Multi-Angle Imager for Aerosols (MAIA) Hosting Services

Solicitation 80LARC18R0004

PreSolicitation Conference

NASA Langley Research Center
February 13, 2018
<table>
<thead>
<tr>
<th>Time</th>
<th>Agenda Item</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>8:00am</td>
<td>Registration</td>
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<tr>
<td>8:15am</td>
<td>NASA Science and Hosting Services</td>
<td>Greg Stover</td>
</tr>
<tr>
<td>9:00am</td>
<td>MAIA Science Overview</td>
<td>Dave Diner</td>
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<tr>
<td>9:30am</td>
<td>MAIA Instrument Overview</td>
<td>Kevin Burke</td>
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<tr>
<td>10:00am</td>
<td>Procurement Information/Other</td>
<td>Michael Kaszyca</td>
</tr>
<tr>
<td>10:30am</td>
<td>Break</td>
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<tr>
<td>11:00am</td>
<td>One-on-One Sessions</td>
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</table>
Conference Guidelines

• All questions/communications pertaining to the Draft RFP (DRFP) and proposal preparation instructions shall be submitted in writing to Karen Dempster at larc-maia@mail.nasa.gov in accordance with the DRFP instructions.
• We will attempt to answer questions during the conference today, but some will likely require some research and/or an official decision, and those will be answered in writing at a later.
• All questions submitted by the February 7, 2018 initial deadline have been addressed and will be posted on the FedBizOps website.
• List of participants and conference presentation will be posted on the FedBizOps website.
• Nothing stated at this conference should be construed as a revision unless subsequently issued in an amendment or incorporated in the Final RFP.
• Communications blackout will be invoked once the Final RFP is issued.
Guiding Recommendation Documents for NASA Earth Science Program of Record

- **2007 Decadal Survey**
  - Research/Applications priorities
  - No realistic budget constraint
  - Shopping list of missions & activities
  - Assumed Legacy missions completed

- **2010 NASA Response to Climate Plan**
  - Identified new Climate Measurements
  - Matched against President’s budget
  - Vetted w/OSTP, OMB & Admin

- **2012 NRC Midterm Report**
  - Endorsed NASA’s implementation
  - “Encouraged” more rigorous cost control
  - Endorsed additional Venture calls

*In addition to these documents, we are responsive to Executive and Congressional direction*
2017 Decadal Survey Snapshot for NASA Earth Science

- Publicly released January 5, 2018
- Supports the NASA Earth Science Division Program of Record through 2023
- Prioritized observations rather than specific missions
- Emphasis on competition
- Provide NASA ESD with implementation flexibility
NASA Earth Science

Missions: Present through 2023

ISS Instruments

JPSS-2 Instruments
OMPS-Limb (2019)

NISTAR, EPIC (DSCOVR / NOAA) (2019)

QuikSCAT (2017)

Landsat 7 (USGS) (~2022)

Aqua (>2022)

CloudSat (~2018)

CALIPSO (>2022)

Aura (>2022)

OSTM/Jason-2 (NOAA) (>2022)

Suomi NPP (NOAA) (>2022)

Landsat 8 (USGS) (>2022)

Terra (>2021)

GPM (>2022)

OCO-2 (>2022)

Suomi NPP (NOAA) (>2022)

Landsat 8 (USGS) (>2022)

Terra (>2021)

GPM (>2022)

OCO-2 (>2022)

Suomi NPP (NOAA) (>2022)

Landsat 8 (USGS) (>2022)

Terra (>2021)

GPM (>2022)

OCO-2 (>2022)
External Logistics Carriers: ELC-1, ELC-2, ELC-3
External Stowage Platforms: ESP-3
Alpha Magnetic Spectrometer
Columbus External Payload Facility
Kibo External Payload Facility
• Addresses unique highly focused requirements in Earth system science research
• Complementary to the Facility-class Earth Systematic missions
• Program consists of legacy missions and Venture Class

