

The University of Texas at El Paso

Office of Research and Sponsored Projects

Proposal Submission Electronic Signature Approval Record

Project PI: Ahsan Choudhuri

Project Title: Development Of Precise Modular Attitude Control Or Deorbit Systems Using High-test Pero

ORSP Number: 20150430

TRANSMITTAL Record: 1235

NOI: 3987

Person	Signature	Date
Principal Investigator (Ahsan Choudhuri)	Choudhuri, Ahsan	Jun 06, 2015 02:56:32
Department Chair (Choudhuri, Ahsan R)	Choudhuri, Ahsan	Jun 06, 2015 02:56:32
Dean (Schoephoerster, Richard)	Schoephoerster, Richard	Jun 06, 2015 03:07:49

TRANSMITTAL



**THE UNIVERSITY OF TEXAS AT EL PASO
PROPOSAL APPROVAL FORM**

Proposal # 2015-0430

ORSP RA Name:

Holguin, Irene S.

1. PROJECT TITLE: Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Pero
Multidisciplinary? ☐ **PROPOSAL DEADLINE:** 6/8/2015

2. PRINCIPAL INVESTIGATOR or PROJECT DIRECTOR: Ahsan Choudhuri
Phone Number: E-mail: ahsan@utep.edu
Academic or Staff Position: PROFESSOR
Department: Mechanical Engineering
College: College Of Engineering *Percent Credit: 100.00%
Submitting College/Center Center for Space Exploration Technology Research (CSETR)

3A. Co-Investigator(s):

Department:

Academic or Staff Position:

College:

* Percent Credit:

3B. Co-Investigator(s):

Department:

Academic or Staff Position:

College:

* Percent Credit:

* Percent Credit is percent of participation/role in project (Not Related to Effort)

4A. Agency:

NATIONAL AERONAUTICS AND SPACE ADMIN (FED)

4B. Primary Agency (if pass-through):

(NONE)

5. SUMMARY OF PROPOSAL BUDGET:

Project Period Begin Date: 10/1/2015 **Project Period End Date:** 9/30/2017

Number of years: 2

	UTEP Contribution	Agency Contribution	Total	Cost Share Approver/Authorizer Signature
Salaries & Wages	\$0	\$59,559	\$59,559	
Fringe Benefits	\$0	\$8,787	\$8,787	
Consultants	\$0	\$0	\$0	
Travel	\$0	\$7,050	\$7,050	
Supplies/Materials	\$0	\$57,054	\$57,054	
Equipment	\$0	\$0	\$0	
Subcontracts	\$0	\$0	\$0	
Stipends/Tuition & Fees	\$10,000	\$0	\$10,000	
Other (Itemize under Remark)	\$0	\$0	\$0	
TOTAL DIRECT COSTS	\$10,000	\$132,450	\$142,450	
INDIRECT COSTS 51.0 MTDC	\$0	\$67,550	\$67,550	
TOTALS	\$10,000	\$200,000	\$210,000	

Point of contact name, e-mail, and phone number for cost share account information after award:



THE UNIVERSITY OF TEXAS AT EL PASO PROPOSAL APPROVAL FORM

6. Source of funds:		<input checked="" type="checkbox"/> Federal – 200 (includes pass through)	<input type="checkbox"/> State – 300 (Texas only)	<input type="checkbox"/> Foundation	<input type="checkbox"/> Industry (For Profit)	<input type="checkbox"/> Local – 380 (City Gov)	<input type="checkbox"/> Other
7. THECB R&D: 4. Engineering/(NONE)							
8. NSF S&E or Non S&E: A6-Engineering - Mechanical							
9. CFDA No. 43.012		CFDA Program Name: Space Technology					
<u>YES</u>	<u>NO</u>						
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>1. Do you anticipate any contractual terms, conditions, and restrictions? Types of restrictions include but are not limited to: ITAR, EAR, OFAC and certain classifications</p> <p>NOTE: IF PROJECT RESULTS IN A “CONTRACT”: The principal investigator understands that an execution of the contract arising out of this proposal may be delayed if both parties are unable to negotiate applicable terms and conditions of a contract. Additional documentation and processes may be required from the PI such as a technology control plan and/or export license depending if the contract has restrictions. All communication between the funding agency and the University must be administered between an agency and ORSP. Preaward commitments and hiring/placement of staff are not allowable on unsigned contracts.</p>					
		<p>2. Please indicate the type of proposal:</p> <p><input checked="" type="checkbox"/> Research <input type="checkbox"/> Applied <input checked="" type="checkbox"/> Basic See below</p> <p><input type="checkbox"/> Instruction (“means the teaching activities of an institution and may require Provost review”)</p> <p><input type="checkbox"/> Other (Example: Health services and community projects, outreach programs, public service programs)</p> <p><u>RESEARCH DETERMINATION SECTION:</u></p> <p><u>Below are example research indicators:</u></p> <ol style="list-style-type: none"> 1. CFDA # (if applicable) 2. Title and abstract 3. Project objectives 4. Purpose of funds 5. IRB/IACUC <p><u>Examples of R&D:</u></p> <ol style="list-style-type: none"> 1. External support for writing books/publications of R&D 2. Training of R&D techniques 3. External funding to maintain R&D facilities, equip, etc 4. R&D costs are $\geq 50\%$ of a total multi-purpose project 5. Curriculum development projects, dissertation work <p>Keywords (should be imbedded in the title and the abstract of the proposal): research, develop, evaluate, analysis, experiment, explore, investigate, inquiry, examine, assess, survey, etc.</p>					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	3. Does this proposal involve <u>international</u> collaborations, subawards, travel, student/faculty exchange?					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	4. Does this proposal require additional space? Renovation/upgrades of current space? Do current facilities (infrastructure, equipment, power supplies, security doors/locks/storage) support project activities?					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	5. Will a <u>portion of the project</u> be subcontracted? (If yes, <u>complete subcontract proposal must be attached in accordance with OMB Circular A-133.</u>)					
<input type="checkbox"/>	<input checked="" type="checkbox"/>	6. Could this research <u>lead to a patentable invention</u>? (If yes, contact ORSP at 747-7007)					
DOES THIS PROJECT USE: (Please go to research.utep.edu to find the appropriate administrator.)							
<input type="checkbox"/>	<input checked="" type="checkbox"/>	7. <u>Radioactive Materials or Radiation Devices?</u>			<input type="checkbox"/> Approval Attached <input type="checkbox"/> Approval Pending		
<input type="checkbox"/>	<input checked="" type="checkbox"/>	8. <u>Recombinant DNA?</u>					



**THE UNIVERSITY OF TEXAS AT EL PASO
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<input type="checkbox"/>	<input checked="" type="checkbox"/>	9. <u>Humans as research subjects?</u> Note: the use of surveys, human tissue, human blood (or any substance derived from humans) will require a "YES" answer. <input type="checkbox"/> Approval Attached <input type="checkbox"/> Approval Pending
<input type="checkbox"/>	<input checked="" type="checkbox"/>	10. <u>Animals as research subjects?</u> <input type="checkbox"/> Approval Attached <input type="checkbox"/> Approval Pending

ENTER A **BRIEF** DESCRIPTION (ABSTRACT) OF PROJECT/ACTIVITY (in layman's terms for publication purposes)

In support of Topic 1: Precise attitude control and pointing systems for cubesats, the project will incorporate the High-Test Peroxide (HTP) micro-thruster developed and demonstrated by firings at the University of Texas at El Paso (UTEP) into a precise attitude control system for CubeSats. The propulsion module will be sized to fit in a 1U CubeSat volume (10 x 10x 10 cm). The demonstrated specific impulse (Isp) will provide approximately twice the Isp of cold gas systems. It will also be demonstrated that the higher performance and relatively benign exhaust products, water and oxygen, can be safely achieved after long-term storage.

ASSURANCE AND CERTIFICATION SECTION:

INVESTIGATOR CONFLICT OF INTEREST STATEMENT

* **Notify ORSP** whether you or your immediate family or other **key personnel** have significant financial interest that could reasonably be expected if this project should get funded and could be affected by this project or its outcomes. **If so**, please disclose the related financial interest in a separate document (in an envelope marked confidential) that identifies the business enterprise or entity involved and the nature and amount of the interest.

DEFINITION: "Significant Financial Interests" are defined as interests valued at \$5,000 or more for payments for services and/or equity interests per year or any equity interest in non-publicly traded entities held by the investigator, the investigator's spouse or dependent children. See additional explanations in the UTEP policy statement, Management of Conflict of Interest in Sponsored R&D.

YOU FURTHER AGREE:

- To update this disclosure during the entire period of the award, at least on an annual basis.
- To cooperate in the development of a conflict of interest management plan, if applicable.
- To comply with any conditions or restrictions imposed by the University to manage, reduce or eliminate potential conflict of interest or forfeit the award.

MANDATORY TRAINING REQUIREMENTS

PI/Co-PI is responsible to insure that he/she, all research staff, and all students (regardless of classification) involved in a Federally funded research project complete the Responsible Conduct In Research (RCR) training offered through a secure 3rd party website at: <http://www.citiprogram.org> and/or go through the ORSP website at: <http://research.utep.edu/Default.aspx?alias=research.utep.edu/orsp> and follow the link called "RCR Training (CITI) for policies, training materials, and access assistance.

INVESTIGATOR ASSURANCE STATEMENT

Your signature below certifies that the information submitted within this application is true, complete and accurate to the best of your knowledge and you agree to accept responsibility for the scientific conduct of the project. In providing this assurance for an application, you agree to provide the required progress reports if a grant is awarded as a result of the application. You understand that any false, fictitious or fraudulent statements or claims on an application or progress report submitted to the funding agency may subject you to criminal, civil or administrative penalties.

<u>APPROVALS: Please review all pages of the document for accuracy before you sign.</u>		<u>Date</u>
<u>Principal Investigator:</u>		
<u>Department Chair:</u>		
<u>Dean and/or Center Director:</u>		
<u>ORSP A VPR:</u>		

NOTES/COMMENTS/REMARKS SECTION:

UNIVERSITY OF TEXAS AT EL PASO

BUDGET SUMMARY

PRINCIPAL INVESTIGATOR: Ahsan Choudhuri
CO-PRINCIPAL INVESTIGATOR: (NONE)
PERIOD: From 10/1/2015 to 9/30/2017
TITLE: Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Pero
AGENCY: NATIONAL AERONAUTICS AND SPACE ADMIN (FED)

		Year 1		Year 2		Total	
		Wages	Fringe	Wages	Fringe	Wages	Fringe
A	SALARIES AND FRINGE						
a. Graduate Students							
1. Graduate Student	(Yrs 1-2) 12.0mos@50.0%	18,956	4,304	19,525	4,308	38,481	8,612
SUBTOTAL		18,956	4,304	19,525	4,308	38,481	8,612
b. Undergraduate Students							
1. Undergraduate RA	(Yrs 1-2) 52.0wks@20.0hrs	10,383	86	10,695	89	21,078	175
SUBTOTAL		10,383	86	10,695	89	21,078	175
B	TOTAL - SALARIES AND FRINGE	29,339	4,390	30,220	4,397	59,559	8,787
C	TOTAL - COMBINED SALARIES AND FRINGE BENEFITS		33,729		34,617		68,346
D	EQUIPMENT						
TOTAL - EQUIPMENT		0		0		0	
E	TRAVEL						
1. DOMESTIC			3,525		3,525		7,050
TOTAL - TRAVEL			3,525		3,525		7,050
F	PARTICIPANT SUPPORT COSTS						
TOTAL - PARTICIPANT COST		0		0		0	
G	OTHER DIRECT COSTS						
1. MATERIALS AND SUPPLIES			28,971		28,083		57,054
TOTAL - OTHER DIRECT COSTS			28,971		28,083		57,054
H	TOTAL DIRECT COSTS		66,225		66,225		132,450
I	INDIRECT COSTS	51.0% Modified total direct cost	33,775		33,775		67,550
J	TOTAL ESTIMATED COSTS		100,000		100,000		200,000

All personnel transactions required to fulfill the provisions of this proposal will be made in accord with, and will be governed by, the appropriate University Personnel Policies and Regulations. All salary increases will conform to University policies, subject to the availability of funds. No officer, member, or employee of the University and no other public officials for the governing body of the locality or localities in which the project is situated or being carried out who exercise any functions or responsibilities in the review or approval of the undertaking or carrying out of this project, shall participate in any decision relating to this project which affects his personal interest or have any personal or pecuniary interest, direct or indirect, in this project or the proceeds thereof.

UNIVERSITY OF TEXAS AT EL PASO

BUDGET SUMMARY/COST-SHARE

PRINCIPAL INVESTIGATOR: Ahsan Choudhuri
CO-PRINCIPAL INVESTIGATOR: (NONE)
PERIOD: From 10/1/2015 to 9/30/2017
TITLE: Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Pero
AGENCY: NATIONAL AERONAUTICS AND SPACE ADMIN (FED)

		Year 1		Year 2		Total	
		Wages	Fringe	Wages	Fringe	Wages	Fringe
A	SALARIES AND FRINGE						
B	TOTAL - SALARIES AND FRINGE	0	0	0	0	0	0
C	TOTAL - COMBINED SALARIES AND FRINGE BENEFITS		0		0		0
D	EQUIPMENT						
TOTAL - EQUIPMENT		0		0		0	
E	TRAVEL						
TOTAL - TRAVEL		0		0		0	
F	PARTICIPANT SUPPORT COSTS						
1. STIPENDS	(Yrs 1-2) 2-UG_1.0mos@\$2500.00		5,000		5,000		10,000
TOTAL - PARTICIPANT COST			5,000		5,000		10,000
G	OTHER DIRECT COSTS						
TOTAL - OTHER DIRECT COSTS		0		0		0	
H	TOTAL DIRECT COSTS		5,000		5,000		10,000
I	INDIRECT COSTS	51.0% Modified total direct cost	0		0		0
J	TOTAL ESTIMATED COSTS		5,000		5,000		10,000

All personnel transactions required to fulfill the provisions of this proposal will be made in accord with, and will be governed by, the appropriate University Personnel Policies and Regulations. All salary increases will conform to University policies, subject to the availability of funds. No officer, member, or employee of the University and no other public officials for the governing body of the locality or localities in which the project is situated or being carried out who exercise any functions or responsibilities in the review or approval of the undertaking or carrying out of this project, shall participate in any decision relating to this project which affects his personal interest or have any personal or pecuniary interest, direct or indirect, in this project or the proceeds thereof.

PROPOSAL



Cover Page for Proposal
Submitted to the
National Aeronautics and
Space Administration

NASA Proposal Number

15-SSTP15-Pro-0028

NASA PROCEDURE FOR HANDLING PROPOSALS

This proposal shall be used and disclosed for evaluation purposes only, and a copy of this Government notice shall be applied to any reproduction or abstract thereof. Any authorized restrictive notices that the submitter places on this proposal shall also be strictly complied with. Disclosure of this proposal for any reason outside the Government evaluation purposes shall be made only to the extent authorized by the Government.

SECTION I - Proposal Information

Principal Investigator Ahsan Choudhuri	E-mail Address ahsan@utep.edu	Phone Number 915-747-6905
Street Address (1) 500 W University Ave	Street Address (2) MS 0521	
City El Paso	State / Province TX	Postal Code 79968-8900
		Country Code US
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats		
Proposed Start Date 10 / 01 / 2015	Proposed End Date 09 / 30 / 2017	Total Budget No budget required

SECTION II - Application Information

NASA Program Announcement Number NNH15ZOA001N-15STP_E1	NASA Program Announcement Title Small Spacecraft Technology Program, Smallsat Technology Partnerships Appendix		
For Consideration By NASA Organization <i>(the soliciting organization, or the organization to which an unsolicited proposal is submitted)</i> Small Spacecraft Technologies			
Date Submitted 06 / 08 / 2015	Submission Method Electronic Submission Only	Grants.gov Application Identifier	Applicant Proposal Identifier
Type of Application New	Predecessor Award Number	Other Federal Agencies to Which Proposal Has Been Submitted	
International Participation No	Type of International Participation		

SECTION III - Submitting Organization Information

DUNS Number 132051285	CAGE Code 0MLB3	Employer Identification Number (EIN or TIN)	Organization Type 2A
Organization Name (Standard/Legal Name) University Of Texas, El Paso			Company Division
Organization DBA Name			Division Number
Street Address (1) 500 W UNIVERSITY AVE		Street Address (2)	
City EL PASO	State / Province TX	Postal Code 79968	Country Code USA

SECTION IV - Proposal Point of Contact Information

Name Ahsan Choudhuri	Email Address ahsan@utep.edu	Phone Number 915-747-6905
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SECTION V - Certification and Authorization

Certification of Compliance with Applicable Executive Orders and U.S. Code

By submitting the proposal identified in the Cover Sheet/Proposal Summary in response to this Research Announcement, the Authorizing Official of the proposing organization (or the individual proposer if there is no proposing organization) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in this solicitation.

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

Authorized Organizational Representative (AOR) Name Irene Holguin	AOR E-mail Address isholguin@utep.edu	Phone Number 915-747-8683
AOR Signature <i>(Must have AOR's original signature. Do not sign "for" AOR.)</i>		Date

PI Name : Ahsan Choudhuri		NASA Proposal Number 15-SSTP15-Pro-0028	
Organization Name : University Of Texas, El Paso			
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats			
SECTION VI - Team Members			
Team Member Role PI	Team Member Name Ahsan Choudhuri	Contact Phone 915-747-6905	E-mail Address ahsan@utep.edu
Organization/Business Relationship University Of Texas, El Paso		Cage Code 0MLB3	DUNS# 132051285
International Participation No	U.S. Government Agency		Total Funds Requested 0.00
Team Member Role Collaborator	Team Member Name William Marshall	Contact Phone 216-433-8419	E-mail Address william.m.marshall@nasa.gov
Organization/Business Relationship NASA Glenn Research Center		Cage Code 1QFP5	DUNS# 004523320
International Participation No	U.S. Government Agency NASA Glenn Research Center		Total Funds Requested 10,000.00

PI Name : Ahsan Choudhuri	NASA Proposal Number 15-SSTP15-Pro-0028
Organization Name : University Of Texas, El Paso	
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats	
SECTION VII - Project Summary	
<p>A modular propulsion system for a CubeSat spacecraft will be built using a green propellant, High-Test Peroxide (HTP), as a monopropellant. The propellant handling requirements are well known and the exhaust products are water and oxygen at a relatively low temperature (< 980°C). The low thrust level (0.1 to 0.5 N) can be used for spacecraft attitude control and small orbit changes. The system will provide 325 m/s of delta-velocity for a 1 kg CubeSat spacecraft. The propellant tank and thruster assembly will be supported by a standard 1U CubeSat structure with resulting exterior dimensions of 10x10x16 cm. The propellant is stored in a high-strength sealed tank that can be placed into a spacecraft launch vehicle. Low power, low voltage valves will provide propellant flow control using blow down tank pressure management.</p>	

PI Name : Ahsan Choudhuri				NASA Proposal Number	
Organization Name : University Of Texas, El Paso				15-SSTP15-Pro-0028	
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats					
SECTION VIII - Other Project Information					
Proprietary Information					
Is proprietary/privileged information included in this application? Yes					
International Collaboration					
Does this project involve activities outside the U.S. or partnership with International Collaborators? No					
Principal Investigator No	Co-Investigator No	Collaborator No	Equipment No	Facilities No	
Explanation :					
NASA Civil Servant Project Personnel					
Are NASA civil servant personnel participating as team members on this project (include funded and unfunded)? Yes					
Fiscal Year	Fiscal Year	Fiscal Year	Fiscal Year	Fiscal Year	Fiscal Year
Number of FTEs	Number of FTEs	Number of FTEs	Number of FTEs	Number of FTEs	Number of FTEs

PI Name : Ahsan Choudhuri	NASA Proposal Number
Organization Name : University Of Texas, El Paso	15-SSTP15-Pro-0028
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats	
SECTION VIII - Other Project Information	
Historical Site/Object Impact	
Does this project have the potential to affect historic, archeological, or traditional cultural sites (such as Native American burial or ceremonial grounds) or historic objects (such as an historic aircraft or spacecraft)?	
No	
Explanation:	

PI Name : Ahsan Choudhuri	NASA Proposal Number
Organization Name : University Of Texas, El Paso	15-SSTP15-Pro-0028
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats	
SECTION IX - Program Specific Data	
<p>Question 1 : Identify whether you have proposed substantially the same kind of research or technology development under any other STMD solicitation within the last 9 months. Provide STMD Solicitation Number and Application or Proposal Identifier.</p> <p>Answer: N/A. The Proposing University Research Center is funded by the Office of Education MUREP Program.</p>	
<p>Question 2 : Please indicate the NASA Center (or JPL) that will be involved in this partnership?</p> <p>Answer: Glenn Research Center</p>	
<p>Question 3 : Technology Readiness Level (TRL) of your proposed concept at the start of the effort?</p> <p>Answer: 3</p>	
<p>Question 4 : What is the expected TRL Level at the end of the project?</p> <p>Answer: 6</p>	
<p>Question 5 : Select the Technology Area Breakdown Structure (TABS) most closely associated with your submission/proposed concept.</p> <p>Answer: 2.0 In-Space Propulsion Technologies</p>	
<p>Question 6 : Please identify the Topic Area of your Proposal</p> <p>Answer: Topic 1: Precise attitude control and pointing systems for cubesats</p>	

PI Name : Ahsan Choudhuri	NASA Proposal Number 15-SSTP15-Pro-0028
Organization Name : University Of Texas, El Paso	
Proposal Title : Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Peroxide for CubeSats	
SECTION X - Budget	
Total Budget: No budget required	

Section 1. Table of Contents

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Section 2. Relevance and Impact

a. Technology Description

High-Test Peroxide (HTP) [85-94% H_2O_2] has been used for decades as a monopropellant and gas generator in larger scale applications. The Center for Space Exploration and Technology Research (cSETR) at the University of Texas at El Paso (UTEP) established by a 5-year grant from NASA (recently renewed for 5 years) has used teams of graduate and undergraduate students to create monopropellant thruster designs with green monopropellants. The cSETR has developed a High-Test Peroxide Thruster (HTPT) using a silver catalyst bed contained inside a pressure chamber¹. This micro-thruster has produced thrust and firings as shown by Fig. 1.

