HASP Flight Operation Plan V2

Payload Title: SHADOMS

Payload Class (Small / Large)**:** Small **Flight Number:** 2019-_________ **Payload ID:** 2019-01

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Flight Operations Release: By submitting this Flight Operation Plan you acknowledge the following conditions, limitations and constraints. Your payload is your responsibility. The CSBF and HASP flight and management team will not be responsible for any payload problems, failures or damage due to lack of proper documentation, inadequate planning and/or design, or delayed notification of remedial action. The HASP flight team will not be able to perform any time intensive or involved tasks necessary to prepare your payload for flight. If you have a set of tasks that needs to be performed prior to flight then a team member from your group should be on the flight line until, at least, launch. The HASP flight team will attempt to perform simple tasks for your payload, but only if these tasks are fully documented by the time of payload integration. Full documentation includes written instructions, images of key steps and/or configuration changes, and labeling on your payload of values, switches, releases or other key features in these operations. Target launch and recovery dates are not guaranteed. These dates depend critically upon weather conditions and are likely to slip by several days and possibly by a week or more. Flight termination and landing are violent events and it is possible that your payload will be damaged beyond repair. The CSBF and HASP flight team will make every effort to assure that your payload is successfully launched, flown, recovered and returned to you intact.

I. Flight-line Setup & Pre-launch Checkout Procedures:

In this section provide a line by line list of tasks for the periods indicated below. This should include detailed instructions, pictures, descriptions and anything else that will be needed to properly complete each task. Please refer to the Flight Operations Release located at the top of this document and see Appendix A for a timeline of the typical sequence of events prior to launch as well as pre-launch and flight operations. Your flight operation planning should take both the release statement and timeline into account. The line by line task list should contain the following:

1. The time at which the task needs to be completed with respect to launch time (i.e. T=0).
2. The person responsible for completing the task. Indicate if it is your desire for HASP personnel to attempt to complete the task.
3. A short title for the task.
4. Task detailed instructions as described above.
5. A description of what constitutes a successful completion of the task (e.g. indicator lights, change in telemetry, picture showing new configuration)

A. **Flight-line Setup Period:** Provide a task list and timeline for the period leading up to the final HASP hang test and MRR. That is from about T = -7 days to about T = - 3 days. This is the period where you will have the greatest access to your payload and the most time available for setup activities. At the time of the MRR your payload should be ready for launch on a few hours notice and access to your payload will become limited.

Our payload will be flight-ready after integration, no tasks will have to be accomplished during the Flight-line Setup Period.

B. **Pre-launch Checkout Period:** Provide a task list and timeline for the pre-launch period starting at T = - 5 hours. Note that access to your payload after pickup (T = -4 hours) is **very** limited due to safety considerations. Thus, only very simple operations (e.g. flipping a switch, opening a valve) that can be performed external to your payload will be possible after HASP pickup.

Our payload will have to be connected to the power supply and serial port during this period. This is done through the HASP plate connection. Ideally, the system should NOT be supplied with power until as close to launch as possible.

II. Flight Operation Procedures

This section documents your procedures for operating your payload from launch through termination. Generally this will be a list of commands transmitted to the payload in a particular order, observing the payload response via telemetry or video (i.e. CosmoCAM), identifying if the response is valid and, if needed, executing a contingency. Note that **all** payloads have at least "Power On" and "Power Off" commands. These commands should be listed as necessary in your procedures. Each command or procedure step should include, at least, the following information:

1. The name of the command.
2. The bytes (two) in hex format of the serial command.
3. A description of the command.
4. Whether or not the command is critical to flight operations.
5. A brief description of how it will be determined, from the ground, that the command was successfully executed.
6. A contingency plan if the command isn't successfully executed.
7. The ramifications to flight success if a command isn't executed properly.

A. **Uplink Command List:** This list should contain all of the commands for your payload.

System Reset: *Value: 0x1CAA.* Cycles the OPC's in the event of an error. This command is critical to flight operations. We will be able to see if the command is successfully received because in our serial string, the OPC state byte will go from 1 to 0 to 1 and the sample PMS data will disappear then come back. If the command is not successful, the system has autonomous failsafes in the event of an issue. If the command and failsafe are both unsuccessful, it will result in a lack of usable data from the flight.

