

Restore Partnership RFI

1 Overview

The National Aeronautics and Space Administration (NASA) is seeking input on a potential public-private partnership to effect the full utilization of NASA-developed technology through an end-to-end technology demonstration of a satellite servicing capability for client satellites located in geosynchronous earth orbit (GEO). The successful completion of the partnership would include developing, implementing, and operating a complete spaceflight mission in cooperation with NASA.

NASA's objectives for the Restore Partnership are to

- Advance the state of robotic servicing technology to enable the routine servicing of satellites that were not designed with servicing in mind
- Position the U.S. to be the global leader in in-space repair, maintenance, and satellite disposal
- Help to enable a future U.S. industry for the servicing of satellites
- Enable the full commercial utilization of NASA-developed technology supporting satellite servicing activities.

The goal is to perform servicing operations in orbit in the 2018 to 2023 timeframe.

NASA, through its Satellite Servicing Capabilities Office (SSCO), is soliciting information through this Request for Information (RFI) to gather market research to assist in confirming interest in such a partnership and conditions under which such a partnership would be viable. This is an RFI only and does not constitute a commitment, implied or otherwise, that NASA will take further action in this matter. Further, neither NASA, nor the Government, will be responsible for any costs incurred in furnishing this information.

1.1 Restore Background

NASA has been developing systems to facilitate satellite servicing since 1976. Eleven repair missions have been conducted in low Earth orbit (LEO) to date, with each mission utilizing the unique advantages and competencies offered by the space shuttle transportation system and the astronaut corps. Extending satellite-servicing capabilities from LEO to GEO requires new technologies and the use of robotic methods, as the GEO environment poses significant challenges for human operations.

Recent NASA-sponsored workshops, in March 2010 and May 2012, brought potential users and providers of on-orbit servicing capabilities together with NASA teams interested in furthering satellite servicing goals. Additional information on these international satellite-servicing workshops can be found at <http://ssco.gsfc.nasa.gov>.

Most recently, NASA developed the Robotic Refueling Mission (RRM) flown to the International Space Station on STS-135 in July 2011 to demonstrate tele-robotic capabilities to service spacecraft not designed for on-orbit servicing. RRM uses the space station's Special Purpose Dexterous Manipulator robot, or "Dextre", to cut and remove insulation, access test ports, cut wires, remove safety caps, access fill and drain valves, and transfer a representative fluid. On-going RRM efforts reduce risks associated with satellite servicing and bolster future robotic servicing missions.

1.2 The Restore Partnership

NASA does not intend to maintain a Government-operated on-orbit satellite servicing capacity, but rather to encourage the creation of a domestic commercial capability that meets both future government and non-government needs. To support this, NASA wishes to pursue a public-private partnership involving collaboration with private domestic entities that leverage the Government's existing intellectual property, technological resources, and expertise in this area with the goal of developing and fostering on-orbit robotic servicing capabilities for existing and future spacecraft. Such capabilities would be valuable for maintaining existing and growing commercial, governmental, and national security assets, and, therefore, increasing the potential return on investment in such assets. NASA believes that the commercial satellite industry's proven capability to finance, design, develop, integrate, operate, and own complex satellite systems, and its growing interest in providing satellite servicing as a commercial service provides the best opportunity for an appropriate risk-reward posture to advance these needed capabilities.

A proposed partnership would seek a commercial partner to advance the current NASA technology to a state of commercial readiness by providing critical hardware and services for the development, deployment, and operations of the Restore capability. NASA's SSCO at Goddard Space Flight Center (GSFC) would provide valuable technical support for these efforts, in addition to providing a significant technology portfolio.

SSCO and NASA's U.S. Government agency collaborators anticipate making available for commercial use a unique core of expertise and competencies for in-space satellite servicing (both human and robotic), including the following resources and capabilities:

- Government patents related to satellite servicing
- Family of tools to conduct precision repair and replacement activity
- Family of special robotic tools for refueling
- A robotic front-end system that includes active arms (each arm having a seven-degree-of-freedom capability)
- Autonomous rendezvous, proximity operations, and capture technologies
- Autonomous and teleoperated flight software system
- On-orbit fuel transfer technology, including fuel and oxidizer metering, pumps, and fill/drain valve interface tools
- "SpaceCube" high speed computer systems
- Servicing payload specific control center workstations (e.g., Autonomous Rendezvous and Docking [AR&D], Robotic teleoperations)
- Mission integration and testing facilities
- Launch support
- Operations control center
- Servicing operations expertise
- GSFC Natural Feature Image Recognition System (GNFIR) and other object recognition software

To bring current technology to an operational state, NASA anticipates that the Partner would need to develop technology to adapt a commercial spacecraft bus to the Restore technology baseline, take responsibility for launching the developed hardware (including providing a launch vehicle), and develop additional capabilities as needed to accomplish the joint demonstration.