This thruster design will be incorporated into a small (1U) volume modular propulsion



Fig. 1: (a) UTEP HTPT. (b) UTEP HTPT firing test.

system to provide attitude control and pointing capability to a CubeSat spacecraft thereby expanding the mission capability for small satellites. Firing pairs of thrusters to rotate the spacecraft around its rotational axes can provide three-axis pointing control for the vehicle. Firing all four thrusters simultaneously could generate a delta-V for orbit change or deorbit.

A blow-down propellant tank will be fabricated using 3D printing capability at the UTEP W. M. Keck Center for 3D Innovation. The tank will use a blow-down ratio of 4:1. A survey of commercial off-the-shelf (COTS) valve suppliers will be made to select components that can be used in the system. These will consist of low voltage, low flow flight weight valves for use on the thruster, a latching tank isolation valve, manual fill and drain valves for the pressurizing gas and propellant, and sensors for tank pressure and temperature of the thrust units. Table 1 describes the proposed system.

Table 1: Modular propulsion system for CubeSats

Model	UTEP HTPT
Propellant	HTP (85-94% H_2O_2)
Blow down tank ratio	4:1
Minimum operating tank pressure	170 kPa (25 psia)
Maximum operating tank pressure	690 kPa (100 psia)
Tank material	Titanium
Tank burst pressure (estimated)	>20.7 MPa (3000 psia)
Minimum tank wall thickness	0.508 – 0.609 mm (0.020 – 0.024 in)
Tank outer diameter	95.25 mm (3.75 in)
Useable propellant at 97%	0.444 kg (0.979 lbm)

¹Choudhuri, A. and Gupta, A., Development of Novel Microcombustor/Microreactor for mN- μN Range Chemical MicroThrusters; Final Technical Report, Missile Defense Agency: HQ0147-09-C-0009, September, 2013.

Delta-V for 1 kg mass CubeSat	325 m/s (1066 ft/s)
Thrust (@ 170 kPa inlet pressure)	0.12 N (0.03 lbf)
Thrust (@ 690 kPa inlet pressure)	0.48 N (0.11 lbf)
Specific impulse - vacuum (estimated)	150 s
Exit area ratio	50
Valve open time	12 ms
Minimum pulse width	TBD
Minimum impulse bit	TBD (duty cycle dependent)
Valve power open/close	0.9 Watts
Nominal voltage	12 Vdc
Propulsion module dry weight (estimated)	0.8 kg
Dimensions	10 x 10 x 16 cm

The propulsion module will enable attitude control of small satellites thereby greatly increasing their capability to perform more complicated missions. The increase in specific impulse and energy density of HTP over cold gas provides twice the total impulse for the same propulsion system volume. The program will demonstrate the thruster repeatability with flight type valves over the range of blow-down of tank pressures from 690 to 170 kPa.

b. Comparison to State-of-the-Art

The proposed system uses “Green Propellant HTP” to provide twice the specific impulse of cold gas systems with relatively benign exhaust gases, water and oxygen, as opposed to hydrazine which is more toxic to handle and has more aggressive exhaust products. The system will provide a delta-velocity capability of 325 m/s for a CubeSat with the propulsion module attached that can be used to make changes in orbit angle or height. A satellite in low Earth orbit would require 135 m/s to make a 1-degree plane change. An increase of the orbit height by 1 km would use 0.56 m/s. These values apply for a 250 km height orbit and decrease slightly as the orbit height is increased. Attitude control of a satellite is highly dependent upon the mass distribution, moment of inertia, and pointing accuracy requirements of the mission. Similar analysis is reported in Refs. 1-3.

The low thrust of this system would provide significant amounts of attitude control however detailed analysis using the actual moments of inertia and mission requirements will be required. The firing sequences planned will provide impulse bit, thrust level response, and steady state specific impulse for this configuration. The propulsion module will provide an interface to satellite control computer and use the system power buss or could be configured to be a standalone with a control computer, sensor interfaces and separate power supply. The figures of merit evaluation are described in Table 2.

Table 2: Figure of Merit Evaluation

Figure of Merit	Evaluation
Accuracy and Precision	Extensive thrust measurement and duty cycle testing on four development thrusters will provide impulse bit and engine-to-engine repeatability measurements. The performance will be measured over the range of HTP concentrations. A precision thrust measurement stand will be used.

Adaptability and Flexibility	The system design can easily be scaled to provide higher thrust levels. The design capability to use larger propellant tanks (outside the 1U configuration) or connect in parallel to another 1U tank. The system could also use a single higher thrust engine if required by the mission for orbit changes.
Cost (non-recurring)	An innovative feature is fabrication of a high strength titanium propellant tank using 3D printing to form the tank membrane and attach mounts as an integral assembly. This will create a low cost tank assembly. COTS valves will be used.
Cost (recurring)	There are no recurring costs as this is a single use item.
Efficiency	The design uses all of the volume of a 1U CubeSat and enables attitude control with twice the specific impulse of cold gas.
Mass	The dry weight of the propulsion module is estimated at 0.8 kg.
Operating Lifetime	The thruster life will far exceed the propellant load.
Power	Power use is only when the thruster are operated and is 0.9 watts.
Reliability	All system components are COTS or will be proven during the optimization and verification tests. Single fault tolerance will be used since no catastrophe failure is envisioned.
Safety	HTP as a green propellant is less toxic than hydrazine and handling processes are well known. A sealed tank demonstration test will prove that decomposition of the HTP is slow enough to be contained in a tank for the time before vehicle loading and launch. The tank has a high burst pressure (>20.7 MPa). It is anticipated that propellant loading will occur about 12 months before launch.
Strength	Standard COTS parts will be incorporated into a compact design volume with sufficient support to meet a normal launch environment.
Tolerance to Radiation	All materials are tolerant, any vehicle control computer would use radiation hardened computation units.
Tolerance to temperature extremes and cycles	HTP will be limited to a maximum temperature of 50°C and will freeze at about 0°C.
Volume	The 1U propulsion module is 10 x 10 x 16 cm.

c. Technology Readiness Level (TRL)

The thruster is at TRL 3 (proof of concept) as shown by the firing test figure 1. The completed testing has shown that the catalyst bed requires more silver contact area. An optimization to the design using silver mesh is in process. This program will optimize the catalyst bed; demonstrate the performance characteristics and duty cycle sensitivity. Individual thruster tests will show engine-to-engine repeatability, cold start thrust transients and steady state thrust and specific impulse over the operating pressure range.

d. Infusion Potential

Small satellite designers can use this modular propulsion system to enable attitude control with a low cost, environmentally compatible system.

Section 3. Objectives and Approach

a. Approach

cSETR has extensive microthruster test capabilities including high speed data acquisition systems, thrust measurement stand, vacuum chamber, propellant handling test procedures, and operational processes. The proposed effort includes optimization and verification of thruster performance, optimization of propellant dwell time in the catalyst bed, demonstration of performance over a range of inlet pressures and integration of the thruster (shown in Fig. 2). The existing equipment and thruster design will be used to ultimately create a modular propulsion system with the dimensions of a 1U CubeSat as shown in Fig. 3.

A sequence of design reviews similar will be used to provide design integrity and to maximize the cSETR's NASA partner's contribution in developing and defining requirements for space vehicle and system design. The sequence of reviews to be used involves system requirements

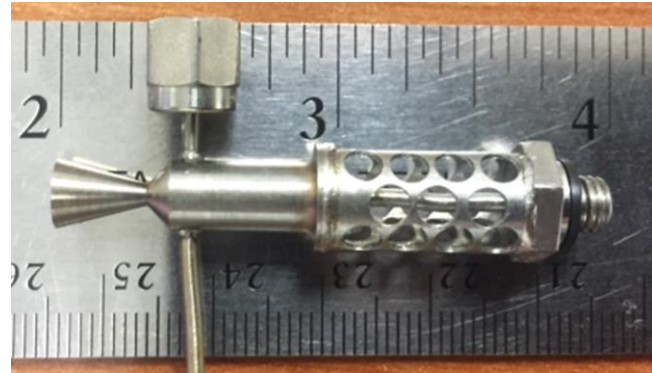


Fig. 2: UTEP HTPT.

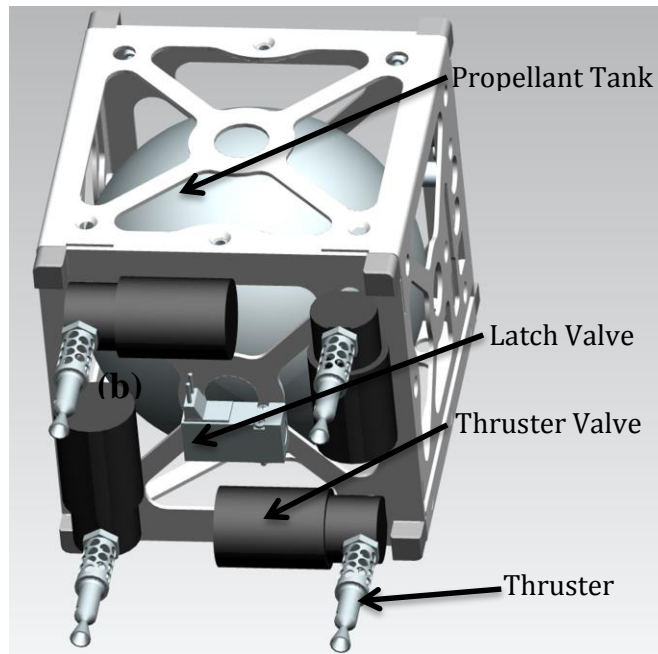
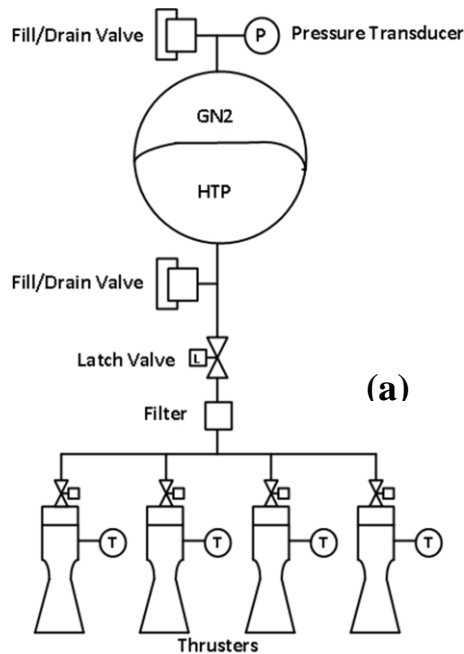


Fig. 3: (a) Propulsion system schematic. (b) Propulsion module CAD model.

review (SRR), preliminary design review (PDR), critical design review (CDR), and test readiness review (TRR). The cSETR staff engineers have experience in the design and review process and will mentor the team to ensure the results are accurate, repeatable and documented. The objectives and their respective milestones are summarized in Table 3.

Table 3: Program objectives and milestones

Objective	Description	Milestones
Thruster optimization	Optimize catalyst bed configuration, procure thruster valves and instrumentation, define verification testing, and create thermal model for structural analysis.	PDR, CDR, TRR
Propellant tank fabrication	Design and fabricate tank, select COTS hardware, and setup decomposition verification tests.	PDR, CDR, TRR
System integration	Define vehicle interfaces and qualification test program content with direct support from NASA partner	SRR, PDR, CDR, TRR

Thruster performance optimization and verification tests will be run on multiple valve-thruster assemblies using the flight engine hardware and valve with and a facility tank to demonstrate engine-to-engine repeatability, impulse bit, thrust level at beginning of life and at end of life as a function of thruster inlet pressure.

The initial activity will document the detailed design requirements of the system and each of the COTS components. The NASA partner, GRC, will review our test results, help define vehicle requirements, assist with interface definition and provide expertise about the end use such as vehicle control, launch vehicle interfaces, and propellant handling and safety issues.

Components will be manual fill and drain valves, latch valve used to isolate the tank from the thruster propellant manifold, and for thruster flow control valves. These will be low voltage, low flow devices that are suitable for use with HTP propellant.

The cSETR will design and fabricate the micro-propellant tank and manifolds that form the fluid flow paths shown in Fig. 4. Two parallel construction methods will be used to ensure success. The primary approach will use 3D printing manufacturing to construct a tank shell with integral support points and inlet/outlet interfaces for the propellant and pressurizing gas. UTEP has 3D printing capability at the W.M. Keck Center. An alternate fabrication approach would be to mill the tank wall from a titanium block using CNC process. This older technology should be more costly but provides less risk. An elastomer diaphragm will be used to provide positive propellant expulsion. The system will operate in blow-down mode using a conservative blow-down ratio of 4:1. Nitrogen will be used to provide the pressure at about 690 kPa (100 psia) initial pressure.

The system integration task to incorporate the thrusters, tank and valves into a modular configuration will be done using CAD and design interfaces. The final configuration will use a welded assembly to eliminate leaks. Electrical connectors will be used to ensure correct wiring and accurate interface to the vehicle power buss and data acquisition system. The system will provide a tank pressure sensor, thruster temperature sensors to ensure safe operation and control of the propulsion module on the satellite. Several options exist for power supply and system control. These will be explored with the NASA partner to ensure useable parameters are chosen.

An operational analysis of the propulsion system will be made to demonstrate the application of the propulsion module to a CubeSat vehicle and launch system. The requirements for an effective qualification program will be defined in conjunction with the NASA partner to define launch loads for vibration, acceleration, temperature variation, and handling and shipping. This program will define a baseline for any potential users of the propulsion system. The performance of these qualification tests will not be part of the planned program.

b. Challenges and Risk

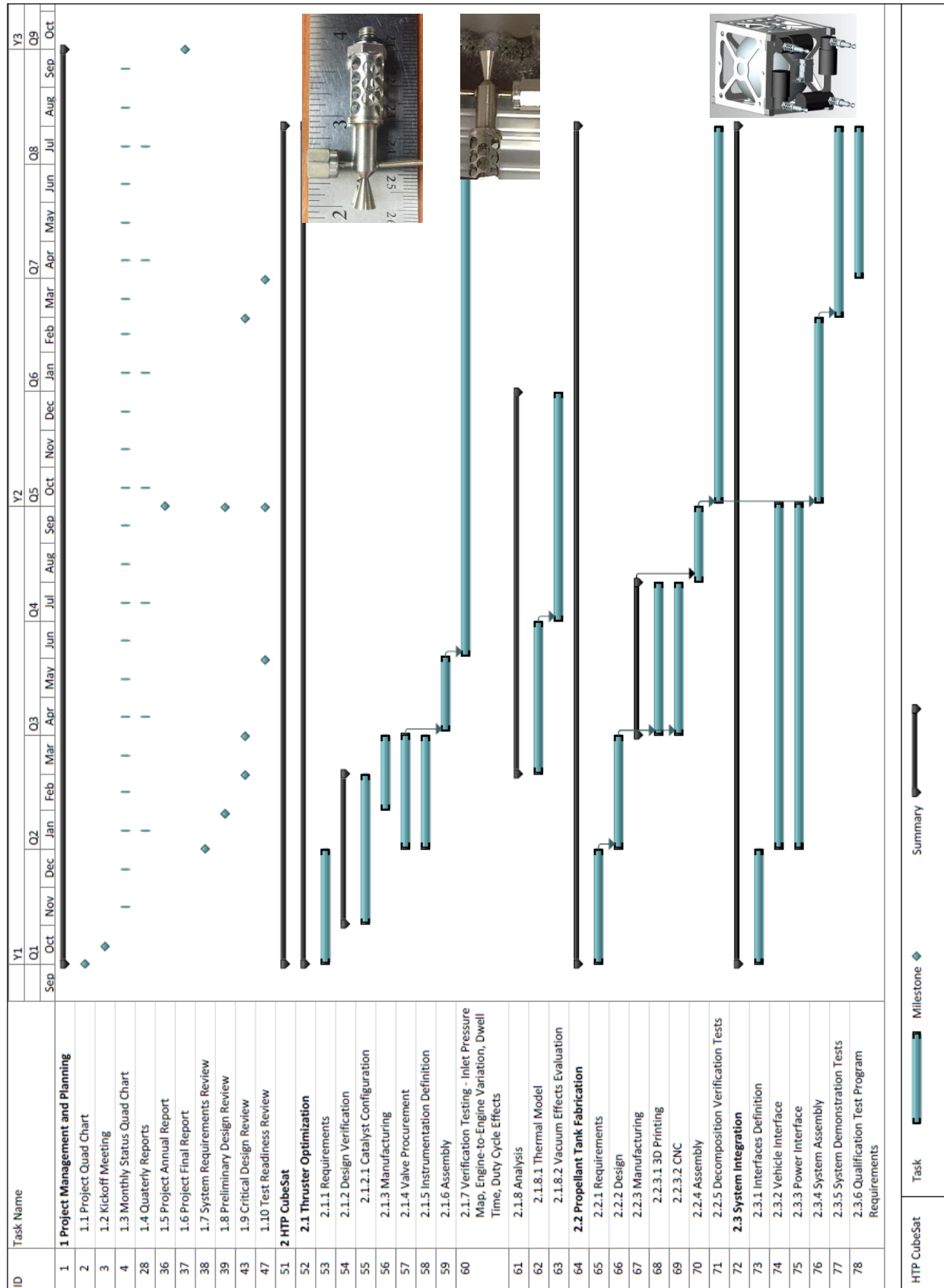
HTP propellant has a known concern of storability. HTP decomposes when heated, when exposed to an organic residue, or slowly decomposes with time. When used for a mission, these propulsion modules will be loaded with propellant and stored for extended times while waiting for launch. The program will demonstrate that with intense multiple passivation cycles and material compatibility, the rate of decomposition that the unit can safely be stored at without over-pressurizing for at least one year. Three years of sealed storage was demonstrated in 1965 and 15 years is estimated to be possible per Ref. 3. The tank will be filled with propellant and the tank pressure will be monitored for a minimum of 1 year over a range of temperature environments up to 45°C. The thrust response time and life of the catalyst bed depends upon the duty cycle and the propellant throughput. The program will demonstrate cold start capability and the effects of operating life upon the thruster during the verification firing tests with the flight type valve. Operational life of a micro-monopropellant thruster will require optimization of the catalyst bed configuration and dwell time of the propellant in the chamber. Tolerance for cold starts and thruster-to-thruster repeatability will be shown early in the program. Thermal analysis will demonstrate thermal isolation of the thruster valve from the chamber. Structural margins will be calculated and operational temperatures demonstrated for space operation and typical launch vehicle vibration loads.

c. Equipment and Facilities

The cSETR laboratory and personnel have micro-thrust measurement capability, micro flow meters and data acquisition systems, vacuum chamber propellant handling expertise and test operation experience. Training is given to all team members to ensure safe operation. Propellant quantities are limited to reduce risk. UTEP has additive manufacturing expertise at the W.M. Keck Center and equipment to do titanium 3D printing. Additionally, CNC machining is available as well as CAD modeling, CFD analysis and combustion expertise. Furthermore, the cSETR has the capability of conducting altitude simulation testing with two vacuum chambers available at the facility.

d. Characteristics of Potential Flight Elements (No flights are planned as part of this program)

Section 4. Schedule



Section 5. Project Management and Partnerships

a. Project Management

The cSETR uses a project team of graduate and undergraduate students focused on the assigned task. The teams are mentored by the PI and cSETR staff engineers using direct contact and a sequence of formal design reviews. The design reviews emulate the design process used at NASA and throughout the aerospace industry. The program will define requirements for a system requirements review (SRR), a preliminary design review (PDR), a critical design review (CDR), and a test readiness review (TRR) for each set of components and the total system integration. In addition to the significant design reviews mentioned previously, biweekly status reviews and working sessions will be coordinated to ensure success of the program. Fig. 4 shows the project flow process within the cSETR.

