EXHIBIT C

LAUNCHER INC. RECONTACT ANALYSIS FOR ORBITER SN3 SPACECRAFT

Orbiter SN3 Long-Term Recontact Analysis

Revision 1.0

1. Introduction

The Launcher Orbiter SN3 spacecraft will launch aboard SpaceX's Rideshare Transponder-8 mission scheduled for June 2023. The Falcon 9 launch vehicle will deploy Orbiter SN3 to a planned 525 +/- 25 km altitude, sun-synchronous orbit.

At least one week after separating from Falcon 9, Orbiter SN3 will deploy four payloads in four deployment events. Three payloads are cubesat form-factor satellites deployed in three deployment events from a TRL11 cubesat deployer. The payloads are integrated into the deployer's forward mounting plate. For the third and final deployment, the fourth deployed payload is a microsatellite that will perform proximity operations with Orbiter SN3. Three hosted payloads and one non-deploying mass simulator will remain permanently attached to Orbiter SN3.

This report presents the probability of recontact or conjunction for the Orbiter SN3 spacecraft and its deployed payloads over a two-year time period.

2. Methodology

Launcher estimated Orbiter SN3's payload recontact risk using Launcher's proprietary six degree of freedom simulation. This approach simulates payload, deployer, and Orbiter SN3 dynamics and control systems. Launcher based the appropriate system performance and properties distributions on vendor and customer inputs as well as Launcher's simulation, analysis, and testing. The following analysis presents the Orbiter SN3 performing deployments in as-planned deployment orientations which will eject each payload with a specific velocity relative to the spacecraft to the orbit radial, along-track, and cross-track (or RSW) frame. The following analysis also contemplates the current deployment plan and order. Launcher will repeat the procedure for the final Orbiter SN3 deployment plan to ensure that the expected recontact risk for the plan, as performed, is equal or better than this analysis.

Launcher conducted 3,000 simulations covering the deployment events and simulating the spacecraft and payload dynamics forward for a 10-day duration. Launcher continuously calculated the distances between the Orbiter SN3 spacecraft and its payloads and the payloads with each other during the simulation time. Local minimums in these distances were logged as “returns,” logging return time, return distance of closest approach, and return relative velocity. Launcher defined a recontact event as a body center to center distance of 10 m. It is conservative because the Orbiter hardbody is ~0.6 m, and the largest deployable payload radius is ~0.4 m. Using 10 m as the recontact threshold provides a 900% margin. The probability of a recontact event is then calculated by counting the number of recontact events proportional to the number of simulations. If all return distances are greater than this radius and no recontact events are observed, probability of recontact can be predicted to be between 1/3000 and 0/3000.

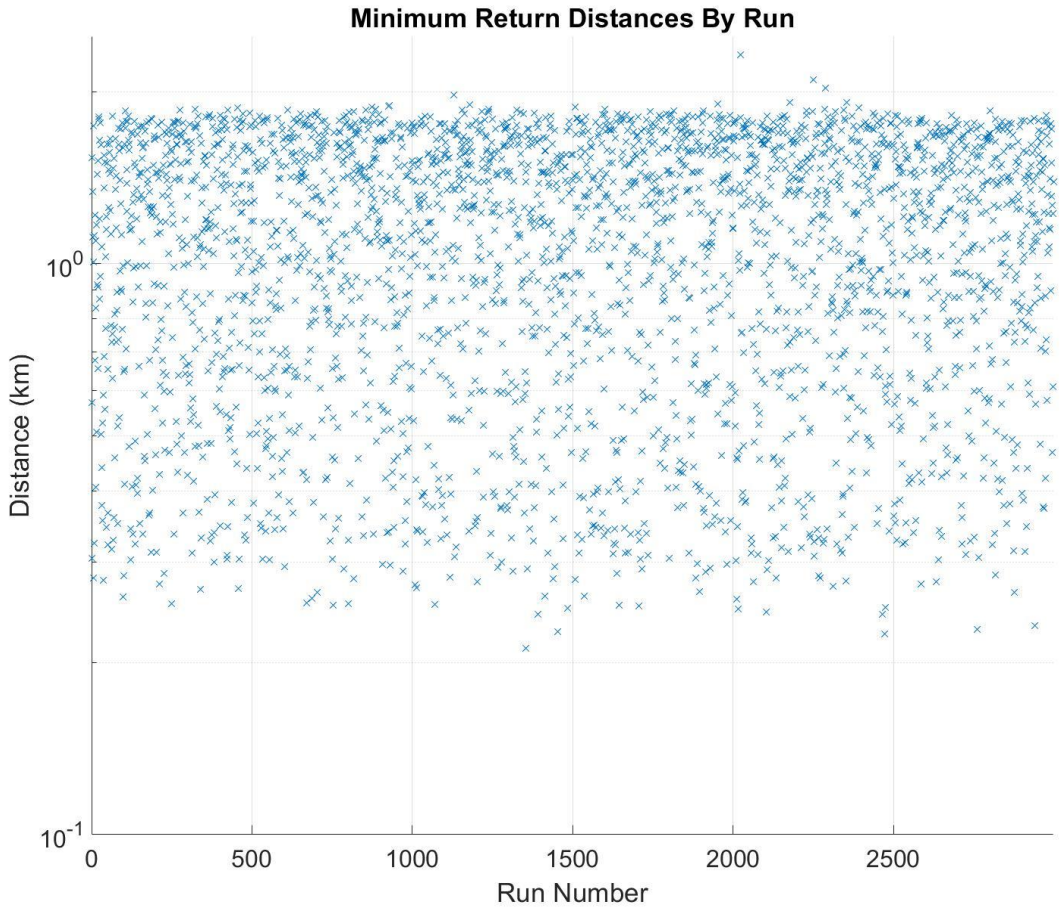

Figure 1: Minimum observed return distances for a 3000-simulation, 10-day Monte Carlo analysis on a log10 scale.

