EXHIBIT 3

TECHNICAL ANNEX

1 INTRODUCTION

This Technical Appendix to the Space Logistics, LLC (SpaceLogistics) application, to operate the telemetry and commanding systems of Mission Robotic Vehicle-1 (MRV-1), provides information in response to Section 25.114(d) of the Commission's rules and to support the application.

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3 GENERAL DESCRIPTION OF MRV-1 SYSTEM

MRV-1 is a Mission Robotic Vehicle (MRV), which has the capability to service in-orbit geosynchronous satellites we call client vehicles (CVs). MRV-1 can perform many types of service including:

- Installation of mission enhancement devices
- Performance of inspections of customer satellites

- Performance of simple repair missions – possibly requiring new tools that can be launched and then recovered in orbit by MRV
- Relocation of CVs to different orbital slots or to different orbits including Graveyard orbit
- Performance of inclination reductions for CVs
- Long-term station keeping and attitude control of customer satellites
- Performance of Space Situational Awareness sensing

By enhancing in-orbit flexibility and options for Geosynchronous Orbit (GSO) satellite operators, SpaceLogistics will be able to assist those operators in maximizing the value of their in-orbit assets and allow them to better respond to customer demand.

Consistent with SpaceLogistics' operating philosophy, the company will conduct operations in a responsible, transparent and cooperative manner aligned with the ISO standard 24330 (Space systems — Rendezvous and Proximity Operations (RPO) and On Orbit Servicing (OOS) — Programmatic principles and practices).

The MRV-1 system consists of the space segment (all aspects of the spacecraft and associated design) and the ground segment (all ground-based services and hardware – including test equipment, mission operations centers, ground networks, transportation and launch site). Both segments are described herein.

The MRV reuses many of the heritage components that are flying on two successful Mission Extension Vehicle (MEV) satellites that SpaceLogistics has on-orbit today. These MEV's successfully rendezvoused and docked with two Intelsat satellites in 2020 and 2021 respectively and as of June 2025 they have delivered more than a combined nine years of life extension service. Both MEV spacecraft have extensive heritage from Northrop Grumman's

GEOStar product line of communications satellites, as well as the Cygnus spacecraft, which delivers cargo to the International Space Station (ISS). However, rather than the Capture Mechanism on the MEV, the MRV-1 has a Robotics Module that has two Robotic Arms.

3.1 Concept of Operations

After launch and separation, MRV-1 will autonomously perform bus activation/initialization, including Telemetry, Command and Ranging (TCR) Comm Boom Assembly (CBA) deployment, and Solar Array (SA) deployment following a SA warmup period. If ground contact is established prior to the autonomous SA deploy, the SAs may be manually deployed via ground commands. During the following few weeks, known as Launch and Early Orbit Operations (LEOP), checkouts are performed on the MRV-1 bus subsystems, followed by initialization and checkout of the Robotic Payload (RP). Once all necessary checkouts, deployments, initializations, and testing have been completed, MRV will begin its Orbit Raising (OR) from its injection orbit to the planned Geosynchronous Earth Orbit (GEO). This may be performed using Chemical Propulsion (CP), Electric Propulsion (EP) or a hybrid of the two. EP orbit raising (EPOR) will be the baseline for the MRV system and is expected to last approximately 370 days.

During Orbit Raising, additional In-Orbit Testing (IOT) may be performed. If necessary, EPOR will be paused to allow for this activity. Anticipated pauses include Robotic Payload (RP) IOT activity that was not completed during the defined LEOP duration, and RPO sensor calibration which requires the moon phase to be half-to-full. A 14-day period during LEOP is allocated for RP initialization and checkout and any remaining activity is planned during the first few weeks of EPOR.

After arriving in, or near GEO, MRV-1 will perform a series of servicing missions from the following categories:

- Installation of mission enhancement devices also called On-orbit Attachable Capabilities (OACs), including small propulsion augmentation systems known as Mission Extension Pods (MEPs)[1]
- Performance of inspections of customer satellites – remote or while grappled to the CV
- Performance of repair missions – possibly requiring new tools that can be launched and then recovered in orbit by MRV
- Relocation of CVs to different orbital slots or to different orbits including Graveyard orbit or inclination reductions
- Long-term station keeping and attitude control of customer satellites
- Performance of Space Situational Awareness sensing

Performance of these services will be executed in accordance with the operational constraints described in the Licensing Narrative.

