



National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

SPR 7900.3 Rev. Basic
December 2020

COMPLIANCE IS MANDATORY

John C. Stennis Space Center
Range and Aviation Operations Management

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PREFACE

P.1 PURPOSE

- a. The purpose of this National Aeronautics and Space Administration (NASA) John C. Stennis Space Center (SSC) Range and Aviation Operations Procedural Requirements document is to define the Center's Range and Aviation Operations Program through the establishment of policy, requirements, and processes applicable to all NASA and NASA-sponsored range and aviation operations conducted at SSC or in Special Use Airspace (SUA) for which NASA SSC is the using and/or scheduling agent.
- b. This Stennis Procedural Requirements (SPR) document implements NASA Policy Directive (NPD) 7900.4 *NASA Aircraft Operations Management* and NASA Procedural Requirements (NPR) 7900.3, *Range and Aviation Operations Management* regarding the operation and management of NASA aircraft, personnel and procedures.
- c. This SPR defines SSC Unmanned Aircraft Systems (UAS) and Unmanned Underwater Systems (UUS) Operations requirements. SSC falls under the guidance of Kennedy Space Center (KSC) on all UAS operations; therefore, this SSC SPR follows the Memorandum of Understanding (MOU), *Small Unmanned Aircraft Systems Flight Operations and Aviation Safety Support* between KSC and SSC and the SSC System Security Plan authorization package OA-9999-M-SSC-4496.
- d. SSC currently owns and operates NASA Category I Small Unmanned Aircraft Systems (sUAS), see Figure 2 - *UAS Classification*. sUAS operations at SSC will span media product development, infrastructure management and applications that reduce risk to workforce or cost of operations in order to promote efficiency in NASA mission support areas.
- e. SSC also has over 5 miles of a canal system that can be utilized for operations such as UUS and Unmanned Surface Vehicles. Any use of the canal system for these types of activities is considered Range Operations.
- f. The SSC Range and Aviation Operations Manager is responsible for assuring compliance with the provisions in this SPR.

P.2 APPLICABILITY

This document applies to all NASA organizational elements, partners and contractors to the extent allowed for in the respective contracts at SSC where range and aviation operations are conducted from NASA property and/or SUA (Restricted Area R-4403) for which NASA SSC is the using and/or scheduling agency. This document will be reviewed annually, and changes and revisions shall be issued as required.

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P.3 AUTHORITY

- a. NASA Policy Directive (NPD) 7900.4, *NASA Aircraft Operations Management*
- b. NASA Procedural Requirement (NPR) 7900.3, *Aircraft Operations Management*

P.4 APPLICABLE DOCUMENTS

- a. 14 Code of Federal Regulations (CFR) Part 61, *Certification: Pilots, Flight Instructors, And Ground Instructors*
- b. 14 CFR Part 73, *Special Use Airspace (SUA)*
- c. 14 CFR Part 107, *Small Unmanned Aircraft Systems (sUAS)*
- d. NPD 2810.1E, *NASA Information Security Policy*
- e. NPD 4200.1, *Equipment Management*
- f. NPR 2810.1A, *Security of Information Technology*
- g. NPR 8621.1, *NASA Procedural Requirements for Mishap and Close Call*
- h. NPR 8715.5, *Range Flight Safety Program*
- i. SPD 1107.1, *SSC/NASA Organization Mission and Responsibilities*
- j. SPD 2810.1, *Information Technology (IT) Network Security*
- k. SPR 8715.1, *Safety and Health Program Requirements*
- l. SPR 8715.7, *SSC Range Safety Program*
- m. SBCC-1150-0031, *Range and Aviation Review Board (RARB) Charter*
- n. SPLN-8621-0003, *SSC Mishap Preparedness and Contingency Plan*
- o. SCWI-7900-0002, *John C. Stennis Space Center Range Control Procedures*
- p. NASA Memorandum, *Revised SUAS Cyber Security Policy* March 1, 2018

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q. NASA Memorandum of Understanding, *Small Unmanned Aircraft Systems Flight Operations and Aviation Safety Support* between KSC and SSC

r. NASA Form 1677, *Certificate of Airworthiness*

s. SSC Form 794, *On the Job Training*

t. SSC Form 946, *Radio Frequency Authorization Request*

u. SSC Form 951, *Approval of Unmanned Aircraft Systems Acquisition*

v. SSC System Security Plan Authorization Package OA-9999-M-SSC-4496

w. Federal Aviation Administration (FAA) Joint Use Restricted Area Letter of Procedures (LOP), *Procedures for Use of Restricted Areas 4403 A/B/C/E/F*

P.5 MEASUREMENT/VERIFICATION

Compliance with the requirements contained in this SPR will be verified through processes contained in NPR 7900.3, *Aircraft Operations Management*.

P.6 CANCELLATION

None.

RICHARD GILBRECH Digitally signed by
RICHARD GILBRECH
Date: 2020.12.14
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Director

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CHAPTER 1. RESPONSIBILITIES

1.1 Center Director shall:

1.1.1 Establish and maintain an SSC Center Range and Aviation Operations Management program within the Center Operations Directorate.

1.1.2 Appoint a Center Range and Aviation Operations Manager for SSC. The SSC Range and Aviation Operations Manager will be responsible for all aviation operations, including UAS, unmanned maritime range operations at SSC, and operations within SUA.

1.1.3 Enter into agreements, as required, with various organizations to support the overall range and aviation operations program at SSC.

1.1.4 Appoint and maintain a Range and Aviation Review Board (RARB) that will include a Chair, Executive Secretary, and voting members with the experience and expertise to conduct flight operation reviews of Center aircraft activities and operations. Other government or industry personnel may be temporarily appointed to the standing RARB as necessary to provide additional expertise to conduct a thorough review.

1.1.5 Review and approve/disapprove recommendations of the RARB. Maintain authority for granting any variances, deviations, or waivers from SSC range and aviation policy through KSC Chief of Flight Operations airworthiness certification process.

1.1.6 Ensure all aviation activities conducted at SSC are reviewed at the appropriate level determined by the RSRB.

1.1.7 Ensure SSC managers who acquire UAS or aviation services coordinate those acquisitions with the SSC Range and Aviation Operations Manager to maintain compliance with NASA's aviation safety program and aircraft management policies.

1.2 Director, Center Operations Directorate (COD) shall:

1.2.1 Provide management oversight of range (airspace/marine) and aviation operations as a functional area of the COD.

1.2.2 Resource, organize, train, and equip a qualified, certified, and competent range and aviation management organization capable of conducting and supporting NASA and NASA-sponsored aviation operations at SSC.

1.2.3 Designate flight crew and specify the types of aircraft and flight crew positions for which they are qualified.

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1.2.4 Ensure activities managed under this SPR do not create significant risks to the primary SSC mission of rocket propulsion testing.

1.2.5 Evaluate and approve acquisition, maintenance, modernization, and disposal of all SSC UAS, including determination of operational readiness.

1.2.6 Provide an RARB and Flight Readiness Review Board (FRRB)/Mission Readiness Review Board (MRRB) secretary for all meetings.

1.2.7 Lead efforts to establish and maintain agreements with NASA aeronautics centers to provide airworthiness, flight safety and flight review capabilities not organic to SSC in order to comply with applicable standards set forth in NPR 7900.3.

1.2.8 Provide and maintain communications systems necessary for range control operations.

1.3 Director, Safety and Mission Assurance (SMA) Directorate shall:

1.3.1 Provide safety oversight in accordance with NPR 8715.5, *Range Flight Safety Program* and SPR 8715.7, *SSC Range Flight Safety Program* for range operations.

1.3.2 In coordination with the SSC Range and Aviation Operations Manager, develop range safety hazard analyses and associated required controls for containing hazards.

1.4 Range and Aviation Operations Manager shall:

1.4.1 Serve as the Center's focal point for all matters involving range and aviation operations.

1.4.2. Serve as the primary Point of Contact (POC) for the Federal Aviation Administration (FAA) and other external organizations involving range and flight operations.

1.4.3 Establish and manage range control and the range scheduling system.

1.4.4 Coordinate and schedule restricted airspace R-4403A/B/C/E/F (Appendix B, *New Orleans Sectional Restricted Airspace Sectors R-4403A/B/C/E/F*) in accordance with FAA Joint Use Restricted Area Letter of Procedure, *Procedures for use of Restricted Areas 4403A/B/C/E/F (R-4403A/B/C/E/F)* when determined necessary to contain hazards. An alternative designated scheduler may be appointed when required.

1.4.5 Enforce scheduling priority should conflicts arise among missions for various agencies.

1.4.6 Enforce NASA and FAA regulations applicable to aviation activities within R-4403A/B/C/E/F.

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1.4.7 Participate in range safety activities and events that pertain to range and aviation operations, such as range safety meetings and analysis discussions.

1.4.8 Identify requirements for all projects proposing flight operations at SSC, including design requirements, restrictions, operational procedures, and support requirements.

1.4.9 Provide orientation briefings to all new users proposing flight operations at SSC.

1.4.10 Serve as project sponsor and agreements manager for all partner range projects at SSC.

1.4.11 Brief Center Director, Directorates, RSRB, FRRB/MRRB, Range Safety Manager (RSM) and/or other cognizant directors/managers on pertinent flight operations requirements or projects.

1.4.12 Serve as the liaison for all military flight operations at SSC, coordinating with applicable Department of Defense (DOD) organization to ensure applicable requirements are satisfied and de-conflicted with NASA-sponsored operations.

1.4.13 Establish UAS flight crew training program, qualification procedures and currency standards in close coordination with KSC Flight Operations.

1.4.14 Maintain equipment and infrastructure necessary for a functional range control capability.

1.4.15 Establish and maintain Range Control Officer (RCO) procedures, training program and qualification criteria.

1.4.16 Ensure proper, timely coordination with maritime, aviation, and other authorities in order to comprehensively fulfill public safety requirements for all applicable flight and unmanned system operations having the potential to adversely affect the public.

1.4.17 Participate in range safety hazard analyses as an unmanned systems subject matter expert and incorporate range flight safety requirements into all applicable operations.

1.4.18 Develop, coordinate, and deliver (or oversee the delivery of) flight project briefs to RSRB and/or FRRB/MRRB.

1.4.19 Under the oversight of KSC Flight Operations, serve as Chief UAS Pilot for SSC, including records management for qualified SSC UAS flight crew and maintenance, currency and medical readiness.

1.4.20 Maintain RARB, FRRB/MRRB, Flight Readiness Review/Mission Readiness Review (FRR/MRR) records for all proposed SSC flight operations.

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1.4.21 Provide annual SUA utilization report for R-4403A/B/C/E/F to the proper FAA authority.

1.4.22 Provide annual SSC UAS aircrew training and evaluations in accordance with (IAW) NPR 7900.3.

1.4.23 Develop and maintain a community outreach program in conjunction with the FAA Safety Team. The purpose of this program is to enhance aviation safety awareness associated with SSC, surrounding airports and the local flying community.

1.5 Stennis Space Center (SSC) Human Resources (HR) Services Branch

The SSC Human Resources Services Branch will maintain records, as required, for employee qualifications, including any on the job training as documented by SSC Form 794, *On the Job Training*, the System for Administration, Training and Educational Resources for NASA (SATERN) training, and copies of any supporting documentation utilized to support the employees' qualification statuses. The Chief UAS Pilot shall retain all local training documents and aircrew certification documents.

1.6 Office of the Chief Information Officer shall:

1.6.1 Provide Information Technology (IT) Security oversight in accordance with NPD, *Information Security Policy*, NPR 2810.1A, *Security of Information Technology*, and Stennis Policy Directive (SPD) 2810.1, *Information Technology (IT) Network Security*.

1.6.2 Monitor the compliance of UAS activities and use as noted in Agency CIO memo dated March 1, 2018.

1.6.3 Provide guidance for the sUAS encompassing IT System Security Plan (SSP) and a signed Authorization to Operate (ATO) maintained in NASA Risk Information Security Compliance System for all sUAS devices and supporting infrastructure.

