# JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION (JOFOC)

**(In accordance with Federal Acquisition Regulation (FAR) 6.3 – Other than Full and Open Competition)**

**MECHANICAL SYSTEMS ENGINEERING DESIGN FOR THE CHANGES IN QUADRUPOLE MASS SPECTROMETER**

**1. This document is justification for other than full and open competition prepared by NASA Goddard Space Flight Center (GSFC)**

NASA/Goddard Space Flight Center (GSFC) proposes to enter into a contract modification with AMU Engineering. This document justifies the determination for using other than full and open competition.

**2. The nature and/or description of the action being approved.**

NASA's GSFC proposes to enter into a sole-source contract modification to NNG10PH02C with AMU Engineering, a **woman-owned small business**, to continue the services of AMU as a MAVEN NGIMS team member for Phase B/C/D portion of the Neutral Gas and Ion Mass Spectrometer (NGIMS) instrument development for the 2013 Mars Atmospheric and Volatile Evolution (MAVEN) mission. AMU Engineering will provide the personnel and services listed in Section 3 of this JOFOC.

**3. Description of the supplies or services required, include an estimated value:**

The MAVEN NGIMS requires that mechanical design changes be made to the Quadrupole Mass Spectrometer designed by AMU Engineering for the 2001 CONTOUR mission in order to satisfy the science requirements of MAVEN NGIMS. AMU will provide the mechanical engineering design and analyses for (a) the changes needed in the Quadrupole Mass Spectrometer (QMS); (b) the RF module, (c) the NGIMS packaging, mechanical structures and spacecraft interfaces. All components and systems listed above require proven, flight heritage or a high degree of design maturity which can only be provided by AMU Engineering in order to successfully meet the aggressive instrument development schedule for the MAVEN mission. The proposed firm fixed price contract modification with an estimated value of "[text redacted]" and will have a six (6) month period of performance.

**4. Statutory authority permitting other than full and open competition:**

The authority for this procurement is 10 U.S.C. 2304 (c)(1) Only One Responsible Source.

**5. A demonstration that the proposed contractor's unique qualification or the nature of the acquisition requires use of this authority cited.**

The MAVEN mission was selected by NASA Headquarters after competing in the Announcement of Opportunity (AO) NNH06ZDA002O "Mars Scout 2006 and Missions of Opportunity" as a low cost mission to explore the Martian atmosphere. One of the prime reasons for its selection was the availability of a heritage QMS design built and flown for the 2001 CONTOUR mission. The availability of the heritage CONTOUR QMS design as well

as that of its successor QMS design currently being developed for the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission enables the MAVEN NGIMS development to come within the delivery and cost constraints established by NASA Headquarters. Having essentially an 'off the shelf' QMS design means the projected launch date in 2013 could be met as the normal development time for typical new missions would not be necessary. AMU Engineering provided the detailed mechanical engineering design and structural analysis for both the CONTOUR QMS and the LADEE QMS units.

The MAVEN mission is pursuing a very aggressive development schedule. The MAVEN NGIMS mission schedule was actually accelerated for programmatic reasons such that the time between the scheduled PDR (May 2010) and the scheduled CDR (May 2011) was shortened. The 12 month time period between PDR and CDR for the MAVEN NGIMS instrument represents a very short time period to complete a final mechanical systems design that meets the NGIMS requirements and to provide all supporting analyses required for a pre-CDR Peer Reviews and the CDR itself by a new vendor for the MAVEN mission. For comparison, the time period between PDR and CDR for the Cassini Ion and Neutral Mass Spectrometer (INMS) instrument (a predecessor of the mass spectrometer from which MAVEN NGIMS is largely based) was 24 months with a 12 month time period prior to PDR just for the preliminary design to occur, which is typical of planetary missions. For some planetary missions, the time period between PDR and CDR for a similar class of instrument as MAVEN NGIMS, has been even longer. For instance, the time period between PDR and CDR for the Cassini Huygens Probe Gas Chromatograph Mass Spectrometer (GCMS) (yet another predecessor of the mass spectrometer from which the MAVEN NGIMS QMS is largely based) was 47 months.

Currently, the development schedule has been accelerated to an even more aggressive posture. Instrument Pre-Environmental Review is scheduled for September 12, 2012 with Pre-Ship Review positioned a scant 2 months after that on November 20, 2012. The need for an experienced team that is already familiar with the work and idiosyncracies of the designs and components already completed is vital to maintain continuity in the effort to instrument delivery.

