Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
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Space Sciences & Engineering LLC, d/b/a PlanetiQ	)	File No. _____
	)	
	)	
Application for Authority to Launch and Operate a Non-Geostationary Satellite Orbit System to Provide Radio Occultation Services	)	

APPLICATION

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APPLICATION

Space Sciences & Engineering, LLC, a subsidiary of Global Weather & Climate Solutions, Inc., d/b/a PlanetiQ ("PlanetiQ") requests authority to launch and operate the GNOMES system consisting of two spacecraft, GNOMES-10 and GNOMES-11. The two spacecraft are identical satellites operating in different orbits. These are non-geostationary orbit ("NGSO") satellites in low-Earth orbit ("LEO"), conducting Radio Occultation ("RO") for the purpose of weather forecasting and space weather forecasts and analyses. This application is submitted under the Commission's Part 25 streamlined licensing procedures governing small satellites.[1] A completed Form 312, Schedule S, Technical Narrative, Orbital Debris Assessment Report ("ODAR"), Ownership Information, and ITU Cost Recovery letter are included with this application.

[1] 47 C.F.R. § 25.122; *see also Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86, *Report and Order*, 34 FCC Rcd 13077 (2019) ("*Streamlined Processing Order*").

I. Background and System Description

PlanetiQ is a Colorado-based company. PlanetiQ plans to sell data products collected from its spacecraft through its RO activity to government customers and commercial parties.

Although this application covers only two spacecraft, PlanetiQ intends to operate in the future a constellation of GNSS[2] Navigation and Occultation Measurement Satellites ("GNOMES"). Two initial, experimental GNOMES have been successfully launched,[3] and both have been decommissioned. PlanetiQ's commercial satellites, GNOMES-4 and GNOMES-5, are currently on-orbit generating RO data.[4] The GNOMES satellites at issue here are scheduled to launch no earlier than October 2026.

Through the GNOMES constellation, PlanetiQ aims to significantly improve weather forecasting, numerical weather prediction ("NWP") models, and space weather forecasts and analyses. To achieve this vision, PlanetiQ has designed a GNSS-RO instrument, Pyxis, which delivers the highest level of performance in a microsatellite spacecraft form factor. This approach enables satellites carrying state-of-the-art instrumentation to be placed into and operate in LEO, dramatically increasing the combined quality and quantity of GNSS occultations assimilated in each NWP and space weather update cycle.

PlanetiQ has an IDIQ contract with the National Oceanic and Atmospheric Administration ("NOAA") for the provision of RO data and has delivered operational data to

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[2] GNSS is an abbreviation for global navigation satellite system, which are satellite systems that provide radio-navigation satellite service or RNSS.

[3] *See* Grant, File No. 0734-EX-CN-2021 (granted March 2, 2022); Grant, File No. 0504-EX-CN2020 (granted November 6, 2020).

[4] *See* Stamp Grant, PlanetiQ, ICFS File No. SAT-LOA-20220921-00113 (granted November 6, 2023) ("GNOMES-4 Grant").

NOAA under this contract.[5] PlanetiQ has also won an IDIQ contract from NASA for our GNSS_RO data for research for climate and future weather forecasting improvement.[6]

These contracts are in furtherance of legislative mandates from the Weather Research and Forecasting Innovation Act of 2017 to improve U.S. weather forecasting capabilities and assess the viability of using commercial RO data to support NOAA's weather forecasting mission[7] and NASA's Commercial Smallsat Data Acquisition Program for Climate and Earth Science research. The collection of such data is critical to weather forecasting and climate monitoring, and having more sources of data helps improve such efforts and sustains the long-term supply of data vital to forecast accuracy. Traditionally, the government and taxpayers have borne the entire burden of funding and managing the development, launch, and daily operations of these vital satellites. PlanetiQ is partnering with governments to implement a new commercial model. By leveraging private funds to fly new satellite systems quickly and at lower cost, with less risk to governments worldwide, public, and private stakeholders can work together to sustain and increase collection of the data required to protect lives, property, and economies. Through such a public-private partnership, spacecraft development and launch are privately funded, with no up-front costs or deployment risk for the government, which pays only upon delivery of data. This shifts the burden of satellite development, launch and operations to the private sector, which benefits taxpayers and frees government resources needed for science, research, and other core missions such as improved weather and climate modeling. This model allows new and emerging

[5] The federal contract ID number is 1332KP23DNEEP0001.