1.6.4 Provide a review of images taken from the UAS flight prior to release.

1.6.5 Provide SSC Radio Frequency Spectrum Manager and frequency management support.

1.6.6 Provide support and operations for the SSC trunk radio system.

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CHAPTER 2. OPERATIONAL GUIDANCE

2.1 Restricted Area 4403 (R-4403) Description

2.1.1 On March 29, 2016, the FAA amended 14 Code of Federal Regulations (CFR) Part 73 by removing restricted area R-4403, Gainesville, MS, and replacing it with expanded restricted airspace consisting of five subareas, designated R-4403A, R-4403B, R-4403C, R-4403E and R-4403F. Further information can be viewed in the Federal Register, <https://www.federalregister.gov/> or Appendix C, *Restricted Airspace R-4403A/B/C/E/F Description* for details.

2.1.2 R-4403A/B will be used solely by NASA for rocket engine testing, space vehicle propulsion system testing and UAS testing and training. Naval Special Warfare Command (NSWC) will use R-4403C/E/F for training as required.

2.2 Scheduling Procedures

2.2.1 NASA SSC is both the using and scheduling agency for R-4403A/B and the scheduling agency for R-4403C/E/F. NSWC is the using agency for R-4403C/E/F, as defined in 14 CFR §73.15. Typically, using agents schedule their respective airspace and provide utilization reporting to the FAA. However, due to overlapping sectors between NASA SSC and NSWC, and the primacy of rocket propulsion test mission, NSWC has delegated its scheduling and utilization reporting to NASA SSC for R-4403C/E/F.

2.2.2 NASA schedules the airspace based on the following scheduling priority:

2.2.2.1 NASA rocket propulsion testing in R-4403A.

2.2.2.2 Military training for R-4403C/E/F.

2.2.2.3 NASA or NASA-sponsored partnership or UAS flight testing in R-4403B.

2.2.2.4 Scheduling de-conflictions will be handled through the SSC Range and Aviation Operations Manager, COD, and the SSC RARB, if required.

2.2.3 Scheduling requires participation in multiple forums and the use of multiple types of media. The Range and Aviation Operations Manager shall host and/or participate in a weekly scheduling meeting to coordinate user requirements and establish/modify scheduled events when within 30 days of planned range activities.

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2.2.4 The Engineering and Test Directorate, EA20, Test Operations, will provide a monthly schedule for all engine testing and flare stack operations by the 20th of each prior month. SMA will review operational parameters to determine if airspace is needed.

2.2.5 Airspace requests for R-4403A/B/C/E/F and other range and aviation events will be submitted via the SSC Range Scheduling System (<https://airrange.ssc.nasa.gov/#/>).

2.2.6 The SSC Range and Aviation Operations Manager will record/approve all requests in the range scheduling system through the following steps:

2.2.6.1 Determine validity of request.

2.2.6.2 Enter valid request into scheduling system as pending.

2.2.6.3 RSM will review request, comment and/or discuss concerns with the Range and Aviation Operations Manager.

2.2.6.4 Valid request will follow RARB Process listed in SBCC-1150-0031, *Range and Aviation Review Board (RARB) Charter*.

2.2.6.5 Following RARB approval, request will change from pending to approve status.

2.2.6.6 If the request is not approved, the Range and Aviation Operations Manager will disapprove request in the system and remove it from the calendar. All requests will remain in system for historical data.

Note: The SSC Range and Aviation Operations Manager may approve request not needing RARB approval, i.e., propulsion testing/Naval operations flying under their own authority/FAA Certificate of Authorization (COA).

2.2.7 At least 30 days prior to an event, the SSC Range and Aviation Operations Manager shall email the proposed schedule to the local Air Traffic Control (ATC) organizations listed in Table 1.

Location
Gulfport ATC Tower
New Orleans ATC Tower
Houston Air Route Traffic Control Center

Table 1 ATC Organizations

2.2.8 At least 10 days prior to an event, the SSC Range and Aviation Operations Manager shall input the request into the Military Airspace Data Entry (MADE) scheduling system. The implicit

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requirement to input this request is an account with user authorities to schedule R-4403A/B/C/E/F.

2.2.9 Schedule changes less than 10 days prior (urgent requirements) to an event must have O-6/GS-15 or above approval and be coordinated on a case-by-case basis with affected ATC organizations.

2.2.10 Twenty-four (24) hours prior to a scheduled event, the SSC Range and Aviation Operations Manager will:

2.2.10.1 Confirm the scheduled event time with the requestor.

2.2.10.2 Confirm issuance of Notices to Airmen (NOTAM) for the scheduled event and verify content accuracy at <https://www.notams.faa.gov/dinsQueryWeb/>. The search location is KZHU, the code for Houston Air Route Traffic Control Center.

2.2.10.3 FAA's SUA website is another tool that can be used to confirm pending activation on various SUA areas. This is displayed on the interactive map under FAA SUA webpage (<https://sua.faa.gov/sua/siteFrame.app>). Color codes designate time until activation.

2.2.10.4 Change notifications are required 48 hours prior to operation. Changes within 48 hours may be denied.

2.2.10.5 The day of event, SSC Range Control will stand up for active airspace in R-4403A/B (see "SCWI-7900-0002, *John C. Stennis Space Center Range Control Procedures*). NSWC will stand up range control for R-4403C/E/F as required.

2.3 Airspace Utilization.

2.3.1 Ensure utilization of R-4403A/B/C/E/F adheres to annual usage outlined in *FAA Joint Use Restricted Area LOP SUBJECT: Procedures R-4403 A/B/C/E/F*. Days allotted for individual sectors are not additive. NASA and NSWC can schedule range activities for multiple sectors in the same 24-hour period. Each sector will be counted under its own utilization count.

2.3.2 Submit annual FAA-required SUA utilization report for all sectors of R-4403A/B/C/E/F by 01 December each year.

2.3.3 Ensure documentation of utilization metrics of R-4403 in MADE.

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2.4 Range Control

2.4.1 Range control provides the communications link between range users, RSO, FAA ATC organizations and pilots in order to ensure the safety of airspace operations. Range control may be operated by either NASA SSC for R-4403A/B or NSWC for R-4403C/E/F but must be active for all R-4403 airspace activations. Stennis Range Control procedures and RCO duties are outlined in SCWI-7900-0002, *John C. Stennis Space Center Range Control Procedures*.

2.4.2 When range control is active, the contact phone number is 228-688-7264. The Very High Frequency (VHF) radio frequency is 123.00 Megahertz (MHz), callsign “Stennis Range Control.”

2.5 Airspace Procedures

2.5.1 Manned Aircraft Check-in/Check-out Procedures R-4403B:

2.5.1.1 Aircrews shall receive permission from Stennis Range Control on 123.00MHz for entrance into any R-4403B during activation or “HOT” status.

2.5.1.2 During multiple operations, the RCO will provide airspace information to the pilot or push over to the ground controller/operations for instructions based on current information from both Stennis Range Control and the RSO.

2.5.1.3 Upon check-in, pilot will provide call sign, number, type aircraft and intentions.

2.5.1.4. Pilots requiring R-4403B must always remain in contact with range control. RCO will coordinate with RSO as required.

2.5.1.5 After mission is completed, contact Stennis Range Control on 123.00MHz upon exiting airspace.

2.5.2 Arrival/Departure within R-4403B:

2.5.2.1 For UAS operations conducted exclusively within R-4403B, SSC RSO will provide launch/recovery and safety procedures.

2.5.2.2 Airspace must be activated/“HOT” status prior to launch and approved through range control.

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2.6 Communications

2.6.1 Operations conducted at SSC will utilize the SSC trunk radio system or pre-coordinated frequencies approved through the SSC Frequency Spectrum Management Office via the Range Operation Manager. SSC has radios that can be checked out on a limited basis that utilize the SSC radio system.

2.6.2 The RCO and RSO will monitor several local FAA frequencies for situational awareness when missions are active and communicate with other agencies as needed.

2.7 Radio Frequency (RF) Spectrum Management

2.7.1 Any operations that transmit radio frequencies must be approved through the SSC RF Spectrum Management Office prior to operations. Frequencies will be submitted through the Range and Aviation Operations Manager 45 days prior for review using SSC Form 946, *Radio Frequency Authorization Request*.

2.7.2 See paragraph 3.4.4.3 for UAS frequency procedures.

2.8 Laser Operations

All outdoor laser operations must be approved through the NASA SSC Health Physics Program and RF Frequency Manager. All requests must be submitted through the SSC Range and Aviation Operations Manager 60-90 days in advance. Repeat requests must be submitted at least 30 days in advance and will be included as part of the range safety hazard analysis.

2.9 Designated Helicopter Landing Pad

2.9.1 SSC has a lighted concrete landing pad, 100' x 100', located off the Northwest corner of Building 8000-Emergency Operations Center (see Figure 1) used primarily as a Medical Helicopter Landing Pad. The Global Positioning System (GPS) coordinates for the pad are 89° 37' 23.671" West, 30° 22' 40.633" North (Using North American Datum 83 with the CRS2007 Geoid correction, 29' Mean Sea Level (MSL)). This area is typically used for emergencies but may be used for other reasons with prior coordination. Non-emergency landings shall be coordinated through the Range and Aviation Operations Manager at 228-688-1257 at least 48 hours in advance. For emergency landings, pilots should call 228-688-3636 (Security Dispatch) prior to arrival. SSC Range Control can be reached at 228-688-7264, 123.00 MHz when open for R-4403A/B operations, call sign "Stennis Range Control," or through the SSC Range and Aviation Operations Manager at 228-688-1257. Three obstructions are located in the vicinity as well as a roadway intersection.

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2.9.1.1 Approximately 400' Above Ground Level (AGL) radio tower located 1,925' ESE of Concrete Heliport Pad.

2.9.1.2 250' AGL radio tower located approximately 740' ESE of Concrete Heliport Pad.

2.9.1.3 160' AGL water tower located approximately 800' SW of Concrete Heliport Pad.

2.9.2 Two additional unimproved small grassy fields located directly NE of the concrete pad may be utilized as landing areas at pilot's discretion. They are both approximately 150' x 150', unmarked and not lighted. Prior coordination is required through the Range and Aviation Operations Manager.

2.9.3 Other areas at SSC may be utilized with prior coordination and RSM approval.



Figure 1, Medical Helicopter Landing Pad

2.10 Night Operations

Night operations can be conducted at Stennis with approval through the initial range request process. A site survey may be required prior to the event to ensure the area is clear of obstructions and reduced lighting is sufficient.

2.11 Range Users

2.11.1 Operational Procedures

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2.11.1.1 Range users consist of NASA, DOD, government, academic and commercial entities that wish to conduct flight operations originating on SSC property or utilizing SUA.

2.11.1.2 Range users shall:

2.11.1.2.1 Submit range requests for new flight projects 60-90 days prior to the planned event, 30 days prior for repeat events, and 5 days for operations that are considered training in designated, approved locations. The 60-90 days provides time to create necessary partnership agreements as required.

2.11.1.2.2 For UAS flight operations, range users will complete Appendix D, *Questionnaire for Small Unmanned Aircraft Systems (UAS) Operations*. If conducting UAS research and development type operations, the Range and Aviation Operations Manager will provide a separate set of questions provided by the RSM.

2.11.1.2.3 Participate in discussions to familiarize SSC personnel with all aspects of the flight project and proposed range operations.

2.11.1.2.4 Ensure development and implementation of operational range requirements, plans, procedures (including contingency plans and procedures), checklists and flight rules are applied.

2.11.1.2.5 Participate in failure/anomaly investigations and provide all data as required.

2.11.1.2.6 Ensure all operational requirements are satisfied prior to initiating each phase of a given operation.

2.11.1.2.7 For R-4403C/E/F range operations, the using agency project manager shall ensure proper scheduling coordination with the SSC Range and Aviation Operations Manager IAW FAA Joint Use Restricted Area Letter of Procedure, *Procedures for use of Restricted Areas 4403A/B/C/E/F (R-4403A/B/C/E/F)*.

2.11.2 Financial Procedures

2.11.2.1 All users utilizing R-4403B and/or conducting operations at SSC may be required to enter into a formal agreement with SSC to ensure compliance with established applicable laws, federal regulations, executive orders, and NASA directives. Roles and responsibilities for both NASA and requesting user will be clearly identified in order to conduct aviation and airspace operations from SSC or flight activities in R-4403B.

