



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

NASA Proposal Number

18-LSITP18_2-0048

NASA PROCEDURE FOR HANDLING PROPOSALS

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SECTION I - Proposal Information

Principal Investigator Gary Barnhard		E-mail Address gary.barnhard@xisp-inc.com		Phone Number 301-229-8012	
Street Address (1) 8012 Macarthur Blvd			Street Address (2)		
City Cabin John		State / Province MD		Postal Code 20818-1608	
				Country Code US	
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming					
Proposed Start Date 06 / 01 / 2019		Proposed End Date 05 / 31 / 2022		Total Budget 3,483,090.00	
				Year 1 Budget 3,483,090.00	
				Year 2 Budget 0.00	
				Year 3 Budget 0.00	

SECTION II - Application Information

NASA Program Announcement Number NNH18ZDA001N-LSITP		NASA Program Announcement Title Lunar Surface Instrument and Technology Payloads			
For Consideration By NASA Organization <i>(the soliciting organization, or the organization to which an unsolicited proposal is submitted)</i> Planetary Science					
Date Submitted 02 / 28 / 2019		Submission Method Electronic Submission Only		Grants.gov Application Identifier SSP&AS	
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 078687892	CAGE Code 6YPS3	Employer Identification Number (EIN or TIN)		Organization Type 2L	
Organization Name (Standard/Legal Name) Xtraordinary Innovative Space Partnerships Inc.				Company Division	
Organization DBA Name				Division Number	
Street Address (1) 8012 MACARTHUR BLVD			Street Address (2)		
City CABIN JOHN		State / Province MD		Postal Code 20818	
				Country Code USA	

SECTION IV - Proposal Point of Contact Information

Name Gary Barnhard		Email Address gary.barnhard@xisp-inc.com		Phone Number 301-229-8012	
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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 Gary Barnhard		AOR E-mail Address gary.barnhard@xisp-inc.com		Phone Number 301-229-8012	
AOR Signature <i>(Must have AOR's original signature. Do not sign "for" AOR.)</i>				Date	

PI Name : Gary Barnhard		NASA Proposal Number 18-LSITP18_2-0048	
Organization Name : Xtraordinary Innovative Space Partnerships Inc.			
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming			
SECTION VI - Team Members			
Team Member Role PI	Team Member Name Gary Barnhard	Contact Phone 301-229-8012	E-mail Address gary.barnhard@xisp-inc.com
Organization/Business Relationship Xtraordinary Innovative Space Partnerships Inc.		Cage Code 6YPS3	DUNS# 078687892
International Participation No	U.S. Government Agency		Total Funds Requested 0.00

PI Name : Gary Barnhard	NASA Proposal Number
Organization Name : Xtraordinary Innovative Space Partnerships Inc.	18-LSITP18_2-0048
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming	
SECTION VII - Project Summary	
<p>I. Surface-to-Surface Power & Ancillary Services Beaming</p> <p>A. Goals and Objectives This payload will demonstrate the ability of Surface-to-Surface Power & Ancillary Services Beaming (SSP&AS) technology to be used to provide wireless utility services (e.g., power, data, communications, navigation, time, heat, etc.) to multiple clients/customers (C/C) in the lunar environment in a cost and resource effective manner.</p> <p>B. Approach and Methodology The integrated payload will consist of a frequency agnostic cognitive Software Define Radio transceiver with a phased array gimbalbed switchable aperture, related control electronics/software with compliant interfaces, as well as the interface specifications/rectenna kits for C/C use. The payload will leverage the International Space Station based Space-to-Space Power Beaming commercial Technology Development, Demonstration, and Deployment (TD**3) mission products (i.e., hardware, software, data, interface kits, and operational experience) to deliver a space qualified surface-to-surface compatible technology demonstration which will be mission enhancing/enabling for the upcoming lunar missions.</p> <p>SSP&AS beaming will make use of a combination of Radio Frequency and Optical frequencies optimized to meet C/C requirements. The C/C rectenna will be designed for accommodation as stand-alone deployable or conformal arrays or for incorporation into reflectarray designs accommodating photovoltaics, Rx/Tx antenna, rectenna elements, and RFID data logs.</p> <p>The payload will be activated and deployed after landing. The transceiver will be quiescent until commanded to provide power & ancillary services to other deployed payloads (e.g., rovers, RFID impactors, distributed assay instruments). The phased array gimbalbed switchable aperture, is an evolvable unit starting with a planar phased array, adding on a flush mounting gimbal when it can be accommodated, as well as tunable/switchable aperture elements based on C/C requirements. The payload will be designed to multiplex the unidirectional power beam with bi-directional ancillary services. The payload will accept available input power from the landing infrastructure and a command data stream, the payload will accept telemetry and instrument data from C/C and provide power, commands, navigation bits, and time as needed.</p> <p>Payload delivery and integration can be supported as early as March 2020, with the ability to support subsequent incorporation as optimized infrastructure in future missions as warranted. The proposed payload has no landing site preferences other than line-of-site access to supported C/C.</p> <p>The primary design elements of the payload will be based on Alpha Cube Sat and the Space-to-Space Power Beaming mission flight test article both of which have a mass limit of 14 kg and a stowed volume of 6U. The payload will live within the other identified potential lunar lander accommodation capabilities. Placement of the payload and operational flexibility required by the C/C will impact the incorporation of the add-on gimbal, special deployment equipment, and design of the switchable aperture elements. The payload will be optimized to meet the C/C requirements in a satisfactory and sufficient manner first with additional performance margin added as available resources permit.</p> <p>C. Relevance to Lunar Surface Instruments and Technology Payloads The availability of power and ancillary services (e.g., communications, data, navigation, time) is essential to most if not all aspects of lunar operations. The unbundling of space electrical power systems (i.e., separation of power generation, transmission, distribution, control, and loads) affords opportunities for redistribution of mass, overall volume, surface area, and complexity which can be mission enhancing/enabling. Accordingly, this work is directly relevant to Power Generation, Distribution, and Energy Storage, and supports all the other stated areas of interest for technology demonstrations.</p>	

PI Name : Gary Barnhard		NASA Proposal Number 18-LSITP18_2-0048
Organization Name : Xtraordinary Innovative Space Partnerships Inc.		
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming		
SECTION VIII - Other Project Information		
Environmental Impact		
Does this project have an actual or potential impact on the environment? No	Has an exemption been authorized or an environmental assessment (EA) or an environmental impact statement (EIS) been performed? No	
Environmental Impact Explanation:		
Exemption/EA/EIS Explanation:		

PI Name : Gary Barnhard	NASA Proposal Number
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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 : Gary Barnhard	NASA Proposal Number
Organization Name : Xtraordinary Innovative Space Partnerships Inc.	18-LSITP18_2-0048
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming	
SECTION IX - Program Specific Data	
<p>Question 1 : Short Title:</p> <p>Answer: Surface-to-Surface Power and ancillary services Beaming</p>	
<p>Question 2 : Type of institution:</p> <p>Answer: Commercial Organization</p>	
<p>Question 3 : Will any funding be provided to a federal government organization including NASA Centers, JPL, other Federal agencies, government laboratories, or Federally Funded Research and Development Centers (FFRDCs)?</p> <p>Answer: Yes</p>	
<p>Question 4 : Is this Federal government organization a different organization from the proposing (PI) organization?</p> <p>Answer: Yes</p>	
<p>Question 5 : Does this proposal include the use of NASA-provided high end computing (HEC)?</p> <p>Answer: No</p>	
<p>Question 6 : HEC Request Number</p> <p>Answer:</p>	
<p>Question 7 : Research Category:</p> <p>Answer: 5) Technology development (includes technologies and subsystems that might be applicable to space and suborbital Instrumentation)</p>	
<p>Question 8 : Flight Services</p> <p>Answer: No</p>	
<p>Question 9 : Team Members Missing From Cover Page:</p> <p>Answer:</p>	
<p>G. Roles of All Team Members• XISP-Inc - Overall payload systems engineering, integration, and operations# Principal Investigator - Gary Pearce Barnhard (1.0 initially, .25 to .5 FTE average)# Staff - (2 to 4 FTE)# TBD - systems engineers, programmers, CAD Technicians, consultant conversion# Overhead Support Team (not counted under technical direct labor)# Joseph Rauscher (.1 to .5 FTE) - Cooperative Agreements and Administration# Lisa Kaspin (.1 to .5 FTE) -- Technical Writer & Copy Editor# TBD - (1 FTE) Office Manager.# Consultants - (1 to 2 FTE)# Seth Potter (.1 to .5 FTE) - Beam Forming & Systems Engineering# Brad Blair (.1 to .2</p>	

FTE) - Economic Analysis & Customer Development# John Mankins (.1 to .2 FTE) - Space Solar Power & Technology Development# Paul Werbos (.1 to .2 FTE) - Energy/Physics Modeling & TD3 Systems# Tim Cash (.1 to .5 FTE) - Radio Frequency Systems Testing# Brahm Segal (.1 to .5 FTE) - Power Conversion Efficiency Testing & Optimization# David Cheuvront (.1 to .25 FTE) - Integration, Verification & Validation, Reliability# Ken Ford (.1 to .5 FTE) - Program Implementation# Richard Dickinson (.1 to .2 FTE) - Power Beaming & Technology Development# Eric Dahlstrom (.1 to .2 FTE) - Mission Planning & Space Systems Engineering# Raytheon, Inc. - Equipment Purchase Power Transmitter/Transceiver and Rectenna# Hooman Kazemi, James McSpadden, Avram Bar Cohen, et al. • Tethers Unlimited, Inc. - Equipment Purchase Ancillary Services Transceiver and Tx/Rx Antenna# Robert Hoyt, et al. • Immortal Data, Inc. - Equipment Purchase Data Acquisition and Capture System# Dale Amon, et al. • Oceaneering Space Systems, Inc. - Service Purchase Interface Engineering & Integration# Michael Withey, et al. • University of Maryland Space Systems Lab - Integration Facility Provider# Dave Akin, et al. • Naval Research Laboratory - Integrated Test Facility Provider# Paul Jaffe, et al. • University Researchers - rectenna/solar array/Tx&Rx antenna optimization, experiment operations support, and/or customer development# CalTech - Michael Kelzenberg, et al.# Colorado School of Mines - George Sowers, et al.# Michigan Technical University E&C Engineering - Reza Zekavat, et al.# St. Louis University - Michael Swartout, et al.# Univ. of MD Space Systems Lab - David Akin, et al.# Univ. of ND Space Systems Lab - Sima Noghianian, et al.# Univ. of NM COSMIAC Lab -- Christos Christodoulou, et al. • XISP-Inc TD3 Mission Development Consortium# Advisory resource for addressing established and emergent challenges associated with the SSP&asB payload mission.# Includes commercial entities, consultants, universities, government agencies, and non-profit organizations available for participation in one or more capacities.

Question 10 : Does this proposal contain information and/or data that are subject to U.S. export control laws and regulations including Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR)?

Answer: No

Question 11 : I have identified the export-controlled material in this proposal.

Answer: N/A

Question 12 : I acknowledge that the inclusion of such material in this proposal may complicate the government's ability to evaluate the proposal.

Answer: N/A

Question 13 : Does the proposed work include any involvement with collaborators in China or with Chinese organizations, or does the proposed work include activities in China?

Answer: No

Question 14 : Are you planning for undergraduate students to be involved in the conduct of the proposed investigation?

Answer: No

Question 15 : If yes, how many different undergraduate students?

Answer:

Question 16 : What is the total number of student-months of involvement for all undergraduate students over the life of the proposed investigation?

Answer:

Question 17 : Provide the names and current year (1,2,3,4) for any undergraduate students that have already been identified.

Answer:

Question 18 : Are you planning for graduate students to be involved in the conduct of the proposed investigation?

Answer: Yes

Question 19 : If yes, how many different graduate students?

Answer: 6

Question 20 : What is the total number of student-months of involvement for all graduate students over the life of the proposed investigation?

Answer: One or more graduate students are anticipated to be part of the university research teams on a part-time basis. Opportunities for up to twenty hours a week per student schedule permitting. This will be negotiated with the universities as part of the effort.

Question 21 : Provide the names and current year (1,2,3,4, etc.) for any graduate students that have already been identified.

Answer:

TBD

The National Environmental Policy Act (NEPA) obligates NASA to consider the potential environmental effects of proposed projects, including those that NASA funds which are implemented by grantees. The majority of grant-related activities are categorically excluded as research and development projects that do not pose adverse environmental impacts. These are covered by a NASA Grants Record of Environmental Consideration (REC) available at <https://www.nasa.gov/nepa/grants>. The following questions enable NASA to confirm that your proposed activity falls within this blanket REC. Proposals that are not covered will require additional NEPA analysis if selected (e.g., filling out an Environmental Checklist) or the completion of NASA's Executive Order (EO) 12114 Checklist for an activity to be conducted abroad. "Yes" responses are not selection criteria, however, if a "Yes" response is marked, proposers should consider NEPA and/or EO compliance in cost and schedule estimates.

Question 22 : Would the proposal involve any activity that includes: a. Construction of new facilities or modification to the footprint of an existing facility, or b. Ground disturbance (e.g., excavation, clearing of trees, installation of equipment, etc.), or c. Outdoor discharges of water (e.g., waste water runoff), air emissions (e.g., ozone-depleting substances) or generation of noise exceeding 115 dBA (excluding those associated with aircraft operations)?

Answer: No

Question 23 : Would the proposal involve any field activity that would: a. Release equipment (e.g., dropsondes, sensors, etc.) or chemicals (e.g., dyes, tracers, etc.) into the air, bodies of water or on the ground, or b. Release a parachute or use equipment that would not be recovered, or c. Involve equipment or a payload that contains hazardous (e.g., petroleum, hypergols, oxidizers, solid propellants, etc.) or radioactive materials?

Answer: No

Question 24 : Would the proposal involve the launch of a payload, equipment, or instrument (e.g., via launch vehicle, sounding rocket, balloon, etc.)?

Answer: Yes

Question 25 : Would the proposal involve any activity to be conducted outside the United States or its territoriesexcluding travel for meetings or conferences?

Answer: No

Question 26 : Comments

Answer:

Question 27 : Relevant strategic goal

Answers :

SMD Planetary Science

HEOMD Strategic Knowledge Gaps

STMD Technology Demonstrations

Question 28 : Technology Type

Answer: Power generation, distribution, and energy store

Question 29 : PDS Nodes

Answer: Yes, at multiple PDS nodes

Question 30 : Data Management Plan

Answer: YES, I understand the requirement for DMPs.

PI Name : Gary Barnhard			NASA Proposal Number 18-LSITP18_2-0048	
Organization Name : Xtraordinary Innovative Space Partnerships Inc.				
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming				
SECTION X - Budget				
Cumulative Budget				
Budget Cost Category	Funds Requested (\$)			
	Year 1 (\$)	Year 2 (\$)	Year 3 (\$)	Total Project (\$)
A. Direct Labor - Key Personnel	135,410.00	0.00	0.00	135,410.00
B. Direct Labor - Other Personnel	604,560.00	0.00	0.00	604,560.00
Total Number Other Personnel	16	0	0	16
Total Direct Labor Costs (A+B)	739,970.00	0.00	0.00	739,970.00
C. Direct Costs - Equipment	1,682,255.00	0.00	0.00	1,682,255.00
D. Direct Costs - Travel	100,000.00	0.00	0.00	100,000.00
Domestic Travel	100,000.00	0.00	0.00	100,000.00
Foreign Travel	0.00	0.00	0.00	0.00
E. Direct Costs - Participant/Trainee Support Costs	0.00	0.00	0.00	0.00
Tuition/Fees/Health Insurance	0.00	0.00	0.00	0.00
Stipends	0.00	0.00	0.00	0.00
Travel	0.00	0.00	0.00	0.00
Subsistence	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00
Number of Participants/Trainees				0
F. Other Direct Costs	332,250.00	0.00	0.00	332,250.00
Materials and Supplies	0.00	0.00	0.00	0.00
Publication Costs	0.00	0.00	0.00	0.00
Consultant Services	0.00	0.00	0.00	0.00
ADP/Computer Services	0.00	0.00	0.00	0.00
Subawards/Consortium/Contractual Costs	0.00	0.00	0.00	0.00
Equipment or Facility Rental/User Fees	40,000.00	0.00	0.00	40,000.00
Alterations and Renovations	0.00	0.00	0.00	0.00
Other	292,250.00	0.00	0.00	292,250.00
G. Total Direct Costs (A+B+C+D+E+F)	2,854,475.00	0.00	0.00	2,854,475.00
H. Indirect Costs	315,607.00	0.00	0.00	315,607.00
I. Total Direct and Indirect Costs (G+H)	3,170,082.00	0.00	0.00	3,170,082.00
J. Fee	313,008.00	0.00	0.00	313,008.00
K. Total Cost (I+J)	3,483,090.00	0.00	0.00	3,483,090.00
Total Cumulative Budget				3,483,090.00

PI Name : Gary Barnhard						NASA Proposal Number		
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Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming								
SECTION X - Budget								
Start Date : 06 / 01 / 2019		End Date : 05 / 31 / 2020		Budget Type : Project		Budget Period : 1		
A. Direct Labor - Key Personnel								
Name	Project Role	Base Salary (\$)	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
Barnhard, Gary	PI	105,725.00	6			105,725.00	29,685.00	135,410.00
Total Key Personnel Costs								135,410.00
B. Direct Labor - Other Personnel								
Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)	
6	Consultant III - University Researchers	12			274,800.00	0.00	274,800.00	
8	Consultant II - Mission Subject Matter Expertss	12			293,120.00	0.00	293,120.00	
2	Consultant I - Mission Discipline Analysts	12			36,640.00	0.00	36,640.00	
16	Total Number Other Personnel	Total Other Personnel Costs					604,560.00	
Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)							739,970.00	

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SECTION X - Budget			
Start Date : 06 / 01 / 2019	End Date : 05 / 31 / 2020	Budget Type : Project	Budget Period : 1
C. Direct Costs - Equipment			
Item No.	Equipment Item Description	Funds Requested (\$)	
1	Power Transmitter & Rectenna	1,000,000.00	
2	Ancillary Services Transceiver & Tx/Rx Antenna	622,255.00	
3	Data Acquisition & Capture System	60,000.00	
		Total Equipment Costs	1,682,255.00
D. Direct Costs - Travel			
		Funds Requested (\$)	
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)		100,000.00	
2. Foreign Travel		0.00	
		Total Travel Costs	100,000.00
E. Direct Costs - Participant/Trainee Support Costs			
		Funds Requested (\$)	
1. Tuition/Fees/Health Insurance		0.00	
2. Stipends		0.00	
3. Travel		0.00	
4. Subsistence		0.00	
Number of Participants/Trainees:		Total Participant/Trainee Support Costs	0.00

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SECTION X - Budget				
Start Date : 06 / 01 / 2019		End Date : 05 / 31 / 2020		Budget Type : Project
				Budget Period : 1
F. Other Direct Costs				
				Funds Requested (\$)
1. Materials and Supplies				0.00
2. Publication Costs				0.00
3. Consultant Services				0.00
4. ADP/Computer Services				0.00
5. Subawards/Consortium/Contractual Costs				0.00
6. Equipment or Facility Rental/User Fees				40,000.00
7. Alterations and Renovations				0.00
8. Other: UMD Space Systems Lab -- Integration Facilities w/Design Review, Testing & Operations Support				100,000.00
9. Other: Oceaneering Space Systems -- Interface Engineering & Integration				50,000.00
10. Other: Cost Reserve (5.97%)				142,250.00
Total Other Direct Costs				332,250.00
G. Total Direct Costs				
				Funds Requested (\$)
Total Direct Costs (A+B+C+D+E+F)				2,854,475.00
H. Indirect Costs				
	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)	
G&A	10.00	2,845,529.00	284,553.00	
Labor Overhead (XISP-Inc Staff)	29.37	135,410.00	31,054.00	
Cognizant Federal Agency: None	Total Indirect Costs		315,607.00	
I. Direct and Indirect Costs				
				Funds Requested (\$)
Total Direct and Indirect Costs (G+H)				3,170,082.00
J. Fee				
				Funds Requested (\$)
Fee				313,008.00
K. Total Cost				
				Funds Requested (\$)
Total Cost with Fee (I+J)				3,483,090.00

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Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming								
SECTION X - Budget								
Start Date : 06 / 01 / 2020		End Date : 05 / 31 / 2021		Budget Type : Project		Budget Period : 2		
A. Direct Labor - Key Personnel								
Name	Project Role	Base Salary (\$)	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
Barnhard, Gary	PI	0.00				0.00	0.00	0.00
Total Key Personnel Costs								0.00
B. Direct Labor - Other Personnel								
Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)	
0	Total Number Other Personnel	Total Other Personnel Costs						0.00
Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)								0.00

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SECTION X - Budget			
Start Date : 06 / 01 / 2020	End Date : 05 / 31 / 2021	Budget Type : Project	Budget Period : 2
C. Direct Costs - Equipment			
Item No.	Equipment Item Description		Funds Requested (\$)
Total Equipment Costs			0.00
D. Direct Costs - Travel			
			Funds Requested (\$)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)			0.00
2. Foreign Travel			0.00
Total Travel Costs			0.00
E. Direct Costs - Participant/Trainee Support Costs			
			Funds Requested (\$)
1. Tuition/Fees/Health Insurance			0.00
2. Stipends			0.00
3. Travel			0.00
4. Subsistence			0.00
Number of Participants/Trainees:		Total Participant/Trainee Support Costs	0.00

