JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION

for the

SPACE LAUNCH SYSTEM CORE STAGE ENGINES

JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION

SPACE LAUNCH SYSTEM CORE STAGE ENGINES

1. **Agency and Contracting Activity.** The procuring agency is the National Aeronautics and Space Administration (NASA) and the contracting activity is NASA's George C. Marshall Space Flight Center (MSFC).

2. **Description of the Action**. NASA's MSFC proposes to modify contract NNM06AB13C with Pratt & Whitney Rocketdyne (PWR), located at 6633 Canoga Avenue, Canoga Park, CA 91303, to procure the Space Launch System (SLS) engine system. This effort is from Authority to Proceed (ATP) through completion of the storage, adaptation, and reacceptance of the RS-25d rocket engines required for four or five early missions of the SLS (depending upon final manifest needs). The "RS-25" is the generic designation for the liquid propellant rocket engine known for the past thirty-five years as the Space Shuttle Main Engine (SSME). Over the long span of the SSME program, the RS-25 has evolved from the original RS-25, known as the First Manned Orbital Flight engine, through the RS-25a, known as the Phase II SSME, to the current flight fleet of RS-25d engines, known as Block 2 SSME.

   The estimated value of this action is $130M with a period of performance from date of execution through December 31, 2024. This justification is required to modify the current J-2X Upper Stage Engine Development contract with PWR since the SLS requirement for the RS-25d is not currently in the scope. The initial contract value of NNM06AB13C, awarded June 2, 2006, was $1.153B with a period of performance through December 31, 2012; due to programmatic changes, the current contract value is $1.556B with a period of performance through September 30, 2014. This action will add the RS-25d Core Stage Engines to the current J-2X contract as a new Contract Line Item in order to have an engine system for the complete SLS architecture. Approval of this JOFOC will allow the RS-25d engine adaptation and development effort to begin immediately.

3. **Description of Supplies/Services Being Acquired**. The RS-25d effort is for the acquisition of storage, adaptation, and reacceptance of existing RS-25d Core Stage Engines, which includes moving and storing the residual inventory of fifteen flight engines, two development engines, and associated ground support equipment. The scope of the effort will also include an assessment of existing engine hardware assets to identify and pursue flight engine and flight spare component refurbishment activities in the interest of supporting the SLS Program flight manifest in a robust manner. Further, this activity will include the work scope necessary for the adaptation of the RS-25d for use as part of the SLS program. Given that the systems for the SLS vehicle will be different than those used by the Space Shuttle Program (SSP), some minor modifications to the engines will have to be considered. In addition, given the lapse of time between last usage and scheduled use for flight, material properties for non-metallic components will be reevaluated and validated for

use prior to testing and flight. These evaluations, combined with each engine being hot-fire tested to demonstrate flight worthiness, will constitute a reacceptance of these engines for SLS use.

Consistent with the NASA Authorization Act of 2010 and Presidential direction, NASA is developing a set of reference missions that rely on evolving a set of development and operational space launch capabilities over a period of time to support increasingly ambitious exploration missions to increasingly more challenging destinations. (Reference missions define missions that NASA intends to perform, including the means of launching those missions, leading directly to a set of launch vehicle needs.) A key early capability required by NASA's reference missions is the Orion Multipurpose Crew Vehicle (MPCV) and a human-rated Space Launch System. MPCV provides crew accommodations, propulsion, and communication for extended exploration missions. Early SLS missions will launch the MPCV for high energy (i.e., higher orbit than Low Earth Orbit (LEO)) un-crewed test flights and Beyond Earth Orbit (BEO) crewed operations. An early milestone is an exploration test flight of the SLS that has enough lift capability to launch the MPCV with a propulsive in-space stage. This mission will allow MPCV to go beyond LEO and return with enough velocity to fully test the MPCV heat shield. The lift capability required for this flight is approximately 70 metric tons to LEO.

NASA's reference missions also require a launch system capable of lifting up to 130 metric tons of payload to LEO for more ambitious exploration missions. The larger payloads enable placement of significant exploration hardware in space and enable potential science missions to Near Earth Objects, such as asteroids, and Mars. The SLS design will be capable of evolving to this capability (stage will be designed to be reconfigurable without performing design analyses) at a pace prescribed by the available budget.

The SLS Program Office has worked to develop a launch system architecture to meet an evolving capability strategy consistent with the reference missions. 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 Core Stage engines seconds before liftoff and then ignites the solid motors at liftoff. The boosters 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 flight demonstration with MPCV and for evolving to a 130 metric ton launch capability using a single Core Stage development that results in a common Core Stage for any SLS mission.

