TIPPING POINT FLIGHT DEMONSTRATION – UNITED LAUNCH ALLIANCE

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156 SUCCESSFUL LAUNCHES – ONE AT A TIME

100% Mission Success
CISLUNAR RESOURCES

20 Billion Metric Tons of H2O

17,000 NEAR EARTH OBJECTS (NEO)
- 13,700 C-Type: Carbon, Water, Industrial Metals
- 3,000 S-Type: Minerals, Industrial Metals
- 300 M-Type: Precious & Industrial Metals

2 Trillion Kg of Industrial Metals
150 Metric Tons of Precious Metals

1,000 Years of Earth’s Production of Industrial Metal

More than the World’s Entire Gold/Silver/Platinum Reserves
After LEO, Destinations are “Close” in Energy
IN-SPACE PROPELLANT

Harvesting H2O
1. Insitu Thermal Mining
2. Dig and Process
3. Chemical Extraction

Making Propellant
Power: Solar Panel, Nuclear Electrolysis
Liquefaction

200 tons/yr current in space propellant demand
100 million years @ current demand

Distribution of Surface Ice on the Moon
Credits: NASA
TRADING TIME FOR FUEL

WEAK STABILITY BOUNDARY TRANSFER

CLASSIC TRANS-LUNAR INSERTION

• Prompt
  – 3 to 5 Days Transit
  – Ideal for Human Travel

1. TLI Insertion burn
2. Trajectory Correction Maneuver
3. NRHO Insertion Burn
4. NRHO Departure Burn
5. Trajectory Return Correction Burn
6. Earth orbit insertion Burn

• More Mass
  – 4 to 5 Months
  – 30% More Payload
  – Ideal for On-Going Cargo and Logistics

1. Departure Burn
2. Trajectory Correction Burn
3. NRHO Insertion Burn
4. Gateway Rendezvous
ULA’s TIPPING POINT

ULA’s Tipping Point Flight Demonstration is an on-orbit flight experiment that will demonstrate new and innovative technologies in the following cryogenic fluid management areas:

- Propellant tank-to-tank transfer
- Propellant pressure control
- Passive thermal control

Technologies developed from this prototype flight demonstration will enable a significant leap forward in space exploration capabilities.

The experiment will fly as a rideshare mission on Vulcan Centaur in 2025.
VULCAN CENTAUR

- Centaur Upper Stage
- Booster
- Interstage
- Solid Rocket Boosters (SRBs)
- Dual BE-4 Engines
- Industry Standard Adapter
- 5.4m Payload Fairing (PLF)
VULCAN CENTAUR // RIDESHARE SOLUTIONS

SECONDARY PAYLOAD ADAPTER (ESPA)
Adapter located between the upper stage and the primary payload

AFT BULKHEAD CARRIER (ABC)
Interface located on equipment shelf on the aft end of the Centaur upper stage
The flight experiment will demonstrate the **transfer of liquid hydrogen (LH2)** from one vessel to another while minimizing propellant mass loss and maintaining pressure control.

The flight experiment will also demonstrate performance of the **Solar White** passive thermal control technology:
- Solar White is a low absorptivity coating developed by NASA Kennedy Space Center.

**Experiment Objectives**
- Transfer LH2 into experiment auxiliary tank
- Maintain pressure control of LH2 system
- Collect temperature data to characterize Solar White solar absorptivity
- Isolate experiment
  - From Centaur flight systems during primary mission and during disposal operations
Completion of ULA’s Tipping Point Flight Experiment will demonstrate new and innovative Cryogenic Fluid Management technologies, directly leading to increased capabilities, NASA knowledge and value for our space launch customers.
QUESTIONS
THANK YOU