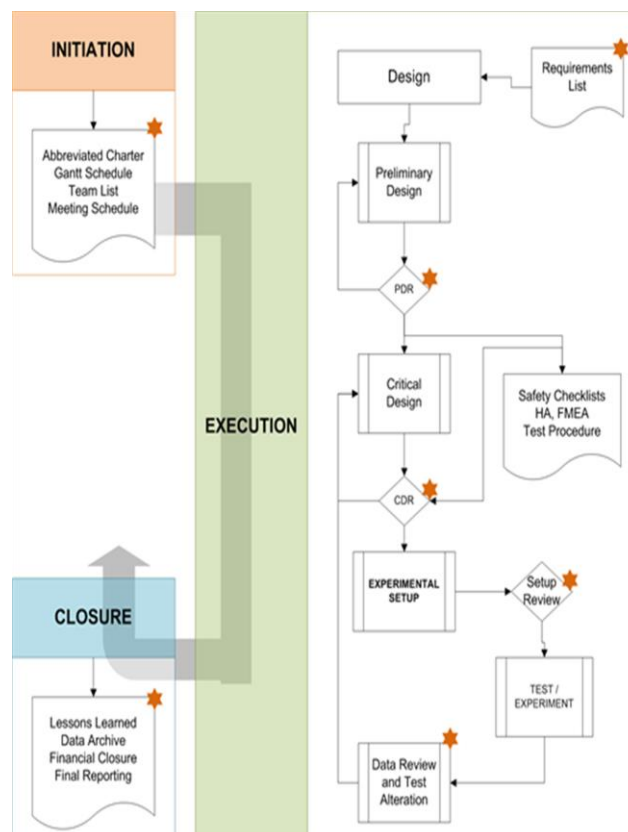


Fig. 4: Project flow process

b. NASA Partnership

The NASA Partner, Glenn Research Center (GRC), will provide direct input and review of the requirements and participate in the design reviews to bring oversight and a systems view for the spacecraft interface and operation. The NASA partner's knowledge and insight into launch environments, range safety, and vehicle control will ensure that the designed system will meet realistic design criteria.

c. Roles and Responsibilities

The Principal Investigator (PI), Dr. Ahsan Choudhuri, will provide technical guidance and have overall responsibility for the staff and student performance and will participate in the design reviews. The cSETR laboratory personnel will provide safety training, process oversight, purchasing, and mentor the student team through the process. The student team will consist of one graduate student and three undergraduate students. The cSETR staff engineers are Abraham Trujillo and C. Scott Hill. An additional engineer will be hired before the start of the contract October 15th. Gloria Salas, the cSETR's program coordinator manager, will provide purchasing support, cost tracking and budgetary reports.

UTEP will provide manufacturing expertise and equipment to support the design and assembly of the tank. The W.M. Keck Center facility will provide equipment for 3D printing of the tank shell structure. The student team will use the assembly equipment, thrust stand, data

acquisition systems and test area in the cSETR Laboratory facility. Figure 5(a) shows the organizational structure of the cSETR while figure 5(b) shows the organizational structure of the HTP CubeSat project.

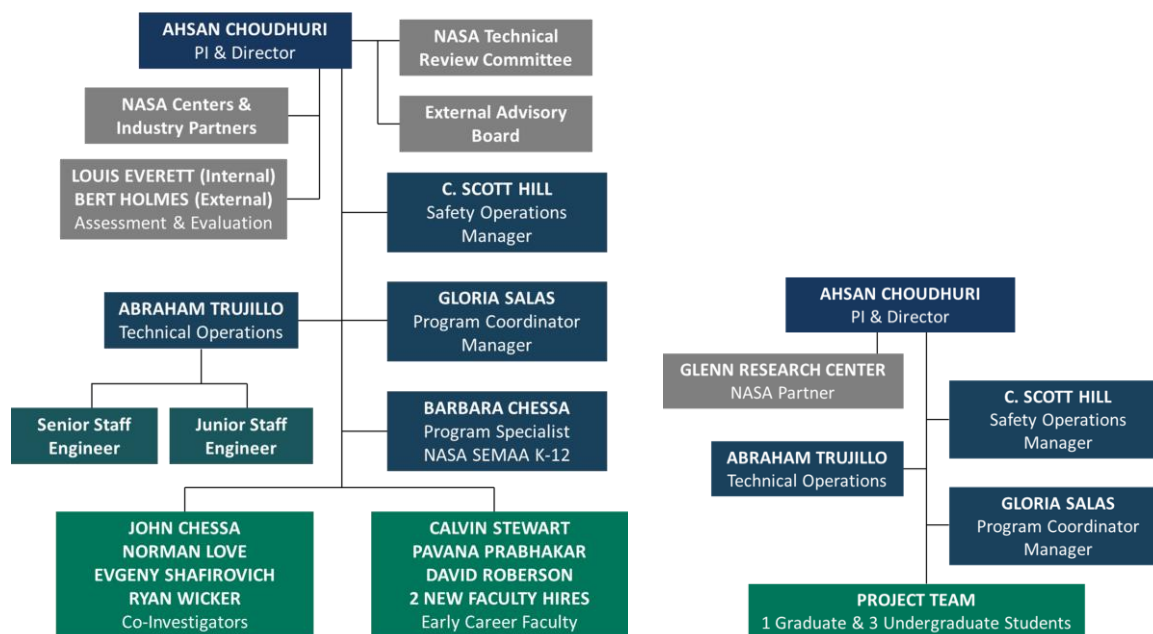


Fig. 5: (a) cSETR organizational chart. (b) HTP CubeSat organizational chart.

NASA GRC will provide detailed participation in design review process, review test setup and instrumentation, and assist the cSETR in data analysis. In addition, GRC will provide engineering advice on microgravity propellant acquisition and tank design as well as on propulsion system control design. GRC will also determine flight environments and flight instrumentation requirements. GRC will work with the cSETR in preparing a flight qualification plan.

Section 6. Proposed Budget Summary

Budget	1st Year	2nd Year
Requested University Funding	\$100,000	\$100,000
NASA Labor Allocation (FTE)	1.0	1.0
NASA Procurement	N/A	\$25,000
Additional Contributions	\$5,000	\$5,000
Total Cost	\$105,000	\$105,000

Section 7. Detailed Budget Justification Plan/Cost Proposal

For this **grant**, a total amount of \$200,000 of the project cost with \$100,000 per year is requested from NASA. Figure 6 shows the percent allocation of fund requested from NASA among different budget categories [see figure 7 for the cost breakdown]. Table 4 lists the personnel to be involved in the project and their work effort.

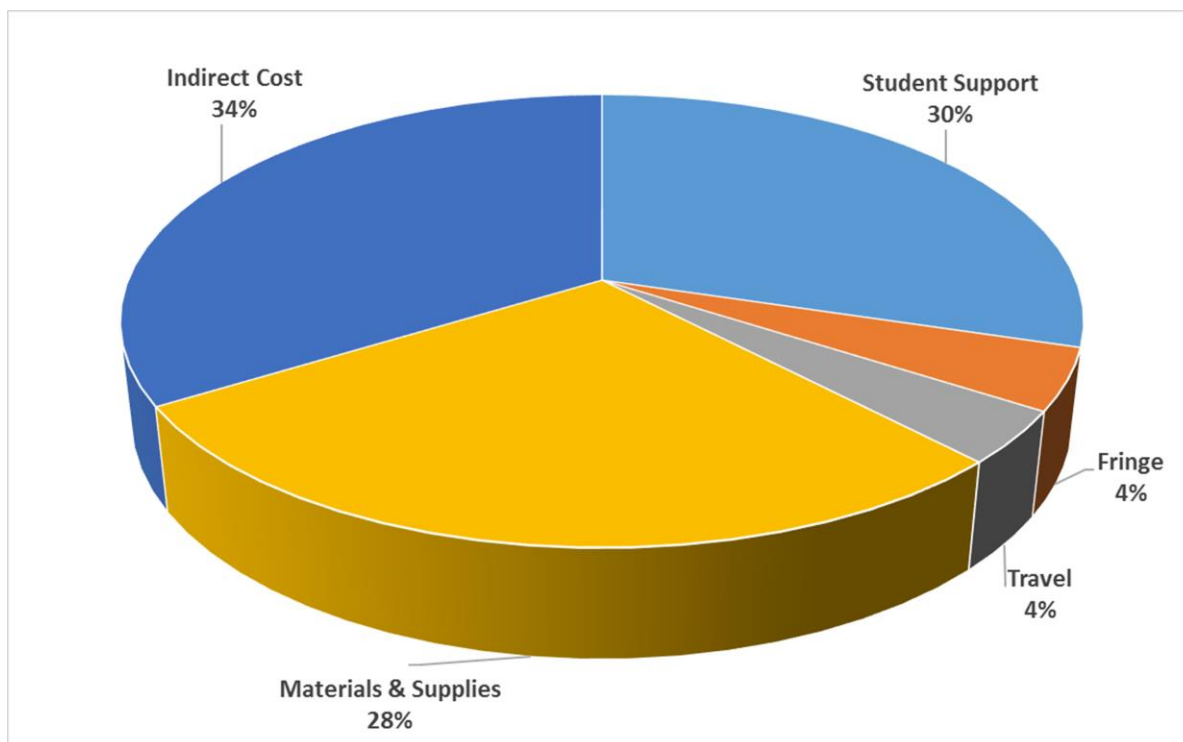


Fig. 6: The percent allocation of fund requested from NASA among different budget categories.

Table 4: Table of personnel and work effort

Personnel	Title	Work Commitment
Ahsan Choudhuri	PI & Director	Not funded by the grant
C. Scott Hill	Staff Engineer	Not funded by the grant
Abraham Trujillo	Staff Engineer	Not funded by the grant
Gloria Salas	Program Coordinator Manager	Not funded by the grant
1 MS Student	Graduate Research Assistant	12 mos. @ 50%, for a total of \$38,481, years 1-2
1 UG Student	Undergraduate Research Assistant	12 mos. @ 50%, for a total of \$21,078, years 1-2
2 UG Students	Undergraduate Research Assistants	Not funded by the grant

a. Funds Requested from NASA

1. Personnel

A total amount of **\$59,559** is requested for salaries for the support of one Graduate Research Assistant and one Undergraduate Assistant.

1.1 Student Support

Graduate Research Assistant

1 student for 12 mos. @ 50%, for a total of \$38,481, years 1-2

Undergraduate Research Assistant

1 student for 12 mos. @ 50%, for a total of \$21,078, years 1-2

The other two undergraduate students from the project team will be supported with \$5000 stipends from internal sources per year at no cost to this NASA project (as shown in Section 6).

1.2 Fringe Benefit Rates

Fringe benefits are based on institutional approved rates that are applied to all university faculty and staff. Personnel costs conform to University rates and policies, and all salary costs are budgeted with a 3% increase per year. A total amount of **\$8,787** is requested to provide fringe benefits for the duration of the project.

2. Travel

Travel funds are requested for the Principal Investigator and two students to travel to NASA for project related meetings. The budget includes **\$7,050** in travel costs. A generic breakdown of the yearly domestic travel is shown below.

<u>Destination:</u>	<u>NASA Glenn</u>
Number of Trips	1
Number of Travelers:	3
Airfare: (\$600 \times 1 \times 3)	\$1,800
Lodging:	
(1 \times 3 \times 3 days @ \$119 day)	\$1,071
Per Diem:	
(1 \times 3 \times 3 days @ \$56 day)	\$504
Ground transportation:	\$150
Total Estimated Costs:	\$3,525

Note: Travel expenses will be reimbursed at actual, reasonable and necessary costs, not to exceed State of Texas Travel Regulations governing contract airfares, per diems, and other allowable travel costs. Requested travel funds are best estimate and are based on cost estimates for similar travel requirements for domestic travel and published schedules within the UT System business information system.

3. Other Direct Costs

The other direct cost category includes materials and supplies needed for research tasks. A total of \$57,054 is requested for this budget category.

3.1 Materials and Supplies

Materials, supplies and other costs include all necessary material for fabricating the test hardware assemblies and conducting experiments and collecting data to fulfill the project objectives. Materials and supplies include (but are not limited to) chemicals such as HTP, and N₂; titanium powder for printing tank, material for manifold assemblies, stainless steel tubing; connectors;

metering valves; propellant fill and drain valve, thruster valves, latch valves; digital mass flowmeters; pressure transducers and gauges; digital data displays; supplies for data acquisition systems; thermocouples; and personal protective equipment (PPE). An estimated amount of **\$57,054** over the life of the project is requested for materials and supplies. The requested amount is based on catalog pricing and on knowledge of prior purchases. UTEP complies with State purchasing rules and regulations regarding competition thresholds, HUB participation requirements, and other regulatory requirements such as the Buy American Act.

4. Indirect Cost Rates

The DHHS negotiated indirect cost rate for UTEP is 51.0%, based on modified total direct costs. Thus, the total amount of indirect costs requested for the project is **\$67,550**.

UNIVERSITY OF TEXAS AT EL PASO

BUDGET SUMMARY

PRINCIPAL INVESTIGATOR: Ahsan Choudhuri

CO-PRINCIPAL INVESTIGATOR: (NONE)

PERIOD: From 10/1/2015 to 9/30/2017

TITLE: Development of Precise Modular Attitude Control or Deorbit Systems using High-Test Pero

AGENCY: NATIONAL AERONAUTICS AND SPACE ADMIN (FED)

		Year 1		Year 2		Total	
		Wages	Fringe	Wages	Fringe	Wages	Fringe
A	SALARIES AND FRINGE						
a.	Senior Personnel						
	SUBTOTAL	0	0	0	0	0	0
b.	Post Doctoral						
	SUBTOTAL	0	0	0	0	0	0
c.	Other Professional						
	SUBTOTAL	0	0	0	0	0	0
d.	Graduate Students						
1.	Graduate Student (Yrs 1-2) 12.0mos@50.0%	18,956	4,304	19,525	4,308	38,481	8,612
	SUBTOTAL	18,956	4,304	19,525	4,308	38,481	8,612
e.	Undergraduate Students						
1.	Undergraduate RA (Yrs 1-2) 52.0wks@20.0hrs	10,383	86	10,695	89	21,078	175
	SUBTOTAL	10,383	86	10,695	89	21,078	175
f.	Secretarial/Clerical						
	SUBTOTAL	0	0	0	0	0	0
g.	Other Personnel						
	SUBTOTAL	0	0	0	0	0	0
B	TOTAL - SALARIES AND FRINGE	29,339	4,390	30,220	4,397	59,559	8,787
C	TOTAL - COMBINED SALARIES AND FRINGE BENEFITS	33,729		34,617		68,346	
D	EQUIPMENT						
1.			0		0		0
	TOTAL - EQUIPMENT		0		0		0
E	TRAVEL						
1.	DOMESTIC		3,525		3,525		7,050
2.	FOREIGN		0		0		0
	TOTAL - TRAVEL		3,525		3,525		7,050
F	PARTICIPANT SUPPORT COSTS						
1.	STIPENDS		0		0		0
2.	TRAVEL		0		0		0
3.	SUBSISTENCE		0		0		0
4.	TUITION AND FEES		0		0		0
	TOTAL - PARTICIPANT COST		0		0		0
G	OTHER DIRECT COSTS						
1.	MATERIALS AND SUPPLIES		28,971		28,083		57,054
2.	PUBLICATION COSTS		0		0		0
3.	CONSULTANTS		0		0		0
4.	COMPUTER SERVICES		0		0		0
5.	SUBCONTRACTS		0		0		0
6.	OTHER COSTS		0		0		0
7.	WORKSHOPS/SEMINARS		0		0		0
8.	RENT AND LEASES		0		0		0
9.	PARTICIPANT EXPENSES		0		0		0
10.	ADMINISTRATIVE EXPENSES		0		0		0
	TOTAL - OTHER DIRECT COSTS		28,971		28,083		57,054
H	TOTAL DIRECT COSTS		66,225		66,225		132,450
I	INDIRECT COSTS 51.0% Modified total direct cost		33,775		33,775		67,550
J	TOTAL ESTIMATED COSTS		100,000		100,000		200,000

All personnel transactions required to fulfill the provisions of this proposal will be made in accord with, and will be governed by, the appropriate University Personnel Policies and Regulations. All salary increases will conform to University policies, subject to the availability of funds. No officer, member, or employee of the University and no other public officials for the governing body of the locality or localities in which the project is situated or being carried out who exercise any functions or responsibilities in the review or approval of the undertaking or carrying out of this project, shall participate in any decision relating to this project which affects his personal interest or have any personal or pecuniary interest, direct or indirect, in this project or the proceeds thereof.

Fig. 7: Budget summary.