As demonstrated in Figure 1 below, each servicing mission will start with the RPO phase, several days in advance of the service, with the initial phasing maneuvers of both MRV-1 and the CV. These maneuvers are performed to align the rendezvous capture box and lighting conditions desired for the final stages of the RPO operations and to avoid other resident space objects (RSOs) that may be in proximity. Initial orbital phasing maneuvers are performed based on ground measured orbit parameters. As MRV-1 approaches within the station-keeping box of the CV, the RPO sensors begin to track the CV and provide additional relative position data that is used to control the relative position between the two satellites. During rendezvous, MRV-1

[1] As discussed in the Licensing Narrative, the MEPs themselves are not part of this license application.

will use a safe circumnavigation trajectory design that seeks to prevent the potential for collision with the CV due to over- or under-performance of maneuvers. During the final R-bar approach (i.e., the radial vector between the center of the earth and the CV), MRV-1 autonomously maneuvers from one ground commanded waypoint to the next using its on-board sensors and navigation flight software. MRV-1 holds at each waypoint until authorized by ground command to proceed to the next waypoint. MRV-1 will slowly approach the CV from the aft end, approximately along the R-bar, ultimately stopping within the “capture hold box” immediately behind the CV. From this position, the MRV will either install an OAC (such as a MEP) onto the CV or grapple the CV to perform its services.

It should be noted that for an OAC installation, the MRV first rendezvous and retrieves the OAC following the same procedures as above. The MRV (together with the OAC) then rendezvous with the CV to perform the installation.

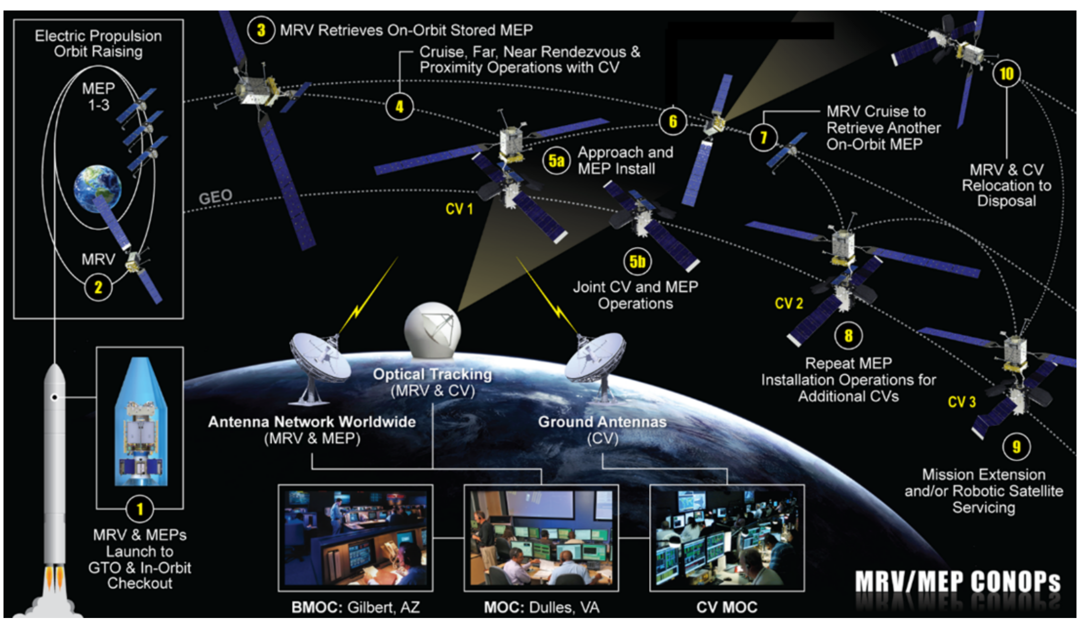

Figure 1 - Notional Mission Sequence

3.2 Space Segment Communications

MRV-1 does not have a typical GSO communications payload as it only needs capability for TT&C functions to control the MRV satellite and its robotic subsystems. Specifically, MRV-1 will have two C-band transmitters operating in the fixed-satellite service (3700 – 4200 MHz space-to-Earth) for commercial servicing, and two S-band transmitters providing service to U.S. and allied government operators (2200 – 2290 MHz space-to-Earth) each of which is tunable in 100 kHz increments. This transmission flexibility is necessary to minimize interference and facilitate coordination with the CV and adjacent satellite operators. All four transmitters are circular polarized. The C-band transmitters are commandable in-orbit between Right-Hand Circular Polarization (RHCP) and Left-Hand Circular Polarization (LHCP). The S-band transmitter polarization is RHCP.

The S-band communications capabilities are funded by the U.S. Space Force and are intended to only be used while performing services for the USG or other approved allied governments.

The downlink communication for MRV-1 consists of ranging data, state-of-health telemetry information, and imaging data during Rendezvous, Proximity Operations (RPO) and servicing operations. The C-band telemetry system has the capability to operate in three different bandwidths or modes depending on the mission phase and operational requirements, as outlined in Table 1.

Downlink Telemetry Mode	Bandwidth
Low rate (C-band, S-band) – drift, RPOD, & servicing operations	200 kHz
Medium rate (C-band, S-band) – pre-rendezvous	8 MHz
High rate (C-band, S-band) – RPOD operations	16 MHz

Table 1 - Bandwidths for each MRV-1 telemetry mode.

