

Announcement of Opportunity for Applications of High-Speed Cameras and Associated Electronic Components or Systems in the International Space Station Radiation Environment

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TABLE of CONTENTS

I.	Introduction and Background	2
II.	Description of the Opportunity	3
III.	Eligibility.....	5
IV.	Submission Instructions	5
V.	Basis For Selection	6
VI.	Selection Information	7

I. Introduction and Background

The National Aeronautics and Space Administration (NASA) is conducting life and physical sciences research on the International Space Station (ISS). NASA is concerned with the radiation impact to high-speed camera systems and associated electronics after exposure to galactic cosmic rays (GCR) and solar particle events (SPE) on the ISS. The major GCR types include p, He, C, O, Ne, Si, Ca, and Fe with a broad energy spectra from below 10 MeV/u to above 10,000 MeV/u. SPE's are low to medium-energy protons with smaller components of helium and heavy nuclei.

The goal of this announcement is to provide a test platform to determine the effects of ionizing radiation on high-speed camera hardware for use on the Flow Boiling and Condensation Experiment aboard ISS. In response to requirements contained within NPR 7120.5E concerning radiation and radiation tolerance, the effort seeks to determine the mean time between failures (MTBF) due to radiation induced single event effects (SEE) as well as a total ionizing dose (TID) which will support the experiment mission life requirements. Results from radiation testing may be used to assess reliability of ISS-based high-speed imaging systems and associated electronic components. The radiation testing is not intended to prove radiation hardness for given components. It is intended to determine the level of risk implementation concerning the high-speed imaging system on ISS for the experiment mission life. NASA is planning to test various high-speed digital cameras in the Indiana University Cyclotron Facility (IUCF) in Bloomington, IN).

The goal of the overall study is to assess high-speed digital camera performance capability in the radiation environment aboard the ISS for possible utilization within the Flow Boiling and Condensation Experiment (FBCE). This investigation is under development at the NASA Glenn Research Center (GRC) (Cleveland, OH) in collaboration with Purdue University (West Lafayette, IN).

Radiation testing for Single Event Effects (SEE's) with high energy protons is designed to establish the susceptibility of a given test article to trapped protons in the South Atlantic Anomaly (SAA) and heavy ions due to Galactic and Solar Cosmic Rays.

The probability of an SEE occurring within a test article is related to the number of particles per square centimeter (called fluence) allowed to impinge on the device. The general criterion used in testing with protons is to expose the entire surface of the test article to a fluence of 10 billion (1E10) protons/cm².

$MTBF = 6 \text{ years} / \text{Number of SEE's in } 1E10 \text{ protons/cm}^2$

For typical orbits for the space station considered here (51.6 - 57 degree inclination, 270 nautical mile altitude), the nominal ionizing radiation environment consists of Galactic Cosmic Rays and trapped protons and electrons.

II. Description of the Opportunity

NASA is interested in partnering with U.S. based digital camera manufacturers and/or U.S. based high speed imaging system integrators to study the effects of radiation on space flight qualified high-speed digital camera systems for use in experimental studies aboard the International Space Station. The Study is particularly focused on the radiation survivability and functionality of such high-speed camera systems while performing experimental studies aboard the ISS.

NASA desires to research the feasibility of using camera systems to undergo proton and heavy ion beam bombardment tests to simulate 1-year of ISS cosmic radiation exposure during camera system operations. Candidate camera systems of interest to NASA must be capable of delivering a minimum 1024-pixel element x 256-pixel element x 8-bit depth images at a rate of 4000 frames per second for a minimum of 1 second duration (10 seconds preferred). NASA will conduct the radiation tests at no cost to interested parties and provide test data pertaining to their particular camera system to the camera-specific party. Due to the sensitive nature of such test results, no results will be shared by NASA to anyone other than the relative party. Such results and data may be used by that party to their benefit, in accordance with Federal Law.

NASA is mainly interested in obtaining high-speed digital camera systems having mean time before failure (MTBF) of one year or greater within the ISS radiation environment. However, of secondary interest are failure modes and recovery options of both data and hardware. For camera systems having less than one year MTBF, NASA is interested in the owner's assessment of camera repair and data recovery.

NASA solicits ground-based participation for high-speed imaging systems, cameras, and associated electronic components including data transfer and storage components, subsystems and complete systems. NASA anticipates the award of Space Act Agreements (SAA) for this effort. Development of better products in the future benefits the public and contributes to industrial capacity and economic growth.

NASA intends to utilize the radiation test and qualification services of the Indiana University Cyclotron Facility (IUCF) in Bloomington, IN and provide test results to individual awardees at no cost to awardees. Data obtained from the radiation qualification tests shall be protected from third party disclosure in accordance with Federal Law. NASA's interest in such data is to make informed determinations as to which (if any) high-speed cameras and associated electronics may be suitable for future low Earth orbit space experiments aboard the International Space Station (ISS).

NASA is seeking U.S. equipment manufacturers and/or U.S. based manufacturers representatives and systems integrators to loan scientific high-speed cameras and associated electronics to NASA for approximately one month for the purpose of performing radiation susceptibility testing at IUCF. All loans shall occur at no cost to NASA. The cameras are to be shipped to NASA GRC and we will confirm receipt and operations of them. They will then be shipped to IUCF for testing. NASA shall obtain appropriate test data through the utilization of the facility and provide the test data to the appropriate party. In cases where a component fails, NASA is interested in determining the failure mode, cause of failure and method for correction. NASA is interested in collaborating with participants to determine strategies that optimize performance of such equipment in the ISS radiation environment.

Cameras and electronics to be considered for such qualification testing must be capable of delivering the following features.