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SECTION X - Budget			
Start Date : 06 / 01 / 2020	End Date : 05 / 31 / 2021	Budget Type : Project	Budget Period : 2
F. Other Direct Costs			
			Funds Requested (\$)
1. Materials and Supplies			0.00
2. Publication Costs			0.00
3. Consultant Services			0.00
4. ADP/Computer Services			0.00
5. Subawards/Consortium/Contractual Costs			0.00
6. Equipment or Facility Rental/User Fees			0.00
7. Alterations and Renovations			0.00
8. Other:			0.00
9. Other:			0.00
10. Other:			0.00
Total Other Direct Costs			0.00
G. Total Direct Costs			
			Funds Requested (\$)
Total Direct Costs (A+B+C+D+E+F)			0.00
H. Indirect Costs			
	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
Cognizant Federal Agency:	Total Indirect Costs		0.00
I. Direct and Indirect Costs			
			Funds Requested (\$)
Total Direct and Indirect Costs (G+H)			0.00
J. Fee			
			Funds Requested (\$)
Fee			0.00
K. Total Cost			
			Funds Requested (\$)
Total Cost with Fee (I+J)			0.00

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SECTION X - Budget								
Start Date : 06 / 01 / 2021		End Date : 05 / 31 / 2022		Budget Type : Project		Budget Period : 3		
A. Direct Labor - Key Personnel								
Name	Project Role	Base Salary (\$)	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)
Barnhard, Gary	PI	0.00				0.00	0.00	0.00
Total Key Personnel Costs								0.00
B. Direct Labor - Other Personnel								
Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary (\$)	Fringe Benefits (\$)	Funds Requested (\$)	
0	Total Number Other Personnel	Total Other Personnel Costs						0.00
Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)								0.00

PI Name : Gary Barnhard		NASA Proposal Number	
Organization Name : Xtraordinary Innovative Space Partnerships Inc.		18-LSITP18_2-0048	
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming			
SECTION X - Budget			
Start Date : 06 / 01 / 2021	End Date : 05 / 31 / 2022	Budget Type : Project	Budget Period : 3
C. Direct Costs - Equipment			
Item No.	Equipment Item Description		Funds Requested (\$)
Total Equipment Costs			0.00
D. Direct Costs - Travel			
			Funds Requested (\$)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)			0.00
2. Foreign Travel			0.00
Total Travel Costs			0.00
E. Direct Costs - Participant/Trainee Support Costs			
			Funds Requested (\$)
1. Tuition/Fees/Health Insurance			0.00
2. Stipends			0.00
3. Travel			0.00
4. Subsistence			0.00
Number of Participants/Trainees:		Total Participant/Trainee Support Costs	0.00

PI Name : Gary Barnhard		NASA Proposal Number	
Organization Name : Xtraordinary Innovative Space Partnerships Inc.		18-LSITP18_2-0048	
Proposal Title : Surface-to-Surface Power & Ancillary Services Beaming			
SECTION X - Budget			
Start Date : 06 / 01 / 2021	End Date : 05 / 31 / 2022	Budget Type : Project	Budget Period : 3
F. Other Direct Costs			
			Funds Requested (\$)
1. Materials and Supplies			0.00
2. Publication Costs			0.00
3. Consultant Services			0.00
4. ADP/Computer Services			0.00
5. Subawards/Consortium/Contractual Costs			0.00
6. Equipment or Facility Rental/User Fees			0.00
7. Alterations and Renovations			0.00
8. Other:			0.00
9. Other:			0.00
10. Other:			0.00
Total Other Direct Costs			0.00
G. Total Direct Costs			
			Funds Requested (\$)
Total Direct Costs (A+B+C+D+E+F)			0.00
H. Indirect Costs			
	Indirect Cost Rate (%)	Indirect Cost Base (\$)	Funds Requested (\$)
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
Cognizant Federal Agency:	Total Indirect Costs		0.00
I. Direct and Indirect Costs			
			Funds Requested (\$)
Total Direct and Indirect Costs (G+H)			0.00
J. Fee			
			Funds Requested (\$)
Fee			0.00
K. Total Cost			
			Funds Requested (\$)
Total Cost with Fee (I+J)			0.00

Surface-to-Surface Power & Ancillary Services Beaming

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Surface-to-Surface Power & Ancillary Services Beaming

II. Scientific/Technical/Management Plan

This proposal incorporates the Step-1 proposal as *italicized text* to insure compliance with the letter and intent of the specified proposal process. Material changes/clarifications that have been made to the Step-1 proposal text are shown as **bolded underlined italicized text**.

A. Objectives & Significance

This payload will demonstrate the ability of Surface-to-Surface Power & ancillary services Beaming (SSP&asB) technology to be used to provide wireless utility services (e.g., power, data, communications, navigation, time, heat, etc.) to multiple Clients/Customers (C/C) in the lunar environment in a cost and resource effective manner.

This payload is part of a Technology Development, Demonstration, and Deployment (TD³) mission which has the following specific objectives:

- **Technology Development**: leverage existing hardware from other missions/applications that can be repackaged as a lunar payload to serve as test bed equipment that supports the characterization, optimization, and operational rule definition for uni-directional, bi-directional, and relay SSP&asB. Since this is a new application of existing equipment the Technology Readiness Level (TRL) is by definition reset 5. This mission will advance the TRL to 9 for SSP&asB.
- **Technology Demonstration**: The SSP&asB test bed equipment will then be used to demonstrate the ability to support other payloads power and ancillary services requirements.
- **Technology Deployment**: The SSP&asB test bed equipment will be made available as configurable/evolvable infrastructure for subsequent missions/applications.

B. Perceived Impact of Work

The availability of power and ancillary services (e.g., communications, data, navigation, time, etc.) is essential to most if not all aspects of lunar operations. The unbundling of space electrical power systems (i.e., separation of power generation, transmission, distribution, control, and loads) affords opportunities for redistribution of mass, overall volume, surface area, and complexity which can be mission enhancing/enabling.

Increasing the availability of power and data transfer performance while simultaneously reducing the resource burden (mass, power, volume) to achieve the same that must be borne by the C/Cs will be mission enhancing if not mission enablement.

C. Relevance of the Work to the Solicitation

This work is directly relevant to Power Generation, Distribution, and Energy Storage, and supports all the other stated areas of interest for technology demonstrations.

Surface-to-Surface Power & Ancillary Services Beaming

More specifically, it impacts power generation, distribution, and energy storage by allowing for the reallocation of mass, power, and volume between the supporting infrastructure and the payload. Allowing more payload experimental data to be collected and returned for analysis.

A visualization of the beaming field relating distance from the lunar lander to the Client/Customer, transmitted power, and received power is shown in Figure 1 – SSP&asB Mission Visualization.

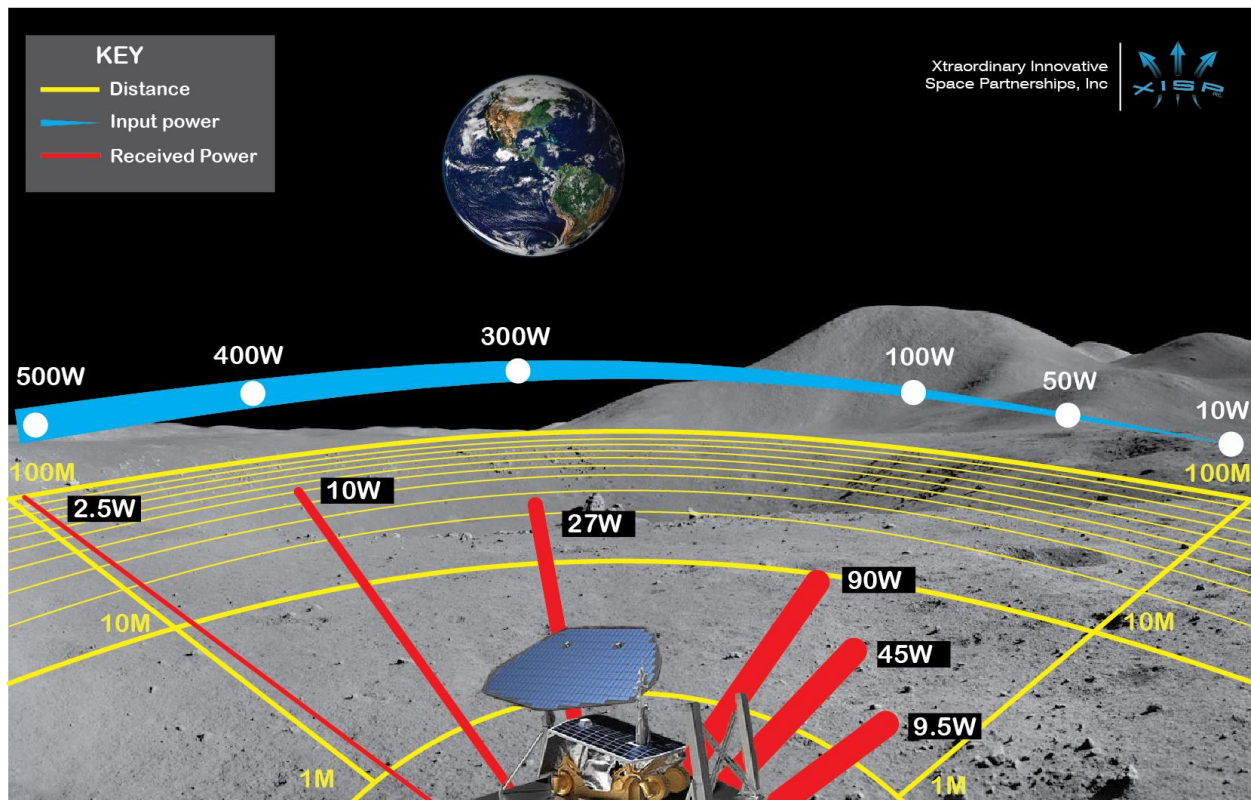


Figure 1 – SSP&asB Mission Visualization

D. Technical Approach and Methodology

*The integrated payload will consist of a **frequency selectable power transmitter (92 GHz is the baseline)** and a **frequency agnostic (Ka Band is the baseline)** cognitive **Software Defined RF transceiver with a gimbaled low profile transmitter/transceiver array**, related control electronics/software with compliant interfaces, as well as the interface specifications/**rectifying antenna (rectenna)** kits for C/C use.*

The payload will leverage the International Space Station based Space-to-Space Power Beaming commercial Technology Development, Demonstration, and Deployment (TD³) mission products (i.e., hardware, software, data, interface kits, and operational experience) to deliver a space qualified surface-to-surface compatible technology demonstration which will be mission enhancing/enabling for the upcoming lunar missions.

Surface-to-Surface Power & Ancillary Services Beaming

SSP&AS beaming will leverage a combination of Radio Frequency and Optical frequencies optimized to meet C/C requirements.

The C/C rectenna will be designed for accommodation as stand-alone deployable or conformal arrays or for incorporation into reflectarray designs accommodating photovoltaics, Rx/Tx antenna, rectenna elements, and RFID data logs (solid state data storage that can be read and cleared like a programmable RFID tag).

The payload will be activated and deployed after landing. The transceiver will be quiescent until commanded to provide power & ancillary services to other deployed payloads (e.g., rovers, RFID impactors, distributed assay instruments).

*The **low profile transmitter/transceiver array**, is an evolvable unit starting with a conformal array, adding on a flush mounting gimbal when it can be accommodated, as well as tunable/switchable aperture elements based on C/C requirements.*

The payload will be designed to multiplex the unidirectional power beam with bi-directional ancillary services. The payload will accept available input power from the landing infrastructure and a command data stream, the payload will accept telemetry and instrument data from C/C and provide power, commands, navigation bits, and time as needed.

*Payload delivery and integration can be supported as early as **June** 2020, with the ability to support subsequent incorporation as optimized infrastructure in future missions as warranted. The proposed payload has no landing site preferences other than **mandatory** line-of-site access to supported C/C.*

*The primary design elements of the payload will be based on the XISP-Inc NASA Cubequest Challenge Alpha Cube Sat and the XISP-Inc CASIS Space-to-Space Power Beaming (**SSPB**) mission flight test article, both of which have a mass limit of 14 kg and a stowed volume of 6U, **as well as the SSPB ISS transceiver repackaged to suit.***

The payload will live within the other identified potential lunar lander accommodation capabilities.

Placement of the payload and operational flexibility required by the C/C will impact the incorporation of the add-on gimbal, special deployment equipment, and design of the switchable aperture elements.

The payload will be optimized to meet the C/C requirements in a satisfactory and sufficient manner first, with additional performance margin added as available resources permit.

Maturity and Technical Readiness Level (TRL)

The primary components of the integrated payload will leverage multiple generations of fielded equipment from the proposed equipment subcontractors. More specifically,

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1. Raytheon, brings their foundational experience in developing, building, and fielding of microwave transmitters, receivers, and rectennas in support of multiple applications including three generations of the Active Denial System (ADS), the Internal Research & Development (IRaD) in support of the SSPB mission development and other applications, as well as the protoflight SSPB mission hardware.
2. Tethers Unlimited, brings their latest generation of Software Defined RF (SDR) microwave transceivers (SWIFT K*) for Cubesat applications including Alpha Cube Sat, the SSPB flight test article and a wealth of experience in cost effective technology development, demonstration, and deployment for cubesat/smallsat applications.

Proprietary and ITAR restricted material for NASA only distribution pertaining to both of these manufacturers' proffered equipment is provided as Appendices C and D respectively to this proposal.

The foundational technology associated with the proposed equipment ranges from TRL 7 to 9. However, given that the specifics of the C/C application requirements (see Table 1 – Key Variables) and the operational environment (lunar surface) are novel, the TRL of the existing equipment to be adapted for use in this payload at the point of submittal of this Step-2 proposal is by definition TRL 5. While it is anticipated that just repackaging and integration of extant equipment (hardware & software) could yield a flight ready payload, the proposed payload preparation phase is scoped to allow for flight system optimization to best accommodate C&C requirements, and allow for the integration into different lunar landers with a minimum of hardware and/or software modifications to deliver the payload. The likelihood, is that with relative ease the proposed payload can be readily integrated into a commercial lunar lander will be maximized by our efforts and pave the way towards future SSP&AS payloads as mission scopes expand. This is elaborated in Table 2 – Technology Development, Demonstration, and Deployment (TD3) mission context.

Table 1 – Key Variables	
	<ul style="list-style-type: none">• Cost/Economics (initial cost to first power, LCOE, market viability, anchor customers),• Frequency/Wavelength (microwave to eye safe optical),• Distance (near field, boundary regions, far field),• Magnitude (i.e. power level supporting application)
	<ul style="list-style-type: none">• Duration (pulsed, scheduled, continuous),• Availability (on demand, scheduled, prioritized, by exception),• Security (misuse, interruption, destruction), and• Performance (net transfer, end -to-end efficiency, piecewise efficiency, steering precision and accuracy, beam shaping, effective operational difference).
	<ul style="list-style-type: none">• Duty cycle of services (baseload power, peak power, augmentation of power during lunar night or in shadowed regions, storage and buffering of data for later transmission, etc.)• Altitude of Transceiver versus terrain features (lander height, telescoping deployment mechanism, terrain features height)

Surface-to-Surface Power & Ancillary Services Beaming

Table 2 – Technology Development, Demonstration, and Deployment (TD ³) mission context		
Technology Development	Technology Demonstration	Technology Deployment
<ul style="list-style-type: none"> • Flight qualified SSP&asB transceiver • Flight qualified SSP&asB reflectarray rectenna/solar array/Tx&Rx antenna • Deployable Power Generation & Relay Towers <ul style="list-style-type: none"> ○ solar concentrator/reflector ○ reflectarray rectenna/solar array/Tx&Rx antenna ○ telescoping tower ○ deployable apertures • Foster Clients/Customers <ul style="list-style-type: none"> ○ Powered Rover ○ Powered Prospector ○ Powered Miner ○ Volatile/Metal Separation 	<ul style="list-style-type: none"> • SSP&asB <ul style="list-style-type: none"> ○ Survive the Night ○ Augment for power tools & instruments ○ Battery recharge ○ Evolving Power & Ancillary Services Utility <ul style="list-style-type: none"> ➔ Emergency ➔ Servicing ➔ Augment ➔ Backup ➔ Primary • Foster Clients/Customers <ul style="list-style-type: none"> ○ Volatiles Mining Demo ○ Propellant Depot Demo ○ Metals Mining Demo 	<ul style="list-style-type: none"> • Dispatchable Power & Ancillary Services • 24x7 Operations Support • Watt to Kilowatt Scale Service • Precursor to Kilowatt to Megawatt Scale Services for Lunar facilities

However, the supplied equipment will be based on a combination of Commercial Off The Shelf (COTS) elements modified as necessary to meet the application requirements and the accommodations provided by the lunar lander assigned and mission unique items that facilitate the ability to meet C/C requirements.

The equipment will consist of a frequency agnostic cognitive Software Defined RF/Optical Power transmitter and an ancillary services transceiver with a phased array switchable aperture, optional gimbal, related control electronics/software with compliant interfaces, as well as the interface specifications/rectenna kits for C/C use.

E. Potential Sources of Uncertainty

- Feasibility of Technology
 - The technical feasibility has been proven and verified by repeated tests.
- Availability of Purposed Equipment
 - Most, if not all, of the proposed equipment is already built and functional in one or more instances for other applications.
- Packaging (Volume, Mass)
 - Use of the proposed equipment will require new protoflight instances to be built that are repackaged to suit the lunar lander interfaces.
 - Given that existing applications require undeployed packaging within a 6U volume and 14 kg mass, living within a reasonable volume limit and a less than approximately 15 kg mass limit is not anticipated to be a problem.
- Radiation
 - Living with anticipated exposure limits of 1 krad is not anticipated to be problem.
 - The combination of parsimonious shielding and deterministic state transition control that allows for memory error correction, warm boot, and cold boot from protected core code reserve should mitigate short term effects of radiation exposure.

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- Radiation driven failure modes and effects will be a payload study component using data gathered.
- Surface Communication
 - Proposed payload is a communications resource for other C/C
 - Proposed payload may be adaptable for accommodating other C/C surface and off surface relay requirements.
- Power
 - Proposed payload is a power resource for other C/C.
 - Proposed payload power requirements will vary based on the C/C requirements and the end-to-end efficiency achievable.
 - Proposed payload may be adaptable for accommodating other C/C surface relay requirements.
 - Keep alive power is TBD.
- Payload launch load limits, and, if available, results of any finite element analysis or vibration testing performed.
 - Solid state equipment
 - Testing legacy of other application instances of the equipment to be used includes survivability in a military deployed field environment and/or expendable launch vehicle environment.
- Payload acoustic and shock load limits and results of any acoustic testing performed, if available
 - Solid state equipment
 - Testing legacy of other application instances of the equipment to be used includes survivability in a military deployed field environment and/or expendable launch vehicle environment.
- Payload thermal conditioning requirements
 - Solid state equipment
 - Testing legacy of other application instances of the equipment to be used includes survivability in a military deployed field environment and/or expendable launch vehicle environment.
 - Lower operating temperatures typically will improve efficiency.
 - Thermal (over temperature, under temperature, and cycling) driven failure modes and effects will be a payload study component using data gathered.
- Payload communication requirements (volume, bandwidth, etc.)
 - It is anticipated that the payload will be fully-instrumented across all defined internal and external interface planes.
 - The payload will include all necessary equipment to capture and store for transmission the data necessary to characterize, optimize, and write/codify the operational rules for SSP&asB.
- Payload communication interfaces (wired and wireless interface port(s), etc.)

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- TBD – anticipated to be adaptable as necessary
 - Provisions will be accommodated for all required ground support (payload development and integration) interfaces as well as all wired and wireless interface ports necessary to interface with anticipated lunar landers.
- Payload power requirements (nominal, peak, power conditioning, etc.) and any grounding requirements
 - TBD – anticipated to be adaptable as necessary
 - Anticipated keep-alive input power is TBD W, TBD V DC
 - Estimated minimum service input power is 10 W, TBD V DC
 - Nominal service input power range 10 W to 100 W, TBD V DC
 - Estimated maximum service input power is 1000 W, TBD V DC
- Payload pointing requirements.
 - TBD – anticipated to be adaptable as necessary
 - Payload will be configurable to accommodate a fixed mount, gimbal mount, or/a deployable gimbal mount depending on the lunar lander accommodations available and C/C requirements.
- Payload mechanical interface(s) (thermal isolation, bolt-hole pattern, dust susceptibility, etc.) and launch lock requirements, if any.
 - TBD – anticipated to be adaptable as necessary
 - Thermal isolation is not required and thermal conductivity as both a heat source and/or a heat sink may prove useful.
 - The payload bolt-hole pattern will be optimized for interoperability with all available lunar landers.
 - The payload are anticipated to be sealed with pressure release valves as needed.
- Payload optical sensitivities (dust, chemicals, line-of-sight to the Sun, etc.) and keep-out zones for sensor operation, if applicable
 - TBD – optical sensitivities are not anticipated to be an issue for microwave frequency operations.
- Payload cleanliness requirements
 - TBD – anticipated to be adaptable as necessary
 - All electronics with exposed metal traces must be cleaned and sealed to prevent the accumulation of tin whiskers which can lead to component failure.
 - Careful attention is required to ensure the cleanliness of all electronic components in order to eliminate failures due to Printed Circuit Board contamination.
- Payload electrical pin configuration
 - TBD – anticipated to be adaptable as necessary
 - Electrical pin configuration will be consistent with the applicable lunar lander interfaces.

Surface-to-Surface Power & Ancillary Services Beaming

F. Present Mitigation Strategy or Alternate Approach Given Obstacles

- The combination of multiple collaborating contractors, competing equipment tests, and the flexibility to redefine the interface planes maintaining forward and backward compatibility as necessary to best accommodate the C/C requirements is anticipated to either mitigate or provide multiple potential work arounds for all identified risks.