OPC Activation: *Value: 0x1CBB.* Activates the OPC's. This command is critical to flight operations. If the command is not executed successfully. We will be able to tell if this command is successful because the OPC status byte will become 1. If the command is not executed successfully, there is a timer and GPS failsafe that will activate the OPC's at our desired altitude or after a certain time into the flight. If the command and failsafes are not successful, it will result in no data being taken for the flight.

OPC Shutdown: *Value 0x1CCC.* Shuts down the OPC's. This command is critical to flight operations. We will be able to tell if this works because our OPC state byte will become 0. If the command is not executed properly, the LOAC OPC will not shut down correctly. Improper shutdown may corrupt the LOAC data or damage its hardware.

B. **Commands to be executed during climb-out:** Provide a list of commands that will be transmitted to the ballooncraft after launch (T = 0) but prior to reaching float altitude (~T = +2 hours). These may be commands that initialize your payload or start your payload's operations.

The commands that will be sent during Climb-out will be OPC Activation and a System Reset if necessary.

C. **Flight Configuration Setup:** Provide a list of commands that will be used for the flight configuration of your payload. Indicate when this procedure should be executed (e.g. once payload reaches float; after every "Power On").

System Reset command as needed in case of a failure.

D. **Failure Response:** This should be a series of procedures that would be executed in response to particular payload failure modes. Each potential failure mode should be listed along with the method used to determine if the failure has occurred, the list of commands used to attempt a remedy and the method used to determine if the attempted remedy was successful

Unacceptable thermal conditions

We will be able to determine if our payload has entered this fail state because our downlink stream will show that the temperatures are below our bottom limit (243 K) or above our upper limit (313K) because our thermal control system failed. To resolve this issue we would send the OPC Activation command to override the emergency shutdown, or wait for the system to recognize that the temperatures have stabilized.

Unacceptable data
Only one of our OPC's is logged on-board. The power status of all OPC's and the logging status of our on-board OPC is represented in our downlink stream by the 'OPC state' byte. If the value of that goes from 1 to 0 we will be able to tell that our OPC's have lost power or our on-board OPC has stopped logging data. If this happens, we will send the System Reset command to cycle the system and fix the issue.

E. Termination: Provide a list of commands that will be used just prior to the termination of HASP.

OPC Shutdown should be sent at the termination of the flight. This ensures all of the OPCs are shut down properly and that the data they collected will not be corrupted.

III. Recovery, Packing and Shipping Instructions

In this section provide detailed instructions for special handling of your payload during recovery, packing and shipping. These instructions should be as detailed as possible including appropriate pictures and payload labeling. As noted above in the Flight Operations Release, incomplete documentation on your part may lead to inadvertent payload damage or data loss.

A. Recovery Instructions: List any specific recovery instructions including handling of hazardous or critical items such as pressurized containers, electronics, storage devices and /or cameras

The payload contains an expensive LOAC optical particle counter. Care should be taken when handling the payload to mitigate risk of damaging the LOAC OPC. Additionally, nozzles, intake pumps, and exhaust vents from three different OPCs are exposed on one side of the payload. It is important that these components aren't damaged. They can be damaged by dirt intake or from large physical forces.

B. Packing Instructions: Provide instructions on how to pack your payload for shipping.

The payload should first be wrapped with multiple layers of bubble wrap around the height of the payload (the payload should come wrapped in bubble wrap to use). Next, place one of the white foam pads on the bottom of the box and place the payload on top of the foam. When placed in the shipping box (the same box that the payload came in), the two top and bottom cardboard pads should be placed at the top and bottom of the payload- below the mounting plate and against the plate where the mounting wires extrude. After that, place the other white foam pad on top of the payload. Finally, place spare pink foam and bubble wrap around the box to fill in empty spaces and deter the shaking of the box, as in standard shipping practice.

C. Shipping: Provide shipping instructions. Normal payload shipping will not take place until after HASP has been returned to LSU. If you wish your payload to be shipped immediately after recovery you will need to provide a box complete with all shipping paperwork, shipping labels already on the shipping box and packing material used to secure the payload during shipping.

Payload does not need to be shipped immediately after recovery. Please ship payload to:

Prof. James Flaten
107 Akerman Hall
110 Union Street SE
Minneapolis, MN, 55455

A prepaid shipping label will be sent to Dr. Guzik by email.

