Hogan Lovells

Hogan Lovells US LLP
Columbia Square
555 Thirteenth Street, NW
Washington, DC 20004
T +1 202 637 5600
F +1 202 637 5910
www.hoganlovells.com

April 15, 2019

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street S.W.
Washington, D.C. 20554

Re: Hiber, Inc., Supplement to Orbital Debris Assessment Report
IBFS File No. SAT-PDR-20180910-00069; Call Sign S3038

Dear Ms. Dortch:

Hiber, Inc. ("Hiber"), through its counsel, submits the attached supplement in response to several International Bureau questions regarding the company's orbital debris assessment report ("ODAR").

If you have any questions regarding the supplement, please do not hesitate to contact me.

Very truly yours,

/s/Tony Lin

Tony Lin
Counsel to Hiber, Inc.

cc: Samuel Karty
Sankar Persaud
Alyssa Roberts

Supplement to Orbital Debris Assessment Report

1. Will satellites 3-24 be on dedicated launches to achieve a given orbit?

It is anticipated that satellites 3-24 will be launched on both dedicated and shared-ride launches and inserted at altitudes between 510 and 700 km. After insertion, Hiber will maneuver the satellites to approximately 600 km, utilizing the propulsion module planned for these satellites.

2. Is the 600km given in the documentation the upper limit?

Yes, currently 600 km is the target nominal operational orbit for satellites 3 to 24. If Hiber changes this altitude in the future, Hiber will seek all necessary approvals.

3. Please confirm if the orbits for satellites 3-24 will NOT be maintained.

The orbits of the satellites will be maintained utilizing the propulsion system. The propulsion system will be used to reach the correct altitude and mean anomaly after ejection from the launcher, to phase satellites on the same orbit plane, to maintain the satellites at approximately 600 km during their operational lifetime, to effectuate any necessary collision avoidance maneuvers, and finally to accelerate the satellite's decay time at end-of-life ("EOL").

4. Are there any plans to use any remaining fuel (fuel not used for avoidance) for orbit lowering at EOL?

Hiber plans on retaining fuel (55 m/s) to lower the orbit's perigee at EOL from 600 to 400 km.

Collision probabilities were computed in the case of a successful de-orbiting at EOL and also in the case of a propulsion failure:

A. Orbit evolution

Time	Case	Successful De-orbiting	Propulsion Failure
	Lifetime	0.95y	11.02y
2023	Semi-major axis (km)	6878	6978
	Eccentricity	0.0145	0.001165
	Inclination (°)	97.8	97.8
	RAAN (°)	191.46	191.46
	Arg. Of perigee (°)	114.04	114.04
2024	Semi-major axis (km)		6961.35
	Eccentricity		0.00118
	Inclination (°)		97.8
	RAAN (°)		192.77
	Arg. Of perigee (°)		112.86
2025	Semi-major axis (km)		6947.07
	Eccentricity		0.001195
	Inclination (°)		97.79
	RAAN (°)		196.74
	Arg. Of perigee (°)		50.98
20	Semi-major axis (km)		6938.48

