SPACEX

October 4, 2022

BY ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street, N.E.
Washington, DC 20554

Re: *IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105*

Dear Ms. Dortch:

SpaceX is excited to be on the cusp of deploying its second-generation ("Gen2") constellation, which will be the most advanced satellite system ever developed for delivering high-speed, low-latency broadband connectivity to people throughout America and around the world. SpaceX's Gen2 system—like its separate Gen1 system—is particularly well-suited to rapidly address the Commission's fundamental broadband policy goals: closing the homework gap, connecting remote and Polar regions, enhancing emergency preparedness and response, promoting efficient use of spectrum, and serving as a model for efficient and sustainable use of orbital resources.

SpaceX submitted a voluntary supplement on August 19, 2022, providing additional information about its Gen2 system and responding to several questions from the International Bureau staff.[1] To provide even more clarity on its plans and expedite resolution of the Gen2 application without conceding that such information is required or necessary to process the application, or can properly form the basis of any license condition, SpaceX voluntarily provides the following information to augment its earlier submission:

EPFD compliance across the Gen2 constellation. Using the ITU-approved validation software, SpaceX has demonstrated that the Gen2 system will comply with the ITU's equivalent power flux-density ("EPFD") limits, which the Commission has incorporated into its own rules.[2]

The Commission relies on the ITU Radiocommunication Bureau to validate that analysis,[3] and thus has made clear that the Commission staff would not conduct its own independent assessment of EPFD compliance, concluding "[w]e do not believe that such review is warranted to reduce the likelihood that an incorrect submission is made to the ITU."[4] In rejecting a challenge to a prior authorization issued to SpaceX, the D.C. Circuit upheld the Commission's refusal to

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1 *See* Letter from David Goldman to Marlene H. Dortch, IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Aug. 19, 2022) ("Voluntary Supplement").

2 Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105, at Exhibit 1 (Feb. 24, 2022).

3 *See* 47 C.F.R. § 25.146(c).

4 *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, 32 FCC Rcd 7809, ¶ 41 (2017).

depart from the ITU validation methodology to evaluate an alternative EPFD analysis precisely because that is what the rules require.

> The FCC must "adhere to its own rules and regulations." *AT&T Corp. v. FCC*, 448 F.3d 426, 434 (D.C. Cir. 2006). Here, the governing rules require interference between GSO and NGSO systems to be assessed through the method used in the ITU-approved validation software. 47 C.F.R. § 25.146(a), (c)(2). DISH acknowledges that SpaceX's desired changes pass muster under that approach. Nevertheless, DISH argues that its experts have a better method for calculating interference. DISH thus faults the FCC for following its own interference rules. But an agency "abuses its discretion when it arbitrarily violates its own rules, not when it follows them." *BDPCS, Inc. v. FCC*, 351 F.3d 1177, 1184 (D.C. Cir. 2003).[5]

Accordingly, the Commission is on solid ground when it follows its rules, including its rule relying on the ITU to make EPFD compliance determinations.

If the Commission were to depart from the ITU approach in this case—by, for example, considering an analysis based on an aggregation of several EPFD data files that will be analyzed individually for EPFD compliance by the ITU—it would abuse its discretion and violate its own rules. Indeed, it would contradict its own conclusion "that the ITU is in the best position to determine whether SpaceX appropriately relied on multiple ITU filings in its analysis."[6] Moreover, it would also establish a precedent that would open the door to competing alternative EPFD analyses from interested parties in every case, thereby undercutting the efficiency and consistency the current approach was designed to achieve. In addition, it would diverge from the approach taken by other administrations for their own NGSO systems, including O3b and OneWeb—neither of which have been asked by the Commission to provide aggregated EPFD showings in connection with their market access applications.[7]

Emergency beacons for non-U.S. operation. In the Voluntary Supplement, SpaceX explained that some of the satellites in the Gen2 constellation will host a small radiofrequency beacon for use in emergency communications and only outside of the United States.[8] While SpaceX is not seeking U.S. market access for these beacons, it voluntarily attaches their specific radiofrequency parameters as **Exhibit A**.

