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MECH-519-001

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The Big Red Battleship (BRB):

Final Design Report
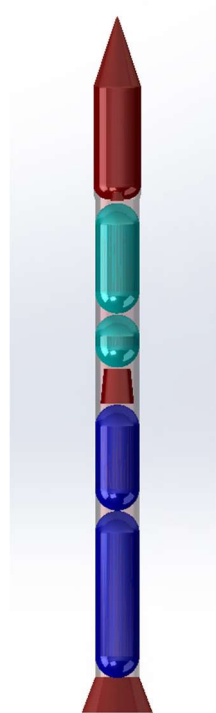
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1. Introduction

Today, I am coming to you all the way from Hanalei, Hawaii in hopes of propelling my company, the United Galactic Federation, to the next level. We have been working for many months to produce a launch vehicle capable of getting to both a GTO orbit of 200 x 35786 km altitude at 27 degrees inclination and a GEO orbit of 42164 km circular orbit at 0 degrees inclination. Both missions come with their own difficulties, but we believe that we have finalized a flawless design. Table 1 shows the Pre-Design parameters, and later we will discuss the optimized final parameters.

Table 1: Pre-Design Parameters for the Big Red Battleship

Pre-Design	Big Red Battleship	
Total Delta V	13678	m/s
Payload	7000	kg
Stage 2		
MF	0.92	
Isp	455	s
Delta V	8678	m/s
Mass Ratio	6.988	
Total Mass	95055.78	kg
Propellant Mass (Ideal)	87451.32	kg
Dry Mass	7604.46	kg
Stage 1		
MF	0.9	
Isp	350	s
Delta V	5000	m/s
Mass Ratio	4.2898	
Total Mass	587970.69	kg
Propellant Mass (Ideal)	529173.62	kg
Dry Mass	58797.07	kg
Total Liftoff Mass	**690026.47**	**kg**

2. Sales Pitch

The Big Red Battleship, or BRB for short, is an iconic rocket. We have designed it to be able to launch from our pad in Hanalei Bay into a geostationary (GEO) orbit as well as a geosynchronous (GTO) orbit. This is a relatively large launch vehicle, hence the name "Big Red Battleship". She has a whopping mass of around 690,000 kilograms, with payloads of 7000 and 6000 kilograms, respectively. She is also around 75 meters tall. But I assure you, her capabilities are worth it. Made almost completely out of 7075 Aluminum, she is light and robust, and designed carefully for these space missions.

Here at the United Galactic Federation, we are a part of a large corporation that involves lots of other planets and solar systems. By having the funding and support of our government and United Nations, we would be able to set up better communication systems with our partners. This is crucial, because having a better relationship with them will lead to less invasions like Roswell and secure protection assistance if it was ever needed. We know that this is a large ask, however, the safety of our planet is our focus point at UGF, which is why we have a launch pad in Hawaii. Launching from these remote islands keeps our risk factors very low.

Now, to get back to the BRB, this is an unmanned mission, only used to set up a GEO satellite to improve our communications with Planet Turo and the Ground Councilwoman that oversees planetary missions. If you still don't understand what we are referring to, the Disney television show *Lilo and Stitch* is completely based on our company and organization. Figure 1 shows the labeled assembly of the rocket, including both the fuel and oxidizer tanks as well as the engines and their very rough models. The engines are not an accurate model, they were modeled completely to scale. Figure 2 is the same, just without labels.
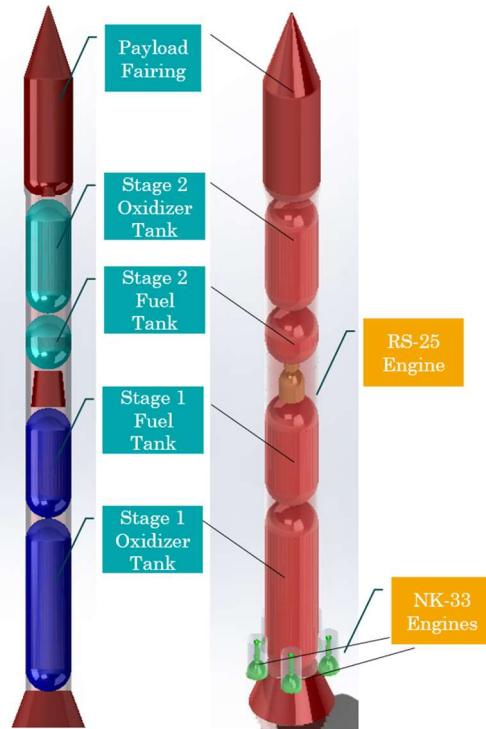
Figure 1: BRB SolidWorks Assembly Labeled
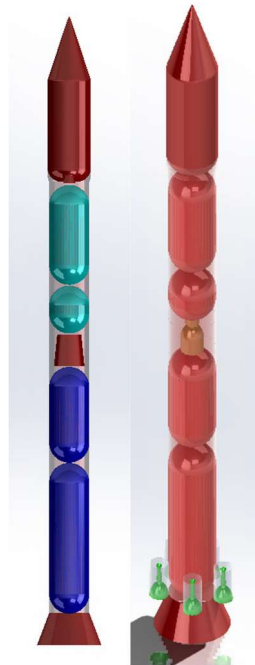
Figure 2: BRB SolidWorks Tanks and Engines Assemblies

The first mission we are embarking on is not the mission the BRB is designed for, however, she is more than capable. It is more for a "practice" run so we can set up tests and improve her if we need to when she comes back from the first mission. This mission is a geosynchronous transfer orbit or GTO for short. This mission has an initial circular orbit of 200 kilometers in altitude. Then, she will burn into her final orbit with an altitude of 200 kilometers at the periapsis and 35,786 kilometers at the apoapsis, with an inclination of 27 degrees. After running the simulations, since this mission was not what she was designed for, our final payload in STK was given as 7630 kilograms. The BRB is designed as a two-stage rocket, so there will be two burn sequences in each mission. The total mission duration ended up being 7158.68 seconds to get to the final orbit and payload separation. The 2D and 3D plots modeled in STK for this GTO mission are shown in Figures 3 and 4, and the actual breakdown of the mission sequencing is shown in Table 2.
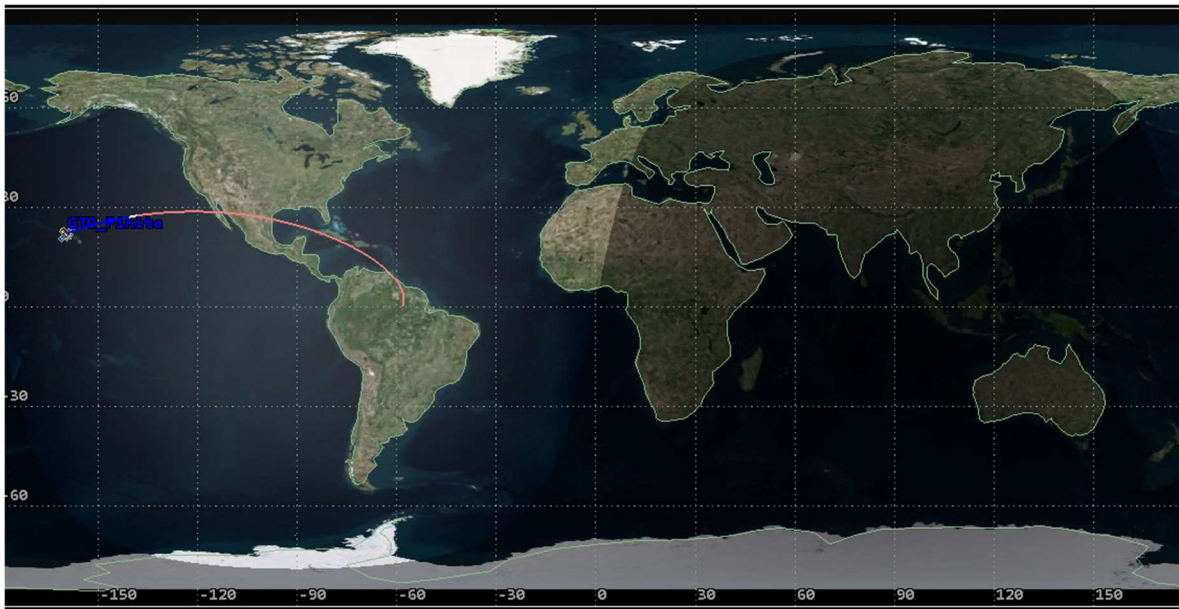
Figure 3: GTO Mission 2D Plot
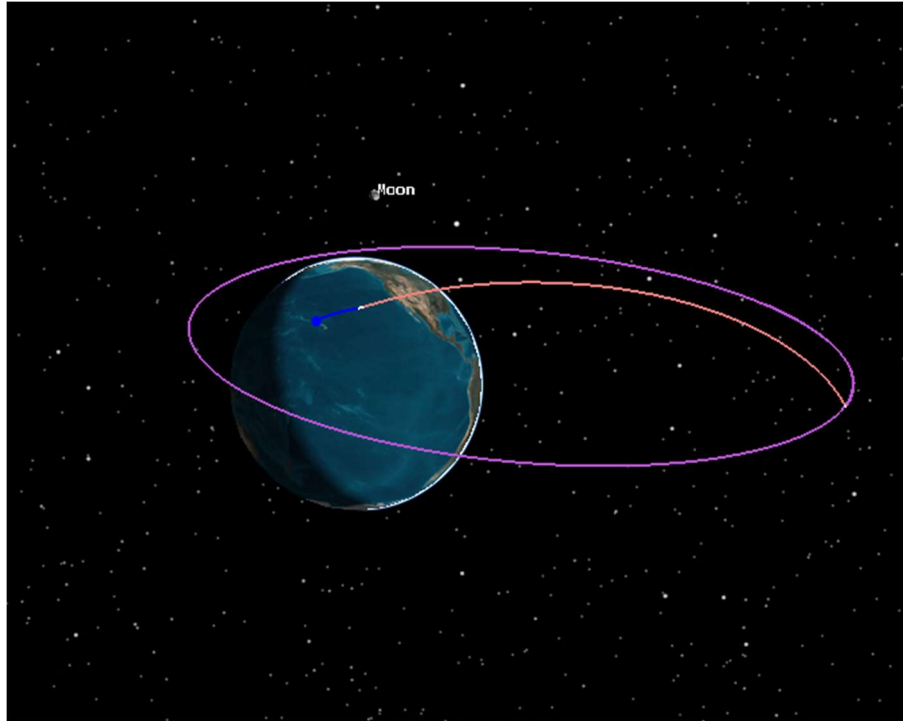
Figure 4: GTO Mission 3D Plot

Table 2: Mission 1 Sequence

Mission 1: GTO	
Mission Event	**MET (s)**
Liftoff	0
Stage 1 Burnout	201.292
Stage 2 Burn 1 Ignition	201.292
Stage 2 Burn 1 Shutdown	228.149
Total Burn Duration	*26.8566*
Coast 1 Duration	*6800.501*
Stage 2 Burn 2 Ignition	7028.65
Stage 2 Burn 2 Shutdown	7058.68
Total Burn 2 Duration	*30.03*
Payload Separation	7158.68

Our second mission is what she was designed for. A geostationary orbit with the same

initial "parking" circular orbit of 200 kilometers in altitude. The final orbit is a circular orbit with

a radius of 42,264 kilometers at 0 degrees inclination. After running the STK simulations, we

have a final payload value of 8788.6 kilograms. This STK modeling can be seen as both a 2D

and 3D plot in Figures 5 and 6 below. Again, with two burns in this mission as well since this is

a two-stage rocket. The total mission duration is 20902.2 seconds to get to the final circular orbit

and payload separation, and the breakdown of specific sequences is shown in Table 3.
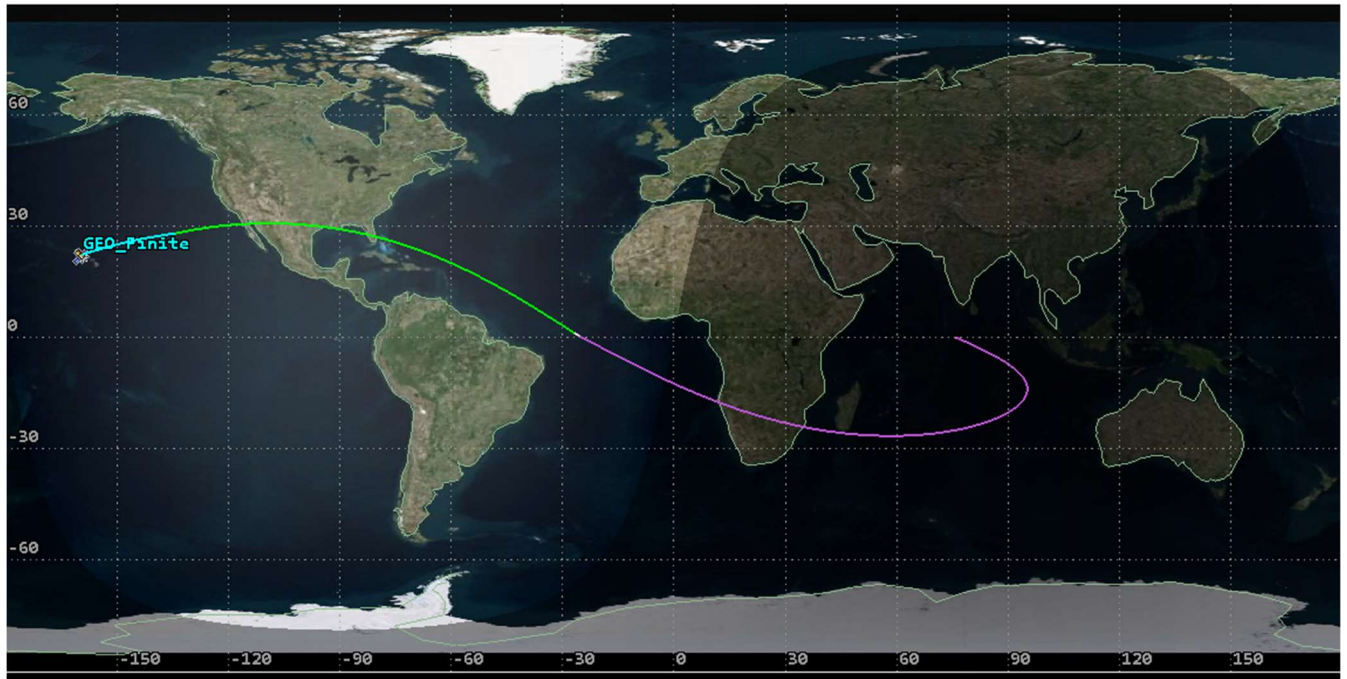
Figure 5: GEO Mission 2D Plot
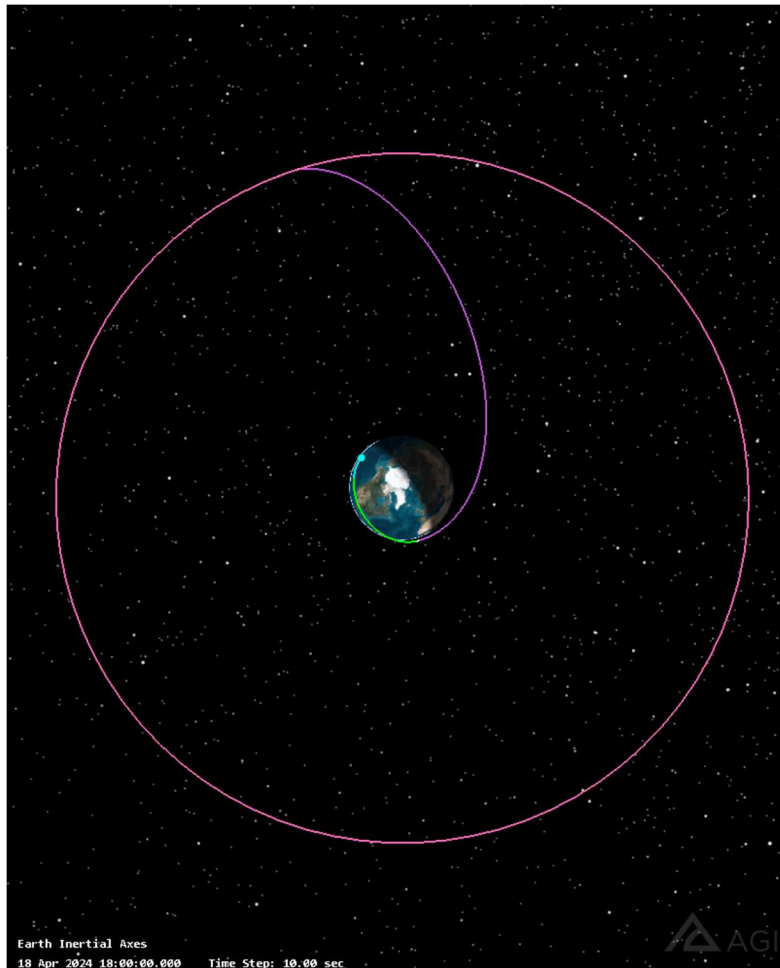
Figure 6: GEO Mission 3D Plot