The receive communication consists of command and ranging for MRV-1. MRV-1 will have two C-band receivers operating in the fixed-satellite service (5925 – 6425 MHz Earth-to-space) for commercial servicing, and two S-band receivers for federal operators (2025 – 2110 MHz Earth-to-space) each of which is tunable in 100 kHz increments. The command uplink has a bandwidth of 1 MHz. This receive flexibility is necessary to minimize interference and facilitate coordination with the CV and adjacent satellite operators. All four receivers are circular polarized. The C-band receivers are commandable in-orbit between RHCP and LHCP. The S-band receiver polarization is LHCP.

Table 2 provides the tunable frequency range for the TT&C system. The center frequency of the command and telemetry communications links can be any frequency (subject to the bandwidth of the transmission) within the tunable frequency range in increments of the 100 kHz tuning resolution. MRV-1 is capable of ceasing radio emissions, as required.[2]

	Command - Uplink		Telemetry - Downlink	
	Tunable Frequency Range (MHz)	Polarization	Tunable Frequency Range (MHz)	Polarization
C-Band	5925 – 6425	LHCP or RHCP	3700 – 4200	LHCP or RHCP
S-Band	2025 – 2110	LHCP	2200 – 2290	RHCP

Table 2 - MRV-1 TT&C Tunable Frequency Ranges and Polarizations

For the avoidance of doubt, selectable center frequencies for the C-band channel may be calculated as:

C-band Uplink Center Frequency (MHz) = $5925 + 0.1*n_1$

C-band Downlink Center Frequency (MHz) = $3700 + 0.1*n_2$

[2] 47 C.F.R. § 25.207.

Where n_1 and n_2 are integers from 0 to 5000, inclusive.

Similarly, the selectable center frequencies for the S-band channel may be calculated as:

S-band Uplink Center Frequency (MHz) = $2025 + 0.1*m_1$

S-band Downlink Center Frequency (MHz) = $2200 + 0.1*m_2$

Where m_1 is an integer from 0 to 1000 (inclusive) and m_2 is an integer from 0 to 1100 (inclusive).

For on-orbit Attachable Capabilities (OAC), retrieval and installation SpaceLogistics will select the appropriate frequencies and will utilize either the CV ground antennas or lease third-party antennas (such as Intelsat TOSS) as necessary.

3.3 Ground Segment Communications

The ground segment consists of the MRV-1 primary and backup mission operations centers (MOC) for controlling MRV-1, ground networks and earth stations providing the radiofrequency communications links to MRV-1. The backup MOCs are for emergency operations in case the primary MOCs are unavailable. No RPO or robotic operations will be performed from the backup MOC.

The MRV-1 MOC will be in Dulles, Virginia at the Northrop Grumman operations facility, co-located with other mission operation centers, including the MEV-1 & 2, Cygnus, and the GEOStar orbit raising and on-orbit support centers. The MRV-1 backup MOC will be in Gilbert, Arizona, co-located with the MEV-1 & 2 backup MOC.

During orbit raising, in-orbit testing (IOT), and drifting, MRV-1 will utilize a leased global network of C-band and S-band TT&C earth stations networked to the MRV-1 MOC. During RPO and CVS operations, MRV-1 will nominally use the CV's primary and redundant TT&C stations and ground antennas with redundant communication links between the TT&C stations and the MRV-1 MOC. However, there may be occasions when MRV-1 will need to utilize leased earth stations to perform such RPO operations.

The MRV-1 MOC and the CV MOC will be in communications during joint operations and CVS servicing to support coordination of activities and safety of both spacecraft. Both MOCs will share critical state of health telemetry of both vehicles and coordinate orbit and maneuver data.

