Draft Discovery 2014 AO: A Quick Tour

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Potential Targets

• Any solid body in the Solar System except the Sun and the Earth
  – Missions to Mars or its satellites are allowed
  – Studies like Genesis of the solar wind as a window on the composition of the early Solar System are still allowed.
  – Identification and characterization of extra-solar planets are not allowed.

• No Missions of Opportunity (MOs) — all MOs now solicited through SALMON.
Money and Time

• Base cost cap = $450M (FY15)
  – Medium performance launch services using a 4m fairing are GFE. Additional costs for larger fairing or increased performance. Incentive for lower performance LV.
  – Post-launch operations costs are not counted against the AO Cost Cap.
  – DSN “aperture fees” no longer assessed but DSN usage will be evaluated.

• 9 month Phase A, $3.0M (RY)
  – Clock starts from expected award of Phase A contracts

• Launch Readiness Date must be NLT 31 December 2021
Discovery Program

• New to the AO is that “Phase E operations” costs are *not* under the AO Cost Cap.
• Removal of operations costs intended to level the playing field between missions with different length cruises.
  – Secondary goal is to allow for a more accurate assessment of costs once a mission/spacecraft design are set (Confirmation).
• Development of flight or ground software or the fabrication or refurbishment of test beds after launch will be considered Phase D work deferred until Phase E and *will* fall under the AO Cost Cap.
• All data must be archived at a NASA data archive or equivalent in minimum time, NLT 6 months after collection.
  – Proposers are encouraged to work with the appropriate archive now to establish data management plans.
  – Generation and archiving of higher-order, derived data products may extend up to 1 year past end of prime mission

• Any samples returned to Earth & any returned space-exposed hardware shall be curated at JSC.
  – Missions must pay for actual costs for all aspects of curation, from inception to two years following sample return.
For this AO, SMD is partnering with STMD and HEOMD. A number of technologies developed by the three directorates are available for the AO under a variety of infusion schemes.

Unfortunately, neither ASRGs nor MMRTGs will be available for this AO.
Technology Infusion Approaches (1)

• **Government Furnished Equipment**
  NASA develops technology, guarantees its readiness and provides it; TMC will *not* evaluate the technology, just the appropriateness of its use
  – *NEXT-C*: Commercialized version of the NEXT ion propulsion system.
    • NASA will provide 2 thrusters and 2 PPFs.
  – *DSOC*: Next generation optical communications.
    • NASA will provide the hardware, labor costs for DSOC team’s participation in integration and operations, and a $30M incentive.
  – *LWRHU*: Lightweight Radioisotope Heater Units
    • NASA will provide up to 30 (all that are available)
Incentivization

NASA develops technology, guarantees its readiness and provides an increase to the AO Cost Cap but missions must purchase any hardware; TMC will not evaluate the technology, just the appropriateness of its use.

- **DSAC**: Deep Space Atomic Clock
  - NASA will provide a $5M incentive for use. Fabrication of a copy of the as-demonstrated unit will be funded by the mission, as will any modifications needed.

- **HEEET**: 3D-woven thermal protection system.
  - NASA will pay for up to $10M of the HEEET material and the labor costs for the HEEET team to work with the mission.
Technology Infusion Approaches (3)

• **Commercialization**

NASA invents, develops, and demonstrates a technology in a relevant environment and then transfers the technology to a for-profit entity. Proposers are then free to purchase the hardware as a commodity (COTS). Risk should be equivalent to a star tracker, *etc.*

  – Advanced Solar Arrays
    • Available from 2 vendors, ATK and DSS
  
  – Green Propellant
    • Available from Aerojet-Rocketdyne
Telecommunications

• Policies unchanged from 2010 AO
  – Routine communications must use a single 34m antenna
    • This does not apply to critical events, emergencies, radio science, delta-DOR, and station hand-offs.
  – Only missions which can meet their requirements within the bandwidth limitations of SFCG Recommendation 23-1 can use X-band; all others must use Ka-band

• DSN “aperture fees” will no longer be included in PIMMC although excessive planned usage will be penalized.
International Collaborations

• NASA still welcomes international participation however:
  – By statute, NASA cannot enter into bilateral collaborations with the People’s Republic of China.
  – By policy, NASA funds cannot be used to support research at non-US institutions,
  – foreign contributions cannot exceed 1/3 of the PIMMC,
  – nor can foreign contributions to instruments exceed 1/3 of the PI-Managed Instrument Cost.
The “PI-Managed Instrument Cost” is defined as the sum of costs associated with WBS 04 & WBS 05 in the standard WBS.
**Launch Vehicles**

**Charges against Cap**

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>4m Fairing</th>
<th>5m Fairing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Performance</td>
<td>-$16M</td>
<td>$13M</td>
</tr>
<tr>
<td>Medium Performance</td>
<td>0</td>
<td>$28M</td>
</tr>
<tr>
<td>High Performance</td>
<td>$14M</td>
<td>$43M</td>
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</table>
Typically, at L-36 months, a Request for Launch Services Proposal (RLSP) is released to the contractors on LSP’s standing contracts with the intent to competitively award a Launch Service Task Order (LSTO) for the mission based on customer requirements.