Section 8. References and Citations

- [1] Amri, R., Gibbon, D., Rezoug, T., 2012. The design, development and test of one newton hydrogen peroxide monopropellant thruster, 47th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, San Diego, California, Paper No. AIAA-2011-6018
- [2] Mueller, J., Hofer, R., Parker, M., Ziemer, J., 2010. Survey of Propulsion Options for CubeSats, 57th JANNAF Propulsion Meeting, Colorado Springs, Colorado, Paper No. JANNAF-1425
- [3] Wernimont, E. J., 2006. System Trade Parameter Comparison of Monopropellants : Hydrogen Peroxide vs Hydrazine and Others, 42nd AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, Sacramento, California, Paper No. AIAA-2006-5235

Section 9. Biographical Sketches

I. Principal Investigator

*Dr. Ahsan Choudhuri, Professor, Mechanical Engineering
University of Texas at El Paso*

IV. NASA Partner

*Dr. William M. Marshall III, Research Aerospace Engineer
NASA Glenn Research Center*

VI. Staff Members

*C. Scott Hill, Safety Operations Manager,
cSETR University of Texas at El Paso
Abraham Trujillo, Junior Research Engineer,
cSETR University of Texas at El Paso
Gloria Salas, Program Coordinator/Manager,
cSETR University of Texas at El Paso*

Ahsan Choudhuri, PhD

*Professor and Chair, Mechanical Engineering
Mr. and Mrs. MacIntosh Murchison Chair II in Engineering
Principal Investigator*

EDUCATION

- Ph.D. in Mechanical Engineering – December 2000
- M.S. in Mechanical Engineering – May 1997
University of Oklahoma, Norman
- B.S. in Mechanical Engineering with Distinction – Jan 1993
Khulna University of Engineering and Technology, Khulna, Bangladesh

PROFESSIONAL EXPERIENCE

- Professor; Associate Professor; Assistant Professor: Jan 2001 – Present
Department of Mechanical Engineering, The University of Texas at El Paso
- Chairman, May 2010 – Present
Department of Mechanical Engineering, The University of Texas at El Paso
- Director, Sep 2009 – Present
NASA Center for Space Exploration and Technology Research, The University of Texas at El Paso
- Director (Engineering), Dec 2010 – Present
Environmental Science and Engineering PhD Program, The University of Texas at El Paso
- Director, Jan 2002 – Aug 2009
Combustion and Propulsion Research Laboratory, The University of Texas at El Paso

SELECTED JOURNAL ARTICLES

1. Karim, H., Delfin, D., Shuvo, M., Chavez, L., Garcia, C., Barton, H., Gaytan, S., Cadena, M., Rumpf, R., Wicker, R., Lin, Y., and Choudhuri, A., Concept and Model of A Metamaterial Based Passive Wireless Temperature Sensor for Harsh Environment Applications, 2014, IEEE Sensors Journal, *In Press*.
2. Mena, J., Ingle, M., Sirshat, V., and Choudhuri, A., An Investigation of a Cavitating Venturi Flow Control Feature in a Cryogenic Propellant Delivery System Flow, 2015, Flow Measurement and Instrumentation, Vol. 41, pp. 97-103.
3. Sarker, S., Nunez, J., Valdez, C., Hossain, S., Love, N., and Choudhuri, A., Preliminary Design of an Optically Accessible High-Pressure Combustor, 2015, J Mechanical Engineering Science, Vol. 229, No. 3, pp. 505-517.
4. Trejo, A., Garcia, C., and Choudhuri, A. Experimental Investigation of Transient Forced Convection of Liquid Methane in a Channel at High Heat Flux Conditions, 2014, Experimental Heat Transfer, DOI:10.1080/08916152.2014.945052.
5. Noor-A-Alam, Gullapalli, S., Rubio, E., Ramana, C. V., Choudhuri, A., Enhanced Stability of Hafnia Based Coatings in Hot Gas Environment, 2014, RSC Advances. Vol. 4, pp. 8224-8229.
6. Acosta, A., Flores, J., and Choudhuri, A. Torsional Thrust Balance Measurement System Development for Testing Reaction Control Thrusters, 2013, Measurement, Vol. 26, No. 9, pp. 3414-3428.
7. Noor-A-Alam, M., Choudhuri, A and Ramana, C. V. Structure and Thermal Conductivity of

- Nanostructured Hafnia-Based Thermal Barrier Coating Grown on SS-403, 2013, J. Nanotechnol. Eng. Med., 4(1), 011007 (Jun 27, 2013) (5 pages) doi:10.1115/1.4024046.
8. Dam, B. K. , Love, N. D. , and Choudhuri, A. R., Flame Stability of Methane and Syngas Oxy-fuel Steam Flames, 2012, Energy Fuels, Vol. 27, No. 1, pp. 523–529.
 9. Roy, C.K., Noor-A-Alam, M., Choudhuri, A, and Ramana, C.V., Synthesis and Microstructure of Gd₂O₃-doped HfO₂ Ceramics, 2012, Ceramics International, Vol. 38, No. 3, pp. 1801–1806.
 10. Dam, B., Corona, G., Hayder. M., Choudhuri, A., Effects of Syngas Composition on Combustion Induced Vortex Breakdown (CIVB) Flashback in a Swirl Stabilized Combustor, 2011, Fuel, Vol. 90, No. 2011, pp. 3274-3284.
 11. Noor-A-Alam, M., Choudhuri, A and Ramana, C. Effect of Composition on the Growth and Microstructure of Hafnia–Zirconia Based Coatings, 2011, Surface & Coatings Technology, Vol. 206, No. 7, pp. 168-1633.

AWARDS

- [1] Outstanding Performance Award, University of Texas, El Paso, 2014
- [2] Faculty Award for Research Innovation, NASA, 2011
- [2] Best Paper Award, International Testing and Evaluation Association, 2011
- [3] Outstanding Leadership Award, University of Texas, El Paso, 2010
- [4] Outstanding Performance Award, University of Texas, El Paso, 2010
- [5] Best Paper Award, International Testing and Evaluation Association, 2005
- [6] Best Paper Award, American Institute of Aeronautics and Astronautics, 2004
- [7] Faculty Advisor, Winning Design, NASA Titan Aerial Vehicle Design Project, 2003
- [8] NASA-Cal Tech Summer School for Planetary Scientists, 2001

SYNERGISTIC ACTIVITIES

- [1] *Panel Speaker, Minorities in Energy Initiative Kick-off Meeting*, Department of Energy Headquarters, Sep 24, 2013, Washington, D.C.
- [2] *Panel Speaker, The Road Ahead for Academia*, 2011 NASA Education Stakeholder’s Summit, Nov 29-Dec 2, 2011, Chantilly, VA.
- [3] *Invited Speaker, Bridging Industry Best Practices in Project Management and Safety Assurance to Academic Propulsion Research*, 2011 NASA IT Summit, August 15-17, 2011, San Francisco, CA.
- [4] *Keynote Speaker, Energy Security in a Carbon Constrained World: Building an Energy R&D Workforce for 21st Century Demographics*, US Department of Energy University Coal Research (UCR) & HBCU/OMI Contractors Review Conference June 7-8, 2011, Pittsburgh, PA.

SPONSORED RESEARCH PROJECTS (\$13.0 MILLION)

- NASA, Department of Energy, Department of Defense, Department of Education, and various industries.

STUDENT SUPERVISION

- [1] Completed MS Thesis: 52; Completed PhD Dissertation: 13
- [2] Current Students: 5 Doctoral, 15 Masters, and 11 Undergraduate students

WILLIAM M. MARSHALL III

21000 Brookpark Road MS: 301:3
Cleveland, OH 44135
Phone: (216) 433-8419
Email: william.m.marshall@nasa.gov

WORK EXPERIENCE:

National Aeronautics and Space Administration

Research Aerospace Engineer

Cleveland, OH

September 2009-Present

- Conduct research on in-space chemical rocket engine components and systems, including liquid oxygen/liquid methane, green propellants, and CubeSat propulsion systems
- Conduct research on in-space nuclear thermal propulsion

Arctic Slope Regional Corporation (ASRC) Aerospace

Aerospace Engineer

Cleveland, OH

September 2008 – September 2009

- Conducted research on in-space chemical rocket engine components and systems

The Pennsylvania State University

Graduate Research Assistant

University Park, PA

June 2001 – August 2008

- Researched aspects of chemical liquid propellant rocket engines, including injector mixing, chamber heat flux, combustion stability and rocket based combined cycles

EDUCATION:

The Pennsylvania State University

Doctor of Philosophy, Mechanical Engineering

University Park, PA

May 2008

Doctoral Dissertation: Experimental Studies on Combustion Instabilities in a Multi-element, Rectangular Rocket Chamber

The Pennsylvania State University

Master of Science, Mechanical Engineering

University Park, PA

May 2003

Master of Science Thesis: Experimental Characterization of Gas-Gas Injector Flowfields

The Pennsylvania State University

Bachelor of Science, Mechanical Engineering

University Park, PA

May 2001

PROFESSIONAL LICENSE AND MEMBERSHIPS:

- **Engineer-in-Training:** Commonwealth of Pennsylvania, License No: ET001009
- **American Society of Mechanical Engineers (ASME):** 1998 - Present
- **American Institute of Aeronautics and Astronautics (AIAA), Senior Member:** 2000 – Present
- **Toastmasters International:** 2011 - Present

HONORS:

- **2015 Cleveland Federal Executive Board Wings of Excellence Award**
- **2013 Rotary National Award for Space Achievement (RNASA) Stellar Award**
- **NASA Honor Award, 2013:** Group Achievement Award, Science and Engineering Promotion Process Improvement Team
- **NASA Honor Award, 2011:** Group Achievement Award, Liquid Oxygen/Liquid Methane Rocket Engine Team
- **Tau Beta Pi:** Engineering Honor Society
- **Pi Tau Sigma:** Mechanical Engineering Honor Society
- **Kappa Theta Epsilon:** Cooperative Education Honor Society

FIRST AUTHOR PAPERS:

1. **Marshall, W. M.** and Deans, M. C., “Recommended Figures of Merit for Green Monopropellants,” NASA TM-2013-216560, National Aeronautics and Space Administration, Cleveland, OH, August 2013. Also published as: AIAA 2013-3722.
2. **Marshall, W. M.** and Kleinhenz, J. E., “Analysis of 100-lbf (445-N) LO₂-LCH₄ Reaction Control Engine Impulse Bit Performance,” NASA TM-2011-217613, National Aeronautics and Space Administration, Cleveland, OH, June 2012.

3. **Marshall, W. M.** and Kleinhenz, J. E., "Performance Analysis of Specific Impulse Tests of a 100-lbf (445-N) LO₂/LCH₄ Reaction Control Engine at Altitude Conditions," NASA TM-2011-217131, National Aeronautics and Space Administration, Cleveland, OH, November 2011.
4. **Marshall, W. M.** and Kleinhenz, J.E., "Hot-Fire Testing of 100 lbf LOX/LCH₄ Reaction Control Engine at Altitude Conditions", JANNAF 57th JPM/7th MSS/5th LPS/4th SPS Joint Subcommittee Meeting, Colorado Springs, CO, May 3-7, 2010.
5. **Marshall, W. M.**, Pal, S. and Santoro, R. J., "Combustion Instability Studies in a Rectangular Rocket Chamber," AIAA 2008-4656, AIAA Joint Propulsion Conference, Hartford, CT, July 2008.
6. **Marshall, W. M.**, Pal, S., Woodward, R. D. and Santoro, R. J. "Experimental Study of Transverse Combustion Instabilities in a Multi-Element, Rectangular Rocket Chamber," AIAA 2007-5588, AIAA Joint Propulsion Conference, Cincinnati, OH, July 2007.
7. **Marshall, W. M.**, Pal, S., Woodward, R. D. and Santoro, R. J. "Combustion Instability Studies Using Gaseous Methane and Liquid Oxygen," AIAA 2006-4526. AIAA Joint Propulsion Conference, Sacramento, CA, July 2006.
8. **Marshall, W. M.**, Pal, S., Woodward, R. D. and Santoro, R. J. *and others*, "Experimental and Computational Investigation of Combustor Acoustics and Instabilities, Part II: Transverse Modes," AIAA 2006-0538. Reno, NV, January 2006.
9. **Marshall, W. M.**, Pal, S., Woodward, R. D. and Santoro, R. J., "Injector Placement Effects on Transverse Self-Induced Instabilities in a Multi-Element Rectangular Rocket Chamber," Abstract Presentation, Eastern States Section of the Combustion Institute, Fall 2005 Technical Meeting, University of Central Florida, November 2005.
10. **Marshall, W. M.**, Pal, S., Santoro, R. J., Tucker, P. K. *and others*, "Benchmark Wall Heat Flux Data for a GO₂/GH₂ Single Element Combustor," AIAA 2005-3572, AIAA Joint Propulsion Conference, Reno, NV, July 2005.
11. **Marshall, W. M.**, Cramer, J. M., Pal, S. and Santoro, R. J., "Experimental Characterization of Gas-Gas Injector Flowfields," 14th Annual Propulsion Engineering Research Center Symposium, Penn State University, December 2002.

ADDITIONAL PAPERS:

1. Kwas, A., MacDonald, E., Muse, D., Wicker, R. Kief, C., Aarestad, J., Zemba, M., **Marshall, W. M.**, Tolbert, C., and Connor, B., "Enabling Technologies for Entrepreneurial Opportunities in 3D printing of SmallSats," SSC14-III-7, 28th Annual AIAA/USU Conference on Small Satellites, Logan, UT, August 2014.
2. Kleinhenz, J. E., Sarmiento, C., and **Marshall, W. M.**, "Experimental Investigation of Augmented Spark Ignition of a LO₂/LCH₄ Reaction Control Engine at Altitude Conditions," NASA TM 2011-217611, National Aeronautics and Space Administration, Cleveland, OH, June 2012.
3. Kleinhenz, J. E., Sarmiento, C., and **Marshall, W. M.**, "Spark Ignition Characteristics of a LO₂/LCH₄ Engine at Altitude Conditions," AIAA 2012-4129, AIAA Joint Propulsion Conference, Atlanta, GA, July 2012.
4. Stiegemeier, B.R. and **Marshall, W.M.**, "Sea-Level Testing of a 100 lbf LOX/Methane Reaction Control Engine", JANNAF 57th JPM/7th MSS/5th LPS/4th SPS Joint Subcommittee Meeting, Colorado Springs, CO, May 3-7, 2010.
5. Hulka, J., Jones, G., Protz, C., Bullard, B., Trinh, H., Santoro, R., Pal, S., Woodward, R.D., and **Marshall, W.**, "Local Combustion Chamber Heat Flux Measurements with LO₂/H₂ Swirl Coaxial Injectors", JANNAF Meeting, 2007.
6. Pal, S., **Marshall, W.**, Woodward, R. and Santoro, R., "Wall Heat Flux Measurements for a Uni-element GO₂/GH₂ Shear Coaxial Injector," Third International Workshop on Rocket Combustion Modeling, Paris, France, March 13-15, 2006.
7. Jones, G., Protz, C., Bullard, B. Hulka, J., Santoro, R., Pal, S., Woodward, R., and **Marshall, W.**, "Local Heat Transfer Measurements in a LO₂/H₂ Single Element Combustor", 53rd JANNAF Propulsion Meeting/2nd Liquid Propulsion Subcommittee Meeting, Monterey, CA, December 5-8, 2005.
8. Santoro, R.J., Lin, J., **Marshall, W.M.**, Pal, S., West, J., Wang, T.S., Williams, R., Chen, Y.S., and Lee, C.P., "GO₂/GH₂ Injector Testing and Analysis," Paper 3.2, NASA Marshall Space Flight Center Spring Fluids Workshop, Huntsville, AL, April 13-15, 2004.
9. Cramer, J. M., **Marshall, W. M.**, Pal, S., Santoro, R. J., "Sea-Level Static Testing of the Penn State Two-Dimensional Rocket-Based Combined Cycle (RBCC) Testbed," 14th Annual Propulsion Engineering Research Center Symposium, Penn State University, December

C. Scott Hill

Lecturer, Mechanical Engineering

EDUCATION

- M.S. in Mechanical Engineering– 1966
University of Southern California, Los Angeles, California
- B.S. in Mechanical Engineering with Distinction – 1961
University of Washington, Seattle, Washington

PROFESSIONAL EXPERIENCE

- Lecturer: January 2010 – Present
Department of Mechanical Engineering, The University of Texas at El Paso
- Casual Employee: April 2006 – December 2009
ARES Corporation, Huntsville, Alabama
- Staff Advisor to Program Manager; Propulsion Department Manager: 1994-2005
White Sands Test Facility
- Technical Lead, Subsystems and Propulsion Specialist: May 1992 – April 1994
Space Station Freedom Integration Team
- Subsystems Design Group Supervisor, Propulsion Specialist: May 1989 – May 1992
Advanced Engineering Department, Rockwell International SSD, Downey, California
- Development Manager; Senior Project Engineer: 1985-1989
Rocketry Department, The Marquardt Company, Van Nuys California
- Project Engineer: 1981 – 1985
Space Shuttle RCS Program, Rocketry Department, The Marquardt Company, Van Nuys California
- Project Manager, Vernier Thruster Project Manager: 1974 – 1981
Rocketry Department, The Marquardt Company, Van Nuys California

PROFESSIONAL CREDENTIALS

- [1] Professional Mechanical Engineering License, (CA 14200), State of California
- [2] Building Contractors License, (CA 432407), State of California
- [3] Los Angeles Community College District Permanent Teaching Certificate, 1983

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Junior Research Engineer, Mechanical Engineering

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- M.S. in Mechanical Engineering – August 2014
The University of Texas at El Paso
- B.S. in Mechanical Engineering– May 2010
The University of Texas at El Paso

PROFESSIONAL EXPERIENCE

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Department of Mechanical Engineering, The University of Texas at El Paso

RELEVANT EXPERIENCE

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NASA Johnson Space Center

RESEARCH EXPERIENCE

- Graduate Research Assistant; Undergraduate Research Assistant: 2012-2010
NASA Center for Space Exploration Technology Research (cSETR), The University of Texas at El Paso

PUBLICATIONS

1. Trejo, A., Trujillo, A., Galvan, M., Melcher, J.C., Bruggemann, J.J., and Choudhuri, A., ***Experimental Investigation of Liquid Methane Convection and Boiling in Rocket Engine Cooling Channels***, 50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, July 2014

AWARDS

- [1] Fellowship – NASA/Texas Space Grant Consortium Fellowship, fall 2013 – spring 2014
- [2] Merit scholarship – Xerox Technical Minority Scholarship, spring 2013
- [3] Merit scholarship – John M. Levosky Mechanical Engineering Scholarship, 2005 – 2009
- [4] Merit scholarship – Hispanic Scholarship Fund Scholarship, Exxon Mobil, 2007
- [5] Merit scholarship – National Action Council for Minorities in Engineering (NACME), 2006 – 2010
- [6] Dean's List of the College of Engineering, fall 2005 – spring 2010

Gloria A. Salas*Program Coordinator/Manager***EDUCATION**

- B.S. in Interdisciplinary Studies– December 2009
The University of Texas at El Paso

PROFESSIONAL EXPERIENCE

- Program Coordinator; September 2013- Present
Center for Space Exploration Technology Research, The University of Texas at El Paso
- Administrative Assistant: August 2012 – August 2013
Department of Mechanical Engineering, The University of Texas at El Paso
- Sales Associate, April 2010- August 2012
El Paso, TX
- Math Tutor and Substitute Teacher, January 2010-May 2011
El Paso School District, El Paso, TX
- Peer Mentor Advisor, February 2006- December 2009
Student Support Services Program, The University of Texas at El Paso

Section 10. Current and Pending Staff Support

I. Principal Investigator

*Dr. Ahsan Choudhuri, Professor, Mechanical Engineering
University of Texas at El Paso*

Ahsan Choudhuri, PhD

*Professor and Chairman, Mechanical Engineering
Mr. and Mrs. MacIntosh Murchison Chair II in Engineering
Principal Investigator*

CURRENT SUPPORT

1. MIRO Center for Space Exploration and Technology Research (MIRO cSETR), Principal Investigator with Co-Investigator Jack Chessa, Norman Love, Evgeny Shafirovich, and Ryan Wicker, NASA, Contract Pending, Amount Funded: \$9,350,000 (the total award includes \$4,350,000 Industry and Institutional Cost Commitments), Months Per Year Committed: 3
2. HAN Based Advanced Hybrid Rocket Motor Technologies, Co-Principal Investigator with Principal Investigator Norman Love and Co-Principal Investigator Evgeny Shafirovich, Missile Defense Agency, Amount Awarded \$588,000, April 2015-March 2018, Months Per Year Committed: 0.7.
3. Development of Courses on Nuclear Engineering Materials at UTEP, Principal Investigator with Co-Principal Investigator Yirong Lin, C.V. Ramana and Louis Everett, US Nuclear Regulatory Commission, Amount Awarded: \$188,684, September 2014-September 2016. Months Per Year Committed: 0.6
4. High Temperature and High Velocity Direct Power Extraction Using an Open-Cycle Oxy-Combustion System, Co-Principal Investigator with Principal Investigator Norman Love. Department of Energy, Amount Awarded: \$500,000, October 2014 – September 2015, Months Per Year Committed: 1.
5. Establishment of a SEMAA to Serve the Southwest, Principal Investigator, NASA, Amount Awarded: \$506,250, February 2011-June 2015, Months Per Year Committed: 0.
6. Aerospace Course Development through Project Based Learning, Texas Space Grant Consortium, Principal Investigator, University of Texas at Austin, Amount Awarded: \$10,000, Months Per Year Committed: 0.
7. Investigation on Smart Parts with Embedded Piezoelectric Sensors via Additive Manufacturing, Co-Principal Investigator with Principal Investigator Yirong Lin and Co-Principal Investigator Ryan Wicker. Department of Energy, Amount Awarded: \$913,362 September 2013 – September 2016, Months Per Year Committed: 1.
8. An Investigation on Structures of Premixed Flames in High Intensity Turbulent Flow, Principal Investigator, Department of Defense, Amount Awarded: \$650,000 (the total award includes a \$70,000 subcontract to Princeton University), May 2013 – April 2016, Months Per Year Committed: 1.
9. Development of 20N Class ADN Thrusters for Fast-Response Time DAC Propulsion Systems, Principal Investigator, Collaborative Proposal with the University of Maryland at College Park (Ashwani Gupta), Missile Defense Agency, Department of Defense, Total Amount Awarded: \$700,000 (UTEP Share: \$348,999), September 2013 – August 2016, Months Per Year Committed: 0.6.
10. Design Optimization of Liquid Fueled High Velocity Thermal Techniques, Principal Investigator with Co-Principal Investigator Ramana Chintalapalle V., Department of Energy, Amount Awarded: \$200,000, July 2012 – June 2015, Months Per Year Committed: 0.2.
11. Graduate Assistance in Areas of National Need (GAANN) Program, Principal Investigator Ahsan Choudhuri with Co-Principal Investigators Evgeny Shafirovich, Norman Love, Ramana

Chintalapalle V., Vinod Kumar, and Harry Meeuwsen, U.S. Department of Education, Amount Awarded: \$405,315, August 2012 – August 2015, Months Per Year Committed: 0.

