



SCIENCE

Technology Infusion

Dr. Curt Niebur
Lead Program Scientist for New Frontiers
Pre-Proposal Conference for NF4 AO
January 20, 2017



Technology Infusion



- The New Frontiers Program encourages the optional infusion of new technologies where beneficial into proposals.
- Intent is to provide a flight opportunity for NASA-developed technologies that provide significant enhancement to missions but perhaps are not readily embraced by proposers.
 - Incentives designed to balance concerns about the perceived risks and/or readiness of the technology.
- Additionally, some technologies are offered for infusion because NASA wishes to derive benefits from its sustained programmatic support of certain technologies.
- The four technologies listed in Table 4 of the AO were chosen after consideration of the technologies under development by NASA.



Interactions with Incentivized Technology Providers



- For technologies being incentivized for this AO, NASA will support technical interactions between individual proposals teams and the technology developer.
- A recurring question is what “technical interactions” covers.
- NASA’s expectation is that this covers providing technical information and answering the occasional question. But the level of support is left up to the POCs for each technology with the following caveats:
 - Equal opportunity for engagement to all proposers
 - Accurate information to all proposers
 - Acknowledgement of the potentially proprietary aspects of the interactions
- Note that the technology providers will not be part of the review process.
- Additional information from each POC is available in backup.

Questions?



**Image of Jupiter acquired by the
JunoCam instrument on Juno**



BACKUP

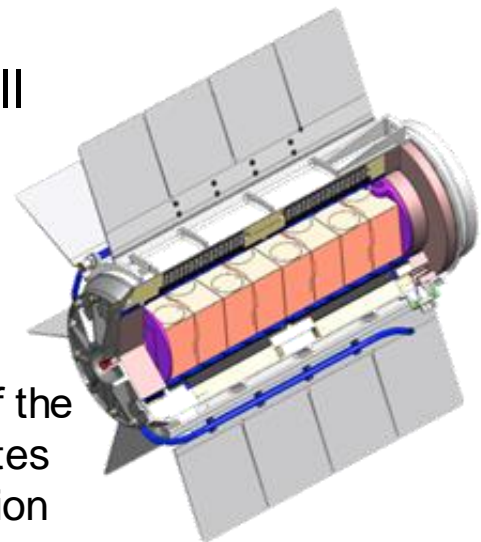


RPS Program Assistance to New Frontiers 4 AO Proposers



- RPS Program will:

- Provide the same level and quality of assistance to all Proposers requesting assistance
- Protect proprietary information
- Assist the Proposer in the understanding of the integration and use of an MMRTG or RHUs
 - This does not remove the proposers' ultimate responsibility of the mission design that appropriately accommodates and integrates the MMRTG or RHUs into the mission or the associated mission technical risks.



- Process

- Contact the RPS AO POC to discuss the assistance being requested. During Step 1, no mission specific analysis will be performed.
 - Assistance to consist of clarification of technical information already provided by the RPS Program
 - See <http://rps.nasa.gov> for User's Guide and additional information
 - If addition technical discussions are required the RPS AO POC will engage the Department Of Energy (DOE) and DOE may engage their contractors as necessary
 - It is the responsibility of the proposer's organization to establish any NDAs with the contractor organizations if so desired



NEXT-C



- The NEXT-C Project will support mission teams during New Frontiers proposal development. All interactions will be coordinated through the NEXT-C Interface lead at NASA GRC. The interface lead will coordinate the GRC technical support required, and will coordinate interactions with the mission team to provide information and to coordinate interface definition and integration/operations planning.
- The NEXT-C project is not currently funded for New Frontiers Phase A support. The NEXT-C project could support Phase A work, however that work should be scoped and included as part of the Phase A proposal and funded appropriately.