2.11.2.2 The SSC Range and Aviation Operations Manager will be the primary coordinator on all agreements concerning range and aviation operations and will work with perspective SSC

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range users to determine proper agreement type and requirements. The following process is a guide and completed prior to conducting operations:

2.11.2.2.1 Provide SSC a mission overview with supporting documents.

2.11.2.2.2 Negotiate a NASA SSC user agreement if required.

2.11.2.2.3 Once mission is completed, SSC will calculate actual reimbursement (if required) and refund any excess, or request additional payment, or agree to apply balance to next operation.

2.11.3 Debrief: SSC Range and Aviation Operations Manager will request a debrief on operations and overall mission effectiveness from the user.

2.12 Maritime Operations

All scheduled maritime range operations will fall under COD and go through the Range and Aviation Operations Manager for scheduling, area of operations and mission requirements. Range Safety will develop a safety analysis prior to operations.

2.13 Personnel Emergency Procedures

See SPLN-8621-0003, *SSC Mishap Preparedness and Contingency Plan*, for guidance and directions.

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CHAPTER 3. UNMANNED AIRCRAFT SYSTEMS (UAS) OPERATIONS

3.1 General

3.1.1 SSC utilizes UAS to increase capabilities and reduce operating costs while decreasing risk exposure to personnel for purposes such as: facilities inspections, public affairs imagery, land management, Center mapping, ecological surveys and Emergency Operations Center's requirements. SSC does not have a Flight Operations Office, therefore KSC provides aviation oversight for UAS operations conducted at SSC. SSC UAS operations shall comply with NPR 7900.3, guidance from KSC, Chief of Flight Operations and this SPR. KSC/SSC Memorandum on *sUAS Flight Operations and Aviation Safety Support* further define roles for each Center.

3.1.2 No UAS (including model/radio-controlled (RC) aircraft) may be operated from or over SSC property without express approval of the SSC Range and Aviation Operations Manager. Any UAS operated or acquired by NASA personnel, on behalf of, or under the authority of NASA (whether on or off SSC) must go through the SSC Range and Aviation Operations Manager.

3.1.3 SSC has tenants onsite that utilize UAS operations for conducting training, research, and other purposes. Tenants will submit all requests for operations through the COD, SSC Range and Aviation Operations Manager, via the Range Scheduling System accessible at <https://airrange.ssc.nasa.gov/#/>. New requests must be submitted 60-90 days in advance for review. Repeat missions must be submitted 30 days in advance. Repeat NASA/Tenant UAS missions conducted in designated approved training areas may be submitted 5 days in advance.

3.1.4 NASA divides UAS into three categories. Figure 2- UAS Classification defines the classifications of UAS owned and operated by NASA. SSC operates Class I only at this time.

Category	I	II	III
Weight (lbs.)	< 55	>55 <= 330	>330
Airspeed (kt)	<=87	<= 200	>=200
Type	Model or sUAS	sUAS (Small-Medium)	UAS (Medium-Large)

Figure 2- UAS Classification

3.2 Definitions

3.2.1 UAS: A UAS is a powered or unpowered aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, and can fly autonomously or be piloted remotely. UASs range in size from micro vehicles weighing ounces to large aircraft weighing more than 30,000 pounds.

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3.2.2 Small UAS (sUAS): An aircraft designed and built to operate with an onboard Flight Management System (FMS). sUAS may carry a variety of payloads and operate using either licensed or unlicensed electronic spectrum for command and control. sUAS can be operated via a manual control, manually via an onboard FMS, or autonomously. sUAS (small-medium) are categorized by weight and airspeed where the vehicle gross weight is less than 330 pounds and has the potential of airspeeds less than or equal to 200 knots.

3.2.3 RC Model: A subscale aircraft that is typically flown by means of a Commercial Off-The-Shelf (COTS) RC flight controller. Model aircraft are designed to be operated within Visual Line of Sight (VLOS) of the controlling pilot (referred to as either an external pilot or safety pilot). Model aircraft in this category typically operate at takeoff gross weights less than 55 pounds and operate at airspeeds less than or equal to 87 knots.

3.2.4 Airspace Control.

3.2.4.1 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 National Airspace System (NAS) or non-NAS (i.e., restricted airspace) 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 the FAA, Mission Commander (MC) or RCO. Principles and procedures of airspace control used in manned flight operations apply to UAS operations. The vehicle operator is responsible for compliance with the airspace control authority. Positive separation between aircraft and UAS is required and is the responsibility of the UAS Pilot in Command (PIC).

3.2.4.2 There are several methods to accomplish airspace control:

3.2.4.2.1 Setting up Restricted Operations Zones (ROZ).

3.2.4.2.2 Altitude separation through block altitudes.

3.2.4.2.3 Time separation which can be incorporated into block altitude and times.

3.2.4.2.4 Route separation or any combination of the above, as required.

3.2.4.3 UAS altitude separation and de-conflicting with other airspace users shall be accomplished with the use of ground Visual Observers (VO) who have been trained in the use of airspace management. The role of the VO is to visually track the activity of the unmanned aircraft and surrounding airspace. The VO shall have access to radio communication with the local air traffic to announce the use of airspace for UAS operations and to communicate any

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potential hazard between other aircraft and the UAS. All manned aircraft shall have right-of-way over the UAS. The pilot shall operate the UAS accordingly to avoid all air traffic entering the operating airspace and have the capability to command, control, coordinate, and manage the UAS through the command and control systems

3.2.4.4 Operation of UAS shall be limited to one UAS in the airspace at a time unless previously approved and authorized by the SSC Range and Aviation Operations Manager through SSC RARB/FRRB. Multiple ROZ can be established to de-conflict airspace based on mitigations from a hazard analysis.

3.2.4.5 NPR 7900.3 lists four methods of airspace control approved for use by NASA for UAS flight operations, SUA, FAA COA, NASA/FAA Memorandum of Agreement (MOA) and 14 CFR Part 107, *Small Unmanned Aircraft Systems*.

3.3 UAS Flight Crew

3.3.1 UAS flight crew may consist of UAS pilots, pilot-operators, engineers, principal investigators, VOs and technicians who are required to operate a UAS and are authorized by position descriptions, letters of appointment, MOU/MOA or contracts to perform UAS operations.

3.3.2 UAS Flight Crew Definition and Responsibilities: UAS flight crews are responsible for the safe control and operation of the UAS and communications with the appropriate airspace control authorities. They shall be involved in all mission planning and complete prelaunch, mission, and recovery checklists and assist in evaluating and disseminating in-flight data. The KSC Chief of Flight Operations shall provide independent oversight over all aspects of UAS operations, flight crew qualifications, training, and risk assessment in accordance with, NPD 7900.4, MOU *sUAS Flight Operations and Aviation Safety Support* between KSC and SSC, and NPR 8715.5. NASA UAS flight crew requirements and qualifications are specified in NPR 7900.3 and apply to all NASA, contractor, and associated UAS pilots.

3.3.3 Pilot in Command (PIC): The PIC is the individual directly responsible for, and is the final authority for, the flight and safe operation of the UAS during all phases of flight regardless of the mode of flight control of the UAS.

3.3.4 Pilot-RC Operator: The RC Pilot (also called Safety Pilot or External Pilot) is an individual who operates an unmanned aircraft by means of a remotely located, manually operated, radio-controlled flight management system (direct control by means of stick-to-surface interface). An RC Pilot also may perform crewmember duties of a safety (or external) pilot who acts as a fail-safe to an unmanned aircraft system that is normally controlled by a pilot-operator. The safety (or external) pilot flight control system may be either stand-alone or be modified to function as a buddy box. In the buddy box configuration, the safety (or external) pilot controls

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the unmanned aircraft through a Ground Control Station (GCS) communication link protocol. All flight operations shall be within visual line of sight of the controlling pilot.

3.3.5 Pilot-Computer Operator: A pilot-operator (also called Ground Control Operator or Internal Pilot) is an individual who manages the operation of an unmanned aircraft by means of the remote GCS. The pilot-operator typically controls the unmanned aircraft autonomously by means of computer interface with an onboard flight management system (fly-by-mouse) through a command and control communications link.

3.3.6 Pilot-Manual Operator: Remote Pilot (also called Remotely Operated Aircraft or Remotely Piloted Vehicle Pilot) is an individual who operates a UAS by manual control in a remote GCS. The Remote Pilot typically manages the unmanned aircraft flight path through a command and control communication link using manual stick-and-rudder inputs, a forward-looking video camera feed, and a moving map display system located in the GCS.

3.3.7 VO: An individual who is a primary crewmember for UAS flight operations. The VO serves as the flight safety monitor to ensure noninterference between the unmanned aircraft and nonparticipating aircraft by means of see and avoid. The VO may perform these duties either on the ground or in a chase aircraft while in direct communication with the controlling pilot daisy chain. VO operations are limited to 5 NM between the PIC and the airborne unmanned aircraft.

3.3.8 UAS Mission Commander (MC): The UAS MC exercises command over single NASA UAS or a formation of UAS. He/she is responsible for all phases of the assigned mission except those aspects of safety of flight that are related to the physical control of the aircraft and fall within the prerogatives of the PIC (unless the PIC and MC are the same individual).

3.3.9 UAS flight crew: UAS flight crew report to the assigned MC. If an MC is not required, all individuals report to the PIC.

3.4 Planning

3.4.1 The level of planning required prior to a UAS flight varies depending on the level of complexity and support resources needed. It also depends on the flight facility and the airspace being utilized—either NAS or SUA (i.e., Restricted Airspace). Project coordination with the Range and Aviation Operations Manager shall occur as soon as possible to avoid schedule delays due to airspace usage conflicts, hazard analysis and approval boards. All UAS operations will require approval from the RARB or FRRB prior to operations.

3.4.2 All NASA UAS flights are conducted under NASA's Public Use authority in accordance with Public Law 106–181 and Title 49 United States Code, Chapter 401. Under this authority, NASA UAS may operate using one of the following five authorities listed: FAA COA,

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NASA/FAA MOA/MOU/Letter of Agreement, SUA, International Airspace and CFR Part 107.

3.4.3 Flight Request Process

3.4.3.1 Once SSC receives a flight request through the Range Scheduling System or email, the SSC Range and Aviation Operations Manager will review the request for validity, capabilities and de-confliction to determine if the request can be executed. A UAS operations questionnaire will be sent to the customer/user to help determine the validity of the request. If the requirement is not valid the Range and Aviation Operations Manager will begin discussions with the user to determine if a solution is possible. All aviation requests must be entered into the range scheduling system for visibility as soon as possible. Requests will be entered with a pending status until final approval/disapproval from RARB or FRRB/MRRB.

3.4.3.2 The Range and Aviation Operations Manager will send out a UAS questionnaire based on the type of aircraft and mission. If the aircraft/mission is a sUAS or COTS type operation, a basic questionnaire will be sent to the user. For complex missions such as research and development or larger types of UAS, a more detailed questionnaire will be submitted. These questionnaires will help provide further details on the operation and potential hazards.

3.4.3.3 Based on received information, the Range and Aviation Operations Manager will determine if an agreement is required and begin the agreement process, if required.

3.4.3.4 The Range and Aviation Operations Manager will develop preliminary airworthiness review/flight package that includes a range hazard analysis for the RARB and submit flight approval form for KSC review, see Appendix F, *Flight Request Form for UAS Flight*.

3.4.3.5 RARB will review and approve or disapproved as required. RARB Chair has authority to delegate approval to the FRRB for operations the Chair deems appropriate. If packages are disapproved, the Range and Aviation Operations Manager will notify the user and either terminate the request or address the board's concerns with the user.

3.4.3.6 Once approved, the Range and Aviation Operations Manager will notify the user and change status in the scheduling system from pending to approved and issue a flight permit.

3.4.4. Additional Planning Requirements:

3.4.4.1 Area of Operations (AO): During the planning phase, it is important to select the right location based on flight details that include type of aircraft, type of activity, payload and PIC skill set. Certain specific flight objectives will drive the AO, such as inspecting a building, imagery for propulsion testing or conducting water operations. The Range and Aviation Operations Manager will assist with the location on all UAS operations and coordinate with the

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RSM. See Appendix E, *CAT I Small Unmanned Aircraft System Designated Training Areas* for a list of locations for training. Operational requirements and restrictions apply with each location, see SSC Range and Aviation Operations Manager for details.

