

Defense Production Act (DPA) Title III

Critical Chemicals Production for The Department of Defense (DoD) Missiles and Munitions

Hydroxyl Terminated Polybutadiene Production Capability Statement of Objectives (SOO)

1.0 SCOPE

The purpose of this effort is to establish a domestic supplier of Hydroxyl Terminated Polybutadiene (HTPB), and to conduct additional production and testing of HTPB R45M for the United States (U.S.) DoD usage as a viable second source solution to the current Poly bd® R-45M source. There are commercial uses of HTPB; however, the U.S. DoD requires a polymer with a specific set of parameters not found in commercial material. However, with the successful implementation of this project, new commercial uses for this grade may well emerge. The Awardee(s) will conduct a process that provides for a scale up and characterization, evaluation, and potential future production of HTPB R45M. A successful solution will demonstrate that the HTPB R45M manufacturing process is of high quality, reliable and repeatable in further propellant studies to ensure that this will be a reliable source of viable material for the DoD. This statement of objectives addresses a need for a chemicals production project to provide a systematic comprehensive, low cost/risk investment that maximizes industry partners' business case potential while minimizing recurring United States Government (USG) user community cost. This effort is anticipated to have a Technical Period of Performance (TPoP) of no more than 24 months with 3 months for the Final Report, for a total Period of Performance (POP) of no more than 27 months. The Full-rate production of HTPB R45M is 200,000-300,000 lbs annually.

2.0 BACKGROUND

The DoD has identified a deficiency in the Industrial Base for the supply of Poly bd® R-45M resin, a liquid hydroxyl terminated polymer of butadiene (HTPB). This polymer is a key component used in the manufacture of Solid Rocket Motors required across the Army, Navy, Air Force, Marine Corps, and Missile Defense Agency, including key systems such as AMRAAM, Sidewinder, SM 2/3/6, THAAD, JASSM, Aircrew Escape Systems (pilot ejection seats), GMLRS, PAC-3 MSE, Delta and Atlas 5 boosters, and SDB, among others. There is a need for more DoD-specific lots of HTPB. The hydroxyl value of the product obtained from the current domestic supplier – tied to equivalent weight – of the resin has decreased from historical levels as a result of attempting to target a lower hydroxyl functionality initially sought for the Peacekeeper Program. As a result of this continuing effort, many users find that they are unable to consistently produce propellant that meets their specifications. There are indications that this low hydroxyl value, low-viscosity HTPB resin does not contain a sufficient quantity of a higher molecular weight, higher functionality fraction to permit the manufacture of a robust propellant

in many applications, especially for air-launched applications. This situation has resulted in significant additional costs for the propellant manufacturers and their customers.

The Critical Energetic Materials Working Group (CEMWG), an OSD chartered, Service-led group that identifies materials for DoD weapons systems that are at risk of becoming unavailable and develops mitigation plans, has identified Poly bd® R-45M resin as one of the ‘critically at-risk’ materials for the Department. The high risk for this material is due to its use in so many key weapons systems for all the Services, and because there is no drop-in replacement or other domestic supplier. Even if there were another material that could be substituted, requalification costs for all the weapons systems with the introduction of a new material would be extremely high. There is a continued requirement for Solid Rocket Motors (SRMs) across the Army, Navy, Air Force and Marine Corps services. These SRMs are key to warfighter strategy with the shift to Asia Pacific.

The Government has suffered from cost overruns, schedule overruns, and material shortages due to issues with the current supply of HTPB, and these will continue to escalate absent an alternate source capable of consistently producing HTPB with properties necessary for production of military grade propellant. There is additionally a significant national security risk in relying on a single source of supply for such a critical material. Private industry has been unwilling to invest to address this issue due to the small commercial demand for this material relative to the scale of existing production capability for similar materials.

If the current supplier were to exit the market for HTPB, enormous costs would be incurred due to requalifying and/or redesigning many DoD weapons systems. Even if the current supplier stays viable and produces HTPB for production of military grade propellant, cost, schedule and technical impacts are likely as the current HTPB specifications are inadequate to determine the suitability of the polymer for propellant manufacture, and the current manufacturer is unwilling to manage their product line to achieve additional quality measures meeting DoD needs. Estimated volumes consumed are between 200,000 and 300,000 pounds/year.

This project is being initiated under the January 16, 2019 Presidential Determination for the Domestic Production of Inert Materials for Munitions. DPA Title III authorities allow for government support in the development of production capabilities in sustainment of critical production (50 U.S.C. §4533(a)(1)(C)). Title III investment in standing up a second source of supply is the most expedient method for mitigating this significant national security risk.

3.0 **OBJECTIVES**

The objectives identified in Sections 3A, 3B, 3C, and 3D are standard requirements for a Title III project. The objectives identified in 3E are the specific technical requirements for this effort. The offeror shall propose a technical effort, in a prioritized list, to address as many of the objectives in Section 3D as deemed possible with the currently available Defense Production Act (DPA) Title III funding and anticipated company cost share for this effort.