Table 3: Mission 2 Sequence

Mission 2: GEO	
Mission Event	**MET (s)**
Liftoff	0
Stage 1 Burnout	203.002
Coast 1 Duration	*1676.158*
Stage 2 Burn 1 Ignition	1879.16
Stage 2 Burn 1 Shutdown	1902.66
Total Burn Duration	*23.5*
Coast 2 Duration	*18966.54*
Stage 2 Burn 2 Ignition	20869.2
Stage 2 Burn 2 Shutdown	20902.2
Total Burn 2 Duration	*33.0*
Payload Separation	20902.2

For the BRB, we have used existing rocket engines to cut down on our costs. The first stage uses five NK-33 engines, which supply 1680 kilonewtons of thrust each, giving us a takeoff thrust to weight ratio of 1.28 G's. This is much higher than our goal, which was 1.1 G's. The second stage only uses one RS-25 engine, supplying around 2280 kilonewtons of thrust, giving us an ignition thrust to weight ratio of 2.2 G's. The total vehicle height comes to around 75 meters with a 5 meter diameter, except for the payload fairing which has a slightly wider diameter of 5.4 meters. Our stage 1 mass fraction is 0.93, and our stage 2 mass fraction turned out to be 0.83, which is not great, but that was the best it could be because we had to keep our stage 2 oxidizer tank's total fill volume low. This happened to be around 67% filled, because we wanted to keep the total diameter at 5 meters, and just didn't need that large of a tank due to our propellant mixture ratio in the second stage. The payload mass fraction, after running our STK simulations and finding out the real payload we could get is 8788.6 kilograms. The anticipated first launch for the BRB is going to be on my 24th birthday, August 5th, 2026. This date was chosen primarily because I personally wanted to be able to celebrate even if our launch does not go quite as planned. Of course, hopefully we will be celebrating more than just an unimportant birthday such as mine, but you never know.

Table 4: BRB Vehicle Design

VEHICLE DESIGN DETAILS					
STAGE 1			STAGE 2		
PROPELLANT MIXTURE RATIO = MR = 2.29 (OX = LOX FUEL = KEROSENE)			PROPELLANT MIXTURE RATIO = MR = 5 (OX = LOX; FUEL = LH2)		
TOTAL STAGE MASS	564328	KG	TOTAL STAGE MASS	104754	KG
DIAMETER	5	M	DIAMETER	5	M
LENGTH	39.6	M	LENGTH	35.6	M
INERT MASS	40447	KG	INERT MASS	18177	KG
MASS FRACTION	0.93		MASS FRACTION	0.83	
PROPELLANT	RP-1/LOX		PROPELLANT TYPE	LH2/LOX	
FUEL MASS	160843	KG	FUEL MASS	14575	KG
OXIDIZER MASS	368331	KG	OXIDIZER MASS	72876	KG
ENGINE, # AND TYPE	5	NK-33	ENGINE, # AND TYPE	1	RS-25
ENGINE LENGTH	3.7	M	ENGINE LENGTH	4.3	M
THRUST	1680	KN (EACH)	THRUST	2279	KN (EACH)
ISP	331	S	ISP	452	S
MASS FLOW RATE	2587	KG/S	MASS FLOW RATE	513.97	KG/S
TOTAL BURN TIME	203	S	TOTAL BURN TIME	168.4	S
MASS AT LIFTOFF	669082	KG	IGNITION T/W	2.22	G'S
LIFTOFF T/W	1.280	G'S			
PAYLOAD FAIRING					
DIAMETER	5.4	M	PERFORMANCE		
LENGTH	20.7	M	GTO MISSION (200 x 35786 ALT 27 DEG)	7630	KG
MASS	4085	KG	GEO MISSION (42164 x 42164 RAD 0 DEG)	8788	KG
PAYLOAD MF	0.01		LAUNCHING	AUGUST 5TH, 2026	

3. Design Details and Discussion

3.a. Launch Site

As a company located out of Hanalei on the island of Kauai, Hawaii, we will also be launching out of Hanalei Bay. This beach is located at 22.21441º N, 159.5068º W. This beach is beautiful, and since this is a smaller island, it is able to mitigate the risk factors of launching. Meaning, there is very little land surrounding the islands of Hawaii, so our ascent will not have a high risk of injuring people if something were to go wrong. Later, you will be able to see the ascent and we will assess in depth the risk factors.
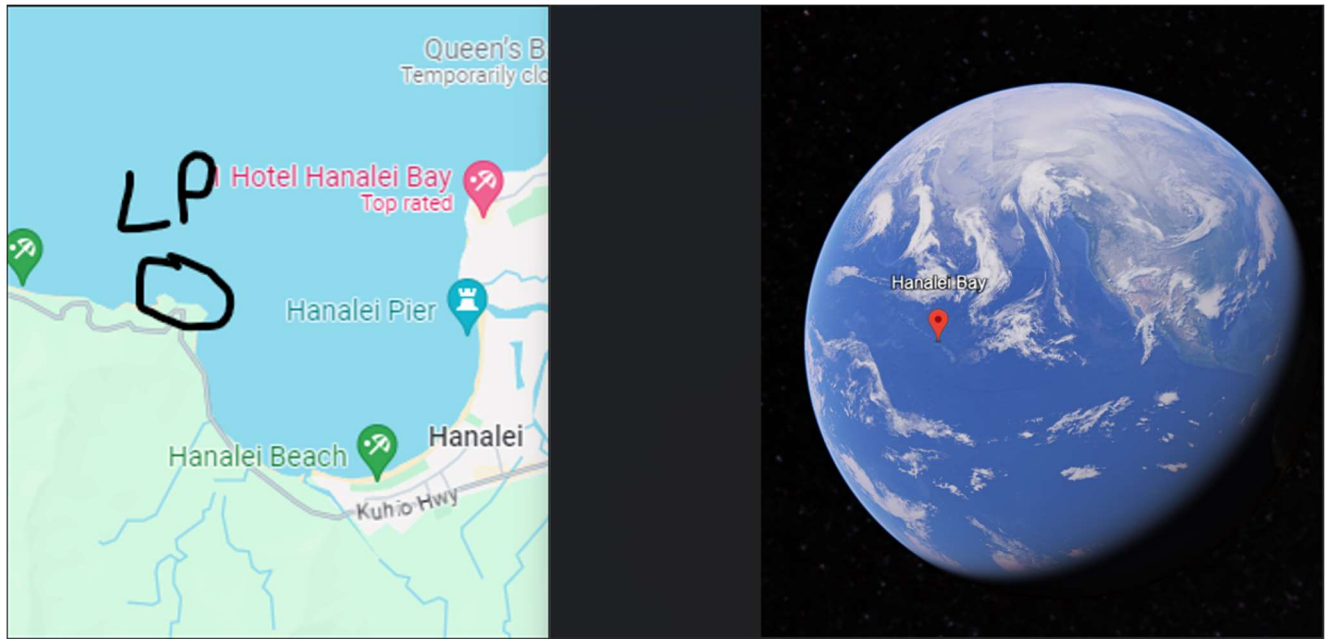
Figure 7: Hanalei Bay

Now that the launch site and location of the launch pad is specified in Figure X, we now have specified our inertial and relative launch azimuth for both missions. The next figure shows the calculations for launch azimuth for the missions. We will be doing the exact same launch for both missions, into a 28.6-degree inclination, and then we will be adjusting during our maneuvers to enter into the final desired orbit. It is also important to note that we cannot technically launch into a 0-degree orbit without changing our inclination a few times during burns. For the GEO mission, we will be launching into a 28.6-degree orbit into LEO and from there we will be able to burn into the desired geosynchronous orbit at 0-degree inclination.

Launch Azimuth Calculation		
Simple Launch Azimuth		
Launch Site Latitude	22.21441	°
Orbit Inclination	28.6	°
Inertial Azimuth	71.509	°

Real Launch Azimuth		
Orbit Radius	6578	km
Injection Inertial Velocity	7.7843	km/s
Earth Velocity	0.4286	km/s
Vx Relative	6.9538	km/s
Vy Relative	2.4688	km/s
Relative Velocity	7.3791	km/s
Relative Azimuth	70.454	°
Delta Azimuth (Inertial–Relative)	1.056	°
Delta V Savings	405.25	m/s

Figure 8: GTO and GEO Missions Launch Azimuth

3.b. Performance Requirements

The performance of this rocket is overall very good. As can be seen in Tables 5 and 6, there are some losses that need to be discussed.

The ascent to LEO has losses calculated from a historical survey of 1,700 m/s, and then gains around 405 m/s from the Earth rotation. These losses are covered from the Delta Videal capability of the first stage, which was around 7700 m/s for both missions without the addition of the Delta V from the first burn. Table 3 shows the first mission details in greater detail. The second stage has losses from three factors, which have to do with mission variability. The first of which being the flight performance reserve or FPR, which is dispersions in flight, and for this factor we used 1% of our ideal velocity. The second of which is launch vehicle development, which is described as uncertainties until flight data is available, for which we used around 1% of our total ideal velocity. The last of which is launch vehicle contingency, which is

flight learning, hardware changes, and anything else during integration. For this we used about

0.5% of our total ideal velocity. This is covered by our second stage delta V as shown in Table 6.

As for the optimized Excel prediction of Delta V split, this is very important.

Figure 9 shows the optimized Delta V split, and Table 1 in the first section ended up being the

values used, to simplify calculations and cut down on the significant figures.

Rocket Evaluator: 2 Stage				
	GTO		GEO	
Total Videal	11843	m/s	13678	m/s
Total Delta V	11843	m/s	13678	m/s
Payload	6000	kg	7000	kg
Stage 2				
MF	0.92		0.92	
Isp	455	s	455	s
Delta V	7921.03151	m/s	8685.7474	m/s
Mass Ratio	5.8979		7.0001	
Total Mass	55641.086	kg	95458.728	kg
Propellant Mass	51189.7992	kg	87822.03	kg
Dry Mass	4451.28688	kg	7636.6982	kg
Stage 1				
MF	0.9		0.9	
Isp	350	s	350	s
Delta V	3921.96849	m/s	4992.2526	m/s
Mass Ratio	3.1339		4.2801	
Total Mass	191568.258	kg	587562.44	kg
Propellant Mass	172411.432	kg	528806.19	kg
Dry Mass	19156.8258	kg	58756.244	kg
Total Liftoff Mass	253209.344	kg	690021.16	kg

Figure 9: GTO and GEO Missions Optimized Rocket Evaluator

Table 5: GTO Mission Rocket Videal Requirements

Rocket Videal Requirements		
Ascent to LEO	9129	m/s
Delta V for Mission	2499.33	m/s
FPR, LVC, LVD	290.70825	m/s
GTO Mission	11919	m/s

Table 6: GEO Mission Rocket Videal Requirements

Rocket Videal Requirements		
Ascent to LEO	13344	m/s
Delta V for Mission	2551.13	m/s
FPR, LVC, LVD	397.37825	m/s
GEO Mission	16293	m/s

Table 7: BRB Pre-Design Requirements

Pre-Design	Big Red Battleship	
Total Delta V	13678	m/s
Payload	7000	kg
Stage 2		
MF	0.92	
Isp	455	s
Delta V	8678	m/s
Mass Ratio	6.988	
Total Mass	95055.78	kg
Propellant Mass (Ideal)	87451.32	kg
Dry Mass	7604.46	kg
Stage 1		
MF	0.9	
Isp	350	s
Delta V	5000	m/s
Mass Ratio	4.2898	
Total Mass	587970.69	kg
Propellant Mass (Ideal)	529173.62	kg
Dry Mass	58797.07	kg
Total Liftoff Mass	**690026.47**	**kg**

Table 8: BRB Real Rocket Design Requirements

Real Rocket	Big Red Battleship	
Total Delta V	12195.17	m/s
Payload	8788.6	kg
Stage 2		
MF	0.83	
Isp	452	s
Delta V	1796.5	m/s
Mass Ratio	1.500	
Total Mass	50939.8	kg
Propellant Mass (Ideal)	25762.8	kg
Dry Mass	25177	kg
Stage 1		
MF	0.93	
Isp	331	s
Delta V	10398.67	m/s
Mass Ratio	24.59	
Total Mass	564329	kg
Propellant Mass (Ideal)	523882	kg
Dry Mass	40447	kg
Total Liftoff Mass	**624057.4**	**kg**

3.c. Payload Fairing and Payload Adapter

For this design, since a 5-meter diameter was chosen for the rest of the rocket, we tried to keep the payload fairing to have the same diameter. However, instead of using the exact 5-meter fairing, we chose to use an existing fairing. We are using the same payload fairing as the Atlas V, which has a 5.4-meter diameter and 20.7 meters in length. Using the same 7075 Aluminum used for the tanks, it weighs around 4085 kilograms total, after the model in SolidWorks shown in Figure 10.

The payload adapter is also based off an existing design from Delta IV. It is the 1575-4 PAF, which has a bottom diameter of 1.575 meters and is about 1.1046 meters in length. This is a feature used to connect the fairing to the rest of the rocket, which is a crucial role if you want to have any payload at all.