3.4.4.2 Information Technology (IT): All NASA UAS or UAS operations utilizing a NASA pilot must have an approved NASA IT System Security Plan (SSP) and a signed Authorization to Operate (ATO) for all UAS devices from a NASA OCIO prior to operating at SSC. All UAS operations must be vetted through the Range and Aviation Operations Manager and SSC OCIO in order to comply with NASA SUAS Cyber Security Policy and SSC Policy Directive 2810.1 *Information Technology (IT) Network Security*. SSC OCIO will be notified for every NASA UAS operation, as required.

3.4.4.3 Radio Frequency:

3.4.4.3.1 All UAS operations on SSC will require radio frequency approval through SSC's RF Spectrum Management office as part of the review process. Frequencies will be submitted through the Range and Aviation Operations Manager at least 45 days prior for review using SSC Form 946.

3.4.4.3.2 All users should have access to at least one of the following: UAS operating manual, military's DD Form 1494, JF-12, Form NTIA-44 or other equivalent document that provides the manufacturer, model, transmissions to include backups, receiver, emission and/or frequency data. Having the Federal Communication Commission ID number is very helpful to RF Spectrum Management when making determinations on RF interference.

3.4.4.3.3 All approvals will come from the SSC RF Spectrum Manager through the Range Operations Office. Long term approvals may be reviewed annually for changes and requirements.

3.4.4.3.4 An approval email for each event from the RF Spectrum Manager will suffice for repeat operations with the original approval on file in the Range Operations Office.

3.4.4.4 Safety Requirements: SMA will conduct a safety analysis on all Range and UAS operations, as required, to determine risk and safety hazards IAW with NPR 8715.5 and SPR 8715.7, SSC Range Safety Program

3.4.4.5 Processing Data: All pictures and video captured by UAS operations will be reviewed by the Office of Communications and Office of Export Control, as required, prior to releasing information.

3.4.4.6 Operations Site: Particular consideration shall be given to the location of the UAS operations site. A proper take-off and landing surface shall be available to safely complete the mission.

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Consideration should be given to the size of the AO, as the location of an adequate launch and recovery area within the AO boundary and the location of the control station are very important considerations when employing a UAS. Availability of adequate roads or other transportation methods for UAS support requirements are critical to sustained UAS operations. If the UAS is expected to move from one site to another, transportation, logistics, support and a safe flight path become increasingly important. Provisions for the operations site shall be included with the facility agreement, management plan documentation, and risk assessment. See Appendix E for a list of currently approved SSC UAS training sites with descriptions.

3.4.4.7 Communication: The VO will monitor frequency 123.00MHz at SSC or nearest airport frequency for local air traffic and act as a flight safety monitor during operations. When SUA is activated, the crew will coordinate with range control, if required on FM Radio Trunk System for flight activities, i.e., take-off, land and operations complete. This will be briefed in the RARB/FRRB.

3.4.4.8 Operational Phase: Once the mission is approved to proceed, many tasks are executed simultaneously. The Range and Aviation Operations Manager or designee will brief SSC requirements with the PIC and flight crew as required. The PIC and the UAS flight crew study the assigned mission and plan for its operation. The PIC begins preparation of the UAS and GCS. There may be other personnel required to fulfill certain roles in order to accomplish the mission. All operations will follow a checklist similar to Appendix H: *UAS Pre, In-Flight, Post and Emergency Checklist* when conducting flight operations.

3.5 Pre-Flight Operations

3.5.1 Route Planning: SSC UAS missions and locations shall be planned by the respective UAS PIC in close coordination with the Range and Aviation Operations Manager, Range Safety Manager and approved by the RARB and/or FRR/MRR. Applicable aeronautical charts, local maps, performance data, and operational manuals shall be utilized in route and pre-flight planning. This planning is done to ensure no conflict with other flight operations, and to allow timely inclusion of UAS missions in the Center's range scheduling process. This planning becomes critical when multiple project operations will be conducted over the same period of time. Even though multiple operations may take place, only one UAS shall occupy the airspace at any one period of time unless otherwise reviewed and approved through RARB and/or FRR/MRR.

3.5.2 Weather: UAS PIC shall consider the expected weather conditions in the AO at the time of operations. Many UAS cannot operate in inclement weather (e.g., high winds or when the cloud layer visibility and separations standards cannot be maintained). Due consideration should be given to weather condition requirements from the outset. Prior to mission deployment, the project lead for flight operations shall review local weather conditions and appropriate Meteorological Aerodrome Reports/Terminal Aerodrome Forecast and make the appropriate determination as to commencing flight operations for that day IAW applicable UAS operating

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manual and regulations. Stennis International Airport (HSA) and Slidell Airport (ASD) are used for SSC. Real time decisions are made by the PIC.

3.5.3 In-flight Emergencies: During planning, sufficient attention shall be given to the possibility that an in-flight emergency may occur. Particular attention shall be given to the location of potential impact sites if the UAS exits controlled flight and impacts the ground. All hazards shall be considered through the range hazard analysis and during the RARB and/or FRRB/MRRB in order to minimize risk to the public, personal property, flight crew, and equipment. During an in-flight emergency requiring immediate action, the PIC may deviate from any rule of this instruction, or other regulations to the extent required to meet the emergency. Any PIC who deviates from a rule under this authority shall immediately notify the SSC Range and Aviation Operations Manager, the RSM/RSO and KSC, Chief of Flight Operations.

3.6 Flight Operations

3.6.1 Flight Brief: The PIC conducts an aircrew flight operation brief prior to all flights. Flight briefs provide specific information in accordance with UAS standard operating procedures. The format for the brief shall depend on the complexity of the day's flight agenda. Briefs shall include, but not be limited to the following:

3.6.1.1 Verification the range permit number is issued.

3.6.1.2 Verification that range control (if required), NOTAM (if required) and airspace approvals are in place.

3.6.1.3 Verification of communications with range control if required.

3.6.1.4 Weather requirements/updates – Web-based at Aviationweather.gov and local conditions.

3.6.1.5 Return to Home criteria.

3.6.1.6 Program agenda for the flight mission.

3.6.1.7 UAS and mission support system status.

3.6.1.8 Aircrew roles, responsibilities and mission objectives.

3.6.1.9 Emergency procedures and terminology.

3.6.1.10 Ensure appropriate checklist completed.

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3.6.2 Takeoff Method: The PIC readies the UAS for launch and performs systems checks to ensure systems perform in accordance with operating checklist procedures. System operating checklists shall include, but not be limited to, an independent means to verify integrity of the radios system control link(s), flight termination configuration or Return to Home selection, and auto navigation waypoints entered into a navigational system if required prior to takeoff. Suitable takeoff area and landing shall be available for UAS operations that are clear of obstructions and non-participating personnel. Appropriate agencies will be notified as required depending on airspace utilized.

3.6.3 Loss of Link Procedures: When a UAS senses a significant delay or loss of the command uplink, the predetermined loss of link procedures shall be invoked to contain the vehicle within the AO, or in the case of an auto navigation system, initiate the return home profile. The UAS return home profile is a preapproved route at a specific altitude to its return home site (waypoint). During this emergency, the UAS pilot shall attempt to reestablish communication with the UAS. In the event the pilot does not reestablish communications, emergency procedures shall be in place to retrieve the vehicle once it makes contact with the ground, see Appendix H.

3.6.4 Preparing for Recovery: Flight crews will use an appropriate UAS recovery checklist prior to landing. Once the recovery operation is completed, complete post flight checklist, see example Appendix H. After each flight, a post flight de-brief shall take place to summarize and review the flight. Depending on the complexity of the operation, debrief may be formal or informal.

3.6.5 Agency Notification: Upon notification of an in-flight emergency, emergency procedures shall be performed by the UAS pilot IAW a UAS emergency operations checklist, example listed in Appendix H. In the event of a mishap where the UAS impacts the ground, other than a hard landing, the Range Safety Officer shall provide notification with the pertinent information to relay and coordinate with the appropriate agencies IAW SPLN-8621-0003.

3.7 Flight Crew Qualifications and Training

3.7.1 All SSC aircrew shall be trained by SSC Chief UAS Pilot and certified through KSC Chief of Flight Operations or designated appointee.

3.7.2 The provisions of this section shall apply to SSC-designated NASA UAS crewmembers. UAS flight crew currencies shall be tracked and verified by the Range and Aviation Operations Manager. KSC Chief of Flight Operations provides oversight of the SSC training program. Flight crew qualifications and certifications will be maintained by SSC Range and Aviation Operations Manager and documented on local form, UAS Training Criteria. For non-SSC crewmembers, the UAS project manager shall submit a crewmember qualification, training, and currency process for approval by the SSC Range and Aviation Operations Manager.

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3.7.3 Qualifications: Designated NASA UAS pilots are those who perform UAS piloting duties as a part of their official position descriptions or appointment letter to fulfill NASA requirements, or in accordance with a partnership agreement. Local forms Appendix I, *UAS Visual Observer Training Certification Form* and J, *UAS Pilot Training Certification Form* list the SSC pilot and VO's training qualifications.

3.7.4 Additional requirements may be defined by the respective project based on vehicle complexity, wing loading, value to the project, and overall project risk management. Flight crew members may be cross trained to perform multi-function roles and responsibilities.

3.7.5 UAS VO: A trained VO is a person who assists the UAS pilot in the duties associated with collision avoidance. The VOs are trained by the pilots during field operations to know what to look for in terms of observing other air traffic in the area and how to communicate to the pilot and crew in the event of air traffic conflict or an emergency. Appendix I lists training required for SSC certification.

3.7.6 UAS Pilot – Class 1 and 2 sUAS: The Class 1 or 2 sUAS pilot serves as the PIC of the sUAS and is responsible for the safe operation and flight of the aircraft under their control.

3.7.7 Mission Qualification Standards (MQS) I Qualifications: MQS Level I operations are those that are Visual Flight Rules (VFR) flights conducted in Visual Meteorological Conditions (VMC) conditions below 1200 feet AGL in Class E, G, or SUA (or international equivalents). Operations are restricted to VLOS/daisy chain operations.

3.7.8. SSC UAS flight crew training requirements:

3.7.8.1 Review of UAS Operator's manuals relevant to the model of aircraft being flown.

3.7.8.2 Review and knowledge of NPR 7900.3 and this SPR.

3.7.8.3 Completion of KSC Crew Resource Management (CRM) course.

3.7.8.4 Title 14 CFR Part 107 Unmanned Aircraft Systems certification.

3.7.8.5 Satisfactory demonstration of flight proficiency standards as defined in this SPR.

3.7.8.6 Knowledge of airspace regulations and procedures.

3.7.8.7 A FAA Class III physical, NASA, or military equivalent with vision correctable to 20/20.

3.7.8.8 All SSC pilots will meet and maintain both VO and pilot training requirements.

3.7.9 MQS II Operations: MQS Level II operations are those that are VFR flights conducted in

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VMC conditions above 1200 feet AGL and below 18,000 feet MSL (or applicable international transitional altitude). Operations at MQS Level II require an MC assigned to the flight. MQS II support will typically come from KSC or another center.

3.7.10 UAS Mission Commander: The UAS MC exercises command over a single UAS or a formation of UAS. He/she is responsible for all phases of the assigned mission except those aspects of flight safety that are related to physical control of the aircraft and fall within the prerogatives of the PIC, unless the PIC and MC are the same individual. This support will come from KSC.

3.7.11 UAS Mission Commander requirements in addition to Paragraph 3.7.8:

3.7.11.1 Review and have knowledge of 14 CFR Subpart E 61.105 and 61.107.

3.7.11.2 Hold an FAA Private Pilot's Certificate, NASA Pilot rating, Military Pilot rating, or have completed a military UAS flight certification course

3.7.11.3 If not qualified in type, UAS MCs shall receive all required ground training for the UAS under their purview. Computer-based simulator training may be utilized at the discretion of the Chief UAS Pilot.

3.7.12 UAS Currency: Complete 3 proficiency events within 90 days utilizing the category of vehicle(s) established in NPR 7900.3 policy.

3.7.13 Annual Evaluation:

3.7.13.1 Perform three scheduled proficiency events annually in the presence of Chief UAS Pilot, KSC Chief of Flight Operations, or designated representative utilizing rated vehicle(s).

