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DATE: October 20, 2023

FROM: Gary P. Barnhard
DOGE-1 Program Manager
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
Under contract with Geometric Energy Corporation (GEC)
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TO: Douglas Young, FCC Experimental Radio Application Review File Manager

SUBJECT: Correspondence Reference Number: 80842,

Dear Mr. Young:

In correspondence Reference Number 80842, dated 10/4/2023, the question was posed: "How long does it take DOGE-1 satellite to reach the Lunar Orbit from the date of launch?". The suspense date given was within 30 days of receipt. Our timely answer is as follows.

We estimate that the DOGE-1 satellite will reach a tractable Lunar Orbit within three (3) months of the date of launch.

The actual time to reach a lunar orbit must necessarily be based on detailed trajectory calculations, which are heavily dependent on the time of launch, the release timing, the resulting release state/velocity vectors, and the duty cycle that we can sustain for the DOGE-1 propulsion system. Until the launch actually occurs, the DOGE-1 spacecraft is deployed, and SpaceX provides us with the resulting release state/velocity vectors, the estimated time cannot be meaningfully improved. Furthermore, our twin propulsion systems do not have any Technology Readiness Level 9 data that directly matches the DOGE-1 use profile. However, once we are provided the necessary data from SpaceX, our detailed trajectory model in the ANSYS System Tool Kit (STK) will be updated, and the resulting solution space optimizing the propulsion system duty cycle, the achievable lunar orbit, and the time to achieve the same will be analyzed on an ongoing basis.

That said, we know we will be deployed on a Geosynchronous Transfer Orbit trajectory subject to a final lunar trajectory insertion maneuver, which the SpaceX Falcon rocket will perform. We will use an alternate minimum energy trajectory (i.e., ballistic trajectory, Weak Stability Boundary (WSB) transition trajectory). There are two general manifolds of these trajectories:

1. Earth - Moon WSB transition trajectory manifold
2. Sun - Moon WSB transition trajectory manifold

Of the two options, the first is the baseline because the desired time to reach lunar orbit is anticipated to be less than three (3) months for the defined solution space.
As noted previously, the ability to achieve the same heavily depends on the time of launch, the release timing, the release state vectors, and the duty cycle that we can sustain for the DOGE-1 propulsion system.

What we intend to do is, given the best available answers to the above variables and the range of desirable orbits, we will begin calculating the entrance to the WSB trajectory manifold that our spacecraft can reach.

We will continue to iterate and recurse the calculations until we have a non-null solution space that minimizes the time to reach a satisfactory and sufficient lunar orbit.

Attached is a brief produced by NASA that analyses a range of similar, if not identical, trajectories. In an abundance of caution, since NASA applied for and was granted a patent for an orbital trajectory set that is strikingly similar, if not for all intents and purposes effectively identical, to the orbital trajectory solution for which XISP-Inc holds prior art XISP-Inc has reached out to NASA to:

(1) Preempt any potential finding of patent infringement by applying for a license for the same, formally documenting the XISP-Inc prior art.
(2) Establish a cooperative, if not collaborative, relationship with NASA to further develop the trajectory analysis for DOGE-1 and subsequent missions that may seek to use similar trajectory solutions.

This brief fits well with the DOGE-1 as a lunar rideshare payload on the IM-1 flight or any other similar flight with a lunar orbit as a destination from a Geostationary Transfer Orbit trajectory should DOGE-1 be manifested to a later flight.

If our detailed calculations result in a null solution space using an Earth-Moon WSB transition manifold, we will use a Sun-Moon WSB transition trajectory manifold which will significantly increase (likely to double) the time to reach a useful lunar orbit.

Thank you very much for your attention to this matter. Please direct any questions concerning the same directed to Gary P. Barnhard, via email at gary.barnhard@xisp-inc.com.

October 20, 2023

Gary P. Barnhard
President & CEO XISP-Inc

Date

Attachment: NASA ARC-17743-1, TOP2-272
CC; sam@geometricenergy.ca