12. Center for Space Exploration Technology Research, Principal Investigator and Center Director with Co-Principal Investigators Jose Hurtado, Louis Everett, David Borrok, John Chessa, Evgeny Shafirovich, and Ramana Chintalapalle V., NASA Office of Education, Amount Awarded: \$4,999,618, October 2009 – June 2015, Months per Year Committed: 3.0.

PENDING SUPPORT

1. Metal 3D Printing of Low-NOx Fuel Injectors with Integrated Temperature Sensors, Principal Investigator with Co-Investigator Ryan Wicker, Department of Energy, March 2015, Amount Requested \$250,000. Months Per Year Committed: 0.2

Section 11. Statements of commitment and Letters of Support

NASA John H. Glenn Research Center

*Dr. George R. Schmidt
Chief, Propulsion Division*

National Aeronautics and
Space Administration

John H. Glenn Research Center
Lewis Field
Cleveland, OH 44135-3191



June 3, 2015

Reply to Attn of: LTR

The University of Texas El Paso
Department of Mechanical Engineering
Attn: Dr. Ahsan Choudhuri
500 W. University, Engineering A126
El Paso, TX 79968-0521

Subject: Letter of Commitment for Precise Attitude Control and Pointing Systems for CubeSats
(the "Proposal") in response to NNH15ZOA001N-15STP_E1, Small Spacecraft
Technology Program, Smallsat Technology Partnerships Appendix

This letter (this "Letter") sets forth the National Aeronautics and Space Administration (NASA) Glenn Research Center's (NASA GRC) estimate for its support of the proposal. Should the proposal be accepted, NASA GRC anticipates providing the following level of support.

1. Provide engineering advice on microgravity propellant acquisition and tank design, 2. Provide engineering advice on propulsion system control design, 3. Review Valve Thruster and System Integration test set ups, test instrumentation, and test matrix, 4. Assist the University of Texas, El Paso (UTEP) in reviewing and analyzing the Valve Thruster and System integration test data, 5. Determine flight environments and flight instrumentation requirements, 6. Assist UTEP in preparing a flight qualification plan.

Assuming your proposal is accepted and authority to proceed is given on October 1, 2015, the estimated GRC resources required to perform these tasks and provide the deliverables are:

	FY16	FY17
Civil Servant Labor (FTE)	1.0	1.0
Procurement (\$k)		25.0

The NASA GRCs intention to provide the above support is nonexclusive and contingent on the selection of the proposal, as well as the availability of appropriated funds and other required resources.

This is a letter of commitment only and is not intended to be, and shall not constitute in any way a binding or legal agreement, or impose any legal obligation or duty on either UTEP or NASA GRC.

This letter shall be interpreted and enforced in accordance with U.S. Federal law for all purposes, including but not limited to, determining the validity of the letter, the meaning of the provisions, and the rights, obligations, and remedies of the parties.

Should your proposal be accepted, we look forward to formalizing an appropriate teaming arrangement to provide the above support. If you have any questions, please contact Mark D. Klem, Chemical and Thermal Propulsion Systems Branch, 216-977-7473, mark.d.klem@nasa.gov.

A handwritten signature in black ink, appearing to read "George R. Schmidt". The signature is fluid and cursive, with the first name "George" being the most prominent.

Dr. George R. Schmidt
Chief, Propulsion Division

Section 12. Special Notifications and/or Certifications

N/A

Section 13. Proposal Summary Chart

Proposal Title: CubeSat 1U Propulsion Module using High-Test Peroxide (HTP)

Topic Area: Topic 1: Precise attitude control and pointing systems for cubesats.

Brief Summary: Use of High-Test Peroxide (HTP) propellant for attitude control of small satellites will enable greater mission capability due the higher specific impulse over cold gas. The proposed effort takes the proof of concept level thruster tests through a demonstration of safe operation and thruster repeatability and system integration for a modular 1U system. Additional verification testing of the thruster performance will demonstrate propellant use and engine-to-engine repeatability. Micro tank design will be demonstrated as well as propellant storage issues for decomposition of HTP.

Budget Summary:

Budget	1st Year	2nd Year
Requested University Funding	\$100,000	\$100,000
NASA Labor Allocation (FTE)	1.0	1.0
NASA Procurement	N/A	\$25,000
Additional Contributions	\$5,000	\$5,000
Total Cost	\$105,000	\$105,000

Submitting Organization: University of Texas at El Paso

All Partner Organizations: NASA Glenn Research Center

AGENCY GUIDELINES



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
HEADQUARTERS
SPACE TECHNOLOGY MISSION DIRECTORATE
300 E Street, SW
Washington, DC 20546-0001

NASA RESEARCH ANNOUNCEMENT (NRA):
NNH15ZOA001N

**Space Technology Research, Development,
Demonstration, and Infusion-2015
(SpaceTech-REDDI-2015)**

Issued: October 1, 2014
Effective through September 30, 2015

REFER TO APPENDICES FOR PROPOSAL DUE DATES

Catalog of Federal Domestic Assistance (CFDA) Number **43.012**
OMB Approval Number 2700-0087

SpaceTech-REDDI-2015

EXECUTIVE SUMMARY

This NASA Research Announcement (NRA), entitled “**Space Technology Research, Development, Demonstration, and Infusion-2015 (SpaceTech-REDDI-2015)**” is NASA Space Technology Mission Directorate’s (STMD) annual umbrella solicitation. The following STMD programs will be included in the solicitation:

NASA Innovative Advanced Concepts (NIAC),
Space Technology Research Grants (STRG),
Game Changing Development (GCD),
Small Spacecraft Technology (SST),
Technology Demonstration Missions (TDM) and
Flight Opportunities Program (FOP)

The Space Technology portfolio supports a combination of early stage studies, for assessing the feasibility of entirely new technologies (which corresponds to a Technology Readiness Level (TRL) range from 1 to 3); maturing feasible technologies through rapid competitive development and ground based testing (TRL 3-5); and flight demonstrations in a relevant environment to complete the final step to mission infusion (TRL 5-7) (Attachment 2 “Technology Readiness Level Descriptions”). This technological diversity results in a sustainable pipeline of revolutionary concepts. STMD seeks aggressive technology development efforts that may require undertaking significant technical challenges and risk to achieve a higher potential payoff.

The focus of this solicitation is to bring the best ideas and talents from all sectors of the aerospace enterprise to solve future technology needs while maximizing the value of the Nation’s investment. Investing in space technology invests in the future of NASA, the U.S. space program, and the Nation.

To the greatest extent practicable, participation will be open to all categories of organizations, domestic and foreign, including industry, educational institutions, nonprofit organizations, NASA centers, and other Government agencies. Foreign entities may also partner with U.S. proposers, but only without an exchange of funding.

Proposals for technology research, development and demonstration in support of STMD will be solicited through Appendices under this umbrella solicitation as technology topics are defined and funding is made available for new opportunities. For informational purposes, we have included the Appendix target release dates on page vi. The Appendices will provide key information including: specific scope of the work solicited, anticipated budget for new awards, number of awards anticipated, notice of intent and proposal due dates, and specific instructions about proposal content and evaluation criteria. The provisions in any Appendix will apply to that

specific opportunity and will supersede any conflicting provisions in this umbrella solicitation or in the *NASA Guidebook for Proposers* (see *Section 9.0 in this solicitation*).

It is possible that additional information will become available or programmatic changes may affect this umbrella solicitation or any of the opportunities offered under its Appendices prior to a proposal submission deadline. If so, such information will be added as a formal amendment to this umbrella solicitation and posted on the following webpage: <http://nspires.nasaprs.com>. Clarifications or questions and answers that are published will also be posted on this website or included in an amendment. It is each prospective offeror's responsibility to check this webpage for updates concerning the programs of interest.

We enthusiastically look forward to your participation in STMD's many upcoming opportunities.



Michael J. Gazarik
Associate Administrator
Space Technology Mission Directorate

SpaceTech-REDDI-2015

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APPENDIX TARGET RELEASE DATES

Program	Appendix	FY 2015 Targeted Release			
		Q1	Q2	Q3	Q4
NASA Innovative Advanced Concepts (NIAC)	A1 - NIAC Phase I	X (Oct)			
	A2 - NIAC Phase II			X (March)	
Space Technology Research Grants (STRG)	B1 - Early Career Faculty (ECF)		X		
	B2 - Early Stage Innovations (ESI)			X	
Game Changing Development (GCD)	C1 - GCD Technology Topics	X (Oct)			
	C2 - GCD Technology Topics			X	
	C3 - GCD Technology Topics				X
Technology Demonstration Missions (TDM)	D1 - Technology Demonstration Mission Topics				X
Small Spacecraft Technology (SST)	E1 - SST Partnerships			X	
	E2 - SST Development and Demonstration			X	
Flight Opportunities Program (FOP)	F1 - FOP Technology Topics			X	

NOTE:

Release of Appendices is subject to availability of appropriated funds and may change. Additional Appendices may be issued throughout the year as needed.

QFY: Quarter of Fiscal Year (Government Fiscal Year: October to September)

SpaceTech-REDDI-2015

1.0 FUNDING OPPORTUNITY DESCRIPTION

1.1 NASA's Strategic Goals

NASA's Vision and Mission guide technology objectives in the orderly pursuit of the Agency's strategic goals.

NASA's Vision is:

To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind.

NASA's Mission is to:

Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of the Earth.

The Space Technology Mission Directorate (STMD) endeavors to fulfill Goal 3 of NASA's Strategic Plan which is to create innovative new space technologies for our exploration, science, and economic future. The outcomes associated with this strategic goal are as follows:

Outcome 3.1: Sponsor early-stage innovation in space technologies in order to improve the future capabilities of NASA, other government agencies, and the aerospace industry.

Outcome 3.2: Infuse game-changing and cross-cutting technologies throughout the Nation's space enterprise, to transform the Nation's space mission capabilities.

Outcome 3.3: Develop and demonstrate the critical technologies that will make NASA's exploration, science, and discovery missions more affordable and more capable.

Outcome 3.4: Facilitate the transfer of NASA technology and engage in partnerships with other government agencies, industry, and international entities to generate U.S. commercial activity and other public benefits.

NASA's Vision, Mission and Strategic Goals and Outcomes can be found in the 2011 NASA Strategic Plan (http://www.nasa.gov/pdf/516579main_NASA2011StrategicPlan.pdf).

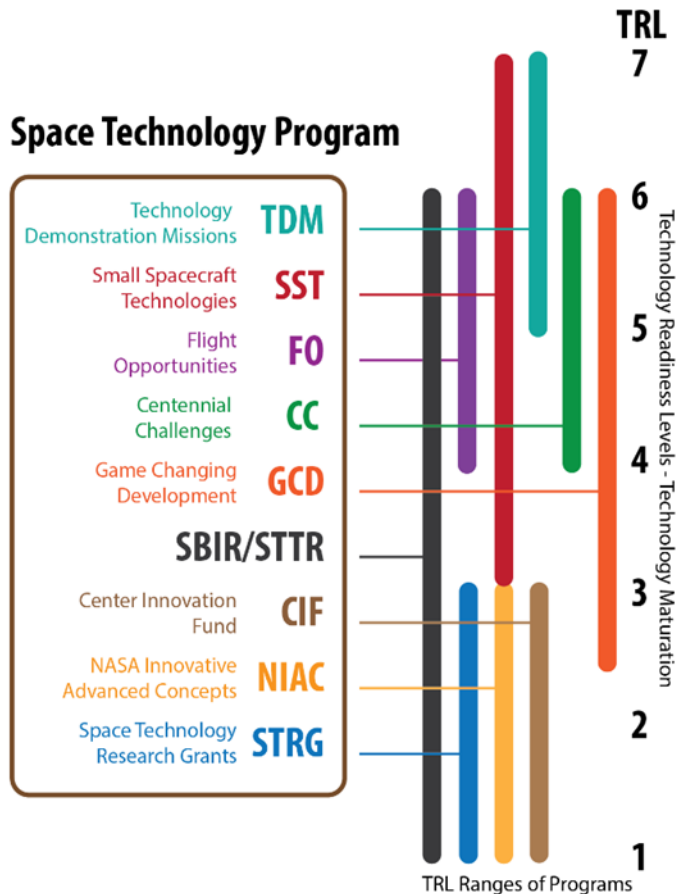
The development of advanced and innovative space technologies is critical for our Nation to meet its goals to explore and understand the Earth, our solar system, and the universe. Space technology efforts will improve the Nation's leadership in key research areas, enable far-term capabilities, and motivate disruptive innovations that make science, space travel, and space exploration more effective, affordable, and

sustainable. These efforts will also provide a more robust national capability for aerospace activities, thereby improving our competitive posture in the international marketplace, enabling new industries, and contributing to economic growth. NASA's pursuit of a suite of revolutionary discoveries will also lead to major breakthroughs that are needed to address energy, health, transportation, and environmental challenges. Investing in space technology invests in the future of NASA, the U.S. space program, and the Nation.

1.2 NASA's Space Technology Mission Directorate's Research and Development Programs

The STMD is responsible for developing the crosscutting, pioneering, new technologies and capabilities needed by the Agency to achieve its current and future missions. The STMD is divided into the following nine programs, representing all levels of technology readiness from early stage innovations to mission-ready projects:

- NASA Innovative Advanced Concepts (NIAC) Program focuses on visionary aeronautics and space system concepts. TRL Range: 1-3
- Space Technology Research Grants (STRG) Program engages academia in innovative research in advanced space technology TRL Range: 1-3
- Center Innovation Fund (CIF) Program stimulates creativity and innovation at the NASA field centers. TRL Range: 1-3
- Small Business Innovative Research (SBIR)/Small Business Technology Transfer (STTR) Program engage small businesses in aerospace research and development for infusion into NASA missions and the nation's economy. TRL Range: 1-6
- Game Changing Development (GCD) Program focuses on maturing advanced space technologies that may lead to entirely new approaches for the Agency's future space missions. TRL Range: 3-5
- Small Spacecraft Technology (SST) Program develops and demonstrates subsystem technologies and new mission capabilities for small spacecraft. TRL Range: 3-7
- Technology Demonstration Missions (TDM) Program seeks to mature laboratory-proven technologies to flight-ready status. TRL Range: 5-7
- Flight Opportunities Program (FOP) facilitates low-cost access to suborbital environments for a broad range of innovators as a means of advancing space technology development and supporting the evolving entrepreneurial commercial space industry. TRL Range: 5-7
- Centennial Challenges Program offers incentive prizes to stimulate innovative solutions by citizen inventors and independent teams outside of the traditional aerospace community. TRL Range: 5-9



Additional information about STMD programs is available at <http://www.nasa.gov/directorates/spacetech/home/index.html>.

By investing in high payoff, disruptive technologies, STMD is able to mature the technologies required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities. By pushing the boundaries of aerospace technology and seizing opportunities, investing in space technology allows NASA and our Nation to remain at the cutting edge. NASA's STMD:

- Advances technology that is broadly applicable to multiple customers
- Employs a portfolio approach to capture the entire spectrum of technology readiness
- Competitively selects research by academia, industry, NASA Centers, and other government organizations based on technical merit
- Coordinates with internal and external stakeholders and leverages the technology investments of our international, other government agency, academic and industrial partners
- Results in new inventions, new capabilities and the creation of a pipeline of innovators aimed at serving future NASA needs and National needs
- Grows the Nation's innovation economy and creates high-technology jobs

STMD programs intentionally push the boundaries of what is possible with a strong focus on innovation. No single effort is guaranteed to succeed and some will fail as novel approaches are attempted. While appropriate safety, design, and verification practices are followed, STMD programs employ a graduated technical risk tolerance approach. More resources, rigor, and greater risk avoidance apply to higher cost and higher technology readiness level (TRL) efforts, such as test articles destined for complex ground tests and/or space flight demonstrations. In all cases, a transparent, informed risk acceptance approach applies.

The following STMD programs are included in this solicitation:

NASA Innovative Advanced Concepts (NIAC),
Space Technology Research Grants (STRG),
Game Changing Development (GCD),
Small Spacecraft Technology (SST),
Technology Demonstration Missions (TDM) and
Flight Opportunities Program (FOP)

As program requirements are defined and funding is made available, specific research and technology development opportunities will be defined and issued as Appendices to this solicitation. The Appendices will provide key information including: specific scope of work solicited, anticipated budget and number of awards, notice of intent and proposal due dates, and specific instructions about proposal content and evaluation criteria.

1.3 Space Technology Roadmaps

STMD programs described in section 1.2 above are aligned with the Agency's Space Technology Roadmaps (STRs) (<http://www.nasa.gov/offices/oct/home/roadmaps/index.html>), which reflect the National Research Council's (NRC's) review (http://www.nap.edu/catalog.php?record_id=13354) of these roadmaps.

NASA developed the STRs in order to facilitate the development and demonstration of space technologies that address the needs of NASA's exploration systems, earth and space science, and space operations mission areas, as well as those that contribute to critical national and commercial needs in advanced space technology. Each of these roadmaps focuses on a technology area. The STRs were initially drafted by NASA and subsequently independently reviewed by the NRC. The NRC's review (link provided above) resulted in findings, recommendations, and priorities – within and across the technology areas – intended to inform NASA's space technology investments. Offerors may refer to the roadmaps and the NRC final report for additional context.

Finally, topic areas solicited under this solicitation are consistent with the NASA Strategic Space Technology Investment Plan (http://www.nasa.gov/sites/default/files/files/space_tech_2013.pdf).

Specifically, NASA will balance investments across all levels of technology readiness. By investing in all TRLs for pioneering, crosscutting technologies, the Agency ensures a robust pipeline of new capabilities.

1.4 NASA Safety Policy

Safety is the freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. NASA's safety priority is to protect the following: (1) the public, (2) astronauts and pilots, (3) the NASA workforce (including employees working under NASA award instruments), and (4) high-value equipment and property.

2.0 AWARD INFORMATION

2.1 Funding and Period of Performance Information

The *Summary of Key Information* section in each Appendix will provide the anticipated total amount of funds available, any funding limitations, potential number of proposal awards for each topic area and period of performance (duration) for awards. While the *Summary of Key Information* will provide estimates for funding and the number of awards, these amounts may vary depending on the merit of proposals submitted and the funding available at the time of selections.

The period of performance (duration) can range from one year for activities of limited scope to multiple years for extensive, comprehensive activities. Offerors shall justify proposed period of performance in their proposals. The appropriateness of the proposed period of performance will be evaluated by peer review. NASA may select proposals for shorter award durations than proposed (See Section 5.4).

For proposals that include NASA civil servant participation, offerors total cost of the effort will include the proposal amount plus all NASA civil servant fully burdened costs (per standard NASA accounting practices for the work-years proposed). The total cost of the effort will be compared to the amount of funds available per award. For example: if the offeror's proposed cost is \$100K and the NASA civil servant cost is 15K, then the total cost of the effort is \$115K.

STMD's goal is to initiate new awards as quickly as possible after the selection of proposals is announced. However, NASA may take longer to make the awards, based on workload, availability of appropriated funds, and any necessary post-selection negotiations with the proposing organizations. To help expedite the processing of awards, offerors are reminded to submit all required information; including full and detailed explanations for the requested budget should their proposal be selected.

Awards made through this solicitation may be in the form of grants, cooperative agreements, or contracts depending on the specific requirements for award as set forth in the Appendices and the nature of the proposing organization. Appendices may specify a particular type of instrument for award. Inter-agency and intra-agency actions may be used to fund selected proposals from other federal agencies or NASA Centers. The type of award to be negotiated with selected offerors will generally follow the policies in Appendix D.1 of the *NASA Guidebook for Proposers*, although in a few cases, only one type of award may be offered, as specified in the Appendix.

A NASA Awards Officer will determine the appropriate award instrument for the selections resulting from this solicitation. Grants and cooperative agreements will be subject to the policies and provisions identified in the regulations at 2 CFR 200 and 1800, 14 CFR 74, NASA GCAM, and Appendix D of the *NASA Guidebook for Proposers*. In the case of any conflict, the regulations at 2 CFR 200 and 1800 and the GCAM takes precedence over the *NASA Guidebook for Proposers*. Contract awards will be subject to the provisions of the Federal Acquisition Regulations (FAR) <http://www.acquisition.gov/far/index.html> and the NASA FAR Supplement (NFS) <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>.