• Venture Class
  • Science-driven, PI-led, competitively selected, cost- and schedule-constrained, regularly solicited, orbital and suborbital
  • Low-to-moderate cost ($30M-$170M), small-to-medium sized orbital (class C/D) and sub-orbital projects
    – Cost capped for entire project life-cycle
# Earth Science Venture Opportunities

<table>
<thead>
<tr>
<th>Mission</th>
<th>Mission Type</th>
<th>Release Date</th>
<th>Selection Date</th>
<th>Major Milestone</th>
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<tr>
<td>EVS-1, aka EVS-1</td>
<td>5 Suborbital Airborne Campaigns</td>
<td>2009</td>
<td>2010</td>
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<td>EVM-1, CYGNSS</td>
<td>Smallsat constellation</td>
<td>2011</td>
<td>2012</td>
<td>Launched Dec 2016</td>
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<td>EVI-1, TEMPO</td>
<td>Geosynchronous hosted payload</td>
<td>2011</td>
<td>2012</td>
<td>Delivery NLT 2017</td>
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<td>EVI-2, ECOSTRESS &amp; GEDI</td>
<td>Class C &amp; Class D ISS-hosted Instruments</td>
<td>2013</td>
<td>2014</td>
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<td>EVS-2</td>
<td>6 Suborbital Airborne Campaigns</td>
<td>2013</td>
<td>2014</td>
<td>N/A</td>
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<tr>
<td>EVI-3, MAIA &amp; TROPICS</td>
<td>Class C LEO Instrument &amp; Class D Cubesat Constellation</td>
<td>2015</td>
<td>2016</td>
<td>Delivery NLT 2021</td>
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<td>EVM-2, GeoCarb</td>
<td>Geostationary hosted payload</td>
<td>2015</td>
<td>2016</td>
<td>Launch ~2021</td>
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<td>EVI-4, EMIT &amp; PREFIRE</td>
<td>CLASS C ISS-hosted payload &amp; Class D twin CubeSats</td>
<td>2016</td>
<td>2018</td>
<td>Delivery NLT 2021</td>
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<tr>
<td>EVS-3</td>
<td>Suborbital Airborne Campaigns</td>
<td>2017</td>
<td>2018</td>
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<td>EVI-5</td>
<td>Instrument Only</td>
<td>2018</td>
<td>2019</td>
<td>Delivery NLT 2024</td>
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<td>EVS-4</td>
<td>Suborbital Airborne Campaigns</td>
<td>2021</td>
<td>2022</td>
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<td>EVI-7</td>
<td>Instrument Only</td>
<td>2021</td>
<td>2022</td>
<td>Delivery NLT 2026</td>
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NASA Approach to Hosted Payloads

• Venture Class enabled an avenue that facilitates hosting

• We are committed to developing instruments and flying them on non-research satellites when it makes sense
  • TEMPO as the very first Earth Venture instrument selected will be hosted on a commercial geostationary satellite
  • MAIA is the first Earth Venture instrument selected to be hosted on a commercial low earth orbit satellite

• It is not only instruments for which the opportunity exists
  • A Principal Investigator can propose hosting as their access to space for their instrument or suite of instruments in the Earth Venture mission line
  • The GeoCarb PI is working with SES to host an instrument at GEO

• Continued discussions and support for the identifying and removing barriers in the hosted payload community will ensure continued opportunities
• Hosting is predicated on industry stating there is capacity to sell at a mutually advantageous price
Earth Venture Projects as Hosted Payloads

**MAIA (Multi-Angle Imager for Aerosols)** maps airborne coarse, fine, sulfate, nitrate, organic carbon, black carbon, and dust particles, and assesses their impacts on human health.

**TEMPO (Tropospheric Emissions: Monitoring of Pollution)** concurrent high temporal and spatial resolution measurements from GEO of tropospheric ozone, aerosols, their precursors, and clouds.

