NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

HEADQUARTERS

SPACE TECHNOLOGY MISSION DIRECTORATE

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SPACE TECHNOLOGY MISSION DIRECTORATE,

INDUSTRY-DEVELOPED TIPPING POINT TECHNOLOGIES – REQUEST FOR INFORMATION

NNH15ZOA003L

Request for Information Issued: *February 3, 2015*

Request for Information Due: ***March 19, 2015 (5:00pm Eastern)***

Catalog of Federal Domestic Assistance (CFDA) Number 43.012

OMB Approval Number 2700-0087

Industry-Developed Tipping Point Technologies – Request for Information

Responders are reminded:

REQUEST FOR INFORMATION (RFI): THIS IS *NOT* A REQUEST FOR PROPOSAL, QUOTATION, OR INVITATION TO BID NOTICE.

1.0 Introduction

The National Aeronautics and Space Administration (NASA) is continually looking for opportunities to help advance the development of U.S. commercial space products and services. With the recent increase of U.S. private-sector companies interested in space operations, and the associated terrestrial spin-off applications, NASA is seeking to better understand U.S. industry interests. In particular, NASA is seeking technology areas of significant interest to the commercial space industry where modest further investments would result in rapid deployment and utilization in space applications. Technology areas of interest should already have reached a Technology Readiness Level of 3 and demonstrate the potential for significant market applicability. A description of NASA's Technology Readiness Levels is shown in Attachment A.

NASA recognizes that commercial space interests have a pipeline of key technologies at various levels of maturity with some near a "tipping point", where a final demonstration or validation would result in rapid adoption and utilization. NASA is interested in technology projects that would advance capabilities to a point, beyond which industry, without further government investments, would willingly develop and qualify them for market. These technologies could have been previously funded through a variety of avenues and should have a substantial benefit to both the commercial and government sectors once the development/demonstration project completes. The Space Technology Mission Directorate is seeking input through this Request for Information (RFI) on industry-developed "tipping point" technologies that could support future commercial and NASA space missions.

2.0 Development Approach

Through a potential resultant effort following this RFI, NASA would seek to mature compelling "tipping point" technologies of significant interest to commercial space. NASA does not envision supporting the development, production, testing and qualification of final operational systems, but instead views the Space Technology Mission Directorate's role as providing support for an existence proof development or demonstration beyond which

industry could proceed without additional government investments. NASA is also interested in understanding different approaches for accomplishing the development/demonstration under the most affordable terms possible. Although not required as part of any suggested development/demonstration approach, NASA seeks to understand any benefits (especially in terms of affordability) in utilizing government facilities and personnel to accomplish the goals of the potential effort. If a spaceflight demonstration is deemed required, the lowest cost approach to achieving the demonstration is encouraged (such as small spacecraft, hosted payload, secondary). Potential options for consideration should include demonstration partnerships such as those used for the SEXTANT (https://gcd.larc.nasa.gov/projects/deep-space-x-ray-navigation-and-communication/#.VL_GKlrn_bo) and MOXIE (https://gcd.larc.nasa.gov/projects/in-situ-resource-utilization/#.VL_GB1rn_bo) projects, where a technology demonstration payload is integrated and flown as an element of another flight mission funded by another source. If approaches exist that achieve the existence proof goals without performing a spaceflight demonstration, these are of significant interest. For example technology maturation approaches where a ground demonstration of a flight-like engineering/test unit would suffice to advance the technology to readiness for implementation. Finally, the Space Technology Mission Directorate is interested in any potential external funding or resource contributions that might contribute to the technology advancement effort.