2.2 Availability of Funds for Awards

There is no funding associated with this umbrella solicitation. All funding will be associated with each particular Appendix. The Government's ability to make awards is contingent upon the availability of appropriated funds and the receipt of proposals that NASA determines are acceptable for award under this solicitation.

NASA reserves the right to select for award all, some, or none of the proposals in response to an Appendix call for proposals. NASA provides no funding for reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this solicitation will not be returned. It is the policy of NASA to treat all proposals as competition sensitive information and to disclose their contents only for the purpose of evaluation.

2.3 Award Reporting Requirements

Required reports for contract awards will be negotiated with the offeror and be subject to the FAR and NASA FAR Supplement. Required reports for grants and cooperative agreements are covered in 2 CFR 1800.902 and the GCAM, Exhibit E 'Technical Publications and Reports.'

2.4 Successor Proposals and Resubmissions

Generally, award recipients holding previous awards selected through any of the opportunities offered through earlier solicitations are welcome to submit "successor" proposals that seek to continue a previously funded line of research (see Section 1.5 of

the *NASA Guidebook for Proposers*). However, to ensure equitable treatment of all submitted proposals, NASA does not extend any special consideration to such successor proposals in terms of preferential handling, review, or priority for selection.

Proposals that were submitted but not selected for any previous NASA solicitation may be submitted either in a revised or original form but must conform to the requirements of the particular Appendix. Such submissions will be treated as new proposals and will be subjected to a full peer review.

Funds provided through instruments awarded under this solicitation cannot be applied as contributions to Space Act Agreements or other NASA awards.

2.5 Use and Disclosure of Research Resulting From Awards

As a Federal Agency, NASA requires prompt public disclosure of the results of its sponsored research to generate knowledge that benefits the Nation. Thus, it is NASA's intent that all knowledge developed under awards resulting from this solicitation be shared broadly. In certain STMD programs, award recipients will be expected to publish their work in peer-reviewed, open literature publications to the greatest extent practical.

NASA recognizes that there are cases when data cannot be disclosed to the public (e.g., export controlled data). Even in these cases, offerors are expected to publish data to the greatest extent possible (e.g., use normalized data or at least discuss new methodologies used with clean "test cases"). NASA also understands that offerors may have legitimate proprietary interests in the technology or data they have produced at their own expense. If results must include proprietary or restricted information, that information should be appropriately marked and segregated into a separate Appendix that will not be publicly disseminated. A publicly releasable version of the final report and other deliverables shall be otherwise complete and comprehensive.

On February 22, 2013, the Office of Science and Technology Policy (OSTP) issued a Memorandum for the Heads of Executive Departments and Agencies entitled "Increasing Access to the Results of Federally Funded Scientific Research" that requested a plan for improving the public's access to the results of federally funded research. Promoting the full and open sharing of data with the research communities, private industry, academia, and the general public is a longstanding core value of NASA. Accordingly, NASA developed a plan in response to the new OSTP requirement that extends NASA's open access culture to data and publications, entitled: "The NASA Plan for Increasing Access to Results of Federally Funded Research", which can be found at:

http://science.nasa.gov/media/medialibrary/2014/12/05/NASA_Plan_for_increasing_access_to_results_of_federally_funded_research.pdf

In keeping with this plan, specific data archival terms and conditions will be included in applicable Appendices to this SpaceTech-REDDI NRA.

2.6 Intellectual Property Resulting From Awards

Ownership of subject inventions is governed by the authorities listed below:

- Domestic small businesses and nonprofits (including educational institutions): Pursuant to the terms and conditions of the Bayh-Dole Act (35 U.S.C. Section 200, *et seq.*), domestic small businesses and nonprofits (including educational institutions) may elect to retain title to their subject inventions.
- Large Businesses and all others: Pursuant to the terms and conditions of Section 20135 of the National Aeronautics and Space Act (51 U.S.C. § 20135(b)), title to subject inventions vests in the U.S. Government. Large business and all others not subject to the Bayh-Dole Act, do not have an automatic right to elect to retain title to their subject inventions; however, they may request a waiver under the NASA Patent Waiver Regulations, 14 CFR Part 1245, Subpart 1, to obtain title to subject inventions. Such a request may be made in advance of award (or 30 days thereafter) for anticipated subject inventions and/or classes of invention, or within 8 months from the first disclosure of a subject invention to NASA.

In the case of contract awards, intellectual property provisions (patent and data rights) are subject to the FAR and the NFS. Intellectual property provisions applicable to grants and cooperative agreement awards are subject to the terms and conditions in 2 CFR 200, 2 CFR 1800 and 14 CFR 1274. The following table identifies certain specific intellectual property clause references for contracts and grants/cooperative agreements.

	Small Businesses and Non-Profits (including Educational Institutions)	Large Business and All Others
Contracts	<ul style="list-style-type: none">• FAR clause 52.227-11 as modified by NFS 1852.227-11 and FAR clause 52.227-14 as modified by NFS 1852.227-14• Offerors shall complete FAR Provision 52.227-15 Representation of Limited Rights Data and Restricted Computer Software and include with proposal.	<ul style="list-style-type: none">• NFS clause 1852.227-70 and FAR clause 52.227-14 as modified by NFS 1852.227-14• Offerors shall complete FAR Provision 52.227-15 Representation of Limited Rights Data and Restricted Computer Software and include with proposal.
Grants/ Cooperative Agreements	CFR Section: 2 CFR 200.59, 2 CFR 200.315, 2 CFR 200.448, 2 CFR 1800.315, 2 CFR 1800.908, 2 CFR 1800.909, 14 CFR 1274.208, 14 CFR 1274.905, 14 CFR 1274.906, 14 CFR 1274.911, and 14 CFR 1274.913.	CFR Sections: 14 CFR 1260.4(b)(4), 2 CFR 1800.923, 2 CFR 1800.924, 14 CFR 1274.208, 14 CFR 1274.905, 14 CFR 1274.906, 14 CFR 1274.911, 14 CFR 1274.912 and 14 CFR 1274.914.

Title and Rights in Property. A stated purpose of NASA under the National Aeronautics and Space Act is to seek and encourage the commercial use of space. During negotiations, offerors should identify where title to property resulting from project activities is critical to their commercialization efforts. NASA will determine whether title to property will remain with offerors for a specified period, to be negotiated at the time of award.

2.7 Cost-Sharing or Matching

For contracts, criteria and procedures for the allowability and allocability of cash and non-cash contributions shall be governed by FAR Parts 30 and 31, and NFS Parts 1830 and 1831.

For an institution of higher education, hospital, or other non-profit organization seeking to receive a grant or cooperative agreement, cost-sharing is not required; however, NASA can accept cost sharing if it is voluntarily offered. See CFR 200.306, 2 CFR 1800.306 and 2 CFR 1800.922 for more information on Cost Sharing.

For a commercial firm seeking to receive a grant or cooperative agreement, cost sharing is required as defined in 14 CFR 1274, unless the commercial firm can demonstrate that they will not receive substantial compensating benefits for performance of the work. If no substantial compensating benefits will be received, cost sharing is not required but can be accepted. The regulations at 2 CFR 200.306, 2 CFR 1800.306 and 2 CFR 1800.922 describe cost sharing and allowability for awards. Acceptable forms of cost sharing for commercial firms are discussed in the Regulations at 14 CFR 1274.204, 'Costs and Payments,' located at http://prod.nais.nasa.gov/pub/pub_library/grantd.html#1274204).

2.8 International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR) Requirements

It is incumbent upon the offeror to assure the protection and nondisclosure of relevant technical data, including requirements of the Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR). U.S. offerors are required to know when hardware, software, or related materials and services, including technical data, are subject to U.S. export control laws, including the U.S. Export Administration Act, the Arms Export Control Act, and their associated regulations. It is incumbent upon the U.S. offeror to strictly comply with all U.S. export control laws, and when applicable, assume the responsibility for obtaining export licenses, or other export authority, as may be required.

Under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and are, therefore, subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130. It is the

offeror's responsibility to determine whether any proposal information is subject to the provisions of ITAR, and to comply with the provisions of ITAR. Information about U.S. export regulations is available at <http://www.pmdtdc.state.gov/> and <http://www.bis.doc.gov/>.

3.0 ELIGIBILITY INFORMATION

To the greatest extent practicable, participation will be open to all categories of U.S. and non-U.S. organizations, including educational, industry, nonprofit institutions, Federally Funded Research and Development Centers (FFRDC), University Affiliated Research Centers (UARC)s, NASA Centers, the Jet Propulsion Laboratory (JPL), and other Government agencies. Historically Black Colleges and Universities (HBCU), other minority universities (OMU), small disadvantaged businesses (SDB), veteran-owned small businesses, service disabled veteran-owned small businesses, HUBZone small businesses, and women-owned small businesses (WOSB) are encouraged to apply.

However, Appendices may identify specific eligibility limitations that apply to that opportunity.

3.1 Limitation on Number of Proposals per Organization

Unless Appendices specify additional information or provide limitations on the number of proposals that may be submitted by an organization, there is no restriction on the number of proposals that an organization may submit in response to an Appendix or on teaming arrangements for any one proposal. Each proposal must be a separate, stand-alone, complete document for evaluation purposes.

3.2 Other Eligibility Limitations

Proposing to more than one Appendix simultaneously or with overlapping timeframes is permitted, provided the proposed efforts are appropriate for the solicitations and the offeror can carry out all proposed efforts, if selected. Appendices may also identify other eligibility restrictions such as limitations on the number of proposals that a PI or key participant may submit.

3.3 Foreign Participation

Participation by eligible non-U.S. organizations is also permitted, but subject to NASA's policy of no-exchange-of-funds, in which each government supports its own national participants and accounts for associated costs (further information on foreign participation is provided in Section 1.6 of the *NASA Guidebook for Proposers*). NASA's policy is to conduct research with foreign entities on a cooperative, no-exchange-of-funds basis (see NPD 1360.2B, Initiation and Development of International Cooperation in Space and Aeronautics Programs, (<http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=1360&s=2B>)). Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of International and Interagency Relations will arrange with the sponsoring foreign agency

or funding/sponsoring institution for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding/sponsoring institution will each bear the cost of discharging their respective responsibilities.

For grants and cooperative agreements, NASA policy on research with foreign organizations is covered in 2 CFR 1800.3.

For contracts, NASA policy on research with foreign organizations is covered in paragraph (I) of NFS provision 1852.235-72, Instructions for Responding to NASA Research Announcements (<http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>).

NASA funding may not be used for subcontracted foreign research efforts. The direct purchase of supplies/services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted, subject to the provisions or terms of the award. However, subject to export control restrictions, a foreign national may receive remuneration through a NASA award for the conduct of research while employed either full or part time by a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*).

3.4 China Funding Restriction

Proposals must not include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of funds arrangement. Grant Information Circular 12-01A instructs NASA, when issuing new NASA Research Announcements, to add the “Assurance of Compliance – China Funding Restriction” to the current proposal requirements.

The FY 15 Omnibus Appropriations Act, Public Law 113-235 Section 532 states that:

(1) NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level and at all subrecipient levels, whether the bilateral involvement is funded or performed under a no exchange of funds arrangement.

(2) Definition: “China or Chinese-owned Company” means the People’s Republic of China, any company owned by the People’s Republic of China, or any company incorporated under the laws of the People’s Republic of China.

(3) The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.

(4) By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the

prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

NASA anticipates this restriction will be contained in future appropriation acts. Active Procurement Information Circular (PIC) 12-01A instructs Contracting Officers to add certification NFS 1852.225-72 entitled “Restriction on Funding Activity with China – Representation” as well as NFS clause 1852.225-71 entitled “Restriction on Funding Activity with China” in all contract awards.

4.0 PROPOSAL SUBMISSION INFORMATION

Some programs will use a one-step submission process while others may use a two-step submission process. Each Appendix will identify whether proposals will be requested, evaluated and selected through a one-step or two-step process and whether the resulting award will involve phases in accordance with NFS 1817.73, Phased Acquisition.

4.1 Introduction

All information needed to respond to Appendices issued in accordance with this solicitation is contained in this solicitation, the relevant Appendices and in the May 2014 edition of the *NASA Guidebook for Proposers*, located at <http://www.hq.nasa.gov/office/procurement/nraguidebook/>. Offerors are responsible for understanding and complying with the procedures in this Guidebook before preparing and submitting proposals. Proposals that do not conform to the standards outlined may be declared noncompliant and rejected without review. **Where this solicitation and the *NASA Guidebook for Proposers* are in conflict, this solicitation takes precedence. In addition, the provisions in any Appendix will apply to that specific opportunity and will supersede any conflicting provisions in this solicitation or in the *NASA Guidebook for Proposers*.**

4.2 Registration

In order to submit a proposal, all team members and their institutions must be registered in NASA’s proposal data system: NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) (<http://nspires.nasaprs.com>). **Therefore, every organization (including Co-I organizations, educational institutions, industry, not-for-profit institutions, the Jet Propulsion Laboratory, NASA Centers and other U.S. Government agencies) that intends to submit a proposal to NASA in response to this solicitation, whether submitting through Grants.gov or the NSPIRES system, must also be registered in NSPIRES.** Every organization that intends to submit a proposal through Grants.gov must be registered in both Grants.gov and NSPIRES. Details of the multi-step registration process, which takes about 3 business days (or up to four weeks if all steps are not completed in a timely manner) to register a new institution, are described in the Applicant User Guide. Go to

<http://www.grants.gov/web/grants/home.html> and search site content for Applicant User Guide.

Registration in NSPIRES cannot be accomplished until each applicable institution obtains a Data Universal Number (DUNS) and registers in the System for Award Management (SAM). Once the DUNS and SAM steps are complete, the institutions and each team member shall then register with NSPIRES and with Grants.gov, if that submission process will be used.

Offerors submitting proposals through Grants.gov:

Registration in NSPIRES is required in order to complete transfer of the Grants.gov proposal to NASA for review. Linking a team member's registration with their institution will automatically associate all required information (DUNS, CAGE, EIN) with the proposal.

Registration for either proposal submittal system must be performed by an organization's Authorized Organizational Representative (AOR). To identify the AOR, the PI should contact his or her Sponsored Research Office (SRO) or Electronic Business Point of Contact (E-Biz POC). The NSPIRES Help Desk can also determine who the AOR is from the SAM system. If an institution is not registered in the SAM database, then the point of contact from the Office of Sponsored Research or the E-Biz POC shall register it on the SAM webpage (<http://www.sam.gov>). See the Applicant User Guide referenced above.

No later than the due date for proposals, offerors are required to obtain:

- 1) An employee identification number (EIN) for the entity. The EIN number or Employer Identification is also commonly called the Tax Identification Number (TIN). Your TIN/EIN can be obtained from the IRS website.
- 2) A Data Universal Numbering System (DUNS) number: Information regarding obtaining a DUNS number may be found at <http://www.dnb.com/>.
- 3) A valid registration with the System for Award Management (SAM) [formerly known as the Central Contractor Registry (CCR)]: Information regarding SAM may be found at <https://www.sam.gov/portal/public/SAM/>.
- 4) A valid Commercial and Government Entity (CAGE) Code: Information regarding CAGE codes may be found at http://www.dlis.dla.mil/cage_welcome.asp.
- 5) A valid registration with NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

IMPORTANT NOTE: FORMER CCR REGISTRANTS

If your entity had an active record in CCR, then it has an active record in SAM. Your entity does not need to take any action with respect to SAM, unless a change in business circumstances requires updates to your entity's record(s) in order to be paid; to receive an award; or to renew your entity(s) prior to its expiration. SAM will send notifications to the registered user via email 60, 30, and 15 days prior to the entity's expiration. To update or renew your entity's records(s) in SAM, your entity is required to create a SAM User Account and link it to your entity's migrated records.

4.3 Content and Form of the Proposal Submission

4.3.1 *Electronic Proposal Submission*

All proposals submitted in response to this solicitation must be submitted in electronic form by the AOR at the proposing principal investigator's (PIs) organization who is authorized to make such a submission; electronic submission of the proposal by the AOR serves as the required original signature by an authorized official of the proposing organization. No hard copy of the proposal will be accepted. Proposals submitted via email or any means other than NSPIRES or grants.gov will also not be accepted.

Appendices to this solicitation will indicate whether offerors may submit proposals via one or both of the electronic proposal submission systems: NSPIRES (<http://nspires.nasaprs.com>) or via Grants.gov (<http://www.grants.gov>). Offerors submitting through Grants.gov must register in NSPIRES in order for proposals to be transferred by NASA to the NSPIRES system for review.

Offerors must not submit the same proposal to both electronic submission systems. Full instructions for submitting proposals using the NSPIRES system are provided in Attachment 3 and for submitting proposals using the Grants.gov system in Attachment 4.

Note carefully the following requirements for submission of a proposal regardless of the intent to submit via NSPIRES or Grants.gov.

- Any organization requesting NASA funds through the proposed project must be listed on the Proposal Cover Page. NASA will not fund organizations that do not appear on the Proposal Cover Page.
- Each individual team member (e.g., PI, co-investigators, collaborators), including all personnel named on the proposal's electronic cover page, must be individually registered and affiliated with their organization in NSPIRES. This registration requirement applies equally for proposals submitted via Grants.gov. Such individuals must perform the registration themselves; no one may register a second party, not even the PI of the proposal on which that person is committed to participate. Proposals that are submitted through Grants.gov may be deemed non-compliant and rejected without review if the above NSPIRES registration requirements are not completed prior to the proposal submission deadline identified in the relevant Appendix.
- Each individual team member (e.g., PI, co-investigators, collaborators), including all personnel named on the proposal's electronic cover page, must specify an organizational affiliation. The organizational affiliation specified on the cover page must be the organization through which the team member would work and receive funding while participating in the proposed effort. If the individual has multiple affiliations, then this organization may be different from the individual's

primary employer or preferred mailing address. Team members are asked to ensure that their contact information in NSPIRES is up-to-date. Changes can be made using the "Account Management" link on the "NSPIRES Options" page.

Submission of proposals via either NSPIRES or Grants.gov requires action by both the PI and the AOR. First, the PI must complete all required electronic forms, and upload the required PDF file(s). Second, the AOR must submit the electronic proposal on behalf of the PI. Coordination between the PI and his/her AOR on the final editing and submission of the proposal materials is facilitated through their respective accounts in NSPIRES and/or Grants.gov. Note that if one individual is acting in both the PI and AOR roles, he/she must ensure that all steps in the process are taken, including submitting the proposal from the organization.

Offerors should be sure to allow adequate time for coordination between the PI and AOR. Depending on the organization and its internal review process, this can take several days. The PIs are encouraged to begin this coordination at the outset of the proposal preparation.

The proposal submission process is complex and involves multiple steps to be carried out by all participants in the proposal. Therefore, offerors are strongly encouraged to familiarize themselves with the system and begin the submittal process early, well in advance of the deadline. While every effort is made to ensure the reliability and accessibility of submission systems and to provide a help center via e-mail and telephone, difficulties may arise at any point, including the user's own equipment. Difficulty in registering or using proposal submission systems (either NSPIRES or Grants.gov) is not a sufficient reason for NASA to consider a proposal submitted after the deadline.

4.3.2 Notice of Intent to Propose

Appendices will indicate whether a notice of intent (NOI) to propose is required for a particular opportunity. The information contained in an NOI is used to expedite the proposal review activities and is, therefore, of value to both NASA and the offeror. To be of maximum value, NOIs should be submitted to NSPIRES by the date given in each Appendix. Note that NOIs may be submitted within NSPIRES directly by the PI; no action by an organization's AOR is required to submit an NOI.

Within NSPIRES, space is provided for the PI to provide the following information:

- A short title of the anticipated proposal;
- A full title of the anticipated proposal (which should not exceed 254 characters and is of a nature that is understandable by a scientifically trained person);
- A brief description of the primary research area(s) and objective(s) of the anticipated investigation, including the NASA Technology Area most closely associated with the potential proposal. See the following website for additional information regarding NASA's Technology Area Breakdown:
(<http://www.nasa.gov/offices/oct/home/roadmaps/index.html>);

- The names of any Co-Investigators and/or Collaborators as may be known by the time the NOI is submitted. In order to enter such names, such team members must have previously accessed and registered in NSPIRES themselves; a PI cannot do this for them.