3.7.13.2 The KSC Chief of Flight Operations may authorize other independent evaluations of UAS pilots.

3.7.14 sUAS Proficiency Events: Pilots are required to demonstrate skills, knowledge, and understanding of how to safely operate and fly applicable UAS. All turns shall be smooth and coordinated. The pilot shall demonstrate reasonable accuracy in maintaining airspeed, glide slope, and heading on the final approach to touchdown without damaging the vehicle. Elements from multiple flights can be grouped to qualify as a proficiency event:

3.7.14.1 Traffic Pattern:

3.7.14.1.1 Takeoff, to be held within 5 feet of intended ground track during climb out, with smooth, controlled corrections as necessary.

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3.7.14.1.2 Perform high-speed pass along designated area at a constant altitude.

3.7.14.1.3 Landing to be held within 5 feet of initial takeoff point, with smooth, controlled corrections as necessary.

3.7.14.2 Maneuvers:

3.7.14.2.1 Perform a horizontal figure-8 with both left- and right-hand patterns, both slowly and at speed.

3.7.14.2.2 Maintain and demonstrate a stable hover.

3.7.14.2.3 From both nose-in and tail-in hover starting positions, perform and maintain a constant flight heading forward, aft and right, left transitioning back to a hover before each directional change.

3.7.14.2.4 Perform a flat 360-degree rotation about the z-axis of the aircraft using slow and controlled maneuvers maintaining constant altitude.

3.7.14.2.5 Perform transition from hover to high speed and back to hover.

3.7.15 Records: All flight crew qualification, training, currency, re-currency, evaluations, and proficiency records shall be kept on file and maintained by SSC Center Operations and KSC Flight Operations as required. Training records and status is reviewed monthly with aircrew. A training folder or equivalent database in electronic format shall be maintained.

3.7.16 Flight Time Limitations: NASA-SSC UAS pilots' duty time will be defined by NPR 7900.3 and SPR 8715.1, *Safety and Health Program Requirements*. UAS pilot, VO, and flight crew shall be considered "critical personnel" per SSC work time requirements and limited to 12 work hours per day waiver able to 16 hours per day when mission dictates and with Center Director and KSC Chief of Flight Operations approval. At no time shall UAS flight crew work more than 16 hours per day.

3.7.17 In the case of prototype, experimental, or research UAS aircraft for which no formal schools are available, the services of the researchers, designers, and the manufacturer's best qualified personnel shall be utilized to brief and familiarize the UAS pilots or NASA personnel with the aircraft, systems, and GCSs. In addition, existing UAS simulators and UAS of a similar nature shall be used to train pilots prior to flying a UAS research vehicle.

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CHAPTER 4. COMMERCIAL AVIATION SERVICES (CAS) AND AIRCRAFT ACQUISITION POLICY AND PROCESS

4.1 Procurement of Commercial Aviation Services (CAS) Aircraft Policy

SSC shall leverage Agency assets to the greatest extent possible. Prior to any solicitation of CAS, SSC shall submit requirements to the KSC Chief of Flight Operations for review to determine if an existing NASA aircraft and/or flight crew may be able to fulfill SSC's needs more economically, or for greater overall benefit (such as currency of pilots) to NASA. If the response of the KSC Chief of Flight Operations is to procure CAS, procurement will proceed in accordance with NPR 7900.3 (Chapter 8), Federal Acquisition Regulations, NASA Federal Acquisition Regulations Supplement and any other applicable procurement policies. The KSC Chief of Flight Operations will serve as the technical approval for CAS procured by SSC.

4.2 Acquisition of Aircraft

4.2.1 Policy

4.2.1.1 Where practical, SSC seeks to use UAS that can support multiple mission requirements. SSC shall use its UAS resources in an effective and efficient manner to conduct and support missions, approved/planned programs, projects and training. SSC shall only acquire sUAS. To the extent permissible by operational needs, proposed acquisitions will make every effort to confine manufacturer and model of aircraft to those for which NASA has already conducted a favorable airworthiness review.

4.2.1.2 All UAS procurements will comply with NPR 7900.3, Federal Acquisition Regulations, NASA Federal Acquisition Regulations Supplement, and SPR 7900.3. The Range and Aviation Operations Manager will be the point of contact on all UAS acquisition at SSC. The KSC Chief of Flight Operations will serve as the technical approval for all aircraft acquisition.

4.2.1.3 UASs are considered by both the FAA and NASA to be aircraft and therefore must follow the NASA aircraft acquisition and disposition process as defined in NPR 7900.3, and as clarified in the UAS Acquisition Policy Amplification dated 3-March 2015. UAS acquisitions that cost less than \$500,000 only require Center Director's approval IAW NASA's asset capitalization threshold.

4.2.2 Process

4.2.2.1 Project Manager develops requirements, budget, and justification for UAS acquisition. Prior to any aircraft acquisition, the SSC Range and Aviation Operations Manager will review requirements for validity. Once requirements are validated and funding is verified, the process will move forward. There may be instances where another NASA department maintains a UAS for various reasons such as engineering. For those instances, a Project Manager will be appointed

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and responsible for all actions associated with that UAS.

4.2.2.2 SSC Chief UAS Pilot will present an acquisition package based on mission requirements to the RARB for review.

4.2.2.3 RARB review package should contain, at a minimum:

4.2.2.3.1 System description.

4.2.2.3.2 Requirement for UAS.

4.2.2.3.3 Operational plans.

4.2.2.3.4 IT requirements and approval through OCIO.

4.2.2.3.5 RF requirements and approval.

4.2.2.3.6 Estimated acquisition costs.

4.2.2.3.7 Funding sources.

4.2.2.3.8 Maintenance and storage costs.

4.2.2.3.9 Environmental impacts.

4.2.2.4 The acquisition package will be discussed and the RARB will make a recommendation for approval/disapproval of acquisition. Decision will be documented and maintained by the SSC Range and Aviation Operations Manager

4.2.2.5 UAS acquisition package will be briefed to NASA-SSC Center Director for final approval. A copy of final approval package will be maintained by SSC Range and Aviation Operations Manager.

4.2.2.6 The formal aircraft acquisition process can commence with the signed approval from the Director, COD, SSC CIO, KSC Chief of Flight Operations and Director, SSC Center through SSC Form 951, *SSC Approval of UAS Acquisition*. The signed copy of SSC Form 951 authorization shall be maintained by the SSC Range and Aviation Operations Manager.

4.2.3 Post-Acquisition Process

4.2.3.1 Each UAS airframe will be assigned a FAA registration number and tracked in the sUAS airframe tracking log maintained by Center Operations.

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4.2.3.2 All new UAS purchases will enter the NASA Property Management System and have NASA property number assigned and shall be tracked by logistics as accountable property database regardless of cost or size.

4.2.3.4 All new UAS purchases will have an IT SSP and a signed ATO for all UAS devices from SSC OCIO prior to operating at SSC.

4.2.3.5 Prior to flight, a new UAS will have an approved NASA Form (NF)1677, *Certificate of Airworthiness*.

4.2.3.6 Range and Aviation Operations Manager or Project Manager will secure UAS and follow guidance outlined in this requirement.

4.2.3.7 For property accountability, a sUAS shall be considered an assembly of:

4.2.3.7.1 Structural components

4.2.3.7.2 Engine(s)

4.2.3.7.3 Servo(s)

4.2.3.7.4 On-Board flight management system(s)

4.2.3.7.5 Control units:

4.2.3.7.5.1 Handheld control unit

4.2.3.7.5.2 Computer based control station

4.2.3.7.5.3 Any control system that is independent of the Unmanned Aerial Vehicle and used to command the vehicle in flight

4.3 Inventory Control

SSC Range and Aviation Operations Manager will maintain oversight on any new UAS and parts. Each project manager over a UAS will tag, track and record each aircraft in the NASA inventory system, property control and tracking systems with a tag number that will be affixed to each UAS so it can be actively tracked. All newly acquired UAS and parts will be logged on a local inventory spreadsheet maintained by the project manager. All UASs and parts will be kept in a secure location until ready for use. The Chief UAS Pilot will conduct a quarterly audit for accountability inventory.

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4.4 Aircraft Material Acquisition Control

SSC Range and Aviation Operations Manager or project manager will oversee aircraft material acquisitions by ordering, replacing and storing of all loose parts for UAS. SSC Range and Aviation Operations Manager will ensure aircraft material acquisition control is in place so that to limit excess parts yet maintain enough for common faulting parts, e.g., rotor blades, screw sets.

4.5 UAS Disposal

4.5.1 When a UAS becomes obsolete, damaged beyond repair, or excess to NASA-SSC needs, it shall be removed from operations and turned-in per SSC property management procedures.

4.5.2 If being disposed of or excessed, SSC Range and Aviation Operations Manager will cancel the FAA registration number through the FAA Drone Zone's website. SSC Range and Aviation Operations Manager or project manager will turn in UAS property through the NASA inventory system and update the local inventory spreadsheet. All turn in and disposals will go through Center Operations, SSC Inventory System Manager and SSC OCIO.

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CHAPTER 5. RANGE AND AVIATION REVIEW BOARD (RARB)

5.1 Since SSC does not possess a Flight Operations Office or a Chief of Flight Operations, it cannot locally fulfill NPR 7900.3 requirements to issue airworthiness certification. As such, SSC shall rely on KSC to provide airworthiness certification on sUASs as required per MOU between SSC and KSC, *sUAS Flight Operations and Aviation Safety Support*.

5.2 The SSC Center Director ultimately approves/accepts airworthiness certificates for SSC aircraft, but KSC Airworthiness and Flight Safety Review Board (AFSRB) Chair is the sole authority for issuing SSC airworthiness certificates. Airworthiness certificates shall be formatted in accordance with NF1677 and signed by both KSC AFSRB Chair (NASA Airworthiness Review Officer) and the SSC Center Director (Center Director's Approval). See SBCC-1150-0031 on RARB responsibilities, membership, reporting requirements and general operating guidance.

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CHAPTER 6. FLIGHT AND MISSION READINESS REVIEW

6.1 Flight Readiness Review Board (FRRB)

6.1.1 The FRRB follows guidance under NPR7900.3 and is chaired under Center Operations. Relevant stakeholders and qualified subject matter experts participate and review agenda items with input from KSCs Flight Operations Department, as required. This board is intended for lower level approvals and evaluation of repeat flight operations. The determination of repeat versus non-repeat is at the discretion of the RARB Chair, who has the authority to delegate approval to the FRRB. The Range and Aviation Operations Manager, project manager or designated representative will initiate all board review requests.

6.1.2 The product of an FRRB may be categorized as a formal FRR or MRR depending on the proposed concept of operations and number of participating aircraft. See SBCC 1150-0031 for FRRB responsibilities, membership, reporting requirements and general operating guidance.

6.2 Readiness Reviews

6.2.1 Flight Readiness Review (FRR)

For single aircraft operations determined by the SSC RARB/FRRB Chair, a FRR will be conducted prior to all flight operations using Appendix G, FRR/MRR Checklist.

6.2.2 Mission Readiness Review (MRR)

For multiple aircraft operations determined by the SSC RARB/FRRB Chair, a MRR shall be conducted for all flight operations involving more than one aircraft aloft simultaneously in close airspace proximity. This review will be conducted prior to flight operations following the FRR/MRR checklist detailed in Appendix G and subsequently be documented via memorandum or email to appropriate parties. Prior to conducting an MRR, each aircraft involved in the flight or campaign shall have an approved RARB/FRRB approval.

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CHAPTER 7. RANGE SAFETY HAZARD ANALYSIS

7.1 Range safety hazard analysis will comply with NPR 8715.5 and SPR 8715.7, *SSC Range Safety Program*, and shall be accomplished for range operations requiring an analysis. The analysis and subsequent risk acceptance shall be published in time for board meetings and included in minutes.

7.2 SSC SMA is responsible for safety hazard analysis. During operations, the RSO provides duties as assigned in accordance with NPR 8715.5 and SPR 8715.7 levied on UAS operations during RARB, FRRB/MRRB and during operations required by the RSM.

