NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION (JOFOC) PURSUANT TO TITLE 10 U.S.C. 2304 (c)(1) – Only One Responsible Source and No Other Supplies or Services Will Satisfy Agency Requirements

1. ## Agency and Contracting Activity

This document is a Justification for Other Than Full and Open Competition (JOFOC) prepared by the NASA Marshall Space Flight Center (MSFC) in accordance with Federal Acquisition Regulation (FAR) Part 6.3, Other Than Full and Open Competition, and NASA FAR Supplement (NFS) Part 1806.3, Other Than Full and Open Competition.

2. ## Description of the Action

NASA MSFC proposes to procure six additional RS-25 flight engines from Aerojet Rocketdyne, located at 8900 De Soto Avenue, Canoga Park, CA 91309-7922, to support a total of five Space Launch System (SLS) missions. This effort will require the restart of RS-25 engine system production lines and the recertification of suppliers, production capability, and certification of new hardware as well as design modifications necessary to meet the SLS operational conditions. The estimated value of this proposed action is $1.5B with an estimated period of performance from date of execution through September 30, 2024.

"RS-25" is the generic designation for the staged combustion, liquid hydrogen/liquid oxygen rocket engine system previously known as the Space Shuttle Main Engine (SSME) and it is the established core stage engine for the SLS Program. The proposed action establishes a contract mechanism to fulfill SLS Program engine requirements that are beyond the scope and the period of performance of the current contract. This current contract – "SLS Rocket Engine Development Project" (NNM06AB13C) – provides the SLS Program with sixteen RS-25 flight engines to support the first four missions with a period of performance through September 30, 2016.

3. ## Description of Supplies/Services Being Acquired

Consistent with the NASA Authorization Act of 2010 and subsequent Presidential direction, NASA established the SLS Program and initiated the development of the SLS vehicle. The SLS Program has worked to develop a launch-system architecture to meet an evolving-capability strategy. NASA selected a launch system that incorporates Liquid Oxygen (LOX) and Liquid Hydrogen (LH2) propulsion technology for the core stage and mature five-segment solid motor technologies for the boost phase on the initial test flights. The vehicle uses a "stage-and-a-half" configuration that ignites the four core stage engines seconds before liftoff and then ignites the solid motors at liftoff. The booster's burn out approximately two minutes into the flight while the core stage engines continue to burn until the desired cutoff point is achieved. This basic configuration is flexible for both early demonstration flights and for evolving ultimately to a configuration with a capability to lift 130 metric tons to low-earth orbit in support of future exploration missions, as required.

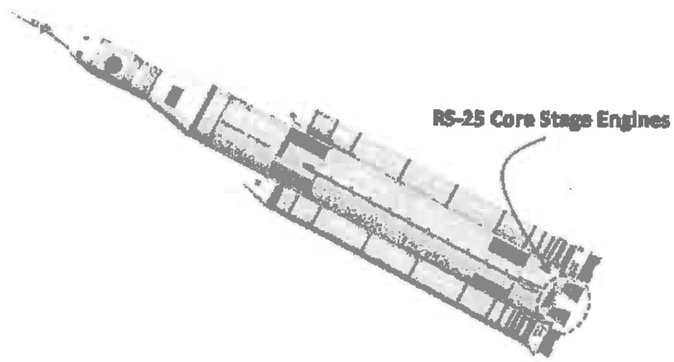


Figure 1, SLS Vehicle, Block 1 Configuration

The NASA strategy for minimizing the cost for development of the SLS vehicle is to leverage the assets, capabilities, and experience of the Space Shuttle Program along with the developed capabilities and resources from the Ares Project. Early SLS vehicle configurations utilizing sixteen RS-25 flight engines from the Space Shuttle Program with necessary refurbishment and adaptations. The availability of sixteen flight assets was one factor in selecting the RS-25 for the SLS architecture along with the demonstrated performance and extensive experience with this engine. These sixteen assets can be used for the first four flights of SLS, with four engines per stage. The proposed action follows directly in line with the strategy for cost minimization by continuing with the use of the same core-stage engine design, with minimal modifications, and with the restart of a historically proven (though currently dormant) production line.