Further details for satellites in the Gen2 constellation. In its previous Voluntary Supplement, SpaceX described the inputs used for its Debris Assessment Software ("DAS") analysis of the Gen2 satellites, along with its methodology for reaching its results.[9] This

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5 *Viasat, Inc. v. FCC*, No. 21-1123, 2022 WL 3694873, at *3 (D.C. Cir. Aug. 26, 2022).
6 *Space Exploration Holdings, LLC*, 36 FCC Rcd. 7995, ¶ 34 (2021).
7 O3b relies upon a combination of the O3B-A and O3B-B ITU network filings for its first-round NGSO system, while OneWeb relies upon the L6 and L7A ITU network filings for its second-round NGSO system.
8 *See* Voluntary Supplement at 6 & n.17.
9 *See id.* at 2-4.

information enables the Commission to replicate SpaceX's analysis and demonstrate that even using extremely conservative inputs, satellites in the Gen2 constellation will meet the Commission's per-satellite collision probability thresholds using the latest version of DAS. To provide further clarity, SpaceX attaches as **Exhibit B** physical dimensions, DAS results using the latest version of the software (version 3.2.3), and sample DAS logs for the current designs of the planned satellites in SpaceX's Gen2 constellation. SpaceX provides this information for the limited purpose of verifying that such satellites will meet NASA's established per-satellite thresholds, and not because they are required under any Commission rule, order, or policy guidance. Indeed, the Commission's rules expressly provide that "technically identical" satellites "need not . . . have the identical physical structure or microelectronics."[10] Instead, the legally relevant parameters are those specifically required under Sections 25.114(c) and (d) of the Commission's rules, which set the contours of an operator's license while permitting necessary changes to address technological advances, supply chain issues, or steps to further improve the resilience of satellites.

Physical coordination with other space stations. In its Voluntary Supplement, SpaceX detailed its ongoing and productive efforts to physically coordinate its satellites with other operators, including manned spacecraft. SpaceX has also explained the steps it takes to ensure efficient and sustainable use of orbital resources, both in its Gen2 application and amendment,[11] as well as through public updates on its website.[12] SpaceX will proactively contact operators of large constellations before they launch and as they mature in an effort to physically coordinate operations. For all operators, SpaceX has and will maintain open lines of communication. As a matter of responsible operations, SpaceX uses a conservative maneuver threshold an order of magnitude more sensitive than the industry standard and offers to take maneuver responsibility for potential approaches except in situations where other operators are better positioned to assume such responsibility (e.g., when they are orbit raising or deorbiting through SpaceX's operational altitudes). SpaceX has also developed sophisticated collision avoidance agreements with many other spacecraft operators to facilitate physical coordination for systems yet to begin deployment and for systems already on orbit.

Orbital tolerance to accommodate uncertainty in the solar cycle. The Voluntary Supplement described the scientific and practical basis for SpaceX's request for its orbital tolerances.[13] To provide additional clarity, while changes in atmospheric drag will affect different shells to different degrees, SpaceX will endeavor to maintain the relative spacing between orbital shells. In any event, SpaceX will continuously physically coordinate with any operators in nearby or overlapping orbits.

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[10] *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands,* 9 FCC Rcd. 5936, ¶ 182 n.250 (1994).

[11] *See* Application for Approval for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, IBFS File No. SAT-LOA-20200526-00055, Technical Attachment at 46-48 (May 26, 2020) ("Gen2 Application"); Amendment, IBFS File No. SAT-AMD-20210818-00105, Technical Attachment at 17-18 (Aug. 18, 2021).

[12] *See SpaceX's Approach to Space Sustainability and Safety*, SpaceX (Feb. 22, 2022), https://www.spacex.com/updates/#sustainability.

[13] *See* Voluntary Supplement at 4-5.

