August 14, 2020

Momentus Inc.
3050 Kenneth Street
Santa Clara, CA 95054

Jose P. Albuquerque
Chief, Satellite Division
International Bureau
Federal Communication Commission
Washington, D.C. 20554

RE: Commission Request Responses, Momentus Inc., IBFS File NO: SAT-STA-20200609-0068

Dear Mr. Albuquerque:

Please find below the Momentus Inc. ("Momentus") responses to your July 23, 2020 letter requesting additional information:

Commission Item #1:
Momentus seeks waiver of section 25.113(g), which requires approval for orbital deployment and a station license before a space station may be deployed and operated in orbit. We ask that Momentus provide responses to Form 312 Main Form, Application for Satellite Space Station Authorizations, Questions 29-34 and 36-40.

Momentus Answers:

Section 310(b)(4) of the Communications Act of 1934, as amended, establishes certain limitations on indirect foreign ownership and voting of certain common carrier and broadcast licensees. By definition, these limitations do not apply to the non-broadcast, noncommon carrier operations of Momentus proposed in this application.

- Question 29: NO
- Question 30: N/A. See discussion above.
- Question 31: N/A. See discussion above.
- Question 32: N/A. See discussion above.
- Question 33: N/A. See discussion above.
- Question 34: N/A. See discussion above.
- Question 36: NO
- Question 37: NO
- Question 38: NO
- Question 39: NO

- Question 40: See attached Exhibit 1

Commission Item #2:
Please clarify when during the mission the customer spacecraft will be deployed. The Narrative at p.4 states that the deployment will occur following orbital insertion, but the Narrative at p.5 and the ODAR state that the deployment will occur following orbit raising to (maximum) altitude of 570 km.

Momentus Answer:
The Narrative is correct. Customer spacecraft will be deployed after orbital insertion and prior to any orbit raising maneuvers. The revised ODAR, attached here as Exhibit 2, corrects the misstatement.

Commission Item #3:
The Narrative states that the earth station operator Leaf Space may be planning to add additional ground stations in the U.S. Would these be utilized for communications with VR-1, if they become available?

Momentus Answer:
No.

Commission Item #4:
Momentus has requested an STA for a period of 180 days. Will Momentus be communicating for the full 180 days using the requested frequency bands – and will any portion of this time be after the perigee has been lowered to 300 km altitude? In other words, will the period of spacecraft disposal that follows the lowering of the perigee to 300 km begin before the 180-day mark, and if so, will telemetry, tracking, and command communications continue for any portion of that period?

Momentus Answer:
Yes, Momentus will be communicating on the requested frequency bands, as necessary, for the full 180 days. Yes, it is possible that some portion of the 180 days will include time when VR-1 has a perigee lower than 300 km. For clarity, spacecraft disposal - i.e., the period of time following the lowering of perigee to 300 km - is planned to begin prior to the 180-day mark. Yes, to the extent possible, Momentus will continue to conduct TT&C communications during the period when the perigee of VR-1 is below 300 km.

Commission Item #5:
The ODAR at p.17 states that Momentus will ensure "real time collision avoidance and orbital maintenance maneuvers." Will the VR-1 reserve fuel for conducting avoidance maneuvers during the planned orbit raising and subsequent lowering of the perigee to 300 km altitude? If so, what type of reserve would be expected to remain? Related to the question above, would the VR-1 retain fuel for conducting collision avoidance during the period of spacecraft disposal that follows lowering the perigee to 300 km, to the extent that communications with the spacecraft are maintained?

Momentus Answer:
Yes, the VR-1 will operate with an approximately 18% margin of propellant, in addition to the propellant necessary to achieve the operational concept (including lowering of perigee to 300 km at end of mission). Momentus contemplates that this reserve will serve as support for all contingencies during the VR-1 mission, including orbital debris avoidance maneuvers. To clarify, the VR-1's capacity for "real time collision avoidance and orbital maintenance maneuvers," is constrained by the availability of uplink and downlink opportunities and thus such maneuvers may not be available in real time during those parts of

orbit that are outside of ground station range. The amount of reserve remaining following an orbital debris avoidance maneuver would depend on the nature and duration of the avoidance maneuver. Anecdotally, however, a single kg of propellant can power many kilometers of orbital adjustment. Additionally, there is historical evidence that collision avoidance maneuvers are rare, and conjunction avoidance is usually accomplished with orbital adjustments of less than 1 km. Accordingly, Momentus expects to have sufficient propellant reserves to conduct multiple contingency operations, including during spacecraft disposal.

Commission Item #6:

The ODAR shows inputs to the NASA Debris Assessment Software (DAS) of masses that do not match the values indicated earlier in the application. The DAS shows 174 kg (initial) 145 kg (final) mass, while Table 2 on p. 8 shows 167.9 kg (total) to 161.8 kg (dry). Please address the discrepancies.