**GeoCarb (Geostationary Carbon Cycle Observatory)** measure key greenhouse gases and vegetation health from space to advance our understanding of Earth’s natural exchanges of carbon between the land, atmosphere and ocean.
In Summary

• We are committed to the Earth Venture line and its support of the recommendations of the first and second decadal survey

• We continue to look for opportunities to fly instruments on non-research satellites

• The commercial space community has been supportive in ensuring pathways exists for hosting instruments on commercial satellites

• Thanks for the opportunity to share how the commercial hosted payloads opportunity supports our vision of Earth Venture
Multi-Angle Imager for Aerosols (MAIA)

Science Overview

David J. Diner
Principal Investigator

Jet Propulsion Laboratory, California Institute of Technology
Inhalation of airborne PM has been associated with cardiovascular and respiratory diseases, heart attacks, low birth weights, lung cancer, and premature deaths.

The relative toxicity of specific PM types—mixtures having different proportions of coarse particles, fine particles, and chemical components—is poorly understood.

Coarse particles (PM\textsubscript{10-2.5}) irritate our respiratory systems.

Fine particles (PM\textsubscript{2.5}) penetrate deep into our lungs. Toxins can migrate to other organs.
MAIA’s primary objective is to assess the impacts of PM type on adverse birth outcomes, cardiovascular and respiratory diseases, and premature deaths.

Science questions

- For which PM types is maternal exposure during pregnancy linked to adverse birth outcomes such as restricted intrauterine growth, preterm delivery, and low birth weight?

- For which PM types is short-term (daily to monthly) exposure linked to acute illness events (e.g., asthma flare-ups) and premature death?

- For which PM types is chronic (multi-year) exposure linked to cardiovascular and respiratory disease?
NASA selected MAIA under the Earth Venture Instrument-3 solicitation as a Hosted Payload.

MAIA is the first competitively selected NASA satellite mission with applications/societal benefit as its primary objective.

At the heart of the MAIA instrument is a spectropolarimetric camera system on a 2-axis gimbal.

The MAIA investigation integrates the satellite instrument observations, ground monitor data, and chemical transport model results to map size and compositional components of ambient PM.

Epidemiologists on the MAIA team will use the resulting data products to conduct health impact investigations.
MAIA Instrument Integrates Multiple Observing Modalities

<table>
<thead>
<tr>
<th>Multi-angle radiometry</th>
<th>Multi-angle polarimetry</th>
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<tr>
<td>Enhances the aerosol signal relative to surface reflection</td>
<td>Sensitive to particle size and compositional proxies such as refractive index</td>
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<tr>
<td>Sensitive to aerosol particle size and shape</td>
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<tr>
<th>Broad spectral coverage</th>
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<tr>
<td>Ultraviolet: Aerosol absorption and height</td>
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<tr>
<td>Visible/near-infrared: Fine mode aerosols</td>
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<tr>
<td>Shortwave infrared: Coarse mode aerosols and cirrus cloud screening</td>
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Instrument design accommodates a 600-850 km sun-synchronous orbit.
The requirement for multi-angle viewing makes low Earth orbit the appropriate orbit choice for MAIA.

Scan (along-track) gimbal axis provides multi-angle viewing using a “step and stare” observing sequence (±60° field of regard)

Targets are observed repeatedly (~5 times at different view angles during each overpass)

Pan (cross-track) gimbal axis allows access to targets that are off the sub-spacecraft track, and assists in onboard calibration (±45° field of regard)
Science Overview

- **Candidate Primary Target Area (PTA):** Main candidate for project epidemiological studies
- **Potential PTA:** Additional site under consideration
- **Secondary Target Area (STA):** Supports other air quality, aerosol, and cloud climate studies
- **Calibration/Validation Target Area (CVTA):** Routinely observed site for vicarious calibration and instrument stability monitoring