IV. List of Participants

Provide the full name, e-mail address, phone number and anticipated deployment dates (arrival, departure) for all personnel who will be participating in flight operations at Ft. Sumner, New Mexico. A complete list is required in order to authorize your access to the Ft. Sumner balloon base.

The University of Minnesota does not plan to send anyone to the flight.

HASP Flight Operation Plan
Appendix A

Timeline Prior to Launch Day: HASP flightline operations will typically begin about 1 week prior to the target launch day. During the first five days we will be performing final assembly, detailed system checks and other tasks necessary to prepare HASP for launch. This is the time period when you will have the most access to your payload and the most time to do any last minute pre-launch setup. At about T = - 3 days we will do a final hang test (if necessary) and the Mission Readiness Review (MRR). After the MRR we wait for optimum surface and high altitude weather conditions in order to stage the launch and flight. This wait can last anywhere from a few days to a couple of weeks. Following the MRR access to your payload will be limited as HASP will be in a launch ready condition.

Typical Flight Day Timeline: The following is an example timeline of the sequence of events and approximate times (in hours relative to T=0) that occur on launch day. Your flight operation planning should take this timeline into account.

T = -5.0 **Show:** This is the time when all crew appear at the flight line. Since launch is usually scheduled for 7:30 am, this is around 2:30 am. Final payload preparation should be accomplished prior to pickup.

T = -4.0 **Ready for pickup:** The launch vehicle is mated with HASP and system checks are performed. For most of this period HASP is on line power and the payloads are off. Prior to "pickup complete" the payloads are briefly powered on for a functional test.

T = -3.0 **Pickup complete:** All systems and payloads have been verified to be functional and all payloads are powered down.

T = -2.5 **Roll out to pad:** Weather conditions are checked and the vehicle is authorized to begin the trip to the launch pad. Effort up to this point is fully reversible and, thus, if a scrub occurs it will usually happen at this point.

T = -2.2 **Arrive at pad:** Layout launch line and begin final preparations for launch

T = -2.0 **Switch to HASP internal batteries:** Power down HASP, remove line power and switch to internal flight batteries. Power up HASP and check systems. Configure all payloads for flight. Payloads are powered up for flight shortly before balloon layout is authorized.

T = -1.5 **Layout balloon:** The balloon is unpacked from the shipping crate, attached to the flight train and readied for filling. This is a major milestone in launch operations as it is very difficult (though not impossible) to repack a balloon once it is laid out. Thus, all HASP systems and payloads must be in flight configuration and fully functional prior to this step. As this step implies a commit to launch there can be a delay in authorization if wind and/or weather conditions are problematic.

T = -0.7 **Fill balloon:** Once the authorization to fill the balloon with helium is given, this is very close to a full launch commit. The only option to abort the launch once helium begins to enter the balloon is to cut the balloon from the flight train resulting in irreversible damage to the balloon. Thus, there can be a delay in authorization if wind and/or weather conditions are problematic.

T = 0.0 **Launch:** Self explanatory and usually a fairly impressive sight.

T = 2.0 **Reach float altitude:** The balloon vehicle will climb out at a rate of about 1000 feet per minute and will reach a float altitude around 124,000 feet at about this time.

T = 12.0 **Switch to downrange station:** The balloon will have drifted west and out of line-of-sight range at about this time. The primary telemetry downlink will be switched to the downrange station and data will be returned to Ft. Sumner over the internet.

T = 17.5 **Prepare for termination:** All payloads are configured for flight termination and powered down.

T = 18.0 **Termination:** The balloon is released from the flight train, rapidly free falls to ~90,000 feet when the parachute begin to slow the descent.

T = 18.8 **Landing:** The official end of the flight. Recovery team is already in the field and recovery operations will begin in the morning.

Target Dates: For the current flight year you can use the following target dates in your planning. However, as discussed in the Flight Operations Release the target dates for launch and recovery can be delayed by days or weeks.

Flight Operations Start .... August 2008 (TBD)

HASP MRR .... August 2008 (TBD)

Target Launch Date ....September 2008 (TBD)

Earliest Post-Flight access to payloads ....September 2008 (TBD)

HASP return to LSU ....September 2008 (TBD)