but must meet Center approved currency requirements for the type/category UAS being flown. At a minimum, 3 Center-approved qualifying currency events must be accomplished in the preceding 90 days. Each Center will document and maintain currency requirements IAW NPR 7900.	Pilot-Operators will meet minimum currency requirements based on NPR 7900 and IAW Center procedures. Each Center will document and maintain currency requirements IAW NPR 7900.	NASA Remote Pilots must meet the minimum currency requirements for a NASA pilot based on NPR 7900 and IAW Center procedures. Each Center will document and maintain currency requirements IAW NPR 7900.	TBD
Waiver Authority	IAW NPR 7900 and applicable NASA HQ-approved Center guidelines.			IAW NPR 7900 and applicable NASA HQ-approved Center guidelines.
Oversight Responsibilities	IAW NPR 7900			IAW NPR 7900