Deployment details for satellites in the Gen2 constellation. SpaceX noted in its Voluntary Supplement that it plans to deploy satellites into the Gen2 constellation at low altitude to confirm that each one is operating nominally before raising the satellite to its operational altitude.[14] SpaceX does not currently intend to deploy directly into its operational altitudes. Moreover, SpaceX does not intend to include tension rods or spacers for its Starship-based Gen2 satellite deployments, but may initially use tension rods and spacers for Gen2 satellite deployments on Falcon 9.

Propellant to accommodate maneuvers throughout all phases of Gen2 satellite missions. SpaceX has gone to extraordinary lengths to design its Gen2 satellite constellation to promote sustainable operations in space. As stated above, SpaceX uses a conservative maneuver threshold an order of magnitude more sensitive than the industry standard, even though this conservative approach requires a significant investment in sustainability and performance. Not only must SpaceX invest in satellites that are more capable and perform more maneuvers that carry considerable cost to SpaceX, but SpaceX leads by example through its willingness to proactively deorbit satellites when it detects issues, rather than waiting for larger issues to develop. SpaceX takes this most costly approach out of an abundance of caution to best preserve and protect low Earth orbit and encourages other operators to follow this best practice. As SpaceX stated in its Gen2 application, "[a]ll satellites will have sufficient propellant and capability to perform any avoidance maneuvers required for all phases of the satellites' mission."[15] SpaceX has budgeted sufficient propellant to accommodate approximately 5,000 propulsive maneuvers over the life of a satellite, including a budget of approximately 350 collision avoidance maneuvers per satellite over that time period. Using SpaceX's semi-annual satellite reports for comparison, the average SpaceX's Gen1 satellite has conducted fewer than three collision-avoidance maneuvers every six months over the last year, and it conducted these maneuvers predominantly to avoid debris from the November 2021 Russian anti-satellite demonstration. Even under these anomalous conditions, a 350-maneuver budget is extremely conservative.

Launch cadence to support rapid broadband deployment. SpaceX remains committed to deploying its Gen2 constellation as quickly as possible to meet the growing needs of consumers throughout the country for high-speed, low-latency broadband service. In the previous Voluntary Supplement, SpaceX explained that it plans to launch satellites for its Gen2 constellation beginning with its three 500-kilometer shells, followed by satellites in the lower-altitude shells.[16] Although its specific launch cadence is being finalized, SpaceX anticipates launching satellites into the Gen2 constellation at a rate of at least once per week during 2023, with a more rapid cadence over time. While the number of satellites per launch will vary depending on the launch vehicle used and whether any other payloads are involved, SpaceX expects that launches will have approximately twenty to sixty satellites on each Falcon 9 launch and approximately fifty to one hundred satellites initially on each Starship launch, with a variable number of satellites per launch as Starship and Falcon 9 capabilities develop over time.

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14 *See id.* at 4.
15 Gen2 Application, Technical Attachment at 41.
16 *See* Voluntary Supplement at 4.

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In SpaceX's initial Gen2 application, filed two-and-a-half years ago, SpaceX included all information required by the Commission's rules. As the application remained pending, SpaceX was required to begin the development of its Gen2 system. To do otherwise would have resulted in years-long delays in providing high-speed internet to those who need it most. As SpaceX developed the Gen2 system, it reasonably relied on the Commission's rules, with the expectation that the rules on the books would be those governing its system. Of course, SpaceX recognized that the Commission could exercise its rulemaking authority to change its rules, but this would have occurred in an open process in which SpaceX, and others, would have been provided with notice and the opportunity to comment on proposed changes.

In this proceeding, SpaceX has provided a wealth of technical and operational information about its Gen2 system, significantly beyond what the Commission's rules specify. In some cases, SpaceX provided information that the Commission previously found unnecessary or redundant, such as specific physical parameters and design details,[17] as well as information outside of the Commission's jurisdiction, such as information about SpaceX's extensive collaborations with the astronomy community to limit the reflectivity of its satellites. Now, two-and-a-half years after filing the Gen2 application and over a year since filing its amended application, the Bureau is requesting yet more information beyond the scope of the Commission's rules. SpaceX values transparency with the Commission, but is concerned that this additional information, which no other operator is required to provide, will be used as a basis for conditioning a grant of its application.