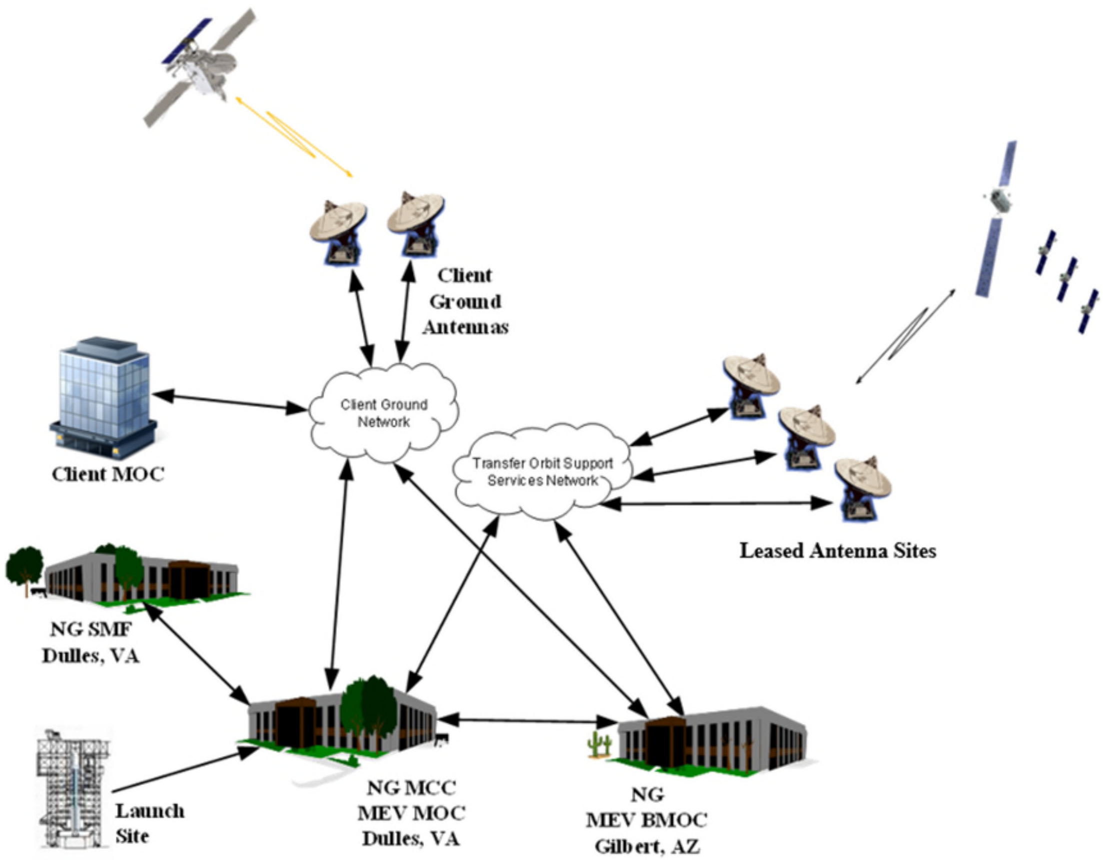

Figure 2 – MRV/MEP Spacecraft Data Flow with Ground CVs and NG Space Assets

3.4 Launch Segment

MRV-1 is scheduled to be launched on a Falcon-9 in the first half of 2026. It will be launched into a GEO transfer orbit, leaving approximately 1700 m/s remaining to reach Geosynchronous orbit. Table 3 lists the nominal Falcon-9 injection parameters for this mission.

Geosynchronous Transfer Orbit (GTO) Parameters1	Target Value	Allowable Dispersion
Perigee altitude (km), osculating at orbit injection	300 km	± 15.0 km
Apogee altitude (km), osculating at orbit injection	44,120 km	± 500 km
Orbit Inclination (degrees), osculating at orbit injection	27.0 deg	± 0.1 deg

Table 3 – Initial Orbit Parameters

3.5 Emission Compliance

The carrier frequency of each transmitter for MRV-1 shall be maintained within 0.002% of the reference frequency.[3] All emissions from MRV-1 shall meet the out-of-band emission limits specified in the Commission's rules.[4]

4 ANTENNA GAIN CONTOURS

Both the TT&C C-band and S-band antennas for MRV-1 provide ±17° half-power beam width from GSO orbit meaning that no transmit or receive antenna gain contours intersect the Earth's surface. Therefore, pursuant to Section 25.114(c)(4)(vi)(A) of the FCC's rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S.

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[3] 47 C.F.R. § 25.202(e).

[4] 47 C.F.R. § 25.202(f).

5 INTERFERENCE ANALYSIS

5.1 Interference Analysis for Hypothetical, Identical Space Station within 2 Degrees of MRV-1

SpaceLogistics certifies that the MRV-1 downlink EIRP density will not exceed 3 dBW/4kHz for digital transmissions during operations. SpaceLogistics certifies that the levels of the uplink emissions in the C-band will not exceed the limits set in 47 C.F.R. § 25.218.

5.2 Band Edge Interference

As discussed in the Licensing Narrative, SpaceLogistics intends on conducting TT&C operations at the upper-most edge of the C-band over CONUS. However, if operations occur outside of the bands edge, SpaceLogistics will meet all requirements of 47 C.F.R. 25.202(g)(1) of the Commission's rules.

6 ORBITAL DEBRIS MITIGATION PLAN

6.1 MRV Flight Safety

SpaceLogistics has established a Systems Safety Program Plan (SSPP) for the identification, evaluation, mitigation, and tracking of all potential hazards associated with the MRV-1 mission. The SSPP defines an MRV Safety Review Process (SRP), which outlines the exact procedures for executing the mitigation and tracking of identified potential hazards. The SRP is a general Northrop Grumman practice that SpaceLogistics has tailored specifically to the MRV program. All potential hazards are categorized by mission phase, including flight operations covering activities after launch and separation. Detailed analyses for each potential hazard in applicable flight operations are documented in the Flight Safety Data Package (FSDP). Orbital debris generation is a subcategory under the FSDP.

MRV-1 is designed such that no debris is generated because of normal operations outside of missions involving disposal of spacecraft debris. This leaves four primary sources for potentially generating debris from the MRV-1 mission including:

1) Accidental explosions from internal or external sources
2) Collision during non-RPOD operations
3) Collision during RPOD operations
4) End-of-life decommissioning

SpaceLogistics leverages four key mitigation layers that address these sources of debris generation, each applying to a unique set of mitigation strategies. The mitigation layers for these debris' generation sources include spacecraft design, autonomous fault protection, the ground segment, and mission operations including trajectory design. Figure 3 illustrates how these mitigations are layered to prevent the generation of orbital debris during the MRV-1 mission. The layers progressively involve mission operators to fully mitigate the potential generation of orbital debris.