Figure 10: Payload Fairing Model

Figure 11: Payload Adapter Model

3.d. Ascent Design

For our specific ascent, we are ideally trying to use a similar ascent burnout time and downrange distance. After doing some quick calculations, we were able to find our burn time for both missions to be around 203 seconds. This gives us a good estimate of downrange distance and altitude. From there, we were able to find our instantaneous impact point and other parameters that go along with finding that. Figure 12 shows our burnout details for the GTO mission, as well as Figure 13 shows the actual ascent. The GTO mission had a slightly lower burn time and after iterations, this came out to a little more than 201 seconds.
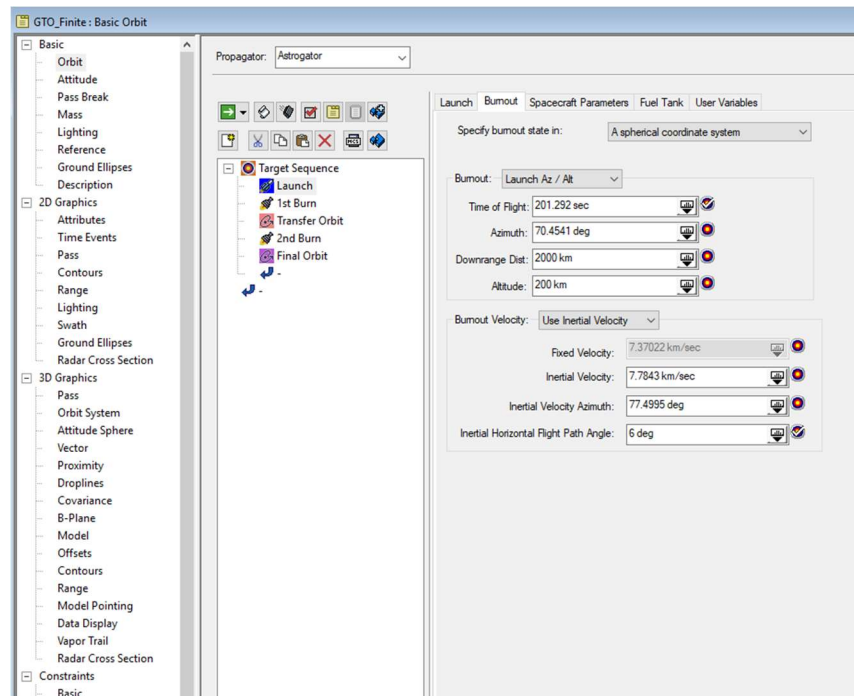
Figure 12: GTO Ascent Burnout

Figure 13: GTO Ascent Profile

For the GEO mission, we have a very similar ascent. With an actual burnout time of 203 seconds, the only major change from the GTO mission came out to be the horizontal

flight path angle and the downrange distance, as shown in Figure 14. Figures 14 and 15 show the

specifics of our ascent profile for this mission.
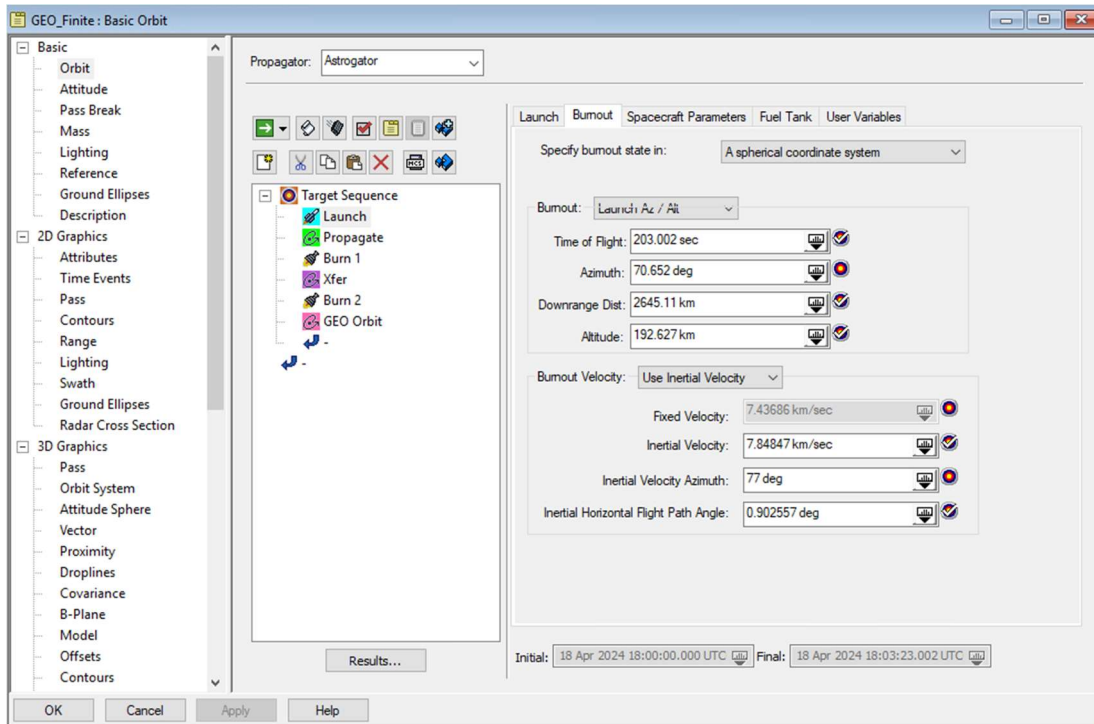
Figure 14: GEO Ascent Burnout

Figure 15: GEO Ascent Profile

4. Vehicle Description and Design Details

The BRB has some interesting design choices. Not to say that they are necessarily bad designs, but it has made for some difficulty when modeling the orbit regime in STK. The first stage of the rocket uses RP-1/LOX for propellant, with RP-1 or Kerosene as the fuel and LOX or liquid oxygen for the oxidizer. This makes for a propellant mixture ratio of 2.29, and with this small mixture ratio, it is much easier to have similar tank sizes. For this rocket, a diameter of 5 meters was chosen to stay somewhat like historical rockets. After running a few calculations, a vertical capsule container was chosen for the shapes of our tanks. There was a calculator used to find the dimensions to get the correct volume in each of the tanks, and then the surface area was calculated. Since there is not a great way to calculate the overall surface area, a SolidWorks model was made, as shown in Figure 16 to be given the actual surface area of all of the tanks. The Stage 1 tanks have a thickness of 5 millimeters, to give them a little more stability to hold everything on top of them.

The second stage of the rocket uses LH2/LOX for propellant, with LH2 or liquid hydrogen as the fuel and LOX or liquid oxygen again as the oxidizer. This gave a propellant mixture ratio of 5, which is much higher than the first stage mixture ratio since hydrogen is so much lighter than oxygen. The hydrogen tank had to be much larger than the oxygen tank for this reason. But again, the same diameter was used. However, one design flaw in this section happened to be the length of the oxidizer tank. Because our necessary oxygen volume was very low, the tank needed to be small. The diameter of 5 meters happened to be much too big, and therefore led to the oxygen fill volume to be only around 63% of the total tank volume. We didn't want the length of the tank to be less than 1 meter, because it might not have been a sturdy

enough tank. This, in the end, led to the mass fraction of the second stage to be 0.83, much lower than desired. It was a necessary decision to keep the structure of the rocket intact, but not optimal. Stage 2 of the rocket had a tank thickness of 2.5 millimeters because in all reality it only must be able to withstand the weight of the payload fairing, which is relatively low compared to the rest of the rocket.

As for the material used, our tanks were all designed using 7075 Aluminum, with a density of 2810 kg/m^3. This is an aluminum alloy that includes zinc and magnesium, making it very light but very strong. It is an optimal material for aerospace structures, because of the high strength-to-weight ratio.
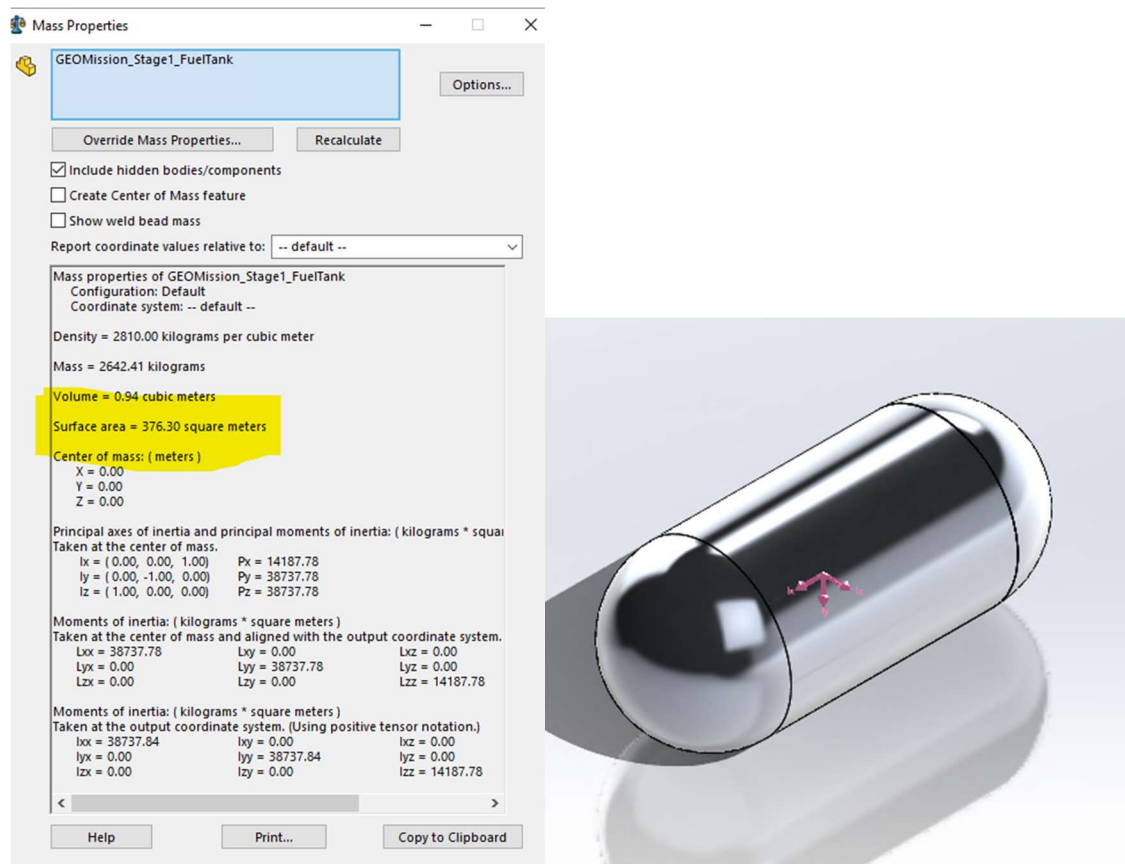
Figure 16: Tank Design and Surface Area

Table 9: BRB Vehicle Tank Design

VEHICLE DESIGN DETAILS					
STAGE 1			STAGE 2		
PROPELLANT MIXTURE RATIO = MR = 2.29 (OX = LOX FUEL = KEROSENE)			PROPELLANT MIXTURE RATIO = MR = 5 (OX = LOX; FUEL = LH2)		
FUEL MASS	160843	KG	FUEL MASS	14575	KG
FUEL DENSITY	0.82	KG/L	FUEL DENSITY	0.071	KG/L
VOLUME OF FUEL	196150.0	L	VOLUME OF FUEL	205284.8	L
FUEL FILL VOLUME %	96.56	%	FUEL FILL VOLUME %	96.38	%
FUEL TANK VOLUME	202894.5	L	FUEL TANK VOLUME	212712	L
DIAMETER	5	M	DIAMETER	5	M
SIDE LENGTH	7	M	SIDE LENGTH	7.5	M
SURFACE AREA	376.30	M^2	SURFACE AREA	392.50	M^2
FUEL TANK THICKNESS	0.005	M	FUEL TANK THICKNESS	0.0025	M
TANK METAL DENSITY	2810	KG/M^3	TANK METAL DENSITY	2810	KG/M^3
TANK SKIN	5287.02	KG	TANK SKIN	2757.31	KG
STRINGER/ISOGRID	1321.754	KG (25%)	STRINGER/ISOGRID	689.328	KG (25%)
INNER-TANK STRUCTURE	1321.754	KG (25%)	INNER-TANK STRUCTURE	689.328	KG (25%)
FUEL TANK MASS	7931	KG	FUEL TANK MASS	4136	KG
OXIDIZER MASS	368331	KG	OXIDIZER MASS	72876	KG
OXIDIZER DENSITY	1.14	KG/L	OXIDIZER DENSITY	1.14	KG/L
VOLUME OF OXIDIZER	323097.0	L	VOLUME OF OXIDIZER	63926.4	L
FILL VOLUME %	95.27	%	FILL VOLUME %	66.90	%
OXIDIZER TANK VOLUME	338375.71	L	OXIDIZER TANK VOLUME	85084.8	L
DIAMETER	5	M	DIAMETER	5	M
SIDE LENGTH	13.9	M	SIDE LENGTH	1	M
SURFACE AREA	592.85	M^2	SURFACE AREA	188.40	M^2
OXIDIZER TANK THICKNESS	0.005	M	OXIDIZER TANK THICKNESS	0.0025	M
TANK METAL DENSITY	2810	KG/M^3	TANK METAL DENSITY	2810	KG/M^3
TANK SKIN	8329.54	KG	TANK SKIN	1323.51	KG
STRINGER/ISOGRID	2082.386	KG (25%)	STRINGER/ISOGRID	330.878	KG (25%)
INTER-TANK STRUCTURE	2082.386	KG (25%)	INTER-TANK STRUCTURE	330.878	KG (25%)
OXIDIZER TANK MASS	12494	KG	OXIDIZER TANK MASS	1985	KG

5. Summary Mass Tables

Table 10: BRB Mass Summary

VEHICLE DESIGN DETAILS					
STAGE 1			STAGE 2		
PROPELLANT MIXTURE RATIO = MR = 2.29 (OX = LOX FUEL = KEROSENE)			PROPELLANT MIXTURE RATIO = MR = 5 (OX = LOX; FUEL = LH2)		
TOTAL STAGE MASS	564328	KG	TOTAL STAGE MASS	104754	KG
MIXTURE RATIO	2.29	OX/FUEL	MIXTURE RATIO	5	OX/FUEL
FUEL USABLE	159235	KG	FUEL USABLE	14429	KG
FUEL UNUSABLE	1608	KG	FUEL UNUSABLE	146	KG
FUEL TANK	7931	KG	FUEL TANK	4136	KG
OXIDIZER USABLE	364647	KG	OXIDIZER USABLE	72147	KG
OXIDIZER UNUSABLE	3683	KG	OXIDIZER UNUSABLE	729	KG
OXIDIZER TANK	12494	KG	OXIDIZER TANK	1985	KG
ENGINE TOTAL MASS	9300	KG	ENGINE TOTAL MASS	9531	KG
ENGINES (#/NAME)	NK-33	+50% ATTACH	ENGINES (#/NAME)	RS-25	+50% ATTACH
FLUID SYSTEMS	3200	KG	FLUID SYSTEMS	450	KG
ELECTRICAL SYSTEMS	900	KG	ATTITUDE CONTROL SYSTEM	250	KG
INTERSTAGE SECTION	730	KG	ELECTRICAL SYSTEMS	370	KG
THRUST SKIRT		KG	PAYLOAD ADAPTER	240	KG
	600		PAYLOAD FAIRING/12	340	XXXX KG

6. Conclusion

In conclusion, I learned that designing a rocket is "astronomically" difficult. There are so many different pieces that get taken into consideration and it is not a simple task. I learned that the phrase, "It's not rocket science" is completely an accurate statement because this was a task that took so much of my time and brain power. Just figuring out the vehicle details was hard, and I think we are all superior because we have now scratched the surface on real rocket science. I am forever going to remember this process and be glad that I was able to learn so many specifics about past real vehicles and everything that goes into them.

