

## FY23 Strategic Initiatives Research and Technology Development (SRTD)

# Mid-Air Helicopter Delivery for Mars (MAHD): Experimental Risk Reduction Campaign

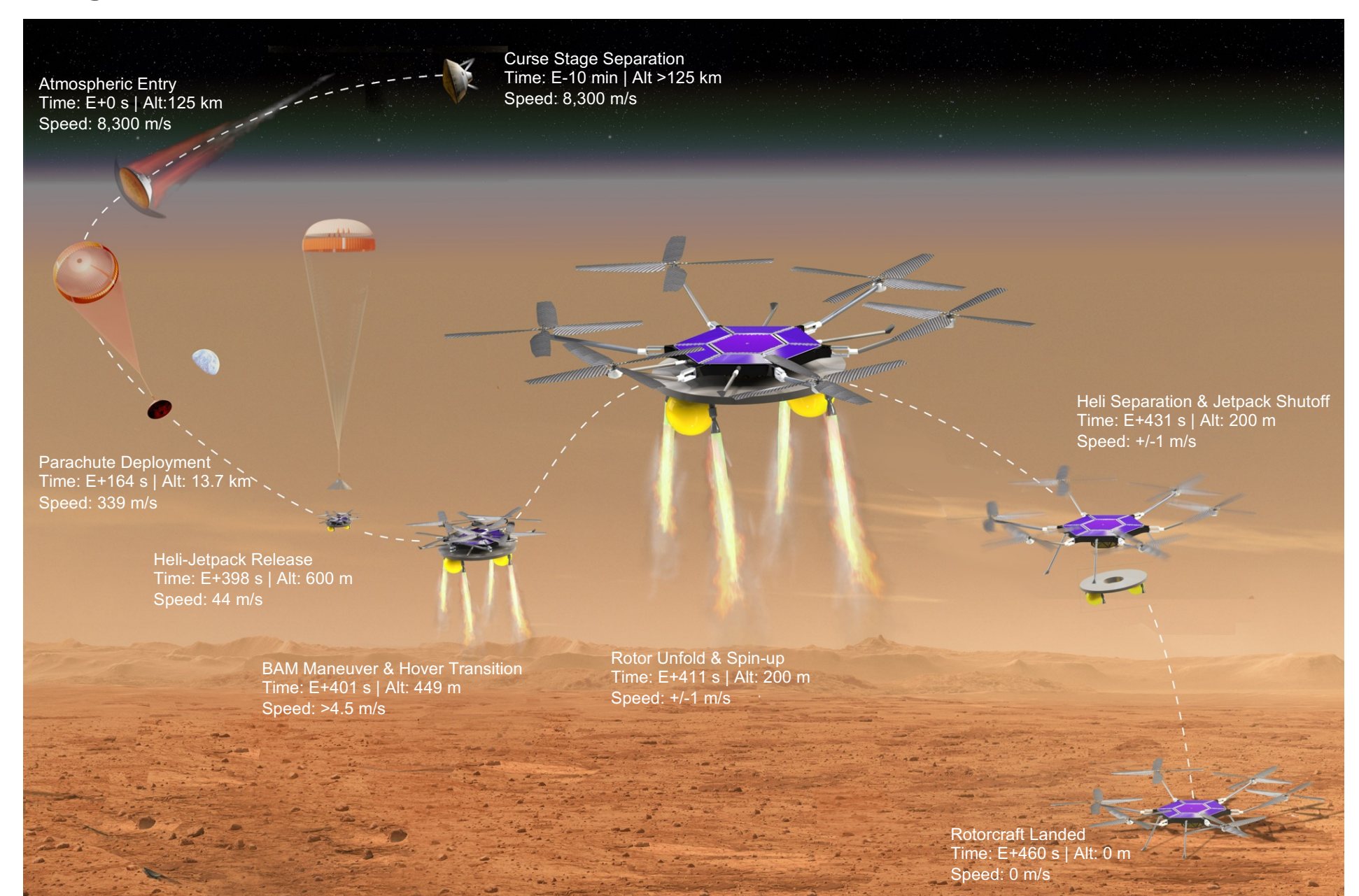
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**Strategic Focus Area:** Mid-Air Deployment for Mars Helicopter | **Strategic Initiative Leader:** J. (Bob) Balam