In the first layer, the spacecraft hardware is designed such that nominal operating conditions do not generate orbital debris. This layer has the least amount of operator intervention since the spacecraft hardware cannot be modified once in orbit. The next layer consists of the MRV-1 on board fault protection, which can autonomously identify, isolate and recover from potential safety issues. In the next layer, the ground segment provides for operator interaction with and configuration of MRV-1 and provides for coordination between the MRV-1 MOC and the CV MOC. The ground systems in the MRV-1 MOCs also actively monitor available spacecraft telemetry and issue alarms to alert the operator and enable ground intervention if necessary. The final layer is mission operations including trajectory design. Mission operations establish and executes MRV-1 operating sequences including trajectories, which are designed to be passively safe to protect against collisions with the CV and other tracked RSOs. This layer involves significant mission operator involvement and active coordination with other GSO spacecraft operators.

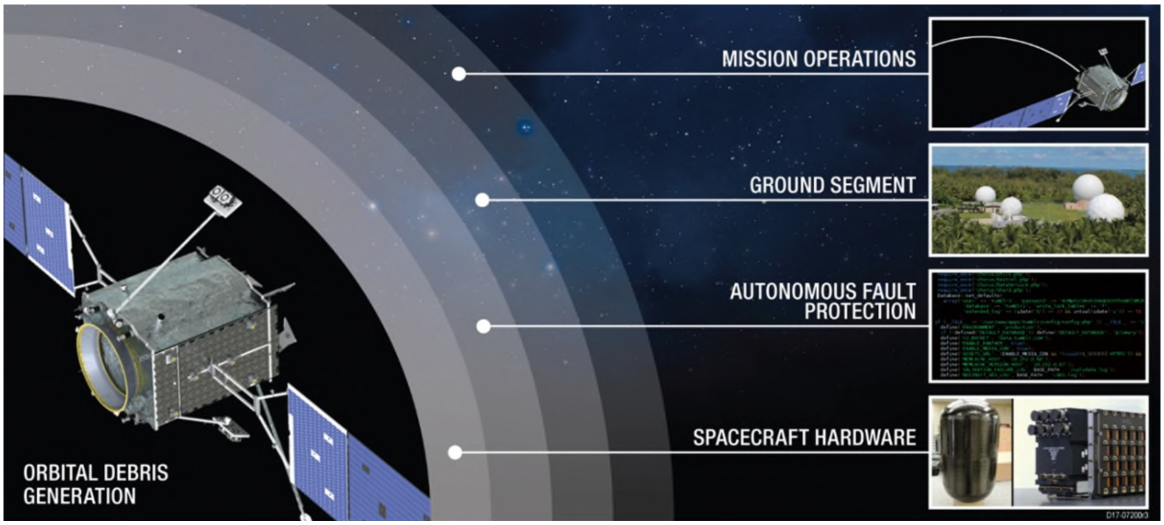

Figure 3 – The MRV-1 mission layers mitigations to protect against orbital debris generation

In addressing each of the possible sources of orbital debris generation, the strategies employed within each of the layers discussed above will be identified and elaborated.

6.2 Mitigation Against Accidental Explosion Events and Collision with Small Objects

Mitigation Layer: Spacecraft Design

SpaceLogistics has assessed and limited the probability of accidental explosions caused by either internal or external sources during and after completion of mission operations.[5] MRV-1 is designed in a manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices.

[5] 47 C.F.R. § 25.114(d)(14)(iii), 47 C.F.R. 25.114(d)(14)(vi).

The propulsion subsystem component construction, preflight verification (through both proof testing and analysis), and quality standards have been designed to ensure a very low risk of leakage or over-pressurization with a potential to cause explosions.

The batteries are designed with sufficient factors of safety to prevent any accidental explosions due to over pressurization. On-board systems manage the charging and discharging of the batteries to ensure that these factors of safety are maintained. At the end of life, the batteries can also be remotely discharged from the ground.

SpaceLogistics has assessed and limited the probability of the space station becoming a source of debris by collision with small debris or meteoroids of less than one centimeter in diameter that could cause loss of control and prevent post-mission disposal.[6] SpaceLogistics has designed MRV-1 to contain most energy-storage components within the central cylinder, including all the propellant storage tanks. This provides the highest level of protection against collisions with micrometeoroids or other space debris. Using a Northrop Grumman assessment tool validated against NASA Debris Assessment Software, SpaceLogistics has calculated this probability to be 0.00937, in compliance with the 47 C.F.R. § 25.114(d)(14)(ii).

The inadvertent release of a tool or device from the end of the Robotic Arms is treated as a catastrophic hazard. This is addressed through elimination of single faults that could cause this failure and all demate actuations are two-step command processes.