G. Roles of All Team Members

- XISP-Inc – Overall payload systems engineering, integration, and operations
 - Principal Investigator – Gary Pearce Barnhard (1.0 initially, .25 to .5 FTE average)
 - Staff – (2 to 4 FTE)
 - TBD – systems engineers, programmers, CAD Technicians, consultant conversion
 - Overhead Support Team (not counted under technical direct labor)
 - Joseph Rauscher (.1 to .5 FTE) - Cooperative Agreements and Administration
 - Lisa Kaspin (.1 to .5 FTE) -- Technical Writer & Copy Editor
 - TBD – (1 FTE) Office Manager,
 - Consultants – (1 to 2 FTE)
 - Seth Potter (.1 to .5 FTE) – Beam Forming & Systems Engineering
 - Brad Blair (.1 to .2 FTE) – Economic Analysis & Customer Development
 - John Mankins (.1 to .2 FTE) – Space Solar Power & Technology Development
 - Paul Werbos (.1 to .2 FTE) – Energy/Physics Modeling & TD³ Systems
 - Tim Cash (.1 to .5 FTE) – Radio Frequency Systems Testing
 - Brahm Segal (.1 to .5 FTE) – Power Conversion Efficiency Testing & Optimization
 - David Cheuvront (.1 to .25 FTE) – Integration, Verification & Validation, Reliability
 - Ken Ford (.1 to .5 FTE) – Program Implementation
 - Richard Dickinson (.1 to .2 FTE) - Power Beaming & Technology Development
 - Eric Dahlstrom (.1 to .2 FTE) – Mission Planning & Space Systems Engineering
- Raytheon, Inc. – Equipment Purchase Power Transmitter/Transceiver and Rectenna
 - Hooman Kazemi, James McSpadden, Avram Bar Cohen, et al.
- Tethers Unlimited, Inc. – Equipment Purchase Ancillary Services Transceiver and Tx/Rx Antenna
 - Robert Hoyt, et al.
- Immortal Data, Inc. – Equipment Purchase Data Acquisition and Capture System
 - Dale Amon, et al.
- Oceaneering Space Systems, Inc. – Service Purchase Interface Engineering & Integration
 - Michael Withey, et al.
- University of Maryland Space Systems Lab – Integration Facility Provider
 - Dave Akin, et al.
- Naval Research Laboratory – Integrated Test Facility Provider
 - Paul Jaffe, et al.

Surface-to-Surface Power & Ancillary Services Beaming

- University Researchers – rectenna/solar array/Tx&Rx antenna optimization, experiment operations support, and/or customer development
 - CalTech – Michael Kelzenberg, et al.
 - Colorado School of Mines – George Sowers, et al.
 - Michigan Technical University E&C Engineering – Reza Zekavat, et al.
 - St. Louis University – Michael Swartout, et al.
 - Univ. of MD Space Systems Lab – David Akin, et al.
 - Univ. of ND Space Systems Lab – Sima Noghianian, et al.
 - Univ. of NM COSMIAC Lab -- Christos Christodoulou, et al.
- XISP-Inc TD³ Mission Development Consortium
 - Advisory resource for addressing established and emergent challenges associated with the SSP&asB payload mission.
 - Includes commercial entities, consultants, universities, government agencies, and non-profit organizations available for participation in one or more capacities.

H. Work Plan/Milestones/Management Structure

The XISP-Inc Principal Investigator (PI) will be responsible for overall mission development and will be the lead systems engineer for the project. XISP-Inc will be responsible for the overall payload systems engineering, integration, and operations. The PI will be supported by TBD Staff, a Consultant pool, a team of subcontractors, and a consortium of advisors.

Equipment and related support services will be purchased via subcontract to:

- Raytheon, Inc. will serve as the equipment manufacturer for the Power Transmitter/Transceiver and Rectenna
- Tethers Unlimited, Inc. will serve as the equipment manufacturer for the Ancillary Services Transceiver and Tx/Rx Antenna.
- Immortal Data, Inc. has developed an integrated line of flight system data management hardware/software and will serve as the equipment manufacturer for the Data Acquisition & Capture System.
- The XISP-Inc designated university researchers will serve as consultants to provide support to the mission for rectenna/solar array/Tx&Rx antenna optimization, experiment operations support, and/or customer development as needed.
- Oceaneering Space Systems, Inc. which specializes in complex interface engineering and integration issues will serve as a consultant for Interface Engineering & Integration with the lunar landers as needed.
- The University of Maryland Space Systems Lab will serve in various capacities (design review, testing, and operations support) and will be providing Integration Facilities as needed.

Surface-to-Surface Power & Ancillary Services Beaming

- The Naval Research Laboratory will serve in various capacities (design review and testing) and will be providing integrated test facilities (e.g., vacuum, thermal, EMI/EMC, etc.) as needed.

The XISP-Inc TD³ Mission Development Consortium will serve as an advisory resource for addressing established and emergent challenges associated with the SSP&asB payload mission.

XISP-Inc has multiple collaborating and competing sub-contractors for the primary hardware and embedded software components:

1. Raytheon, which brings their foundational experience in field of microwave transmitters, receivers, and rectennas, along with multiple fielded applications. Raytheon is assigned the responsibility for the power transmitter and the rectenna.
2. Tethers Unlimited, which brings their latest generation of Software Defined Radio microwave transceivers for Cubesat applications and a wealth of experience in cost effective technology implementation. Tethers Unlimited is assigned the responsibility for the ancillary services transceiver and the Tx/Rx antenna.

Based on the available data XISP-Inc is confident that both Raytheon and Tethers Unlimited can individually supply a satisfactory and sufficient instance of the required primary hardware and embedded software components that they have been assigned within the program time and resource limits to complete the technology development and support the technology demonstration. In fact, either entity could likely supply a suitable unified transceiver and rectenna/Tx&Rx antenna given sufficient time and resources. However, it is anticipated that the combination of both contractors working with XISP-Inc as a collaborative team will maximize the probability of assured timely payload delivery, a more capable end-to-end system, and the most cost effective implementation that can be both demonstrated and deployed for use on the initial and subsequent missions.

The work will kick off with a payload and client/customer requirements review which will culminate with a “flat sat” mixed-mode testbed bakeoff to establish the interface lines, test points, test interfaces to be used during ground test and support during the mission.

Authorized work will be allocated between the subcontractors based on the established interface lines from the testbed bakeoff. Based on periodic review the interface lines maybe adjusted to reflect actual demonstrated progress made by each subcontractor.

In parallel, the university research team will research how the rectenna, the Tx&Rx antenna, and solar arrays if applicable can be converged, their piecewise and overall efficiency improved, the development of an experiment operations support plan, and customer development initiatives.

Each subcontractor will test what they have built and when complete deliver the protoflight equipment to the University of Maryland for integration and subsequent testing at the Naval Research Lab.

Surface-to-Surface Power & Ancillary Services Beaming

The payload will then be delivered to the Launch provider for integration with the lunar lander.

During the Flight Phase the initial focus will be on optimizing the operational software environment of the XISP-Inc virtual Payload Operations workstation, then successfully completing integration with the lunar lander, building a compendium of all allowable payload state transitions, definition and walk-through of all experimental procedures including edge case recoveries, support of payload checkout and operations, and data management plan follow through. The nominal mission schedule is shown in Table 2 – SSP&asB Nominal Mission Schedule.

I. Data Management Plan

All SSP&asB payload commands received and telemetry generated will be logged with a consistent time base along with any applicable ancillary data from the lunar lander that must be captured. Appropriate Quality of Service (QoS) headers will be inlaid and the data queued for transmit. The data will be buffered by the SSP&asB payload until confirmation of receipt on the ground is received. The data will be forwarded to the XISP-Inc virtual Payload Operations Center workstation(s) for immediate processing to displays, near real-time synthesis, off-line analysis, and archival storage of the raw data sets. All XISP-Inc virtual Payload Operations Center workstation displays will be captured as NASA ARC Open Mission Control Technologies (MCT) telemetry and command streams (or equivalent) integrated into a near real-time state model of the SSP&asB payload. All SSP&asB payload commands generated and telemetry received will be logged with a consistent time base along with any applicable ancillary data from the Mission Operations Center that must be captured. Appropriate Quality of Service (QoS) headers will be inlaid and the data queued for transmit. The data will be buffered by the XISP-Inc virtual Payload Operations Center workstations until confirmation of receipt by the SSP&asB payload has been received. All off-line analysis will be time tagged, linked to the source data, generated results, recommended command sequences for the next work cycle, and copied to the SSP&asB payload ground archive. Once payload operations end, the performance analysis is complete, and the payload mission report has been published a full mission data archive will be provided to NASA and maintained in the XISP-Inc payload mission data repository for use as the starting point for the next payload mission.

Surface-to-Surface Power & Ancillary Services Beaming

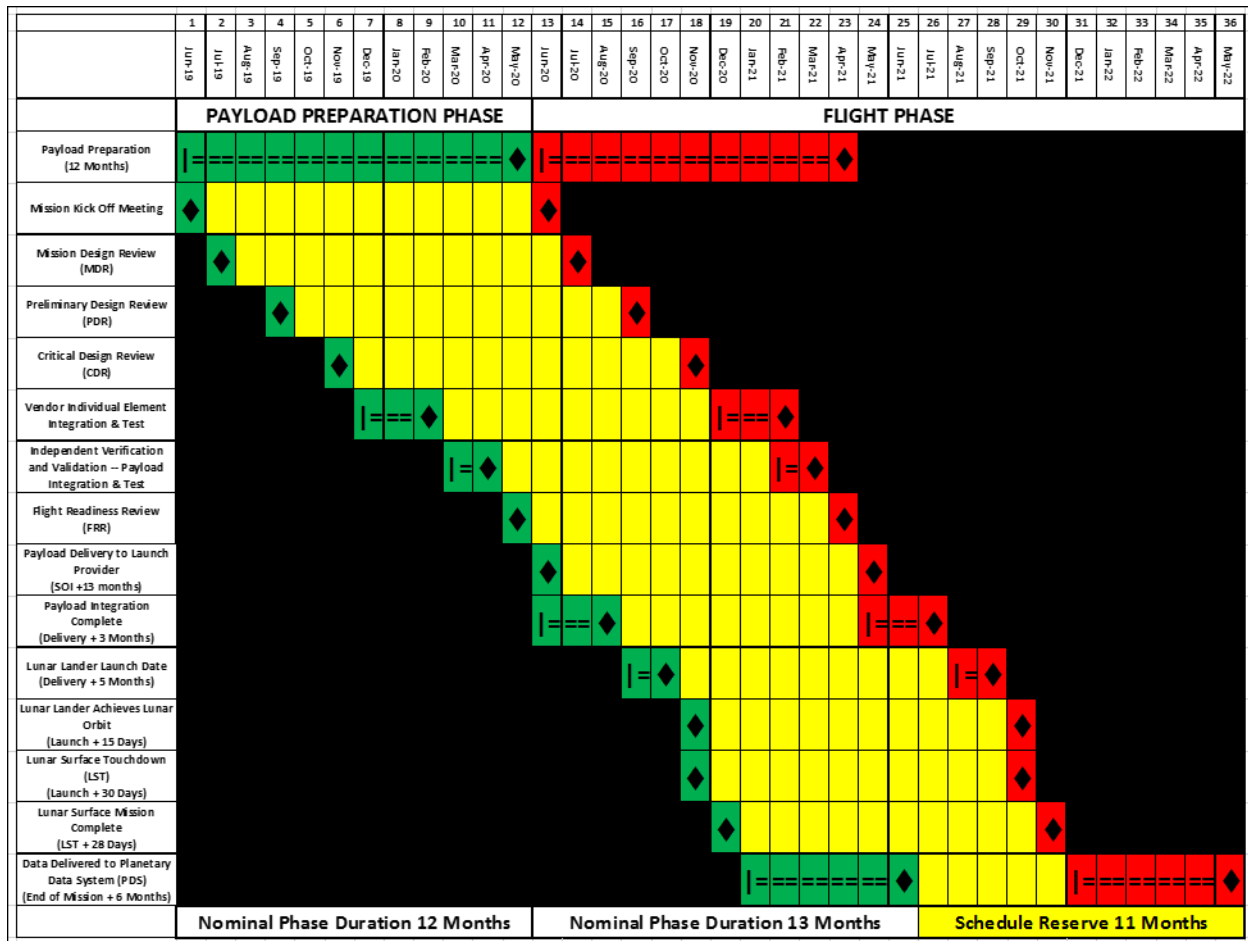


Table 2 – SSP&asB Nominal Mission Schedule

The SSP&asB Payload plans for data analysis include near real-time data display, quick reaction data synthesis, off-line data analysis, data availability to the community of interest as soon as it can be presented and published in the appropriate technical fora:

- International Space Development Conference (ISDC) (May),
- International Space Station/Cislunar R&D Conference (June),
- AIAA Space Forum (August),
- International Astronautical Congress (IAC) (October),
- Lunar Exploration Analysis Group (LEAG) (November), and
- IEEE Wireless in Space and Extreme Environments (WiSEE) (December).

The proposed SSP&asB mission will archive all correlated primary and ancillary data as well as all mission related work products in the Planetary Data System (PDS) and other repositories as requested.

J. Special Content **Intrinsic Merit Considerations**

Surface-to-Surface Power & Ancillary Services Beaming

- The proposed SSP&asB payload leverages mature hardware with a TRL of 8/9 that is reset to TRL 5 due to the novel application/environment and some repackaging required. The mission plan calls for a baseline that minimizes the hardware and/or software modifications required to deliver the payload and allows for layering on enhancements that maximize the value of the payload for technology development, demonstration, and deployment.
- The proposed SSP&asB payload leverages hardware designs with an established testing heritage, already factors in resource constraints (mass, volume, power, etc.), and is sourced from a vendor base that is committed to fielding products with a high degree of interoperability.
- The proposed SSP&asB payload management plan leverages the proven skill sets of entities with a more than sufficient depth and breadth of experience to successfully accomplish the proposed mission. Explicit provisions for managing cost, schedule, and technical risk. The combination of cooperation, collaboration, and competition proposed maximizes the probability of mission success and the value proposition of the same. The project timeline provides for Payload Preparation Phase with a nominal phase duration of 12 months, a Flight Phase with a nominal phase duration of 13 months, and a Schedule Reserve of 11 months.
- The effectiveness and resilience of the proposed SSP&asB payload experiment design draws on the over six years of mission development work by XISP-Inc and the Space-to-Space Power Beaming TD³ mission consortium, as well as the product development work of the participating vendors. The methods, techniques, and approaches draw on this cumulative experience base to offer a payload mission which is biased to success.
- The goals/objectives of the proposed SSP&asB payload mission are clearly articulated and achievable with a high degree of operational resiliency; affording the ability to withstand adverse circumstances, and provide the potential to recover from anomalies.
- The qualification, capabilities, and expertise of the proposed personnel (XISP-Inc Staff/Consultants) include over 300 cumulative years of systems engineering experience. Combined with the skills the commercial entities, universities, government agencies, and non-profit organizations bring to the table the SSP&asB payload mission will have an extraordinary pool of resources to draw on to achieve mission success. The multiplicity of resources is in part necessary to provide resiliency against an unknown timeline may extend the launch date by months to several years from the planning schedule. There is a Principal Investigator designated as key personnel for this mission all other contributing resources are mutable as necessary to maximize the probability of mission success. The proposed role of each resource (entity/individual) has been clearly defined and is or may be necessary to ensure mission success.
- The SSP&asB Payload Preparation Phase is focused on providing a payload for the earliest missions so that the probability of evolution and reflight as lunar lander infrastructure is maximized.
- The SSP&asB Payload plans for data analysis include near real-time data display, quick reaction data synthesis, off-line data analysis, data availability to the community of interest

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as soon as it can be presented and published in the appropriate technical fora (i.e., ISDC, ISS/Cislunar R&D, AIAA Space Forum, IAC, LEAG, IEEE WiSEE), and detailed archiving plan including all correlated primary and ancillary data as well as all mission related work products.

Cost Considerations

- The SSP&asB Payload Preparation Phase costing is based on the \$3 million dollar cost guidance provided.
- The SSP&asB Flight Phase costing is based on the \$2 million dollar cost guidance provided.
- The Principal Investigator has proven history of successfully managing complex systems engineering projects for NASA, Commercial, University, Other Government Agencies, and Non-profit Clients as well as Internal Research & Development programs.
- XISP-Inc as a virtual enterprise provides cost-effective access to an extraordinary talent pool.
- XISP-Inc is a small business and has included a small business contracting plan.

Space-to-Space Power Beaming (SSPB) TD³ mission – a leverageable resource

The Space-to-Space Power Beaming (SSPB) TD³ mission, planned for implementation on the International Space Station (ISS) builds on foundational research in the field as well as mission development work accomplished to date by the proposed Principal Investigator (PI), XISP-Inc, and the XISP-Inc SSPB Consortium participants. The overarching objective of this mission is to hasten the development of viable applications of SSPB technology and ancillary services through focused incremental efforts that bridge the technology development “valley of death” as well as substantially mitigate perceived and actual cost, schedule, and technical risk associated with applications of the technology. The SSPB mission objectives include the technology development necessary to support the unbundling of a commercially relevant space power system (i.e., the separation of power generation, transmission, distribution, and loads) along with the multiplexing of ancillary services (e.g., data, communications, navigation, time) to enable Space-to-Space and Space-to-Alternate Surface power beaming, and support the evolution of Space-to-Earth power beaming.

The first phase (Phase I) of the SSPB mission is technology development. This includes lab/ground test work (XISP-Inc & teammate Internal Research and Development (IRaD) and leverageable contract research & development) which will transition into highly configurable space-qualified instances of Software Defined RF (SDR) transceivers, rectennas, and related control systems. These elements will have mutable/switchable apertures (frequency-agnostic radiant energy beaming source), separate and converged conformal rectenna/solar array/antenna constructs that are configurable/tunable (combination of phased array, reflectarray, and multi-layer/junction, and related technologies), and software-driven controls. The elements will be integrated to form an on-orbit testbed consisting of an ISS-based transceiver, a co-orbiting CubeSat flight test article, and related management operations control applications. The testbed

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will support the near-real-time characterization, optimization, and operationalization of an unbundled power and ancillary services beaming system.

The ability to provide power and ancillary services when and where needed is essential to virtually all aspects of human endeavor and enables all forms of space development / settlement. The SSPB missions will deliver significant commercial value in the form of power and bi-directional ancillary services to a growing number of customers interested in co-orbiting with the ISS and lay the foundation for a myriad of Cislunar applications. Furthermore, space solar power technology holds the promise of being one of the few large-scale energy generation options that can scale upward to meet the growing electrical energy demand both for space and for terrestrial applications worldwide. This mission is a unique opportunity to foster the development of space-to-space power beaming, by leveraging ISS resources to create a SSPB testbed environment on and near the ISS that supports the development of frequency-agnostic radiant energy beaming technology. A visualization of the mission is shown in Figure 2 SSPB Mission Overview.



Figure 2 - SSPB Mission Overview

III. References and Citations

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IV. **Biographical Sketch for the Principal Investigator**

PROFESSIONAL BIOGRAPHY: Gary Pearce Barnhard

A self-described synergistic technological philanthropist, entrepreneur, and serial venture capitalist now serving as the President & CEO of Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc) a start-up company focused on International Space Station technology development, demonstration and deployment work. He also owns Barnhard Associates, LLC, a systems engineering consulting firm and Internet Service Provider (Xisp.net) based in Cabin John, Maryland. He is a robotic space systems engineer whose professional work includes a wide range of robotic, space, and computer systems engineering projects. He received a Bachelor of Science in Engineering from the University of Maryland College Park in 1982 combining Aerospace Engineering, Materials Science, with graduate work in science policy, solar physics, and artificial intelligence/knowledge based systems. He served as a Space Systems Engineer and Information Systems Architect for EER Systems, and as a Senior Space Systems Engineer on the Grumman Space Station Systems Engineering and Integration Contract (SSEIC) responsible for advanced automation and robotic systems support. He was the Executive Secretary of the Space Station Freedom Program Robotics Working Group and received a NASA Group Achievement Award for the Robotic Systems Integration Standards Interface Design Review Team, as well as an Outstanding Support Award from the Canadian Space Agency Space Station Freedom Program Liaison Office. He is an Associate Fellow of the AIAA. He is a member of the AIAA Space Colonization Technical Committee and the AIAA Space Automation and Robotics Technical Committee.

He is a life member of the National Space Society (NSS) serving the society in many capacities and has received multiple awards including NSS Pioneering Space Award (2004); NSS Award for Excellence in (2005) & (2008). He was the Executive Director and co-founder of 1000+ member Space Interest Group MSFA/MASC (1977-1982) (L5 Society affiliate). Other space advocacy involvement includes: Space Development Foundation Founder/President/CEO, Space Studies Institute (SSI) Senior Associate, Planetary Society member, American Astronautical Society (AAS) member, Space Frontier Foundation (SFF) Advocate, and Students for the Exploration and Development of Space (SEDS) Alumni.

Author and/or co-author and presenter of over fifty-eight space related professional papers and/or technical presentations (2005 – present) to a wide range of professional fora sponsored by the AIAA, IEEE, IAC, NASA, AAS, NSS, and CASIS as well as space media.

KEY EXPERIENCE SUMMARY:

In particular, my previous work on the Space Station Engineering and Integration Contract (SSEIC) that is highly relevant included serving as the Automation & Robotics Lead Engineer for the Structures, Mechanisms & Robotics Branch of SSEIC. I was the SSEIC recognized expert in robotic, space, and computer systems analysis/systems engineering responsible for evaluating all robotics (and most advanced automation) related Space Station Control Board (SSCB)

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Engineering Change Requests, writing the SSEIC opinion, jurying all SSCB opinions, and presenting the integrated decision package to the SSCB.

Key activities included: development, negotiation & documentation of the Robotic Systems Integration Standards (RSIS), Volume I: Robotic Accommodation Requirements, and Volume II: Robotic Interface Standards; analysis of collision detection & avoidance methods; development & assessment of fault tolerant system architectures; technical risk assessment/mitigation; and Space Station Robotics Working Group support as SSEIC Lead & Executive Secretary. These efforts required extensive negotiation/collaboration with NASA centers, industry, international partners, and academia.