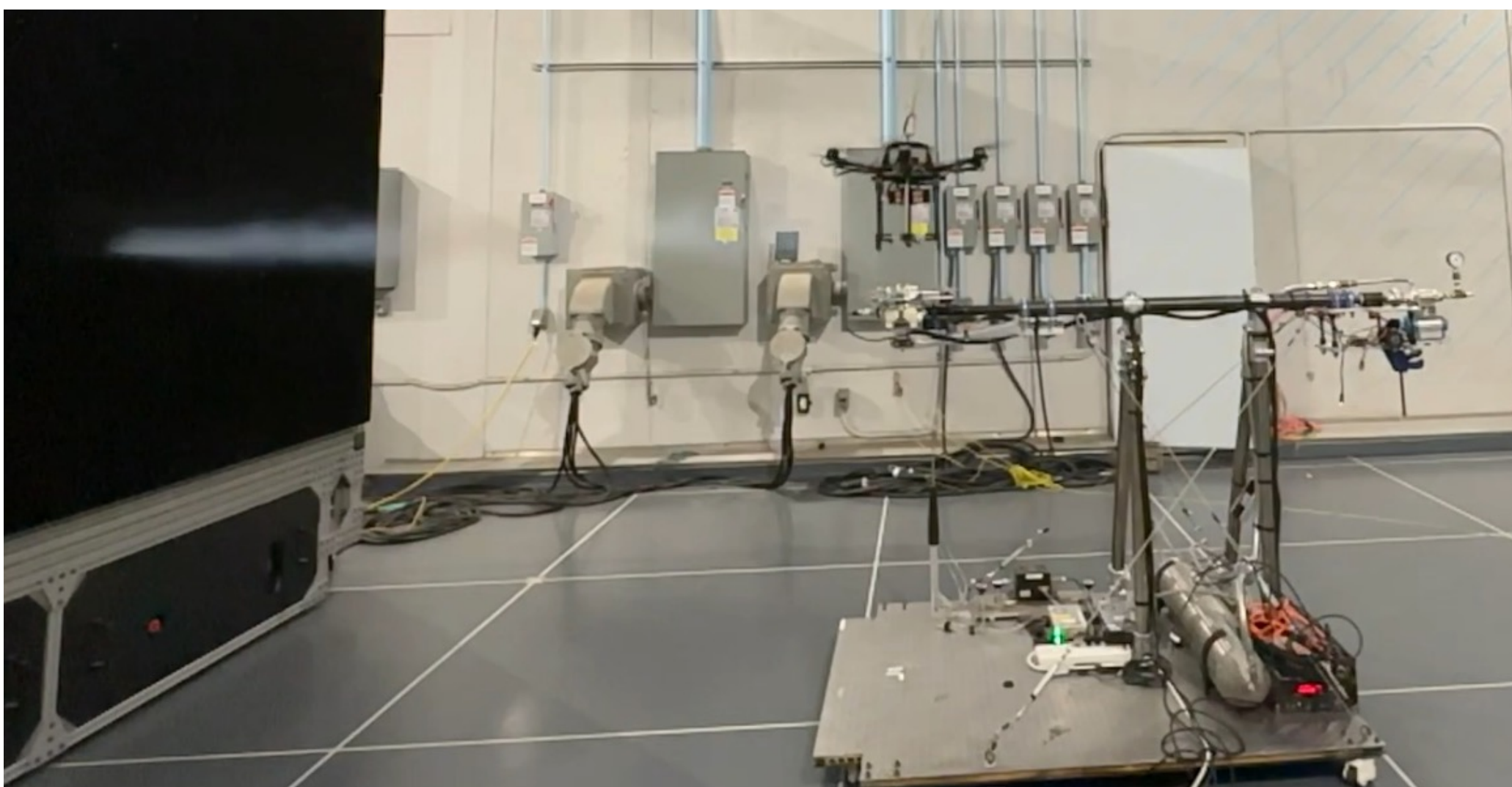
### Objectives:

1. Confirm the Mars Science Helicopter (MSH) can robustly take off in the jetpack EDL disturbance environment.
2. Demonstrate MAHD in end-to-end closed-loop simulations
3. Run TRL Planning Assessment Review