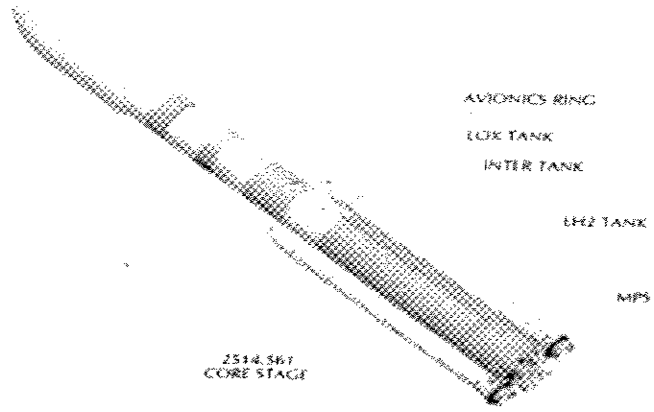

Figure 1: Launch configuration (shows upper stage as well)

The main Elements of SLS are divided along the major hardware components, and also constitute "projects" within the SLS Program. The early SLS configuration will incorporate the RS-25 engine as the Core Stage main engine. The RS-25 was selected because of the experience with this propulsion system on the SSP, the performance of the engine, and the availability of engines from the SSP inventory. The RS-25 will be used "as is" (no new qualification or requalification except for minor changes due to obsolescence, like replacement of the engine controller electronics box, and qualification test firing at the Stennis Space Center). The booster configuration selected for the early SLS flights consist of two boosters derived from the Ares I Reusable Solid Rocket Motor V (RSRMV) project; the "V" indicates a five segment motor configuration. These boosters were selected for similar reasons to the RS-25. The development of the motor components is nearly complete, with few technical risks remaining, and boosters can be available in time to support the launch schedule due to use of Shuttle heritage Forward Skirt, Aft Skirt and interface hardware, and the use of mature Ares I booster avionics. Avionics and software will be developed using, with some modifications, the Ares I Instrument Unit Avionics systems and Flight software that has been previously developed by an in-house NASA design team. System Integration of the integrated stages and boosters will be provided by an experienced NASA engineering team consisting of NASA personnel from MSFC, Kennedy Space Center, Johnson Space Center, Glenn Research Center, and Langley Research Center as well as support contractor personnel.

The only remaining SLS flight element needed for the early flights required to be developed is a Core Stage, which forms the backbone of the SLS launch vehicle configuration. In its most basic form, the Core Stage consists of structural tanks and dry structure, Main Propulsion System (MPS), thrust vector control for the SLS engines (RS-25), and attitude control systems. Even though the missions are different, the general functionality between the ARES Upper Stage and the SLS Core Stage is the same in that both stages provide large volume cryogenic (LOX/LH2) storage and fluid delivery to an engine complement. Additionally, both stages contain similar components and thereby would utilize singular, if not identical, supply chains.

NASA's strategy for minimizing cost on SLS is dependent upon leveraging (capitalizing on effort expended on Ares I that can be used on SLS Core, thus saving that effort for SLS) common stage elements (Core and Upper Stage) and producing those stages using as much of the same tooling, processes, and procedures as practical. Early SLS configurations will incorporate RS-25d engines with necessary refurbishment and adaptations. The availability of fifteen (15) Government-owned flight assets was one factor in selecting the RS-25d for the early SLS architecture along with the demonstrated performance and extensive experience with this engine. Additionally, the supporting effort for SLS includes furnishing the necessary management, labor, facilities, tools, materials, and equipment associated with the initial flight sets for the period of performance.

4. **Statutory Authority.** This Justification for Other Than Full and Open Competition (JOFOC) is made pursuant to FAR 6.302-1, which states that only one responsible source and no other supplies or services will satisfy agency requirements, which implements the authority for 10 U.S.C. 2304(c)(1).