I was responsible for definition, management, verifiability, and flow down of Program & System level requirements for advanced automation and robotics for the Space Station Program, SSEIC technical Lead and coauthor of the Systems Requirements documents for the Mobile Servicing Centre (MSC) and the Special Purpose Dexterous Manipulator (SPDM). I lead the team responsible, and received a NASA Group Achievement Award, for the development of the Robotic Systems Integration Standards (RSIS) Volumes I (Accommodation Requirements) & Volume II (Interface Standards), and I lead the Space Station External Utility Port Standardization project. I was a direct participant in requirements/interface negotiation, design assessment/review, and interdisciplinary problem resolution for all Space Station robotic systems/elements and Space Station Program level reviews.

Other prior work that is relevant includes: participant in the development and analysis of the Space Station User Information System Requirements, and the Space Station Data Systems Requirements, architect and lead engineer for the development of a master engineering database system and modeling tools for the support of multi-discipline systems engineering design analysis, concept development, and problem resolution. I also served as part of the Space Station Mission Requirements Working Group Technology Development Missions Panel responsible for the NASA GSFC Technology Development Missions, co-authored all NASA GSFC Space Station Mission Requirements Working Group Data Base submissions and supported the editing and review of all submissions.

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V. Table of Personnel and Work Effort

XISP-Inc:

Overall payload systems engineering, integration, and operations

- Principal Investigator – Gary Pearce Barnhard (.5 FTE average)
- Staff – (0 to 2 FTE total)
 - Some number of the consultants/university researchers will likely become XISP-Inc Staff
 - XISP-Inc is committed to hiring staff as soon as practical. All consultants/university researchers may apply for any full or part-time slots to be filled. Current facilities can accommodate up to 5 FTE including the PI.
- Consultants – (2 FTE total)

Consultant III – University Researchers: (1.0 FTE total)

- CalTech – Michael Kelzenberg, et al. – reflectarray Solar/Rectenna/Tx&Rx antenna efficiency
- Colorado School of Mines – George Sowers, et al. – customer development
- Michigan Technical University E&C Engineering – Reza Zekavat, et al. – piecewise efficiency
- St. Louis University – Michael Swartout, et al. – small sat technology resources
- Univ. of MD Space Systems Lab – David Akin, et al. – integration, test & operations support
- Univ. of ND Space Systems Lab – Sima Noghanian, et al. – antenna/rectenna design
- Univ. of NM COSMIAC Lab -- Christos Christodoulou, et al. – antenna/rectenna design

Consultant II – Mission Subject Matter Specialists: (.8 FTE total)

- Seth Potter - Beam Forming & Space Systems Engineering
- Brad Blair - Commercial Mission Development & Economics
- Richard Dickinson - Power Beaming & Technology Development
- David Cheuvront - Space Systems Engineering
- Ken Ford -- Program Implementation & Space Systems Engineering
- John Mankins - Space Solar Power & Technology Development
- Paul Werbos - Energy/Physics Modeling & Technology Development
- Richard Dickinson - Power Beaming & Technology Development

Consultant I – Mission Discipline Analysts: (.2 FTE total)

- Tim Cash - RF Systems Testing
- Brahm Segal - RF/Power systems engineering, test, verification & validation

Equipment Vendors:

- Raytheon, Inc. – Equipment Vendor – Power Transmitter & Rectenna
 - Hooman Kazemi (Lead)
 - James McSpadden

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- Avram Bar Cohen
- Tethers Unlimited, Inc. – Equipment Vendor – Ancillary Services Transceiver & Tx/Rx Antenna
 - Robert Hoyt, et al.
- Immortal Data, Inc. – Equipment Vendor – Data Acquisition & Capture System
 - Dale Amon, et al.

Subcontractors:

- University of MD Space Systems Lab – Integration Facility Provider
 - Dave Akin, et al.
- Oceaneering Space Systems, Inc. – Interface Engineering & Integration
 - Michael Withey, et al.

Facilities:

- Barnhard Associates, LLC – Technical offices/lab, contract admin
 - Gary Barnhard, et al.
- Naval Research Laboratory – Integrated Test Facility Provider
 - Paul Jaffe, et al.

XISP-Inc TD³ Mission Development Consortium Participants (US Only):

Commercial Entities:

- XISP-Inc - Consortium Participant
- Barnhard Associates, LLC - Consortium Participant
- Raytheon, Inc. - Consortium Participant
- Northrop Grumman Innovation Systems (formerly Orbital ATK) - Consortium Participant
- Immortal Data, Inc. - Consortium Participant
- Made In Space, Inc. - Consortium Participant
- Blue Canyon Technologies, Inc. - Consortium Participant
- Oceaneering Space Systems - Consortium Participant
- Tethers Unlimited, Inc. - Consortium Participant

Customers:

- United Launch Alliance - Potential Customer
- ViaSat - Potential Customer
- Blue Origin - Potential Customer
- Northrop Grumman Innovation Systems (formerly Orbital ATK) - Potential Customer
- Made In Space, Inc. - Potential Customer
- Orbit Fab, Inc. - Potential Customer

Consultants:

- Seth Potter - Beam Forming & Space Systems Engineering
- Brad Blair - Commercial Mission Development & Economics
- Joseph Rauscher - Cooperative Agreements and Administration
- David Chevront - Space Systems Engineering
- Ken Ford -- Program Implementation & Space Systems Engineering
- John Mankins - Space Solar Power & Technology Development
- Paul Verbos - Energy/Physics Modeling & Technology Development
- Richard Dickinson - Power Beaming & Technology Development
- Michael Doty - Systems Integration
- Aaron Harper - Communications & Data Systems Engineering

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- Tim Cash - RF Systems Testing
- Brahm Segal - RF/Power systems engineering, test, verification & validation
- Tom Nugent - Optical Systems Testing
- Christopher Cassell - Orbital Dynamics
- Ed Belbruno -- Orbital Dynamics
- Eric Dahlstrom -- Space Systems Engineering

Government:

- Naval Research Laboratory (Paul Jaffe, et al.) - Consortium Participant
- NASA HEOMD AESD - Division Deputy (John Guidi.) - Consortium Participant
- NASA HEOMD SCan - Cislunar Comm & Nav Architect (Jim Schier, et al.) - Consortium Participant
- NASA SMB – Jim Green, et al. – Potential Consortium Participant
- AFRL Space Solar Power Initiative - Potential Consortium Participant

Non-Profit:

- US National Laboratory/CASIS (Etop Esen, et al.) - Consortium Participant
- National Space Society (Michael Snyder, et al.) - Consortium Participant
- Space Development Foundation (Joseph Rauscher, et al.) - Consortium Participant
- Heinlein Prize Trust (Buckner Hightower, et.al.) - Potential Consortium Participant

Universities:

- University of Maryland Space Systems Lab (David Akin, et al.) - Consortium Participant
- University of North Dakota Space Systems Lab (Sima Noghanian, et al.) - Consortium Participant
- University of New Mexico COSMIAC Lab (Christos Christodoulou, et al.) - Consortium Participant
- St. Louis University (Michael Swartwout, et al.) - Consortium Participant
- Michigan Technological University (Reza Zekavat, et al.) – Consortium Participant
- Colorado School of Mines (George Sowers, et al.) – Consortium Participant
- California Institute of Technology (Michael Kelzenberg, et al.) – Consortium Participant

VI. Current and Pending Support

The Principle Investigator has no current and/or pending support obligations.

However, multiple proposals are in development or being evaluated that involve complementary/leverageable work which could obligate up .5 FTE of the PI's time hence his availability for this proposal is set to .5 FTE (average).

The availability of all staff/consultants while variable has been affirmed with each individual as of the time of proposal submittal.

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VII. Statements of Commitment and Letters of Support

- See Appendix E

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VIII. Budget Justification

Payload Preparation Phase Budget

See Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Payload Preparation Phase Budget. Annotated narrative summary is as follows:

\$ 2,845,529 w/o G&A, Profit, Government Lab Costs

\$ 3,483,090 Estimated Total Payload Preparation Phase Cost

- XISP-Inc – Overall payload systems engineering, integration, and operations
 - Direct Labor – See Table 3 – XISP-Inc Direct Labor
 - Travel –
 - Based on defined trip schedule
 - Meeting space & hotel room blocks will be negotiated with The Hotel at the University of Maryland.
 - Lab space will be negotiated with the UMD Space Systems Lab as needed.
- Material Equipment and Other Direct Costs (ODCs)
 - Raytheon, Inc. – Transmitter and Rectenna – An XISP-Inc generated estimate for replicated equipment, repackaged, and tweaked to meet C/C requirements has been provided. Specific leverage considerations must be negotiated between Raytheon, XISP-Inc, NASA, and AFRL to realize the anticipated cost reductions/offsets factored in before a Firm Quote can be provided.
 - Tethers Unlimited, Inc. – Transceiver and Tx/Rx Antenna – Firm Quote
 - Immortal Data, Inc. – Data Acquisition and Capture System – Firm Quote
- Subcontracts
 - University of Maryland Space Systems Lab – Integration Facility Provider w/Design Review, Testing, and Operations Support – XISP-Inc Estimate
 - Oceaneering Space Systems, Inc. – Interface Engineering & Integration – XISP-Inc Estimate
- Consultants
 - Consultant III - University Researchers ((XISP-Inc discounted blended rate)
 - Consultant II - Mission Subject Matter Specialists (XISP-Inc discounted rates)
 - Consultant I - Mission Discipline Analysts (XISP-Inc discounted rates)
- Cost Reserve
 - A five (5) percent cost reserve was included in the budget for contingency resolution.
- General & Administrative (G&A)
 - The de minimus G&A election of 10% was included.
- Offeror Profit

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- Based on established contracting precedent for Barnhard Associates, LLC the offeror profit of 10% was included.
- NASA Civil Servant/Other Government Labs
 - Naval Research Laboratory (NRL) – Integrated Test Facility Provider w/Testing Support (XISP-Inc negotiated flat rate access to available environmental testing facilities including but not limited to thermal, vacuum, and EMC/EMI). NRL Estimate

The Payload Preparation Phase Budget includes:

- ***Kick-Off Mission Kick-Off Meeting – Month 1***
 - All hands face-to-face meeting at The Hotel at the University of Maryland
 - Lunar Lander & Launch Payload requirements development
 - Client/customer requirements development
 - Advanced Development Work
 - Piecewise and end-to-end efficiency improvement
 - Rectenna, Tx&Rx antenna, and solar arrays convergence
 - Virtual Payload Operations Center workstation implementation
- ***MDR Mission Design Review – Month 2***
 - Face-to-Face & Virtual Attendance at The Hotel at the University of Maryland
 - Development of an experiment operations support plan
 - Codify all verifiable payload and client/customer requirements
 - “Flat Sat” mixed-mode testbed bakeoff
 - Establish the interface lines, test points, and test interfaces
 - Derive repackaging requirements
 - Identify application driven piecewise/end-to-end efficiency design tweaks
- ***PDR – Preliminary Design Review – Month 4***
 - Face-to-Face & Virtual Attendance at The Hotel at the University of Maryland
 - Virtual Payload Operations Center software integration and customization
 - Disposition all Review Item Discrepancies
 - Review and baseline repackaging design
 - Review and baseline application driven design tweaks
 - Implement baseline changes to hardware/software
- ***CDR – Critical Design Review – Month 6***
 - Face-to-Face & Virtual Attendance at The Hotel at the University of Maryland
 - Verify disposition and implement all actionable Review Item Discrepancies
- Vendor Individual Element Integration & Test
 - Each equipment subcontractor will integrate and test their equipment at their facility
 - XISP-Inc Face-to-Face meetings at vendor facilities
- Independent Verification, and Validation – Payload Integration and Test

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- Each equipment subcontractor will deliver their individually tested equipment to the University of Maryland Space Systems Lab for integration and subsequent testing at the Naval Research Lab (launch environment, thermal, vacuum, EMI/EMC).
- ***FRR – Flight Readiness Review – Month 12***
 - Face-to-Face & Virtual Attendance at The Hotel at the University of Maryland
 - Clear any remaining FRR Review Item Discrepancies

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Flight Phase Budget

See Budget Table 2 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Flight Phase Budget. Annotated narrative summary is as follows:

\$ 1,546,224 w/o G&A and Fee

\$ 1,870,931 Estimated Total Flight Phase Cost

- XISP-Inc – Overall payload systems engineering, integration, and operations
 - Direct Labor – Treated as an equivalent level of effort (.5 FTE) with refocused tasking
 - Travel – Treated as equivalent dollar volume with an updated mix of destinations and with typically longer durations.
 - Based on a TBD trip schedule
 - Meeting space & hotel room blocks will be negotiated with The Hotel at the University of Maryland and other venues as needed.
 - Lab space will be negotiated with the UMD Space Systems Lab and other venues as needed.
- Material, Equipment and Other Direct Costs (ODCs)
 - Raytheon, Inc. – Technical personnel will support Lunar Lander payload integration for the equipment they provided, as well as operations planning, operations, and follow-on analysis as needed (XISP-Inc Estimate).
 - Tethers Unlimited, Inc. – Technical personnel will support Lunar Lander payload integration for the equipment they provided, as well as operations planning, operations, and follow-on analysis as needed (XISP-Inc Estimate).
 - Immortal Data, Inc. – Technical personnel will support Lunar Lander payload integration for the equipment they provided, as well as operations planning, operations, and follow-on analysis as needed (XISP-Inc Estimate).
- Subcontracts
 - University of Maryland Space Systems Lab – Technical personnel will support operations planning, operations, and follow-on analysis/review as needed (XISP-Inc Estimate).
 - Oceaneering Space Systems, Inc. – Technical personnel will support operations planning, operations, and follow-on analysis/review as needed (XISP-Inc Estimate).
- Consultants (2 FTE)
 - Consultant III - University Researchers (1 FTE) (XISP-Inc discounted blended rate)
 - Focus is on improving the mission value proposition by packaging innovations and application driven tweaks.
 - Consultant II - Mission Subject Matter Specialists (.8 FTE) (XISP-Inc discounted rates)

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- Focus is on risk management (technical, cost, schedule, etc.) and client/customer development.
 - Consultant I - Mission Discipline Analysts (.2 FTE) (XISP-Inc discounted rates)
 - Focus is on mission assurance and modeling analytics
- Cost Reserve
 - A five (5) percent cost reserve was included in the budget for contingency resolution.
- General & Administrative (G&A)
 - The de minimus G&A election of 10% was included.
- Offeror Profit
 - Based on established contracting precedent for Barnhard Associates, LLC the offeror profit of 10% was included.
- NASA Civil Servant/Other Government Labs
 - Naval Research Laboratory (NRL) – Technical personnel will support operations planning, operations, and follow-on analysis/review as needed (XISP-Inc Estimate).

The Flight Phase Budget includes:

- ***Payload delivery – Month 13***
 - The payload will be delivered to the Launch provider for integration with the lunar lander.
 - All mission team members will support the integration effort as needed.
 - Immortal Data will support the extension/enhancement of MCT software suite for payload use.
 - Systems Tool Kit (STK) “as built” analysis model will be completed.
 - Virtual Payload Operations Center Tri-Screen Workstation Kits five (5) will be procured, configured, and customized for use.
- ***Payload Integration Complete – (Delivery + 3 Months)***
 - Optimizing the operational software environment of the XISP-Inc virtual Payload Operations workstation
 - Successfully completing integration with the lunar lander
 - Building a compendium of all allowable payload state transitions
 - Definition and walk-through of all experimental procedures including edge case recoveries
- ***Lunar Lander Launch Date – (Delivery + 5 Months)***
 - XISP-Inc payload team representatives will attend launch event
- ***Lunar Lander Achieves Lunar Orbit – (Launch + 15 Days)***
- ***Lunar Surface Touchdown (LST) – (Launch + 30 Days)***
 - All mission team members will support the integration effort as needed.

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- Face-to-Face & virtual support of payload checkout and operations from designated Payload Operations Center and virtual locations as permitted.
- ***Lunar Surface Mission Complete – (LST + 28 Days)***
 - Data management plan follow through including professional fora papers/presentations based on accepted abstracts and appropriate timing:
 - International Space Development Conference (ISDC) (May),
 - International Space Station/Cislunar R&D Conference (June),
 - AIAA Space Forum (August),
 - International Astronautical Congress (IAC) (October),
 - Lunar Exploration Analysis Group (LEAG) (November), and
 - IEEE Wireless in Space and Extreme Environments (WiSEE) (December).
- ***Data Delivered to Planetary Data System (PDS) – (End of Mission + 6 Months)***

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IX. Facilities and Equipment

The execution of this payload preparation and flight phase proposal will make use of existing contractor and government facilities and equipment wherever possible.

Facilities:

- Barnhard Associates, LLC – Technical offices/lab, contract administration
- Raytheon, Inc. – Technical offices/lab, manufacturing, test
- Tethers Unlimited, Inc. – Technical offices/lab, manufacturing, test
- Immortal Data, Inc. – Technical offices/lab, manufacturing, test
- Oceaneering Space Systems, Inc. – Technical offices/lab, test
- University of MD Space Systems Lab – Integration Facility Provider
- Naval Research Laboratory – Integrated Test Facility Provider (launch environment, thermal, vacuum, EMI/EMC)

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X. Detailed Budget

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Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Payload Preparation Phase Budget			
	Payload Preparation Phase Duration: ~12 Months 6/1/2019 to 5/31/2020		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$1,682,255
● Power Transmitter & Rectenna	1,000,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna	622,255	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System	60,000	Immortal Data, Inc.	
Subcontract(s) ⁵			\$ 150,000
● Integration Facilities w/Design Review, Testing & Operations Support	100,000	UMD Space Systems Lab	
● Interface Engineering & Integration	50,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		5.00%	\$ 142,250
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 2,845,529
G&A ²		10.00%	\$ 284,553
Total Offeror Cost (U)			\$ 3,130,082
Fee -- Offeror Profit (V)		10.00%	\$ 313,008
NASA Civil Servant/Other Government Labs (W) ⁷			\$ 40,000
● Integrated Test Facilities w/Testing Support (flat rate)	40,000	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 3,483,090
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(s): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(s): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

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XISP-Inc Labor Rate Build Up - Negotiated Intellectual Property Transfer 2019 - Short Term Consulting														
Government Rates = (Salary) + (Fringe)+ (Overhead) + (G&A) + (Profit)	Salary	Fringe Variable	Fringe Fixed	Fringe Total	S+F Subtotal	Overhead	S+F+O Subtotal	G&A	S+F+O+G&A Subtotal	Profit	Raw Total	Burdened Rate	Salary Multiplier*	
Technical Labor Categories	\$/hour	23.64%	4.43%	28.08%				10%		10%	\$	\$		
CEO/Principal Investigator/Principal Systems Engineer	\$115.42	\$27.29	\$5.12	\$32.41	\$147.83	\$58.87	\$206.70	\$20.67	\$227.37	\$22.74	\$250.11	\$250	2.17	
Engineer IV - Senior Systems Engineer - Specialist (30+ years or specialty)	\$77.94	\$18.43	\$3.46	\$21.88	\$99.82	\$39.76	\$139.58	\$13.96	\$153.54	\$15.35	\$168.89	\$169	2.17	
Engineer III - Senior Systems Engineer - Specialist (20+ years or specialty)	\$67.51	\$15.96	\$2.99	\$18.96	\$86.47	\$34.44	\$120.90	\$12.09	\$132.99	\$13.30	\$146.29	\$146	2.17	
Engineer II - Systems Engineer (10-20 Years or equivalent)	\$54.34	\$12.85	\$2.41	\$15.26	\$69.60	\$27.72	\$97.32	\$9.73	\$107.05	\$10.70	\$117.75	\$118	2.17	
Engineer I - Discipline Engineer (1-10 Years or equivalent)	\$42.42	\$10.03	\$1.88	\$11.91	\$54.33	\$21.64	\$75.97	\$7.60	\$83.57	\$8.36	\$91.92	\$92	2.17	
Government Rates = (Salary) + (Fringe)+ (Overhead) + (G&A) + (Profit)	Salary	Fringe Variable	Fringe Fixed	Fringe Total	S+F Subtotal	Overhead	S+F+O Subtotal	G&A	S+F+O+G&A Subtotal	Profit	Total	Burdened Rate	Salary Multiplier*	
Administration/Support Labor Categories	\$/hour	23.64%	4.43%	28.08%				10%		10%	\$	\$		
Admin III - Contract Specialist (G5-13+ or higher/equivalent)	\$52.50	\$12.41	\$2.33	\$14.74	\$67.24	\$26.78	\$94.02	\$9.40	\$103.42	\$10.34	\$113.76	\$114	2.17	
Admin II - Systems Administration	\$39.50	\$9.34	\$1.75	\$11.09	\$50.59	\$20.15	\$70.74	\$7.07	\$77.81	\$7.78	\$85.59	\$86	2.17	
Admin I - Administrative Assistant	\$26.50	\$6.27	\$1.18	\$7.44	\$33.94	\$13.52	\$47.46	\$4.75	\$52.20	\$5.22	\$57.42	\$57	2.17	
XISP-Inc Labor Rate Build Up Summary		Technical Labor Categories				Administration/Support Labor Categories				* Typical Salary Multipliers				
Fully Burdened Rate Build Up with G&A + Profit		%	\$92	\$118	\$146	\$250					are between 2 to 3			
Salary	29.4900%	\$42.42	\$54.34	\$67.51	\$115.42	29.49%				\$26.50	\$39.50	\$52.50		
Fringe Variable	23.64%	\$10.03	\$12.85	\$15.96	\$27.29	23.64%				\$6.27	\$9.34	\$12.41		
Fringe Fixed	4.43%	\$1.88	\$2.41	\$2.99	\$5.12	4.43%				\$1.18	\$1.75	\$2.33		
Overhead	39.83%	\$21.64	\$27.72	\$34.44	\$58.87	39.83%				\$13.52	\$20.15	\$26.78		
G&A	10.00%	\$7.60	\$9.73	\$12.09	\$20.67	10.00%				\$4.75	\$7.07	\$9.40		
Profit	10.00%	\$8.36	\$10.70	\$13.30	\$22.74	10.00%				\$5.22	\$7.78	\$10.34		
Fully Burdened Rate Build Up with G&A + Profit	117.39%	\$92	\$118	\$146	\$250	117.39%				\$57	\$86	\$114		