Ability for the QMS and Mechanical Systems Design vendor to hold and maintain and deliver according to this demanding schedule is *especially* important for MAVEN. As a planetary mission to Mars, MAVEN has an unmovable launch window. Inability to meet the schedule deadlines will result in extremely costly budget overruns (**e.g.** Mars Science Laboratory 2 year delay resulted in a $400M cost increase.).

AMU Engineering is the only known vendor that can meet this requirement within the aggressive MAVEN NGIMS schedule and budget constraints. The basis for this statement is that the only way the QMS and Mechanical Systems Design can be developed under these constraints is to have an intimate knowledge of the QMS and Mechanical Systems Designs of heritage space flight mass spectrometers, particularly the LADEE NMS instrument, on which the MAVEN NGIMS instrument is heavily based in order to most efficiently re-engineer portions of the heritage designs to suit MAVEN NGIMS requirements. AMU Engineering is the sole developer of the QMS and Mechanical Systems Design of the LADEE NMS

instrument and thus is uniquely qualified and best able to ensure the required work is completed in the very short time period allowed in the MAVEN schedule. The learning curve for any other vendor to attain such a level presents an unnecessary technical and schedule risk to the government.

AMU Engineering has extensive experience with the QMS and Mechanical Systems Designs on many heritage QMS instruments including the CONTOUR NGIMS and the LADEE NMS instruments on which the MAVEN NGIMS design is very closely based. For MAVEN NGIMS, work is required in several areas: 1) Design changes are necessary in the ion source and inlet region of the QMS similar to that the system used both on the CONTOUR and LADEE missions to increase instrument sensitivity necessary to achieve several scientific goals of the mission. AMU Engineering was responsible for the mechanical engineering design and structural analysis of the CONTOUR and LADEE QMS ion source and inlets. 2) An in-flight calibration system similar to the system used on CONTOUR will be required. AMU Engineering was responsible for the mechanical engineering design and structural analysis of the in-flight CONTOUR calibration system. 3) A QMS RF module will be required that houses and connects the electronics RF section to the QMS unit. The MAVEN RF module will be very similar to the RF module used on the Cassini/Huygens Gas Chromatograph Mass Spectrometer. 4) A Main Electronics Box (MEB) will be required to house the MAVEN NGIMS electronics system. Its design is based on the MEB used on the LADEE NMS instrument. AMU Engineering is responsible for the mechanical engineering design, structural analysis, and for ensuring that all mechanical requirements of both the LADEE QMS and MEB interface correctly for the MAVEN NGIMS instrument. 5) Packaging of the QMS, the RF module and MEB into the MAVEN NGIMS mechanical structure and its interface with the spacecraft structure will be required. The packaging, mechanical layout, mechanical support structure and spacecraft interface will be similar to that used for CONTOUR, the Cassini Ion and Neutral Mass Spectrometer, as well as LADEE NMS. AMU Engineering's employees provided detailed designs for the packaging and mechanical layout for both the CONTOUR, Cassini, and LADEE missions. 6) There will also be task management and systems engineering responsibilities including providing monthly inputs to the Project regarding work status, funding and scheduling updates; reviewing and providing inputs to Project documents such as systems safety plan, and the Mission Assurance Plan; participate in weekly MAVEN NGIMS staff meetings where technical status and schedule issues are discussed as well as coordinating with other team members; provide inputs into and participate in formal reviews including Monthly Management Reviews, Preliminary Design Review, Critical Design Review, hardware peer reviews and the Pre-Environmental Review. AMU Engineering is baselined as the Mechanical Engineering Element Lead in the current MAVEN NGIMS Team Structure and will be a key participant in reviews listed above.

The following is a detailed rationale supporting the selection of AMU Engineering as being uniquely qualified to provide the mechanical engineering design, structural analyses, and MAVEN management and systems engineering services for the MAVEN NGIMS mission.

AMU Engineering recently completed the mechanical engineering design support for the SAM instrument suite. During this time, the company did a considerable amount of work

involving the mechanical engineering design and analysis as well as the fabrication and assembly of the QMS and Gas Processing System which included gas manifolds, gas traps, scrubbers, getters, gas inlet leaks, gas transfer lines. Work included the initial conceptual designs followed by detailed designs and fabrication drawings; interacting with the fabrication vendors to ensure each part was fabricated correctly and within specification; generating assembly and processing steps and drawings for each sub assembly; interacting with the assembly technicians to ensure the parts were assembled correctly; and interacting with the Integration and Testing (I&T) team during integration of all the components into the SAM suite. Many of the designs, components, fabrication vendors and team members used for the SAM mission will be used for the MAVEN NGIMS work. AMU Engineering provided the SAM QMS Lead Engineer and had the responsibilities for all the management and systems engineering tasks as will be required in the MAVEN project. AMU Engineering prepared and gave presentations at all major SAM reviews where Goddard and JPL management were present as well as NASA Headquarters personnel. The AMU Engineering was often complemented on the professional and thorough way the presentations were given. AMU Engineering will be doing this again for the MAVEN NGIMS work.