Personally, I would not have chosen a GEO mission, because there are so many perturbations that GEO vehicles experience and even though I was able to successfully model the final orbit, I know that it will likely not stay in that orbit for much time. I would also probably

change the fuel and oxidizers or maybe just the diameter for the tanks, to give a better mass fraction for the second stage to get better overall performance.

The STK modeling was by far the hardest part of this project. I spent many hours on the IPOPT optimizer, with it randomly quitting out of STK in the middle of running. I spent many hours researching, trying to figure out how finite maneuvers are different than impulsive and how to seed them. It was a headache, until Dr. Thompson gave us the advice to seed and then run nominal sequences until our orbits were close. After that advice, everything went smoothly, and I was done in just a couple of hours.

I think I may have supplied too much thrust into my vehicle, because the actual payload values were very large, and the velocities were smaller than I would have thought. I had a blast designing the rocket, but I will say it was a lot of work. It was, in the end, a very rewarding experience.

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Appendix 1: GTO Mission

```
                                                                  6 May 2024
13:56:06
Satellite-GTO_Finite


                    Astrogator Mission Control Sequence Summary
----------------------------------------------------------------------------------------------------
--

***------------------------------------------------------------------------***
MCS Segment Type: TargeterSequence
Name: Target Sequence
User Comment:  Sequence that runs targeting profiles

Sequence Start: 18 Apr 2024 18:00:00.000 UTCG;   2460419.25 UTC Julian Date
Sequence Stop:  19 Apr 2024 09:50:58.680 UTCG;   2460419.91040138 UTC Julian Date

***<<<< Start of Sequence: Target Sequence >>>>***


***------------------------------------------------------------------------***
MCS Segment Type: Launch
Name: Target Sequence.Launch
User Comment:  Launches from a central body

---------------------------------
Satellite State at End of Segment:
---------------------------------

UTC Gregorian Date: 18 Apr 2024 18:03:21.292  UTC Julian Date: 2460419.25232976
Julian Ephemeris Date: 2460419.2531305
Time past epoch: 201.292 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     5416.7487561893922248 km          Vx:        2.8738897787607640 km/sec
        Y:    -2252.1394014481488739 km          Vy:        6.9904975469967710 km/sec
        Z:     2966.5803923511784888 km          Vz:        1.8625327044018687 km/sec

Parameter Set Type:  Keplerian
      sma:     6569.3891416694195868 km        RAAN:        273.5876924121594 deg
      ecc:        0.1045305269179706            w:        330.4682482798084 deg
      inc:       29.39827444164072 deg          TA:         96.36002679901326 deg

Parameter Set Type:  Spherical
 Right Asc:        337.4237640461134 deg    Horiz. FPA:        6.000000000000008 deg
     Decl:         26.82572456789899 deg      Azimuth:       77.49951000000001 deg
     |R|:     6573.7278765946057320 km           |V|:        7.7843000000000000 km/sec


Other Elliptic Orbit Parameters :
Ecc. Anom:        90.36200995358985 deg    Mean Anom:         84.37297147554648 deg
Long Peri:       244.0559406919679 deg     Arg. Lat:         66.82827507882172 deg
True Long:       340.4159674909812 deg     Vert FPA:         83.99999999999999 deg
 Ang. Mom:        50891.54505220854 km^2/sec       p:   6497.6078502436175768 km
      C3:       -60.67541941939328 km^2/sec^2   Energy:       -30.33770970969664 km^2/sec^2
  Vel. RA:        67.65176148838977 deg    Vel. Decl:         13.84333216311438 deg
Rad. Peri:     5882.6874331615199480 km    Vel. Peri:        8.6510707275259744 km/sec
 Rad. Apo:     7256.0908501773174066 km     Vel. Apo:        7.013631182824136 km/sec
Mean Mot.:        0.06793663590661209 deg/sec
   Period:     5299.055438877894 sec        Period:         88.31759064796489 min
   Period:        1.471959844132748 hr        Period:        0.06133166017219784 day
             Time Past Periapsis:        1241.936259421622 sec
        Time Past Ascending Node:         888.5176781362532 sec
   Beta Angle (Orbit plane to Sun):       -15.9923466205403 deg
Mean Sidereal Greenwich Hour Angle:        118.182792554942 deg

Geodetic Parameters:
  Latitude:        27.10028007378991 deg
 Longitude:       -140.4749716026563 deg
  Altitude:      200.0000000000050875 km
Geocentric Parameters:
  Latitude:        26.94925620417541 deg
 Longitude:       -140.4749716026563 deg
```

```
Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  24177 kg
      Fuel Mass:  86577 kg
     Total Mass:  110754 kg
Area/Mass Ratio:  1.8058e-10 km^2/kg
  Tank Pressure:  5000                       Pa
   Fuel Density:  1000                       kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


***----------------------------------------------------------------------***
MCS Segment Type: Maneuver:Finite
Name: Target Sequence.1st Burn
User Comment:  Maneuvers satellite with an impulsive burn or finite burn

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 18:03:48.148 [2460419.2526406]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:   7
  Average step size:  3.54714 sec
  Largest step size:  4.372 sec
  Smallest step size:  2.669 sec

Maneuver Summary:
  Maneuver Start: 18 Apr 2024 18:03:21.292 UTCG;   2460419.25232976 UTC Julian Date
  Maneuver Stop:  18 Apr 2024 18:03:48.148 UTCG;   2460419.2526406 UTC Julian Date
  Duration:  26.8566 sec
  Fuel Used:         69499.59903601096 kg
  DeltaV Magnitude:        3205.60053849993 m/sec
  Maneuver Direction Specification:  Thrust Vector
  Maneuver direction is updated during maneuver.
  Burn centering is OFF.
  Thrust Efficiency:  1  (Affects acceleration and mass flow rate)

Thrust vector at maneuver start with respect to VNC(Earth) axes:

        X (Velocity):        0.7646534954127119
         Y (Normal):        -0.1330340430563178
      Z (Co-Normal):         0.6305608419028348
            Azimuth:        -9.869503540342439 deg
          Elevation:        39.09151256539887 deg

Thrust vector at maneuver start with respect to Earth Inertial axes:

               X:        0.8454541483318038
               Y:        0.4140300755817178
               Z:        0.3373223674503983
         Azimuth:        26.09160266351603 deg
       Elevation:        19.71382194159424 deg

Thrust vector at maneuver stop with respect to VNC(Earth) axes:

        X (Velocity):        0.7646534954127122
         Y (Normal):        -0.1330340430563179
      Z (Co-Normal):         0.6305608419028348
            Azimuth:        -9.869503540342444 deg
          Elevation:        39.09151256539886 deg

Thrust vector at maneuver stop with respect to Earth Inertial axes:

               X:        0.9139844599049518
               Y:        0.2219237893636395
               Z:        0.3396796119385687
         Azimuth:        13.64782243957449 deg
       Elevation:        19.85735550644561 deg

Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to VNC(Earth) axes:

        X (Velocity):         2218.587576753201 m/sec
         Y (Normal):         -473.7751963738802 m/sec
```

```
        Z (Co-Normal):            2256.875711466936 m/sec
               Azimuth:           -12.05434506044979 deg
             Elevation:            44.85142933138945 deg
             Magnitude:            3200.012773323278 m/sec


Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to Earth Inertial
axes:

                  X:              2833.524768035917 m/sec
                  Y:              1016.424737115718 m/sec
                  Z:              1085.403101220179 m/sec
            Azimuth:              19.73361613409739 deg
          Elevation:              19.82735648314626 deg
          Magnitude:              3200.012773323278 m/sec


Thrust vector at maneuver start with respect to spacecraft body axes:

                  X:               0.9999999999999999
                  Y:               1.110223024625157e-16
                  Z:              -1.942890293094024e-16
            Azimuth:               6.361109362927035e-15 deg
          Elevation:                               0 deg


Thrust vector at maneuver stop with respect to spacecraft body axes:

                  X:                               1
                  Y:               8.326672684688674e-17
                  Z:              -1.110223024625157e-16
            Azimuth:               4.770832022195275e-15 deg
          Elevation:                               0 deg


Attitude with respect to Earth Inertial axes:
   ---  ----Maneuver Start-----  -----Maneuver Stop-----
   qx:      0.8676266402775205        0.9375910676327158
   qy:      0.1192996089450657        0.05917392907868819
   qz:      0.251078730958344         0.1987617069883293
   qs:      0.4122512428685254        0.2791329787893577

Data for Engine "NK-33":
  UserComment: Engine that has a constant Thrust and Isp
  Description: Engine that has a constant Thrust and Isp

  Engine values at beginning of segment:
           Thrust:                   8400000 N
              Isp:                       331 s
   Mass Flow Rate:       -2587.799452874501 kg/sec

  Engine values at end of segment:
           Thrust:                   8400000 N
              Isp:                       331 s
   Mass Flow Rate:       -2587.799452874501 kg/sec


-------------------------------------
Satellite State at Beginning of Segment:
-------------------------------------


UTC Gregorian Date: 18 Apr 2024 18:03:21.292  UTC Julian Date: 2460419.25232976
Julian Ephemeris Date: 2460419.2531305
Time past epoch: 201.292 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)


State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     5416.7487561893922248 km          Vx:          2.8738897787607640 km/sec
        Y:    -2252.1394014481488739 km          Vy:          6.9904975469967710 km/sec
        Z:     2966.5803923511784888 km          Vz:          1.8625327044018687 km/sec

Parameter Set Type:  Keplerian
      sma:     6569.3891416694195868 km         RAAN:          273.5876924121594 deg
      ecc:        0.1045305269179706             w:          330.4682482798084 deg
      inc:       29.39827444164072 deg           TA:           96.36002679901326 deg

Parameter Set Type:  Spherical
 Right Asc:       337.4237640461134 deg    Horiz. FPA:        6.000000000000008 deg
     Decl:        26.82572456789899 deg     Azimuth:         77.49951000000001 deg
      |R|:     6573.7278765946057320 km       |V|:           7.7843000000000000 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:       90.36200995358985 deg     Mean Anom:        84.37297147554648 deg
 Long Peri:      244.0559406919679 deg      Arg. Lat:         66.82827507882172 deg
```

```
   True Long:        340.4159674909812 deg        Vert FPA:        83.99999999999999 deg
   Ang. Mom:       50891.54505220854 km^2/sec           p:     6497.6078502436175768 km
         C3:        -60.67541941939328 km^2/sec^2   Energy:      -30.33770970969664 km^2/sec^2
    Vel. RA:         67.65176148838977 deg        Vel. Decl:       13.84333216311438 deg
   Rad. Peri:     5882.6874331615199480 km        Vel. Peri:        8.6510707275259744 km/sec
   Rad. Apo:      7256.0908501773174066 km        Vel. Apo:         7.013631182824136 km/sec
   Mean Mot.:        0.06793663590661209 deg/sec
      Period:       5299.055438877894 sec            Period:        88.31759064796489 min
      Period:          1.471959844132748 hr           Period:        0.06133166017219784 day
                  Time Past Periapsis:        1241.936259421622 sec
              Time Past Ascending Node:         888.5176781362532 sec
       Beta Angle (Orbit plane to Sun):         -15.9923466205403 deg
   Mean Sidereal Greenwich Hour Angle:           118.182792554942 deg

Geodetic Parameters:
   Latitude:         27.10028007378991 deg
   Longitude:       -140.4749716026563 deg
   Altitude:        200.0000000000050875 km
Geocentric Parameters:
   Latitude:         26.94925620417541 deg
   Longitude:       -140.4749716026563 deg


Spacecraft Configuration:
      Drag Area:   20 m^2
       SRP Area:   20 m^2
       Dry Mass:   24177 kg
      Fuel Mass:   86577 kg
     Total Mass:   110754 kg
Area/Mass Ratio:   1.8058e-10 km^2/kg
   Tank Pressure:  5000                        Pa
    Fuel Density:  1000                        kg/m^3
             Cr:  1.000000
             Cd:  2.200000
  Rad Press Area:  20 m^2
 Rad Press Coeff:  1.000000


User-selected results:
     Inclination =         29.39827444164072 deg
     Altitude Of Apoapsis =      877.9538501773178041 km


---------------------------------
Satellite State at End of Segment:
---------------------------------


UTC Gregorian Date: 18 Apr 2024 18:03:48.148  UTC Julian Date: 2460419.2526406
Julian Ephemeris Date: 2460419.25344134
Time past epoch: 228.148 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
         X:     5522.5878194338783942 km        Vx:          5.50332533137358936 km/sec
         Y:    -2050.4981002407007509 km        Vy:          8.0873817710882676 km/sec
         Z:     3027.2914317888948972 km        Vz:          2.8357313572950060 km/sec

Parameter Set Type:  Keplerian
       sma:    23969.4596991660437197 km        RAAN:        268.1103485095755 deg
       ecc:        0.7590774561356791           w:           28.30263323072353 deg
       inc:         28.45000000495657 deg        TA:          45.32218762891645 deg

Parameter Set Type:  Spherical
  Right Asc:        339.6303919568498 deg     Horiz. FPA:       19.38835918104542 deg
      Decl:          27.19803400582581 deg     Azimuth:        81.31492955235007 deg
      |R|:         6623.2931458174653017 km        |V|:       10.1849745186237559 km/sec


Other Elliptic Orbit Parameters :
  Ecc. Anom:         17.5669484199924 deg      Mean Anom:        4.440213428795182 deg
  Long Peri:        296.412981740299 deg       Arg. Lat:       73.62482085963998 deg
  True Long:        341.7351693692155 deg      Vert FPA:       70.61164081895458 deg
   Ang. Mom:      63632.53301648804 km^2/sec         p:    10158.2909513521935878 km
         C3:        -16.62951299289689 km^2/sec^2   Energy:      -8.314756496448444 km^2/sec^2
    Vel. RA:         55.76538084133536 deg      Vel. Decl:      16.16610810160588 deg
   Rad. Peri:     5774.7832057764026104 km      Vel. Peri:      11.0190340916759713 km/sec
   Rad. Apo:     42164.1361925556775532 km      Vel. Apo:        1.509162495963162 km/sec
   Mean Mot.:        0.009747744856826349 deg/sec
      Period:      36931.61908601782 sec           Period:       615.5269847669637 min
      Period:         10.25878307944939 hr           Period:        0.427449294977058 day
```

```
          Time Past Periapsis:              455.51186392468 sec
     Time Past Ascending Node:         723.8065070297775 sec
  Beta Angle (Orbit plane to Sun):     -13.9658707061829 deg
Mean Sidereal Greenwich Hour Angle:      118.295001532406 deg


Geodetic Parameters:
  Latitude:          27.47484157105175 deg
 Longitude:         -138.3785219383196 deg
  Altitude:         249.6788207578685785 km
Geocentric Parameters:
  Latitude:          27.32354460513545 deg
 Longitude:         -138.3785219383196 deg




Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  24177 kg
      Fuel Mass:  17077.4 kg
     Total Mass:  41254.4 kg
Area/Mass Ratio:  4.84797e-10 km^2/kg
  Tank Pressure:  5000                     Pa
  Fuel Density:   1000                     kg/m^3
            Cr:  1.000000
            Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000




User-selected results:
    Inclination =          28.45000000495657 deg
    Altitude Of Apoapsis =    35785.9991925556823844 km


***--------------------------------------------------------------------------***
MCS Segment Type: Propagate
Name: Target Sequence.Transfer Orbit
User Comment:  Propagates until stopping conditions are met

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 19:57:08.648 [2460419.33135009]:  Stopped on: DescendingNode; Run Sequence STOP

Propagation Statistics:
  Number of steps:    39
  Average step size:  176.131 sec
  Largest step size:  396.681 sec
  Smallest step size:  56.17 sec


--------------------------------
Satellite State at End of Segment:
--------------------------------

UTC Gregorian Date: 18 Apr 2024 19:57:08.648  UTC Julian Date: 2460419.33135009
Julian Ephemeris Date: 2460419.33215083
Time past epoch: 7028.65 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     1049.0635996019611866 km          Vx:       -1.7525673240103403 km/sec
        Y:    30534.2528662857366726 km          Vy:        2.3206818764085266 km/sec
        Z:       -0.0000000000003492 km          Vz:       -0.9926328910941733 km/sec

Parameter Set Type:  Keplerian
      sma:  23939.0452027981591527 km          RAAN:         268.032266136084 deg
      ecc:     0.7586671839711197              w:           28.38657052852542 deg
      inc:       28.46041386889527 deg          TA:          151.6134294714746 deg

Parameter Set Type:  Spherical
 Right Asc:        88.032266136084 deg     Horiz. FPA:        47.32357930947489 deg
     Decl:                      0 deg      Azimuth:          118.4604138688953 deg
     |R|:   30552.2688607292875531 km          |V|:            3.0728450421656053 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:        111.3539803377681 deg     Mean Anom:         70.86972181547556 deg
 Long Peri:        296.4188366646094 deg     Arg. Lat:                       180 deg
 True Long:         88.032266136084 deg     Vert FPA:          42.67642069052509 deg
  Ang. Mom:      63638.84960332949 km^2/sec         p:       10160.3078099831691361 km
```

```
        C3:         -16.65064074708414 km^2/sec^2   Energy:       -8.325320373542068 km^2/sec^2
    Vel. RA:         127.05991971191 deg      Vel. Decl:      -18.84649741557703 deg
  Rad. Peri:     5777.2771918339385593 km      Vel. Peri:     11.0153706478341888 km/sec
   Rad. Apo:    42100.8132137623833842 km      Vel. Apo:       1.511582431441646 km/sec
  Mean Mot.:       0.00976632748376929 deg/sec
     Period:        36861.34840330573 sec       Period:      614.3558067217622 min
     Period:          10.2392634453627 hr        Period:      0.4266359768901126 day
               Time Past Periapsis:        7256.537519682225 sec
            Time Past Ascending Node:      7525.888704387622 sec
   Beta Angle (Orbit plane to Sun):       -13.9133561952546 deg
 Mean Sidereal Greenwich Hour Angle:        146.707997613711 deg


Geodetic Parameters:
  Latitude:      0.006811155777026054 deg
 Longitude:      -58.36440787049353 deg
  Altitude:    24174.1318610305643233 km
Geocentric Parameters:
  Latitude:      0.006801636991406729 deg
 Longitude:      -58.36440787049353 deg



Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  24177 kg
      Fuel Mass:  17077.4 kg
     Total Mass:  41254.4 kg
Area/Mass Ratio:  4.84797e-10 km^2/kg
  Tank Pressure:  5000                    Pa
   Fuel Density:  1000                    kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000



***---------------------------------------------------------------------***
MCS Segment Type: Maneuver:Finite
Name: Target Sequence.2nd Burn
User Comment:  Maneuvers satellite with an impulsive burn or finite burn

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 19:57:38.680 [2460419.33169768]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:    10
  Average step size:  2.8713 sec
  Largest step size:  3.248 sec
  Smallest step size:  1.865 sec

Maneuver Summary:
  Maneuver Start: 18 Apr 2024 19:57:08.648 UTCG;   2460419.33135009 UTC Julian Date
  Maneuver Stop:  18 Apr 2024 19:57:38.680 UTCG;   2460419.33169768 UTC Julian Date
  Duration:  30.0315 sec
  Fuel Used:        15447.31698555172 kg
  DeltaV Magnitude:       2079.374255082182 m/sec
  Maneuver Direction Specification:  Thrust Vector
  Maneuver direction is updated during maneuver.
  Burn centering is OFF.
  Thrust Efficiency:  1   (Affects acceleration and mass flow rate)

Thrust vector at maneuver start with respect to VNC(Earth) axes:

       X (Velocity):        0.06353958154086686
          Y (Normal):        0.9976874406075644
     Z (Co-Normal):        -0.02413487997771629
           Azimuth:         86.35593312403097 deg
         Elevation:         -1.382961044666506 deg

Thrust vector at maneuver start with respect to Earth Inertial axes:

             X:         -0.527560191215157
             Y:          0.04849715884069545
             Z:          0.8481322244965152
       Azimuth:          174.7477182349031 deg
     Elevation:          58.00909725621557 deg

Thrust vector at maneuver stop with respect to VNC(Earth) axes:
```

```
        X (Velocity):        0.06353958154086681
        Y (Normal):          0.9976874406075649
    Z (Co-Normal):          -0.02413487997771618
           Azimuth:          86.35593312403097 deg
         Elevation:          -1.382961044666499 deg
```