Mitigation Layer: Autonomous Fault Protection Design

The MRV-1 autonomous fault protection is designed to continuously monitor subsystem conditions during mission operations which could lead to over-pressurization of the propellant

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[6] 47 C.F.R. § 25.114(d)(14)(ii), 47 C.F.R. 25.114(d)(14)(vi).

tanks or stressing the batteries. The primary cause of propellant or battery explosion is over-pressurization due to high temperature and/or overcharging. Additionally, there are autonomous responses for voltage spikes in the battery cells that could lead to a failure or potential explosion.

Mitigation Layer: Ground Segment Design

In addition to the on-board autonomous fault protection of the subsystems, the spacecraft transmits state of health information for all subsystems including telemetry for propulsion tank pressures and temperatures, as well as battery pressures, temperatures, and cell voltages.

All of these telemetry points are monitored by the ground software with autonomous limit checking. Out-of-limit conditions are flagged on the MOC displays with a prominent alert and require operator acknowledgement. Conditions detected by limit or other signatures in the ground systems can also initiate activities such as alerting off-console support engineers.

Mitigation Layer: Mission Operations

Mission Operations employs flight rule constraints to avoid potentially hazardous conditions, trends subsystems data to actively avoid risks leading to a hazardous condition, and re-actively responds to ground system alerts. At the completion of the mission and upon disposal of the spacecraft, SpaceLogistics will ensure the removal of all stored energy on the spacecraft by depleting all propellant tanks, venting all pressurized systems and by leaving the batteries in a permanently discharged state.

6.3 Mitigation Against Collisions with Other GSO Satellites and Tracked Residential Space Objects (RSOs) (non-RPOD)

Mitigation Layer: Mission Operations and Trajectory Design

SpaceLogistics will take standard measures to ensure that MRV-1 will not collide with other RSOs (including other space stations and large debris).[7] This includes the utilization of both commercial and U.S. government orbit determination services to coordinate MRV-1 mission planning and trajectory design.

SpaceLogistics uses Space-Track to monitor the risk of close approach of its satellites with other objects. The 19th Space Defense Squadron (19 SDS) executes the conjunction assessment mission on behalf of U.S. Space Command in cooperation with the 18th Space Defense Squadron (18 SDS). Both 19 SDS and 18 SDS provide spaceflight safety services for Space-Track. Any close encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions.

The MRV-1 spacecraft will be trackable.

6.4 Rendezvous, Proximity Operations and Docking

RPOD is a unique feature of the MRV-1 mission compared to other vehicles operating in the GSO arc. MRV-1 is designed to approach and mechanically attach cooperatively with another satellite. This mission activity introduces debris-generating risks which SpaceLogistics has diligently mitigated, as required by 47 C.F.R. 25.114(d)(14)(vi), through a layered approach based on heritage rendezvous and proximity operations and berthing operations of the Cygnus system with the manned International Space Station. RPOD is a unique feature of the MRV-1

[7] 47 C.F.R. 25.114(d)(14)(iv).

mission compared to other vehicles operating in the GSO arc. In this section, docking refers to either installing a MEP or grappling or capturing a space vehicle directly with a robotic arm tool. The docking is the most safety critical phase of the mission and there will be both manual ground-based and autonomous on-board elements to preclude and detect failures and respond appropriately.

47 C.F.R. 25.114(d)(14)(vi) requires operators to take measures to mitigate release of debris, accidental explosions, and accidental collision during planned proximity operations. SpaceLogistics has designed MRV-1 using heritage, space qualified hardware ensuring debris generation is effectively mitigated in compliance with 47 C.F.R. § 25.114(d)(14)(i) and 47 C.F.R. 25.114(d)(14)(vi). Mitigation design strategies to effectively mitigate risk of release of debris, accidental explosions, and accidental collision during planned proximity operations are described in the subsections below.

The only missions for which planned release of debris could occur are those in which SpaceLogistics is servicing a client vehicle to repair or actively remove structures or components. SpaceLogistics will conduct such missions in compliance with U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP),[8] NASA-STD-8719.14C (NASA

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[8] U.S. Government Orbital Debris Mitigation Standard Practices, November 2019 Update, https://orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf (ODMSP Objectives). Consistent with 47 C.F.R. 25.114(d)(14)(vi), the ODMSP Objectives for rendezvous, proximity operations, and satellite servicing provide that the program with should limit the risk of debris generation as an outcome of the operations, limit the probability of accidental collision, and limit the probability of accidental explosion resulting from the operations. For active debris removal operations, the objectives also provide that operators should avoid fragmentation of the debris structure. *See* ODMSP Objectives 5-3, 5-4.

Technical Standards),[9] and 47 C.F.R. 25.114(d)(14)(vi) by operating in a manner to reduce risk of debris generation, collision risk, and risk of accidental explosions and by disposing of structures or components in the graveyard orbit in an altitude sufficiently above GEO.