[6] *See* NASA Selects Commercial Smallsat Data Acquisition Contractors (October 2, 2023), https://www.nasa.gov/news-release/nasa-selects-commercial-smallsat-data-acquisitioncontractors/.

[7] *See* Weather Research and Forecasting Innovation Act of 2017, P.L. 115-25 (April 18, 2017) (directing NOAA to obtain commercial weather data from private sector providers).

technologies to make it to orbit for evaluation much faster than is typically possible with government systems and procurements, improving the impact of data and spawning derivative products and applications. A public-private partnership for weather and environmental satellite data provides numerous benefits for government, end users, and taxpayers. For these reasons, PlanetiQ submits that grant of this application is in public interest and requests FCC action in time to allow PlanetiQ to launch the GNOMES system by October 2026.

A. Space Segment

As discussed in the Technical Annex,[8] the GNOMES system will use S-band frequencies (2025-2110 MHz) for primary data and TT&C uplinks and X-band frequencies (8025-8400 MHz) for primary data and TT&C downlinks.

PlanetiQ is the mission developer and owner and has contracted with Muon Space for a spacecraft with details as follows. The GNOMES system is expected to be launched into and operate in the following orbits:

GNOMES-10 will be deployed into a near-circular SSO orbit (current estimate is LTDN 22:30, RAAN of 157.6) at an altitude between 510+/-20 km, with an inclination of 97.6 +/-0.5 degrees. After completion of on-orbit commissioning, the spacecraft will maneuver, as required, to its nominal operational orbit at 575 ± 25 kilometers altitude and approximately 97.6 degrees inclination. PlanetiQ plans to perform system commissioning at the injection altitude. The commissioning period is expected to be less than 1 month.

GNOMES-11 is expected to be deployed into a near-circular orbit at an altitude between 500 and 600 +/-20 km, with an inclination of 53 +/-0.1 degrees, and a placeholder RAAN of 160 degrees to be finalized closer to launch. After completion of on-orbit commissioning, the

[8] *See* Exhibit C.

spacecraft will maneuver, as required, to its nominal operational orbit at 575 ± 25 kilometers altitude and approximately 53 degrees inclination. PlanetiQ plans to perform system commissioning at the injection altitude. The commissioning period is expected to be less than 1 month.

The GNOMES system will conduct routine mission operations in its nominal operational orbit for a planned total mission life of six years (from launch to demise). The spacecraft is equipped with propulsion sufficient to support collision avoidance, orbit maintenance, and post-mission disposal activities. At the conclusion of the operational mission, propulsion will be used to lower the spacecraft to approximately 380 km to initiate atmospheric drag-assisted deorbit. The GNOMES system will continue operating during the deorbit phase down to approximately 350 km altitude, after which rapid orbital decay and re-entry will occur.

B. Ground Segment

The atmospheric soundings measured by the GNOMES system will be downlinked via commercial ground station networks. At present, PlanetiQ intends to work with Kongsberg Satellite Services (KSAT), and Leaf Space for use of the ground station networks specified in the Technical Annex.

The company may expand its future ground station network to include stations inside and/or outside the United States for the purposes of increasing opportunities for data transmissions. The company will coordinate all such ground stations, including non-U.S. ground stations, with Federal operators in the relevant bands prior to operating any such stations and

requests authority for such communications subject to coordination with relevant Federal operators.[9]

II. Frequency Use and Spectrum Sharing

A. S-band/X-band Frequencies

As discussed further in the Technical Annex, the GNOMES system will operate communications links with the frequency parameters specified below in Table 1:

	Center Frequency (MHz)	Bandwidth (kHz)	Data Rate(s)
2025-2110 MHz	2062.20 (TT&C uplink)	280	100 kbit/s
2025-2110 MHz	2062.65 (High speed uplink)	620	990 kbit/s

Uplink Parameters

Frequency Band	Center Frequency	Bandwidth (MHz)	Data Rate(s)
8025-8400 MHz	8385.00 (TT&C downlink)	2.80	500 kbit/s
8025-8400 MHz	8390.00 (TT&C downlink)	2.80	500 kbit/s
8025-8400 MHz	8175.00 (High speed downlink)	48.0	19-100 Mbit/s

Downlink Parameters

Table 1: *Proposed Frequency Parameters*

The S-band (2025-2110 MHz) and X-band (8025-8400 MHz) frequency bands each have allocations for Earth Exploration-Satellite Service ("EESS") use. Specifically, the 2025-2110 MHz (Earth-to-space) band is allocated internationally and in the U.S. for non-Federal EESS use, subject to conditions as may be applied on a case-by-case basis and the limitation that any use