The Partner would then have the exclusive right to utilize the NASA technology to perform commercial servicing missions for its own customers.

The ultimate goal of the Restore partnership is to provide a satellite servicing capability to client satellites located in GEO as illustrated in the mission profile shown in Figure 1.

Restore would potentially provide life extension servicing over a range of candidate client satellites. Specific on-orbit servicing capabilities may include:

- Remote Survey: visually inspect, record and evaluate client satellite external conditions
- Relocate: re-position client satellite to another orbital location
- Refuel: transfer propellant to/from a client satellite
- Repair: fix degraded, malfunctioning, or inoperative satellite
- Replace: replace degraded, malfunctioning or inoperative satellite components

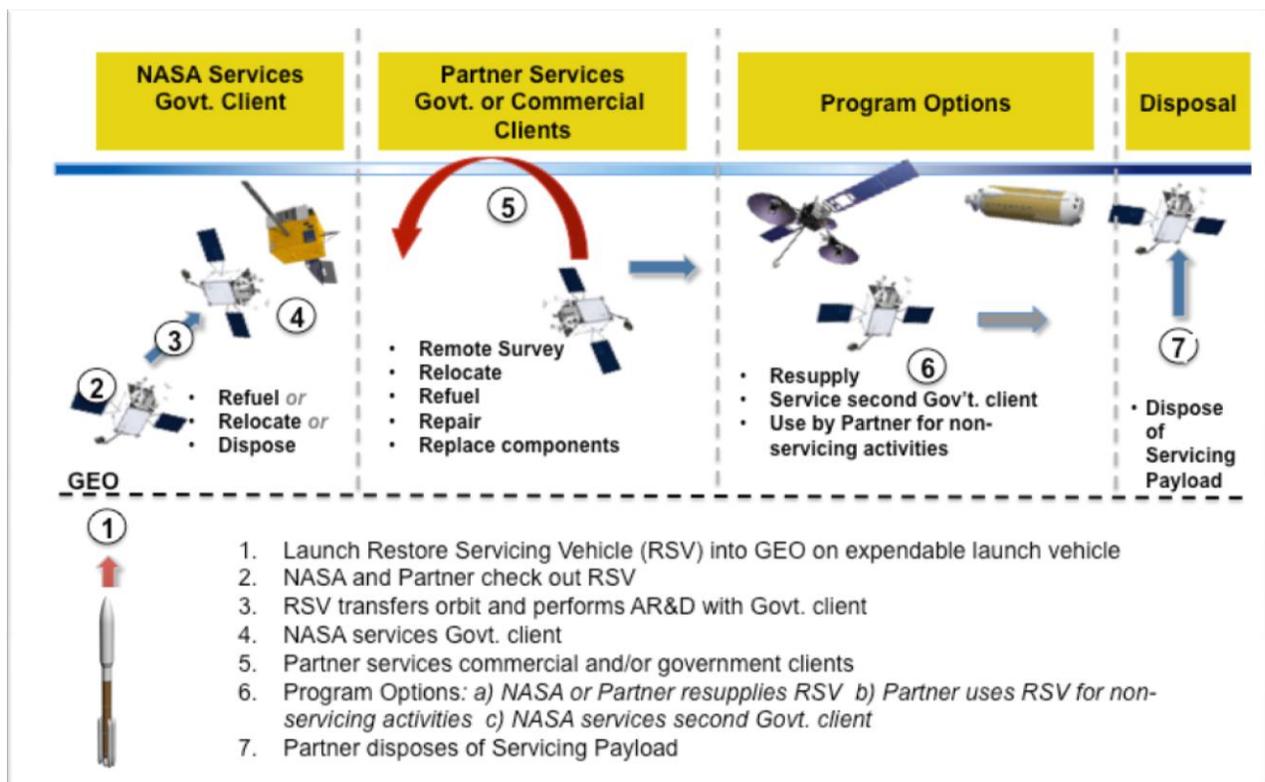


Figure 1. Notional Restore Profile

Over the notional five-year Restore spacecraft mission scenario, the Government would lead operations for servicing the initial (such as, a Geostationary Operational Environmental Satellite [GOES] or a Tracking and Data Relay Satellite [TDRS]) client (a U.S. Government satellite). The Partner would operate the servicing vehicle for the other (Partner identified) clients. Restore may include accommodation for a future orbiting resupply of the RSV, either as a hosted servicing payload or a dedicated resupply vehicle, although there is no Government plan or commitment to resupply.