XISP-Inc Fringe Benefits		
Cumulative Leave Cost	11.92%	
Vacation (15 Days * 8 Hours/Day)		
Holidays (10 days * 8 Hours/Day)		
Personal Leave (6 days * 8 Hours/Day)		
Social Security/FICA (on the first \$128,700 of earnings) Employer's Share	6.20%	
Medicare Taxes (no cap) Employer's Share	1.45%	
Workman's Compensation	1.07%	
Retirement - 401K	3.00%	
Variable Benefit Costs Subtotal	23.64%	
Federal Unemployment Tax (FUTA) .06% of first \$7,000	0.60%	\$ 42.00
State Unemployment Tax - Maryland (SUTA) - \$8,500 base for 2018	2.60%	\$ 182.00
Health Insurance (Single employee \$750/month)	\$ 750.00	\$ 9,000.00
Fixed Benefit Costs Subtotal		\$ 9,224.00
	2080	4.43%
Estimated Fringe Total	28.08%	

XISP-Inc Optional "Cafeteria Plan" Fringe Benefits (Employee Funded)		
Life Insurance	0.00%	
Disability Insurance	0.00%	
Relocation Assistance	0.00%	
Transportation Benefits	0.00%	
Child Care Benefits	0.00%	
Legal Assistance Plan	0.00%	
Employee Discounts	0.00%	
Fitness Center Access/Discount	0.00%	
Tuition Reimbursement	0.00%	
Meals & Cafeteria Plans	0.00%	
Vision Plan	0.00%	
Dental Plan	0.00%	
Other "bona fide" fringe benefits	0.00%	

Cumulative Leave Calculation		Annual
Total Hours - (52 Weeks x 40 hours/week)		2080
Productive Hours - (Total Hours - Leave Hours)		1832
Leave Hours		248
Percentage of Time Allocated to Leave		11.92%

Labor Year	(52 Weeks * 40 Hours/Week)	2080
Vacation	(15 Days * 8 Hours/Day)	-120
Holidays	(10 days * 8 Hours/Day)	-80
Personal	(6 days * 8 Hours/Day)	-48
Productive Hours	(Year)	1832

Projected Equivalent Technical Direct Labor Pool	
Staff #	Category Salary Rate \$+F Rate Hours Annual Cost
1	PI \$115.42 \$147.83 1832 \$270,819.56
2	EIV \$77.94 \$99.82 1832 \$182,877.12
3	EIII \$67.51 \$86.47 1832 \$158,404.34
4	EII \$54.34 \$69.60 1832 \$127,502.47
5	EI \$42.42 \$54.33 1832 \$99,533.58
6	
7	
8	
Mean Salary Rate	\$71.53 Direct Labor Pool \$839,137.07

Overhead	\$334,200
%	39.83%

Office Space Calculations	
Functional Area	Est Sq.Ft.
Office	500
Rest Room	60
Utility	30
Hallway/Planning	210
Server Room/Tools	200
Media Center ==> Lab	400
Storage	200
Estimated Sq. Footage	1600

Cross Tie to Standing Usage Estimate		
6400	25%	1600

Fair Market Value 4840 Cordell Ave.		
\$/Sq.Ft.	Sq.Ft.	\$ Annual
\$38	1600	\$60,000

XISP-Inc Overhead	Multiplier	Monthly	Annual		Basis of Overhead Estimate Provided
Bonuses	1	\$0	\$ -	=====	TBD - No prior data available
Allocated Fringe	1	\$0	\$ -	=====	TBD - No prior data available
Meetings & Conferences (Public Info & Peer Review - Registration)	3	\$ 1,000	\$ 36,000	=====	BALLC Comp - 3 X FY 2017, ~10 Conferences year, adjusted to remove in-kind offsets
Satellite Office Expenses	2	\$ 1,000	\$ 24,000	=====	BALLC Comp - Phone/Equipment/Services/Supplies
Recruitment	1	\$1,000	\$ 12,000	=====	BALLC Comp - Conference Advertising/Sponsorship
Automobile & Local Business Travel	1	\$1,500	\$ 18,000	=====	BALLC Comp - Projected Car Payment \$1,000/month + \$500/month Fuel/Insurance/Maintenance
Nonreimbursed Business Travel	2	\$1,250	\$ 30,000	=====	BALLC Comp - 2 X FY 2017 BALLC Expenses
Rent (~1600 Square Feet, \$5,000/month) Fair Market Value	1	\$ 5,000	\$ 60,000	=====	BALLC Comp - ~1600 sq.ft. in use Cabin John, MD, market rate for 50% of 4840 Cordell Ave. Rental
Office Supplies (Staples)	1	\$500	\$ 6,000	=====	BALLC Comp - typical Office Supply Expenses
IT Services (FIOS Business Services)	1	\$600	\$ 7,200	=====	BALLC Comp - Business FIOS 1 Gb Symmetric with /24 & /30 network address pools
Hardware (estimated maintenance and refresh costs)	8	\$300	\$ 28,800	=====	BALLC Comp - 8 X Typical Desktop+Laptops+Servers+Phones+Printers+Fax+WiFi
Software (Software maintenance subscription renewals)	8	\$100	\$ 9,600	=====	BALLC Comp - 8 X Groupware, Office Pro+, Acrobat, Creative Suite, Symantec, etc.
Software (Specialty License/Maintenance subscription renewals)	1	\$1,750	\$ 21,000	=====	BALLC Comp - 1 X Shared License AutoCAD, STK, MatLab, etc.
Printing	1	\$300	\$ 3,600	=====	BALLC Comp - Solid Ink, Toner Cartridges, business cards, banner, posters, etc
Telephone	1	\$500	\$ 6,000	=====	BALLC Comp - Landlines + Cell Phones
Indirect labor costs directly associated with contract 40/hr month	1	\$ 5,000	\$ 72,000	=====	BALLC Comp - Prior BALLC contracting experience and similarity to other contractors
Estimated Overhead Budget			\$ 334,200		
Direct Labor Pool			\$839,137		
Estimated Overhead Rate (Annual Overhead/Annual Direct Labor)			39.83%		

Surface-to-Surface Power & Ancillary Services Beaming

[illegible]

Budget Table 4D – XISP-Inc Wage Comparison Data 17-2011 Aerospace Engineers									
SOURCE OF WAGE COMPARISON DATA https://www.bls.gov/oes/current/oes172011.htm#(2) Occupational Employment and Wages, May 2017 Bureau of Labor Statistics (BLS) 17-2011 Aerospace Engineers									
Perform engineering duties in designing, constructing, and testing aircraft, missiles, and spacecraft. May conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture. May recommend improvements in testing equipment and techniques.									
National Percentile	10%	25%	50%	75%	90%	Location Adjusted Percentile	MD/DC/VA	Los Angeles, CA	Boulder, CO
			(Median)			(Mean)	(Mean)	(Mean)	
Hourly Wage Data BLS	\$34.06	\$42.42	\$54.34	\$67.51	\$77.94	Hourly Wage Data BLS	\$66.23	\$63.75	\$62.44
Annual Wage (See Note 1)	\$70,840	\$88,240	\$113,030	\$140,420	\$162,110	Annual Wage (See Note 1)	\$137,750	\$132,600	\$129,880
XISP-Inc Wage Data		Engineer I	Engineer II	Engineer III	Engineer IV	XISP-Inc Wage Data	(Mean)	(Mean)	(Mean)
XISP-Inc 2018 Hourly Wage		\$42.42	\$54.34	\$67.51	\$77.94	Mean Hourly Wage Proposed	\$66.23	\$63.75	\$62.44
Annual Wage (See Note 1)		\$88,234	\$113,027	\$140,421	\$162,115	Annual Wage (See Note 1)	\$137,750	\$132,600	\$129,880
Compare XISP-Inc vs BLS Percentiles		25th	50th	75th	90th	Comparison XISP-Inc vs BLS Mean	Equal BLS Mean	Equal BLS Mean	Equal BLS Mean
NOTES: (1) Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly wage published, the annual wage has been directly calculated from the reported survey data.									
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Technical Labor Categories and Rates Effective January 1, 2019									
Technical Labor Categories	Engineer I	Engineer II	Engineer III	Engineer IV		Administrative Labor Categories	Admin I	Admin II	Admin III
XISP-Inc Fully Burdened Billing Rate	\$91.92	\$117.75	\$146.29	\$168.89		XISP-Inc Fully Burdened Billing Rate	\$40.00	\$70.00	\$100.00
XISP-Inc 2018 Hourly Wage	\$42.42	\$54.34	\$67.51	\$77.94		XISP-Inc 2018 Hourly Wage	\$19.95	\$34.92	\$49.88
Burden Expressed as Multiplier	2.17	2.17	2.17	2.17		Burden Expressed as Multiplier	2.00	2.00	2.00
Burden Expressed as Percentage	46%	46%	46%	46%		Burden Expressed as Percentage	50%	50%	50%
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Administrative Labor Categories and Rates Effective January 1, 2019									

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 4D – XISP-Inc Wage Comparison Data 11-1011 Chief Executives												
SOURCE OF WAGE COMPARISON DATA https://www.bls.gov/oes/2017/may/oes111011.htm#(2) Occupational Employment and Wages, May 2017 Bureau of Labor Statistics (BLS) 11-1011 Chief Executives Determine and formulate policies and provide overall direction of companies or private and public sector organizations within guidelines set up by a board of directors or similar governing body. Plan, direct, or coordinate operational activities at the highest level of management with the help of subordinate executives and staff managers.												
National Percentile	10%	25%	50%	75%	MD/DC/VA	Location Adjusted Percentile	MD/DC/VA					
			(Median)		(Mean)		(Mean)					
Hourly Wage Data BLS	\$32.74	\$54.55	\$88.11	\$100.00	\$115.42	Hourly Wage Data BLS	\$115.42					
Annual Wage (See Note 1)	\$68,110	\$113,470	\$183,270	\$208,000	\$240,080	Annual Wage (See Note 1)	\$240,080					
XISP-Inc Wage Data					CEO/PI	XISP-Inc Wage Data	(Mean)					
XISP-Inc 2018 Hourly Wage					\$115.42	Mean Hourly Wage Proposed	\$115.42					
Annual Wage (See Note 1)					\$240,080	Annual Wage (See Note 1)	\$240,080					
Compare XISP-Inc vs BLS Percentiles					Less than 90th	Comparison XISP-Inc vs BLS Mean	Equal BLS Mean					
NOTES: (1) Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly wage published, the annual wage has												
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Technical Labor Categories and Rates Effective January 1, 2019 - No IP Transfer						Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Administrative Labor Categories and Rates Effective January 1, 2018						
Technical Labor Categories					CEO/PI	Administrative Labor Categories	Admin I	Admin II	Admin III			
XISP-Inc Fully Burdened Billing Rate					\$225.00	XISP-Inc Fully Burdened Billing Rate	\$40.00	\$70.00	\$100.00			
XISP-Inc 2018 Hourly Wage					\$115.42	XISP-Inc 2018 Hourly Wage	\$19.95	\$34.92	\$49.88			
Burden Expressed as Multiplier					1.95	Burden Expressed as Multiplier	2.00	2.00	2.00			
Burden Expressed as Percentage					51%	Burden Expressed as Percentage	50%	50%	50%			

Budget Table 3 – XISP-Inc Direct Labor Cost (In-House Staff Employees Technical)												
Employee Name	Salary Hourly Rate	Fringe Rate	Overhead Rate	Burdened Direct Labor Rates	G&A Rate	Burdened Direct Labor Rates	Profit Rate	Fully Burdened Direct Labor Rates	Salary Multiplier	Annual Proposed Labor	Annual Proposed Labor	Annual Proposed Labor
Title												
Relevant Specialized Skill/Experience	(\$)	28.08%	39.83%	(\$+F+O)	10%	(\$+F+O+G&A)	10%	(\$)		(FTE)	(Hours)	(\$)
Gary Barnhard Principal Investigator & Mission Technical Director Computer/Robotics/Space Systems Engineer (35+ years)	\$115.42	\$32.41	\$58.87	\$206.70	\$20.67	\$227.37	\$22.74	\$250	2.2	0.50	916	\$229,100.11
New Hire Engineer IV - Senior Systems Engineer (30+ years or specialist) TBD	\$77.94	\$21.88	\$39.76	\$139.58	\$13.96	\$153.54	\$15.35	\$169	2.2	0.00	0	\$-
New Hire Engineer III - Senior Systems Engineer (20+ years or specialist) TBD	\$67.51	\$18.96	\$34.44	\$120.90	\$12.09	\$132.99	\$13.30	\$146	2.2	0.00	0	\$-
New Hire Engineer II - Systems Engineer (10-20 Years or equivalent) TBD	\$54.34	\$15.26	\$27.72	\$97.32	\$9.73	\$107.05	\$10.70	\$118	2.2	0.00	0	\$-
New Hire Engineer I - Discipline Engineer TBD	\$42.42	\$11.91	\$21.64	\$75.97	\$7.60	\$83.57	\$8.36	\$92	2.2	0.00	0	\$-
Estimated Annual XISP-Inc Direct Labor FTE										0.50		
Estimated Annual XISP-Inc Direct Labor Hours											916	
Estimated Annual XISP-Inc Fully Burdened Direct Labor Cost												\$229,100
Notes: (1) XISP-Inc FTE = 1832 Hours (2) Additional cost metrics (3) New hires are subject to the availability of funds, changes in prospective employee circumstance, and mutual agreement on employment contract terms. (4) Second and third year labor rates are subject to a to be negotiated labor rate escalation percentage.												
				XISP-Inc Blended Hourly Rate		\$250.11		XISP-Inc Blended FTE Annual Cost				\$458,200

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 8 – XISP-Inc Consultant Labor Rates								
Consultant Name	Standard Hourly Rate	XISP-Inc Consultant's Hourly Rates*	XISP-Inc G&A Rate	XISP-Inc Profit Rate	Fully Burdened Consulting Rates	Annual Proposed Labor	Annual Proposed Labor	Annual Extended Cost
Consultant Company (If Applicable)								
Consultant Labor Category								
Relevant Specialized Skill/Experience								
Variable (see list in proposal narrative)	Blended Rate \$30 to \$225	\$150.00	\$15.00	\$16.50	\$181.50	1	1832	\$274,800
University Researchers								
Blended Rate Honorarium								
Specialist/Discipline Analyst/Technician/Operator								
Consultant Type III Subtotal						1	1832	
John Mankins	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Mankins Space Technology, Inc.								
Mission Subject Matter Specialist								
Space Solar Power & Technology Development								
Richard Dickinson	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Mankins Space Technology, Inc.								
Mission Subject Matter Specialist								
Power Beaming & Technology Development								
Paul Verbos	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
IntControl LLC								
Mission Subject Matter Specialist								
Energy/Physics Modeling & TD ³ Systems								
David Cheuvront	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Integration, Verification & Validation, Reliability								
Seth Potter	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Beam Forming & Systems Engineering								
Brad Blair	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,643
NewSpace Analytics LLC								
Mission Subject Matter Specialist								
Economic Analysis & Customer Development								
Eric Dahlstrom	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
International Space Consultants								
Mission Subject Matter Specialist								
Mission Planning & Space Systems Engineering								
Ken Ford	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Program Implementation								
Consultant Type II Subtotal						0.8	1466	
Tim Cash	\$150.00	\$100.00	\$10.00	\$11.00	\$121.00	0.1	183	\$ 18,320
Independent Consultant								
Mission Discipline Analyst								
Radio Frequency Systems Testing								
Brahm Segal	\$150.00	\$100.00	\$10.00	\$11.00	\$121.00	0.1	183	\$ 18,320
Power Correction Systems, Inc.								
Mission Discipline Analyst								
Power Conversion Efficiency Testing & Optimization								
Consultant Type I Subtotal						0.2	366	
Estimated Annual XISP-Inc Consultant FTE						2.0		
Estimated Annual XISP-Inc Consultant Labor Hours							3664	
Estimated Annual XISP-Inc Fully Burdened Consultant Labor								\$604,563
Effective Blended Hourly Rate								\$ 165.00
Notes:								
(1) XISP-Inc Full Time Equivalent (FTE) = 1832 Hours								
(2) The difference between the Consultants Standard Hourly Rate and the XISP-Inc Consultant's Hourly Rate must be spread to average out.								
(3) Please note this table has representative place holder values that must be confirmed by the individual consultants.								
(4) The allowable costs incurred for Consultant participation must in most instances be covered by XISP-Inc and allocated to the proper cost pool.								

Surface-to-Surface Power & Ancillary Services Beaming

XI. Appendices

A. "Total" Budget

- a. Detailed Cost Estimate Payload Preparation Phase (PPP)
- b. Preliminary Cost Estimate Flight Phase (FP)
- c. Quotes

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Payload Preparation Phase Budget			
	Payload Preparation Phase Duration: ~12 Months 6/1/2019 to 5/31/2020		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$1,682,255
● Power Transmitter & Rectenna	1,000,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna	622,255	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System	60,000	Immortal Data, Inc.	
Subcontract(s) ⁵			\$ 150,000
● Integration Facilities w/Design Review, Testing & Operations Support	100,000	UMD Space Systems Lab	
● Interface Engineering & Integration	50,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		5.00%	\$ 142,250
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 2,845,529
G&A ²		10.00%	\$ 284,553
Total Offeror Cost (U)			\$ 3,130,082
Fee -- Offeror Profit (V)		10.00%	\$ 313,008
NASA Civil Servant/Other Government Labs (W) ⁷			\$ 40,000
● Integrated Test Facilities w/Testing Support (flat rate)	40,000	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 3,483,090
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(s): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(s): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Preliminary Flight Phase Budget			
	Payload Preparation Phase Duration: ~13 Months 6/1/2020 to 6/30/2021		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$182,700
● Virtual Payload Operations Center Tri-Screen Workstation Kits (5@ \$20,000)	100,000	Barnhard Associates, LLC (BALLC)	
● Systems Took Kit (STK) Systems Bundle Network Token License (GSA)	82,700	BALLC/AGI, Inc.	
Subcontract(s) ⁵			\$ 385,000
● Payload Operations Support	100,000	UMD Space Systems Lab	
● Power Transmitter & Rectenna Support	100,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna Support	100,000	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System Support + MCT Software Mods	60,000	Immortal Data, Inc.	
● Interface Engineering & Integration Support	25,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		6.95%	\$ 107,500
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 1,546,224
G&A ²		10.00%	\$ 154,622
Total Offeror Cost (U)			\$ 1,700,847
Fee -- Offeror Profit (V)		10.00%	\$ 170,085
NASA Civil Servant/Other Government Labs (W) ⁷			\$ -
● Integrated Test Facilities w/Testing Support (flat rate)	-	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 1,870,931
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(s): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(s): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

Surface-to-Surface Power & Ancillary Services Beaming



Quote Date	9/11/18
Good Till	12/10/18
Prepared For	XISP
Project	SSPB

Description	Baseline SSPB
Quote Number	180911-2b

Business	Robert Hoyt
	contracts@tethers.com
Engineering	Sage Secilmis
	sscilmis@tethers.com

Base

Item	Milestone Description	Lead Time (weeks ATP)	Unit Cost	Qty	Price
1	SWIFT-SLX Software Development Unit	8	\$ 10,000	1	\$ 10,000
	Long Lead Item Procurement (Due ARO) Hardware Delivery		\$ 14,500	1	\$ 14,500
2	SWIFT-KAX Flight Model (26.5 Ghz-band transmitter & receiver)	52	\$ 50,000	2	\$ 100,000
	Long Lead Item Procurement (Due ARO) Hardware Delivery and EIDP (FM100 Acceptance Protocol)		\$ 200,000	2	\$ 400,000
3	T&M Engineering Support	per 40-hr block	\$ 6,500	2	\$ 13,000
	Support for Integration with Lunar Lander selected		\$ 6,500	10	\$ 65,000
	Support for End-to-End Comms Testing		\$ 6,500	2	\$ 13,000
	Support for Ground Station Modem Integration Testing		\$ 6,500	4	\$ 26,000
	Support for Software Interface to Raytheon W-band system				
				Total:	\$ 641,500

TERMS	NET 30
TOTAL DUE	\$ 641,500
PAYMENT DUE ARO	\$ 110,000

OPTIONAL TERMS	PIA
TOTAL DUE	\$ 622,255

Surface-to-Surface Power & Ancillary Services Beaming

20180919-DMA-001							
IDI Part Number	Part description	Quantity	Unit cost	total cost	Markup %	total price	Notes
CUSTOM	Custom analog board	1	\$0.00	\$0.00	0.00%	\$2,515.50	In house development, full recovery of cost on a one off. Art Tanaka design time included. Markup built in
S002	Shipslog 4.0 (Cheetah) software	1	\$2,000.00	\$2,000.00	0.00%	\$2,000.00	
V005	64 Analog Channel DAQ	1	\$832.00	\$832.00	35.00%	\$1,123.20	
C002	6" Cat-6e ether cable (Aerospace, high temp and vacuum	1	\$50.00	\$50.00	35.00%	\$67.50	
P001	AnyVolt3 (Unfiltered PSU)	2	\$55.00	\$110.00	35.00%	\$148.50	
S004	Mirabox Shipslog compute module	1	\$150.00	\$150.00	35.00%	\$202.50	
	Misc hardware and parts	1	\$1,000.00	\$1,000.00	35.00%	\$1,350.00	
Project Specific Engineering		Hours	Base rate	total cost		total price	Notes
E3	David Chevront, Mechanicals, Testing	20	\$100.00	\$2,000.00	50.00%	\$3,000.00	Systems engineering
E3	Dale Amon, Integration and systems engineering	40	\$100.00	\$4,000.00	50.00%	\$6,000.00	Systems engineering
E1	Doug Weathers, DAQ assembly and software install and checkout	20	\$50.00	\$1,000.00	50.00%	\$1,500.00	Component engineering
QUOTATION TOTALS				\$11,142.00		\$17,907.20	
It is anticipated that you would need at least three sets to accommodate testing, and flight. Adding in support time we anticipate that a budget of \$60,000 is appropriate.							
In addition, Immortal Data would be pleased to support an expanded scope in the Flight Phase. For the preliminary budget we recommend also including \$60,000.							