The RS-25 Production Restart effort includes two parts. The first part is the recertification of the newly produced RS-25 for flight. This activity will involve the restart of the RS-25 production lines, both at the prime contractor and supplier facilities, and then the rigorous process of testing and demonstration necessary to show that the newly produced hardware meets the SLS Program requirements and is consistent with historically-based technical expectations. The second part of the overall RS-25 Production Restart effort is the production of six RS-25 flight engines to be used for the SLS Program.

The restart of the RS-25 production lines includes reestablishing prime contractor internal manufacturing, engineering support, and quality management processes, and includes similar activities at suppliers with re-certification of these suppliers and their processes and products as required. Some of this restart activity may include process redevelopment and minor redesign efforts due to obsolescence issues or to take advantage of modern manufacturing technologies in pursuit of lower productions costs, all while maintaining the form, fit, function, and performance of the historical and heritage RS-25 engine components and subsystems.

The certification of newly produced hardware will be accomplished through the engine system hot-fire testing of select components on an existing, retrofitted RS-25 development engine (i.e., non-flight hardware, separate from the sixteen flight assets) and then through extensive hot-fire testing of a certification engine that will be the first, entirely new production unit. Assessments of the hot-fire test data and post-test inspections will verify that the restarted production lines are consistent with historical RS-25 production and that the new engines meet the SLS Program requirements.

In order to meet SLS Program flight manifest requirements, production of RS-25 flight engines will need to begin concurrent with the engine recertification effort. The number of new flight engines to be included as part of this action is six (6). This amount of flight hardware is necessary to fulfill the needs of one SLS launch (four engines are used per launch) and two complete sets of engine hardware (i.e., the equivalent of two engines) necessary for risk mitigation in the form of spare hardware for both newly certified engines and residual RS-25 engines. This engine hardware will also serve as risk mitigation when the last four of the existing RS-25 inventory are used in support of the fourth SLS flight. The determination of the needed quantity of risk mitigation hardware is based upon a historical evaluation of operations data. In combination with the sixteen engines available under the current SLS Rocket Engine Development Project contract, this procurement activity will support the first five launches of the SLS Program.

It is important to note that this proposed effort will be based on the restart of a previously existing production line for an engine system with thirty years of human spaceflight history. It is not a new engine development effort. NASA studied and considered the option of performing wholesale changes to the RS-25 engine design but determined that the cost, schedule, technical, and safety risks of that approach outweighed the potential benefits. Based on that assessment, NASA requires the reestablishment and initial exercise of the complete programmatic, technical, safety, and manufacturing infrastructure behind the RS-25 engine system to enable NASA to acquire six additional RS-25 engines and engine-related activities in support of the five planned SLS launches.

4. <u>Statutory Authority</u>

This Justification for Other than Full and Open Competition (JOFOC) is made pursuant to FAR 6.302-1 (a)(2)(ii & iii), which implements the authority for 10 U.S.C. 2304(c)(1) for acquisition of supplies or services from only one source and no other supplies or services will satisfy agency requirements.

This authority supports the use of a follow-on contract with the original source for the continued development or production of a major system such as the RS-25 engine where it is likely that award to any other source at this time would result in substantial duplication of cost to the Government that is not expected to be recovered through competition as well as unacceptable delays in fulfilling Agency requirements.

5. **Rationale Supporting Use of the Authority**

The rationale for only one responsible source is provided below:

The SLS vehicle architecture has been established and part of that architecture is the RS-25 as the core-stage engine. Every liquid propellant rocket engine design has unique interfaces, interface conditions, physical features, and performance characteristics. These factors drive the design of the stage main propulsion system, the sizing of the propellant tanks, the constituents and capabilities of the ancillary systems used to support engine operation such as pneumatic and hydraulic fluid supply, communications, electrical power, and thrust vector control. They also can influence ground systems including handling and test equipment and even engine test stands. The engine performance also drives mission design at the vehicle level in terms of payload manifest, trajectory design, and abort scenario development.