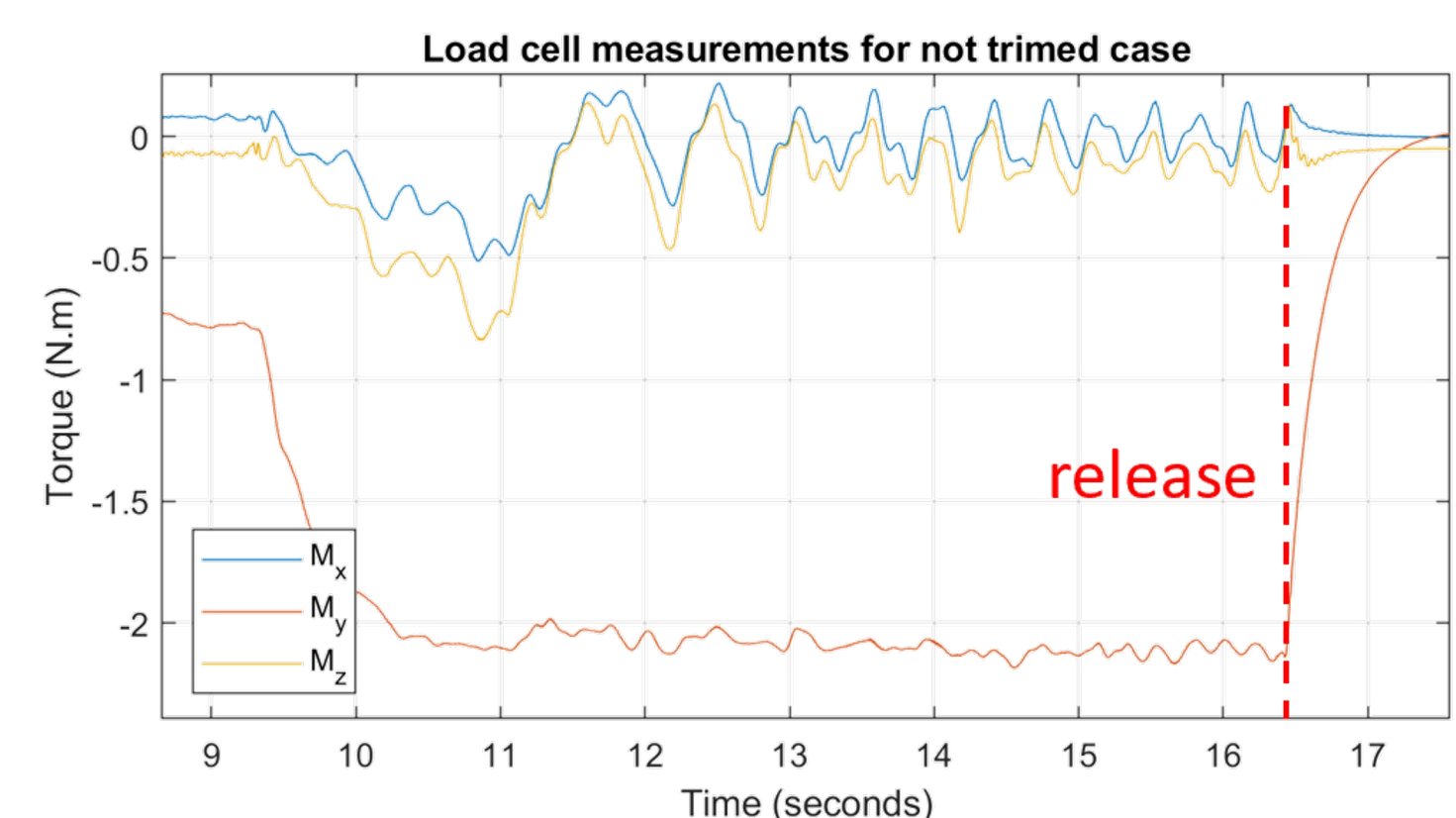
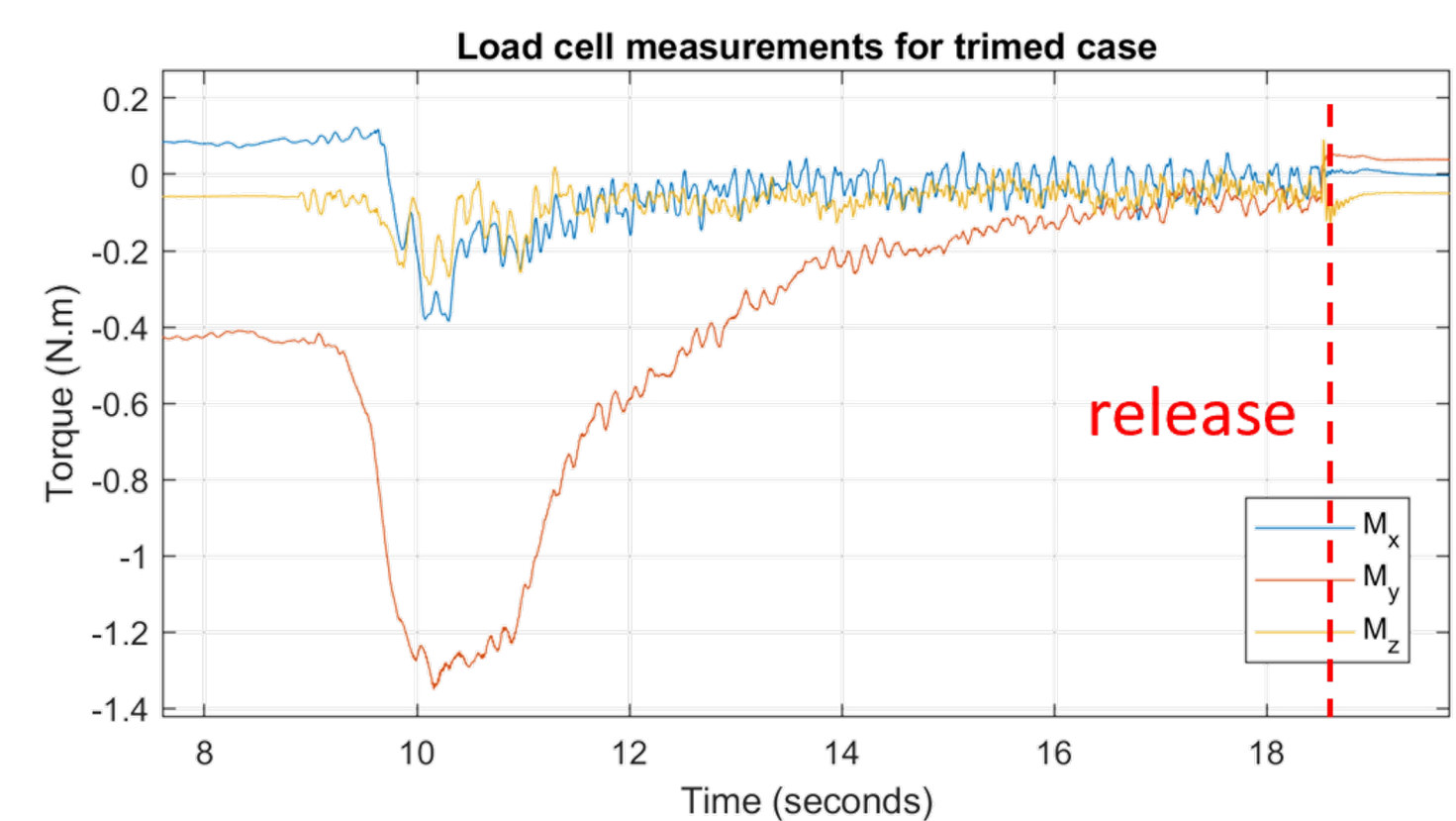
### Background: Concept of operations for MAHD



### Approach and Results



- Demonstrated autonomous take-off of MSH in cross winds in trimmed conditions (top figure).
- Verified benefits of actively trimming for winds (right figure)
- Implemented high-fidelity simulation in DARTS
- On-going: demonstration with variable pitch actuation



### Significance/Benefits to JPL and NASA:

Pushing MAHD to TRL 5 by end of FY24 makes it ready for inclusion in a mission proposal.

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Jet Propulsion Laboratory  
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[www.nasa.gov](http://www.nasa.gov)

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### Publications:

[A] Veismann et al., Study of Rotor-Jetpack-Wind Aerodynamic Interaction for Mid-Air Helicopter Delivery on Mars, IEEE Aerospace Conference, 2023.

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