5. **Rationale Supporting Use of the Authority.** The following rationale for only one responsible source is provided below:

   a) The Government estimate for the time required for the replacement of the RS-25d Core Stage engines with engines of comparable performance is nine years for development (includes two years to obtain and transfer the necessary property plus six to seven years for development and fabrication) plus one year for stage and vehicle integration. Therefore, replacement of the RS-25d Core Stage engines starting in 2011 would result in a schedule slip for the first SLS launch from 2017 to no earlier than 2021. The replacement schedule does not meet the 2010 Authorization Act (P.L. 111-267, October 11, 2010) intent or the Government schedule for a first launch in 2017. A set of approved and tested engines must be delivered for integration into the Core Stage by the summer of 2016 to meet the current SLS manifest. Further, the choice of the RS-25d and its associated performance characteristics (i.e. specific impulse, thrust level) are tightly coupled with the tank diameters and other design characteristics of the SLS Core Stage so no other existing, human-rated engine can meet SLS mission requirements. Thus, no other engine besides the RS-25d can fulfill the SLS architecture requirements while meeting the SLS manifest.

   b) PWR designed, developed, and matured the RS-25d engine as the SSME, a process that began nearly forty years ago, and PWR has been the only responsible source for the design, development, refurbishment, recycle, testing and flight operations of the RS-25 for the life of the SSP. The scope of the

RS-25d effort under the SLS program includes the storage, adaptation, and reacceptance of the engines. The adaptation aspect of this effort includes development activity related to modifications to the command, control, and data communications and electrical power systems. Further, the incorporation of the RS-25d into the SLS vehicle will require a significant amount of technical integration regarding an evaluation of the impact of different operating conditions and different induced environments (i.e., structural loads, thermal loads, and fluid interface conditions). A complete, in-depth assessment of the engine capabilities will depend upon the use of analytical tools developed by PWR and anchored by decades of accumulated and correlated empirical data. In addition, almost all of the RS-25d engines comprising the flight fleet contain components in need of refurbishment based upon life limits. This refurbishment activity goes beyond simple assembly. It includes the teardown and inspection of these units, procurement or manufacture of some key pieces, reassembly of these units, and hot-fire green run and acceptance of the refurbished components prior to integration into the SLS vehicle. The scope of the RS-25d effort within SLS represents activities for which PWR has product-specific history, knowledge, tools, and hands-on experience as demonstrated through decades of SSP involvement. Because of this, PWR possesses the sole capability for supporting early flights of the SLS program using RS-25d.

c) The PWR staff has demonstrated capabilities for performing complex assemblies of the RS-25d turbomachinery, valves, combustion devices, and the overall engine. The manifestation of these capabilities is exemplified by PWR's demonstrated experience of developing new hardware designs for RS-25 components and incorporating these new designs into the engine and an active flight program. It is this critical knowledge and skill that makes PWR solely capable for performing the work envisioned in SLS for the RS-25d engines. For another contractor to obtain and relocate these critical skills, staff capabilities, and historical knowledge base, the process would inherently involve some level of capability loss based upon experience with changing SSP contractors or contract performance locations and limited capture rates of incumbent personnel. Such a loss would result in cost and schedule impacts and an increase in performance risks of meeting the December 2017 launch date.

d) PWR's place of performance continues to be at the contractor's facilities in Canoga Park, CA; Desoto, CA; and West Palm Beach, FL. PWR possesses multiple facilities capable of turbopump, valve, and engine assembly for RS-25d engines. These facilities uniquely incorporate resources such as cryogenics and furnace operations within 100,000-class clean rooms in which complex assemblies are performed. The Government has a substantial investment in large scale liquid rocket engine production equipment and facilities at the multiple PWR sites, as well as investments in specialized infrastructure and equipment at Government owned sites as required to support the development and utilization of the engines. Duplication of this infrastructure, facilities, special test equipment, ground support equipment, transportation and handling equipment, special or unique tooling and/or complex assets under the auspices of a different contractor is cost prohibitive. Transfer of this infrastructure and equipment to another contractor would likely require purchasing all that is not currently Government owned; disassembly, transport, reassembly, calibration and, potentially, additional capital investment at another contractor's site; and training of new personnel to operate the facilities, infrastructure, and equipment. All of this activity represents cost and schedule impacts relative to engaging PWR for the RS-25d endeavor. If the existing inventory of RS-25d engines were not used for this effort, they would be dispositioned and would not be available for use by SLS. This means they would no longer be available for flight or test for SLS. If these engines are not utilized, NASA would be duplicating this unique capability at a significant taxpayer expense.

6) **Potential Sources.** The proposed contract action was published on September 28, 2011, on the NASA Acquisition Internet Service (NAIS) which included posting the Federal Business Opportunities as a pre-solicitation synopsis in accordance with FAR 5.201. The synopsis closed October 13, 2011, with only one response received.