Thus, once an engine is chosen for a launch vehicle architecture and that vehicle is certified for flight, changing to another engine with substantive differences in form, fit, function, or performance would necessitate significant stage and vehicle redesign and recertification. The SLS Program budget was built upon the cost savings from utilizing residual RS-25 assets from the Space Shuttle Program for the first four launches. Redesign efforts applied to the SLS vehicle to accommodate a change to a different core-stage engine would represent a substantial duplication of cost to the SLS Program and unacceptable schedule delays for the fifth flight.

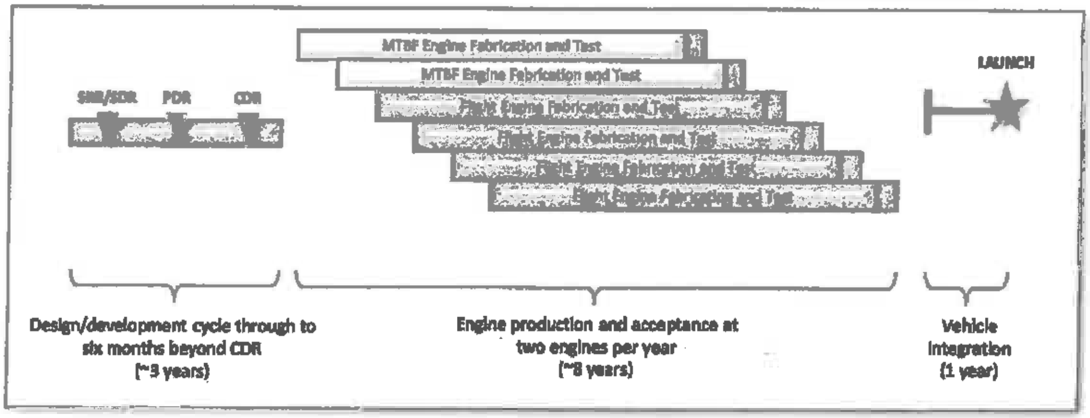
An alternative to procuring additional RS-25 engines for the planned SLS missions would be to develop a new staged combustion liquid hydrogen/liquid oxygen engine with the exact same form, fit, function, and performance as the RS-25. For the past forty years the RS-25 was, and remains today, the highest performing large staged combustion liquid hydrogen engine in the world. It is a unique engine with unique capabilities that took substantial and prolonged effort to develop and certify for human spaceflight. Given the uniqueness of the design and performance of the RS-25 engine, the estimated cost for the design, development, test, and evaluation for a new engine with the characteristics of RS-25 would be substantially greater than the cost of restarting and re-certifying the historically proven RS-25 production line. A recent, parametric estimate performed by NASA suggests that just the design cost for creating and certifying an RS-25 equivalent engine would be approximately $2.2B, which is 40% greater than the total estimated cost of this procurement action to acquire six RS-25 flight ready engines. In addition to this estimate for a new certified design additional costs would be incurred for development, test and evaluation, production of the required six engines, and the capital investments necessary to replicate the current Aerojet Rocketdyne owned manufacturing infrastructure. This type of assessment led NASA to make the decision when formulating the SLS Program, to not attempt wholesale changes to the RS-25 design due to substantial cost duplication with limited payback over the life of the SLS Program.

Using additional RS-25 engines, including restarting the RS-25 production line and re-certifying the design is relatively less expensive than developing a new, equivalent engine because the expertise, testing and operational history, and final assembly infrastructure for RS-25 production still exists and does not need to be replicated. An attempt to develop a new engine with a new contractor would require the costly redevelopment of the entire manufacturing infrastructure and require significantly more engine hot fire testing to certify for flight. This represents a substantial duplication of cost and likely schedule delays as compared to the approach of the proposed action.