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APPENDIX A. ACRONYMS

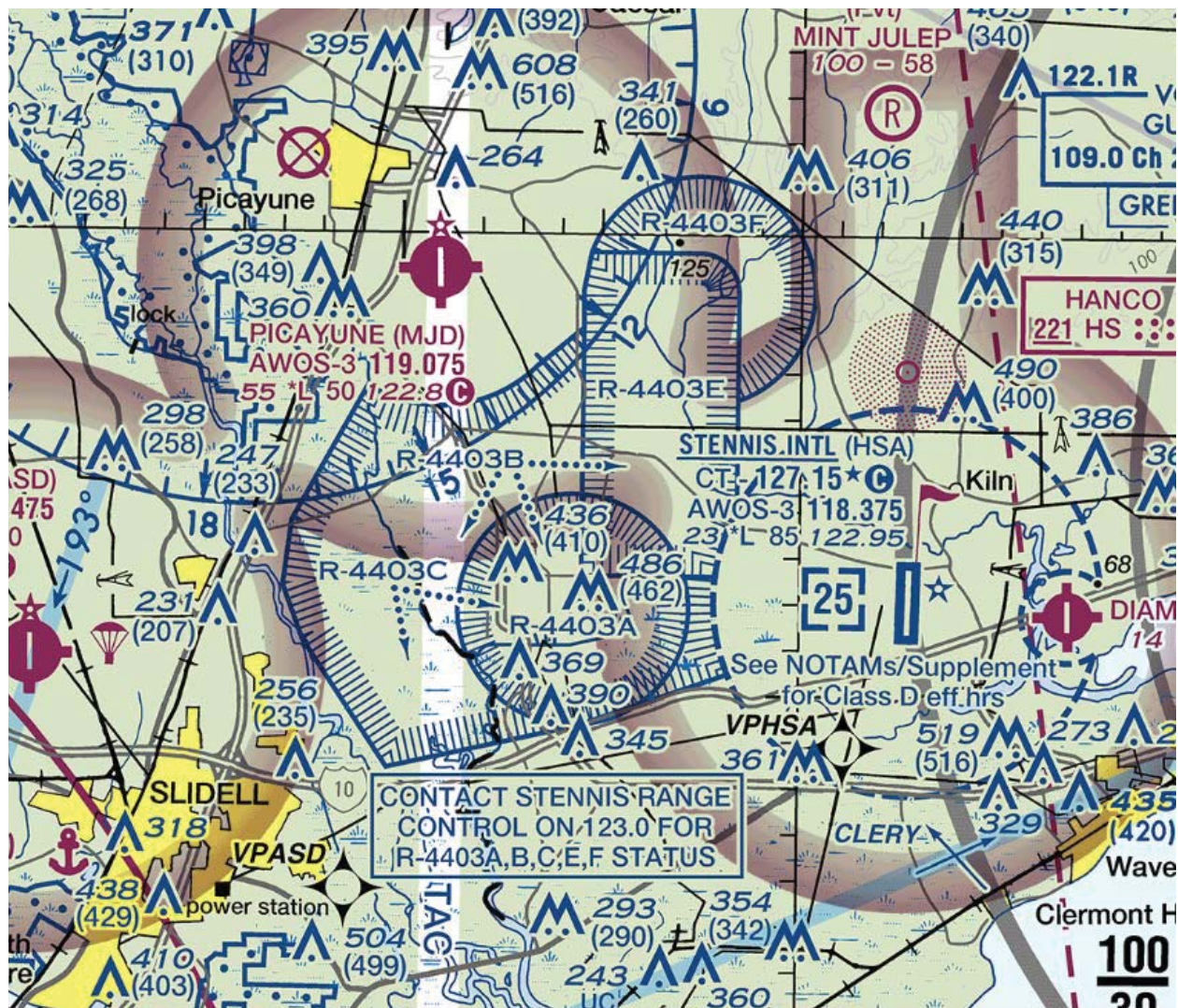
AFSRB	Airworthiness and Flight Safety Review Board
AGL	Above Ground Level
AO	Area of Operation
ATC	Air Traffic Control
ATO	Authorization to Operate
CAS	Commercial Aviation Services
CFR	Code of Federal Regulations
COA	Certificate of Authorization
COD	Center Operations Directorate
COTS	Commercial off the Shelf
CRM	Crew Resource Management
DOD	Department of Defense
FAA	Federal Aviation Administration
FAAST	Federal Aviation Administration Safety Team
FMS	Flight Management System
FRR	Flight Readiness Review
FRRB	Flight Readiness Review Board
GCS	Ground Control Station
GPS	Global Positioning System
IAW	In Accordance With
IT	Information Technology
KSC	Kennedy Space Center
KZHU	Houston Air Route Traffic Control Center
LOP	Letter of Procedures
MADE	Military Airspace Data Entry
MC	Mission Commander
MHz	Megahertz
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MQS	Mission Qualification Standards
MRR	Mission Readiness Review
MSL	Mean Sea Level
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NODIS	NASA Online Directives Information System
NOTAM	Notices to Airmen
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NSWC	Naval Special Warfare Command
OCIO	Office of the Chief Information Office

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PIC	Pilot in Command
POC	Point of Contact
RARB	Range and Aviation Review Board
RC	Radio Control
RCO	Range Control Officer
RF	Radio Frequency
ROZ	Restricted Operating Zone
RSM	Range Safety Manager
RSO	Range Safety Officer
SATERN	System for Administration, Training and Educational Resources
SCWI	Stennis Center Work Instruction
SBCC	Stennis Charters Board, Council and Committees
SMA	Safety and Mission Assurance Directorate
SPD	Stennis Policy Directive
SPLN	Stennis Plan
SPR	Stennis Procedural Requirements
SSC	John C. Stennis Space Center
SSP	System Security Plan
SUA	Special Use Airspace
sUAS	Small Unmanned Aircraft System
UAS	Unmanned Aircraft System
UUS	Unmanned Underwater Systems
VFR	Visual Flight Rules
VHF	Very High Frequency
VLOS	Visual Line of Sight
VMC	Visual Meteorological Conditions
VO	Visual Observer

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APPENDIX B. NEW ORLEANS SECTIONAL RESTRICTED AIRSPACE SECTORS R-4403A/B/C/E/F



Note: Always check for the latest publication addition prior to conducting any flight operations.

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APPENDIX C. RESTRICTED AIRSPACE R-4403A/B/C/E/F DESCRIPTION

R-4403A Stennis Space Center, MS [New]

Boundaries- Within a 2.5 Nautical Mile (NM) radius centered at lat. 30°21'51" N., long. 89°35'39" W.

Designated altitudes- Surface to 12,000 feet MSL.

Time of designation- Intermittent by NOTAM at least 24 hours in advance.

Controlling agency- FAA, Houston ARTCC.

Using agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

Scheduling agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

R-4403B Stennis Space Center, MS [New]

Boundaries- Beginning at lat. 30°29'37" N., long. 89°35'16" W.; to lat. 30°29'37" N., long. 89°32'33" W.; thence clockwise along a 0.85–NM arc centered at lat. 30°28'46" N., long. 89°32'33" W.; to lat. 30°28'46" N., long. 89°31'34" W.; to lat. 30°26'25" N., long. 89°31'34" W.; to lat. 30°24'02" N., long. 89°31'34" W.; thence counterclockwise along a 4.2–NM arc centered at lat. 30°22'04" N., long. 89°27'17" W.; to lat. 30°20'28" N., long. 89°31'46" W.; to lat. 30°19'19" N., long. 89°35'32" W.; to lat. 30°18'23" N., long. 89°40'17" W.; to lat. 30°21'08" N., long. 89°42'25" W.; to lat. 30°22'22" N., long. 89°42'58" W.; to lat. 30°23'44" N., long. 89°42'43" W.; to lat. 30°26'40" N., long. 89°40'51" W.; thence counterclockwise along a 3–NM arc centered at lat. 30°29'15" N., long. 89°39'04" W.; to lat. 30°27'08" N., long. 89°36'37" W.; to lat. 30°27'58" N., long. 89°35'27" W.; to lat. 30°28'47" N., long. 89°35'27" W.; to the point of beginning.

Designated altitudes- Surface to 6,000 feet MSL.

Time of designation- Intermittent, 1000 to 0300 local time, as activated by NOTAM at least 24 hours in advance.

Controlling agency- FAA, Houston ARTCC.

Using agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

Scheduling agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

R-4403C Stennis Space Center, MS [New]

Boundaries- Beginning at lat. 30°27'58" N., long. 89°35'27" W.; to lat. 30°22'35" N., long. 89°35'27" W.; to lat. 30°22'35" N., long. 89°32'06" W.; thence counterclockwise along a 4.2–NM arc centered at lat. 30°22'04" N., long. 89°27'17" W.; to lat. 30°20'28" N., long. 89°31'46" W.; to lat. 30°19'19" N., long. 89°35'32" W.; to lat. 30°18'23" N., long. 89°40'17" W.; to lat. 30°21'08" N., long. 89°42'25" W.; to lat. 30°22'22" N., long. 89°42'58" W.; to lat. 30°23'44" N., long. 89°42'43" W.; to lat. 30°26'40" N., long. 89°40'51" W.; thence counterclockwise along a 3–NM arc centered at lat. 30°29'15" N., long. 89°39'04" W.; to lat. 30°27'08" N., long. 89°36'37" W.; to the point of beginning.

Designated altitudes- Surface to 10,000 feet MSL or Surface to 6,000 feet MSL

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Time of designation- Intermittent, 2000 to 0500 local time, as activated by NOTAM at least 24 hours in advance; and 1800 to 2000 local time, November 1 to March 1, as activated by NOTAM at least 24 hours in advance, not to exceed 20 days per year.

Controlling agency- FAA, Houston ARTCC.

Using agency- U.S. Navy, Commander, Naval Special Warfare Command, Naval Special Warfare N31 Branch, Stennis Space Center, Bay St. Louis, MS.

Scheduling agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

R-4403E Stennis Space Center, MS [New]

Boundaries- Beginning at lat. 30°29'37" N., long. 89°35'16" W.; to lat. 30°29'37" N., long. 89°32'33" W.; thence clockwise along a 0.85M arc centered at lat. 30°28'46" N., long. 89°32'33" W.; to lat. 30°28'46" N., long. 89°31'34" W.; to lat. 30°26'25" N., long. 89°31'34" W.; to lat. 30°24'02" N., long. 89°31'34" W.; thence counterclockwise along a 4.2–NM arc centered at lat. 30°22'04" N., long. 89°27'17" W.; to lat. 30°22'35" N., long. 89°32'06" W.; to lat. 30°22'35" N., long. 89°35'27" W.; to lat. 30°27'58" N., long. 89°35'27" W.; to lat. 30°28'47" N., long. 89°35'27" W.; to the point of beginning.

Designated altitudes- Surface to 10,000 feet MSL.

Time of designation- Intermittent, 2000 to 0500 local time, as activated by NOTAM at least 24 hours in advance; and 1800 to 2000 local time, November 1 to March 1, as activated by NOTAM at least 24 hours in advance, not to exceed 20 days per year.

Controlling agency- FAA, Houston ARTCC.

Using agency- U.S. Navy, Commander, Naval Special Warfare Command, Naval Special Warfare N31 Branch, Stennis Space Center, Bay St. Louis, MS.

Scheduling agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

R-4403F Stennis Space Center, MS [New]

Boundaries- Beginning at lat. 30°29'37" N., long. 89°35'16" W.; thence clockwise along a 2.5–NM arc centered at lat. 30°28'46" N., long. 89°32'33" W.; to lat. 30°26'25" N., long. 89°31'34" W.; to lat. 30°28'46" N., long. 89°31'34" W.; thence counterclockwise along a 0.85–NM arc centered at lat. 30°28'46" N., long. 89°32'33" W.; to lat. 30°29'37" N., long. 89°32'33" W.; to the point of beginning.

Designated altitudes- 4,000 feet MSL to 10,000 feet MSL.

Time of designation- Intermittent, 2000 to 0500 local time, as activated by NOTAM at least 24 hours in advance; and 1800 to 2000 local time, November 1 to March 1, as activated by NOTAM at least 24 hours in advance, not to exceed 20 days per year.

Controlling agency- FAA, Houston ARTCC.