Unfortunately, as a practical matter, SpaceX has little choice but to accede to these requests despite these concerns or add further to the already significant delays in the processing of its application. This would harm SpaceX, the American people, and those globally who will benefit from the Gen2 system. Therefore, SpaceX voluntarily provides the above information only for informational purposes in an effort to bring this long-running process to a close. SpaceX does not concede that such information is necessary for the processing of its application. Similarly, there is no legal basis by which the information provided in this or other voluntary supplements could serve as the basis for a condition on the grant of its application. Where, as here, the Commission made an affirmative decision that information is unnecessary, the Commission should not bypass legal prerequisites through substantive licensing conditions that overstep Commission authority or conflict with existing rules.

The Commission should be particularly wary of doing so in response to anticompetitive requests from competitors such as those that have sought to avoid Commission oversight by licensing overseas and now seek to abuse the Commission's processes to obtain sensitive, proprietary information from—and to impose invented, heightened requirements solely on—American satellite operators. Finally, as the Supreme Court has recognized, though afforded wide

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[17] *See Comprehensive Review of Licensing and Operating Rules for Satellite Services*, 28 FCC Rcd. 12403, ¶ 89 (2013) (eliminating a number of space station application requirements, including the requirement to specify spacecraft weight and dimensions, because they are "redundant or unnecessary").

latitude in its supervision over communication by wire and radio, "the Commission was not delegated unrestrained authority"[18] and the public-interest standard "is not to be interpreted as setting up a standard so indefinite as to confer an unlimited power."[19]

With a complete record before it, the Commission should swiftly grant the Gen2 application, enabling rapid deployment of next-generation satellite broadband to American consumers and businesses, no matter where they are.

Sincerely,

/s/ David Goldman

David Goldman
Senior Director, Satellite Policy

SPACE EXPLORATION TECHNOLOGIES CORP.
1155 F Street, NW
Suite 475
Washington, DC 20004
Tel: 202-649-2641
Email: David.Goldman@spacex.com

[18] *FCC v. Midwest Video Corp.*, 406 U.S. 649, 706 (1972).
[19] *FRC v. Nelson Bros. Bond & Mortgage Co.*, 289 U.S. 266, 285 (1933).

EXHBIT A

GEN2 RADIOFREQUENCY BEACON CHARACTERSTICS

Operating Frequency Bands:

137.00-138.00 MHz Transmit (space-to-Earth)
148.00-150.05 MHz Receive (Earth-to-space)

Receiving Channel Characteristics			
Channel ID	Channel Bandwidth (MHz)	Center Frequency (MHz)	Type of Link
R001	0.03	148.2825	Service
R002	0.03	148.3125	Service
R003	0.03	148.3425	Service
R004	0.03	148.3725	Service
R005	0.03	148.4025	Service
R006	0.03	148.4325	Service
R007	0.03	148.4625	Service
R008	0.03	148.4925	Service
R009	0.03	148.5225	Service
R010	0.03	148.5525	Service
R011	0.03	148.6625	Service
R012	0.03	148.6925	Service
R013	0.03	148.7225	Service
R014	0.03	149.9250	Service

Receiving Beam Parameters	
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
G/T at Max. Gain Point	-24.8 dB/K
Min. Saturation Flux Density	-154.2 dBW/m^2
Max. Saturation Flux Density	-125.2 dBW/m^2
Co- or Cross-Polar Mode	Co-Polar
Service Area	Global

Transmitting Channel Characteristics			
Channel ID	Channel Bandwidth (MHz)	Center Frequency (MHz)	Type of Link
T001	0.03	137.055	Service
T002	0.03	137.085	Service
T003	0.03	137.115	Service
T004	0.03	137.145	Service
T005	0.03	137.3513	Service
T006	0.03	137.5038	Service
T007	0.03	137.6175	Service
T008	0.03	137.8463	Service
T009	0.03	137.8763	Service
T010	0.03	137.9063	Service
T011	0.03	137.9363	Service
T012	0.03	137.9663	Service