Thrust vector at maneuver stop with respect to Earth Inertial axes:

```
              X:        0.3990525075727459
              Y:        0.01652235613538587
              Z:        0.9167792034877531
        Azimuth:        2.370918267183928 deg
      Elevation:        66.45967462784358 deg
```

Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to VNC(Earth) axes:

```
        X (Velocity):        -515.5319871115299 m/sec
        Y (Normal):          1818.501565911888 m/sec
    Z (Co-Normal):           651.5680629705391 m/sec
           Azimuth:          105.82764807443 deg
         Elevation:          19.01984247496527 deg
         Magnitude:          1999.315411745314 m/sec
```

Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to Earth Inertial axes:

```
              X:        -136.0163243843112 m/sec
              Y:         67.3643267990289 m/sec
              Z:         1993.545515562218 m/sec
        Azimuth:        153.6523277413315 deg
      Elevation:        85.64602958525248 deg
      Magnitude:        1999.315411745314 m/sec
```

Thrust vector at maneuver start with respect to spacecraft body axes:

```
              X:        1
              Y:       -2.081668171172169e-17
              Z:        1.110223024625157e-16
        Azimuth:       -1.192708005548819e-15 deg
      Elevation:                            0 deg
```

Thrust vector at maneuver stop with respect to spacecraft body axes:

```
              X:        1
              Y:       -3.469446951953614e-18
              Z:        5.551115123125783e-17
        Azimuth:       -1.987846675914698e-16 deg
      Elevation:                            0 deg
```

Attitude with respect to Earth Inertial axes:

---	----Maneuver Start-----	-----Maneuver Stop-----
qx:	0.4858263945548562	0.8363429119044015
qy:	0.0249560127775332	0.004938870139331325
qz:	0.8735887436510535	0.5481326060137035
qs:	0.01387871558360735	0.007535747716025508

Data for Engine "RS-25":
  UserComment: Engine that has a constant Thrust and Isp
  Description: Engine that has a constant Thrust and Isp

  Engine values at beginning of segment:
```
           Thrust:               2280000 N
              Isp:                   452 s
    Mass Flow Rate:      -514.3701251304594 kg/sec
```

  Engine values at end of segment:
```
           Thrust:               2280000 N
              Isp:                   452 s
    Mass Flow Rate:      -514.3701251304594 kg/sec
```

Satellite State at Beginning of Segment:

UTC Gregorian Date: 18 Apr 2024 19:57:08.648 UTC Julian Date: 2460419.33135009
Julian Ephemeris Date: 2460419.33215083
Time past epoch: 7028.65 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

```
Parameter Set Type:  Cartesian
        X:      1049.0635996019611866 km          Vx:        -1.7525673240103403 km/sec
        Y:     30534.2528662857366726 km          Vy:         2.3206818764085266 km/sec
        Z:        -0.0000000000003492 km          Vz:        -0.9926328910941733 km/sec

Parameter Set Type:  Keplerian
      sma:     23939.0452027981591527 km        RAAN:          268.032266136084 deg
      ecc:         0.7586671839711197            w:           28.38657052852542 deg
      inc:        28.46041386889527 deg         TA:          151.6134294714746 deg

Parameter Set Type:  Spherical
 Right Asc:           88.032266136084 deg   Horiz. FPA:        47.32357930947489 deg
     Decl:                         0 deg     Azimuth:         118.4604138688953 deg
     |R|:      30552.2688607292875531 km         |V|:          3.0728450421656053 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:         111.3539803377681 deg    Mean Anom:        70.86972181547556 deg
 Long Peri:         296.4188366646094 deg     Arg. Lat:                      180 deg
 True Long:          88.032266136084 deg     Vert FPA:        42.67642069052509 deg
 Ang. Mom:        63638.84960332949 km^2/sec         p:     10160.3078099831691361 km
       C3:       -16.65064074708414 km^2/sec^2   Energy:      -8.325320373542068 km^2/sec^2
  Vel. RA:         127.05991971191 deg     Vel. Decl:        -18.84649741557703 deg
Rad. Peri:    5777.2771918339385593 km     Vel. Peri:       11.0153706478341888 km/sec
 Rad. Apo:   42100.8132137623833842 km      Vel. Apo:        1.511582431441646 km/sec
Mean Mot.:        0.00976632748376929 deg/sec
   Period:        36861.34840330573 sec        Period:          614.3558067217622 min
   Period:        10.2392634453627 hr          Period:        0.4266359768901126 day
                    Time Past Periapsis:        7256.537519682225 sec
                Time Past Ascending Node:       7525.888704387622 sec
         Beta Angle (Orbit plane to Sun):       -13.9133561952546 deg
Mean Sidereal Greenwich Hour Angle:              146.707997613711 deg

Geodetic Parameters:
  Latitude:       0.006811155777026054 deg
 Longitude:     -58.36440787049353 deg
  Altitude:   24174.1318610305643233 km
Geocentric Parameters:
  Latitude:       0.0068011636991406729 deg
 Longitude:     -58.36440787049353 deg



Spacecraft Configuration:
     Drag Area:   20 m^2
      SRP Area:   20 m^2
      Dry Mass:   24177 kg
     Fuel Mass:   17077.4 kg
    Total Mass:   41254.4 kg
Area/Mass Ratio:   4.84797e-10 km^2/kg
  Tank Pressure:   5000               Pa
  Fuel Density:   1000                kg/m^3
           Cr:   1.000000
           Cd:   2.200000
 Rad Press Area:   20 m^2
 Rad Press Coeff:   1.000000



User-selected results:
     Inclination =          28.46041386889527 deg
     Altitude Of Periapsis =    -600.8598081660614980 km


----------------------------------
Satellite State at End of Segment:
----------------------------------

UTC Gregorian Date: 18 Apr 2024 19:57:38.680  UTC Julian Date: 2460419.33169768
Julian Ephemeris Date: 2460419.33249842
Time past epoch: 7058.68 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)


State Vector in Coordinate System: Earth Inertial


Parameter Set Type:  Cartesian
        X:       989.6605469544043672 km          Vx:        -1.8890103506182041 km/sec
        Y:     30604.8553450422878086 km          Vy:         2.3752568342983578 km/sec
        Z:        -2.5928631351034386 km          Vz:         1.0009152943974595 km/sec


Parameter Set Type:  Keplerian
      sma:     25191.9399978571273095 km        RAAN:          88.15740977373817 deg
      ecc:         0.7388824612525264            w:          212.0126412580731 deg
      inc:        26.99999894901263 deg         TA:          147.9766721752009 deg
```

```
Parameter Set Type:  Spherical
 Right Asc:          88.14788797295243 deg      Horiz. FPA:       46.36608250130119 deg
     Decl:    -0.004851599571413233 deg         Azimuth:       63.00000145412321 deg
      |R|:    30620.8524605717138911 km             |V|:        3.1956277255310139 km/sec


Other Elliptic Orbit Parameters :
Ecc. Anom:         106.9573235953855 deg      Mean Anom:       66.46310038126174 deg
Long Peri:         300.1700510318113 deg       Arg. Lat:      359.989313433274 deg
True Long:         88.14672320701223 deg       Vert FPA:       43.63391749869881 deg
 Ang. Mom:       67523.17105224609 km^2/sec          p:    11438.4685872227892105 km
       C3:      -15.82253853946563 km^2/sec^2   Energy:        -7.911269269732815 km^2/sec^2
  Vel. RA:        128.4947659465087 deg       Vel. Decl:       18.25302731729555 deg
Rad. Peri:     6578.0573685144872798 km       Vel. Peri:      10.2649106369065830 km/sec
 Rad. Apo:     43805.8226271997627919 km       Vel. Apo:       1.541419998589864 km/sec
Mean Mot.:        0.009046885634846239 deg/sec
   Period:        39792.69933659536 sec          Period:        663.2116556099227 min
   Period:        11.05352759349871 hr           Period:        0.460563649729113 day
                Time Past Periapsis:         7346.517140137513 sec
           Time Past Ascending Node:        39790.10884460357 sec
     Beta Angle (Orbit plane to Sun):         34.1993794541355 deg
Mean Sidereal Greenwich Hour Angle:         146.833471632991 deg

Geodetic Parameters:
   Latitude:        0.001680866478201092 deg
  Longitude:         -58.37427166530373 deg
   Altitude:     24242.7154605900650495 km
Geocentric Parameters:
   Latitude:        0.001678522680397961 deg
  Longitude:         -58.37427166530373 deg



Spacecraft Configuration:
       Drag Area:  20 m^2
        SRP Area:  20 m^2
        Dry Mass:  24177 kg
       Fuel Mass:  1630.08 kg
      Total Mass:  25807.1 kg
Area/Mass Ratio:  7.74981e-10 km^2/kg
   Tank Pressure:  5000                    Pa
    Fuel Density:  1000                    kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


User-selected results:
    Inclination =          26.99999894901263 deg
    Altitude Of Periapsis =      199.9203685144875067 km


***------------------------------------------------------------------------***
MCS Segment Type: Propagate
Name: Target Sequence.Final Orbit
User Comment:  Propagates until stopping conditions are met

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  19 Apr 2024 09:50:58.680 [2460419.91040138]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:    144
  Average step size:  340.853 sec
  Largest step size:  1174.8 sec
  Smallest step size:  42.861 sec


----------------------------------
Satellite State at End of Segment:
----------------------------------

UTC Gregorian Date: 19 Apr 2024 09:50:58.680  UTC Julian Date: 2460419.91040138
Julian Ephemeris Date: 2460419.91120212
Time past epoch: 57058.7 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type: Cartesian
        X:    -16512.1531677728926297 km            Vx:       -1.3916785270845768 km/sec
```

```
        Y:      39070.1380465929541970 km          Vy:       -0.3510001046451707 km/sec
        Z:       9104.2713461750099668 km          Vz:        0.7023476923260290 km/sec


Parameter Set Type:  Keplerian
        sma:    25191.2668613277783152 km         RAAN:       87.99421165305458 deg
        ecc:        0.7388302981469499              w:       212.2829037469151 deg
        inc:       26.99822263692294 deg           TA:       175.2519946437011 deg


Parameter Set Type:  Spherical
 Right Asc:        112.9103040043128 deg    Horiz. FPA:       13.05660292188767 deg
     Decl:         12.11426199685033 deg      Azimuth:       65.68766288046889 deg
     |R|:      43382.1927288214210421 km         |V|:        1.5978931369540694 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:       167.7882300893157 deg    Mean Anom:      158.8339594562478 deg
 Long Peri:       300.2771153999697 deg     Arg. Lat:       27.53489839061623 deg
 True Long:       115.5291100436708 deg     Vert FPA:       76.94339707811233 deg
 Ang. Mom:      67528.00012909836 km^2/sec        p:    11440.1047431742717890 km
        C3:       -15.82296133394979 km^2/sec^2  Energy:     -7.911480666974893 km^2/sec^2
  Vel. RA:        194.155544828662 deg    Vel. Decl:       26.07492395222288 deg
 Rad. Peri:      6579.1956554735970712 km   Vel. Peri:      10.2638686649967728 km/sec
 Rad. Apo:     43803.3380671819613781 km    Vel. Apo:       1.541617673646914 km/sec
 Mean Mot.:        0.009047248250385522 deg/sec
    Period:      39791.10443715962 sec        Period:      663.1850739526603 min
    Period:         11.05308456587767 hr        Period:        0.460545190244903 day
               Time Past Periapsis:        17556.05185803093 sec
          Time Past Ascending Node:        10271.27834121336 sec
     Beta Angle (Orbit plane to Sun):        34.2069197779275 deg
 Mean Sidereal Greenwich Hour Angle:        355.737202794441 deg

Geodetic Parameters:
  Latitude:        12.07533980182467 deg
  Longitude:      117.5111921625063 deg
  Altitude:     37004.9892213155326317 km
Geocentric Parameters:
  Latitude:        12.06380212158851 deg
  Longitude:      117.5111921625063 deg




Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  24177 kg
      Fuel Mass:  1630.08 kg
     Total Mass:  25807.1 kg
Area/Mass Ratio:  7.74981e-10 km^2/kg
   Tank Pressure:  5000                  Pa
   Fuel Density:  1000                  kg/m^3
            Cr:  1.000000
            Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000




***<<<< End of Sequence: Target Sequence >>>>***


----------------------------------
Satellite State at End of Segment:
----------------------------------

UTC Gregorian Date: 19 Apr 2024 09:50:58.680  UTC Julian Date: 2460419.91040138
Julian Ephemeris Date: 2460419.91120212
Time past epoch: 57058.7 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     -16512.1531677728926297 km          Vx:       -1.3916785270845768 km/sec
        Y:      39070.1380465929541970 km          Vy:       -0.3510001046451707 km/sec
        Z:       9104.2713461750099668 km          Vz:        0.7023476923260290 km/sec

Parameter Set Type:  Keplerian
        sma:    25191.2668613277783152 km         RAAN:       87.99421165305458 deg
        ecc:        0.7388302981469499              w:       212.2829037469151 deg
        inc:       26.99822263692294 deg           TA:       175.2519946437011 deg

Parameter Set Type:  Spherical
```

```
 Right Asc:        112.9103040043128 deg      Horiz. FPA:        13.05660292188767 deg
     Decl:        12.11426199685033 deg        Azimuth:        65.68766288046889 deg
      |R|:    43382.1927288214210421 km            |V|:     1.5978931369540694 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:        167.7882300893157 deg       Mean Anom:        158.8339594562478 deg
 Long Peri:        300.2771153999697 deg        Arg. Lat:        27.53489839061623 deg
 True Long:        115.5291100436708 deg        Vert FPA:        76.94339707811233 deg
 Ang. Mom:      67528.00012909836 km^2/sec             p:    11440.1047431742717890 km
       C3:       -15.82296133394979 km^2/sec^2   Energy:        -7.911480666974893 km^2/sec^2
  Vel. RA:         194.155544828662 deg       Vel. Decl:        26.07492395222288 deg
 Rad. Peri:     6579.1956554735970712 km       Vel. Peri:        10.2638686649967728 km/sec
 Rad. Apo:     43803.3380671819613781 km       Vel. Apo:         1.541617673646914 km/sec
 Mean Mot.:        0.009047248250385522 deg/sec
    Period:       39791.10443715962 sec          Period:        663.1850739526603 min
    Period:       11.05308456587767 hr           Period:        0.460545190244903 day
                   Time Past Periapsis:        17556.05185803093 sec
            Time Past Ascending Node:        10271.27834121336 sec
    Beta Angle (Orbit plane to Sun):        34.2069197779275 deg
Mean Sidereal Greenwich Hour Angle:        355.737202794441 deg

Geodetic Parameters:
  Latitude:        12.07533980182467 deg
 Longitude:        117.5111921625063 deg
  Altitude:    37004.9892213155326317 km
Geocentric Parameters:
  Latitude:        12.06380212158851 deg
 Longitude:        117.5111921625063 deg



Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  24177 kg
      Fuel Mass:  1630.08 kg
     Total Mass:  25807.1 kg
Area/Mass Ratio:  7.74981e-10 km^2/kg
  Tank Pressure:  5000                     Pa
   Fuel Density:  1000                     kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000
```