Surface-to-Surface Power & Ancillary Services Beaming

B. Special Notifications and/or Certifications

No special notifications and/or certifications have been identified.

C. Raytheon Company

- a. Rectenna & Transceiver Proprietary ITAR Restricted Disclosure NASA Only is available on request

D. Tethers Unlimited

- a. Transceiver & Tx/Rx Antenna Proprietary ITAR Restricted Disclosure NASA Only is available on request.

Immortal Data Incorporated

13548 Arcadian Drive
Leesburg, VA 20176
27 February 2019



TO: Gary Barnhard, President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc.)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a vendor to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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. A pro forma estimate for the proposed work is attached.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dale Amon", with a stylized, cursive script.

Dale Amon, President
Immortal Data Incorporated, 27 February 2019

NewSpace Analytics
Brad R. Blair, General Partner
770 Santa Fe Drive, Denver, CO, 80204
(720) 280-5100
planetminer@gmail.com



27 February, 2019

Gary Barnhard
Xtraordinary Innovative Space Partnerships, Inc.
8012 MacArthur Boulevard
Cabin John, MD 20818 U.S.A.
www.xisp-inc.com
(301) 229 8012 phone

Subject: Consulting support for Lunar Power Beaming demo.

Dear Gary,

Per our recent discussions, NewSpace Analytics would be pleased to conduct a study of the economics of and customer development for 15kg surface to surface power beaming systems in or near polar craters, peaks of eternal light or other geological exploration targets as needed. This work would be in support of the XISP lunar power beaming and ancillary services study.

NewSpace Analytics and Brad Blair propose to provide the following work tasks:

1. Develop economic and customer models in collaboration with other team members
2. Participate in regular teleconferences
3. Provide written contribution to interim and final reports

New Space Analytics proposes a 0.1-0.2 FTE equivalent level of work at a nominal rate of \$200/hr, with the possible inclusion of in-kind leverage as commercial or partnership opportunities become available. New Space Analytics greatly appreciates the opportunity to provide these services, and looks forward to supporting XISP on this exciting program. Please do not hesitate to contact the undersigned for any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Brad R. Blair', written in a cursive style.

Brad R. Blair



TimesOne™
The Energy Efficiency Company

Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035
Tel: (310) 247-4848
Fax: (310) 273-7719
Contact: bsegal@activeharmonicfilters.com
URL: www.activeharmonicfilters.com

DATE: February 22, 2019

FROM: Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035

TO: Gary Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Participation Statement for NASA Proposal Number 18-LSITP18-0048;
NNH18ZDA001N-LSITP Lunar Surface Instrument and Technology Payloads

Dear Mr. Barnhard:

I acknowledge that am identified by name as a collaborate or (aka, core team member or consultant) in the study proposal, entitled “XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V1-3”, that is submitted by Gary Pearce Barnhard to the NASA Research Announcement NNH18ZDA001N-LSITP (ROSES-2018), 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 the proposal will be considered during peer review in determining in part the merits of this proposal.

I have read the entire proposal and I agree that the proposal correctly describes my commitment to the proposed investigation.

For the purposes of conducting work for this study, I anticipate my participation will be as an:

- ☐ XISP-Inc Independent contractor employed by
Power Correction Systems, Inc.

If the contact is awarded I anticipate my time commitment to be between 0.1 to 0.5 Full Time Equivalent for the duration of the contract (nominally 12 months starting 6/1/2019 – 5/31/2020) .

My established standard consulting rate is \$100.00/hour. I have reviewed the proposal billing rate information and understand that the actual rates paid each employee, independent contractor, or consultant will be negotiated on an individual basis consistent with their professional experience, specialized skills, established billing rates, IRS status,



TimesOne™
The Energy Efficiency Company

Power Correction Systems, Inc.

1800 S. Robertson Blvd., Suite 419

Los Angeles, CA 90035

Tel: (310) 247-4848


Fax: (310) 273-7719

Contact: bsegal@activeharmonicfilters.com

URL: www.activeharmonicfilters.com

contract cost structure and award constraints as applicable. In lieu of the standard consulting rate adjusted as required by the aforementioned constraints, it is understood that XISP-Inc may seek to negotiate some form of block time buy, flat rate agreement, honoraria arrangement, labor swap, and/or other bi-lateral agreement to facilitate amicable working arrangements with a minimum of administrative overhead.

Sincerely,



February 22, 2019

CEO

Brahm R. Segal

Power Correction Systems, Inc.

DATE: February 27, 2019

FROM: Christos Christodoulou
University of New Mexico COSMIAC
christos@unm.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am university Consultant.

Sincerely,

/Original Signed By/

Christos Christodoulou

DATE: February 27, 2019

FROM: Michael Withey
Oceaneering Space Systems, Inc.
mwithey@oceaneering.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as the contact for my company in the proposal entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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 subject to mutual agreement on the terms and conditions.

Sincerely,

/Original Signed By/

Michael Withey

David L. Chevront
11611 Orchard Mountain Drive
Houston, TX 77059

Mr. Gary Pearce Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. - XISP-Inc.
8012 MacArthur Boulevard
Cabin John, MD 20818 U.S.A.

February 27, 2019

Subject: Commitment of Support

I acknowledge that I am identified by name as a Consultant for the project, entitled "Surface-to-Surface Power & Ancillary Services Beaming" that is submitted by Mr. Gary Pearce Barnhard for NNH18ZDA001N-LSITP: NASA Lunar Surface Instrument and Technology Payloads (LSITP18_2) Step-2 , and that I intend to carry out all responsibilities identified for me in this proposal. I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, I am performing the work as a natural person rather than as an organization.



David L. Chevront

DATE: February 27, 2019

FROM: Eric L. Dahlstrom
International Space Consultants
2443 FILLMORE ST #380-2690
SAN FRANCISCO CA 94115-1814 USA

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

Eric L. Dahlstrom

DATE: February 27, 2019

FROM: Gary Barnhard
Barnhard Associates, LLC
8012 MacArthur Blvd.
Cabin John, MD 20918
barnhard@barnhard.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

Gary P. Barnhard

DATE: February 27, 2019

FROM: George Sowers
Colorado School of Mines
gsowers@mines.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

George Sowers

DATE: February 27, 2019

FROM: John C. Mankins, President
Artemis Innovation Management Solutions, LLC
P.O. Box 6660
Santa Maria, California 93456 USA

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

John C. Mankins

DATE: February 27, 2019

FROM: Joseph M. Rauscher
Spacefaring-Services.com
813 3rd St., S.W.
Washington, D.C. 20024-3105

TO: Gary Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

Seth D. Potter, Ph.D.

DATE: February 27, 2019

FROM: Kenneth E. Ford
13807 Thach Court
Huntersville, NC 28078

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

Kenneth E. Ford

DATE: February 27, 2019

FROM: Lisa C Kaspin-Powell
3206 Summertime Lane Unit 206
Culver City, CA 90230

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

Lisa C Kaspin-Powell

DATE: February 27, 2019

FROM: Michael Swartwout
St. Louis University
mswartwo@slu.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am university Consultant.

Sincerely,

/Original Signed By/

Michael Swartwout

DATE: February 27, 2019

FROM: Michael Withey
Oceaneering Space Systems, Inc.
mwithey@oceaneering.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as the contact for my company in the proposal entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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 subject to mutual agreement on the terms and conditions.

Sincerely,

/Original Signed By/

Michael Withey

Gary barnhard - RE: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

From: Paul Jaffe <paul.jaffe@nrl.navy.mil>
To: Gary barnhard <Barnhard@barnhard.com>
Date: 2/27/2019 10:03 AM
Subject: RE: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

Hi Gary,

What you have looks reasonable to me for NRL. What additional specificity is needed and where?

Thanks,
 Paul

Paul Jaffe, Ph.D.

Electronics Engineer, Spacecraft Engineering Department/Space Electronics Systems Development
 U.S. Naval Research Laboratory

T [202.767.6616](tel:202.767.6616) DSN [312.297.6616](tel:312.297.6616)
www.nrl.navy.mil

From: Gary barnhard <Barnhard@barnhard.com>
Sent: Wednesday, February 27, 2019 2:08 AM
To: Brahm Segal <bsegal@activeharmonicfilters.com>; Kenneth Ford <kenford103@aol.com>; offearth7@aol.com; Joseph Rauscher <spacefaring-servicescom@earthlink.net>; sima.noghanian@engr.und.edu; Tim Cash <cash.tim@gmail.com>; david.cheuvront@gmail.com; doddsar@gmail.com; john.c.mankins@gmail.com; Paul J. Werbos <paul.werbos@gmail.com>; Brad Blair <planetminer@gmail.com>; Seth Potter <sethpotter3@gmail.com>; Eric Dahlstrom <Eric.Dahlstrom@InternationalSpace.com>; gsowers@mines.edu; rezaz@mtu.edu; Paul Jaffe <paul.jaffe@nrl.navy.mil>; cwalz@oceaneering.com; mwithey@oceaneering.com; Avram. Bar-Cohen <Avram.Bar-Cohen@raytheon.com>; Hooman.Kazemi@raytheon.com; James Mcspadden <James_McSpadden@raytheon.com>; mswartwo@slu.edu; David Akin <dakin@ssl.umd.edu>; hoyt@tethers.com; christos@unm.edu; Dale Amon <amon@vnl.com>
Subject: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

Greetings all -

The draft Step 2 proposal is still missing

- completed budget narrative
- refreshed quotes if applicable
- letters of support
- FTE availability ranges need to be affirmed if you have not already done so

----- GWAVA AUTHENTICATED & SIGNED MESSAGE -----

Gary Pearce Barnhard
President & CEO

Xtraordinary Innovative Space Partnerships, Inc. - XISP-Inc.

gary.barnhard@xisp-inc.com

[\(301\) 229-8012](tel:(301)229-8012) Voice

[\(301\) 320-5025](tel:(301)320-5025) Fax

[\(301\) 509-0848](tel:(301)509-0848) Cell

www.xisp-inc.com

DATE: February 27, 2019

FROM: Paul Werbos
5304 1st Pl N
Arlington, VA 22203
paul.werbos@gmail.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am an independent Consultant.

Sincerely,

/Original Signed By/

Paul Werbos

This is a representative letter of commitment from the Naval Research Lab. A formal letter has been requested and will be on file contemporary with the processing of this proposal. An informal email is being attached indicating general concurrence with the proposal content.



January 19, 2017

TO: Gary Barnhard
President & CEO, Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818
E-mail: gary.barnhard@xisp-inc.com

SUBJECT: Letter of Industry Contribution to XISP-Inc ISS Utilization Technology Development, Demonstration, and Deployment (TD3) Proposal

Dear Mr. Barnhard:

This Letter of Industry Contribution supports the Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc) proposal for award under RESEARCH OPPORTUNITIES FOR ISS UTILIZATION NASA Research Announcement: NNJ13ZBG001N Soliciting Proposals for Exploration Technology Demonstration and National Lab Utilization Enhancements.

The U.S. Naval Research Laboratory (NRL) in Washington, DC has been a pioneer for nearly one hundred years in the advancement of technology for space and other areas. We were responsible for America's second satellite, which for the next several thousand years will remain humankind's oldest object in space. A few of our many notable achievements include the first use of solar cells in space, the creation of the first satellite of the Global Positioning System (NTS-2), and the discovery of ice on the moon. Since the dawn of the space age, we have led in the development of ground-breaking satellite and space technology. Our mission is to "boldly fly what never has flown before," by conceiving, constructing, testing, launching, and operating experimental satellites and systems.

NRL is particularly interested in cooperating and/or collaborating on the following elements of the XISP-Inc commercial mission set: XISP-Inc Management Operations Control Architecture/Applications (MOCA) Mission, XISP-Inc Space-to-Space Power Beaming (SSPB) Mission, XISP-Inc Interoperating Network Communications Architecture (INCA) Mission, XISP-Inc Halfway To Anywhere (HTA) Mission, and the XISP-Inc Alpha CubeSat (ACS) Mission.

NRL anticipates potentially being a: Full Service Equipment Vendor for one or more mission elements, Subcontractor for one or more mission elements, Consultant for one or more mission elements, Facilities and/or Equipment Provider for one or more mission elements, Ground Testing Support Provider for one or more mission elements, and Research Collaborator for one or more mission elements.

Naval Center for Space Technology, Integration and Test Section – Code 8243
U.S. Naval Research Laboratory
4555 Overlook Ave. S.W., Washington, DC 20375

www.nrl.navy.mil

NRL recognizes that this effort will be a public-private partnership implemented with a combination of direct and in-direct support from NASA and from the mission participants. NRL anticipates, subject to the approval of this proposal and mutual agreement on the terms, providing the following resources in-kind to further the accomplishment of the XISP-Inc mission set: In-Kind Resources (including but not limited to access to existing facilities, personnel, equipment, intellectual property rights, and/or prior experience).

NRL proposes to perform the following Scope of Work for the mission set as outlined in the Work Breakdown Structure provided in this proposal: Under WBS 2.0, Engineering Reviews, and under WBS 6.0, environmental testing likely including but not necessarily limited to thermal vacuum testing and EMI/EMC testing.

NRL appreciates the opportunity to participate in the execution of this proposal leveraging our extant resources stemming from past government support and/or internal research and development investments.

NRL will provide equipment/service pricing substantiation and/or prevailing Labor Categories, Rate, and Terms, as well as the imputed fair market value of in-kind resources proposed to be made available to accomplish the mission set pursuant to applicable Federal Acquisition Regulations and NASA Guidance. NRL would be pleased to perform the allocated work described in the Work Breakdown Structure at the price specified in the proposal Pro Forma Budget, subject to mutual agreement on the terms, conditions, and master schedule.

Sincerely,



Paul Jaffe, PhD
Integration and Testing Section Head
NRL Code 8243
4555 Overlook Ave SW
Washington, DC 20375

CC: George C. Nelson
Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Code OZ
2101 NASA Parkway 21
Houston, TX 77058
E-mail: george.nelson-1@nasa.gov

Naval Center for Space Technology, Integration and Test Section – Code 8243
U.S. Naval Research Laboratory
4555 Overlook Ave. S.W., Washington, DC 20375

www.nrl.navy.mil



Raytheon Company
Space and Airborne Systems
1100 Wilson Boulevard
Arlington, VA
22209 USA

20 January, 2017

National Aeronautics and Space Administration
Space Technology Mission Directorate
300 E Street, SW
Washington, DC 20546-0001

Dear Sirs,

This letter is in support of the Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc) proposal for award under the RESEARCH OPPORTUNITIES FOR ISS UTILIZATION NASA Research Announcement: NNJ13ZBG001N Soliciting Proposals for Exploration Technology Demonstration and National Lab Utilization Enhancements.

Raytheon has reviewed the XISP-Inc proposal and, if selected by NASA for award, Raytheon Space and Airborne Systems (SAS) would be pleased to support XISP-Inc in the execution of this proposal as a full service equipment vendor, as a subcontractor, and/or in a consulting capacity. Please note that Raytheon has not been asked to provide a statement of work, technical volume, or cost estimate to date and that Raytheon supports government contracting efforts on a cost plus basis only.

Raytheon is a diversified large aerospace business with market capitalization in excess of \$40B. Our Space and Airborne Systems business unit builds radars and other sensors for aircraft, spacecraft and ships. The business also provides communications and electronic warfare solutions and performs research in areas ranging from linguistics to quantum computing.

Sincerely,

A handwritten signature in blue ink, appearing to read "T. Clark", written over a horizontal line.

Timothy S. Clark
Technical Director
Raytheon Space and Airborne Systems
Advanced Concepts and Technologies

This is a representative letter of support on file from the Raytheon Company. A request for a new letter of support and a firm quote is under development consistent with Raytheon Company procedures.

An XISP-Inc generated estimate for replicated equipment, repackaged, and tweaked to meet Customer/Client requirements has been included in this proposal. Specific leverage considerations must be negotiated between Raytheon, XISP-Inc, NASA, and AFRL to realize the anticipated cost reductions/offsets factored in before a Firm Quote can be provided from Raytheon Company.

DATE: February 27, 2019

FROM: Reza Zekavat
Michigan Technological University
rezaz@mtu.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am university Consultant.

Sincerely,

/Original Signed By/

Reza Zekavat

DATE: February 27, 2019

FROM: Richard Dickinson
offearth7@aol.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Richard Dickinson

DATE: February 27, 2019

FROM: Robert Hoyt
Tethers Unlimited, Inc.
hoyt@tethers.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as the contact for my company in the proposal entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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 subject to mutual agreement on the terms and conditions.

A pro forma quote has been provided.

Sincerely,

/Original Signed By/

Robert Hoyt

DATE: February 27, 2019

FROM: Seth D. Potter, Ph.D.
320 The Village Apt. 207
Redondo Beach, CA 90277

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Seth D. Potter, Ph.D.

DATE: February 27, 2019

FROM: Sima Noghanian
University of North Dakota Space Systems Lab
sima.noghanian@engr.und.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Sima Noghanian

DATE: February 27, 2019

FROM: Tim Cash
Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Tim Cash

Surface-to-Surface Power & Ancillary Services Beaming

X. Detailed Budget

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Payload Preparation Phase Budget			
	Payload Preparation Phase Duration: ~12 Months 6/1/2019 to 5/31/2020		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$1,682,255
● Power Transmitter & Rectenna	1,000,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna	622,255	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System	60,000	Immortal Data, Inc.	
Subcontract(s) ⁵			\$ 150,000
● Integration Facilities w/Design Review, Testing & Operations Support	100,000	UMD Space Systems Lab	
● Interface Engineering & Integration	50,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		5.00%	\$ 142,250
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 2,845,529
G&A ²		10.00%	\$ 284,553
Total Offeror Cost (U)			\$ 3,130,082
Fee -- Offeror Profit (V)		10.00%	\$ 313,008
NASA Civil Servant/Other Government Labs (W) ⁷			\$ 40,000
● Integrated Test Facilities w/Testing Support (flat rate)	40,000	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 3,483,090
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(s): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(s): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

Surface-to-Surface Power & Ancillary Services Beaming

XISP-Inc Labor Rate Build Up - Negotiated Intellectual Property Transfer 2019 - Short Term Consulting													
Government Rates = (Salary) + (Fringe)+ (Overhead) + (G&A) + (Profit)	Salary	Fringe Variable	Fringe Fixed	Fringe Total	S+F Subtotal	Overhead	S+F+O Subtotal	G&A	S+F+O+G&A Subtotal	Profit	Raw Total	Burdened Rate	Salary Multiplier*
Technical Labor Categories	\$/hour	23.64%	4.43%	28.08%	\$	39.83%	\$	10%	\$	10%	\$	\$	
CEO/Principal Investigator/Principal Systems Engineer	\$115.42	\$27.29	\$5.12	\$32.41	\$147.83	\$58.87	\$206.70	\$20.67	\$227.37	\$22.74	\$250.11	\$250	2.17
Engineer IV - Senior Systems Engineer - Specialist (30+ years or specialty)	\$77.94	\$18.43	\$3.46	\$21.88	\$99.82	\$39.76	\$139.58	\$13.96	\$153.54	\$15.35	\$168.89	\$169	2.17
Engineer III - Senior Systems Engineer - Specialist (20+ years or specialty)	\$67.51	\$15.96	\$2.99	\$18.96	\$86.47	\$34.44	\$120.90	\$12.09	\$132.99	\$13.30	\$146.29	\$146	2.17
Engineer II - Systems Engineer (10-20 Years or equivalent)	\$54.34	\$12.85	\$2.41	\$15.26	\$69.60	\$27.72	\$97.32	\$9.73	\$107.05	\$10.70	\$117.75	\$118	2.17
Engineer I - Discipline Engineer (1-10 Years or equivalent)	\$42.42	\$10.03	\$1.88	\$11.91	\$54.33	\$21.64	\$75.97	\$7.60	\$83.57	\$8.36	\$91.92	\$92	2.17
Government Rates = (Salary) + (Fringe)+ (Overhead) + (G&A) + (Profit)	Salary	Fringe Variable	Fringe Fixed	Fringe Total	S+F Subtotal	Overhead	S+F+O Subtotal	G&A	S+F+O+G&A Subtotal	Profit	Total	Burdened Rate	Salary Multiplier*
Administration/Support Labor Categories	\$/hour	23.64%	4.43%	28.08%	\$	39.83%	\$	10%	\$	10%	\$	\$	
Admin III - Contract Specialist (GS-13+ or higher/equivalent)	\$52.50	\$12.41	\$2.33	\$14.74	\$67.24	\$26.78	\$94.02	\$9.40	\$103.42	\$10.34	\$113.76	\$114	2.17
Admin II - Systems Administration	\$39.50	\$9.34	\$1.75	\$11.09	\$50.59	\$20.15	\$70.74	\$7.07	\$77.81	\$7.78	\$85.59	\$86	2.17
Admin I - Administrative Assistant	\$26.50	\$6.27	\$1.18	\$7.44	\$33.94	\$13.52	\$47.46	\$4.75	\$52.20	\$5.22	\$57.42	\$57	2.17
XISP-Inc Labor Rate Build Up Summary				Technical Labor Categories				Administration/Support Labor Categories				* Typical Salary Multipliers	
Fully Burdened Rate Build Up with G&A + Profit				%	\$92	\$118	\$146	\$250	\$57	\$86	\$114	are between 2 to 3	
Salary				29.4900%	\$42.42	\$54.34	\$67.51	\$115.42	29.49%	\$26.50	\$39.50		
Fringe Variable				23.64%	\$10.03	\$12.85	\$15.96	\$27.29	23.64%	\$6.27	\$9.34	\$12.41	
Fringe Fixed				4.43%	\$1.88	\$2.41	\$2.99	\$5.12	4.43%	\$1.18	\$1.75	\$2.33	
Overhead				39.83%	\$21.64	\$27.72	\$34.44	\$58.87	39.83%	\$13.52	\$20.15	\$26.78	
G&A				10.00%	\$7.60	\$9.73	\$12.09	\$20.67	10.00%	\$4.75	\$7.07	\$9.40	
Profit				10.00%	\$8.36	\$10.70	\$13.30	\$22.74	10.00%	\$5.22	\$7.78	\$10.34	
Fully Burdened Rate Build Up with G&A + Profit				117.39%	\$92	\$118	\$146	\$250	117.39%	\$57	\$86	\$114	
XISP-Inc Fringe Benefits													
Cumulative Leave Cost		11.92%											
Vacation (15 Days * 8 Hours/Day)													
Holidays (10 days * 8 Hours/Day)													
Personal Leave (6 days * 8 Hours/Day)													
Social Security/FICA (on the first \$128,700 of earnings) Employer's Share		6.20%											
Medicare Taxes (no cap) Employer's Share		1.45%											
Workman's Compensation		1.07%											
Retirement - 401K		3.00%											
Variable Benefit Costs Subtotal		23.64%											
Federal Unemployment Tax (FUTA) .06% of first \$7,000		0.60%	\$ 42.00										
State Unemployment Tax - Maryland (SUTA) - \$8,500 base for 2018		2.60%	\$ 182.00										
Health Insurance (Single employee \$750/month)		\$ 750.00	\$ 9,000.00										
Fixed Benefit Costs Subtotal			\$ 9,224.00										
		2080	4.43%										
Estimated Fringe Total		28.08%											