The RS-25 engine design carries with it four decades of development and production activity and three decades of flight experience. As a staged-combustion liquid hydrogen engine, the RS-25 engine design is also the most advanced and complex engine ever built and flown. It utilizes a staged-combustion cycle yielding extremely efficient thrust generation, has closed-loop power level and mixture ratio control, and is compact and lightweight in construction. The development of a new engine design with the same form, fit, function, and performance of the RS-25 would involve significant and inherent technical risks and safety concerns. The RS-25 is fully matured from a technical perspective. With over one million seconds of accumulated hot-fire test time and the equivalent of over four hundred human spaceflights, the RS-25 design, production processes, and operational procedures have incorporated within them thousands of lessons learned. A new engine would require that the selected contractor design, produce, test and operate the new engine and the value lost from lessons learned is incalculable and generates many programmatic and technical risks which are not present with RS-25. Buying down these risks with a different vendor in order to achieve comparable performance, safety and mission assurance levels as available with the RS-25 might be possible, but only with inestimable added costs and delays to the SLS Program.

There are also schedule implications for proceeding with RS-25 production restart. There are sixteen RS-25 flight engines in inventory from the Space Shuttle Program to be used for the SLS Program. This includes fourteen fully-assembled and flown engines, one engine that was assembled for flight but did not go through acceptance testing, and one engine currently at component level that was never assembled for flight. Given the current baseline flight manifest for the SLS Program, and given that the vehicle uses clusters of four engines for each launch, the first complete set of four new RS-25 production engines is not needed

needed until 2027. Assuming that budget was not an issue, the opportunity exists in terms of schedule to recreate the engine design under the auspices of a different contractor. There are, however, a number of factors that make such a proposition high risk.



The figure above shows a top-level schedule leading up to the first launch using the new production RS-25 engines. Working backwards from the right-hand side, (i.e., from the launch date), there is a least one year necessary for stage and vehicle integration. The full set of flight engines needs be the ready for installation into the stage one year prior to the launch date.

To the left, there is a series of bars representing engine production and acceptance testing. For this first set of RS-25 engines, each unit will take five years to fabricate and assemble. While it will be the goal of this procurement action to reduce this cycle time, the timeline of five years matches the documented Aerojet Rocketdyne historical norm for this engine. At the end of each engine build cycle is a brief period allotted for acceptance testing and post-test processing. The first two engines represent what are typically called "mean time between failure" (MTBF) engines. As was mentioned above, the sixteenth RS-25 flight engine was assembled using residual assets and that process used up nearly all of the spare parts available. Predictions based upon compiled historical experience suggests that these two MTBF engines (or, more accurately, their constituent engine components) will be necessary in order to ensure robust support of the last SLS planned launch using residual RS-25 engines. Engine production rate shown is set at two engines per year, which is the SLS Program baseline steady state need and therefore establishes the manufacturing infrastructure and labor force size. From the initiation of engine production to the point of having the fourth new flight engine ready for delivery, the time span is approximately eight years.

Within the figure above is a bar to the left representing the design and development phase of the RS-25 recertification activity. A reasonable rate of progress through the design cycle of system requirements review (SRR), system definition review (SDR), preliminary design review (PDR), and critical design review (CDR) results in a duration of at least two and a half years. Also, as part of the recertification effort, the fabrication of development and certification hardware will be necessary and this production will commence prior to the initiation of flight engine production. Thus flight engine production will not begin until three years after authority to proceed. This flight hardware will be in production three or four years before the first newly built hardware gets tested for the first time. This means that this entire cycle of flight hardware fabrication is taking place at risk and upon the assumption of success.