[9] *See, e.g.*, GNOMES-4 Grant at Condition 6 ("PlanetiQ shall provide the FCC with an updated list of coordinated non-Federal earth stations within ten business days following any changes to this list.").

may not cause harmful interference to authorized Federal and non-Federal operations.[10] The 8025-8400 MHz (space-to-Earth) band is allocated internationally and in the U.S. for non-Federal EESS use on a primary basis.[11]

Radio occultation is a remote sensing technique used for measuring the physical properties of the atmosphere.[12] Specifically, it relies on the detection of a change in a radio signal as it passes through a planet's atmosphere, *i.e*., as it is occulted by the atmosphere. Accordingly, the RO service proposed by the GNOMES system meets the definition of EESS because the satellite will observe and analyze data derived from signals passing through the Earth's atmosphere.[13] Further, this data will be used for weather forecasting, NWP modeling, and space weather forecasts and analyses, all of which is consistent with EESS activities. Accordingly, use of these frequency bands is consistent with the international and domestic EESS frequency allocations.[14]

Spectrum sharing in the proposed EESS frequencies will be possible because the GNOMES system and satellites in other similar systems transmit/receive only in short periods of time while visible to a receiving/transmitting earth station. For harmful interference to occur, satellites belonging to the different systems would have to be visible to the Earth station and

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[10] *See* 47 C.F.R. § 2.106 n.US347. The 2025-2110 MHz (Earth-to-space) band is also allocated to space operations internationally. *Id*. § 2.106.

[11] The 8025-8400 MHz band is also subject to an electromagnetic compatibility analysis as may be applied on a case-by-case basis. *Id*. § 2.106 n.US258.

[12] *See, e.g*., *Radio Occultation*, Wikipedia, https://en.wikipedia.org/wiki/Radio_occultation (last visited September 12, 2022).

[13] *See* 47 C.F.R. § 2.1 (defining EESS as a "radiocommunication service … in which 'information relating to the characteristics of the Earth and its natural phenomena … is obtained from active sensors or passive sensors on Earth satellites'").

[14] The Commercial Remote Sensing Regulatory Affairs office of NOAA has previously determined that PlanetiQ's RO satellites do not require NOAA remote sensing licenses because they do not collect data that can be processed into imagery of the surface features of the Earth.

transmitting or receiving using the same frequencies at the exact same time. In such an unlikely event, the resulting inline interference could be avoided by coordinating the satellite transmissions so that they do not occur simultaneously. Accordingly, there is no mutual exclusivity between the GNOMES system and other EESS (or similar) systems using the same frequency bands. PlanetiQ will also comply with technical requirements in Part 2 of the Commission's rules and applicable ITU rules and complete coordination with the Federal operators as required.[15]

PlanetiQ will further mitigate the potential for co-frequency interference through operational measures including coordinated scheduling of ground station contacts, time-limited transmissions during visibility windows, and the ability to modify or cease transmissions as necessary to resolve any interference events. These measures ensure compatibility with both existing and future operators in the relevant frequency bands.

B. GNSS Signals

As discussed in more detail in the Technical Annex,[16] the Pyxis-RO instruments on the GNOMES system is designed to collect data, *i.e.*, an RO sounding, from publicly available GNSS signals from the GPS (L1 at 1575.42 MHz and L2 at 1227.6 MHz), Galileo (E1 at 1575.42 and E5 at 1207.14 MHz), GLONASS (FDMA signals centered at L1 at 1602 MHz and L2 at 1246 MHz), and BeiDou (B1 at 1575.42 MHz and B2 at 1207.14 MHz) constellations. For science data products, obtaining RO soundings from all four GNSS constellations is critical because it significantly increases the number of RO observations per satellite, enhancing weather

[15] *See Space Imaging, LLC*, Declaratory Order and Order and Authorization, 20 FCC Rcd 11964 ¶¶ 26-31 (2005); DigitalGlobe, Inc., Order and Authorization, 20 FCC Rcd 15696 ¶¶ 1, 15 (2005); *see also* Stamp Grant, Planet Labs Inc., ICFS File No. SAT-MOD-20170713-00103 (granted July 2018).