Using agency- U.S. Navy, Commander, Naval Special Warfare Command, Naval Special Warfare N31 Branch, Stennis Space Center, Bay St. Louis, MS.

Scheduling agency- NASA, Director, Stennis Space Center, Bay St. Louis, MS.

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APENDIX D. QUESTIONNAIRE FOR SMALL UNMANNED AIRCRAFT SYSTEMS (UAS) OPERATIONS OR COMMERCIAL OFF THE SHELF AIRCRAFT

Instructions:

Please answer all questions completely. Areas that do not apply or are “to be determined”, please indicate with N/A (Not Applicable) or TBD (To Be Determined). This questionnaire is designed to describe a single UAS type and block of vehicle. Any subsequent system blocks/upgrades/changes will require completion of a new questionnaire for safety review.

Note: * Indicates a mandatory field

1. Project Name and Agency/Company:

2. sUAS Name/ID/Type/Model number if multiple vehicles:

3. Program Classification (check all that apply):

- ☐ Unclassified
☐ Company Proprietary
☐ Classified (explain classification level and company non-disclosure requirements below):

4. Vehicle Description & Performance:

Wing Span:	Length:	Empty Weight:	Gross Weight:
Engine (size/rating):	Fuel Type/Qty:	Payload Capacity:	Glide Ratio:
Max Speed:	Cruise Speed:	Stall Speed:	Glide Speed:
Rate of Climb:	Rate of Descent:	Max Altitude:	Max Range:
Construction:	Wing Loading:	Max Duration:	

5. Photo or drawing of sUAS vehicle (flight article):

6. Concept of Operations:

Describe intended UAS operations to include, but not limited to: typical crew complement, preflight activities, launch/recovery details, typical mission profile, payload operations (video camera, typical maneuvers, releasable objects), & post-flight activities.

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7. Program Schedule:

Describe intended flight operations schedule to include desired project start date, projected completion date and any additional dates necessary to accomplish project objectives.

8. System Description:

Radio Frequency Requirements: See Range and Aviation Operations Manager for SSC Form 946, *Radio Frequency Authorization Request*.

Autopilot System:

Describe system type, manufacturer, model, serial number, software or hardware modifications, performance capabilities and limitations in detail.

Payload and/or Video System:

Describe payload and/or video system in detail. If the payload is a sensor, describe the sensor characteristics/performance capabilities (operating spectrum, resolution, zoom, analog/digital, etc.).

Ground Control Station (GCS):

Describe equipment, system capabilities, simulator, performance (limitations).

Vehicle Launch/Recovery System:

Describe launch/recovery methodology.

Flight Termination System: Describe equipment type, configuration, time-out sequence, etc., in detail. **Note:** The Flight Termination System requirements are shown in NPR 7900.3

9. Describe type(s) of activities or expected test (check all that apply):

<input type="checkbox"/> Acceptance Flight Test	<input type="checkbox"/> FAA Certification	<input type="checkbox"/> Performance
<input type="checkbox"/> Aero-Elastic/Flutter Stability	<input type="checkbox"/> Flight Controls	<input type="checkbox"/> Radar/IR Signature
<input type="checkbox"/> Airborne Science	<input type="checkbox"/> Flight Plan/Navigation	<input type="checkbox"/> Radio Frequency Interference
<input type="checkbox"/> Avionics/Systems Capabilities	<input type="checkbox"/> Flight Termination System	<input type="checkbox"/> Research & Development
<input type="checkbox"/> Combined System Test	<input type="checkbox"/> Functional Check Flight	<input type="checkbox"/> Sensors
<input type="checkbox"/> Communications	<input type="checkbox"/> Ground Equipment (GCS)	<input type="checkbox"/> Structural Loads
<input type="checkbox"/> Data Link/C2	<input type="checkbox"/> Ground Operations	<input type="checkbox"/> Software
<input type="checkbox"/> Design	<input type="checkbox"/> Guidance Systems	<input type="checkbox"/> Taxi
<input type="checkbox"/> Engine Performance	<input type="checkbox"/> Handling Qualities	<input type="checkbox"/> Test & Verification
<input type="checkbox"/> Emergency Procedures	<input type="checkbox"/> Instrumentation	<input type="checkbox"/> Test Article
<input type="checkbox"/> EMI	<input type="checkbox"/> Launch/Recovery System	<input type="checkbox"/> Test Facility
<input type="checkbox"/> Envelope Expansion	<input type="checkbox"/> Operational Test & Evaluation	<input type="checkbox"/> Tow
<input type="checkbox"/> Environmental Factors	<input type="checkbox"/> Payloads	<input type="checkbox"/> Training
<input type="checkbox"/> EO Video/Camera	<input type="checkbox"/> Payload Drop	<input type="checkbox"/> Other (explain in remarks)

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10. Operational Requirements:

Weather Minimums:

Meteorological Conditions:

Wind Limits (HW/TW/CS):

Ceiling & Visibility

Environmental Limitations

Range Requirements:

Describe any test site operational requirements and/or limitations in detail.

Crew Training:

Describe crew qualifications, minimum crew size, currencies, etc., in detail.

Ground/Visual Observer (VO) and/or Chase Aircraft Requirements:

Describe ground observer requirements, qualification and training and/or chase aircraft requirements (aircraft type, chase procedures, times required) in detail.

Host Support Requirements:

Describe desired support requirements from Center Operations or SSC.

11. Risk Management:

COTS equipment modifications:

Describe any modifications to COTS systems, why modified, and possible new failure modes. If no modifications, mark as "N/A".

Test Hazard Analysis:

Describe system safety methodology, risk analysis and fault tree analysis in detail.

Loss of Control Safeguards:

Describe procedures for the following conditions: loss of system C2 link, loss of position/sight, unresponsive flight controls, loss of propulsion, loss of electrical power and ground control station failure in detail.

Pre-Mishap Plan:

Describe in detail what actions the team will take in the event of an aircraft mishap (include the pre-mishap plan as an attachment).

Vehicle Safety History & Reliability:

Describe safety record of system (include number of hours or sorties flown, mishaps, engine failures (MTBF), C2 anomalies, critical flight components, Avoidance of Collision with Other Aircraft, Emergency Procedures etc.).

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12. Describe Hazardous Materials/Equipment (check all that apply):

<input type="checkbox"/> Batteries/Uninterrupted Power Supply (UPS)	<input type="checkbox"/> Power Distribution Equipment
<input type="checkbox"/> Chemicals (solids & liquids)	<input type="checkbox"/> Pressure Vessels
<input type="checkbox"/> Compressed Gasses	<input type="checkbox"/> Propellant (fuel)
<input type="checkbox"/> Cryogenics	<input type="checkbox"/> Radioactive Materials
<input type="checkbox"/> Heaters	<input type="checkbox"/> Radio Frequency Emitters
<input type="checkbox"/> Lasers	<input type="checkbox"/> Releasable Payload
<input type="checkbox"/> Motors/Pumps	<input type="checkbox"/> Other

Describe in detail any checked item above (add diagrams, specifications, MSDS, etc.).

13. Visitor Information:

Complete a SSC Visitor's Request form thru the Office of Protective Services for each member of the team who will participate in flight activities at SSC and are not currently badged.

14. Project Manager (or Designated POC) Information:

Name: Submittal Date:

Organization: Address:

Phone Number: E-Mail Address:

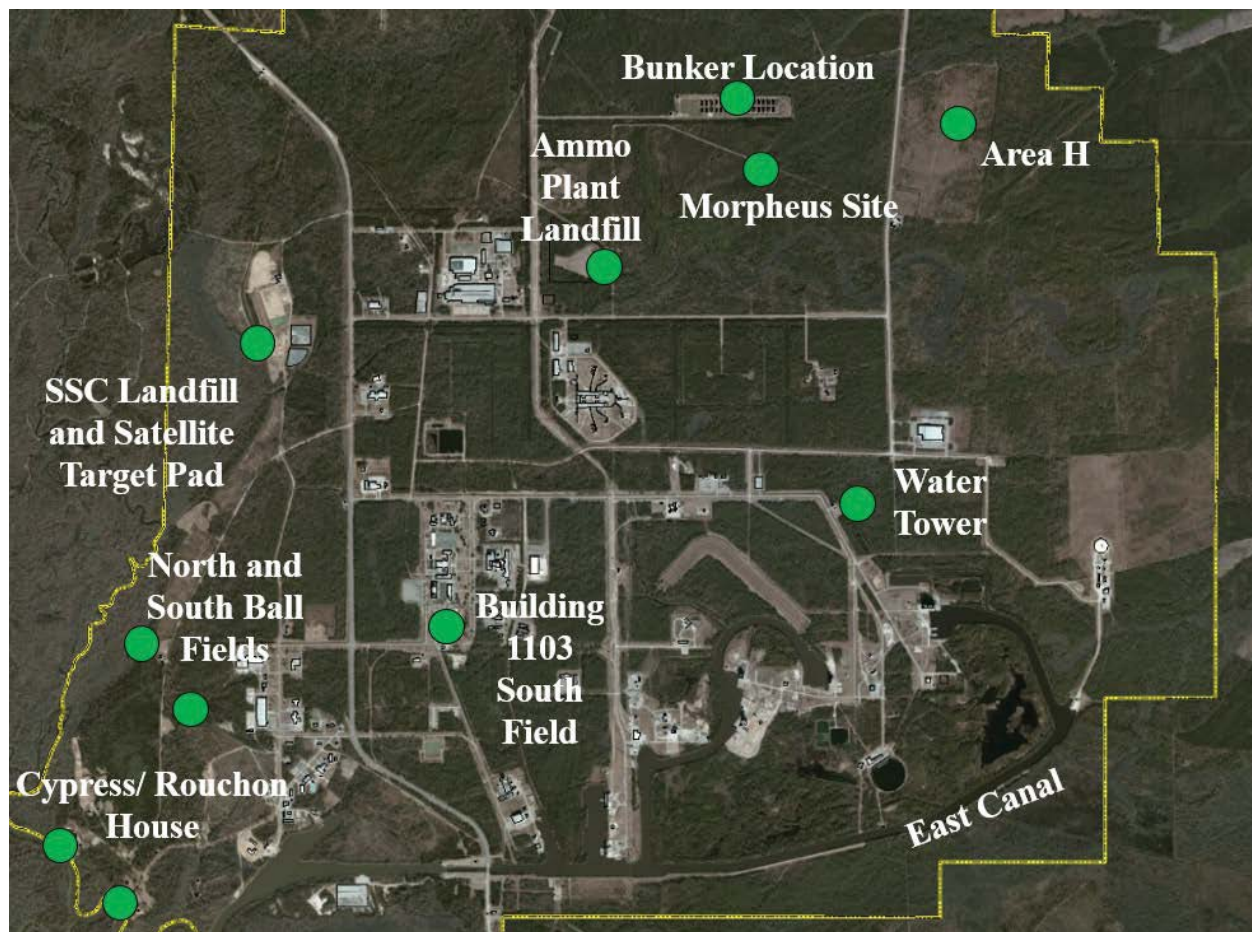
Mobile Number: Fax Number:

15. Submit completed form to:

SSC Range and Aviation Operations Manager
Jason Peterson
Bldg. 1100
Room 3030U
Stennis Space Center, MS 39529
228-688-1257

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APPENDIX E. CAT I Small Unmanned Aircraft System Designated Training Areas



Note: Operational requirements and restrictions apply with each location, see SSC Range and Aviation Operations Manager prior to flight for details.

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APPENDIX G. FLIGHT READINESS REVIEW/MISSION READINESS REVIEW CHECKLIST

This checklist combines flight safety and mission safety considerations contained in NPR 7900.3, and shall be used to brief all single and multi UAS flights and other missions as directed by the SSC RARB/FRRB Chair. Documentation kept on file with the SSC Range and Aviation Operations Manager.