The overall timeline for the proposed activity in support of the current SLS Program flight manifest is approximately twelve years. Given that this JOFOC is being developed and processed in the final months of calendar year 2014, this timeline fits within the SLS Program need for these new engines supporting a 2027 launch. The entire timeline as shown here is constructed based upon acceptance of the RS-25 engine historical norms demonstrated by Aerojet Rocketdyne and upon a successful development effort. Fulfilling this kind of timeline with any contractor other than Aerojet Rocketdyne:

- Poses a risk to the SLS program in that it is not likely the first RS-25 flight engines created by another contractor be fabricated faster than the Aerojet Rocketdyne historical norm.
- Poses a risk to the SLS program in that it is not likely another contractor could complete the upfront design and development cycle and be in a position to start flight hardware production within three years.
- Poses a risk to the SLS program in that either additional time to accommodate a competitive procurement process would lengthen the overall timeline and further delay delivery of the needed engines or accommodating a competitive procurement process within the existing timeframe would delay the start of development and fabrication and further compress the schedule to deliver the engines by 2027.
- Poses a risk to the SLS program in that a new source would be providing MTBF engine components for integration into the residual RS-25 assets without benefit of the historical experience possessed by Aerojet Rocketdyne. This is a very likely technical risk for the fourth SLS Program flight, the mitigation for which is potential cost increases and schedule delays.

Even with Aerojet Rocketdyne's extensive knowledge base and existing manufacturing infrastructure with regards to RS-25 engine development and production for meeting SLS requirements, the current schedule is challenging. It would be an unacceptable risk of schedule delay for the SLS Program if this challenging schedule was burdened by the addition of a competitive procurement process and if the effort was not leveraging all of the existing infrastructure, knowledge and experience resulting from NASA's previous contracts with Aerojet Rocketdyne.

Aerojet Rocketdyne designed, developed, and matured the RS-25 engine system as the SSME over the past forty years, and Aerojet Rocketdyne has been the only source utilized for the design, development, manufacture, refurbishment, recycle, testing, and flight operations of the RS-25 for the life of the Space Shuttle Program. Further, Aerojet Rocketdyne is the contractor currently responsible for adapting the residual Space Shuttle RS-25 hardware for use as part of the SLS Program. No other contractor has this accumulated knowledge with respect to hands-on technical experience and programmatic history of this engine and no other contractor has the knowledge with respect to integration and operation of this engine as part of the SLS Program and vehicle. Aerojet Rocketdyne has unique insight and unique demonstrated capabilities with respect to the RS-25 engine system. No other contractor could gain this level of insight and capability without a significant expenditure of time and resources representing a substantial duplication of cost that would not be expected to be recovered through competition, even taking into consideration the transfer to another contractor of non-proprietary information pertaining to RS-25 design and fabrication. Aerojet Rocketdyne has demonstrated capabilities for performing complex manufacturing and assembly of the RS-25 turbomachinery, valves, combustion devices, and the overall engine system integration. The manifestation of these capabilities is exemplified by demonstrated and repeated experience during the Space Shuttle Program of Aerojet Rocketdyne developing new RS-25 component designs and integrating these new designs into the engine system during an active, challenging, and successful flight program. These capabilities, critical skills, staffing, and management systems and approaches represent a corporate knowledge base that is proprietary to the incumbent Aerojet Rocketdyne. Most of this historically developed know-how is not transferrable to another contractor.

Beyond the issue of personnel and the corporate knowledge base there is the issue of facilities. Aerojet Rocketdyne manufacturing is performed at three facilities; machining, welding, assembly and test of subassemblies at the Canoga Park, California Strategic Fabrication Center, Turbopump assembly at the West Palm Beach, Florida facility, and final assembly and test at the NASA Stennis Space Center in Mississippi. While the NASA Stennis Space Center is a Government-owned facility, the other two facilities are Aerojet Rocketdyne facilities. Aerojet Rocketdyne has made a significant investment in facility and factory upgrades, updating equipment, and incorporating lean principles into the manufacturing processes. This commercial investment has also reduced the use and need for government-furnished equipment and facilities. Any attempt to develop similar infrastructure dedicated to rocket engine manufacturing would necessarily involve the duplication of cost even if all such infrastructure were corporate capital investment. There would necessarily be delays and start-up work intrinsic for any production effort of this magnitude. If, , an alternate scenario involved the extensive use of government-furnished equipment and facilities, then the duplication of cost becomes more direct in that the Government does not currently have facilities that could replicate the Aerojet Rocketdyne capabilities.