A. Program Management, Administration, and Reporting

The Awardee(s) are required to:

1. Conduct a Technical and programmatic Project Kickoff Meeting no later than 60 days After Receipt of Agreement or Award (ARA).
2. Manage and implement the project. Monitor and control the project's cost, schedule, and performance parameters.
3. Establish a cumulative monthly expenditure profile baseline for the Government funds. Track the actual and forecasted monthly expenditures against the baseline and report it to the Government on a quarterly basis.
4. Participate on the project's Integrated Product Team (IPT) and interface with DPA Title III project managers and agreements personnel.
5. Conduct Quarterly Project Management Reviews (PMRs) and ad hoc Technical Interchange Meetings (TIMs), as required. The yearly PMR schedule is typically conducted as follows: one PMR shall be conducted at the recipient's facility, one PMR per year shall be conducted at the Title III Program Offices at Wright-Patterson Air Force Base, and the remaining two PMRs shall be conducted by teleconference calls. Key sub-awardees and/or subcontractors should actively participate in the PMRs.
6. Insure, maintain, operate and service all government and non-government owned capital equipment and tooling required to produce HTPB. Update and provide the Government Equipment Property List at the time of quarterly PMRs and as required.
7. Prepare for a Business Viability No Cost Monitoring (NCM) phase after the conclusion of the technical effort to demonstrate and support the long-term goals of this project. This NCM effort shall provide the government with insight into the continuing operations and business viability of the recipient.
8. Establish and track Key Performance Parameters (KPPs) with DPA Title III IPT concurrence. Threshold (minimum) and Objective (stretch) targets shall be established for at least two KPPs in each of the following four categories: Product Technical Performance, Manufacturing, Financial, and Marketing. Report KPP performance at quarterly PMRs and as required.
9. Conduct the following reviews, as applicable, to this project: Preliminary Design Reviews (PDRs), Critical Design Reviews (CDRs), Test Readiness Reviews, Manufacturing Readiness Reviews (MRR's), Post-Test Reviews, and any Anomaly Reviews. For MRR's, a Baseline Manufacturing Readiness Assessment (MRA) shall be conducted at the beginning of the technical effort, and a Final MRA shall be conducted near the conclusion of the technical effort to measure progress made on the project.

B. Strategic Business Planning

The Awardee(s) are required to:

1. Develop and maintain a Strategic Business Plan, to include:
 - a. Submit initial plan nine months after initial award; update and resubmit the plan on an annual basis thereafter.
 - b. Include in the planning the key issues related to the establishment of a competitive and commercially viable merchant supplier of HTPB.

- c. The comprehensive strategic business planning should cover a minimum outlook of three years, and preferably five years, including all financial statements, actual and forecasts.
- d. Provide performance-to-plan evaluations at quarterly intervals, with management review comments, to the DPA Title III project manager so long as an Agreement relationship exists.

C. Market Planning and New Business Development

The Awardee(s) are required to:

1. Develop and maintain a Marketing Plan to include, but not be limited to:
 - a. Submit initial plan six months after initial award; update and resubmit the plan on an annual basis thereafter.
 - b. Strategic market planning should address current and future customer needs for HTPB.
 - c. Survey, be responsive to, and report to the Title III IPT on (DoD and commercial) customer needs, requests, and trends for HTPB.
 - d. Provide performance-to-plan updates at regular intervals, including reports on business capture plans (target business awards, actual awards, and missed opportunities), to the DPA Title III project manager so long as an Agreement relationship exists.

D. Business Viability and Manufacturing capability/experience

The Awardee(s) are required to:

1. Address the availability of resources to be employed to become, or maintain a position as, a competitive, economically viable, responsive merchant supplier to the government and commercial sectors for HTPB.
2. Provide evidence of technical understanding and institutional knowledge with respect to HTPB for both the U.S. Government and commercial markets. Evidence may include, but is not limited to, intellectual property, documented manufacturing capability and experience, technical specifications for existing devices, and dossiers of key personnel.

E. Technical Requirements

A phased approach would be employed in order to achieve a U.S.-based source of aerospace grade HTPB. The envisioned production capabilities generated by this effort would be to ensure a minimum of 10 years of sustained production. Phase 1 consists of producing acceptable batches of HTPB R45M, each batch produced in a pilot facility capable of handling the raw materials, process conditions, purification, and waste management. The contractor would be responsible for testing material to the requirements of existing weapon specifications for HTPB R45M (either WS-20700 or WS-23148), as well as providing samples to U.S. government labs and/or industrial partners to independently evaluate material quality. Each lot would be thoroughly characterized, employing the test methods used for acceptance of lots according to the current specification and also subjected to additional characterization testing above and beyond the specification requirements. The contractor shall provide an engineering design package, product/technology roadmap and a draft production capability plan. Cost factors would be developed in the Phase I

effort for estimating the cost of the material in production volumes. Any quantity remaining after the small-scale evaluations could be blended into a single lot for use in scaled-up propellant formulation testing.