2 Schedule

The goal is to demonstrate the on-orbit servicing capability within approximately four (4) years after initiation of the partnership.

3 Participation Policies

Because of U.S commercial objectives and various legal constraints, any potential Restore Partnership would be limited to prospective partners that are U.S. commercial entities. However, a Partner may incorporate some international components as long as it is in compliance with U.S. export laws and regulations. The required launch services under a Restore contract must utilize a U.S. launch vehicle.

4 Development Approach

The objective of this partnership is ultimately to bring the robotic servicing technology to a mature state, and if successful, complete a spacecraft refueling and provide the capability for continued on-orbit servicing. The work would include analysis and publication of data in the peer reviewed engineering literature, application for patents, and, if applicable, servicing of multiple clients, extended operations or other technology enhancement options, and closeout/decommission. (NASA recognizes that most if not all data returned by Restore cannot be disclosed in the public domain [e.g., export-controlled data and proprietary data]. However, the Partner would be expected to publish data to the greatest extent possible [e.g., use normalized data or at least discuss new methodologies used with clean “test cases”.] The Partner is encouraged to share results at appropriate conferences and symposia and in journals.)

A complete Restore refueling flight, assuming successful development of the technology, would encompass, at a minimum, the following Partner efforts:

- Jointly with the Government, develop refueling flight objectives and requirements
- Jointly with the Government, establish servicing-payload-to-bus interface requirements
- Develop and provide a spacecraft bus with demonstrated operational or test performance and the associated quality documentation to help the Government understand system performance, reliability, and accepted risk. This includes adapting the technology to meet the specific Restore flight objectives.
- Develop the Propellant Transfer Subsystem up to the interface with the Hose Management System, and provide all propellants for on-orbit refueling.
- Perform system-level integration and test, including ground element compatibility testing, Restore Servicing Vehicle (RSV) compatibility testing, mission operations simulations, and pre-launch mission readiness testing with the entire ground element, in conjunction with the Government
- Under the contract, supply launch services for the Restore flight, including an U.S.-built expendable launch vehicle (ELV) and support for launch vehicle integration process
- Identify/solicit clients for Restore (commercial and/or government clients)
- Obtain needed licenses and regulatory approvals for operations
- Operate the RSV for its own clients, and provide backup operations support for servicing the Government’s client(s)
- Procure insurance for its part of the mission (the Government would self insure)
- Develop and maintain the required simulators needed to reduce risk of incompatibility between the spacecraft bus and other Restore elements with which it interfaces, and demonstrate their performance through ground and on-orbit testing
- Provide the ground system/element to support Restore, including ground stations and communications networks
- Dispose of the Government-provided servicing payload at the end of the spacecraft life, as agreed upon with NASA

- Obtain/provide financing for above items.

Offerors are also encouraged to propose the following Partner efforts as options:

- Supply a satellite for a servicing demonstration
- Support orbiting resupply of RSV
- Carry a replacement component or tools to GEO on a commercial flight
- Support servicing of a second Government-specified client.

The Partner would also be allowed to propose utilization of its spacecraft bus for other commercial non-servicing activities (such as, communications) as long as they do not interfere with the servicing capability demonstration.

NASA efforts include the following:

- Identify/solicit government clients—classified or unclassified—in particular the first (such as, a GOES or TDRS spacecraft)
- Contribute Intellectual Property (IP)—expertise—to meet Restore requirements, in particular software, patents, and other related intellectual property for robotics, autonomous rendezvous and docking (AR&D), and propellant transfer technology
- Design and build a servicing payload suite for servicing satellites, which would include robotic arms and end effectors/tools, Rendezvous and Proximity Operations (RPO) sensors, algorithms, and vision processing avionics, payload avionics, and flight software, and a structural support.
- Support integration and test of the servicing payload with the spacecraft bus
- Lead operations for servicing the Government-selected client

5 Acquisition Approach

If approval to proceed with this partnership is received, NASA anticipates utilizing a Broad Agency Announcement (BAA) process to solicit offers and select a partner for this collaborative effort. NASA would select one Partner through the competitive award (under a single BAA) of a Cooperative Research and Development Agreement (CRADA) for the joint development of necessary technologies and a Firm-Fixed Price (FFP) contract with milestone payments to the selected Partner for launch services and operations.

