Abeona:

Design of a Nuclear-Electric Vehicle for Transport to Neptune and Triton

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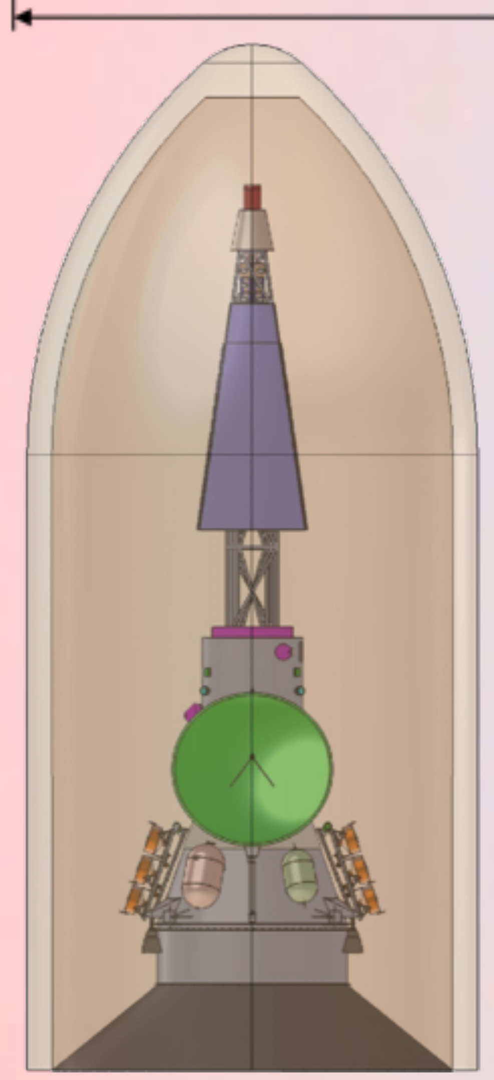
Figure 1: Abeona vehicle in flight configuration



MEL Summary: Case 3 NEP Delivery to Triton CD-2020-177	Delivery Vehicle
Main Subsystems	Basic Mass (kg)
Science	188.4
Attitude Determination and Control	57.1
Command & Data Handling	57.0
Communications and Tracking	73.6
Electrical Power Subsystem	2209.3
Thermal Control (Non-Propellant)	170.4
Propulsion (Chemical Hardware)	196.1
Propellant (Chemical)	1094.5
Propulsion (EP Hardware)	411.4
Propellant (EP)	5188.8
Structures and Mechanisms	693.5
Element Total	***10340.0***
Element Dry Mass (no prop,consum)	4056.7
Element Propellant	6283.3
Element Mass Growth Allowance (Aggregate)	914.9
MGA as %'age	23%
Predicted Mass (Basic + MGA)	4971.6
Recommended Mass Margin (Additional System Level Growth) 15%	608.5
Element Dry Mass (Basic+MGA+Margin)	5580.1
Element Inert Mass (Basic+MGA+Margin)	5946.8
Total Wet Mass (Allowable Mass)	***11863.4***

Fig. 2 (left): Abeona vehicle in launch configuration.
Table 1 (right): Abeona mass by subsystem

Introduction: In support of a NIAC project designing a "hopper" mission to Neptune's moon Triton, designed study of a Nuclear Electric Propulsion (NEP) transport vehicle for transportation from Earth orbit to Neptune and Triton. We have named this vehicle "Abeona," after the Roman protective goddess of travelers.

Power and Propulsion: NASA has recently been developing the "Kilopower" nuclear reactor as a power source for future exploration missions and a 1-kW prototype was tested under the KRUSTY program. The initial Kilopower concept was designed for electrical power of 1-10 kW, but analysis of lunar applications shows that a next-generation reactor with increased performance is feasible with only incremental changes in the design. This study assumed a 17.5 kW next-generation Kilopower-derived reactor, of which 14.1 kW is used for the electric propulsion system, and 3.4 kW includes other spacecraft systems and power growth allowance.