List is not finalized. Host orbit is a key consideration in final target selection.
Observations of at least 10 globally-distributed PTAs covering a broad range of PM concentrations and particle types

Candidate PTAs currently include areas with low pollution (e.g., Canada) to areas with high pollution (e.g., India)

Each PTA observed, on average, at least 3 times per week

Orbital mission duration: 3 years (baseline), 2 years (threshold)

Orbit altitude: in the range 600-850 km

Polar, sun-synchronous orbit with mean equator-crossing time between 9:00 am and 3:00 pm, exclusive of 11:30 am to 12:30 pm
Concept of Operations

Illustration of operations that occur on a typical MAIA orbit. Earth science data are collected on the orbit dayside only.
On average, fewer clouds are expected in the morning than in the afternoon. Since clouds interfere with MAIA's ability to determine PM concentrations, a morning equator crossing time is preferred.

Late morning allows time after sunrise for the near-surface boundary layer to become well mixed, which benefits MAIA’s ability to determine near-surface particle concentrations from the satellite measurements.

Drift in equator crossing time over mission life of up to 30 minutes is acceptable, provided 11:30 am - 12:30 pm keepout zone is avoided.
Higher spatial resolution favors lower altitudes, but being able to cover more cities with a given target area favors higher altitudes.

Increased target revisit frequencies favor higher altitudes.

Target revisit pattern is related to orbit period, leading to certain discrete altitude ranges being more or less desirable.

For the final RFP, this chart will be simplified.

Narrow preference ranges will be smoothed out and there will be less variability with altitude.

General preference for orbits in the 700-800 km range will be retained.
**Ascending vs. descending node**

When multiple targets are observable on the same orbit track, the instrument can typically acquire data over only one of them, so it is necessary to choose which target to observe.

The frequency of such conflicts depends on the specific geographic locations of the targets, and whether the orbit dayside is on the ascending or descending node.

Given the specific target locations under consideration by the MAIA Science Team, we prefer an **ascending node** orbit.

**Eccentricity**

To provide consistency in spatial resolution and coverage between different PTAs, and between successive observations of the same PTA, circular or near-circular orbits are preferred, with eccentricity < 0.001.
✓ We look forward to your feedback on the draft RFP, your responses to the final RFP, and a productive partnership to benefit Earth science and human health.

✓ Questions?
Multi-Angle Imager for Aerosols (MAIA)

Instrument Overview

Kevin A. Burke
Project Manager

Jet Propulsion Laboratory,
California Institute of Technology

MAIA
Associating airborne particle types with adverse health outcomes
The MAIA Instrument, currently under development, incorporates a spectropolarimetric camera system on a bi-axial gimbal that provides scan rotation (pointing the cameras along-track) and pan rotation (pointing the cameras cross-track).

Operation of the bi-axial gimbal

During launch: the MAIA cameras point internal to the MAIA Instrument with a launch lock engaged

During MAIA In-Orbit Checkout: the launch lock would be disengaged

During nominal operations: the MAIA Instrument’s scan and pan actuators would be commanded, via ground commands and scripts relayed to the MAIA Instrument Electronics, to point the cameras to targets of interest within the Instrument’s Field-of-Regard or to an on-board calibrator (OBC)

During spacecraft thruster usage: the MAIA cameras point to a location within the MAIA Instrument as a means of contamination protection
The MAIA Instrument configuration shown on the previous slide is in the configuration consistent with a sun synchronous ascending orbit with day-side equator crossing time in the morning (this is the preferred orbit).

This configuration is identical to the configuration for a sun synchronous descending orbit with day-side equator crossing time in the afternoon.

There are two additional orbit options:
- ascending orbit with day-side equator crossing time in the afternoon
- descending orbit with day-side equator crossing time in the morning

For the latter two options, the instrument would rotate 180° about the nadir (+Z) axis so that the Focal Plane Radiator is located on the anti-sun side of the instrument.
The scan (along-track) gimbal axis provides multi-angle viewing of selected target areas using a “step and stare” observing sequence. The pan (cross-track) gimbal axis allows access to targets that are not directly situated on the sub-spacecraft track.

