COMMERCIAL SPACE TRANSPORTATION

AST R&D Update

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Federal Aviation Administration

Agenda

- Changes Since August Update
- LOX/Methane Project
- Human Spaceflight
- White House Initiatives

Changes Since Last August Update

- One employee retired, and we lost his slot.
- Second employee out on series of leaves.
- Remaining employee focused on LOX/Methane research project and STEM efforts.
- Beginning efforts through Aerospace on Human Spaceflight.
- White House initiatives on Lower Earth Orbit R&D and STEM.
- Research Alliance on hold.

LOX/Methane

- There are at least five U.S. companies developing LOX/Methane launch vehicles and three are planning their first launch this calendar year.
- LOX/Methane is a liquid propellant combination that has several advantages:
  - Launch vehicles can gain altitude and velocity more quickly. This is because LOX/Methane has a higher "specific impulse" than other propellants. In other words, it needs less propellant to produce a similar thrust for the same time period as other propellants.
  - More fuel stays in the launch vehicle before launch. Because both liquid oxygen and liquid methane can stay liquid at higher temperatures than, say, liquid hydrogen, LOX/Methane requires less refrigeration, less insulation at the launch facility and inside the launch vehicle, and so there is less propellant lost due to "boil-off."
  - Burns cleaner. LOX/Methane also burns cleaner than some other liquid propellants, producing less residue. This can reduce the time and costs when processing reusable launch engines.

LOX/Methane (Cont.)

- One of the big challenges in using LOX/Methane that they are both “miscible” substances, meaning both can physically mix in liquid form (like alcohol and water, for example.) This makes the fuel highly explosive and presents greater risks when fueling the launch vehicle.
- That is what the FAA, DOD, and NASA are working on.
  - This research will help ensure the FAA, Department of Defense, NASA, and the commercial space industry have for the first time a statistically valid set of explosive yield data for LOX/Methane propellants.
  - This will ensure consistent safety determinations that will more accurately provide safe launch criteria for public safety.
  - FAA is about to conduct drop tests at Dugway Proving Grounds this month and plans to complete the first phase of research by June of this year. We are currently planning a second phase next year.
- FAA has worked closely with NASA and DOD to ensure that each organization will conduct LOX/Methane R&D that complement each other without overlap.

LOX/Methane (Cont.)

- The tower was constructed in late February.
- It is 140’ tall, with a 120’ span.
- Significantly delayed due to weather – worst conditions in 20 years according to Dugway Proving Ground range personnel.

Notional LOX/Methane Test Schedule

Test Number	Test Description	Pressurized Tank	Date (Notional)
Cal	1,000 lb. C-4	N/A	March
0	Pathfinder LN2, 2,000lb. LOX/LNG - 0	Yes	March
1	2,000 lb. LOX/LNG – 1	Yes	April
2	2,000 lb. LOX/LNG – 2	No	May
3	20,000 lb. LOX/LNG – 1	Yes	June
4	20,000 lb. LOX/LNG – 2	No	July
5	500 lb. LOX/LNG – 1	Yes	August
6	500 lb. LOX/LNG – 2	No	August

Human Spaceflight R&D

- As we get more resources, we will focus on Human Spaceflight R&D tied to our regulations.
- Under the current Moratorium from Congress, we cannot create any rules or required standards for human spaceflight.
- Congress originally created this Moratorium in 2012, and unless they act, it will automatically lift by the end of this year.

White House Initiatives

- Lower Earth Orbit Strategy
  - Vision is to have extensive operations of private R&D space stations.
  - Many challenges on authorities.
- Government-wide STEM initiative
  - Trying to leverage interagency collaboration on STEM
  - Focus on inspiration, preparation, and workforce.