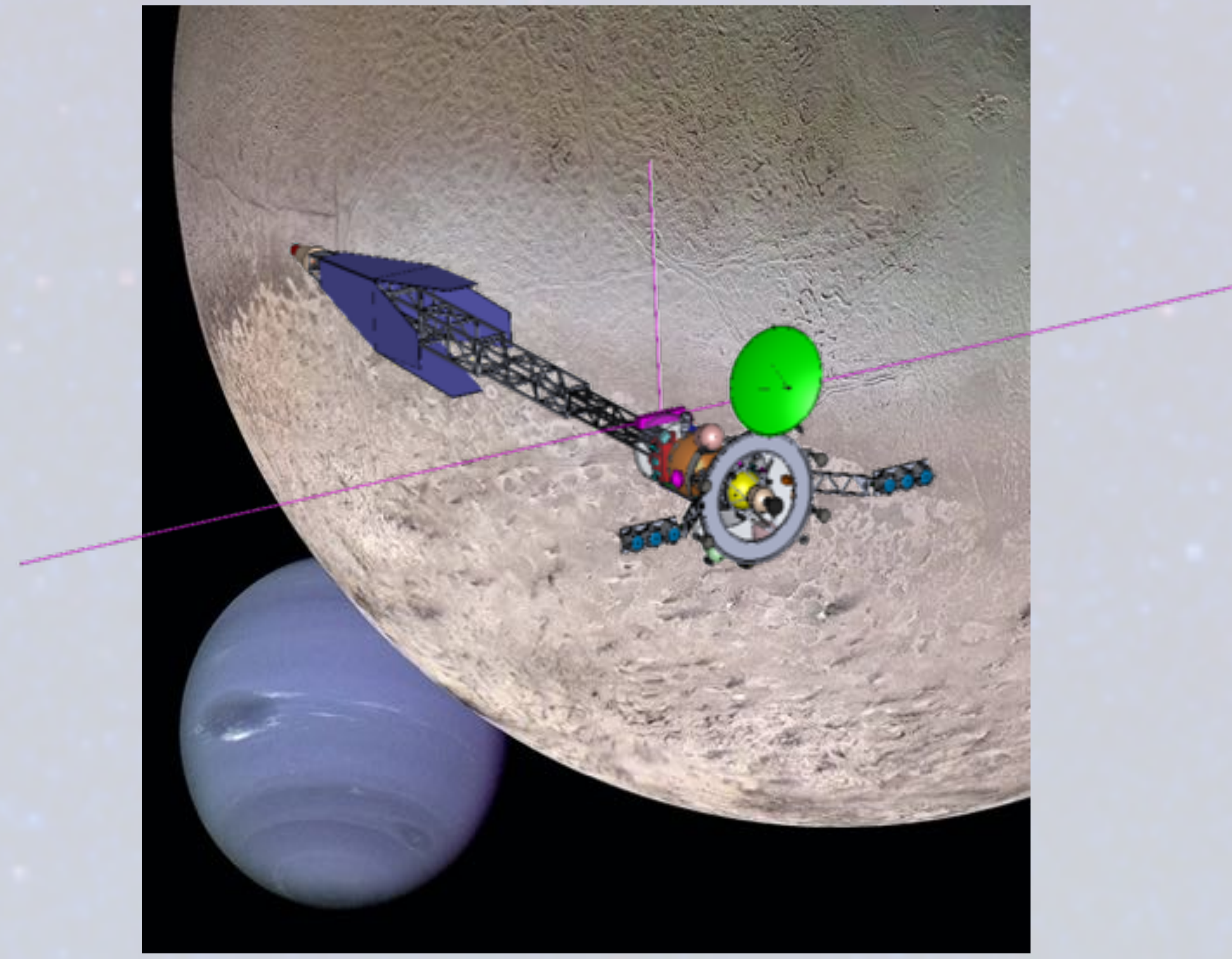


Figure 3: After delivering the hopper, Abeona leaves Triton orbit for Neptune

Figure 1 shows the vehicle. An extensible truss distances the reactor from the spacecraft, to position the main body of the spacecraft behind a shield to minimize neutron flux. Figure 2 shows the vehicle stowed for launch inside an 8.4-m fairing for a SLS launch.

Propulsion. Primary propulsion consists of two NEXT-C ion thrusters. 5189 kg of Xenon are expended in the mission. In addition to the two active thrusters, three additional thrusters are required to achieve the required lifetime, and the design incorporates a sixth as spare in case of engine failure. Table 1 shows the mass breakdown. This includes 188 kg of science instrumentation on the vehicle itself; but not the 1,164 kg payload transported to the Neptune system, comprising the Triton lander/hopper and a Neptune atmospheric probe. Total mass includes a mass growth allowance (MGA) according to AIAA standards, 23% of the system mass.

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