HEEET for New Frontiers-4



- **HEEET is in the 3rd year of a 4 year development timeline, (end FY18), to mature and demonstrate the technology readiness for mission infusion**
 - ◆ With the manufacturing, integration and testing of a 1 m diameter heat-shield HEEET project would demonstrate a scalable system for use by NF-4 proposers
- **NF-4 AO states:**
 - NASA pays for HEEET team consulting and technology transfer³. This is in addition to incentive of \$20M and exemption from risk associated with the readiness of the technology for missions proposing to use the technology.
 - ³NASA support for HEEET team will extend through the life time of the mission*
- **The HEEET Team will engage with the proposers**
 - ◆ Ensure risks are understood and addressed in step 1, phase A and during execution.
 - ◆ Provide insight and guidance on HEEET implementation and support proposal teams with HEEET integration specific to selected mission concept
 - ◆ In Step 1:
 - Facilitate communication between proposal teams and vendors (BRM and FMI) supporting HEEET manufacturing
 - Ensure mission infusion technical, cost and schedule challenges are identified and addressed
 - HEEET team support to the proposal teams in Step 1 is detailed in page 3
 - ◆ In Phase A:
 - A list of documentation and deliverables to be made available to proposal teams is detailed in page 5.



HEEET Team Responsibilities

In Step 1 and Phase A



- **Aerothermal constraints, TPS thickness constraints, TPS Sizing**
 - Constraints on trajectories based on manufacturing and testing limitations
 - HEEET surface roughness estimates to be used by proposal team to compute roughness heating augmentation
 - Limited sizing for mission design trajectories
 - Guidance on margin policy for HEEET
- **Carrier Structure Guidance**
 - Seam strain level, Radius of curvature, Interface with payload, etc
 - ETU carrier design under development (Ref: Saturn Entry Probe)
- **Guidance on estimating implementation cost and schedule**
 - Information on vendors that contributed to ETU build
 - Detailed insight into integration challenges and implementation experience
 - No detailed cost estimates or implementation schedules
- **Guidance on HEEET specific implementation tasks (> TRL 6)**
- **Guidance on Risks/Challenges related to implementation of HEEET for specific proposal**
- **HEEET Implementation Credibility Review (HICR)**
 - Will review cost, schedule and technical aspects of HEEET implementation and provide a written report to proposal team
 - Not an embedded design function
- **Engineering Science Instrumentation**
 - ESI is outside the scope of HEEET development
 - Provide lessons learned from ground based instrumentation.

Proposal Team Responsibilities In Step 1 and Phase A



- **Trajectory Analysis, Aeroheating (CFD), Payload and Compatible Aeroshell Sizing, Carrier Structure Design and Structure Costing, Engineering Science Instrumentation**
- **HEEET Design:**
 - HEEET team provides constraints on tile size and lessons learned from 1m MDU/ETU
- **Flight MDU/EDU and other required testing:**
 - Test Definition/Costing
 - HEEET team provides limited guidance on HEEET specific issues
- **HEEET Costing and schedule**
 - HEEET team only provides background on manufacturing process, ID's sources for raw materials, vendors supporting manufacturing steps
 - Proposal team must negotiate directly with suppliers for detailed cost estimates and lead time and integrated schedule.
- **# of heat shields**
 - Flight + spare + EDU + MDU, etc...
 - This coupled with testing requirements etc....will define how much woven material is required
 - Given the high cost of set-up would be advisable to set up loom only once and weave everything.
- **Proposal writing related to HEEET**

HEEET Deliverables (FY'18)*



Final documents listed below will be delivered at the end of FY'18.

• **Material and Process Specifications**

- Raw materials
- Weaving
 - 12" and 24" wide. Up to 2" thick dual layer
- Acreage Tile and Gap Filler:
 - Forming
 - Resin Infusion
 - Machining
- Gap Filler – ESH
- Integration
 - 1m scale
- NDE (CT scan)

• **Seam Design**

• **Material Property Database**

• **Thermal Response Model**

• **Sizing Study Report**

- Saturn and Venus reference missions

• **Engineering Test Unit (ETU)**

- ETU Test Report

• **Validated Structural Analysis Tools**

• **TRL and MRL Assessment**

• **Sustainability Assessment**

• **Maturation Plan**

- End of HEEET to Flight

• **Assessment of remaining risks/concerns**

• **DAC Reports**

- Saturn (~1m) specific
- Venus (~3.5m) specific

• **Seam/Integration approach is applicable for repair**

• **Manufacturing/integration demonstrated at 1m scale**

- Approaches should be scaleable to larger size (however will not be demonstrated)

• **EDL flight instrumentation is outside the scope of HEEET project**

* Draft documents could be made available sooner to the proposal teams in Phase A.