[16] *See* Technical Annex § II.

prediction accuracy and capabilities for the GNOMES system and the future GNOMES constellation. Additionally, allowing the GNOMES satellite to maximize RO collections reduces the number of total satellites that PlanetiQ would need to optimally operate the future GNOMES constellation, which would not only mitigate system costs but would also support space sustainability. In terms of sharing, conducting RO sounding cannot cause harmful interference or otherwise exclude other users from using those same signals.[17]

Moreover, there are no national security or other similar concerns regarding the RO observations obtained from GLONASS or BeiDou satellites. Because of the necessary post-processing of the RO observations, which involves the use of *a priori* information about the various GNSS systems,[18] PlanetiQ would be able to detect any deliberate falsification or spoofing of the foreign GNSS signals and would not release weather data products derived from any such signals. Indeed, the NOAA commercial data buy program allows and encourages use of all available RO signals, including specifically those from the GLONASS and BeiDou constellations.[19]

The GNOMES systems satellite navigation will not be conducted based on any GLONASS or BeiDou signals. Rather, conventional orbit determination for the GNOMES system and on-board scheduling will be performed using GPS data (and Galileo, as needed).

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[17] In analogous situations, the FCC has concluded that the reception of signals cannot cause harmful interference. *See, e.g.*, *Iridium Constellation LLC*, Order and Authorization, 31 FCC Rcd 8675 21 (2016); Stamp Grant, Spire Global, Inc., ICFS File No. SAT-AMD-20161114001O7 (granted in part Apr. 7, 2017) (authorizing satellite reception of AIS 1, AIS 2, AIS 3, AIS 4, ASM 1, ASM 2, and ADS-B signals).

[18] *See* Technical Annex § II.

[19] *See* Commercial Weather Data Program Radio Occultation Data Buy II (RODB) – 2, Request for Proposal Amendment 0002, RFP 1332KP22RNEEP0003 (August 16, 2022), at p. 9 (stating expressly that parties may obtain RO soundings from any of the four GNSS constellations); *see also* Stamp Grant, Loft Orbital Solutions, Inc., ICFS File No. SAT-LOA-20240517-00107, (granted April 28, 2025), at para. 4 n. 11 (authorizing Loft Orbital to conduct RO activities).

III. Application Of Streamlined Rules

Section 25.122 of the Commission's rules states that applicants filing under the streamlined rules must certify that they meet certain criteria.[20] The following table identifies the streamlined rules criteria and confirms that the GNOMES system meets the criteria.

47 C.F.R. § 25.122(c) Criteria	PlanetiQ Compliance
(1) The space station(s) will operate only in nongeostationary orbit.	The GNOMES system will operate in LEO at a target altitude of 575 km.[21]
(2) The total in-orbit lifetime for any individual space station will be six years or less.	The GNOMES system is expected to have a total in-orbit lifetime of six years.[22]
(3) The space station(s): (i) Will be deployed at an orbital altitude of 600 kilometers or below; or (ii) Will maintain a propulsion system and have the ability to make collision avoidance and deorbit maneuvers using propulsion.	GNOMES-10 will be deployed in a target altitude 575 +/-25 km. GNOMES-11 will be deployed in a target altitude range of 500-600 km +/- 20 km.[23] Both satellites will also have a propulsion system with the ability to make collision avoidance and deorbit maneuvers.
(4) Each space station will be identifiable by a unique signal-based telemetry marker distinguishing it from other space stations or space objects.	The GNOMES system will use a telemetry downlink with a unique spacecraft identifier to ensure that it will be identifiable during commissioning and in-orbit activities.[24]
(5) The space station(s) will release no operational debris.	The GNOMES system will not release any operational debris.[25]
(6) The space station operator has assessed and limited the probability of accidental explosions, including those resulting from the conversion of energy sources on board the	PlanetiQ has assessed and limited the probability of accidental explosions, including those resulting from the conversion of energy sources on board the GNOMES

[20] *See* 47 C.F.R. § 25.122; s*ee also Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 4156 (2020) (Appendix A); 85 Fed. Reg. 52422 (Aug. 25, 2020).

[21] *See* Exhibit B, Orbital Debris Assessment Report.

[22] *See id.* § 1.

[23] *See id*.

[24] *See* Technical Annex § 2.2.3.