Aerojet Rocketdyne (and its predecessor companies) has been a part of every human space flight launch from the United States. They are the only contractor in this country to design and build large liquid hydrogen / liquid oxygen rocket engines for human space flight. They designed and built the first liquid hydrogen / liquid oxygen engines to ever fly, the RL10, first launched in 1963. They designed and built the J-2 engine used for the second stage of the Saturn IB vehicle and the second and third stages of the Saturn V vehicle. They designed and build the SSME/RS-25 as discussed here. And they have designed and built the J-2X engine that is currently in development for the SLS Program. Further, they designed and built the world's largest liquid hydrogen / liquid oxygen production engine, the RS-68, for the Delta IV vehicle in support of the Department of Defense. No other domestic contractor has the accumulated experience of Aerojet Rocketdyne with regards to liquid rocket engines in general and large liquid hydrogen / liquid oxygen rocket engines in particular. This unique experience base enables Aerojet Rocketdyne to produce and recertify the engines without substantial duplication of costs already incurred by NASA.

Given the technical and safety-related rationale for retaining the mature RS-25 design as the SLS Program core-stage engine, and given the unique experience, knowledge, and capabilities specifically pertaining the RS-25 engine that is possessed by Aerojet Rocketdyne, they are the only available source for RS-25 Production Restart that does not involve substantial and unrecoverable duplication of cost, unacceptable schedule delays, and substantial increases in technical risk.

6) **Potential Sources**

Pursuant to NFS 1804.570, this proposed contract action will be published as a pre-solicitation synopsis in accordance with FAR 5.201 via the Government Point of Entry (FedBizOpps) and on the NASA Acquisition Internet Service (NAIS), which is the NASA portal for posting its Federal Business Opportunities. The Internet site, or URL, for the NASA/MSFC Business Opportunities home page is http://prod.nais.nasa.gov/cgi-bin/eps/bizops.cgi?gr=D&pin=62.

Aerojet Rocketdyne is the only known source with the capability to provide six additional, high-performance RS-25 rocket engines certified for human spaceflight needed for the SLS flights by 2027.

7) **Determination of Fair and Reasonable Cost**

A cost analysis will be performed as described in FAR 15.4. Aerojet Rocketdyne will submit a proposal that will be evaluated and negotiated by the Government. All sources such as the Contracting Officer, cost and price analysts, the Defense Contract Audit Agency (DCAA), and Government technical representatives will be utilized in the determination of a fair and reasonable cost. In addition, data compiled from the current SLS Rocket Engine Development Project contract and historical data established under the Aerojet Rocketdyne SSME contract will be used for cost comparisons, when applicable.

8) Market Research

Market research for the proposed acquisition was conducted via information obtained from the Space Shuttle Program, the Ares Project, the SLS Program, and a number of review and studies that led to the establishment of the SLS Program and the architecture of the SLS vehicle.

Additionally, a Request for Information (RFI) was released March 13, 2013 (NASA Solicitation Number: SLS-LEO-NNM13ZPS001L) to research the existence of responsible alternative sources. Two responses were received. One was from Pratt & Whitney Rocketdyne and the other was from a small company, which has not previously developed or produced rocket engines. The response from Pratt & Whitney Rocketdyne documented 40 years of demonstrated capabilities on the RS-25 engine to include rocket engine design, development, manufacturing, and testing. The response from the small, local company (approximately two dozen employees, founded in 2009) indicated that this contractor does not have the experience, capability, or facilities necessary to develop, manufacture, assemble, test, integrate, or deliver 500,000 pounds-force thrust class LOX/LH2 rocket engines (e.g., engines like RS-25).