Field of regard: ±60° along-track × ±45° cross-track, at the instrument.

Target area dimensions: at least 300 km × 150 km, increasing with orbit altitude.

Nadir footprint ~200 m.

Radiance measured in 14 spectral bands in the UV/VNIR/SWIR, polarization measured in 3 of the bands.
Maximum expected mass: 80 kg
Maximum expected dimensions: 70 cm (along-track) × 90 cm (cross-track) × 50 cm (height)
Maximum expected power: 85 W (orbit average), 100 W (peak)
Maximum expected data rate: 10 Mbps (average), 100 Mbps (peak)
Class C instrument per NASA NPR 8705.4
Implementation Approach

Instrument Overview

✓ JPL In-house development, integration and test with significant reliance on industry for components
  Detector, Telescope, Modulator, Filters, Polarizers and Gimbal Assemblies are sub-contracted
  Camera Electronics in-house
  Instrument Electronics out-of-house
  Mechanical/Thermal in-house (numerous purchases)
  Instrument Operations System (IOS) and Science Data System (SDS) in-house

✓ Leverages architecture and development team from similar airborne instruments developed at JPL (AirMSPI / AirMSPI-2)

✓ Leverages Science Data System (SDS) from AirMSPI, and Instrument Operations System and SDS from precursor spaceborne instrument (MISR)
Project Status

Instrument Overview

- SRR/IDR completed March 2017
- Subsystem PDRs nearing completion
- All subcontracts are in place
- PDR scheduled for April 2018
- CDR tentatively planned for early 2019
Procurement Information/Other

Michael Kaszyca, Contracting Officer
Office of Procurement (OP)
Procurement Specifics (1 of 3)

- **Full & Open Competition** under NAICS 541715 - Research and Development in the Physical, Engineering, and Life Sciences (Except Nanotechnology and Biotechnology (Size Standard of 1,000 employees). *(SF1449)*

- **Commercial Item/Service** in accordance with FAR Part 12. *(Section 2)*

- Contract type is **Firm-Fixed-Price (FFP)** with Milestone Payments. *(Clauses 1.1 & 2.16; Exhibit D)*

- Potential period of performance (POP) will be ~9 years consisting of a ~6-year base period and three, 1-year options. *(Clause 1.3)*
  - **Exact POP will be dependent on Offeror solutions**; however the preferred launch date is no later than June 2022 based on a planned MAIA Instrument delivery availability of June 2020.
  - Operations are planned for 36 months following launch and the 90 calendar day In-orbit Checkout Period.
  - Option periods will be utilized for any extended mission operations.
• MAIA Instrument and Instrument-Specific Ground Support Equipment (GSE) will be provided as Government-Furnished Property (GFP). *(Clauses 2.8 & 2.15)*  
  – Contractor accountable for MAIA Instrument after completion of post-ship testing through the period up to launch vehicle ignition, at which time accountability transfers back to NASA.  
  – NASA will test the MAIA Instrument prior to transfer of accountability to the Contractor at the Contractor’s facility for integration with the spacecraft.  
  – GFP Includes:  
    • The MAIA Instrument.  
    • GSE including, but not limited to:  
      – Electrical and optical support equipment for testing the MAIA Instrument upon arrival at the Contractor’s facility (e.g., target sources, power supplies, electrical simulator for spacecraft functions and control computers).  
      – Handling fixtures including two lift fixtures, baseplates, and a cart with provision for moving and rotating the instrument.  
    • Containers for shipping and storing the MAIA Instrument and the GSE.  
      – The MAIA shipping container will contain purge equipment to control MAIA Instrument contamination during shipping and storing.
Procurement Specifics (3 of 3)

• Contractor shall be **AS9100 compliant** as of the date of proposal submission. *(Clause 2.14 & Provision 5.2.6)*
  – If AS9100 certified/registered, provide certificate with proposal.
  – If not AS9100 certified/registered, provide documentation required in provision 5.2.6.

