TECHNICAL MEMORANDUM

To: Karen Perez  
Licensing and Evaluation  
FAA Office of Commercial Space Transportation

From: Brian Gulliver  
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Date: October 26, 2020

Subject: Spaceport Camden – Response to Information Request from DoD – SWS Questions

INFORMATION REQUEST FROM DOD

On October 22, 2020, the Federal Aviation Administration (FAA) Office of Commercial Space Transportation facilitated a meeting between Spaceport Camden and the Department of Defense (DoD) Strategic Weapons Systems (SWS) regarding questions connected to a policy review of the Launch Site Operator License (LSOL) application for the proposed Spaceport Camden. Following the meeting, the FAA forwarded the SWS questions to Spaceport Camden. Responses to these questions are provided below:

1. **What analysis has been done to look at probabilities of rocket debris from a failed launch on the pad (i.e. explosion) reaching the SUBASE Kings Bay?**

   An explosive site plan, consistent with the guidelines provided in DOD 6055.09-M “DoD Ammunition and Explosive Safety Standards”, was prepared and included in the LSOL application. Camden County respectfully requests that the FAA share this component of the LSOL application with the DoD.

2. **What mitigations are in place to prevent #1?**

   The explosive site plan contains quantity-distance (QD) arcs for each explosive hazard facility at Spaceport Camden, including the launch pad. The maximum anticipated Public Area Distance (equivalent to the DoD Inhabited Building Distance) at the launch pad is 4,021 ft and includes upland property of Spaceport Camden and adjacent marshland and creeks. The QD arc is located more than 5 miles north of Naval Submarine Base (NSB) Kings Bay. Specific operational and mitigation procedures for on-pad operations will be the responsibility of future launch operators. It should be noted that future launch operators will go through the FAA permitting or licensing process and be required to demonstrate that they satisfy regulator safety and policy requirements.
3. FAA requires risk analysis to determine expected causalities based on population densities and building inhabitance. What analysis has been done for buildings at SUBASE that may house large ordnance rather than just people?

While specific analysis was not completed to analyze ordnance facilities at NSB Kings Bay, flight safety analysis models conducted by Aerospace Corporation demonstrated that with the use of limit lines and Autonomous Flight Safety Systems (AFSS) it is possible to reduce the chance of debris in the vicinity of NSB Kings Bay to near zero.

Flight safety limit lines were utilized in the flight safety analysis to provide safety buffers in the region in and around NSB Kings Bay. The model utilized the limit lines to initiate flight termination if the launch vehicles instantaneous impact point is anticipated to cross the limit line. The flight safety model included various failure modes, including catastrophic on trajectory failures, loss of thrust failures, and malfunction turn failures.

The debris dispersion scatter plot in Attachment A, provided by Aerospace Corporation, is based on a Monte Carlo simulation of 100,000 failures for the representative small launch vehicle on a 100-deg reference trajectory. The scatter plot demonstrates, that while there exists the probability of some inert impacts to exceed the bounds of the limit lines, the inert debris is anticipated to stay well clear of NSB Kings Bay. The range of proposed launch azimuths for Spaceport Camden span from 83-deg to 115-deg. Future launch operators will conduct debris analysis for their proposed launch operations prior to FAA approval within that range of azimuths.

4. Will autonomous flight termination systems (FTS) be required on all rockets? What is the reliability (or probability of failure) value per launch? Is FTS reliability a codified standard/requirement/law?

Prior to conducting launches at Spaceport Camden individual launch operators need to conduct a system safety analysis as part of their vehicle operator license with the FAA. During the system safety review the specific FTS system will be identified and analyzed by the FAA. It is likely that potential future operators may utilize autonomous FTS and/or man-in-the-loop systems.

Camden County does not know the reliability of FTS or codified standards/requirements. Camden County defers to the FAA on how these systems are approved for use.

5. What efforts are being made to mitigate malfunction turns and reduce the probability of malfunction turns towards SUBASE?

Malfunction turns are one of the possible failure modes analyzed in the flight safety analysis. To mitigate and minimize the potential impact that this failure mode has on NSB Kings Bay limit lines are used to initiate flight termination of the vehicle. Spaceport Camden, the FAA, DoD, and future launch operators can collaborate on refining the placement of these limit lines to minimize potential impacts.
6. What is the probability of a rocket experiencing a malfunction turn towards SUBASE Kings Bay combined with a failure of the FTS?

Spaceport Camden does not have a probability of failure value for this scenario. Before a launch operator, with an FTS, obtains a license to operate from Spaceport Camden, the FAA will conduct a system safety analysis of the launch system and FTS, and conduct a policy review with the DoD. This probability question would best be addressed at that time for the specific launch system analyzed.

7. What (if any) backup termination systems are in place in the event of a malfunction turn towards SUBASE Kings Bay and failure of the FTS?

See response to question #6.

8. Are rocket propellants restricted to liquid only, or will solid propellant rockets be launched?

The current LSOL application and Environmental Impact Statement are limited to liquid propellants only. If solid propellants were to be considered in the future, an amendment to the license application and updated environmental review would be required.

9. What mitigations are in place to prevent liquid fuel from raining down on SUBASE in the event of a flight failure?

See response to question #3.

10. Is Camden ready to handle (i.e. “foot the bill” for) additional requirements levied on them to preclude or mitigate launch failures?

Camden County will comply with all requirements imposed by the FAA and expects to work closely with the Department of Navy to ensure all operations carried out from Spaceport Camden are safe and in compliance with all local, state and federal requirements.

11. How will changes in spaceport operation scope (increase in number of launches, increase in size of rockets, addition of reusable first stages, etc.) be codified and routed to SSP for mishap risk acceptance review?

If Spaceport Camden was to propose changes to the spaceport operations scope, beyond what was included in the LSOL application, a site license amendment would be required. This process would require additional FAA approval and would result in an additional policy review with the DoD. Additionally, if desired, consideration of proposed operational limit increases could be rolled into a local area operating agreement between SWFLANT and Camden County.
ATTACHMENT A
Impacts for 100-deg Reference Trajectory (100,000 failure cases)