Transmitting Beam Parameters	
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross-Polar Mode	Co-Polar
Service Area	Global

Maximum Power Flux Density (dBW/m^2/BW)						
BW:	0°-5°	5°-10°	10°-15°	15°-20°	20°-25°	25°-90°
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

EXHIBIT B

SATELLITE DIMENSIONS AND DAS OUTPUTS

The tables below present information for the current form factors of SpaceX Gen2 satellites: two of which will be launched initially on Falcon 9 rockets and one that will be launched on Starship. For convenience, these satellites are labeled satellites F9-1, F9-2, and Starship, respectively. Note that to better reflect a non-maneuverable satellite in a tumbling deorbit a scaling factor has been applied to the area-to-mass ratios used with NASA's Debris Assessment Software ("DAS"). Specifically, a factor of 0.5 has been applied to the two larger satellites and a factor of 0.516 has been applied for the smallest one. Following the tables, SpaceX includes sample logs from its DAS analyses for each of the current Gen2 form factors.

	Length (m)	Width (m)	Number	Area (m^2)	DAS Area (m^2)	DAS Mass (kg)
Solar Array F9-1	8.1	2.8	1	22.68		
Bus F9-1	2.8	1.3	1	3.64		
Total Area F9-1				26.32	30	303
Solar Array F9-2	12.8	4.1	2	104.96		
Bus F9-2	4.1	2.7	1	11.07		
Total Area F9-2				116.03	120	800
Solar Array Starship	20.2	6.36	2	256.94		
Bus Starship	6.4	2.7	1	17.28		
Total Area Starship				274.22	294	2000

SpaceX Gen2 F9-1 Satellite DAS input parameters:
Area = 30 m^2
Mass = 303 kg
Area-to-Mass = 0.051 (tumbling)

DAS 3.2.3 - SpaceX Gen2, F9-1 Satellite			
Altitude (km)	Inclination (deg)	Demise Time (yrs)	Large Debris Passive Decay PC
535	33	2.18	1.04E-04
530	43	2.05	1.01E-04
525	53	1.93	1.14E-04
360	96.9	0.09	1.40E-05
350	38	0.07	8.71E-06
345	46	0.06	9.01E-06
340	53	0.06	8.56E-06
604	148	4.03	2.48E-04
614	116.7	4.96	3.30E-04

SpaceX Gen2 F9-2 Satellite DAS input parameters:
Area = 120 m^2
Mass = 800 kg
Area-to-Mass = 0.075 (tumbling)

DAS 3.2.3 - SpaceX Gen 2, F9-2 Satellite			
Altitude (km)	Inclination (deg)	Demise Time (yrs)	Large Debris Passive Decay PC
535	33	1.63	3.25E-04
530	43	1.54	2.72E-04
525	53	1.51	3.06E-04
360	96.9	0.06	5.43E-05
350	38	0.05	3.38E-05
345	46	0.04	3.36E-05
340	53	0.04	3.33E-05
604	148	3.18	8.95E-04
614	116.7	3.80	1.21E-03

SpaceX Gen2 Starship Satellite DAS input parameters:
Area = 294 m^2
Mass = 2000 kg
Area-to-Mass = 0.0735 (tumbling)

DAS 3.2.3 SpaceX Gen 2, Starship Satellite			
Altitude (km)	Inclination (deg)	Demise Time (yrs)	Large Debris Passive Decay PC
535	33	1.66	8.25E-04
530	43	1.56	6.28E-04
525	53	1.47	7.87E-04
360	96.9	0.06	1.31E-04
350	38	0.05	8.12E-05
345	46	0.04	8.09E-05
340	53	0.04	7.99E-05
604	148	3.23	2.17E-03
614	116.7	3.85	2.89E-03