The MAVEN NGIMS design is very similar to the design of the engineering unit of the CONTOUR mass spectrometer built in 2001 as well as the LADEE NMS instrument currently in development. For MAVEN, changes in the ion source design needed to increase the instrument's sensitivity and modifications to the ion source cover are necessary to interface properly with the Martian environment. The MAVEN NGIMS in-flight calibration system will be similar to the in-flight calibration system used on the CONTOUR mass spectrometer with differences being a design change necessary to interface properly with the new ion source cover and changes reflecting the MAVEN science requirements. The MAVEN's electronics packaging is based on a combination of that used on the CONTOUR mission, the SAM mission, and the LADEE mission and will be tailored to fit into the MAVEN space and mass requirements. MAVEN's mechanical support structures will be based on a combination of both the CONTOUR mission, the SAM mission, and LADEE mission and again will be tailored to fit into MAVEN's space and mass requirements. The MAVEN NGIMS interface to the spacecraft requires thermal and structural designs will use features common to the CONTOUR, SAM, and LADEE interfaces. The AMU structural and thermal analyst that will be used for LADEE is the same for SAM and much of the same programs created for the SAM analyses can be used for the MAVEN work. Being able to use the same company and to directly use many of the same designs and analyses work created on SAM, CONTOUR, and LADEE or at a minimum can be modified to reflect MAVEN's NGIMS requirements, will enable AMU to meet the aggressive MAVEN schedule and cost contraints.

AMU Engineering has been a member of GSFC's mass spectrometer experiment team for almost 16 years and have been key participants in the last 6 missions – the Cassini Ion and Neutral Mass Spectrometer (INMS) the Cassini/Huygens GCMS, the Japanese Nozomi Neutral Mass Spectrometer, the CONTOUR Neutral Gas and Ion Mass Spectrometer and, most recently, the 2011 MSL SAM instrument suite, and the 2012 LADEE NMS instrument. It should be noted that the Cassini INMS instrument was the precursor for the design and packaging of the CONTOUR mass spectrometer. AMU was involved in the mechanical engineering design and analyses of all 6 instruments and have accumulated a vast amount of

'corporate knowledge' over these years relating to space flight mass spectrometry and is uniquely qualified to continue in this endeavor by performing the required work on MAVEN.

The mass spectrometer group at GSFC has designed, built and flown more mass spectrometers on earth and planetary missions than any organization in the world. By providing the mechanical engineering design and analysis for many of these missions, AMU Engineering has gained an enormous wealth of experience unsurpassed elsewhere and is uniquely qualified to perform similar work on MAVEN. There is no other company that has participated in the design of more space flight neutral mass spectrometers than has AMU Engineering. This gives AMU Engineering clear and unique capabilities over other companies in being able to provide this required support that will enable the science requirements to be met within the aggressive schedule, mass, power and cost constraints imposed by the MAVEN mission.

The MAVEN NGIMS having a complex analytical instrument combined with an in-flight gas calibration system and a sophisticated electronics package becomes a complex, integrated system requiring great skills, knowledge and ingenuity in its' design to insure the scientific requirements are met while meeting very stringent mass, budget and schedule constraints. An in-depth knowledge of the inter-workings of a mass spectrometer, the in-flight calibration system and the electronics packaging system is a pre requisite for providing an efficient, well integrated system that can meet MAVEN's requirements. With nearly 16 years of 'corporate knowledge' residing at AMU Engineering for performing similar work as required for LADEE, any other vendor would have to spend several months in just learning about the designs of previous instruments on which the MAVEN design is based. They would also have to spend a considerable amount of time in learning about the complex interactions and interfaces between the mass spectrometer, the in-flight calibration system, the QMS to electronics interface and the mechanical structures and spacecraft interfaces in order to be on the same level as AMU Engineering. The amount of time required for another vendor to acquire such knowledge would be prohibitive and would cause schedule delays.