	Eccentricity		0.00121
	Inclination (°)		97.77
	RAAN (°)		202.27
	Arg. Of perigee (°)		135.90
2027	Semi-major axis (km)		6933.43
	Eccentricity		0.001215
	Inclination (°)		97.75
	RAAN (°)		208.19
	Arg. Of perigee (°)		78.21
2028	Semi-major axis (km)		6930.54
	Eccentricity		0.00122
	Inclination (°)		97.73
	RAAN (°)		213.68
	Arg. Of perigee (°)		90.03
2029	Semi-major axis (km)		6928.37
	Eccentricity		0.001225
	Inclination (°)		97.7
	RAAN (°)		218.29
	Arg. Of perigee (°)		98.29
2030	Semi-major axis (km)		6926.28
	Eccentricity		0.001225
	Inclination (°)		97.67
	RAAN (°)		221.84
	Arg. Of perigee (°)		47.18
2031	Semi-major axis (km)		6922.51
	Eccentricity		0.001225
	Inclination (°)		97.63
	RAAN (°)		224.31
	Arg. Of perigee (°)		112.46
2032	Semi-major axis (km)		6908.57
	Eccentricity		0.001225
	Inclination (°)		97.60
	RAAN (°)		226.54
	Arg. Of perigee (°)		53.97
2033	Semi-major axis (km)		6867.34
	Eccentricity		0.001225
	Inclination (°)		97.55
	RAAN (°)		231.68
	Arg. Of perigee (°)		105.28
2034	Semi-major axis (km)		6642.38
	Eccentricity		0.0015
	Inclination (°)		97.49
	RAAN (°)		249.69
	Arg. Of perigee (°)		94.31

Table 1: Orbit Evolution

B. Collision probability

Year	Successful	Propulsion

	De-orbiting	Failure
2023	0.1641 x 10-4	0.3357 x 10-4
2024		0.2391 x 10-4
2025		0.2001 x 10-4
2026		0.2166 x 10-4
2027		0.3857 x 10-4
2028		0.2835 x 10-4
2029		0.2553 x 10-4
2030		0.2597 x 10-4
2031		0.2410 x 10-4
2032		0.2100 x 10-4
2033		0.2103 x 10-4
2034		0.1228 x 10-5
Total	0.1641 x 10-4	2.84928 x 10-4

Table 2: Per Satellite Lifetime Collision Probability

Note: It is assumed that during the mission, the propulsion module will allow for any avoidance maneuver, and therefore the collision probability during the mission will be 0. If during the mission, the module fails, then this case will be equivalent to the one where the module fails at EOL: the satellite will be at 600 km and will naturally decay. Thus, the collision probability in the case of a propulsion module failure during the mission or at EOL will be the same.

Calculating these probabilities for satellites 3 to 24, the total collision probabilities are as follows:

# Propulsion Failures	0	1	2	3
Total Collision Probability	0.00036	0.00063	0.00090	0.00117

Table 3: Aggregate Lifetime Collision Probability for Satellites 3 to 24

To calculate the aggregate collision probability for the entire Hiber system, the collision probability for Hiber-1 and Hiber-2, respectively 0.8199 x 10-4 and 2.3454 x 10-4, must be included, as follows:

# Propulsion Failures	0	1	2	3
Total Collision Probability	0.00068	0.00095	0.00121	0.00148

Table 4: Aggregate Lifetime Collision Probability for Entire Hiber System

With a propulsion failure rate of 1/22 or less, the aggregate lifetime collision probability of the entire 24 satellite system will be under the 0.001 threshold. A failure rate of 1/11 or higher will result in a collision probability for the system that is higher than the 0.001 threshold.

However, a failure rate of 1/11 or higher seems unlikely; the propulsion module Hiber will use in its satellites is developed in partnership with Dawn Aerospace and Hyperion Technologies, which have extensive experience in this field. The propulsion module is derived from a design with flight heritage. Additionally, the European Space Agency is a contributing partner in the development of the propulsion module, further demonstrating the technical expertise and resources supporting the project.

5. Once the satellites are put into EOL configuration, can they still be commanded for reliable propulsive maneuvers?

Once at EOL, the satellites can be commanded for reliable propulsive maneuvers provided that the necessary systems are still operational (propulsion module, EPS, OBC, TTC).

Technical Certification

I, Maarten Engelen, hereby certify that I am the technically qualified person responsible for the preparation of the engineering information contained in the foregoing supplement to the orbital debris assessment report of Hiber, Inc. I have either prepared or reviewed the engineering information submitted in the supplement, and it is complete and accurate to the best of my knowledge and belief.

Maarten Engelen
Program Executive/Project Manager
Hiber, Inc.

Dated: April 15, 2019