1. Minimum image resolution of 1024 X 256
2. Minimum dynamic range of 8-bits
3. Minimum frame rate at minimum resolution and bit depth of 4000 frames per second
4. Minimum record time of 1 second

Transfer rate of image data to permanent storage media may vary greatly, however it is desirable to have capability to transfer 4 GB of image data to permanent storage media within 2 minutes.

Systems that NASA has considered, which may meet these requirements include, but are not necessarily limited to, Gb-Ethernet high-speed CMOS cameras with on-board memory, full camera-link systems using SATA-3 solid state or 10,000 rpm hard drive storage, or specialized camera-link systems utilizing multiple SATA-2 hard drives. Other systems may also be considered.

Cameras and camera systems must be able to be operated remotely from a distance of approximately 75 feet away from the radiation chamber.

Interested parties should note that their camera systems on loan to NASA may not be returned for up to one month due to residual radioactivity. Furthermore, interested parties should note that their camera systems may sustain some form of damage due to proton and heavy ion bombardment. All loaned components will be returned to their respective owners once NASA and IUCF have determined that residual radiation levels have decayed sufficiently to assure safe handling. Normal deactivation times are usually reached within two to three weeks, but times may vary due to material composition and radiation dose. NASA shall not be held responsible for any damages incurred to camera systems during the delivery or testing processes.

III. Eligibility:

This opportunity is open to all U.S. camera manufacturers, equipment manufacturers and/or U.S. based manufacturer's representatives and U.S. systems integrators.

This announcement is open through May 10, 2013. NASA will select a limited number of participants for the current test opportunity.

Electronic correspondence for this opportunity is strongly encouraged in advance of the cutoff date. To be considered, correspondence must be received by 5:30 P.M. Eastern Time on the cutoff date specified on page 1 of this announcement and must be submitted via email to the NASA point of contact (POC), Nancy R. Hall at nancy.r.hall@nasa.gov.

IV. Submission Instructions.

See the Submission Instructions on the Announcement web page for step-by-step instructions.

Prior to submission of information, discussion with the NASA Point of Contact is strongly encouraged in order to discuss camera requirements, test methods, special needs or any other particulars. The Point of Contact information is listed as follows.

Point of Contact Name: Nancy R. Hall

Title: Project Manager

Email: nancy.r.hall@nasa.gov

Phone: 216-433-5643

Fax: 216-433-3790

The final PDF document emailed to complete your correspondence shall contain the following sections (and cannot be larger than 10 Megabytes):

Section 1

Points of Contact: List relevant information for all points of contact, specifically complete name, title, mailing address, telephone number, email address and URL if applicable.

Section 2

Executive Summary: Provide a one page summary describing the hardware, its prominent or distinguishing features and recent photo.

Section 3

Additional Information: Provide detailed information of hardware, along with anticipated outcomes, any communication protocol(s) for communicating with remote systems in order to control remotely and/or retrieve image data. Provide sufficient information on its operation so it can be operated by NASA. Finally, provide information on the method of communication with NASA hardware.

Appendix: Any additional information not covered above.

Page Limitations

Section 1: Points of Contact – 1 page

Section 2: Executive Summary - 1 page (not to exceed 750 words)

Section 3: Additional Information – 4 Pages

Appendix – No Limit

NASA has posted project goals, guidance and technical information about the camera systems of interest and radiation testing protocol at the ISS and Human Health Office Radiation Test website, <http://spaceflightsystems.grc.nasa.gov/SOPO/ICHO/IRP/FCF/Investigations/FBCE/AO/> Complete information on submission of concepts and other details regarding camera test activities are also posted at this site. Respondents and other interested persons should check the site often for pertinent information and updates.

Responses must be received by the due date above and shall not exceed six pages total (excluding appendices) using no smaller than 12 point type;

Submission of responses must be via email to nancy.r.hall@nasa.gov. The subject line of the submission should include "ISS Research RFI" and attachments should be in PDF format and cannot exceed 10 Meg. The body of the email message should identify a point-of-contact and provide his or her name, address, telephone number(s), and email address. Additional submission details are provided in the website. Paper submissions can be submitted to the NASA POC, Nancy Hall, following the guidelines above.

The number of selections made via this announcement will be determined through a competitive process based on evaluation of the responses and subsequent ability to negotiate a no-exchange-of-funds Space Act Agreement. Such selections are also subject to the availability of appropriated funds available at any given time.

V. Basis for Selection:

NASA reserves the right to select all, some or none of the proposals submitted in response to this announcement. Hardware meeting the performance requirements listed in Section II will be considered. The performance features are listed below for reference.

1. Minimum image resolution of 1024 X 256
2. Minimum dynamic range of 8-bits
3. Minimum frame rate at minimum resolution and bit depth of 4000 frames per second
4. Minimum record time of 1 second

Hardware must be available to loan for qualification testing by the dates specified on the website. NASA shall be responsible for shipping, insurance and return of the hardware to partner.

VI. Selection Information:

Government personnel from NASA, and NASA contractors may participate in the evaluation of proposals. All Contractor personnel participating in the evaluation will be bound by conflict of interest provisions and appropriate non-disclosure requirements to protect proprietary information.

Partners shall be notified by email from the NASA POC upon selection. Selection information shall be treated as confidential by NASA and its affiliates. It is not NASA's intent to publicly disclose proprietary information obtained during this announcement. To the fullest extent possible, pursuant to FOIA and other laws and regulations, information identified by a respondent as "proprietary or confidential" will be kept confidential.

By submitting a proposal under this agreement, the respondent is deemed to have consented to release of proposal data to NASA contractors supporting evaluation of proposals.