1. Flight/Mission Readiness Considerations
 - a. Requirements of aviation support
 - i. Mission Objective
 - ii. Schedule / Timeline
 1. Sequence and timing of events
 2. Signal/Multiple-day operations impact
 3. Area of Operations
 4. Day / Night considerations
 5. CRM, Crew duty day / crew rest considerations
 - b. Aircraft / Crew Readiness
 - i. Aircraft Maintenance
 1. Aircraft inspected
 2. Limiting aircraft factors
 3. Weight and Balance
 - ii. Pilot qualifications, flight operations training, and flight manuals
 1. Pilot currency ref: flight / mission requirements
 2. Review completion of appropriate documents
 3. Aircraft prepared for activity
 - c. Outside agency coordination
 - i. Airspace coordination (single vs. multiple UAS)
 - ii. Support / partner organizations (if required)
 - iii. Public Affairs / Outreach (if required)
 - iv. Security (if required)
 - d. SMA - Hazard analysis, risk matrix, etc.
2. Flight Operations Considerations
 - a. Describe overall maneuver
 - b. Aircraft configuration
 - c. Crew roles
 - d. Headsets / ear protection
 - e. Special equipment
 - f. Mission execution
 - i. GCS Site
 - ii. Time on station / battery requirements
 - iii. Communication plan / alternate / loss of communication

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iv. Payloads

- (a) Camera
- (b) LiDAR
- (c) EO / IR

v. Go / No-Go

- (a) Weather Criteria
- (b) Mission
- (c) Go / No-go timeline

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APPENDIX H. UAS PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

Planning Checklist

<u>Description</u>	<u>Check</u>
• Submit Flight Approval Request	
• Check weather conditions	
• Check firmware updates for aircraft	
• Check firmware updates for controller(s)	
• Visual aircraft inspection (loose hardware, chipped blades, etc.)	
• Check and charge aircraft batteries	
• Charge controllers	
• Check SD cards to ensure there is sufficient space on them	
• Charge all iPads/tablets/computers	
• Update all iPad/tablet flight apps	

Loading Checklist

<u>Item</u>	<u>Description</u>	<u>Check</u>
Aircraft	Includes props, gimbal, camera(s)	
Controller(s)	Controller for each vehicle to be flown	
Aircraft Batteries	All available batteries for aircraft to be flown	
Battery Chargers	Minimum of two chargers for each battery type	
SD Cards	Enough SD cards for all planned flight(s)	
iPad(s)/Tablet(s)	iPad/tablet with flight software	
Lightning to USB cable(s)	For all new iPads/iPhones	
Micro USB to USB	for Android tablets/phones	
Mini HDMI to HDMI cable	Controller-to-Display cable	
HDMI to HDMI cables	If multiple displays are going to be used	
Extra props	Extra props for vehicle being flown	
Tools	Any tool required to perform basic field repair	
Binoculars	Used for non-VO duties	
Radio(s)	For monitoring, pre- and post-flight	

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APPENDIX H (Cont): UAS PLAN, PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

Flight Preparation

Description	Check
• Visually inspect site for onsite risk assessment	
• Determine main and alternate take-off and landing sites	
• Check wind speed and direction (Kestrel)	
• Check weather, 3SM, Clouds 500' below cloud. 2,000' horizontal. Further restrictions may apply based on operations.	
• Brief all relevant personnel regarding operational procedures during flight operations	
• Brief minimum battery return procedure to crew based on environmental factors: Minimum RTH at 30%, land by 20%	
• Verify geofencing coordinates/locations are correct for the specified mission	

Vehicle Preparation

Description	Check
• Check integrity of the frame and landing gear	
• Check propellers for cracks and/or chips	
• Check for proper propeller direction and tightness	
• Check motors for any binding	
• Check gimbal rubber dampers and pins	
• Check camera mount	
• Check cleanliness of camera lens	
• Check SD cards to ensure there is sufficient space on them	
• Check to ensure all components are securely fastened to frame	

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APPENDIX H (Cont): UAS PLAN, PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

Pre-Flight Checklist

Description	Check
Aircraft/Controller	
• Power up iPad/tablet and controller	
• Check battery level on both	
• Start Flight application on iPad/tablet	
• Install SD card	
• Check aircraft battery level	
• Install battery on aircraft and power up	
• Check aircraft video and radio link quality	
• Check amount of visible satellites	
• Select flight mode	
• Set altitude limit	
• Check gimbal control	
• Perform compass calibration if necessary	
Camera	
• Select photo or video mode	
• Check photo/ISO shutter speed	
• Check video resolution and frame rate	

Take off Checklist

Description	Check
• Notify Range Control prior to operations, if required	
• Announce: Clear to spin by VO	
• Start motors	
• Check all motors are operational	
• Record start Flight time	
• Announce: Taking off (Pilot)	
• Bring aircraft up and hover at 15-20 ft. for 5-10 seconds	
• Announce: Good hover by VO	
• Carry out planned flight	
Don't forget to hit record when ready!	

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APPENDIX H (Cont): UAS PLAN, PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

In-Flight Monitoring/Checks

Description	Check
Aircraft battery level	
Radio Signal strength	
GPS satellites and GPS hold	
Video link	
Aircraft height	
VO to maintain sight of aircraft at all times	
NOTE: Prior to landing, move camera position up to prevent any damage to camera.	

Post-Flight Checklist

Description	Check
Record landing time	
Safe UAS system	
<ul style="list-style-type: none"> Power off unit 	
<ul style="list-style-type: none"> Remove battery and inspect 	
<ul style="list-style-type: none"> ✓ Note any physical abnormality such as swelling 	
<ul style="list-style-type: none"> ✓ Check voltage to verify that it was not discharged below 3 volts per cell 	
<ul style="list-style-type: none"> ✓ Check temperature to verify that it does not exceed manufacturer specifications 	
<ul style="list-style-type: none"> Check propellers for cracks, scratches, or deformation 	
<ul style="list-style-type: none"> Check gimbal and camera 	
<ul style="list-style-type: none"> Check motor temperature/bearing play 	
<ul style="list-style-type: none"> Check aircraft frame 	
Notify Range Control flight ops is complete, if required	
Debrief with entire flight crew	
<ul style="list-style-type: none"> Were objectives met? 	
<ul style="list-style-type: none"> Was the operation performed safely? 	
<ul style="list-style-type: none"> Were there any close calls or incidents that need reporting? 	
Log flights in online flight tracking system	
Provide data to customers and archive (if applicable) for later access	
Wipe memory cards and replace in UAS system	
Charge batteries if there is another flight that week, otherwise storage charge at 60% of max amp-hours. Do not store aircraft with batteries installed*	
Ensure all storage requirements are met	

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APPENDIX H (Cont): UAS PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

Emergency Procedures

Description	Check
Aborted Takeoff	
Before Liftoff:	
• Aero termination (Completed)	
• Disarm and deactivate (Completed)	
After Liftoff:	
• Manual control mode (Selected)	
• Throttle down (Completed)	
• Descend and land (Completed)	
• Aero termination (As necessary)	
• Disarm and deactivate (Completed)	
• Downed aircraft/Hard landing checklist (Completed)	
Aborted Landing	
• Manual Control mode (Selected)	
• Climb to safe altitude & position (Completed)	
Unstable Flight Behavior	
• Manual Control mode (Selected)	
• Attitude mode (Selected)	
• No control: Aero Termination (As necessary) (Completed)	
• Fly to landing area or safe alternate (Completed)	
• Descend and land (Completed)	
• Disarm and deactivate (Completed)	
• Downed aircraft/Hard landing checklist (Completed)	
Fly - Away	
• Go to WP (waypoint) or RHH&L (Return home, hover & land) (Selected)	
No response:	
• Manual Control Mode (Selected)	
• Fly to landing area or safe alternate (Completed)	
• Descend and land (Completed)	
• Disarm and deactivate (Completed)	
Unable to control aircraft:	
• Aero Termination (Completed)	
Aero termination failure:	
• Last vehicle position, speed and heading (Recorded)	
• Hazards along vehicle flight path (Identified)	
• Local authorities and airports notified (As necessary)	
• Downed aircraft checklist (Completed)	

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APPENDIX H (Cont): UAS PRE, IN-FLIGHT, POST AND EMERGENCY CHECKLIST

Abnormal Procedures

GCS Crash	<u>Check</u>
• Force close GCS (Completed)	
• Open GCS (Completed)	
• Attempt to connect to aircraft (Completed)	
• Aircraft position and state indicators (Completed)	
• Flight package & plans synced (Verified)	
Post Hard Landing	
• No present or impending personal injury (Verified)	
• No present or impending property damage (Verified)	
• No present or impending risk or fire (Verified)	
• Aircraft battery disconnected (Completed)	
• Remove vehicles and parts from landing area (Completed)	
• Aircraft mechanical inspection (Completed)	
• Aircraft log (Recorded and Updated)	
• Flight core logs (Downloaded and Saved)	
Downed Aircraft	
• Aero Termination	
• Crash site (Located)	
• Travel to crash site (Completed)	
• No present or impending personal injury (Verified)	
• No present or impending property damage (Verified)	
• No present or impending risk or fire (Verified)	
• Aircraft battery disconnected (Completed)	
• Notify property owners (Completed)	
• Photograph aircraft crash site (Completed)	
• Photograph aircraft damage (Completed)	
• Retrieve vehicle and parts from crash site (Completed)	
• Crash damage (Recorded in AVL)	
• Crash report (Completed)	
• Flight Core logs (Downloaded)	
• Flight operation stakeholders (Notified)	

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APPENDIX I. UAS VISUAL OBSERVER TRAINING CERTIFICATION FORM

1. Date Submitted	Certification Criteria		2. Certification Number sUAS-C-O REV-BASIC
3. Name (Last, First, MI)	4. NASA UUPIC	5. Mail Code/Organization	
6. Certification Title	sUAS Visual Observer		7. Effective Date
8. Certification Description: To ensure personnel receive required training and can demonstrate proficiency in the operation of sUAS Visual Observer.			
9. Re-certification Requirements: FA2 Physical and currency flights			
Certification Requirements			
Description of Requirements	Completion Date	Verification Signature	
10. Training Requirement(s) (course number and title) FAA GROUND SCHOOL Airplanes/Aerodynamics, Airports, Air Traffic Control, Air Space, Federal Aviation Regulations, 14 CFR Part: 73, 91.3, 91.13, 91.17, 91.111, 91.113, 91.133, 91.155, 107 CREW RESOURCE MANAGEMENT (CRM) Training Review of NPR 7900.3C Review of SPR 7900.3 and KTI 7900_UAS Visual Observer Training	 	11. Certifying Official	
12. Medical Requirements (indicate exam title and three-digit code): FAA Class III/NASA/Military Equivalent medical certification with vision correctable to 20/20			
Trainee/Supervisor Signature			
13. Employee Signature	Date	14. Supervisor	Date
Approval Signatures			
15. SSC Chief UAS Pilot Signature	Date	16. KSC Chief UAS Pilot Signature	Date
NASA CFO Approval Signatures			
17. NASA KSC Aviation Safety Officer	Date	18. NASA KSC Chief of Flight Ops Signature	Date

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APPENDIX J. UAS PILOT TRAINING CERTIFICATION FORM

1. Date Submitted	Certification Criteria		2. Certification Number sUAS-C-O REV-BASIC
3. Name (Last, First, MI)		4. NASA UUPIC	5. Mail Code/Organization
6. Certification Title sUAS Pilot – Rotorcraft – Class 1 – MQS I		7. Effective Date	
8. Certification Description: To ensure personnel receive required training and can demonstrate proficiency flight and operation of Class 1 sUAS at the MQS I level.			
9. Re-certification Requirements CRM training and flight proficiency check			
Certification Requirements			
Description of Requirements		Completion Date	Verification Signature
10. Training Requirement(s) (course number and title) CREW RESOURCE MANAGEMENT (CRM) Training Review of NPR 7900.3C, SPR 7900.3 and KTI 7900_UAS Review of applicable flight manuals and OEM documentation Flight proficiency demonstration to standards identified in SPR 7900.3, Range and Aviation Operations 14 CFR Part 107 certification Airspace procedures review and test		 	11. Certifying Official
12. Medical Requirements (indicate exam title and three-digit code) FAA Class III/NASA/Military Equivalent medical certification with vision correctable to 20/20			
Trainee/Supervisor Signature			
13. Employee Signature	Date	14. Supervisor	Date
Approval Signatures			
15. SSC Chief UAS Pilot Signature	Date	16. KSC Chief UAS Pilot Signature	Date
NASA CFO Approval Signatures			
17. NASA KSC Aviation Safety Officer	Date	18. NASA KSC Chief of Flight Ops Signature	Date