Under the CRADA, if approved, NASA and the Partner would further develop the technology to permit a domestic commercial satellite servicing capability that would enable robotic refuel, repair, remote survey, component replacement, and orbit modifications to satellites in GEO. This would include fabricating the required hardware, integrating and testing the hardware, and developing the software needed for Restore. Note that under a CRADA, NASA cannot provide funds to a non-federal party. If approved, an FFP contract with milestone payments would be awarded to reimburse the Partner for NASA's share of the cost of launch and operations services (including the launch vehicle to deliver the RSV to the required orbit, the ground systems, control center operations [including the refueling of the first, Government-specified client], and disposal of NASA hardware at the end of the mission). It is anticipated that this FFP Contract would be capped at \$35 million Fiscal Year (FY) 2013 dollars. The allocation of the work between the CRADA and the contract is illustrated in Figure 2.

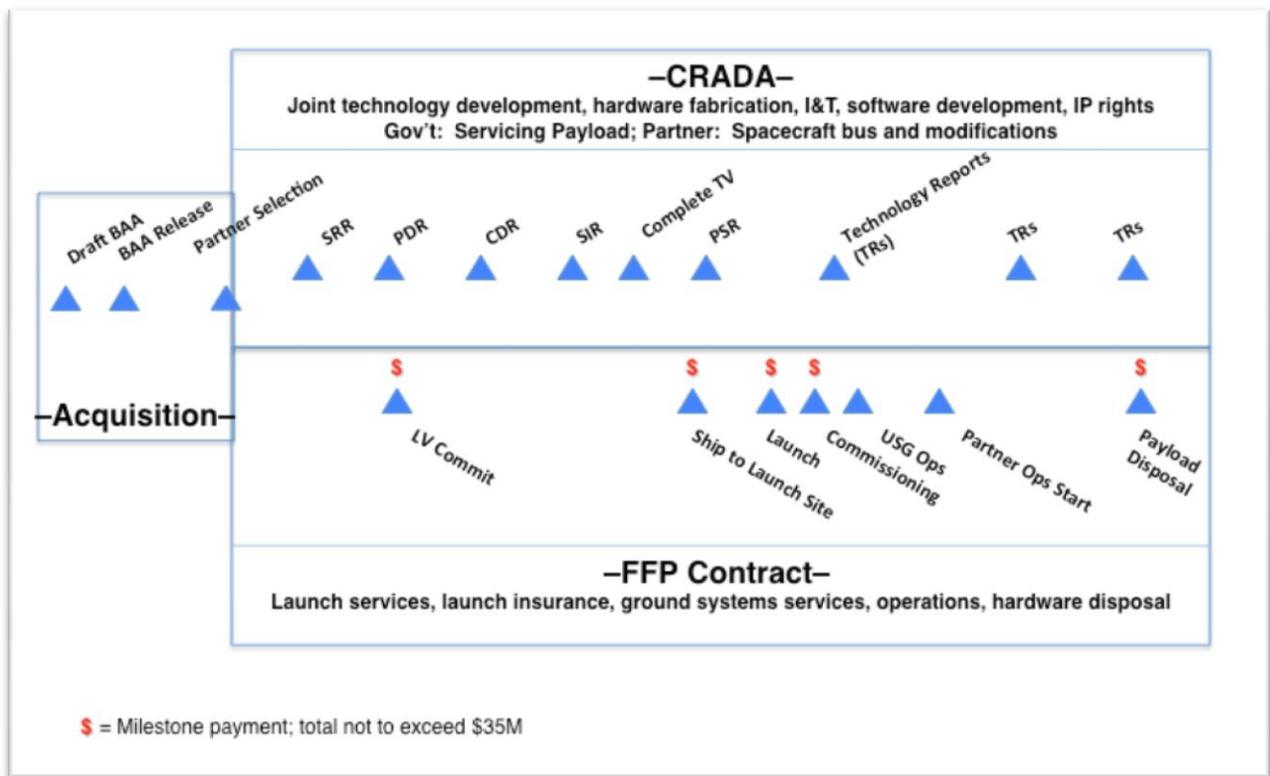


Figure 2. Allocation of Work between CRADA and Contract

6 Proposal Evaluation and Selection

Proposals would be evaluated and one offeror selected for award of the CRADA and the FFP Contract through a single unified competitive process using the following factors, to be defined more fully in the potential BAA:

- Technology development and demonstration, and implementation merit, feasibility, and approach
- Management and cost realism of the proposed approach, including commercialization approach merit, cost risk, and the realism of the Partner’s proposed business case.