Of the 3000 simulations conducted, none presented a significant recontact risk to Orbiter SN3 with its payloads or the payloads with each other. The minimum return distance simulated between all objects was 211 meters, and the median return distance was 1323 meters. As no recontact events were observed, the recontact risk is assumed to be equal to the most conservative estimate, 1/3000 or 3.33×10^{-4}. However, the fact that the worst return case observed has a minimum return distance an order of magnitude higher than the recontact event radius suggests that the true recontact risk is significantly lower. Additionally, all minimum return distances observed were calculated to have a return relative velocity less than 2 m/s. Collisions at these velocities may cause minor damage to the colliding objects, but significant debris generation from a potential recontact is unlikely.

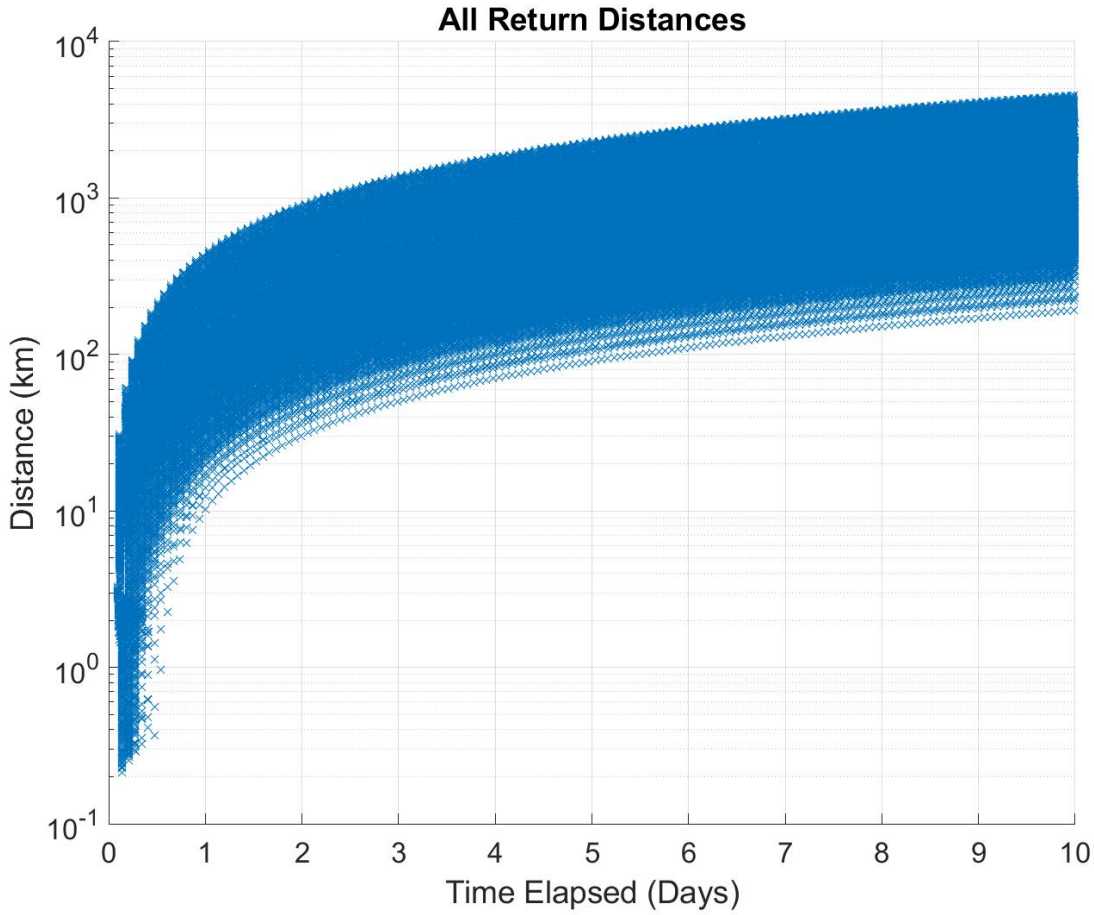

Figure 2: All observed return distances for a 3000-simulation, 10-day Monte Carlo analysis plotted as function of mission elapsed time.

Based on Figure 2, the return distances for all objects increase with separation time. This result is expected as the Orbiter SN3 mission deployment plan intentionally will inject each payload into an orbit with a period different to Orbiter SN3 and different to all other payloads. After initial deployment, the mean orbital motion of each object will increase the separation distance with all other objects with time until differential drag, radiation pressure, and orbital perturbations move individual objects into different altitudes, inclinations, and RAANs, further increasing separation. As a result, the risk of object recontact per unit time for the remaining 2-year period will be equal or better than that observed at the end of the 10 day simulation period.

Additionally, Orbiter SN3 and one payload have the capability to perform conjunction avoidance maneuvers with the Orbiter SN3 mission payloads and other resident space objects. This possibility allows the recontact risk for these maneuverable spacecraft to drop near zero for the duration of their nominal missions, assuming nominal object tracking, communication, and control capability is maintained.

3. Conclusions

Launcher estimates that the probability of recontact for the Orbiter SN3 and maneuvering payloads to be near zero due to the low probability of recontact during initial deployment and ability to perform conjunction avoidance maneuvers during their missions. For non-maneuvering payloads, Launcher's analysis demonstrates that the probability of recontacting with other non-maneuvering objects is less than 3.33×10^{-4}.