XISP-Inc Optional "Cafeteria Plan" Fringe Benefits (Employee Funded)													
Life Insurance		0.00%											
Disability Insurance		0.00%											
Relocation Assistance		0.00%											
Transportation Benefits		0.00%											
Child Care Benefits		0.00%											
Legal Assistance Plan		0.00%											
Employee Discounts		0.00%											
Fitness Center Access/Discount		0.00%											
Tuition Reimbursement		0.00%											
Meals & Cafeteria Plans		0.00%											
Vision Plan		0.00%											
Dental Plan		0.00%											
Other "bona fide" fringe benefits		0.00%											

XISP-Inc Overhead	Multiplier	Monthly	Annual		Basis of Overhead Estimate Provided
Bonuses	1	\$0	\$ -	=====	TBD - No prior data available
Allocated Fringe	1	\$0	\$ -	=====	TBD - No prior data available
Meetings & Conferences (Public Info & Peer Review - Registration)	3	\$ 1,000	\$ 36,000	=====	BALLC Comp - 3 X FY 2017, ~10 Conferences year, adjusted to remove In-kind offsets
Satellite Office Expenses	2	\$ 1,000	\$ 24,000	=====	BALLC Comp - Phone/Equipment/Services/Supplies
Recruitment	1	\$1,000	\$ 12,000	=====	BALLC Comp - Conference Advertising/Sponsorship
Automobile & Local Business Travel	1	\$1,500	\$ 18,000	=====	BALLC Comp - Projected Car Payment \$1,000/month + \$500/month Fuel/Insurance/Maintenance
Nonreimbursed Business Travel	2	\$1,250	\$ 30,000	=====	BALLC Comp - 2 X FY 2017 BALLC Expenses
Rent (~1600 Square Feet, \$5,000/month) Fair Market Value	1	\$ 5,000	\$ 60,000	=====	BALLC Comp - ~1600 sq.ft. in use Cabin John, MD, market rate for 50% of 4840 Cordell Ave. Rental
Office Supplies (Staples)	1	\$500	\$ 6,000	=====	BALLC Comp - typical Office Supply Expenses
IT Services (FIOS Business Services)	1	\$600	\$ 7,200	=====	BALLC Comp - Business FIOS 1 Gb Symmetric with /24 & /30 network address pools
Hardware (estimated maintenance and refresh costs)	8	\$300	\$ 28,800	=====	BALLC Comp - 8 X Typical Desktop+Laptops+Servers+Phones+Printers+Fax+WiFi
Software (Software maintenance subscription renewals)	8	\$100	\$ 9,600	=====	BALLC Comp - 8 X Groupwise, Office Pro+, Acrobat, Creative Suite, Symantec, etc.
Software (Specialty License/Maintenance subscription renewals)	1	\$1,750	\$ 21,000	=====	BALLC Comp - 1 X Shared License AutoCAD, STK, Matlab, etc.
Printing	1	\$300	\$ 3,600	=====	BALLC Comp - Solid Ink, Toner Cartridges, business cards, banner, posters, etc
Telephone	1	\$500	\$ 6,000	=====	BALLC Comp - Landlines + Cell Phones
Indirect labor costs directly associated with contract 40/hr month	1	\$ 6,000	\$ 72,000	=====	BALLC Comp - Prior BALLC contracting experience and similarity to other contractors
Estimated Overhead Budget				\$ 334,200	
Direct Labor Pool				\$839,137	
Estimated Overhead Rate (Annual Overhead/Annual Direct Labor)				39.83%	

Surface-to-Surface Power & Ancillary Services Beaming

[illegible]

Budget Table 4D – XISP-Inc Wage Comparison Data 17-2011 Aerospace Engineers									
SOURCE OF WAGE COMPARISON DATA https://www.bls.gov/oes/current/oes172011.htm#(2) Occupational Employment and Wages, May 2017 Bureau of Labor Statistics (BLS) 17-2011 Aerospace Engineers									
Perform engineering duties in designing, constructing, and testing aircraft, missiles, and spacecraft. May conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture. May recommend improvements in testing equipment and techniques.									
National Percentile	10%	25%	50%	75%	90%	Location Adjusted Percentile	MD/DC/VA	Los Angeles, CA	Boulder, CO
			(Median)			(Mean)	(Mean)	(Mean)	
Hourly Wage Data BLS	\$34.06	\$42.42	\$54.34	\$67.51	\$77.94	Hourly Wage Data BLS	\$66.23	\$63.75	\$62.44
Annual Wage (See Note 1)	\$70,840	\$88,240	\$113,030	\$140,420	\$162,110	Annual Wage (See Note 1)	\$137,750	\$132,600	\$129,880
XISP-Inc Wage Data		Engineer I	Engineer II	Engineer III	Engineer IV	XISP-Inc Wage Data	(Mean)	(Mean)	(Mean)
XISP-Inc 2018 Hourly Wage		\$42.42	\$54.34	\$67.51	\$77.94	Mean Hourly Wage Proposed	\$66.23	\$63.75	\$62.44
Annual Wage (See Note 1)		\$88,234	\$113,027	\$140,421	\$162,115	Annual Wage (See Note 1)	\$137,750	\$132,600	\$129,880
Compare XISP-Inc vs BLS Percentiles		25th	50th	75th	90th	Comparison XISP-Inc vs BLS Mean	Equal BLS Mean	Equal BLS Mean	Equal BLS Mean
NOTES: (1) Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly wage published, the annual wage has been directly calculated from the reported survey data.									
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Technical Labor Categories and Rates Effective January 1, 2019									
Technical Labor Categories	Engineer I	Engineer II	Engineer III	Engineer IV		Administrative Labor Categories	Admin I	Admin II	Admin III
XISP-Inc Fully Burdened Billing Rate	\$91.92	\$117.75	\$146.29	\$168.89		XISP-Inc Fully Burdened Billing Rate	\$40.00	\$70.00	\$100.00
XISP-Inc 2018 Hourly Wage	\$42.42	\$54.34	\$67.51	\$77.94		XISP-Inc 2018 Hourly Wage	\$19.95	\$34.92	\$49.88
Burden Expressed as Multiplier	2.17	2.17	2.17	2.17		Burden Expressed as Multiplier	2.00	2.00	2.00
Burden Expressed as Percentage	46%	46%	46%	46%		Burden Expressed as Percentage	50%	50%	50%
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Administrative Labor Categories and Rates Effective January 1, 2019									

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 4D – XISP-Inc Wage Comparison Data 11-1011 Chief Executives												
SOURCE OF WAGE COMPARISON DATA https://www.bls.gov/oes/2017/may/oes111011.htm#(2) Occupational Employment and Wages, May 2017 Bureau of Labor Statistics (BLS) 11-1011 Chief Executives Determine and formulate policies and provide overall direction of companies or private and public sector organizations within guidelines set up by a board of directors or similar governing body. Plan, direct, or coordinate operational activities at the highest level of management with the help of subordinate executives and staff managers.												
National Percentile	10%	25%	50%	75%	MD/DC/VA	Location Adjusted Percentile	MD/DC/VA					
			(Median)		(Mean)		(Mean)					
Hourly Wage Data BLS	\$32.74	\$54.55	\$88.11	\$100.00	\$115.42	Hourly Wage Data BLS	\$115.42					
Annual Wage (See Note 1)	\$68,110	\$113,470	\$183,270	\$208,000	\$240,080	Annual Wage (See Note 1)	\$240,080					
XISP-Inc Wage Data					CEO/PI	XISP-Inc Wage Data	(Mean)					
XISP-Inc 2018 Hourly Wage					\$115.42	Mean Hourly Wage Proposed	\$115.42					
Annual Wage (See Note 1)					\$240,080	Annual Wage (See Note 1)	\$240,080					
Compare XISP-Inc vs BLS Percentiles					Less than 90th	Comparison XISP-Inc vs BLS Mean	Equal BLS Mean					
NOTES: (1) Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly wage published, the annual wage has												
Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Technical Labor Categories and Rates Effective January 1, 2019 - No IP Transfer						Xtraordinary Innovative Space Partnerships, Inc. XISP-Inc Standard Administrative Labor Categories and Rates Effective January 1, 2018						
Technical Labor Categories					CEO/PI	Administrative Labor Categories	Admin I	Admin II	Admin III			
XISP-Inc Fully Burdened Billing Rate					\$225.00	XISP-Inc Fully Burdened Billing Rate	\$40.00	\$70.00	\$100.00			
XISP-Inc 2018 Hourly Wage					\$115.42	XISP-Inc 2018 Hourly Wage	\$19.95	\$34.92	\$49.88			
Burden Expressed as Multiplier					1.95	Burden Expressed as Multiplier	2.00	2.00	2.00			
Burden Expressed as Percentage					51%	Burden Expressed as Percentage	50%	50%	50%			

Budget Table 3 – XISP-Inc Direct Labor Cost (In-House Staff Employees Technical)												
Employee Name	Salary Hourly Rate	Fringe Rate	Overhead Rate	Burdened Direct Labor Rates	G&A Rate	Burdened Direct Labor Rates	Profit Rate	Fully Burdened Direct Labor Rates	Salary Multiplier	Annual Proposed Labor	Annual Proposed Labor	Annual Proposed Labor
Title												
Relevant Specialized Skill/Experience	(\$)	28.08%	39.83%	(\$+F+O)	10%	(\$+F+O+G&A)	10%	(\$)		(FTE)	(Hours)	(\$)
Gary Barnhard Principal Investigator & Mission Technical Director Computer/Robotics/Space Systems Engineer (35+ years)	\$115.42	\$32.41	\$58.87	\$206.70	\$20.67	\$227.37	\$22.74	\$250	2.2	0.50	916	\$229,100.11
New Hire Engineer IV - Senior Systems Engineer (30+ years or specialist) TBD	\$77.94	\$21.88	\$39.76	\$139.58	\$13.96	\$153.54	\$15.35	\$169	2.2	0.00	0	\$-
New Hire Engineer III - Senior Systems Engineer (20+ years or specialist) TBD	\$67.51	\$18.96	\$34.44	\$120.90	\$12.09	\$132.99	\$13.30	\$146	2.2	0.00	0	\$-
New Hire Engineer II - Systems Engineer (10-20 Years or equivalent) TBD	\$54.34	\$15.26	\$27.72	\$97.32	\$9.73	\$107.05	\$10.70	\$118	2.2	0.00	0	\$-
New Hire Engineer I - Discipline Engineer TBD	\$42.42	\$11.91	\$21.64	\$75.97	\$7.60	\$83.57	\$8.36	\$92	2.2	0.00	0	\$-
Estimated Annual XISP-Inc Direct Labor FTE										0.50		
Estimated Annual XISP-Inc Direct Labor Hours											916	
Estimated Annual XISP-Inc Fully Burdened Direct Labor Cost												\$229,100
Notes: (1) XISP-Inc FTE = 1832 Hours (2) Additional cost metrics (3) New hires are subject to the availability of funds, changes in prospective employee circumstance, and mutual agreement on employment contract terms. (4) Second and third year labor rates are subject to a to be negotiated labor rate escalation percentage.												
				XISP-Inc Blended Hourly Rate		\$250.11		XISP-Inc Blended FTE Annual Cost				\$458,200

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 8 – XISP-Inc Consultant Labor Rates								
Consultant Name	Standard Hourly Rate	XISP-Inc Consultant's Hourly Rates*	XISP-Inc G&A Rate	XISP-Inc Profit Rate	Fully Burdened Consulting Rates	Annual Proposed Labor	Annual Proposed Labor	Annual Extended Cost
Consultant Company (If Applicable)								
Consultant Labor Category								
Relevant Specialized Skill/Experience								
Variable (see list in proposal narrative)	Blended Rate \$30 to \$225	\$150.00	\$15.00	\$16.50	\$181.50	1	1832	\$274,800
University Researchers								
Blended Rate Honorarium								
Specialist/Discipline Analyst/Technician/Operator								
Consultant Type III Subtotal						1	1832	
John Mankins	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Mankins Space Technology, Inc.								
Mission Subject Matter Specialist								
Space Solar Power & Technology Development								
Richard Dickinson	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Mankins Space Technology, Inc.								
Mission Subject Matter Specialist								
Power Beaming & Technology Development								
Paul Verbos	\$225.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
IntControl LLC								
Mission Subject Matter Specialist								
Energy/Physics Modeling & TD ³ Systems								
David Cheuvront	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Integration, Verification & Validation, Reliability								
Seth Potter	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Beam Forming & Systems Engineering								
Brad Blair	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,643
NewSpace Analytics LLC								
Mission Subject Matter Specialist								
Economic Analysis & Customer Development								
Eric Dahlstrom	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
International Space Consultants								
Mission Subject Matter Specialist								
Mission Planning & Space Systems Engineering								
Ken Ford	\$200.00	\$200.00	\$20.00	\$22.00	\$242.00	0.1	183	\$ 36,640
Independent Consultant								
Mission Subject Matter Specialist								
Program Implementation								
Consultant Type II Subtotal						0.8	1466	
Tim Cash	\$150.00	\$100.00	\$10.00	\$11.00	\$121.00	0.1	183	\$ 18,320
Independent Consultant								
Mission Discipline Analyst								
Radio Frequency Systems Testing								
Brahm Segal	\$150.00	\$100.00	\$10.00	\$11.00	\$121.00	0.1	183	\$ 18,320
Power Correction Systems, Inc.								
Mission Discipline Analyst								
Power Conversion Efficiency Testing & Optimization								
Consultant Type I Subtotal						0.2	366	
Estimated Annual XISP-Inc Consultant FTE						2.0		
Estimated Annual XISP-Inc Consultant Labor Hours							3664	
Estimated Annual XISP-Inc Fully Burdened Consultant Labor								\$ 604,563
Effective Blended Hourly Rate								\$ 165.00
Notes:								
(1) XISP-Inc Full Time Equivalent (FTE) = 1832 Hours								
(2) The difference between the Consultants Standard Hourly Rate and the XISP-Inc Consultant's Hourly Rate must be spread to average out.								
(3) Please note this table has representative place holder values that must be confirmed by the individual consultants.								
(4) The allowable costs incurred for Consultant participation must in most instances be covered by XISP-Inc and allocated to the proper cost pool.								

Surface-to-Surface Power & Ancillary Services Beaming

XI. Appendices

A. "Total" Budget

- a. Detailed Cost Estimate Payload Preparation Phase (PPP)
- b. Preliminary Cost Estimate Flight Phase (FP)
- c. Quotes

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Payload Preparation Phase Budget			
	Payload Preparation Phase Duration: ~12 Months 6/1/2019 to 5/31/2020		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$1,682,255
● Power Transmitter & Rectenna	1,000,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna	622,255	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System	60,000	Immortal Data, Inc.	
Subcontract(s) ⁵			\$ 150,000
● Integration Facilities w/Design Review, Testing & Operations Support	100,000	UMD Space Systems Lab	
● Interface Engineering & Integration	50,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		5.00%	\$ 142,250
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 2,845,529
G&A ²		10.00%	\$ 284,553
Total Offeror Cost (U)			\$ 3,130,082
Fee -- Offeror Profit (V)		10.00%	\$ 313,008
NASA Civil Servant/Other Government Labs (W) ⁷			\$ 40,000
● Integrated Test Facilities w/Testing Support (flat rate)	40,000	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 3,483,090
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(s): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(s): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

Surface-to-Surface Power & Ancillary Services Beaming

Budget Table 1 – XISP-Inc Surface-to-Surface Power and ancillary services Beaming Preliminary Flight Phase Budget			
	Payload Preparation Phase Duration: ~13 Months 6/1/2020 to 6/30/2021		
	Hours, indirect cost base, or fee/profit base, as applicable	Rates	Costs
Labor Categories: ¹			
Gary Barnhard, CEO/Principal Investigator, Lead Systems Engineer (35+ years and specialized experience)	916	\$115.42	\$ 105,725
Engineer IV - Senior Systems Engineer (30+ years or senior specialist)	0	\$77.94	\$ -
Engineer III - Senior Systems Engineer (20+ years or specialist)	0	\$67.51	\$ -
Engineer II - Systems Engineer (10-20 Years or equivalent)	0	\$54.34	\$ -
Engineer I - Discipline Engineer (1-10 Years or equivalent)	0	\$42.42	\$ -
Total Direct Labor Cost ¹	916	\$115.42	\$ 105,725
Fringe Benefits ²		28.08%	\$ 29,685
Labor Overhead ²		29.37%	\$ 31,054
Loaded Labor			\$ 166,464
Travel ³	\$ 100,000	1	\$ 100,000
Material, Equip., and ODCs ⁴		1	\$182,700
● Virtual Payload Operations Center Tri-Screen Workstation Kits (5@\$20,000)	100,000	Barnhard Associates, LLC (BALLC)	
● Systems Took Kit (STK) Systems Bundle Network Token License (GSA)	82,700	BALLC/AGI, Inc.	
Subcontract(s) ⁵			\$ 385,000
● Payload Operations Support	100,000	UMD Space Systems Lab	
● Power Transmitter & Rectenna Support	100,000	Raytheon Company	
● Ancillary Services Transceiver & Tx/Rx Antenna Support	100,000	Tethers Unlimited, Inc.	
● Data Acquisition & Capture System Support + MCT Software Mods	60,000	Immortal Data, Inc.	
● Interface Engineering & Integration Support	25,000	Oceaneering	
Consultant(s) ⁶			\$ 604,560
● Consultant III - University Researchers (Blended Rate)	1,832	\$150.00	\$274,800
● Consultant II - Mission Subject Matter Specialists	1,466	\$200.00	\$293,120
● Consultant I - Mission Discipline Analysts	366	\$100.00	\$36,640
Cost Reserve		6.95%	\$ 107,500
Subtotal Payload Preparation Phase w/o G&A, Profit, Gov Facilities			\$ 1,546,224
G&A ²		10.00%	\$ 154,622
Total Offeror Cost (U)			\$ 1,700,847
Fee -- Offeror Profit (V)		10.00%	\$ 170,085
NASA Civil Servant/Other Government Labs (W) ⁷			\$ -
● Integrated Test Facilities w/Testing Support (flat rate)	-	Naval Research Lab	
Estimated Total Payload Preparation Phase Cost (X = U + V + W)			\$ 1,870,931
NOTES:			
(1) DIRECT LABOR: The total quantity and mix of labor was based on similarity to the requirements of other analogous space and terrestrial projects , the likely scale of available funding, the Direct Labor Cost, and the Statement of Work/Work Breakdown Structure.			
(2) INDIRECT COSTS: Since XISP-Inc is essentially a startup company financed by Barnhard Associates, LLC the indirect rates were estimated by equating the XISP-Inc indirect rates to Barnhard Associates, LLC indirect rates (the firms are collocated). Transition accounting will be addressed in the effective business relationship inversion between Barnhard Associates. LLC and XISP-Inc on contract award.			
(3) TRAVEL: Estimated travel budget developed using the Scheduled Travel for review participation, current GSA per Diem rates for lodging, meals, and incidentals, estimated transportation expenses, and estimated number of participants.			
(4) OTHER DIRECT COSTS (ODCs): In order to secure the most advantageous estimated pricing for the payload every effort will be made to leverage vendor involvement with the ISS Space-to-Space Power Beaming (SSPB) mission, existing DoD funded research and development efforts, and internal research and development efforts. Furthermore, vendors will be asked to factor in quantity price breaks based on the potential for additional orders. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(5) SUBCONTRACT(S): In order to secure the most advantageous pricing an allocation of costs based on the aggregation of individual vendor estimates has been provided. These estimates must be affirmed by definitized quotes as part of the mission development process.			
(6) CONSULTANT(S): In order to secure the most advantageous pricing a pool of potential consultants was listed. Some transition from Constant to Employee status is anticipated.			
(7) NASA CIVIL SERVANT/Other Government Lab COSTS: The Naval Research Lab estimated co-payment for access to resources is provided.			