7) **Determination of Fair and Reasonable Cost.** A cost analysis will be performed as described in FAR 15.4. PWR 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, historical data established under the PWR 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 SSP, Ares, and associated reviews at MSFC. The contracts awarded under the SLS Broad Agency Announcement (BAA) also provided substantial data concerning potential sources. After extensive study of all viable options, and in concert with an internal review and streamlining of SSP and Ares best practices and processes along with selected innovation and efficiency changes, NASA has determined that PWR provides the only source for attaining affordable early mission SLS engines while optimizing safety, cost, and schedule performance. Benefits and efficiencies are recognized from PWR's existing development and manufacturing facilities, engineering products, established business, technical, safety processes, and established workforce which will promote reduced life cycle cost.

Based on this knowledge, additional market research activities will not be pursued since no other potential sources can meet SLS requirements without exposing the Government to substantial duplication of costs and unacceptable schedule delays.

9) **<u>Other Facts Supporting the Use of Other than Full and Open Competition.</u>** The SLS is 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 with SSP and Ares derived assets.

<u>Section 304 (a) of the Act states:</u>

> ***<u>"In developing the Space Launch System</u>*** *... 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..."*

Currently, fifteen (15) RS-25d flight ready engines and two development engines remain in inventory from the SSP and are available to be utilized with the SLS engine system immediately. If the Government does not make efficient use of the available assets, the outcome would potentially result in: 1) dispositioning of fifteen (15) flight ready engines and two development engines as well as $2.6B of existing inventory and tooling, which includes flight qualified spare components; all ground support equipment needed to handle and operate the residual engines; and the hardware and software needed to safely operate and integrate the engines into the vehicle; or 2) transferring the existing inventory to a new contractor; or 3) allowing PWR to complete the existing hardware prior to transferring it to a successor contractor. The existing inventory and tooling value was determined during the SSP Transition and Retirement planning effort by conducting an inventory of property and property management systems containing all SSME Government Furnished Equipment (GFE) at all field sites; therefore, each scenario is unacceptable due to the adverse cost impacts and substantial development schedule delays.

Additionally, for the RS-25d engine PWR will utilize common suppliers, manufacturing locations, machines, processes and procedures with both the J-2X project and RS-68 project. The use of common suppliers for these engine projects allows for potential savings due to economies of scale. For the RS-25d, there will be substantial necessary work for refurbishing the turbomachinery, for example. The suppliers that support this activity also support the J-2X development effort. Utilizing suppliers for multiple development efforts translates to lower labor costs as overhead rates can be spread further across the workload. This applies for PWR in-house work at the contractor site as well as the fixed costs of the contractor infrastructure when supported by a broader base of multiple active projects. Also, as part of the RS-25d adaptation effort, the engine controllers may be replaced with controllers based upon the architecture developed for the J-2X engine controller, thereby saving on development and flight qualification costs for the SLS Program. This consolidation of engine activities and workforce offers cost benefits to the Government on existing contracts for all three of these engines.

For the reasons described above, no other contractor can meet the Government requirements for SLS without years of development and significant cost impacts.

10) **Interested Sources.** A statement of interest was received on October 13, 2011, from Aerojet-General Corporation in response to the synopsis of September 28, 2011. The response from Aerojet was reviewed by the Government and the determination was made that Aerojet does not possess the requisite capabilities required for the development and adaptation of the RS-25d engines for use on the SLS in order to meet the first launch in 2017. The Government notified Aerojet via letter on November 3, 2011, of this decision.

11) **Barriers to Competition.** Due to PWR's unique capabilities for the RS-25d engines and associated flight hardware, there are no specific actions that the Agency may take at this time to remove or overcome barriers to competition. The Government is sensitive to the need to promote competition and therefore will keep this as a goal while proceeding through this acquisition by minimizing whenever practical the use of proprietary data and by promoting future subcontract competition for critical components and systems for separate competitive buys.

Unique knowledge of the existing RS-25d engine, its components and processes place PWR in the only position to successfully provide the Government's requirement for the SLS.

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.

Michael H. Kynard
Manager, Liquid Engines Element

11/2/2011
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

11/3/11
Date

Concurrence:

Kim E. Whitson
Procurement Officer

11/3/11
Date

Arthur E. Goldman
Center Competition Advocate

11/3/11
Date

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

6 Nov 2011
Date

Sheryl Goddard
Agency Competition Advocate

11/7/2011
Date

Approval:

for Sheryl Goddard

William P. McNally
Assistant Administrator for Procurement

11/7/2011
Date