3.0 Information Requested

The responses to this RFI should include the following information:

The responses this RFI should include the following information:

- **Company Information:** Company name and address, point-of-contact name, e-mail address, and phone number.
- **Technology Description**: Provide a detailed description of the technology, including the principals involved, the capabilities it provides, differences relative to other solutions to the problem it solves, comparisons to current state of the art, and performance metrics.
- **Technology Development History:** Previous research and development efforts, previous funding sources, and Intellectual Property rights.
- **Technology Readiness Level:** Identify the Technology Readiness Level (TRL) including sufficient data / information to support the assessment.
- **Development Approach:** Describe the suggested approach to mature the technology to the point where industry can qualify and market the technology with no further government investments. This description should include a list of ground tests and any required flight demonstrations as well as the suggested means to perform these efforts. In order to provide a better understanding of the scope of the effort, provide a Rough

Order of Magnitude (ROM) cost and timeframe of the total potential effort including a breakdown by major project tasks. Indicate the anticipated TRL at the conclusion of the development effort. Discuss why the selected approach is the most affordable approach and detail why this advancement will get the technology past the "tipping point". Additionally, include a discussion of the key development and demonstration risks.

- **Potential NASA Contributions and Partnerships:** List the expertise and support (including both labor and facilities) desired from NASA (if any). Explain any advantages or disadvantages (particularly in terms of cost) for leveraging NASA personnel, facilities or capabilities, as well as the likelihood of any funding or resource contributions to complete the work.
- **Market Potential Assessment:** Discuss the commercial market for the technology once the development project is completed, including potential customers and the expected market size. Detail how this technology has the potential to significantly change the commercial market space. Provide details that describe the value proposition or return on investment of the technology – that is the benefits in terms of reduced costs and increased market resultant from, and relative to, the required technology development costs. The assessment should include the potential need for the technology by industry, NASA, and other government agencies.

4.0 RFI Questions

If you have questions concerning this RFI prior to submitting a response, please send your questions to stmdrfi1@nasaprs.com. NASA will review the questions and post a response in the Frequently Asked Questions (FAQs) document that will posted on the RFI Website in NSPIRES. Questions must be submitted by March 1, 2015 to be considered by NASA for a response.

5.0 Submitting Responses

Responses to the Space Technology Mission Directorate, Industry-Developed Tipping Point Technologies Request for Information (NNH15ZOA003L) must be submitted electronically using the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) at http://nspires.nasaprs.com/. It is important to note that some of the functionality of the NSPIRES system uses terminology that does not exactly track to the collection of RFI data. For instance, when submitting responses to this RFI, submitters will be prompted to "Access 'Proposals/NOIs' in the NSPIRES Options Page." Use of the term "proposals" and "notices of intent" in these instructions does not mean that NASA is inviting proposals or offers in response to this RFI.

Responses are limited to no more than 15 pages and should be uploaded as a single PDF file attachment not to exceed 10MB at the NSPIRES web site (http://nspires.nasaprs.com). The information provided in response to this RFI will not be disclosed publicly or used outside of the government for any purposes. The target audience of responders is primarily commercial entities as potential NASA and other government responses are regularly captured through collaborations.

NSPIRES Account Registration

All respondents are required to register with NSPIRES and are urged to access this site well in advance of the RFI due date to familiarize themselves with its structure and enter the requested identifier information. This data site is secure and all information entered is strictly for NASA use only. Respondents do not have to affiliate with an organization during registration to submit an RFI. Respondents will submit the RFI directly and do not have to have an authorized organizational representative submit on their behalf. To register for an account, go to: http://nspires.nasaprs.com/external/ and click on "Getting an Account" on the left hand margin of the screen.

Creating Your RFI Response

Responses must be submitted using the "Notice of Intent (NOI)" module within the NSPIRES system. To initiate an RFI response:

- Log in using your NSPIRES user name and password (http://nspires.nasaprs.com/external/
- Access "Proposals/NOIs" in the NSPIRES Options Page.
- Click on the "Create NOI" button on the right side of the screen. Select the "Space Technology Mission Directorate, Industry-Developed Tipping Point Technologies Request for Information (NNH15ZOA003L).
- Follow the step-by-step instructions provided in NSPIRES to complete your RFI. The following two elements are mandatory for this RFI submission:
    - Utilize the "Summary" element of the RFI to provide a concise paragraph summarizing your response to this RFI (limited to 4,000 characters).
    - Utilize the "Program Specific Data" element to respond to the series of specific questions (each text question response is limited to 4,000 characters).