The LSTO is awarded to the Contractor (e.g., ULA or SpaceX) that provides the best value in launch services to meet the Government's requirements based on technical capability/risk, reasonableness of proposed price, and past performance.

Accordingly, assumption of a specific launch vehicle configuration as part of the AO proposal will not guarantee that the proposed LV configuration will be selected.

LVs currently available on LSP contracts include Antares, Athena, Atlas V, Falcon 9, Pegasus, and Taurus. New vehicle configurations can be awarded contracts or added to existing contracts as part of an annual on-ramp mechanism.
• Missions involving entry, descent, and landing (EDL) into the atmosphere of a Solar System object (including the Earth) shall include an Engineering Science Investigation to obtain diagnostic and technical data about vehicle performance and entry environments.
• Will be funded outside of the AO cost cap.
• Goals and objectives outlined in a document in the Program Library.
## Goals and Measurements

<table>
<thead>
<tr>
<th>Technical Objectives</th>
<th>Quantity/Measurement</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td><strong>Aerothermal Environment and Thermal Protection System (TPS)</strong></td>
<td></td>
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<tr>
<td>Aerodynamic heating</td>
<td>Heat Flux – Forebody</td>
<td>±5%</td>
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<tr>
<td></td>
<td>Heat Flux – Afterbody</td>
<td>±10%</td>
</tr>
<tr>
<td>Reduced TPS and vehicle mass, reduced subsystem risk for future missions</td>
<td>In-Depth Temperatures, as a function of time at multiple locations</td>
<td>±15%</td>
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<td></td>
<td>Recession in Flight (multiple locations)</td>
<td>±2 mm</td>
</tr>
<tr>
<td></td>
<td>Final Recession (if recovered)</td>
<td>±1 mm</td>
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<tr>
<td>Demonstrate adequate bonding and bond-line integrity</td>
<td>TPS-to-structure bond-line visualization (before and after flight)</td>
<td>±0.5 mm</td>
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<tr>
<td><strong>Atmosphere, Aerodynamics, and Flight Dynamics</strong></td>
<td></td>
<td></td>
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<td>Reconstruct EDL including atmospheric density. Increase landing accuracy.</td>
<td>Inertial Rates (IMU), mass properties</td>
<td>varies</td>
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<td></td>
<td>Static pressure on vehicle surface at stagnation point</td>
<td>±0.5% FS</td>
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<tr>
<td>Determine vehicle attitude in hypersonic regime</td>
<td>IMU, mass properties, and static pressure on vehicle surface at multiple locations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure</td>
<td>±0.5% FS</td>
</tr>
<tr>
<td>Verify aerodynamic coefficients in hypersonic and supersonic regimes; winds in the</td>
<td>IMU, mass properties, and static pressure on vehicle surface at multiple locations</td>
<td></td>
</tr>
<tr>
<td>supersonic regime</td>
<td>Pressure</td>
<td>±0.5% FS</td>
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<tr>
<td><strong>Atmospheric Decelerator</strong></td>
<td></td>
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<tr>
<td>Enhance system capability (heavier payloads, higher attitudes, etc.), reduce mass,</td>
<td>Aero decelerator total angle of attack at start of inflation</td>
<td>±2°</td>
</tr>
<tr>
<td>increase reliability and performance for future missions</td>
<td>Observations of aero decelerator area oscillations</td>
<td>30 fps</td>
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<tr>
<td></td>
<td>Aero decelerator force-time history</td>
<td>±2% of force @ 60 Hz</td>
</tr>
<tr>
<td></td>
<td>Aero decelerator angles of attack and sideslip vs. time</td>
<td>±1° @ 30 Hz</td>
</tr>
<tr>
<td></td>
<td>Aero decelerator drag coefficient vs. time and Mach number</td>
<td>±4% @ 60 Hz</td>
</tr>
<tr>
<td><strong>Vehicle Structure</strong></td>
<td></td>
<td></td>
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<tr>
<td>Reduce mass, increase reliability and performance for future missions</td>
<td>Entry Loads</td>
<td>±10%</td>
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<td></td>
<td>Landing Loads</td>
<td>±10%</td>
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AO contains a new requirement for the submission of the input file and output of a specific parametric cost model.

Goal is to provide some more transparency into cost estimation.

- Usually, cost estimators can speak with project engineers to reconcile assumptions. This can’t happen in proposal evaluations.
- The input and output of a selected model will allow TMC cost estimators, after they have performed their initial assessment, to see what the project assumed about heritage, complexity, etc.
QUESTIONS? COMMENTS?
ROTTEN FRUIT?