The outcome of Phase I would be an understanding of the quality/batch-to-batch variability of the product, the estimated product cost/lb (at projected production levels) and verification in appropriate testbeds. Sample lots will be provided to the government for testing purposes.

Approval for advancement to Phase II will be given upon demonstration of the ability to produce acceptable HTPB R45M, with IPT concurrence. Phase II will address scale-up of the manufacturing process to meet full annual production capacity, and the evaluation of the produced HTPB in acceptable propellant formulations.

Scale-up & Testing

- A. PHASE 1 - The Awardee(s) shall provide the government with 5 separate lots (200 lbs each) of HTPB meeting requirements of WS-20700 or WS-23148 or any number of similar published specifications for this product. Additional testing shall include all specification tests as well as Inductively Coupled Plasma (ICP), Nuclear Magnetic Resonance (NMR), Acid Content, molecular weight distribution by Gel Permeation Chromatography (GPC), functionalized weight distribution by GPC/UV-Vis. Samples shall be provided to U.S). Government labs for independent evaluations as well as to the industrial partners who currently utilize HTPB in DoD production.

Lots of polymer prepared in this phase should fall within the following ranges:

Polymer Property Ranges

Test	Min Value	Max Value
Hydroxyl Value, meq/g ⁱ	0.72	0.78
Antioxidant (AO 2246), %	0.10	--
Brookfield Viscosity, CPs at 30°C	40.0	55.0
Water content, wt. %	N/A	0.05
Total Peroxides, as H ₂ O ₂ , ppm	N/A	300
Specific Gravity (at 25C)	0.87	0.92
Mw ⁱⁱ	6000	--
Mn ⁱⁱ	3000	--
Iron, %	N/A	0.010
Acid number	Informational	TBD
Epoxides, % ⁱⁱⁱ	Informational	TBD
Functionality ⁱⁱⁱ	2	

ⁱPhthalation method.

ⁱⁱUsing polybutadiene standards.

ⁱⁱⁱThe Acid Number, Functionality and Epoxide values collected from this effort will be used to later to enhance a revised specification for this polymer.

- B. PHASE II – Phase II is intended to fund the Awardee(s) to demonstrate the ability to meet an annual production capacity of 200,000-300,000 lbs/yr, with an initial quantity of up to 6,000 lbs made available to the US Government - and its selected industrial base

contractors - for evaluation in large-scale propellant mixes. This batch shall meet the technical specifications listed in the above table and be delivered to the USG with a certificate of analysis (CoA).

It is anticipated that this would coincide with the development cycle of an Army, Air Force or Navy system requiring an HTPB binder, and that program leveraging and endorsement could be obtained. Awardee(s) and U.S. Government employees will work closely with the PEO IWS, PEO Weapons and PEO Missiles & Space (MS) to ensure situational awareness of the project progression.

Awardee(s) shall provide monthly progress reports, a quality control plan, and a safety plan that will state how the Awardee(s) will be able to safely/environmentally responsibly produce, store, and transport this material. The Awardee(s) will also be required to deliver a final report.

4.0 OPERATIONS SECURITY

The following statements apply to the objectives and requirements of this SOO. *The SOW is additionally required to include the following statements:*

A. Operations Security (OPSEC) Requirements

The recipient shall participate in all activities associated with the disciplines of the organization's Industrial Security, Information Security, Personnel Security, Operations Security (OPSEC), and Antiterrorism programs, following appropriate measures in each program as required for this particular agreement. Security measures are required to reduce program vulnerability from successful adversary collection, exploitation of critical information, and violations of export control requirements. The prime recipient shall ensure all subrecipients, if applicable, conform to these requirements as required by the prime recipient.

B. Program Protection Plan (PPP)

Any potential critical program information (CPI) generated, as part of this effort, will be reviewed to determine the need for a PPP or to be included as part of an existing PPP.

5.0 REQUIRED DELIVERABLES

The Awardee(s) will have the following required deliverables:

Deliverable Item	Submittal Requirement
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Property Control List	Quarterly/As Required
Final Report*	Draft Final report due 30 days after completion of the TPoP, Final Report due 90 days after completion of TPoP
Funds & Man-hour Expenditure Report	Quarterly
Recipient's Progress, Status, & Management Report	Quarterly
Strategic Business Plan	9 months ARA**/ Updated Annually
Presentation Materials	As Required
Marketing Plan	6 months ARA**/ Updated Annually
Copy of Recipient's Billing Voucher	As Required
Manufacturing Readiness Assessment (MRA)	As Required
COAs*** for each 200-lb batch of HTPB	12 months ARA**
COAs*** for up to 6000 pounds of HTPB	18 months ARA**
Up to 6000 pounds of HTPB****	Delivered to a USG location(s) TBD at the end of the TPoP
<p>* Final report shall contain estimate of cost/lb of HTPB at 300,000 lbs annual production levels.</p> <p>**After Receipt of Agreement or Award (ARA)</p> <p>***Certificates of Analysis</p> <p>****Final deliverable quantity to be determined by program testing needs</p>	