Requests for assistance in accessing and/or using the NSPIRES website should be submitted by e-mail to nspires-help@nasaprs.com or by telephone to (202) 479-9376 Monday through Friday, 8:00 AM – 6:00 PM Eastern Time. FAQs on NSPIRES may be accessed through the Proposal Online Help site at http://nspires.nasaprs.com/external/help.do. Tutorials of NSPIRES are available at http://nspires.nasaprs.com/tutorials/index.html.

The information is requested for planning purposes only, subject to Federal Acquisition Regulation (FAR) Clause 52.215-3, entitled "Solicitation for Information for Planning Purposes." Provided the availability of funds, the Space Technology Mission Directorate will consider a competitive Broad Area Announcement (BAA) in one or more such topic areas. However, the release of this RFI does not indicate that the government will issue a solicitation in this area nor does it obligate the government to invest any resources specific to the targeted technology area.

Attachment A: Description of NASA Technology Readiness Levels

TRL	Definition	Hardware Description	Software Description	Exit Criteria
1	Basic principles observed and reported	Scientific knowledge generated underpinning hardware technology concepts/applications.	Scientific knowledge generated underpinning basic properties of software architecture and mathematical formulation.	Peer reviewed publication of research underlying the proposed concept/application.
2	Technology concept and/or application formulated	Invention begins, practical applications is identified but is speculative, no experimental proof or detailed analysis is available to support the conjecture.	Practical application is identified but is speculative; no experimental proof or detailed analysis is available to support the conjecture. Basic properties of algorithms, representations, and concepts defined. Basic principles coded. Experiments performed with synthetic data.	Documented description of the application/concept that addresses feasibility and benefit.
3	Analytical and experimental critical function and/or characteristic proof-of-concept	Analytical studies place the technology in an appropriate context and laboratory demonstrations, modeling and simulation validate analytical prediction.	Development of limited functionality to validate critical properties and predictions using non-integrated software components.	Documented analytical/experimental results validating predictions of key parameters.
4	Component and/or breadboard validation in laboratory environment.	A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments, and associated performance predictions are defined relative to final operating environment.	Key, functionality critical software components are integrated and functionally validated to establish interoperability and begin architecture development. Relevant environments defined and performance in the environment predicted.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.

5	Component and/or breadboard validation in relevant environment.	A medium fidelity system/component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realistic support elements that demonstrate overall performance in critical areas. Performance predictions are made for subsequent development phases.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.
6	System/sub-system model or prototype demonstration in a relevant environment.	A high fidelity system/component prototype that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype implementations of the software demonstrated on full-scale, realistic problems. Partially integrated with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.
7	System prototype demonstration in an operational environment.	A high fidelity engineering unit that adequately addresses all critical scaling issues is built and operated in a relevant environment to demonstrate performance in the actual operational environment and platform (ground, airborne, or space).	Prototype software exists having all key functionality available for demonstration and test. Well integrated with operational hardware/software systems demonstrating operational feasibility. Most software bugs removed. Limited documentation available.	Documented test performance demonstrating agreement with analytical predictions.

8	Actual system completed and "flight qualified" through test and demonstration.	The final product in its final configuration is successfully demonstrated through test and analysis for its intended operational environment and platform (ground, airborne, or space).	All software has been thoroughly debugged and fully integrated with all operational hardware and software systems. All user documentation, training documentation, and maintenance documentation completed. All functionality successfully demonstrated in simulated operational scenarios. Verification and validation completed.	Documented test performance verifying analytical predictions.
9	Actual system flight proven through successful mission operations.	The final product is successfully operated in an actual mission.	All software has been thoroughly debugged and fully integrated with all operational hardware and software systems. All documentation has been completed. Sustaining software support is in place. System has been successfully operated in the operational environment.	Documented mission operational results.

Note: In cases of conflict between NASA directives concerning TRL definitions, NPR 7123.1 will take precedence.