**6. Description of the efforts made to ensure that offers are solicited from as many potential sources as practicable, including whether a notice was or will be publicized as required by Federal Acquisition Regulation (FAR 5.2):**

Notice of intent to award a noncompetitive contract modification to AMU Engineering was advertised in the Federal Business Opportunities (FedBizOpps) in accordance with Federal Acquisition Regulation Subpart 5.2. This procurement was synopsized and posted on the NASA Acquisition Internet Service in accordance with the FAR Subpart 5.2.

**7. A determination by the contracting officer that the anticipated cost to the Government will be fair and reasonable:**

The Contracting Officer will conduct a cost and price analysis to determine that the proposed price will be fair and reasonable. We have also performed an in-house (independent government estimate) that will be used to evaluate the proposal for fair and reasonable costs.

**8. Description of the market research conducted and the results or a statement of the reasons market research was not conducted.**

A formal market survey was not conducted; however a similar procurement was synopsized previously on the NAIS and FEDBIZOPPS to ensure that any other potential offerors had the opportunity to express their interest in proposing to meet the requirements for the very similar LADEE instrument requirements. No responses were received.

The expertise required for manufacturing the components and providing the services needed for the MAVEN NGIMS are unique and specialized experience is required to design, develop and build them. Based on NASA GSFC engineering knowledge of the market that goes back more than 30 years in participating in similar missions, it is felt there is no other viable source that could readily participate in development of the MAVEN NGIMS subsystems required here. Members of the project team, however, have always been alert for any vendor that may be able to provide similar support. Contacts are maintained with other research groups, universities and manufacturers during meetings, trade shows, etc. who might provide acceptable, low risk alternatives. To date, no alternate US source has been identified.

**9. Other Facts Supporting the Use of Other than Full and Open Competition.**

Previous experience with components and services needed for space flight mass spectrometers and gas chromatograph mass spectrometers has demonstrated that unique experience and expertise is required to properly design, develop, test, assemble, qualify and deliver these highly specialized components within the tight MAVEN schedule constraints. This experience and expertise requires years of effort to develop and cannot be captured or developed by another vendor that lacks the above described level of experience and still meet the tight MAVEN schedule. The amount of time required for another vendor to acquire sufficient expertise to provide input for the MAVEN NGIMS would be prohibitive. Any other manufacturer would incur substantial start-up costs to acquire the requisite expertise. The learning curve to attain such a level presents an unnecessary technical risk to the government. During the past few years, NASA/GSFC has been developing measurement techniques and identifying critical technology areas that are essential for producing a scientific compelling and high technology-ready experiment for the 2013 MAVEN mission. The science and experimental team for MAVEN has evolved over the past 4 years and now include Co-I's, companies and organizations who have either been involved with past GSFC's flight missions, and/or manufacture components and systems having high technology ready levels as a result of development funding from competitively selected SBIR and PIDDP sources. AMU Engineering is a member of this team and is well positioned to provide a smooth transition into MAVEN Phase B/C/D activities. As discussed in Section 5, there is only a 12 month time period between MAVEN PDR and CDR. By the time this procurement is awarded, there will be only about 1 month before PDR making it essentially impossible for a new company to complete the required work under these time constraints. Selecting another source for these requirements would result in unacceptable risks and schedule delays negating any advantage of utilizing the competitive procurement process.

**10. Sources, if any, that expressed an interest, in writing, in the acquisition:**

As stated in paragraph 6, a notice of intent to award a noncompetitive contract to AMU Engineering will be advertised in the Federal Business Opportunity (FedBizOpps). This requirement was publicized through the presolicitation synopsis posted on August 20, 2012, with a response date of September 4, 2012. No other sources responded to the synopsis expressing an interest in this procurement.

**11. The action the Agency may take to remove or overcome any barriers to competition before any subsequent acquisition for the supplies or services required.**

A subsequent acquisition of similar components and services in support of the MAVEN NGIMS is not anticipated. Should a similar requirement develop in the future, it will be synopsized and competed to the maximum extent practical.

**JOFOC Signature Page for Mars Atmosphere and Volatile Evolution (MAVEN) Neutral Gas and Ion Mass Spectrometer (NGIMS) mechanical systems engineering design and analyses for the changes in the Quadrupole Mass Spectrometer.**

TECHNICAL DIRECTORATE: I certify that the facts presented in this Justification are accurate and complete.

Signature 8/15/12 Date

CONTRACTING OFFICER: I certify that this Justification is accurate and complete to the best of my knowledge and belief.

Signature Date