Appendix 2: GEO Mission

```
7 May 2024 12:54:05
Satellite-GEO_Finite


                              Astrogator Mission Control Sequence Summary
------------------------------------------------------------------------------------------------------
--

***------------------------------------------------------------------------***
MCS Segment Type: TargeterSequence
Name: Target Sequence
User Comment:  Sequence that runs targeting profiles

Sequence Start: 18 Apr 2024 18:00:00.000 UTCG;   2460419.25 UTC Julian Date
Sequence Stop:  19 Apr 2024 23:58:22.238 UTCG;   2460420.49886849 UTC Julian Date

***<<<< Start of Sequence: Target Sequence >>>>***


***------------------------------------------------------------------------***
MCS Segment Type: Launch
Name: Target Sequence.Launch
User Comment:  Launches from a central body

---------------------------------
Satellite State at End of Segment:
---------------------------------

UTC Gregorian Date: 18 Apr 2024 18:03:23.002  UTC Julian Date: 2460419.25234956
Julian Ephemeris Date: 2460419.2531503
Time past epoch: 203.002 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     5581.6507134820158171 km          Vx:         1.4398212167217865 km/sec
        Y:    -1614.4237835941567027 km          Vy:         7.5433372697922740 km/sec
        Z:     3058.1134835113398367 km          Vz:         1.6197299647131274 km/sec

Parameter Set Type:  Keplerian
      sma:     6664.03541062924434153 km        RAAN:        280.2355925504788 deg
      ecc:        0.0215450075714396              w:         18.97499506799573 deg
      inc:       30.43113673637659 deg           TA:         47.88272276616588 deg

Parameter Set Type:  Spherical
 Right Asc:       343.8681378127961 deg    Horiz. FPA:        0.9025566437477914 deg
     Decl:        27.75844995937011 deg      Azimuth:        77.00000000000001 deg
      |R|:      6566.0678429622266776 km        |V|:         7.8484742122624667 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:        46.973531412369 deg        Mean Anom:        46.07110962589154 deg
 Long Peri:       299.2105876184746 deg        Arg. Lat:        66.85771783416162 deg
 True Long:       347.0933103846405 deg        Vert FPA:        89.0974433562522 deg
  Ang. Mom:     51527.22039669604 km^2/sec          p:      6660.9420496833254219 km
       C3:        -59.81367398862045 km^2/sec^2   Energy:       -29.90683699431023 km^2/sec^2
  Vel. RA:        79.19375100800386 deg       Vel. Decl:        11.91001029166519 deg
 Rad. Peri:      6520.4587172508945514 km      Vel. Peri:        7.9023919376059704 km/sec
  Rad. Apo:      6807.6121040075922792 km       Vel. Apo:        7.569059401366645 km/sec
 Mean Mot.:        0.0664944772198694 deg/sec
    Period:      5413.983462260042 sec          Period:        90.23305770433403 min
    Period:         1.503884295072234 hr         Period:        0.06266184562800974 day
            Time Past Periapsis:          692.8561822292951 sec
        Time Past Ascending Node:         966.3275567750585 sec
   Beta Angle (Orbit plane to Sun):        -18.1164483603722 deg
Mean Sidereal Greenwich Hour Angle:         118.189940209234 deg

Geodetic Parameters:
  Latitude:         28.04194560334612 deg
 Longitude:       -134.0313577404746 deg
  Altitude:       192.6269758285023102 km
Geocentric Parameters:
  Latitude:          27.8872364666855 deg
```

```
 Longitude:        -134.0313577404746 deg



Spacecraft Configuration:
     Drag Area:  20 m^2
      SRP Area:  20 m^2
      Dry Mass:  25177 kg
     Fuel Mass:  86577 kg
    Total Mass:  111754 kg
Area/Mass Ratio:  1.78965e-10 km^2/kg
  Tank Pressure:  5000                     Pa
   Fuel Density:  1000                     kg/m^3
           Cr:  1.000000
           Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000



User-selected results:
    Inclination =         30.43113673637659 deg
    Altitude Of Periapsis =     142.3217172508947499 km

***-----------------------------------------------------------------------***
MCS Segment Type: Propagate
Name: Target Sequence.Propagate
User Comment:  Propagates until stopping conditions are met

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 18:31:19.162 [2460419.27174956]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:    25
  Average step size:  65.7514 sec
  Largest step size:  68.64 sec
  Smallest step size: 57.565 sec

---------------------------------
Satellite State at End of Segment:
---------------------------------

UTC Gregorian Date: 18 Apr 2024 18:31:19.162  UTC Julian Date: 2460419.27174956
Julian Ephemeris Date: 2460419.2725503
Time past epoch: 1879.16 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
         X:     -948.0990692947467551 km          Vx:     -6.49752730990012583 km/sec
         Y:     6724.3100840755178069 km          Vy:     -0.7781963968385451 km/sec
         Z:      141.9928316196911169 km          Vz:     -3.8427376710588077 km/sec

Parameter Set Type:  Keplerian
        sma:    6667.9938608346228648 km        RAAN:      280.0629120792789 deg
        ecc:       0.0200601398023562           w:       18.88263543083443 deg
        inc:      30.46212516488662 deg         TA:      158.7540913739647 deg

Parameter Set Type:  Spherical
  Right Asc:       98.02555765058182 deg    Horiz. FPA:       0.4244234898675638 deg
     Decl:        1.19785305553566 deg      Azimuth:      120.4408251904399 deg
      |R|:     6792.3044628630013904 km        |V|:       7.5888130549869031 km/sec

Other Elliptic Orbit Parameters :
  Ecc. Anom:       158.3336244838633 deg    Mean Anom:       157.9092786369025 deg
  Long Peri:       298.9455475101134 deg    Arg. Lat:       177.6367268047992 deg
  True Long:        97.69963888407814 deg   Vert FPA:        89.57557651013244 deg
  Ang. Mom:     51544.11457554129 km^2/sec       p:     6665.3105987001990798 km
       C3:      -59.77816564007871 km^2/sec^2  Energy:      -29.88908282003936 km^2/sec^2
   Vel. RA:       186.8296738753494 deg    Vel. Decl:      -30.42225429918352 deg
 Rad. Peri:     6534.2329717850279849 km    Vel. Peri:       7.8883190725078220 km/sec
  Rad. Apo:     6801.7547498842177447 km    Vel. Apo:       7.578061319605607 km/sec
  Mean Mot.:       0.06643527440393938 deg/sec
    Period:     5418.808053852988 sec         Period:       90.31346756421645 min
    Period:        1.505224459403608 hr       Period:        0.06271768580848365 day
              Time Past Periapsis:        2376.889085710453 sec
             Time Past Ascending Node:      2650.0747086246 sec
       Beta Angle (Orbit plane to Sun):     -18.1107625006842 deg
  Mean Sidereal Greenwich Hour Angle:       125.193061806694 deg
```

```
Geodetic Parameters:
  Latitude:           1.188669322059944 deg
 Longitude:          -26.85341469897669 deg
  Altitude:          414.1765924590307577 km
Geocentric Parameters:
  Latitude:           1.181199261575471 deg
 Longitude:          -26.85341469897669 deg



Spacecraft Configuration:
        Drag Area:  20 m^2
         SRP Area:  20 m^2
         Dry Mass:  25177 kg
        Fuel Mass:  86577 kg
       Total Mass:  111754 kg
Area/Mass Ratio:  1.78965e-10 km^2/kg
    Tank Pressure:  5000                     Pa
     Fuel Density:  1000                     kg/m^3
               Cr:  1.000000
               Cd:  2.200000
   Rad Press Area:  20 m^2
  Rad Press Coeff:  1.000000



***----------------------------------------------------------------------***
MCS Segment Type: Maneuver:Finite
Name: Target Sequence.Burn 1
User Comment:  Maneuvers satellite with an impulsive burn or finite burn

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 18:31:42.663 [2460419.27202156]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:    6
  Average step size:  3.788 sec
  Largest step size:  4.916 sec
  Smallest step size:  2.793 sec

Maneuver Summary:
  Maneuver Start: 18 Apr 2024 18:31:19.162 UTCG;   2460419.27174956 UTC Julian Date
  Maneuver Stop: 18 Apr 2024 18:31:42.663 UTCG;   2460419.27202156 UTC Julian Date
  Duration:  23.5004 sec
  Fuel Used:         60814.22368555627 kg
  DeltaV Magnitude:        2550.240112834776 m/sec
  Maneuver Direction Specification:  Thrust Vector
  Maneuver direction is updated during maneuver.
  Burn centering is OFF.
  Thrust Efficiency:  1  (Affects acceleration and mass flow rate)

Thrust vector at maneuver start with respect to VNC(Earth) axes:

      X (Velocity):        0.9667098613104743
        Y (Normal):        0.2478576488849686
   Z (Co-Normal):         -0.063355021584778307
          Azimuth:         14.38046727449168 deg
        Elevation:         -3.643614502546983 deg

Thrust vector at maneuver start with respect to Earth Inertial axes:

             X:          -0.9429503891652212
             Y:          -0.1840513192393945
             Z:          -0.2774340921000816
       Azimuth:        -168.9554893416175 deg
     Elevation:         -16.10712282503814 deg

Thrust vector at maneuver stop with respect to VNC(Earth) axes:

      X (Velocity):        0.9667098613104743
        Y (Normal):        0.2478576488849686
   Z (Co-Normal):         -0.06355021584778303
          Azimuth:         14.38046727449168 deg
        Elevation:         -3.64361450254698 deg

Thrust vector at maneuver stop with respect to Earth Inertial axes:

             X:          -0.9515335775094859
             Y:          -0.2275285118336997
```

```
              Z:           -0.2069169571947682
        Azimuth:           -166.5520756277884 deg
      Elevation:           -11.94173896709813 deg
```

Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to VNC(Earth) axes:

```
      X (Velocity):         2434.526790297317 m/sec
       Y (Normal):          724.4577554509609 m/sec
   Z (Co-Normal):          -219.6126848149731 m/sec
          Azimuth:           16.57176384169037 deg
        Elevation:           -4.9415394860145 deg
        Magnitude:          2549.507690406139 m/sec
```

Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to Earth Inertial axes:

```
              X:           -2416.802150549619 m/sec
              Y:           -531.4102547609917 m/sec
              Z:           -613.7262986654829 m/sec
        Azimuth:           -167.5990538346283 deg
      Elevation:           -13.92924315808252 deg
      Magnitude:            2549.507690406138 m/sec
```

Thrust vector at maneuver start with respect to spacecraft body axes:

```
              X:                             1
              Y:                             0
              Z:           2.775557561562891e-16
        Azimuth:                             0 deg
      Elevation:                             0 deg
```

Thrust vector at maneuver stop with respect to spacecraft body axes:

```
              X:                             1
              Y:           2.775557561562891e-17
              Z:           4.996003610813204e-16
        Azimuth:           1.590277340731758e-15 deg
      Elevation:                             0 deg
```

Attitude with respect to Earth Inertial axes:

```
   ---   ----Maneuver Start-----   -----Maneuver Stop-----
   qx:    -0.04875970064581846     -0.06296446013710405
   qy:     0.9436651415085037       0.9034005506370572
   qz:    -0.2845555559015816      -0.399542530731592
   qs:     0.1617012585304133       0.1423681425210714
```

Data for Engine "NK-33":
  UserComment: Engine that has a constant Thrust and Isp
  Description: Engine that has a constant Thrust and Isp

  Engine values at beginning of segment:
```
          Thrust:                     8400000 N
             Isp:                         331 s
   Mass Flow Rate:       -2587.799452874501 kg/sec
```

  Engine values at end of segment:
```
          Thrust:                     8400000 N
             Isp:                         331 s
   Mass Flow Rate:       -2587.799452874501 kg/sec
```

```
----------------------------------------
Satellite State at Beginning of Segment:
----------------------------------------
```

UTC Gregorian Date: 18 Apr 2024 18:31:19.162 UTC Julian Date: 2460419.27174956
Julian Ephemeris Date: 2460419.2725503
Time past epoch: 1879.16 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type: Cartesian
```
        X:    -948.0990692947467551 km          Vx:      -6.4975273099012583 km/sec
        Y:    6724.3100840755178069 km          Vy:      -0.7781963968385451 km/sec
        Z:    141.9928316196911169 km           Vz:      -3.8427376710588077 km/sec
```

Parameter Set Type: Keplerian
```
      sma:   6667.9938608346228648 km          RAAN:      280.0629120792789 deg
      ecc:      0.0200601398023562               w:       18.88263543083443 deg
      inc:      30.46212516488662 deg           TA:      158.7540913739647 deg
```