DAS 3.2.3 SpaceX Gen2 303 kg bus

Passive Decay Large Debris Collision Probability Analysis

==========
Run Data
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INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2022.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.2571E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)

RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2023.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.7064E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2024.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 8.0780E-05

Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2025.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.7433E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2026.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 4.8945E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2027.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 3.4781E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range

Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2028.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 7.6127E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)

Start Year = 2029.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.5404E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2030.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.3212E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2031.000 (yr)
Initial Mass = 303.000 (kg)
Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.4004E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0510 (m^2/kg)
Start Year = 2032.000 (yr)
Initial Mass = 303.000 (kg)

Final Mass = 303.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.4870E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

DAS 3.2.3 Decay Time

INPUT

Start Year = 2022.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.659138 (yr)
Time Spent in LEO during Lifetime = 1.659138 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:50:40PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2023.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.492129 (yr)
Time Spent in LEO during Lifetime = 1.492129 (yr)
Last year of Propagation = 2024 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:51:04PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2024.000000 (yr)

Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.097878 (yr)
Time Spent in LEO during Lifetime = 1.097878 (yr)
Last year of Propagation = 2025 (yr)
Returned Error Message: Object reentered

09 25 2022; 18:51:12PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2025.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.966461 (yr)
Time Spent in LEO during Lifetime = 0.966461 (yr)
Last year of Propagation = 2025 (yr)
Returned Error Message: Object reentered

09 25 2022; 18:51:21PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2026.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.056810 (yr)
Time Spent in LEO during Lifetime = 1.056810 (yr)
Last year of Propagation = 2027 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:51:29PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2027.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.522245 (yr)
Time Spent in LEO during Lifetime = 1.522245 (yr)
Last year of Propagation = 2028 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:51:36PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2028.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.531828 (yr)
Time Spent in LEO during Lifetime = 3.531828 (yr)
Last year of Propagation = 2031 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:51:46PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2029.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 4.355921 (yr)
Time Spent in LEO during Lifetime = 4.355921 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:51:56PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2030.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.641342 (yr)
Time Spent in LEO during Lifetime = 3.641342 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:52:05PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2031.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.770705 (yr)
Time Spent in LEO during Lifetime = 2.770705 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 25 2022; 18:52:14PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2032.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.051000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.853525 (yr)
Time Spent in LEO during Lifetime = 1.853525 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 25 2022; 21:42:28PM Science and Engineering - Orbit Lifetime/Dwell Time

DAS 3.2.3 SpaceX Gen2 800 kg bus

Passive Decay, Large Debris Collision Probability Analysis

==========
Run Data
==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2022.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 3.4285E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)

RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2023.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 4.6126E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2024.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1066E-04

Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2025.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.0651E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2026.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.0954E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2027.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.0788E-04
Returned Message: Normal Processing

Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2028.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 3.3413E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2029.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 4.2421E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2030.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 5.6821E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range

Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)
Start Year = 2031.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 6.4022E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0750 (m^2/kg)

Start Year = 2032.000 (yr)
Initial Mass = 800.000 (kg)
Final Mass = 800.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 3.6881E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