Grants.gov does not provide NOI capability; therefore, an NOI must be submitted via NSPIRES regardless of whether the proposal will be submitted via NSPIRES or Grants.gov. Interested offerors must register with NSPIRES before they can prepare an NOI; see Attachment 3 to this solicitation.

4.3.3 Proposal Format and Contents

All proposals submitted in response to this solicitation must include the appropriate required electronic forms available through either of the two proposal submission systems, NSPIRES or Grants.gov.

The required sections of the proposal must be submitted as one searchable, unlocked PDF file that is attached to the electronic submission using one of the proposal submission systems. Offerors must comply with the format and page limit requirements specified in the Appendices. **The provisions in each Appendix will apply to that specific opportunity and will supersede any conflicting provisions in this solicitation.**

Important note on creating PDF files for upload: It is essential that all PDF files generated and submitted by the offeror meet NASA requirements. This will ensure that the submitted files can be ingested by NSPIRES regardless of whether the proposal is submitted via NSPIRES. At a minimum, it is the responsibility of the offerors to: (1) ensure that all PDF files are unlocked and that edit permission is enabled – this is necessary to allow NSPIRES to concatenate submitted files into a single PDF document; and (2) ensure that all fonts are embedded in the PDF file and that only Type 1 or TrueType fonts are used. In addition, any offeror who creates files using TeX or LaTeX is required to first create a DVI file and then convert the DVI file to Postscript and then to PDF. See http://nspires.nasaprs.com/tutorials/PDF_Guidelines.pdf for more information on creating PDF documents that are compliant with NSPIRES. PDF files that do not meet NASA requirements may be declared noncompliant and may not be evaluated.

It is each offeror's responsibility to verify the accuracy and completeness of his/her proposal, including all text, figures, tables, and required forms. NSPIRES allows applicants to verify before submission that all information contained in proposal PDF file(s) being provided to NSPIRES is complete and accurate.

There is a 10MB file size limit for proposals (Section 2.3.1(c) of the *NASA Guidebook for Proposers*). In order to meet the 10 MB file size limit, you should crop and compress any embedded photos and graphic files to an appropriate size and resolution. Only

attachments that are specifically requested either in this solicitation or in Appendices to this solicitation should be submitted.

Requirements in the Appendices supersede any requirements in the *NASA Guidebook for Proposers* or in this solicitation.

4.3.4 Proposal Cover Page and Proposal Attachments

In general, each proposal shall include a *Proposal Cover Page* and a *Proposal Attachment* consisting of the technical/management section and all other required attachments. Instructions for completing the Proposal Cover Page are specific to the electronic proposal submission system used by the offeror (NSPIRES or Grants.gov). Offerors must also follow the instructions in each Appendix regarding proposal organization, proposal sections, required content, and page limits. *In some cases, not all sections will be required and there may be additional unique requirements.*

4.3.4.1. Proposal Cover Page

Additional information for completing the Proposal Cover Page:

Proposal Summary (Abstract):

Both electronic systems require a Proposal Summary suitable for release through a publicly accessible archive should the proposal be selected (per Section 2.3.3 of the *NASA Guidebook for Proposers*). The Proposal Summary should be concise, should not exceed 4000 characters in length, and should not contain any special characters, graphics or formatting (use text only). Note that, while Grants.gov does not impose a limit on the length of the proposal summary, it will be truncated to 4000 characters when the proposal is transmitted from Grants.gov to NSPIRES. Grants.gov users must use a writeable pdf form (downloadable from grants.gov) named ProposalSummary.pdf. This form restricts the Proposal Summary document to 4000 characters or less.

Budget:

Both electronic systems require budget figures on the Proposal Cover Page. Offerors need to include budget figures for all years of the proposed project on the Proposal Cover Page, including subawards and NASA team member costs. Offerors should refer to section 2.3.10 of the *NASA Guidebook for Proposers* and additional budget instructions provided in the relevant Appendix.

Program Specific Data (PSD):

This section consists of questions specific to the relevant Appendix. Responses to the PSD questions are required regardless of whether the proposal is submitted through NSPIRES or Grants.gov. NSPIRES will automatically prompt the offeror to answer the PSD questions prior to submission. Grants.gov submissions are required to include the NASA Program Specific Data (PSD) form. Grants.gov submissions that do not include the NASA PSD form may be deemed non-compliant and rejected without review.

Proposal Team:

Each team member (e.g., PI, co-investigators, collaborators, graduate, undergraduate students, consultants, postdoctoral associates, support staff, etc.) must register him/herself in NSPIRES and complete all the required information. Each individual team member must also be included on the proposal's electronic cover page. The organizational affiliation specified on the cover page must be the organization through which the team member would work and receive funding while participating in the proposed effort. If the individual has multiple affiliations, then this organization may be different from the individual's primary employer or preferred mailing address. Team members are asked to ensure that their contact information in NSPIRES is up-to-date. Changes can be made using the "Account Management" link on the "NSPIRES Options" page.

Required Certifications:

In order to submit a proposal, the AOR of the proposing organization must read the "Certification of Compliance with Applicable Executive Orders and U.S. Code" and click the checkbox to accept the certifications. Attachment 5 to this solicitation contains additional applicable certifications, assurances and representations that are not referenced on the Proposal Cover Page. The AOR's signature on the Proposal Cover Page automatically certifies that the proposing organization has read and is in compliance with all the certifications identified in Attachment 5.

4.3.4.2. Proposal Attachments:

Proposal Attachment instructions will be provided in each Appendix released under this solicitation.

4.3.5 *Additional Cost Proposal/Budget Guidelines:*

During the evaluation of proposals submitted under this solicitation, NASA will show all of the proposal data, including cost data, to peer reviewers. Peer reviewers may be from within or outside the Government but will be required to certify that they have no financial interest in the outcome of the review. Offerors should include all relevant details in this Cost Proposal section and should not upload a separate budget document. The Cost Proposal section does not count against the proposal page limit but it should be of a reasonable length.

Proposals with NASA civil servant team members: Proposals that include NASA civil servant team members must include civil servant fully burdened labor costs (and will be evaluated with civil servant labor costs) in its detailed cost breakdown. Offerors are required to enter the NASA civil servant team member names and fraction of full-time equivalent (FTE) involvement. The funds requested for each NASA civil servant team member should include salary, fringe, materials, travel, etc. and include a Total Requested Funds for the NASA civil servant team members. This budget entry should be made for each NASA civil servant involved, and is in addition to the agency identification on the Proposal Cover Page under the Team Member Information (Section

VI) and the NASA civil servant FTE designation under the NASA Civil Servant Project Personnel information (Section VIII). NOTE: Proposal budgets from NASA Centers must include all costs that will be paid out of resulting awards.

Since NASA funding sent to NASA Centers must be obligated in the same fiscal year (FY) in which they are received, proposals submitted by NASA Centers (except JPL) should begin the budget section of the proposal with a breakdown of funding by NASA Center and by fiscal year.

Principal Investigators from JPL should not include the JPL fixed fee in the total requested amount, nor should the budgets of JPL Co-Investigators on proposals from other institutions include the JPL fixed fee in their total requested amount. The total requested amount is the amount that shows on the NSPIRES online (cover page) budget form or the Grants.gov standard budget form. JPL fixed fees are paid for and accounted for by a different mechanism than the mechanism used to fund research projects. JPL proposers and Co-Investigators may include the fixed fee for informational purposes in their budget narratives and detailed budgets.

Non-NASA U.S. Government organizations proposing as team members should propose based on full-cost accounting unless no such standards are in effect; in that case such offerors should follow the Managerial Cost Accounting Standards for the Federal Government, as recommended by the Federal Accounting Standards Advisory Board (for further information, see <http://www.hq.nasa.gov/fullcost>). Proposal budgets must include all costs that will be paid through the resulting award.

Allowable costs for contract awards are covered in Part 31 of the FAR, located at <https://www.acquisition.gov/far/index.html> and part 1831 of the NASA FAR Supplement (NFS), located at <http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>. Pre-contract costs are covered in FAR 31.109, and NFS 1852.231-70.

Certified Cost or Pricing Data: Certificate of Current Cost or Pricing Data (FAR 15.406-2) will be required after negotiations and before award of a contract when the cost proposal exceeds \$700,000. The requirements for certified cost or pricing data will be in accordance with FAR 15.403-4.

Allowable costs for grant and cooperative agreement awards with universities, hospitals, and other nonprofit organizations and awards with commercial firms that do not involve cost-sharing are covered in 2 CFR 200 Subpart E – COST PRINCIPLES. Pre-award costs are covered in 2 CFR 200.209 and 2 CFR 1800.209.

Allowable costs for grant and cooperative agreement awards with commercial firms involving cost sharing are covered in 14 CFR 1274.204. Pre-award costs are covered in FAR 31.109 and NFS 1831.205-32

4.3.6 Proposal Funding Restrictions

In addition to the funding restrictions and requirements given in the NASA Guidebook for Proposers, 2 CFR 200, 2 CFR 1800, 14 CFR 1274 and the GCAM, the following restrictions are applicable to this solicitation:

- The estimated funding and number of proposals anticipated to be funded are subject to the availability of appropriated funds, as well as the submission of a sufficient number of proposals of adequate merit.
- It is not anticipated that this solicitation will require the construction of facilities (i.e., buildings, structures, or other real property). However, if new or modified facilities are required to further the technology, the offerors shall clearly state the rationale. For further information on allowable costs, refer to the cost principles cited 2 CFR 200 Subpart E – COST PRINCIPLES or FAR Part 31 and NFS Part 1831 depending on whether a grant/cooperative agreement or contract will be the resulting award instrument.
- U.S. award recipients may directly purchase supplies and/or services that do not constitute research from non-U.S. sources, but award funds may not be used to fund research carried out by non-U.S. organizations. However, subject to export control restrictions, a foreign national may receive remuneration through a NASA award for the conduct of research while employed either full or part time by a U.S. organization (see Section 1.6 of the *NASA Guidebook for Proposers*).
- Typically travel, including foreign travel, is allowed as may be necessary for the meaningful completion of the proposed investigation, as well as for publicizing its results at appropriate professional meetings.
- Profit for commercial firms is not allowable under grant or cooperative agreement awards but is allowable under contract awards.

4.3.7 International Space Station (ISS) Research, Development, Demonstration Opportunities

The ISS provides proposers with a national laboratory resource with unique environments for the development of space technologies.

Although ISS utilization is not required, if the offeror proposes to use ISS, the following guidance is provided.

The ISS program provides transportation to the ISS and standard experiment integration activities free of charge to approved, sponsored technology development investigations. For submissions proposing to utilize the ISS or its commercial launch assets please contact the ISS Research Integration Office to obtain a letter of feasibility.

For STMD, Advanced Exploration Systems (AES), or general engineering research, development, or demonstration proposals, the point of contact is:

Dr. George Nelson
Manager, ISS Technology Demonstration Office
281.244.8514
george.nelson-1@nasa.gov

4.4 Proposal Submission Dates, Time, and Location

For each opportunity described in the Appendices to this solicitation, the electronic proposal must be submitted in its entirety by an AOR, **no later than 5:00 p.m. Eastern Time** on the appropriate proposal due date given in the respective Appendix. During the final hours before the submission deadline, offerors may experience server/connection congestion. Therefore, offerors are urged to familiarize themselves with the submission system(s), ensure they are registered in NSPIRES (even if offerors are submitting through Grants.gov), and begin the submission process early. **Offerors are strongly encouraged to submit proposals at least 48 hours in advance of submission deadline.**

Proposals submitted after the proposal deadline on the proposal due date will be considered late and may be rejected without review. Late proposals will be handled in accordance with NASA's policy given in section (g) of NFS clause 1852.235-72 "Instructions for Responding to NRAs". Offerors should also keep in mind that the NSPIRES Help Desk is not staffed after 6:00 p.m. Eastern Time and the Grants.gov customer support contact center is not staffed after 9:00 p.m. Eastern Time.

4.5 Use and Disclosure of Proposal Information

Except as provided below, information contained in proposals is used for evaluation purposes only and will be protected to the extent permitted by law. In order to maximize protection of trade secrets or other information that are confidential or privileged, proposers should identify such information in their proposals.

For selected proposals, NASA requires the Proposal Title, the Principal Investigator's name and organization, the Proposal Summary and the one-page summary/overview chart to be publishable and submission of a proposal constitutes consent to publication of that information on an appropriate publicly accessible location. Offerors should draft their Proposal Summaries and one-page summary/overview charts in anticipation of public disclosure. Offerors are free, but not required by NASA, to release any additional information about their proposals. NASA considers other sections of proposals to be proprietary and, therefore, does not release these sections of successful proposals to the public without prior consultation with the offerors.

4.6 Conflict of Interest Check Information

The integrity of the peer review process is of utmost importance to STMD. The peer review process will be conducted in accordance with STMD's Organizational Conflict of Interest (OCI) Mitigation Plan and Appendix C.4 of the *NASA Guidebook for Proposers*. In order to ensure that all proposal evaluations are conducted as fairly and equitably as possible, it is important to ascertain whether prospective reviewers may have conflicts of interest that might affect their impartiality.

To facilitate the process of identifying potential conflicts of interest, it is necessary to collect information about the organizations participating in each proposal. Information provided in the NSPIRES Cover Sheet will be used to collect this information. Offerors using Grants.gov should ensure that all information requested in the Grants.Gov response structure is provided. Failure to submit the required information may result in the proposal being deemed nonresponsive to the solicitation.

5.0 PROPOSAL REVIEW INFORMATION

5.1 Compliance Review

NASA will prescreen all proposals for compliance with requirements of this solicitation and its subsequent Appendices. This includes:

- Submission of a complete proposal with all required elements.
- Submission of a proposal from an eligible offeror as specified in the Eligibility Information in this solicitation and relevant Appendix.
- Submission of a budget that includes details of any subawards and that is for a funding period consistent with this NRA.
- Submission of a proposal that is consistent with the page limitations and formatting guidelines specified in this NRA.

Non-compliant proposals will not be further considered.

5.2 Evaluation Criteria

The evaluation criteria described in Section C.2 of the *NASA Guidebook for Proposers* are superseded by the evaluation criteria described below:

- Relevance to NASA's Objectives
- Technical Approach
- Management Approach
- Cost

The Appendices will provide additional information regarding the evaluation criteria and may contain additional or tailored evaluation criteria. The relative weightings for each evaluation criterion will also be provided in the Appendices. If any

criteria in the Appendices conflict with any other part of this umbrella solicitation, the criteria identified in the Appendices will take precedence.

Offerors are cautioned that their proposals will be evaluated based upon the contents of their proposal, which must be responsive to the requirements for proposal submission set forth in Section 4 above and in the relevant Appendix.

A panel of subject matter experts (SME) will be used to assess each proposal against the evaluation criteria. This panel of experts may include non-NASA and other non-Government personnel. The SMEs may also express opinions on the perceived programmatic relevancy and cost reasonableness of a proposal in light of its technical content.

Evaluation of the proposed cost may also include the realism and reasonableness of the proposed cost and comparison to available funds. Offerors must follow the budget format requirements provided in Section 2.3.10 of the *NASA Guidebook for Proposers* and additional budget format requirements provided in the relevant Appendix.

The selection official may take portfolio balance and other program related factors into account when selecting proposals for funding. Cost-sharing is generally not considered a part of the evaluation. However, funding contribution may become a factor at the time of selection when deciding between proposals of otherwise equal technical merit.

5.3 Review and Selection Processes

Review of proposals submitted in response to this solicitation will be consistent with the general policies and provisions described in Appendix C.1, C.3, and C.4 of the *NASA Guidebook for Proposers*. Unless otherwise specified in the relevant Appendix, selection procedures will be consistent with the procedures identified in Appendix C.5 of the *NASA Guidebook for Proposers*. Unless otherwise specified in the relevant Appendix, the STMD Associate Administrator will be the Selection Official. The Selection Official may take portfolio balance and other programmatic considerations into account when making final selections.

5.4 Partial Awards and Participation with Others

NASA may elect to offer selection of only a portion of a proposed project, usually at a level of support reduced from that requested in the original proposal or may also offer tentative selections in which NASA requests offerors to team in a joint project. Additionally, NASA may decide to award an effort for less than the full period of the proposal. Offerors will be given the opportunity to accept or decline such selection. If the offeror accepts such an offer, a revised budget and statement of work may be required before funding action on the proposal can be initiated. If the offeror declines the offer of a partial selection, or participation in a joint project, NASA may withdraw the offer of selection in its entirety.

5.5 Selection Announcement and Award Dates

NASA's goal is to announce selections as soon as possible. However, NASA does not usually announce new selections until the funds needed for those awards are approved through the Federal budget process. Therefore, a delay in the budget process for NASA usually results in a delay of the selection date. By submitting a proposal, the offeror acknowledges that the proposal is valid for no less than 6 months from submission.

In order to announce selection decisions as soon as is practical, even in the presence of budget uncertainties, the Selection Official may decide to defer selection decisions on some proposals while making selection decisions on others. If a Selection Official uses this option, then proposals will be categorized as selected, not selected, or "not selected at this time." Proposals that are "not selected at this time" may be considered for a supplemental selection when circumstances allow. All offerors whose proposals are "not selected at this time" will eventually be notified whether their proposal is selected through a supplemental selection or is no longer being considered for a supplemental selection.

All offerors will be notified via electronic mail sent by NSPIRES and offered a debriefing that is consistent with the policy in Appendix C.5.3 and C.6 of the *NASA Guidebook for Proposers* and information in the relevant Appendix, if applicable.

5.6 Process for Appeals

5.6.1 *Ombudsman Program*

The NASA Procurement Ombudsman Program is available under this solicitation as a procedure for addressing concerns and disagreements. The clause at NASA FAR Supplement (NFS) 1852.215-84 ("Ombudsman") is incorporated into this solicitation.

The cognizant ombudsman is:

Ronald A. Poussard
Director, **Contracts and Grants Policy Division**
Office of Procurement
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-0445
Fax: 202-358-3083
Email: ronald.a.poussard@nasa.gov

5.6.2 *Protests*

Only prospective offerors seeking contract awards are subject to bid protest, either at the Government Accountability Office (GAO) or with the Agency, as defined in FAR

33.101. The provisions at FAR 52.233-2 (“Service of Protest”) and NFS 1852.233-70 (“Protests to NASA”) are incorporated into this solicitation. Under both of these provisions, the designated official for receipt of protests to the Agency and copies of protests filed with the GAO is:

William P. McNally
Assistant Administrator for Procurement
Office of Procurement
NASA Headquarters
Washington, DC 20546
Telephone: 202-358-2090
Fax: 202-358-3082
Email: William.P.McNally@nasa.gov

6.0 AWARD ADMINISTRATION INFORMATION

6.1 Notice of Award

Notification of both the selected, as well as the non-selected proposals will be consistent with the policy given in Appendix C.5.3 and C.6 of the NASA Guidebook for Proposers. For selected proposals, a NASA Awards Officer, who is the only official authorized to obligate the Government, will contact the offeror’s business office. For a grant or cooperative agreement, any costs incurred by the offeror in anticipation of an award will be subject to 2 CFR 1800.209 “Pre-award Costs”.

6.2 Administrative and National Policy Requirements

This solicitation does not invoke any special administrative or national policy requirements, nor do the awards that will be made involve any special terms and conditions that differ from NASA’s general terms and conditions as given in the FAR, NASA FAR Supplement, 2 CFR 1800 Appendix B, and the NASA Guidebook for Proposers. Please note that it is expected that offerors will comply with Homeland Security Presidential Directive/ HSPD-12. HSPD-12 applicability will be determined during negotiation for award for selected proposals.

7.0 POINTS OF CONTACT FOR FURTHER INFORMATION

General questions and comments about this solicitation may be directed in writing to:

Bonnie F. James
Senior Investment Strategist
Space Technology Mission Directorate
NASA Headquarters
[Email: HQ-STMD-SpaceTech-REDDI@mail.nasa.gov](mailto:HQ-STMD-SpaceTech-REDDI@mail.nasa.gov)

Note: Proposals shall not be submitted to this email address or point of contact. Proposals shall be submitted electronically as described in Section 4.0 above and in the relevant Appendix.

Specific questions about a given Appendix should be directed to the specific point(s) of contact designated in the relevant Appendix.