These factors encompass such subfactors as the business case for commercialization, viability of the long-term business plan, probability of success, financial stability of the proposer, adequacy of the management approach for achieving the goals, and ability to provide launch services.

It is anticipated that an offeror’s past performance of relevant tasks – for example, performing related technology development, developing a spacecraft bus, performing systems-level integration of a spacecraft bus and a payload, acquiring and conducting launch services, and conducting on-orbit operations – would be an important risk factor in the selection of a proposal under this BAA. The overriding consideration would be to maximize return while minimizing implementation risk and advancing NASA's goals and commercialization objectives within the available budget.

7 Key Terms and Conditions

The following is a list of key terms and conditions that NASA has identified in relation to the Restore Partnership CRADA and the contract for launch services and operations. It should be noted that these are not fully developed provisions but instead provide the potential Partner with the general concepts that would be eventually incorporated in more detail if a draft BAA were released for this effort.

Exclusive Right to Government IP: After a successful on-orbit checkout, the Government envisions the Partner would be granted two (2) years of exclusive rights to Government IP, subject to negotiations. (Applicable to the CRADA)

Contract Type and Price: The Government currently envisions an FFP contract for the launch services and operations required for this effort. The price would be driven by the competitive market, but no more than \$35 million would be made available to the Partner. This amount does not include any options proposed by the Partner beyond the requirements established by NASA. (Contract)

Advance Agreement on Termination Costs/Termination Liability (including launch delays): The commercial Partner and the Government would pre-negotiate termination costs including a schedule with milestones and termination costs. In the event that the Government decides to terminate the CRADA and/or the Contract, it would be terminated based on a specific milestone as directed by the Government. The value of any such termination costs shall at no time exceed the value of the FFP Contract. (Applicable to both the CRADA and Contract)

Technical Conflict: Specific provisions/clauses would be incorporated for handling any technical conflict that arises between the Government and the Partner. This clause would highlight the details for different scenarios when Government approval versus insight would be required. It is expected that effective coordination amongst the Restore team institutions would utilize boards (e.g., Management Board, Systems Engineering Board, Mission Assurance Board, and Configuration Control Board). (CRADA, Contract)

Liability: If the commercial Partner damages one of its client's spacecraft (other than normal wear and tear) during a commercial mission, the Government has no liability for such damages. The idea is that each party (both Government and Partner) agrees to assume liability for its own risks arising from the satellite-servicing activities outlined in the Restore BAA. (Contract)

Launch and Operations Insurance: The Partner shall procure insurance for its part of the mission. (The Government would self insure). (Contract)

Milestone Payments: The Government envisions the following milestone payment schedule: (Contract)

Approximate Date	Milestone	Criteria	Payment Allocation
Partner Selection + 6 months	LV Order	<ul style="list-style-type: none"> Commitment from LV provider 	20%
Partner Selection + 48 months	Ship RSV to Launch Site	<ul style="list-style-type: none"> RSV arrives at launch site for integration with LV 	20%
Partner Selection + 51 months	Launch	<ul style="list-style-type: none"> Launch integration Successful launch 	20%
Launch + 2 months	On-Orbit Checkout	<ul style="list-style-type: none"> Successfully reach orbit Perform checkout Verify readiness to maneuver to first client 	20%
Launch + 5 years	Payload Disposal	<ul style="list-style-type: none"> Dispose of servicing payload per NASA standards 	20%
Total			100%

Milestone Completion/Acceptance Criteria: See criteria in table above. (Contract)

Use of Government Equipment, Facilities, Services: If the commercial Partner uses any government resources/services (such as networks [like the Deep Space Network (DSN)] or ground stations [like White Sands]) for its commercial operations, the Government envisions consideration to be negotiated for use of these resources per FAR 45.301(f) and NFS 1845.301-71. This consideration does not necessarily have to be monetary and would be subject to negotiations. (CRADA, Contract)