The ODMSP objectives for rendezvous, proximity operations, and satellite servicing, and for active debris removal provide that any planned debris generated as a result of the operations should follow the standard practices for mission-related debris set forth in Objective 1 of the Guidelines,[10] and that for active debris removal, operations should be designed for the structure to follow applicable post mission disposal practices set forth in Objective 4.[11] SpaceLogistics has designed mission operations to follow these Objectives.

For missions in GEO, Objective 1 provides that release of debris should be eliminated or minimized, and that if required, minimized with justification. Release of debris will be minimized through the mitigation design strategies discussed in the subsections below. Further, debris will only be released if absolutely required for a servicing mission, which otherwise would create more risk in the aggregate by leaving defunct structures in place. Any debris released is justified because public interest is served by repairing defunct satellites and structures and removing defunct components and structures out of GEO. Extending the life of in-orbit satellites, conducting repairs, and disposing of any defunct or obsolete components or structures ultimately reduces the number of objects on-orbit and reduces the likelihood of accidental collisions or debris generation that could otherwise remain in the GEO orbit. Additionally, the

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[9] NASA, Process for Limiting Orbital Debris, NASA-STD-8719.14C, Superseding NASA-STD-8719.14B (Approved Nov. 5, 2021), https://standards.nasa.gov/sites/default/files/standards/NASA/C/0/nasa-std-871914c.pdf (NASA-STD-8719.14C) (NASA-STD-8719.14C).
[10] ODMSP Objectives 5-3, 5-4.
[11] ODMSP Objective 5-4.

services envisioned herein are consistent with US policy objectives for furthering US in-space servicing, assembly, and manufacturing capabilities[12] and, accordingly, serve the public interest.

Operations will be designed for structures or components actively removed to follow applicable disposal practices set forth in ODMSP Objective 4 and the NASA Technical Standards by disposing of any structures or components in an orbit sufficiently above 35,986 km (the identified upper boundary of the GEO zone),[13] to assure that the structure or component will not enter the GEO zone (or GEO +/- 200 km and GEO +/- 15° band) for a period of at least 100 years after disposal.[14] Before conducting any servicing missions involving active repair or disposal of a structure, SpaceLogistics will calculate the disposal orbit using the NASA Debris Assessment Software (DAS),[15] ensuring safe disposal and compliance with both the ODMSP and NASA Technical Standards. By operating consistent with these standards, SpaceLogistics will comply with 47 C.F.R. 25.114(d)(14)(vi).

Mitigation Layer: Spacecraft Design

Redundant RPOD sensors onboard MRV-1 provide visual imaging and telemetry that are used both onboard and on ground to determine relative position and attitude between MRV-1 and the CV. During RPOD, MRV-1 provides high data rate telemetry of these sensors to support ground-based monitoring and authorization to proceed. MRV-1's capture mechanisms are designed to minimize contact forces to prevent unwanted relative dynamic motion between MRV-1 and the CV. The mechanical attachment tools are designed to operate safely by use of

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[12] *See, e.g.*, Gov. Accountability Office, In-Space Servicing, Assembly, and Manufacturing: Benefits, Challenges, and Policy Options, GAO-25-107555, (July 10, 2025), https://www.gao.gov/products/gao-25-107555.
[13] ODMSP Objective 4.
[14] NASA-STD-8719.14C, 4.6.2.3(b) (post-mission disposal); 4.3.2.3, 4.3.4.4 (planned disposal).
[15] *See, e.g.*, NASA-STD-8719.14C 4.3.4.4.

design margins (mechanical and electro-mechanical). Design elements have also been included to address any electrical charge potential between MRV-1 and the CV which could result in damaging Electro-Static Discharge (ESD) events. Full six-degree of freedom control is implemented on MRV-1 using the chemical propulsion system, in conjunction with momentum wheels providing additional margins on control authority needed for the proximity operations.

Specifically, the RPO subsystem consists of the sensors, electronics, and algorithms required for detecting and tracking the CV during rendezvous and proximity operations, sensing the relative position and attitude of the CV, and enabling each robotic arm to be properly positioned such that the required task can be successfully executed – E.g., grappling a space object. The RPO techniques used by the MRV are directly derived from the successful MEV 1 & 2 missions; taking advantage of lessons learned. Additionally, the MRV Robotic arms are equipped with a tool changer at the end of the arms that create mechanical, electrical, and data connection with tools (or space objects) that are compatible with this interface. The MRV will launch with redundant pairs of two specially designed tools used for grappling compatible space objects. These tools are 1) The Pod Capture Tools (PCT) that is designed to capture a compatible Grapple Fixture (GF) located on a space object, and 2) A Marman Ring Tool (MRT) that is used to grapple a launch adaptor ring on a CV. These tools ensure the capability of safe operations.

Mitigation Layer: Autonomous Fault Protection

At any point during RPOD, the MRV-1 can autonomously detect anomalies either in MRV-1 itself, or the relative position and orientation with the CV and take appropriate action from recovering from the fault to aborting the approach and causing a retreat to a safe orbit.