Momentus Answer:

Attached here as Exhibit 2, please find an updated ODAR, created using DAS 3.1.0 software. Additionally, the updated ODAR, corrects the discrepancy in the initial, final and dry masses and uses the most-up-to-date values for the propellant mass and customer payload masses (+ 0.1 kg and + 2.8 kg, respectively). The updates do not result in any material changes in the ODAR. .

For completeness, below is a list of the differences in the initial ODAR and updated ODAR:

1. Requirement 4.5-1 included a Critical Surface analysis, which was not required in DAS 2.1.1. The result of this requirement assessment remained unchanged: compliant, passed.

2. The Diaphragm Tank physical properties were updated to more accurately reflect the available DAS options.

3. The Summary Analysis Results changed. The DAS 2.1.1 assessment showed three VR-1 components may survive re-entry. The DAS 3.1.0 assessment shows six VR-1 components may survive re-entry. However, in each case, impact energy remains less than 15 joules.

4. The Table 2. General Spacecraft Description data was updated from 167.9 kg total launch mass, including 6.1 kg of propellant and 16.2 kg of planned deployable payloads to 161 kg total launch mass, including 6 kg of propellant and 19 kg of planned deployable payloads.

Commission Item #7:

The ODAR casualty risk assessment indicates that there may be surviving debris but that the impact energy of any surviving piece of debris is less than 15 joules. This analysis uses an older version of DAS – v.2.1.1, and re-entry modeling has been updated for the DAS 3.0 software. Please provide analyses either using the newer version or, alternatively, provide the material compositions and initial masses of the objects expected to survive reentry.

Momentus Answer:

Please see Exhibit 2 for the requested updated analyses. As demonstrated in the updated ODAR, there are no material changes and the calculated impact energy of any surviving piece of debris remains below 15 joules. See also the response to Item #6.

Commission Item #8:

Please clarify whether the casualty risk assessment in the application includes a scenario in which mass dummies would remain on board the spacecraft for atmospheric re-entry. If not, please provide a casualty risk analysis for a worst-case scenario where all customer spacecraft are replaced with mass dummies. This analysis would take into consideration the material expected to be used for the mass dummies.

Momentus Answer:

Yes, the casualty risk assessment in the application includes a scenario in which mass dummies would remain on board the spacecraft throughout the mission and during re-entry. The same worst-case scenario analysis is reflected in the updated ODAR attached here as Exhibit 2. The mass dummies will be composed of aluminum and designed for demise.

Commission Item #9:

The application states that Momentus is aware of the requirement to obtain a commercial remote sensing license. What is the current status of this application process?

Momentus Answer:

Under the new commercial remote sensing regulations, Momentus understands that it is not required to obtain a license. *See* 15 C.F.R. § 960.2(b). Momentus recently spoke with representatives from the commercial remote sensing organization at NOAA and submitted a letter seeking confirmation of that conclusion. NOAA responded to this letter asking for Momentus to submit a complete commercial remote sensing license application as a predicate to further consideration for the request to confirm no license is required. If the Momentus request to confirm the new commercial remote sensing regulations is denied by NOAA, Momentus will apply for a NOAA license.

Commission Item #10:

Please indicate whether the electromagnetic emissions of the VR-1 thruster would exceed 15 uV/m at a distance of 300 meters.

Momentus Answer:

The electromagnetic emissions of the VR-1 thruster would NOT exceed 15 uV/m at a distance of 300 meters. Our calculations indicate the thruster is expected to produce electromagnetic emissions at levels less than 10 uV/m at a distance of 300 meters.

Commission Item #11:

The antenna gain contours provided do not show gains in 2 dB steps to 10 dB below max gain. Please provide antenna gain contours for transmit and receive antenna beams in accordance with the above.

Momentus Answer:

Attached here as Exhibit 3, please find antenna gain contours for transmit and receive antenna beams showing, in 2 dB steps, to 10 dB below max gain.

Commission Item #12:

The Schedule S provided does not include peak gain values for the transmit and receive beams. Please provide this information.

Momentus Answer:

The peak gain value for the transmit beam is 5.15 dB. The peak gain value for the receive beam is 6 dB.

If you require any further information related to this application, please contact Philip Hover-Smoot at 415.254.1295 or via phhs@momentus.space.

Very Respectfully,

Philip Hover-Smoot
Chief Ethics & Compliance Officer
Momentus Inc.

Attachments: 1) Exhibit 1 – Momentus Ownership Information
2) Exhibit 2 – Momentus ODAR (Revised)
3) Exhibit 3 – Momentus VR-1 Antenna Gain Contours at 2 dB Steps

CC: Merissa Velez