No communication concerning this solicitation may be made to any NASA official other than those specifically listed in this solicitation and in the Appendices. All questions shall be submitted via email as indicated above. Telephone requests will not be accepted.

Inquiries about accessing or using the NASA proposal database located at <http://nspires.nasaprs.com> should be submitted via an e-mail message that includes a telephone number to nspires-help@nasaprs.com or by calling (202) 479-9376. This Help Center is staffed Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

Inquiries about accessing or using Grants.gov located at <http://www.grants.gov> should be directed by an e-mail to support@grants.gov or by calling (800) 518-4726. This customer support contact center is staffed Monday through Friday, 7:00 a.m. – 9:00 p.m. Eastern Time.

8.0 ANCILLARY INFORMATION

8.1 Announcement of Updates/Amendments to Solicitation

Amendments will be posted on the SpaceTech-REDDI-2015 NSPIRES page, which can be found at <http://solicitation.nasaprs.com/> (or by going to <http://nspires.nasaprs.com>, selecting "Solicitations", then "Open Solicitations", then "NNH15ZOA001N"). NASA STMD will also send an electronic notification of any such amendments to all subscribers of its electronic notification system (see Section 8.2 below), it is the responsibility of the prospective offeror to check this solicitation's NSPIRES page for updates concerning the program(s) of interest.

Any clarifications or questions and answers that are published will be posted on the relevant program's Appendix NSPIRES page at <http://nspires.nasaprs.com> (select "Solicitations", then "Open Solicitations", then "NNH15ZOA001N", then "List of Open Program Elements", and finally the relevant Appendix).

8.2 Electronic Notification of NASA Solicitations

NASA Headquarters maintains an electronic notification system to alert interested parties of program announcements. Subscription to this service is free to all registered users of the NASA proposal data base system at <http://nspires.nasaprs.com/>. To add or change a subscription to the electronic notification system, users should login to the data base system and select "Account Management", then "Email Subscriptions."

This e-mail service will notify all subscribers of:

- (1) All NASA Headquarters research program solicitations (within a given Directorate)
- (2) Amendments to those solicitations
- (3) Special information that NASA Headquarters wishes to communicate to those interested in proposing.

Regardless of whether or not this service is used, all NASA Headquarters research announcements and amendments may be accessed at <http://nspires.nasaprs.com/> (select "Solicitations" then "Open Solicitations") as soon as they are posted .

9.0 REFERENCES

NASA Strategic Plan: <http://www.nasa.gov/about/budget/index.html>.

NASA Space Technology Mission Directorate information is available at: <http://www.nasa.gov/directorates/spacetech/home/index.html>.

Guidebook for Proposers Responding to a NASA Research Announcement (NRA) or Cooperative Agreement Notice (CAN), May 2014 Edition, is available online at the following address: <http://www.hq.nasa.gov/office/procurement/nraguidebook/>.

Federal Acquisition Regulation (FAR) is available online at the following address: <http://www.acquisition.gov/far/index.html> or <http://farsite.hill.af.mil/>.

NASA Federal Acquisition Regulations Supplement (NFS) is available online at the following address: <http://www.hq.nasa.gov/office/procurement/regs/nfstocA.htm>.

48 CFR 1852.235-72, Instructions for Responding to NASA Research Announcements is available online at the following address: http://www.ecfr.gov/cgi-bin/text-idx?SID=406e676673b2f2ddf3520d74f5f4192d&node=pt48.6.1852&rgn=div5#se48.6.1852_1235_672.

NASA Grants and Cooperative Agreement Manual is available online at the following address: https://prod.nais.nasa.gov/cgi-bin/nais/nasa_ref.cgi.

NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES), is available online at the following address: <http://nspires.nasaprs.com>.

Grants.gov electronic proposal submission system is available online at the following address: <http://grants.gov>.

Attachment 1 - Acronym List

Acronym	Description
AFRC	NASA Armstrong Flight Research Center, Edwards, CA
AOR	Authorized Organizational Representative
ARC	NASA Ames Research Center, Moffett Field, CA
ATP	Authority to Proceed
BAA	Broad Agency Announcement
CFR	Code of Federal Regulations
CIF	Center Innovation Fund
CO	Contracting Officer
CO-I	Co-Investigator
COM	Cost of Money
DoD	Department of Defense
DUNS	Data Universal Numbering System
EAR	Export Administration Regulations
EEE	Electrical, Electronic, and Electromechanical
EMI/EMC	Electromagnetic Interference/Electromagnetic Compatibility
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
FOP	Flight Opportunities Program
FRR	Flight Readiness Review
FTE	Full Time Equivalent
FY	Fiscal Year (October to September)
G&A	General and Administrative
GAO	General Accounting Office
GCAM	Grants and Cooperative Agreements Manual
GCD	Game Changing Development
GOLD	Governance of Labor Distribution
GRC	NASA Glenn Research Center, Cleveland, OH
GSFC	NASA Goddard Space Flight Center, Greenbelt, MD
HBCU	Historically Black Colleges and Universities

H/W	Hardware
I&T	Integration and Test
ISP	Specific Impulse
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation
JPL	NASA Jet Propulsion Laboratory, Pasadena, CA
JSC	NASA Johnson Space Center, Houston, TX
KSC	NASA Kennedy Space Center, FL
LaRC	NASA Langley Research Center, Hampton, VA
LLIL	Limited Life Items List
MCR	Mission Concept Review
MDR	Mission Definition Review
MSFC	NASA Marshall Space Flight Center, Huntsville AL
NAICS	North American Industry Classification System
NASA	National Aeronautics and Space Administration
NIAC	NASA Innovative Advanced Concepts
NID	NASA Interim Directive
NFS	NASA FAR Supplement
NOI	Notice of Intent
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRA	NASA Research Announcement
NSPIRES	NASA Solicitation and Proposal Integrated Review and Evaluation System
OCT	Office of the Chief Technologist
OMU	Other Minority University
ORR	Operational Readiness Review
PDF	Portable Document Format
PDR	Preliminary Design Review
PI	Principal Investigator
PM	Project Manager
PRA	Probabilistic Risk Assessment
QA	Quality Assurance
RCS	Reaction Control System
RFA	Requests for Action

RID	Review Item Discrepancy
SBIR/STTR	Small Business Innovative Research (SBIR)/Small Business Technology Transfer (STTR)
SDB	Small Disadvantaged Business
S&MA	Safety and Mission Assurance
S/W	Software
SDP	Software Development Plan
SDR	System Definition Review
SI	International System of Units
SOW	Statement of Work
SSTP	Small Spacecraft Technology Program (SSTP)
STRG	Space Technology Research Grants
TDM	Technology Demonstration Missions
TRL	Technology Readiness Level
UARC	University Affiliated Research Center
V&V	Verification and Validation
WBS	Work Breakdown Structure
WOSB	Woman Owned Small Business

Attachment 2 - Technology Readiness Level (TRL) Descriptions

The Technology Readiness Level describes the stage of maturity in the development process from observation of basic principles through final product operation. The exit criteria for each level documents that principles, concepts, applications or performance have been satisfactorily demonstrated in the appropriate environment required for that level.

Refer to NPR 7123.1B for NASA Technology Readiness Level (TRL) descriptions. The TRL descriptions can found by following the link:

http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7123_001B_&page_name=AppendixE&search_term=7123.1b

In any case of conflict between NASA directives concerning TRL definitions, NPR 7123.1B will take precedence.

Attachment 3 - Submission of Proposals via NSPIRES

Proposals may be submitted electronically via NASA's master proposal data base system, the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES). In order to submit a proposal via NSPIRES, this solicitation requires that the offeror register key data concerning the intended submission with NSPIRES at <http://nspires.nasaprs.com>. Potential applicants are urged to access this site well in advance of the NOI and proposal due date(s) of interest to familiarize themselves with its structure and enter the requested identifier information.

It is especially important to note that every individual named on the proposal's electronic *Cover Page* form (see below) as a proposing team member in any role, including co-investigators and collaborators, must be individually registered in NSPIRES and that such individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. It is also important to note that every named individual must be identified with the organization through which they are participating in the proposal, regardless of their place of permanent employment or preferred mailing address. This data site is secure and all information entered is for NASA's use only. Offerors are reminded that peer reviewers performing the evaluation of proposals may be non-Government personnel (see Section 4.6 above).

Every individual identified on the NSPIRES proposal cover page as a team member must indicate their commitment to the proposed work through NSPIRES prior to proposal cover page submission. In addition, team members must confirm the organization through which they are participating in this proposal by requesting an affiliation with their organization in NSPIRES. An AOR with the organization must then login to NSPIRES and approve this affiliation request.

Each team member will receive an email from NSPIRES indicating that he/she has been added to the proposal and should log in to NSPIRES.

- Once logged in, the team member should follow the link in the "Reminders and Notifications" section of his NSPIRES homepage, titled "Need Co-I and/or Collaborator Statement of Commitment For: Proposal to Solicitation <<solicitation number>>." On the "Team Member Statement of Commitment - Confirmation" page, the team member should read the commitment language, click the "Accept" button, and then click "OK".
- PI's may monitor the status of team member commitments by examining the "Commitment Confirmed" column on the Team Member page of the NSPIRES proposal cover page record.

All proposals submitted via NSPIRES in response to this solicitation and Appendices issued under this solicitation must include a required electronic *Cover Page* form that is

accessed at <http://nspires.nasaprs.com>. This form is comprised of several distinct sections:

- *Applicant and Proposing Organization Information* that contains the identifier information for the proposing institution and personnel;
- *Proposal Summary* that provides an overview of the proposed project suitable for release through a publicly accessible archive should the proposal be selected;
- *Budget Data* that provides the proposed start and end dates, as well as other proposal characteristics and a budget summary;
- *Program Specific Data* that includes required questions specific to this solicitation and Appendix; and
- *Proposal Team* that provides the co-investigators and other participants in the proposal.

This *Cover Page* form is available for access and submission starting at the solicitation/Appendix release date and remains open until the proposal due date. Unless specified in an Appendix to this solicitation, no other forms are required for proposal submission via NSPIRES. See the *NASA Guidebook for Proposers*, Sections 2 and 3 for further details.

The required elements of a proposal submitted in response to an Appendix to this solicitation must be submitted as a single, searchable, unlocked PDF document that is attached to the Cover Page using the tools in NSPIRES. The PDF document shall contain the complete proposal, including all components listed in the Appendix to which the offeror is responding. All required information and permitted attachments must be included in the PDF file and should not be uploaded as separate attachments, unless specified otherwise in the relevant Appendix. Documents such as the team member biographical sketches, letters of commitment, and current and pending support should not be uploaded to NSPIRES as separate files.

NSPIRES will provide a list of all elements that make up an electronic proposal, and after clicking the “Check Elements” button, the system will conduct an element check to identify any item(s) that is (are) apparently missing or incomplete. NSPIRES will also generate error and warning messages as part of the element check concerning possibly missing data. An error (designated by a red “X”) will preclude proposal submission to NASA by the AOR. A warning (indicated by an exclamation mark “!” on a yellow field) is an indication that data may be missing; a warning can be ignored after verifying that the material is included in the single attachment containing the complete proposal. Any actions taken because of warnings are at the PI's discretion. It is the offeror's responsibility to ensure that the proposal is complete and includes all required components upon submission.

It is unnecessary to download the Proposal Cover Page and incorporate it into the Proposal Document. NSPIRES will automatically combine the two parts of the proposal (*Cover Page* form and *Proposal Attachment*) for the reviewers.

Offerors are encouraged to begin their submission process early. Tutorials and other NSPIRES help topics may be accessed through the NSPIRES online help site at <http://nspires.nasaprs.com/external/help.do>. For any questions that cannot be resolved with the available on-line help menus, requests for assistance may be directed to the NSPIRES Help Desk by e-mail to nspires-help@nasaprs.com or by telephone to (202) 479-9376, Monday through Friday, 8:00 a.m. – 6:00 p.m. Eastern Time.

Attachment 4 - Submission of Proposals via Grants.gov

Grants.gov allows organizations to electronically find and apply for competitive grant opportunities from all Federal grant-making agencies; it provides a single access point for over 1000 grant programs offered by the 26 Federal grant-making agencies. The U.S. Department of Health and Human Services is the managing partner for Grants.gov.

In order to submit a proposal via Grants.gov, Grants.gov requires that the PI download an application package from Grants.gov. Identifying the appropriate application package requires the funding opportunity number which may be found on the Cover Page of each Appendix. Proposals submitted via Grants.gov must be submitted by the AOR.

Submitting a proposal via Grants.gov requires the following steps:

- Grant researchers do NOT need to register with Grants.gov. However, every individual named in the proposal as a proposing team member in any role, including PI, co-investigators and other team members must be registered in NSPIRES (<http://nspires.nasaprs.com>) and those individuals must perform this registration themselves; no one may register a second party, even the PI of a proposal in which that person is committed to participate. This data site is secure and all information entered is strictly for NASA's use only. However, offerors are reminded that peer reviewers performing the evaluation of proposals may be non-Government personnel (see Section 4.6 above).
- All team members must be affiliated with their organizations in NSPIRES. Each proposed team member's organization must be registered in NSPIRES.
- Follow Grants.gov instructions provided at the website to download any software tools or applications required to submit to Grants.gov.
- Download the application package from Grants.gov by selecting "Download grant application packages" under "Apply for Grants" at <http://www.grants.gov>. Each program element described in an Appendix to this solicitation requires a different application package and has a different Funding Opportunity Number; the Funding Opportunity Number may be found on the Cover Page of each Appendix. Enter the appropriate Funding Opportunity Number (e.g. "NNH15ZOA001N-XX") to retrieve the desired application package. All NASA application packages may be found by searching on CFDA Number 43.009.
- Complete the required Grants.gov forms including the SF424 Application for Federal Assistance, Research and Research-Related (R&R) Other Project Information, R&R Senior/Key Person Profile, and R&R Budget. Every named individual must be identified with the organization through which they are participating in the proposal, regardless of their place of permanent employment or preferred mailing address.
- Complete the required NASA specific forms: NASA Other Project Information, NASA Principal Investigator and Authorized Representative Supplemental Data Sheet, and NASA Senior/Key Person Supplemental Data Sheet (this form is only required if there are Senior/Key Persons other than the PI).

- Complete the NASA program-specific data (PSD) form that is required for the specific Appendix. This form is included as a PDF form within the proposal application package downloaded from Grants.gov
- Create a proposal in a single PDF including the technical and management section and all other required proposal sections as identified in the relevant Appendix (also see Section 2 of the *NASA Guidebook for Proposers*). In addition, as prompted by grants.gov, upload sections as separate PDF documents.
- Because Grants.gov does not support the electronic commitment of team members, statements of commitment from all team members must be provided as letters attached to the proposal application at the place(s) specified by Grants.gov. This statement must include confirmation of both the team member role in the proposed effort (e.g., Co-Investigator, collaborator) and the identification of the organization through which the team member will be participating. Here is an example statement of commitment:
 - "I acknowledge that I am identified by name as <<role>> to the investigation, entitled <<name of proposal>>, that is submitted by <<name of Principal Investigator>> to the NASA Research Announcement <<alpha-numeric identifier>>, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, my participating organization is <<insert name of organization>>"
- Submit the proposal via the AOR; the proposal PI may not submit the application to Grants.gov unless he/she is an AOR.

Potential applicants are urged to access Grants.gov site well in advance of the proposal due date(s) of interest to familiarize themselves with its structure and download the appropriate application packages and tools.

Additional instructions for formatting and submitting proposals via Grants.gov may be found in Sections 2 and 3 of the *NASA Guidebook for Proposers*. Instructions for the use of Grants.gov may be found in the Grants.gov User Guide at <http://www.grants.gov/web/grants/home.html> and searching under Site Content for User Guide. Instructions for NASA-specific forms and NASA program-specific data forms may be found in the application package. These NASA program-specific data forms are required, and failure to properly include them may result in the proposal being deemed unacceptable. For any questions that cannot be resolved with the available on-line help menus and documentation, requests for assistance may be directed by e-mail to support@grants.gov or by telephone to (800) 518-4726, Monday through Friday, 7:00 a.m. – 9:00 p.m. Eastern Time.

Attachment 5 – Summary of Certifications, Assurances and Representations

Following is a summary of the required certifications, assurances and representations. For additional information, see Appendix E to the *NASA Guidebook for Proposers* (<http://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2014.pdf>):

- *Appendix E.1.1 Certification of Compliance on Proposal Cover Page
- *Appendix E.1.2 Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs (each award)
- *Appendix E.1.3 Certification Regarding Lobbying (awards over \$100,000)
- *Appendix E.1.4 Certification Regarding Debarment, Suspension, and Other Responsibility Matters (each award)
- **Appendix E.1.5 Assurance and Representation on China restrictions set out in section 532 of PL 113-235 (each award)
- **Appendix E.1.6 Certification of Tax Compliance as provided in section 523 of PL 113-235 (awards over \$5M)
- **Appendix E.1.7 Certification regarding Association of Community Organizations for Reform Now (ACORN) or its subsidiaries is hereby deleted in its entirety.
- **Appendix E.1.8 Representation regarding corporate felony convictions as provided in section 745 of PL 113-235: (each corporate award)
- **Appendix E.1.9 Representation regarding unpaid corporate tax liabilities as provided in section 523 and 744 of PL 113-235 (each corporate award)
- **Appendix E.1.10 Representation regarding Whistleblower Protection as provided in section 743 of PL 113-235 (each award)
- **Assurance of Compliance - China Funding Restriction”:

Notes:

*Referenced on the NSPIRES Proposal Cover Page.

** Proposal Cover Page has not been updated to add these certifications, therefore they are summarized below:

Following are Certifications E.1.5 to E.1.9 and “Assurance of Compliance - China Funding Restriction”:

E.1.5 Assurance and Representation on China restrictions set out in section 532 of PL 113-235:

By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

E.1.6 Certification of Tax Compliance as provided in section 523 of PL 113-235:

Proposer certifies it has filed the Federal tax returns required during the three years preceding this certification, has not been convicted of a criminal offense under the Internal revenue Code of 1986, and has not, more than 90 days prior to certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

E.1.7 Certification regarding Association of Community Organizations for Reform Now (ACORN) or its subsidiaries as provided in section 523 of PL 113-235:

The prospective recipient represents, by submission of its offer, that it is not the Association of Community Organizations for Reform Now (ACORN) or a subsidiary thereof, and that no funds made available under this award will be distributed to ACORN or its subsidiaries.

E.1.8 Representation regarding corporate felony convictions as provided in section 745 of PL 113-235:

If a corporation, the prospective recipient represents that it has not been convicted, or had an officer or agent acting on behalf of the corporation convicted, of a felony criminal violation under a Federal law within the preceding 24 months.

E.1.9 Representation regarding unpaid corporate tax liabilities as provided in section 523 and 744 of PL 113-235:

If a corporation, the prospective recipient represents that it has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; unless an agency has considered suspension or debarment of the corporation and made a

determination that this further action is not necessary to protect the interests of the Government.

E.1.10 Representation Regarding Whistleblower Protection as provided in section 743 of PL 113-235:

A corporation or prospective recipient represents that employees or contractors of such entity seeking to report fraud, waste, or abuse are NOT required to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contractors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

ASSURANCE OF COMPLIANCE – CHINA FUNDING RESTRICTION

An Assurance of Compliance with The Department of Defense and Full-Year Appropriation Act, **Public Law 113-235 Section 532**; and future-year appropriations herein after referred to as “the Acts”, whereas:

(1) NASA is restricted from using funds appropriated in the Acts to enter into or fund any grant or cooperative agreement of any kind to participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level and at all subrecipient levels, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

(2) Definition: “China or Chinese-owned Company” means the People’s Republic of China, any company owned by the People’s Republic of China, or any company incorporated under the laws of the People’s Republic of China.

(3) The restrictions in the Acts do not apply to commercial items of supply needed to perform a grant or cooperative agreement.

(4) By submission of its proposal, the proposer represents that the proposer is not China or a Chinese-owned company, and that the proposer will not participate, collaborate, or coordinate bilaterally with China or any Chinese-owned company, at the prime recipient level or at any subrecipient level, whether the bilateral involvement is funded or performed under a no-exchange of funds arrangement.

Title of Authorizing Official: _____

Printed Name: _____

Signature: _____ Date: _____

Name of Proposing Institution: _____

Phone: _____ Fax: _____

E-mail: _____

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