Subsequent to the RFI, Aerojet Corporation acquired Rocketdyne from Pratt & Whitney in July, 2013. This new company, Aerojet Rocketdyne, effectively consolidates almost the entire U.S. historical base for large liquid hydrogen / liquid oxygen rocket engines into one company:

- Pratt & Whitney (formerly of the United Technologies Corporation);
- Rocketdyne (formerly of North American Aviation, Rockwell, Boeing, and United Technologies Corporation);
- Aerojet (GenCorp).

Thus, a review by NASA of viable options from the historical perspective, from the corporate perspective, and as informed by the active market research performed via the RFI has determined that there is only one available source – Aerojet Rocketdyne – for obtaining SLS RS-25 core-stage engines while optimizing safety, cost, and schedule performance. Benefits and efficiencies are recognized from Aerojet Rocketdyne's existing development and manufacturing facilities, engineering products, established business, technical, and safety processes, and its established workforce that will promote reduced life cycle cost.

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

The SLS Program represents an aggressive and challenging mission and one of major significance within NASA and the scientific community. The NASA Authorization

Act of 2010 directed NASA to initiate the development of a new SLS vehicle with Space Shuttle Program and Ares derived assets to the extent practicable.

> **Section 304 (a) of the 2010 Act states:**
> *"In developing the Space Launch System ... the Administrator shall, to the extent practicable utilize ... existing contracts, investments, workforce, industrial base, and capabilities ...that use existing United States propulsion systems, including liquid fuel engines..."*

The procurement action proposed by this JOFOC is consistent with the language of the 2010 Act regarding the establishment of the SLS Program and the development of the SLS vehicle. The work proposed here will leverage substantial capital investments in RS-25-specifc infrastructure and the effort will utilize the existing, experienced, and capable workforce that makes up the largest portion of the industrial base supporting NASA in the area of liquid propellant rocket engines.

10) **Interested Sources**

Presently, there are no other known interested sources other than the two identified and discussed in the above section regarding market research. Should other sources present themselves as a result of the pre-solicitation synopsis, they will be given appropriate consideration as required by the FAR.

11) **Barriers to Competition**

Due to Aerojet Rocketdyne's unique capabilities, knowledge, and historical experience with the RS-25 engine system, there are no specific actions that the Agency may take at this time to remove or overcome barriers to competition that do not require significant investment of unavailable agency financial resources and time as detailed in the above information.

NASA is sensitive to the need to promote competition. Accordingly, several actions are planned during the contract period of performance to promote competition opportunities with a primary focus being competition at the subsystem, component, and tooling levels. NASA plans to pursue pilot programs involving open competitions potentially involving both incentivized prime contractor-led and NASA-led activities. In support of these pilot programs, NASA will review and evaluate contractor-provided Make-or-Buy plans for all elements of the RS-25 engine to determine competitive subcontract opportunities.

While competition at the engine system level is not feasible for this current acquisition cycle, NASA intends to gather information during this contract cycle that, combined with anticipated technology advances and potential market developments, may lead to the next acquisition cycle for core stage engine production being an opportunity for a full and open competition at the engine system level.

Summary

With its unique knowledge of and experience with the RS-25 engine, its components, and its processes, Aerojet Rocketdyne is the only responsible source that can meet the SLS Program requirements for additional RS-25 engines. For the reasons discussed above, full and open competition for the NASA requirement is not feasible at this time.

I hereby certify the facts in this justification and any supporting data used for this justification are accurate and complete to the best of my knowledge.

Steven J. Wofford
Manager, Liquid Engines Element

10/24/14
Date

I hereby certify that the above justification is complete and accurate to the best of my knowledge and belief. In addition, I hereby determine that the anticipated cost to the Government will be fair and reasonable.

G. Earl Pendley
Contracting Officer

10/24/14
Date

Concurrence:

Kim E. Whitson
Procurement Officer

Nov 3, 2014
Date

L. Dale Thomas
Center Competition Advocate

Nov. 4 '14
Date

William H. Gerstenmaier
Associate Administrator for Human Exploration and Operations Mission Directorate

11/17/14
Date

Monica Y. Manning
Agency Competition Advocate

11/25/2014
Date

Approval:

William P. McNally
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