DAS 3.2.3 Demise Time

INPUT

Start Year = 2022.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.073238 (yr)
Time Spent in LEO during Lifetime = 1.073238 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:47:27PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2023.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.117043 (yr)
Time Spent in LEO during Lifetime = 1.117043 (yr)
Last year of Propagation = 2024 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:47:38PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2024.000000 (yr)
Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.774812 (yr)
Time Spent in LEO during Lifetime = 0.774812 (yr)
Last year of Propagation = 2024 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:47:49PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2025.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.659822 (yr)
Time Spent in LEO during Lifetime = 0.659822 (yr)
Last year of Propagation = 2025 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:00PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2026.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.698152 (yr)
Time Spent in LEO during Lifetime = 0.698152 (yr)
Last year of Propagation = 2026 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:10PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2027.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.936345 (yr)
Time Spent in LEO during Lifetime = 0.936345 (yr)
Last year of Propagation = 2027 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:20PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2028.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.727584 (yr)
Time Spent in LEO during Lifetime = 1.727584 (yr)
Last year of Propagation = 2029 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:30PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2029.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.630390 (yr)
Time Spent in LEO during Lifetime = 3.630390 (yr)
Last year of Propagation = 2032 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:41PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2030.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.277207 (yr)
Time Spent in LEO during Lifetime = 3.277207 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:49PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2031.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.472279 (yr)
Time Spent in LEO during Lifetime = 2.472279 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:48:59PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2032.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.075000 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.585216 (yr)
Time Spent in LEO during Lifetime = 1.585216 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 21 2022; 17:49:19PM Science and Engineering - Orbit Lifetime/Dwell Time

DAS 3.2.3 SpaceX Gen2 2000 kg bus

Passive Decay Large Debris Collision Probability Analysis

==========
Run Data
==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2022.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 9.3857E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)

RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2023.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1737E-03
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Fail

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2024.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.7111E-04

Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2025.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.6093E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2026.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.6836E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2027.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 2.6428E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range

Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2028.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 8.5721E-04
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)

Start Year = 2029.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1190E-03
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Fail

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2030.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.4033E-03
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Fail

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2031.000 (yr)
Initial Mass = 2000.000 (kg)
Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

OUTPUT

Collision Probability = 1.5840E-03
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Fail

==========

INPUT

Space Structure Name = 535
Space Structure Type = Payload
Perigee Altitude = 535.000 (km)
Apogee Altitude = 535.000 (km)
Inclination = 33.000 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0735 (m^2/kg)
Start Year = 2032.000 (yr)
Initial Mass = 2000.000 (kg)

Final Mass = 2000.000 (kg)
Duration = 7.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

DAS 3.2.3 Decay Time

INPUT

Start Year = 2022.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.100616 (yr)
Time Spent in LEO during Lifetime = 1.100616 (yr)
Last year of Propagation = 2023 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:40:41PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2023.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.133470 (yr)
Time Spent in LEO during Lifetime = 1.133470 (yr)
Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered
09 23 2022; 12:40:54PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2024.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.788501 (yr)
Time Spent in LEO during Lifetime = 0.788501 (yr)
Last year of Propagation = 2024 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:05PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2025.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.673511 (yr)
Time Spent in LEO during Lifetime = 0.673511 (yr)
Last year of Propagation = 2025 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:14PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2026.000000 (yr)
Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.711841 (yr)
Time Spent in LEO during Lifetime = 0.711841 (yr)
Last year of Propagation = 2026 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:24PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2027.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 0.958248 (yr)
Time Spent in LEO during Lifetime = 0.958248 (yr)
Last year of Propagation = 2027 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:33PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2028.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.785079 (yr)
Time Spent in LEO during Lifetime = 1.785079 (yr)
Last year of Propagation = 2029 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:44PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2029.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.685147 (yr)
Time Spent in LEO during Lifetime = 3.685147 (yr)
Last year of Propagation = 2032 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:41:56PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2030.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 3.296372 (yr)
Time Spent in LEO during Lifetime = 3.296372 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:42:05PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2031.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 2.485969 (yr)
Time Spent in LEO during Lifetime = 2.485969 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:42:14PM Science and Engineering - Orbit Lifetime/Dwell Time

INPUT

Start Year = 2032.000000 (yr)
Perigee Altitude = 535.000000 (km)
Apogee Altitude = 535.000000 (km)
Inclination = 33.000000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Area-To-Mass Ratio = 0.073500 (m^2/kg)

OUTPUT

Orbital Lifetime from Startyr = 1.596167 (yr)
Time Spent in LEO during Lifetime = 1.596167 (yr)
Last year of Propagation = 2033 (yr)
Returned Error Message: Object reentered
09 23 2022; 12:42:42PM Science and Engineering - Orbit Lifetime/Dwell Time