Surface-to-Surface Power & Ancillary Services Beaming



Quote Date	9/11/18
Good Till	12/10/18
Prepared For	XISP
Project	SSPB

Description	Baseline SSPB
Quote Number	180911-2b

Business	Robert Hoyt
	contracts@tethers.com
Engineering	Sage Secilmis
	ssecilmis@tethers.com

Base

Item	Milestone Description	Lead Time (weeks ATP)	Unit Cost	Qty	Price
1	SWIFT-SLX Software Development Unit	8	\$ 10,000	1	\$ 10,000
	Long Lead Item Procurement (Due ARO) Hardware Delivery		\$ 14,500	1	\$ 14,500
2	SWIFT-KAX Flight Model (26.5 Ghz-band transmitter & reciever)	52	\$ 50,000	2	\$ 100,000
	Long Lead Item Procurement (Due ARO) Hardware Delivery and EIDP (FM100 Acceptance Protocol)		\$ 200,000	2	\$ 400,000
3	T&M Engineering Support	per 40-hr block	\$ 6,500	2	\$ 13,000
	Support for Integration with Lunar Lander selected		\$ 6,500	10	\$ 65,000
	Support for End-to-End Comms Testing		\$ 6,500	2	\$ 13,000
	Support for Ground Station Modem Integration Testing		\$ 6,500	4	\$ 26,000
	Support for Software Interface to Raytheon W-band system				
				Total:	\$ 641,500

TERMS	NET 30
TOTAL DUE	\$ 641,500
PAYMENT DUE ARO	\$ 110,000

OPTIONAL TERMS	PIA
TOTAL DUE	\$ 622,255

Surface-to-Surface Power & Ancillary Services Beaming

20180919-DMA-001							
IDI Part Number	Part description	Quantity	Unit cost	total cost	Markup %	total price	Notes
CUSTOM	Custom analog board	1	\$0.00	\$0.00	0.00%	\$2,515.50	In house development, full recovery of cost on a one off. Art Tanaka design time included. Markup built in
S002	Shipslog 4.0 (Cheetah) software	1	\$2,000.00	\$2,000.00	0.00%	\$2,000.00	
V005	64 Analog Channel DAQ	1	\$832.00	\$832.00	35.00%	\$1,123.20	
C002	6" Cat-6e ether cable (Aerospace, high temp and vacuum	1	\$50.00	\$50.00	35.00%	\$67.50	
P001	AnyVolt3 (Unfiltered PSU)	2	\$55.00	\$110.00	35.00%	\$148.50	
S004	Mirabox Shipslog compute module	1	\$150.00	\$150.00	35.00%	\$202.50	
	Misc hardware and parts	1	\$1,000.00	\$1,000.00	35.00%	\$1,350.00	
Project Specific Engineering		Hours	Base rate	total cost		total price	Notes
E3	David Cheuvront, Mechanicals, Testing	20	\$100.00	\$2,000.00	50.00%	\$3,000.00	Systems engineering
E3	Dale Amon, Integration and systems engineering	40	\$100.00	\$4,000.00	50.00%	\$6,000.00	Systems engineering
E1	Doug Weathers, DAQ assembly and software install and checkout	20	\$50.00	\$1,000.00	50.00%	\$1,500.00	Component engineering
QUOTATION TOTALS				\$11,142.00		\$17,907.20	
<p>It is anticipated that you would need at least three sets to accommodate testing, and flight. Adding in support time we anticipate that a budget of \$60,000 is appropriate.</p> <p>In addition, Immortal Data would be pleased to support an expanded scope in the Flight Phase. For the preliminary budget we recommend also including \$60,000.</p>							

Surface-to-Surface Power & Ancillary Services Beaming

B. Special Notifications and/or Certifications

No special notifications and/or certifications have been identified.

C. Raytheon Company

- a. Rectenna & Transceiver Proprietary ITAR Restricted Disclosure NASA Only is available on request

D. Tethers Unlimited

- a. Transceiver & Tx/Rx Antenna Proprietary ITAR Restricted Disclosure NASA Only is available on request.

Immortal Data Incorporated

13548 Arcadian Drive
Leesburg, VA 20176
27 February 2019



TO: Gary Barnhard, President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc.)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a vendor to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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. A pro forma estimate for the proposed work is attached.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dale Amon", with a stylized, cursive script.

Dale Amon, President
Immortal Data Incorporated, 27 February 2019

NewSpace Analytics
Brad R. Blair, General Partner
770 Santa Fe Drive, Denver, CO, 80204
(720) 280-5100
planetminer@gmail.com



27 February, 2019

Gary Barnhard
Xtraordinary Innovative Space Partnerships, Inc.
8012 MacArthur Boulevard
Cabin John, MD 20818 U.S.A.
www.xisp-inc.com
(301) 229 8012 phone

Subject: Consulting support for Lunar Power Beaming demo.

Dear Gary,

Per our recent discussions, NewSpace Analytics would be pleased to conduct a study of the economics of and customer development for 15kg surface to surface power beaming systems in or near polar craters, peaks of eternal light or other geological exploration targets as needed. This work would be in support of the XISP lunar power beaming and ancillary services study.

NewSpace Analytics and Brad Blair propose to provide the following work tasks:

1. Develop economic and customer models in collaboration with other team members
2. Participate in regular teleconferences
3. Provide written contribution to interim and final reports

New Space Analytics proposes a 0.1-0.2 FTE equivalent level of work at a nominal rate of \$200/hr, with the possible inclusion of in-kind leverage as commercial or partnership opportunities become available. New Space Analytics greatly appreciates the opportunity to provide these services, and looks forward to supporting XISP on this exciting program. Please do not hesitate to contact the undersigned for any questions.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Brad R. Blair', written in a cursive style.

Brad R. Blair



TimesOne™
The Energy Efficiency Company

Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035
Tel: (310) 247-4848
Fax: (310) 273-7719
Contact: bsegal@activeharmonicfilters.com
URL: www.activeharmonicfilters.com

DATE: February 22, 2019

FROM: Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035

TO: Gary Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Participation Statement for NASA Proposal Number 18-LSITP18-0048;
NNH18ZDA001N-LSITP Lunar Surface Instrument and Technology Payloads

Dear Mr. Barnhard:

I acknowledge that am identified by name as a collaborate or (aka, core team member or consultant) in the study proposal, entitled “XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V1-3”, that is submitted by Gary Pearce Barnhard to the NASA Research Announcement NNH18ZDA001N-LSITP (ROSES-2018), 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 the proposal will be considered during peer review in determining in part the merits of this proposal.

I have read the entire proposal and I agree that the proposal correctly describes my commitment to the proposed investigation.

For the purposes of conducting work for this study, I anticipate my participation will be as an:

- ☐ XISP-Inc Independent contractor employed by
Power Correction Systems, Inc.

If the contact is awarded I anticipate my time commitment to be between 0.1 to 0.5 Full Time Equivalent for the duration of the contract (nominally 12 months starting 6/1/2019 – 5/31/2020) .

My established standard consulting rate is \$100.00/hour. I have reviewed the proposal billing rate information and understand that the actual rates paid each employee, independent contractor, or consultant will be negotiated on an individual basis consistent with their professional experience, specialized skills, established billing rates, IRS status,



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The Energy Efficiency Company

Power Correction Systems, Inc.

1800 S. Robertson Blvd., Suite 419

Los Angeles, CA 90035

Tel: (310) 247-4848

Fax: (310) 273-7719

Contact: bsegal@activeharmonicfilters.com

URL: www.activeharmonicfilters.com

contract cost structure and award constraints as applicable. In lieu of the standard consulting rate adjusted as required by the aforementioned constraints, it is understood that XISP-Inc may seek to negotiate some form of block time buy, flat rate agreement, honoraria arrangement, labor swap, and/or other bi-lateral agreement to facilitate amicable working arrangements with a minimum of administrative overhead.

Sincerely,

February 22, 2019

CEO

Brahm R. Segal

Power Correction Systems, Inc.

DATE: February 27, 2019

FROM: Christos Christodoulou
University of New Mexico COSMIAC
christos@unm.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am university Consultant.

Sincerely,

/Original Signed By/

Christos Christodoulou

DATE: February 27, 2019

FROM: Michael Withey
Oceaneering Space Systems, Inc.
mwithey@oceaneering.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as the contact for my company in the proposal entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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 subject to mutual agreement on the terms and conditions.

Sincerely,

/Original Signed By/

Michael Withey

David L. Chevront
11611 Orchard Mountain Drive
Houston, TX 77059

Mr. Gary Pearce Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. - XISP-Inc.
8012 MacArthur Boulevard
Cabin John, MD 20818 U.S.A.

February 27, 2019

Subject: Commitment of Support

I acknowledge that I am identified by name as a Consultant for the project, entitled "Surface-to-Surface Power & Ancillary Services Beaming" that is submitted by Mr. Gary Pearce Barnhard for NNH18ZDA001N-LSITP: NASA Lunar Surface Instrument and Technology Payloads (LSITP18_2) Step-2 , and that I intend to carry out all responsibilities identified for me in this proposal. I agree that the proposal correctly describes my commitment to the proposed investigation. For the purposes of conducting work for this investigation, I am performing the work as a natural person rather than as an organization.



David L. Chevront

DATE: February 27, 2019

FROM: Eric L. Dahlstrom
International Space Consultants
2443 FILLMORE ST #380-2690
SAN FRANCISCO CA 94115-1814 USA

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as a Consultant to the investigation, entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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, I am an independent Consultant.

Sincerely,

/Original Signed By/

Eric L. Dahlstrom

DATE: February 27, 2019

FROM: Gary Barnhard
Barnhard Associates, LLC
8012 MacArthur Blvd.
Cabin John, MD 20918
barnhard@barnhard.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

I acknowledge that I am identified by name as the contact for my company in the proposal entitled Surface-to-Surface Power and Ancillary Services Beaming, that is submitted by XISP-Inc to the NASA funding announcement Lunar Surface Instrument and Technology Payloads (NASA Program Announcement Number NNH18ZDA001N-LSITP), 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 subject to mutual agreement on the terms and conditions.

Sincerely,

/Original Signed By/

Gary P. Barnhard

DATE: February 27, 2019

FROM: George Sowers
Colorado School of Mines
gsowers@mines.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

Dear Mr. Barnhard:

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Sincerely,

/Original Signed By/

George Sowers

DATE: February 27, 2019

FROM: John C. Mankins, President
Artemis Innovation Management Solutions, LLC
P.O. Box 6660
Santa Maria, California 93456 USA

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Proposal

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Sincerely,

/Original Signed By/

John C. Mankins

DATE: February 27, 2019

FROM: Joseph M. Rauscher
Spacefaring-Services.com
813 3rd St., S.W.
Washington, D.C. 20024-3105

TO: Gary Barnhard
President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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Sincerely,

/Original Signed By/

Seth D. Potter, Ph.D.

DATE: February 27, 2019

FROM: Kenneth E. Ford
13807 Thach Court
Huntersville, NC 28078

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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Sincerely,

/Original Signed By/

Kenneth E. Ford

DATE: February 27, 2019

FROM: Lisa C Kaspin-Powell
3206 Summertime Lane Unit 206
Culver City, CA 90230

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Lisa C Kaspin-Powell

DATE: February 27, 2019

FROM: Michael Swartwout
St. Louis University
mswartwo@slu.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Michael Swartwout

DATE: February 27, 2019

FROM: Michael Withey
Oceaneering Space Systems, Inc.
mwithey@oceaneering.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Michael Withey

Gary barnhard - RE: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

From: Paul Jaffe <paul.jaffe@nrl.navy.mil>
To: Gary barnhard <Barnhard@barnhard.com>
Date: 2/27/2019 10:03 AM
Subject: RE: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

Hi Gary,

What you have looks reasonable to me for NRL. What additional specificity is needed and where?

Thanks,
 Paul

Paul Jaffe, Ph.D.

Electronics Engineer, Spacecraft Engineering Department/Space Electronics Systems Development

U.S. Naval Research Laboratory

T [202.767.6616](tel:202.767.6616) DSN [312.297.6616](tel:312.297.6616)

www.nrl.navy.mil

From: Gary barnhard <Barnhard@barnhard.com>
Sent: Wednesday, February 27, 2019 2:08 AM
To: Brahm Segal <bsegal@activeharmonicfilters.com>; Kenneth Ford <kenford103@aol.com>; offearth7@aol.com; Joseph Rauscher <spacefaring-servicescom@earthlink.net>; sima.noghanian@engr.und.edu; Tim Cash <cash.tim@gmail.com>; david.cheuvront@gmail.com; doddsar@gmail.com; john.c.mankins@gmail.com; Paul J. Werbos <paul.werbos@gmail.com>; Brad Blair <planetminer@gmail.com>; Seth Potter <sethpotter3@gmail.com>; Eric Dahlstrom <Eric.Dahlstrom@InternationalSpace.com>; gsowers@mines.edu; rezaz@mtu.edu; Paul Jaffe <paul.jaffe@nrl.navy.mil>; cwalz@oceaneering.com; mwithey@oceaneering.com; Avram. Bar-Cohen <Avram.Bar-Cohen@raytheon.com>; Hooman.Kazemi@raytheon.com; James Mcspadden <James_McSpadden@raytheon.com>; mswartwo@slu.edu; David Akin <dakin@ssl.umd.edu>; hoyt@tethers.com; christos@unm.edu; Dale Amon <amon@vnl.com>
Subject: XISP-Inc Surface-to-Surface Power and Ancillary Services Beaming Step 2 Proposal V2.0

Greetings all -

The draft Step 2 proposal is still missing

- completed budget narrative
- refreshed quotes if applicable
- letters of support
- FTE availability ranges need to be affirmed if you have not already done so

----- GWAVA AUTHENTICATED & SIGNED MESSAGE -----

Gary Pearce Barnhard
President & CEO

Xtraordinary Innovative Space Partnerships, Inc. - XISP-Inc.

gary.barnhard@xisp-inc.com

[\(301\) 229-8012](tel:(301)229-8012) Voice

[\(301\) 320-5025](tel:(301)320-5025) Fax

[\(301\) 509-0848](tel:(301)509-0848) Cell

www.xisp-inc.com

DATE: February 27, 2019

FROM: Paul Werbos
5304 1st Pl N
Arlington, VA 22203
paul.werbos@gmail.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
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Sincerely,

/Original Signed By/

Paul Werbos

This is a representative letter of commitment from the Naval Research Lab. A formal letter has been requested and will be on file contemporary with the processing of this proposal. An informal email is being attached indicating general concurrence with the proposal content.



January 19, 2017

TO: Gary Barnhard
President & CEO, Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818
E-mail: gary.barnhard@xisp-inc.com

SUBJECT: Letter of Industry Contribution to XISP-Inc ISS Utilization Technology Development, Demonstration, and Deployment (TD3) Proposal

Dear Mr. Barnhard:

This Letter of Industry Contribution supports the Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc) proposal for award under RESEARCH OPPORTUNITIES FOR ISS UTILIZATION NASA Research Announcement: NNJ13ZBG001N Soliciting Proposals for Exploration Technology Demonstration and National Lab Utilization Enhancements.

The U.S. Naval Research Laboratory (NRL) in Washington, DC has been a pioneer for nearly one hundred years in the advancement of technology for space and other areas. We were responsible for America's second satellite, which for the next several thousand years will remain humankind's oldest object in space. A few of our many notable achievements include the first use of solar cells in space, the creation of the first satellite of the Global Positioning System (NTS-2), and the discovery of ice on the moon. Since the dawn of the space age, we have led in the development of ground-breaking satellite and space technology. Our mission is to "boldly fly what never has flown before," by conceiving, constructing, testing, launching, and operating experimental satellites and systems.

NRL is particularly interested in cooperating and/or collaborating on the following elements of the XISP-Inc commercial mission set: XISP-Inc Management Operations Control Architecture/Applications (MOCA) Mission, XISP-Inc Space-to-Space Power Beaming (SSPB) Mission, XISP-Inc Interoperating Network Communications Architecture (INCA) Mission, XISP-Inc Halfway To Anywhere (HTA) Mission, and the XISP-Inc Alpha CubeSat (ACS) Mission.

NRL anticipates potentially being a: Full Service Equipment Vendor for one or more mission elements, Subcontractor for one or more mission elements, Consultant for one or more mission elements, Facilities and/or Equipment Provider for one or more mission elements, Ground Testing Support Provider for one or more mission elements, and Research Collaborator for one or more mission elements.

Naval Center for Space Technology, Integration and Test Section – Code 8243
U.S. Naval Research Laboratory
4555 Overlook Ave. S.W., Washington, DC 20375

www.nrl.navy.mil

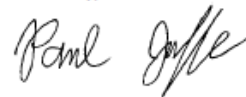
NRL recognizes that this effort will be a public-private partnership implemented with a combination of direct and in-direct support from NASA and from the mission participants. NRL anticipates, subject to the approval of this proposal and mutual agreement on the terms, providing the following resources in-kind to further the accomplishment of the XISP-Inc mission set: In-Kind Resources (including but not limited to access to existing facilities, personnel, equipment, intellectual property rights, and/or prior experience).

NRL proposes to perform the following Scope of Work for the mission set as outlined in the Work Breakdown Structure provided in this proposal: Under WBS 2.0, Engineering Reviews, and under WBS 6.0, environmental testing likely including but not necessarily limited to thermal vacuum testing and EMI/EMC testing.

NRL appreciates the opportunity to participate in the execution of this proposal leveraging our extant resources stemming from past government support and/or internal research and development investments.

NRL will provide equipment/service pricing substantiation and/or prevailing Labor Categories, Rate, and Terms, as well as the imputed fair market value of in-kind resources proposed to be made available to accomplish the mission set pursuant to applicable Federal Acquisition Regulations and NASA Guidance. NRL would be pleased to perform the allocated work described in the Work Breakdown Structure at the price specified in the proposal Pro Forma Budget, subject to mutual agreement on the terms, conditions, and master schedule.

Sincerely,



Paul Jaffe, PhD
Integration and Testing Section Head
NRL Code 8243
4555 Overlook Ave SW
Washington, DC 20375

CC: George C. Nelson
Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Code OZ
2101 NASA Parkway 21
Houston, TX 77058
E-mail: george.nelson-1@nasa.gov

Naval Center for Space Technology, Integration and Test Section – Code 8243
U.S. Naval Research Laboratory
4555 Overlook Ave. S.W., Washington, DC 20375

www.nrl.navy.mil



Raytheon Company
Space and Airborne Systems
1100 Wilson Boulevard
Arlington, VA
22209 USA

20 January, 2017

National Aeronautics and Space Administration
Space Technology Mission Directorate
300 E Street, SW
Washington, DC 20546-0001

Dear Sirs,

This letter is in support of the Xtraordinary Innovative Space Partnerships, Inc (XISP-Inc) proposal for award under the RESEARCH OPPORTUNITIES FOR ISS UTILIZATION NASA Research Announcement: NNJ13ZBG001N Soliciting Proposals for Exploration Technology Demonstration and National Lab Utilization Enhancements.

Raytheon has reviewed the XISP-Inc proposal and, if selected by NASA for award, Raytheon Space and Airborne Systems (SAS) would be pleased to support XISP-Inc in the execution of this proposal as a full service equipment vendor, as a subcontractor, and/or in a consulting capacity. Please note that Raytheon has not been asked to provide a statement of work, technical volume, or cost estimate to date and that Raytheon supports government contracting efforts on a cost plus basis only.

Raytheon is a diversified large aerospace business with market capitalization in excess of \$40B. Our Space and Airborne Systems business unit builds radars and other sensors for aircraft, spacecraft and ships. The business also provides communications and electronic warfare solutions and performs research in areas ranging from linguistics to quantum computing.

Sincerely,

A handwritten signature in blue ink, appearing to read "T. Clark", written over a horizontal line.

Timothy S. Clark
Technical Director
Raytheon Space and Airborne Systems
Advanced Concepts and Technologies

This is a representative letter of support on file from the Raytheon Company. A request for a new letter of support and a firm quote is under development consistent with Raytheon Company procedures.

An XISP-Inc generated estimate for replicated equipment, repackaged, and tweaked to meet Customer/Client requirements has been included in this proposal. Specific leverage considerations must be negotiated between Raytheon, XISP-Inc, NASA, and AFRL to realize the anticipated cost reductions/offsets factored in before a Firm Quote can be provided from Raytheon Company.

DATE: February 27, 2019

FROM: Reza Zekavat
Michigan Technological University
rezaz@mtu.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

SUBJECT: Statement of Commitment for XISP-Inc Surface-to-Surface Power and Ancillary Services
Beaming Proposal

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Sincerely,

/Original Signed By/

Reza Zekavat

DATE: February 27, 2019

FROM: Richard Dickinson
offearth7@aol.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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Sincerely,

/Original Signed By/

Richard Dickinson

DATE: February 27, 2019

FROM: Robert Hoyt
Tethers Unlimited, Inc.
hoyt@tethers.com

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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A pro forma quote has been provided.

Sincerely,

/Original Signed By/

Robert Hoyt

DATE: February 27, 2019

FROM: Seth D. Potter, Ph.D.
320 The Village Apt. 207
Redondo Beach, CA 90277

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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Sincerely,

/Original Signed By/

Seth D. Potter, Ph.D.

DATE: February 27, 2019

FROM: Sima Noghanian
University of North Dakota Space Systems Lab
sima.noghanian@engr.und.edu

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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Sincerely,

/Original Signed By/

Sima Noghanian

DATE: February 27, 2019

FROM: Tim Cash
Power Correction Systems, Inc.
1800 S. Robertson Blvd., Suite 419
Los Angeles, CA 90035

TO: Gary Barnhard President & CEO
Xtraordinary Innovative Space Partnerships, Inc. (XISP-Inc)
8012 MacArthur Boulevard
Cabin John, MD 20818-1608

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/Original Signed By/

Tim Cash