Mitigation Layer: Ground Segment

The MRV-1 ground segment is designed to provide redundancy during mission operations. The primary MRV-1 MOC is located in Dulles, VA while the backup MOC is located in Gilbert, AZ. This provides enough geographical separation to isolate the two MOCs from common weather hazards and other contingencies that may occur. Additionally, the TT&C ground stations utilize multiple redundant and diverse ground networks for added reliability.

During the RPO&D phase, both the MRV-1 MOC and the CV MOC are connected through a continuous, real-time interface to ensure critical data is passed between operators of the two spacecraft. Autonomous telemetry monitors continuously check for events and alarms, while an independent ground-based system correlates relative position and attitude information using telemetered RPOD sensor data from MRV-1. Mission operators are provided both graphical and tabular data displays to provide full situational awareness.

Mitigation Layer: Mission Operations and Trajectory Design

Nominal and contingency procedures will be developed for all identified practicable scenarios. These procedures will be executed on simulators and the actual spacecraft when feasible. SpaceLogistics will conduct multiple rehearsals for both nominal and contingency mission scenarios to further train the operations staff and test all software and ground systems under flight-like conditions. During the mission, critical operations such as the RPOD phase are fully staffed by a team of experts with a wealth of mission operations and technical experience.

During RPOD, mission operations are performed collaboratively with the CV MOC. At each proximity operation waypoint mentioned above, both SpaceLogistics and the CV operators must provide authorizations to proceed to continue to the next waypoint. During the docking phase, MRV-1 operators utilize the CV as a viable control to help prevent the vehicles from colliding under some fault scenarios.[16] The ground operators can also send retreat, scrub, or abort commands to MRV-1 if an anomalous condition is detected in either MRV-1 or the CV. MRV-1 is designed to safely and autonomously retreat and depart (if necessary) from the defined keep-out zones around the CV following an autonomous or ground-initiated scrub or abort.

SpaceLogistics uses a robust trajectory design to minimize risk of collision as MRV-1 approaches the CV during the RPOD phase. This trajectory ensures that the natural motion orbit of MRV-1 does not intersect the CV including over and under thrust performance or failure to execute a maneuver, during all but the very final RPOD maneuver which has additional safety procedures incorporated to prevent collision.

The final approach trajectory is designed to minimize any chances of impacts that could generate orbital debris. During this final approach, the relative speed is decreased from 30 mm/s to about 1 mm/s just before MRV-1 enters the capture box directly behind the CV. At this speed, the potential for debris generation caused by an unintended impact has been assessed to be very low. As an added layer of protection during this phase, MRV-1 approaches the capture box in such a way as to allow dual fault tolerance to credible scenarios of loss of control of MRV-1 by enabling time for the CV mission operators to perform a collision avoidance maneuver if they determine MRV-1 is unable to respond.

6.5 Post-Mission Disposal

Mitigation Layer: Trajectory Design

SpaceLogistics plans to reserve sufficient fuel and power to dispose of MRV-1 at the end of its mission-capable life at a planned minimum altitude of 300 kilometers (perigee) above the

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[16] Narrative at 4, 20-22 (discussing SpaceLogistics' cooperative, transparent, and responsible operating philosophy).

GSO arc.[17] The proposed disposal orbit altitude complies with the altitude resulting from application of the Inter-Agency Space Debris Coordination Committee ("IADC") formula based on the following calculation:

36,021 km + (1000 × C_R × A/m) = 36,044.0 km, or 258.0 km above the GSO arc (35,786 km), where

A, Area of the satellite (average aspect area) is: 42 m^2
m, Mass of the spacecraft is: 2730 kg, minimum expected EOL mass
C_R (solar radiation pressure coefficient) is: 1.5

Accordingly, MRV-1's planned disposal orbit complies with the FCC's rules.[18]

Mitigation Layer: Mission Operations and Trajectory Design

After MRV-1 reaches its final disposal orbit, all on-board sources of stored energy will be depleted, all batteries will be left in a permanent discharge state, and the transmitters will be shut off.[19] The solar arrays will also be skewed away from the sun to minimize power generation.

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[17] 47 C.F.R. § 25.283(a); *see also* Inter-Agency Space Debris Coordination Committee, IADC Space Debris Mitigation Guidelines, § 5.3 (2007).

[18] 47 C.F.R. § 25.283(a).

[19] 47 C.F.R. §§ 25.283(c), 25.114(d)(14)(ii).

Technical Certification

I, Gregg Herbert, hereby certify, under penalty of perjury, that I am the technically qualified person responsible for the preparation of the engineering information contained in the technical portions of the foregoing application and the related attachments, that I am familiar with Part 25 of the Commission's rules, and that the technical information is complete and accurate to the best of my knowledge and belief.

/s/ Gregg Herbert
Gregg Herbert
Systems Engineer
Northrop Grumman, parent company of
Space Logistics LLC

Dated: September 30, 2025