8 Information Requested

RFI responses must include the following Respondent Information:

- a. Name of Respondent;
- b. Respondent's address;
- c. Name and contact information for primary Respondent Point of Contact (POC), including POC's name, title (or affiliation with Respondent entity), email address, and phone number;
- d. General description of Respondent's capabilities and experience in the subject matter of this RFI;
- e. Specific feedback, comments, and suggestions on information provided in Sections 2 through 7 of this RFI.
- f. Responses to the following specific questions:
 1. Does the period of exclusive IP rights defined in the CRADA make a significant difference to your business model/plan? If so, why, and what alternative would you propose?
 2. Are the evaluation factors appropriate for determining which proposal best meets the objectives, and do they provide meaningful discriminators for selection of a Partner? If not, why not, and what would you suggest?
 3. Is the type of information provided by the Government sufficient for performing your

business analysis? If not, what more would you need to know to conduct that analysis?

4. Are you able to fulfill all aspects of the described partnership as a potential prime offeror? Please indicate whether you would propose to accomplish all aspects yourself or through teaming arrangements or subcontracts. If the latter, which activities would you perform?
5. Is the time interval specified in Section 2 of the RFI reasonable from your perspective, and would you be able to commit to the development effort needed to achieve this scenario? What, if any, is the impact of the start date to your business case? Is there a more efficient schedule technically and financially?
6. Are there any significant or unique terms and conditions not included in Section 7 of this RFI that are critical from your perspective?
7. Is the allocation of roles and responsibilities between the Government and the Partner outlined in Section 4 optimal from your standpoint? If not, what changes would you suggest to improve overall efficiency, system performance, and safety?
8. Discuss any aspects of the information provided in this RFI that would significantly impact the cost, schedule, or technical capabilities of your company and your ability to participate as a NASA Partner in this endeavor. What clarifications or suggestions do you propose to minimize impacts or improve design flexibility, safety, or reliability? Provide rationale for any alternative suggestions that still meet or exceed the intent of these requirements and standards.

9 Disclaimer

It is not NASA's intent to publicly disclose Respondents' proprietary information obtained in response to this RFI. To the full extent that it is protected pursuant to the Freedom of Information Act and other laws and regulations, information identified by a Respondent as "Proprietary or Confidential" will be kept confidential.

In accordance with FAR 15.201(e), the information being requested is for planning purposes only and is not intended to bind the Government.

It is emphasized that this RFI is NOT a Request for Proposal, Quotation, or Invitation for Bid. This RFI is for information and planning purposes only, subject to FAR Clause 52.215-3 titled "Solicitation for Information or Planning Purposes," and is NOT to be construed as a commitment by the Government to enter into a contractual agreement. The Government will not pay for information submitted in response to this RFI. No solicitation exists; therefore, do not request a copy of the solicitation. If a solicitation were released, it would be synopsized in the FedBizOpps or NASA Acquisition Internet Service websites. It is the responsibility of any potential offerors/bidders to monitor these sites for the release of any solicitation, synopsis, or related documents.

The Government reserves the right to consider a small business or 8(a) set-aside based on responses hereto. As part of its assessment of industry capabilities, NASA GSFC may contact respondents to this Request for Information if clarifications or further information is needed.

10 Responding to this RFI

An entity responding to this RFI must be a U.S. domestic entity.

All final submissions shall be submitted via e-mail to both points of contact listed below no later than February 5, 2013, 5:00 pm Eastern Standard Time. Two hardcopies of the final submission shall be sent to:

NASA Goddard Space Flight Center
ATTN: Dean Patterson/210.9 8800 Greenbelt Road Greenbelt, MD 20771

Please reference NNG12FA82-RFI-mod4 in any response.

Files may be submitted in MS Word, PDF, or RTF format. All responses shall be no more than forty (40) pages. A page is defined as one (1) sheet 8 1/2 x 11 inches using a minimum of 12-point font size for text.

NO CLASSIFIED INFORMATION SHOULD BE INCLUDED IN THIS RFI RESPONSE.

Respondents are highly encouraged to submit any questions regarding this RFI by January 29, 2013, to allow the Government time to develop responses prior to the due date for submissions. All questions and responses will be posted prior to the response date to the maximum extent practicable to assist all potential respondents.

11 Points of Contact

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