Parameter Set Type: Spherical

```
Right Asc:        98.02555765058182 deg     Horiz. FPA:      0.4244234898675638 deg
    Decl:         1.19785305553566 deg       Azimuth:      120.4408251904399 deg
     |R|:      6792.3044628630013904 km          |V|:       7.5888130549869031 km/sec


Other Elliptic Orbit Parameters :
  Ecc. Anom:      158.3336244838633 deg      Mean Anom:      157.9092786369025 deg
  Long Peri:      298.9455475101134 deg       Arg. Lat:      177.6367268047992 deg
  True Long:       97.69963888407814 deg      Vert FPA:       89.57557651013244 deg
  Ang. Mom:     51544.11457554129 km^2/sec          p:     6665.3105987001990798 km
        C3:      -59.77816564007871 km^2/sec^2   Energy:      -29.88908282003936 km^2/sec^2
   Vel. RA:      186.8296738753494 deg       Vel. Decl:      -30.42225429918352 deg
  Rad. Peri:    6534.2329717850279849 km      Vel. Peri:       7.8883190725078220 km/sec
  Rad. Apo:     6801.7547498842177447 km       Vel. Apo:       7.578061319605607 km/sec
  Mean Mot.:       0.06643527440393938 deg/sec
    Period:       5418.808053852988 sec         Period:       90.31346756421645 min
    Period:          1.505224459403608 hr       Period:       0.06271768580848365 day
              Time Past Periapsis:      2376.889085710453 sec
          Time Past Ascending Node:      2650.0747086246 sec
    Beta Angle (Orbit plane to Sun):      -18.1107625006842 deg
Mean Sidereal Greenwich Hour Angle:      125.193061806694 deg

Geodetic Parameters:
  Latitude:        1.188669322059944 deg
  Longitude:      -26.85341469897669 deg
  Altitude:      414.1765924590307577 km
Geocentric Parameters:
  Latitude:        1.181199261575471 deg
  Longitude:      -26.85341469897669 deg



Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  25177 kg
      Fuel Mass:  86577 kg
     Total Mass:  111754 kg
Area/Mass Ratio:  1.78965e-10 km^2/kg
  Tank Pressure:  5000                     Pa
   Fuel Density:  1000                     kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


User-selected results:
    Inclination =        30.46212516488662 deg
    Altitude Of Apoapsis =      423.6177498842179716 km
    DeltaV =       0.0000000000000000 km/sec
    Altitude Of Periapsis =     156.0959717850275297 km

---------------------------------
Satellite State at End of Segment:
---------------------------------

UTC Gregorian Date: 18 Apr 2024 18:31:42.663  UTC Julian Date: 2460419.27202156
Julian Ephemeris Date: 2460419.2728223
Time past epoch: 1902.66 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)


State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:     -1125.1153080883616440 km          Vx:      -8.8834405778232988 km/sec
        Y:      6698.4392346924450976 km          Vy:      -1.5105333314157783 km/sec
        Z:        45.0222498944167100 km          Vz:      -4.4593054112913446 km/sec

Parameter Set Type:  Keplerian
      sma:     24478.6703411458584014 km        RAAN:      280.3021869820313 deg
      ecc:         0.7225241495765587            w:      179.7920160887297 deg
      inc:        26.33118964726521 deg          TA:      359.3517552009433 deg

Parameter Set Type:  Spherical
 Right Asc:       99.53478495149038 deg     Horiz. FPA:      -0.271910026796953 deg
     Decl:        0.3797767141098797 deg       Azimuth:      116.3286462937411 deg
      |R|:      6792.4222218842842267 km          |V|:       10.0539858860159477 km/sec


Other Elliptic Orbit Parameters :
  Ecc. Anom:      359.7398206266174 deg      Mean Anom:      359.9278058610463 deg
```

```
Long Peri:         100.0942030707611 deg      Arg. Lat:          179.143771289673 deg
True Long:          99.44595827170437 deg     Vert FPA:          90.27191002679695 deg
Ang. Mom:       68290.14813125154 km^2/sec           p:      11699.7972060406755190 km
       C3:      -16.28358223485685 km^2/sec^2   Energy:          -8.141791117428426 km^2/sec^2
  Vel. RA:       189.6502294786698 deg      Vel. Decl:          -26.32971507818882 deg
Rad. Peri:    6792.2398701445154074 km      Vel. Peri:        10.0541425857798163 km/sec
 Rad. Apo:   42165.1008121471968479 km       Vel. Apo:         1.619589347965654 km/sec
Mean Mot.:       0.009445170122329425 deg/sec
    Period:       38114.71845794712 sec          Period:       635.2453076324521 min
    Period:          10.5874217938742 hr          Period:       0.4411425747447583 day
              Time Past Periapsis:        38107.07495994564 sec
           Time Past Ascending Node:       18955.21169137623 sec
      Beta Angle (Orbit plane to Sun):      -14.1941262413705 deg
 Mean Sidereal Greenwich Hour Angle:        125.291248128976 deg

Geodetic Parameters:
  Latitude:        0.3618846598177206 deg
  Longitude:     -25.44429006728951 deg
  Altitude:      414.2860681856272436 km
Geocentric Parameters:
  Latitude:        0.3596098860489021 deg
  Longitude:     -25.44429006728951 deg


Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  25177 kg
      Fuel Mass:  25762.8 kg
     Total Mass:  50939.8 kg
Area/Mass Ratio:  3.9262e-10 km^2/kg
  Tank Pressure:  5000                    Pa
   Fuel Density:  1000                    kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


User-selected results:
    Inclination =        26.33118964726521 deg
    Altitude Of Apoapsis =    35786.9638121472016792 km
    DeltaV =         2.5502401128347758 km/sec
    Altitude Of Periapsis =      414.1028701445152933 km


***------------------------------------------------------------------------***
MCS Segment Type: Propagate
Name: Target Sequence.Xfer
User Comment:  Propagates until stopping conditions are met

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 23:47:49.238 [2460419.4915421]:  Stopped on: Apoapsis; Run Sequence STOP

Propagation Statistics:
  Number of steps:   62
  Average step size:  312.199 sec
  Largest step size:  1012.68 sec
  Smallest step size:  50.344 sec


---------------------------------
Satellite State at End of Segment:
---------------------------------

UTC Gregorian Date: 18 Apr 2024 23:47:49.238  UTC Julian Date: 2460419.4915421
Julian Ephemeris Date: 2460419.49234284
Time past epoch: 20869.2 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
      X:       7404.9991444936586049 km            Vx:      1.4347007445035178 km/sec
      Y:     -41336.1693337352917297 km            Vy:      0.2565812485147284 km/sec
      Z:        -24.7919547583531816 km            Vz:      0.7209559807754767 km/sec


Parameter Set Type:  Keplerian
    sma:   24394.7288102595448436 km            RAAN:       280.2246698801052 deg
    ecc:       0.7214459945181032              w:       179.923709986674 deg
    inc:       26.32000842465094 deg            TA:       180.0000006670204 deg
```

```
Parameter Set Type:  Spherical
 Right Asc:          280.1562893165435 deg      Horiz. FPA:     -1.727561530780577e-06 deg
     Decl:        -0.03382548491821818 deg       Azimuth:         63.68001176013478 deg
      |R|:       41994.2081977766356431 km          |V|:          1.6260312695591850 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:                       180 deg    Mean Anom:                        180 deg
 Long Peri:         100.1483798667792 deg    Arg. Lat:          359.9237106536944 deg
 True Long:         280.1483805337995 deg    Vert FPA:           90.00000172756152 deg
  Ang. Mom:         68283.89566996344 km^2/sec       p:      11697.6549005313954694 km
        C3:       -16.33961355341499 km^2/sec^2  Energy:        -8.169806776707496 km^2/sec^2
   Vel. RA:         10.13955896412778 deg    Vel. Decl:          26.31998330191764 deg
 Rad. Peri:    6795.2494227424231212 km      Vel. Peri:         10.0487695773800567 km/sec
  Rad. Apo:   41994.2081977766647469 km      Vel. Apo:           1.626031269559183 km/sec
 Mean Mot.:       0.009493962856909925 deg/sec
    Period:         37918.83383428067 sec        Period:         631.9805639046778 min
    Period:        10.5330093984113 hr           Period:        0.4388753916004707 day
            Time Past Periapsis:          18959.41691714033 sec
           Time Past Ascending Node:      37884.44599426676 sec
     Beta Angle (Orbit plane to Sun):    -14.0717713218537 deg
Mean Sidereal Greenwich Hour Angle:      204.535014212777 deg

Geodetic Parameters:
  Latitude:       -0.01222954501575141 deg
 Longitude:        75.93264979281292 deg
  Altitude:    35616.0711987482936820 km
Geocentric Parameters:
  Latitude:       -0.01221711060831296 deg
 Longitude:        75.93264979281292 deg



Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  25177 kg
      Fuel Mass:  25762.8 kg
     Total Mass:  50939.8 kg
Area/Mass Ratio:  3.9262e-10 km^2/kg
  Tank Pressure:  5000                    Pa
   Fuel Density:  1000                    kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


***----------------------------------------------------------------------***
MCS Segment Type: Maneuver:Finite
Name: Target Sequence.Burn 2
User Comment:  Maneuvers satellite with an impulsive burn or finite burn

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  18 Apr 2024 23:48:22.238 [2460419.49192405]:  Stopped on: Duration; Run Sequence STOP

Propagation Statistics:
  Number of steps:    7
  Average step size:  4.59914 sec
  Largest step size:  4.764 sec
  Smallest step size:  4.42 sec

Maneuver Summary:
  Maneuver Start: 18 Apr 2024 23:47:49.238 UTCG;   2460419.4915421 UTC Julian Date
  Maneuver Stop:  18 Apr 2024 23:48:22.238 UTCG;   2460419.49192405 UTC Julian Date
  Duration:  33 sec
  Fuel Used:          16974.21412930355 kg
  DeltaV Magnitude:        1796.52158461795 m/sec
  Maneuver Direction Specification:  Thrust Vector
  Maneuver direction is updated during maneuver.
  Burn centering is OFF.
  Thrust Efficiency:  1   (Affects acceleration and mass flow rate)

Thrust vector at maneuver start with respect to VNC(Earth) axes:

      X (Velocity):       0.8132705036308426
       Y (Normal):       -0.5818825621910375
   Z (Co-Normal):        0.001942097327466066
```

```
            Azimuth:        -35.58313856733484 deg
          Elevation:        0.1112740502170189 deg


Thrust vector at maneuver start with respect to Earth Inertial axes:

               X:           0.9718180701219342
               Y:           0.1722159319920015
               Z:          -0.1609699082207778
          Azimuth:          10.04906324444921 deg
        Elevation:          -9.26319763409241 deg


Thrust vector at maneuver stop with respect to VNC(Earth) axes:

     X (Velocity):          0.8132705036308423
       Y (Normal):         -0.5818825621910375
    Z (Co-Normal):          0.001942097327466215
          Azimuth:         -35.58313856733486 deg
        Elevation:          0.1112740502170275 deg


Thrust vector at maneuver stop with respect to Earth Inertial axes:

               X:           0.8009852543767231
               Y:           0.1431143385119787
               Z:          -0.5813268515932623
          Azimuth:          10.13030440967436 deg
        Elevation:         -35.54392052362387 deg


Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to VNC(Earth) axes:

     X (Velocity):          1141.962021511651 m/sec
       Y (Normal):         -1366.876192808413 m/sec
    Z (Co-Normal):          2.016113663332385 m/sec
          Azimuth:         -50.1227996201429 deg
        Elevation:          0.06485471980263639 deg
        Magnitude:          1781.132181999894 m/sec


Integrated Inertial DeltaV vector referenced to maneuver start thrust vector with respect to Earth Inertial
axes:

               X:           1604.37287998657 m/sec
               Y:           285.7917894257566 m/sec
               Z:          -718.8480818755263 m/sec
          Azimuth:          10.10032719149585 deg
        Elevation:         -23.80283263064829 deg
        Magnitude:          1781.132181999893 m/sec


Thrust vector at maneuver start with respect to spacecraft body axes:

               X:           0.9999999999999999
               Y:                           0
               Z:          -8.604228440844963e-16
          Azimuth:                           0 deg
        Elevation:                           0 deg


Thrust vector at maneuver stop with respect to spacecraft body axes:

               X:                           1
               Y:           5.551115123125783e-17
               Z:          -5.551115123125783e-17
          Azimuth:           3.180554681463517e-15 deg
        Elevation:                           0 deg

Attitude with respect to Earth Inertial axes:
  ---   ----Maneuver Start-----   -----Maneuver Stop-----
  qx:       0.3953986125855602        0.1142526712395877
  qy:       0.1088754190073044        0.3131531564191359
  qz:       0.04727016137499217       0.03797990832493708
  qs:       0.9108067699717549        0.942039783821777

Data for Engine "RS-25":
  UserComment: Engine that has a constant Thrust and Isp
  Description: Engine that has a constant Thrust and Isp

  Engine values at beginning of segment:
           Thrust:                 2280000 N
              Isp:                     452 s
    Mass Flow Rate:        -514.3701251304594 kg/sec

  Engine values at end of segment:
           Thrust:                 2280000 N
              Isp:                     452 s
```

```
     Mass Flow Rate:        -514.3701251304594 kg/sec


----------------------------------------
Satellite State at Beginning of Segment:
----------------------------------------


UTC Gregorian Date: 18 Apr 2024 23:47:49.238  UTC Julian Date: 2460419.4915421
Julian Ephemeris Date: 2460419.49234284
Time past epoch: 20869.2 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
         X:     7404.9991444936586049 km           Vx:      1.4347007445035178 km/sec
         Y:   -41336.1693337352917297 km           Vy:      0.2565812485147284 km/sec
         Z:      -24.7919547583531816 km           Vz:      0.7209559807754767 km/sec


Parameter Set Type:  Keplerian
       sma:    24394.7288102595448436 km         RAAN:       280.2246698801052 deg
       ecc:        0.7214459945181032            w:         179.923709986674 deg
       inc:       26.32000842465094 deg          TA:         180.0000006670204 deg


Parameter Set Type:  Spherical
 Right Asc:       280.1562893165435 deg     Horiz. FPA:    -1.727561530780577e-06 deg
     Decl:       -0.03382548491821818 deg     Azimuth:        63.68001176013478 deg
     |R|:     41994.2081977766356431 km         |V|:         1.6260312695591850 km/sec


Other Elliptic Orbit Parameters :
Ecc. Anom:                    180 deg      Mean Anom:                      180 deg
Long Peri:       100.1483798667792 deg      Arg. Lat:       359.9237106536944 deg
True Long:       280.1483805337995 deg      Vert FPA:        90.00000172756152 deg
 Ang. Mom:      68283.89566996344 km^2/sec        p:    11697.6549005313954694 km
       C3:      -16.33961355341499 km^2/sec^2  Energy:     -8.169806776707496 km^2/sec^2
  Vel. RA:       10.13955896412778 deg     Vel. Decl:        26.31998330191764 deg
Rad. Peri:    6795.2494227424231212 km     Vel. Peri:        10.0487695773800567 km/sec
 Rad. Apo:   41994.2081977766647469 km     Vel. Apo:         1.626031269559183 km/sec
Mean Mot.:        0.009493962856909925 deg/sec
   Period:       37918.83383428067 sec        Period:        631.9805639046778 min
   Period:          10.5330093984113 hr       Period:        0.4388753916004707 day
              Time Past Periapsis:        18959.41691714033 sec
           Time Past Ascending Node:        37884.44599426676 sec
       Beta Angle (Orbit plane to Sun):      -14.0717713218537 deg
Mean Sidereal Greenwich Hour Angle:        204.535014212777 deg

Geodetic Parameters:
  Latitude:       -0.01222954501575141 deg
 Longitude:        75.93264979281292 deg
  Altitude:     35616.0711987482936820 km
Geocentric Parameters:
  Latitude:       -0.01221711060831296 deg
 Longitude:        75.93264979281292 deg




Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  25177 kg
      Fuel Mass:  25762.8 kg
     Total Mass:  50939.8 kg
Area/Mass Ratio:  3.9262e-10 km^2/kg
  Tank Pressure:  5000                  Pa
   Fuel Density:  1000                  kg/m^3
             Cr:  1.000000
             Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000


User-selected results:
    Inclination =          26.32000842465094 deg
    Flight Path Angle =    -1.727561530780577e-06 deg
    DeltaV =        0.0000000000000000 km/sec
    Eccentricity =         0.7214459945181032
    Semimajor Axis =    24394.7288102595448436 km

--------------------------------
Satellite State at End of Segment:
--------------------------------
```

```
UTC Gregorian Date: 18 Apr 2024 23:48:22.238  UTC Julian Date: 2460419.49192405
Julian Ephemeris Date: 2460419.49272479
Time past epoch: 20902.2 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)


State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
         X:     7477.8716846007500862 km          Vx:        3.0377527085054594 km/sec
         Y:   -41323.0361897100374335 km          Vy:        0.5497143409952442 km/sec
         Z:      -10.0131443060285257 km          Vz:        0.0021105990400696 km/sec


Parameter Set Type:  Keplerian
       sma:   42164.4686078950908268 km        RAAN:          299.4839693113358 deg
       ecc:       0.0040384408168957             w:          340.7691425045509 deg
       inc:       0.04148626173794873 deg       TA:        0.004199969714864837 deg


Parameter Set Type:  Spherical
 Right Asc:         280.2573164557459 deg    Horiz. FPA:     1.689310729848362e-05 deg
      Decl:      -0.01366167356080095 deg       Azimuth:        89.96082770599533 deg
       |R|:    41994.1898973000570550 km          |V|:        3.0870911598714410 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:       0.004183042525253484 deg     Mean Anom:      0.004166149555595697 deg
 Long Peri:         280.2531118158867 deg      Arg. Lat:        340.7733424742657 deg
 True Long:         280.2573117856015 deg      Vert FPA:        89.9999831068927 deg
  Ang. Mom:        129639.8923979119 km^2/sec         p:     42163.7809473981396877 km
        C3:        -9.453467686424583 km^2/sec^2   Energy:       -4.726733843212291 km^2/sec^2
   Vel. RA:        10.25729022234557 deg       Vel. Decl:        0.0391722888630965 deg
 Rad. Peri:    41994.1898968462483026 km       Vel. Peri:        3.0870911599046673 km/sec
  Rad. Apo:    42334.7473189439260750 km       Vel. Apo:        3.062257379764749 km/sec
 Mean Mot.:        0.004178030182865471 deg/sec
    Period:        86165.0070112937 sec          Period:       1436.083450188228 min
    Period:        23.9347241698038 hr           Period:       0.9972801737418251 day
            Time Past Periapsis:        0.9971564046333371 sec
        Time Past Ascending Node:      81599.5299824212 sec
   Beta Angle (Orbit plane to Sun):    11.1058439977876 deg
Mean Sidereal Greenwich Hour Angle:    204.672890767955 deg

Geodetic Parameters:
  Latitude:       0.008189410379136853 deg
 Longitude:         75.8957534109759 deg
  Altitude:    35616.0528977357462281 km
Geocentric Parameters:
  Latitude:       0.008181083780618478 deg
 Longitude:         75.8957534109759 deg




Spacecraft Configuration:
     Drag Area:  20 m^2
      SRP Area:  20 m^2
      Dry Mass:  25177 kg
     Fuel Mass:  8788.56 kg
    Total Mass:  33965.6 kg
Area/Mass Ratio:  5.88832e-10 km^2/kg
 Tank Pressure:  5000                       Pa
  Fuel Density:  1000                       kg/m^3
            Cr:  1.000000
            Cd:  2.200000
 Rad Press Area:  20 m^2
 Rad Press Coeff:  1.000000


User-selected results:
    Inclination =       0.04148626173794873 deg
    Flight Path Angle =     1.689310729848362e-05 deg
    DeltaV =       1.7965215846179501 km/sec
    Eccentricity =        0.0040384408168957
    Semimajor Axis =    42164.4686078950908268 km

***------------------------------------------------------------------------***
MCS Segment Type: Propagate
Name: Target Sequence.GEO Orbit
User Comment:  Propagates until stopping conditions are met

Propagator model used: Earth_HPOP_Default_v10  (Default Earth HPOP settings for STK 10.0)

Stopping Condition Information (Gregorian Date [Julian Date]):
  19 Apr 2024 23:58:22.238 [2460420.49886849]:  Stopped on: Duration; Run Sequence STOP
```

```
Propagation Statistics:
  Number of steps:    82
  Average step size:  1055.97 sec
  Largest step size:  1097.89 sec
  Smallest step size:  60 sec


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Satellite State at End of Segment:
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UTC Gregorian Date: 19 Apr 2024 23:58:22.238  UTC Julian Date: 2460420.49886849
Julian Ephemeris Date: 2460420.49966923
Time past epoch: 107902 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)

State Vector in Coordinate System: Earth Inertial

Parameter Set Type:  Cartesian
        X:    10006.5566234490852366 km          Vx:        2.9982848196621092 km/sec
        Y:   -40785.4363049425664940 km          Vy:        0.7348372832922817 km/sec
        Z:       -7.8665862403537696 km          Vz:        0.0021018926255441 km/sec

Parameter Set Type:  Keplerian
      sma:    42164.2579735006293049 km        RAAN:        299.1665095590514 deg
      ecc:        0.0040209013089981            w:        341.1035088728873 deg
      inc:        0.040463575680762 deg         TA:          3.514996052431913 deg

Parameter Set Type:  Spherical
 Right Asc:       283.7850181384777 deg    Horiz. FPA:        0.01406812800908531 deg
     Decl:        -0.01073274929361059 deg    Azimuth:        89.9609857837798 deg
     |R|:     41995.0360391082213027 km          |V|:        3.0870215598024644 km/sec


Other Elliptic Orbit Parameters :
 Ecc. Anom:        3.500899693812809 deg    Mean Anom:        3.486831679245736 deg
 Long Peri:       280.2700184319387 deg    Arg. Lat:        344.6185049253193 deg
 True Long:       283.7850144843705 deg    Vert FPA:        89.98593187199091 deg
 Ang. Mom:       129639.5777495847 km^2/sec          p:     42163.5762766475017997 km
       C3:        -9.453514911859997 km^2/sec^2  Energy:     -4.726757455929999 km^2/sec^2
  Vel. RA:        13.77094269923967 deg    Vel. Decl:        0.03901157909185901 deg
 Rad. Peri:    41994.7196534220493049 km    Vel. Peri:        3.0870447241816672 km/sec
  Rad. Apo:    42333.7962935792165808 km    Vel. Apo:        3.062318740576715 km/sec
 Mean Mot.:        0.004178061490351917 deg/sec
    Period:       86164.36135066966 sec        Period:        1436.072689177828 min
    Period:       23.93454481963046 hr        Period:        0.9972727008179358 day
             Time Past Periapsis:        834.557291054144 sec
         Time Past Ascending Node:     82511.74343904197 sec
     Beta Angle (Orbit plane to Sun):     11.4536581002777 deg
 Mean Sidereal Greenwich Hour Angle:     208.165382931491 deg

Geodetic Parameters:
  Latitude:        0.01926483116196144 deg
 Longitude:       75.93098215549281 deg
  Altitude:    35616.8990415193402441 km
Geocentric Parameters:
  Latitude:        0.0192452440042445 deg
 Longitude:       75.93098215549281 deg




Spacecraft Configuration:
      Drag Area:  20 m^2
       SRP Area:  20 m^2
       Dry Mass:  25177 kg
      Fuel Mass:  8788.56 kg
     Total Mass:  33965.6 kg
Area/Mass Ratio:  5.88832e-10 km^2/kg
  Tank Pressure:  5000                      Pa
   Fuel Density:  1000                      kg/m^3
            Cr:  1.000000
            Cd:  2.200000
 Rad Press Area:  20 m^2
 Rad Press Coeff:  1.000000



***<<<< End of Sequence: Target Sequence >>>>***


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Satellite State at End of Segment:
---------------------------------
```

```
UTC Gregorian Date: 19 Apr 2024 23:58:22.238  UTC Julian Date: 2460420.49886849
Julian Ephemeris Date: 2460420.49966923
Time past epoch: 107902 sec   (Epoch in UTC Gregorian Date: 18 Apr 2024 18:00:00.000)


State Vector in Coordinate System: Earth Inertial


Parameter Set Type:  Cartesian
        X:     10006.5566234490852366 km           Vx:        2.9982848196621092 km/sec
        Y:    -40785.4363049425664940 km           Vy:        0.7348372832922817 km/sec
        Z:        -7.8665862403537696 km           Vz:        0.0021018926255441 km/sec


Parameter Set Type:  Keplerian
      sma:    42164.2579735006293049 km          RAAN:        299.1665095590514 deg
      ecc:        0.0040209013089981             w:          341.1035088728873 deg
      inc:        0.040463575680762 deg          TA:           3.514996052431913 deg


Parameter Set Type:  Spherical
 Right Asc:        283.7850181384777 deg      Horiz. FPA:        0.01406812800908531 deg
      Decl:        -0.01073274929361059 deg     Azimuth:       89.9609857837798 deg
      |R|:     41995.0360391082213027 km          |V|:         3.0870215598024644 km/sec


Other Elliptic Orbit Parameters :
Ecc. Anom:         3.500899693812809 deg      Mean Anom:         3.486831679245736 deg
Long Peri:       280.2700184319387 deg        Arg. Lat:        344.6185049253193 deg
True Long:       283.7850144843705 deg        Vert FPA:         89.98593187199091 deg
 Ang. Mom:    129639.5777495847 km^2/sec            p:       42163.5762766475017997 km
      C3:        -9.453514911859997 km^2/sec^2   Energy:        -4.726757455929999 km^2/sec^2
  Vel. RA:        13.77094269923967 deg        Vel. Decl:        0.03901157909185901 deg
Rad. Peri:    41994.7196534220493049 km       Vel. Peri:         3.0870447241816672 km/sec
 Rad. Apo:    42333.7962935792165808 km        Vel. Apo:         3.062318740576715 km/sec
Mean Mot.:         0.004178061490351917 deg/sec
    Period:     86164.36135066966 sec          Period:         1436.072689177828 min
    Period:        23.93454481963046 hr         Period:           0.9972727008179358 day
              Time Past Periapsis:            834.557291054144 sec
           Time Past Ascending Node:        82511.74343904197 sec
    Beta Angle (Orbit plane to Sun):        11.4536581002777 deg
Mean Sidereal Greenwich Hour Angle:        208.165382931491 deg


Geodetic Parameters:
 Latitude:        0.01926483116196144 deg
 Longitude:       75.93098215549281 deg
 Altitude:     35616.8990415193402441 km
Geocentric Parameters:
 Latitude:        0.0192452440042445 deg
 Longitude:       75.93098215549281 deg



Spacecraft Configuration:
     Drag Area:  20 m^2
      SRP Area:  20 m^2
      Dry Mass:  25177 kg
     Fuel Mass:  8788.56 kg
    Total Mass:  33965.6 kg
Area/Mass Ratio:  5.88832e-10 km^2/kg
 Tank Pressure:  5000                      Pa
  Fuel Density:  1000                      kg/m^3
           Cr:  1.000000
           Cd:  2.200000
 Rad Press Area:  20 m^2
Rad Press Coeff:  1.000000
```