• Contractor required to obtain and maintain all necessary licenses, permits, clearances, etc. required to perform services *(Clause 2.18)*

• Contractor shall remain a “United States commercial provider” (as defined at 51 U.S.C. § 50101) throughout the entire contract period of performance, including any exercised option periods. *(Clauses 2.20 & Provision 4.3)*
Proposal Preparation/Evaluation (1 of 3)

• Please read the solicitation carefully and ask questions!
  – This presentation is not covering the specific proposal and evaluation instructions, requirements, and process contained therein.
  – Anticipate possible changes in Final RFP compared to DRFP.

• Ensure proposal contains all necessary information, required documentation, and is complete in all aspects.
  – Offeror responsible for proposal clarity and ensuring it considers the entire solicitation, including information in any solicitation Attachments, such as Attachment 3, Reference Documents. *(Provision 5.2.1)*
  – Ensure all Offeror-required fill-ins are complete (e.g., Section 1.1, Contract Pricing; Exhibit D, Milestone Payment Schedule; Items in Exhibit C, MRD). *(Provision 5.2.5)*
  – Total POP is based on Offeror’s overall approach to meeting requirements. *(Section 1.3 & Provision 5.1.5)*
  – Additional Required Documentation (AS9100 Compliance & Government Property Management Information) NOT part of overall evaluation/selection, but IS part of overall responsibility determination. *(Provisions 5.2.6 & 6.2)*
Proposal Preparation/Evaluation (2 of 3)

- Electronic proposals ONLY; no paper. *(Provision 5.2.2)*
- NASA is not establishing Small Business Goals.
  - Offeror responsibility to propose goals and Small Business Subcontracting Plan (Exhibit E). *(Provision 5.2.7, Subfactor 4)*
  - NASA Small Business Specialist available to discuss any specific questions.
- NASA may, unilaterally, choose to incorporate any positive aspects of an Offeror’s approach to meeting/exceeding contract requirements into the final awarded contract, particularly if any positive proposal area results in Strength or Significant Strength findings in the Mission Suitability evaluation. *(Provisions 5.2.7 & 6.3)*
- NASA may reject any proposal that fails to comply with all proposal instructions, including those for electronic submissions, as incomplete and unacceptable. *(Provision 5.2.1)*
Proposal Preparation/Evaluation (3 of 3)

- **Method of Evaluation** *(Provision 6.2)*
  - Proposals received in response to this solicitation will be evaluated by a Source Evaluation Board (SEB) in accordance with NFS 1815.3.
  - A best value trade-off process, as described at FAR 15.101-1, Tradeoff Process, will be used in making the source selection.
  - Evaluation is based upon actual material presented and not on the basis of what is implied.

- The Government intends to award a contract without discussions, but reserves the right to hold discussions if the Contracting Officer deems necessary. *(Provision 52.212-1(g))*

- Overall, in the selection of a Contractor for contract award, Mission Suitability and Past Performance will be of approximately equal importance. In accordance with FAR 15.304(e), Mission Suitability and Past Performance, when combined, are approximately equal to Price. *(Provision 6.4)*
### Schedule (Tentative)

- **Draft RFP Comments Due**: March 1, 2018
- **RFP Release**: April 30, 2018
- **Proposal Due**: RFP Release + 30 calendar days
- **Proposal Evaluation Period**: June – October 2018
- **Award**: October 2018

### MAIA Instrument Milestones

<table>
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<th>MAIA Instrument Milestones</th>
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<th>FY18</th>
<th>FY19</th>
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### MAIA Host Procurement Timeline

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Break
One-on-One Sessions