[25] *See* ODAR § 3.

space station(s) into energy that fragments the spacecraft.	system into energy that fragments the spacecraft.[26]
(7) The probability of a collision between each space station and any other large object (10 centimeters or larger) during the orbital lifetime of the space station is 0.001 or less as calculated using current NASA software or other higher fidelity model.	The probability of collision between GNOMES-10 and other large objects is 4.1768E-05, and for GNOMES-11 is 2.8984E-05 as calculated by the NASA Debris Assessment Software ("DAS").[27]
(8) The space station(s) will be disposed of postmission through atmospheric re-entry. The probability of human casualty from portions of the spacecraft surviving re-entry and reaching the surface of the Earth is zero as calculated using current NASA software or higher fidelity models.	The GNOMES system will be disposed of through atmospheric re-entry. The probability of human casualty from portions of the spacecraft surviving reentry and reaching the surface of the Earth is zero as calculated using current NASA DAS.[28]
(9) Operation of the space station(s) will be compatible with existing operations in the authorized frequency band(s). Operations will not materially constrain future space station entrants from using the authorized frequency band(s).	Operation of the GNOMES system will be compatible with existing and future operators in the authorized frequency bands, as discussed below.
(10) The space station(s) can be commanded by command originating from the ground to immediately cease transmissions and the licensee will have the capability to eliminate harmful interference when required under the terms of the license or other applicable regulations.	The GNOMES system can be commanded by the mission operation center at any time to immediately cease transmissions and to eliminate harmful interference.[29]
(11) Each space station is 10 cm or larger in its smallest dimension.	The smallest dimension of the GNOMES system is approximately 78 cm.[30]

[26] *See id*. § 4

[27] *See id.* § 5

[28] *See id.* § 7.

[29] *See* Technical Annex § 2.3.7.

[30] *See* ODAR § 2.

(12) Each space station will have a mass of 180 kg or less, including any propellant.	The mass of each GNOMES satellite is approximately 155 kg.[31]
(13) The probability that any individual space station will become a source of debris by collision with small debris or meteoroids that would cause loss of control and prevent disposal is 0.01 (1 in 100) or less.	The GNOMES system meets this requirement as demonstrated in the ODAR.[32]
(14) Upon receipt of a space situational awareness conjunction warning, the licensee or operator will review and take all possible steps to assess the collision risk, and will mitigate the collision risk if necessary. As appropriate, steps to assess and mitigate the collision risk should include, but are not limited to: contacting the operator of any active spacecraft involved in such a warning; sharing ephemeris data and other appropriate operational information with any such operator; and modifying space station attitude and/or operations.	PlanetiQ will review conjunction warnings, coordinate physical operations of the GNOMES system with any operator using similar orbits, and, if necessary, mitigate collision risks to minimize operational impacts.[33]

The Commission has categorically exempted systems operating under the streamlined rules from the Part 25 processing round and default service requirements. Excluding these systems is sensible because small satellite systems eligible for streamlined processing are "designed to serve [their] purpose within a limited, relatively short period of time [and] have more limited frequency use characteristics than more traditional operations licensed under part 25."[34] In lieu of the processing round rules, the Commission requires applicants to "(a) certify that operations of its satellites will not interfere with those of existing operators, (b) certify that it will not materially constrain future operators from using the assigned frequency band(s), and (c)

[31] *See id*.

[32] *See id*. § 5.

[33] *See id*.

[34] *Streamlined Processing Order*, at 80 (2019).

provide a brief narrative description illustrating the methods by which both current and future operators will not be materially constrained."[35] PlanetiQ certifies that the operations of its satellites will not interfere with those of existing operators and that it will not materially constrain future operators from using the requested frequency bands.

In the *Streamlined Processing Order*, the Commission provided examples of applications that would satisfy the specified requirement. Potentially acceptable scenarios include EESS operations[36] and those where the satellite operator possesses "a limited number of earth stations and downlinks during relatively short periods of time, with the ability to effectively schedule transmissions such that future satellite entrants can be accommodated."[37] As detailed above, the GNOMES system is an EESS satellite system, and in any event, the proposed GNOMES system activities will not materially constrain current and future co-frequency systems.[38] Accordingly, the proposed frequency use is consistent with the FCC's streamlined processing rules.

IV. ITU Compliance

PlanetiQ has prepared the ITU Advance Publication Information submission for its proposed system (USASAT-30T-1) and is contemporaneously providing this information to the Commission under separate cover. Additionally, attached to this application is PlanetiQ's signed ITU cost recovery letter.

V. Conclusion

For the reasons stated above, PlanetiQ submits that the public interest would be served by expeditious grant of the application.

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[35] *Id.* 81.

[36] *Id*. 81 n. 223.

[37] *Id.* 81.

[38] *See supra* § II.

Respectfully submitted,

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