## I. Program Overview

<table>
<thead>
<tr>
<th>Organization Name/Program Name:</th>
<th>Northrop Grumman Corporation/Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS)</th>
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<tbody>
<tr>
<td>Your Name/Position/Contact information – E-mail, Phone</td>
<td>Walt Kreitler/Director of Business Development, <a href="mailto:Walter.Kreitler@ngc.com">Walter.Kreitler@ngc.com</a>, (703) 539-9282</td>
</tr>
<tr>
<td>Customer: Organization/Name/Position/Contact information</td>
<td>United States Navy CAPT Robert Dishman, Program Manager Persistent Maritime Unmanned Aircraft Systems PMA-262 22707 Cedar Point Rd. Bldg 3262 Patuxent River, MD 20670-1193 <a href="mailto:robert.dishman@navy.mil">robert.dishman@navy.mil</a> (301) 757-5821</td>
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<tr>
<td>Program Category</td>
<td>System level R&amp;D/SDD program</td>
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### Program Background: What is this program all about? (No more than one page). Describe:

- The overarching need for this program
- History of the program
- The product that is created by this program
- Scope of work – original & updated
- Expected deliverables
- Current status of the program

The BAMS UAS is a key enabler to achieve the Navy's Maritime Patrol and Reconnaissance Force’s mission to provide Surface Surveillance capabilities to generate the necessary Maritime Domain Awareness to maintain a common operating picture of surface activity over the battle space. This mission is accomplished through an integrated multi-sensor surveillance system that includes a two dimensional Active Electronically Scanned Array (AESA) radar, an electro-optical system, Electronic Support Measures (ESM), Automatic Identification System (AIS) and robust communications systems to disseminate tactical data directly to US and allied forces. Ultimately, the product of the BAMS UAS system is Maritime Information Dominance to support the Combatant Commanders’ maritime ISR needs.

The BAMS UAS mission originated as a result of the Persistent Unmanned Maritime Aircraft System study that was used to develop an adjunct to the Navy’s future Maritime Multi-mission Aircraft (MMA). The study provided insight and guidance into the optimal force mix of manned and unmanned platforms in the future Maritime Patrol Reconnaissance Force. The Program delivers two test air vehicles and associated
command and control systems that will begin flight test in May of 2012. In 2009, the program successfully completed a Systems Functional Review, an Integrated Baseline Review, and a full range of Subsystem Preliminary Design Reviews.

In 2010, the program completed its System Level Preliminary Design Review and is tracking to a fiscal year 2011 Critical Design Review en route to the May 2012 First Flight. The program was recognized as a Top 5 DOD program by OSD/NDIA in Nov 2009.

I. **Value Creation = 20 points**

**Value:**
What is the value, competitive positioning, advantage, and return created by this program to your:
- Customers – National interests, war fighter
- Company – Strength, bottom line, and shareholders
- Scientific/technical value (particularly for R&D programs)

**Excellence and Uniqueness:**
What makes this program unique? Why should this program be awarded the Program Excellence Award? In what ways is this a stellar program?

BAMS UAS is based on a high-altitude long-endurance (HALE) RQ-4 UAS that will operate from land-based sites around the world. Unmanned aircraft at each operating location is capable of providing persistent airborne maritime Intelligence, Surveillance and Reconnaissance (ISR) 24 hours a day, 7 days a week out to ranges of 2,000 nautical miles. BAMS UAS will support worldwide maritime domain awareness by providing coverage to nearly all the world's high-density sea lanes, littorals and areas of national interest in support of the Combatant Commander operational requirements. This will be accomplished by combining 30+ hours of flight endurance with a weapon system that provides a 360° field of regard, multi-sensor capability which, combined with secure data links, delivers persistent maritime ISR. This capability becomes the linchpin in the U.S. Navy’s Maritime Patrol and Reconnaissance Force replacing the aging P-3C platform.

The BAMS UAS Program provides advantages to the Department of Defense in training, maintenance, and operations worldwide with a noteworthy level of Systems Engineering applied in the critical design phases to ensure interoperability with both domestic and international forces. The thorough Systems Engineering approach and practices applied to the BAMS UAS program with traceability from the U.S. Navy’s Capabilities Development Document down to the lowest level of hardware and software design artifacts sets this program apart from its peers. The program’s accomplishments to date are evidence of Northrop Grumman’s lessons learned and experience in recent successful development programs, most notably the E-2D Advanced Hawkeye and EA-18G Growler programs where systems engineering.
software engineering and program management processes and personnel have been leveraged to the highest degree.

III. ORGANIZATIONAL PROCESSES/BEST PRACTICES: (HOW DO YOU DO THINGS) = 30 POINTS

**Strategic:**
Describe how you developed your program strategy and competitive advantage in support of your company strategy, how you monitor progress toward achieving this strategy

Northrop Grumman has aggressively pursued unmanned air vehicle systems as a centerpiece of its aviation programs in the reconnaissance and strike warfare missions (BAMS UAS, Global Hawk, Fire Scout and N-UCAS). This strategy was undertaken to capitalize on the endurance and range advantage that unmanned systems provide and delivers a substantial edge to not only BAMS UAS, but all Northrop Grumman programs. The continuing success that the company enjoys in maintaining an edge in this area is sustained through superior systems engineering and program integration and management, and is reflected in the technical achievements of the BAMS UAS program.

**Strategic:**
Requirements Management – How do you define, revise and control your requirements?

The BAMS UAS requirements were defined in the Capabilities Development Document and are being further developed in the System Design and Development (SDD) phase of program. BAMS UAS has implemented significant improvements to the existing processes by applying relentless rigor and identifying cost, schedule and performance risks and issues up front where long term impacts are reduced. Analysis of low level specifications in the requirements phase of a program generally occurs after PDR and beyond resulting in costly re-design efforts, but by recognizing that concurrent engineering cannot be avoided in major SDD programs, an analysis of the requirements impacting lower-level subsystems was accomplished during the early systems analysis phase of the program. This process included modifications to our current tool set to allow full traceability and a database that was used simultaneously across the country.

The NGC Systems Engineering (SE) process is centered on a disciplined Systems Engineering & Integration Team (SEIT) that provides the processes and tools to meet program objectives. Specifically, the SEIT toolset makes use of Telelogic’s DOORS for requirements management and traceability, System Architect for DoDAF artifacts, and ClearCase and ClearQuest for S/W configuration management and change control. While these are common tools and processes used across industry, the BAMS UAS Program developed a method of cross-linking them providing instant visibility into the effects of changes in one area to the effects in the other two, including Interface Requirement Specifications (IRS) and Interface Design
**Documents (IDD).** These processes and tools promote the effective management of the BAMS UAS program to meet technical, schedule and cost requirements in every phase of the program life cycle.

**Strategic:**
**Systems Engineering –** Describe your systems engineering planning and management processes.

The BAMS UAS program uses the NGC Systems Engineering (SE) methodology that led to the BAMS UAS selection by OSD and NDIA as one of DODs Top 5 Systems Engineering programs in 2009. This was enabled by strict traceability from the CDD to all lower artifacts, which supported a successful PDR in February of 2010. Further, all SE processes and deliverables are developed in a joint contractor/customer team to ensure the requirement interpretation issues are synchronized. The dedicated SEIT oversees and develops the SE products across the BAMS UAS Program. This structure has allowed integration and consistency across the program.

**Strategic:**
**Opportunity Management -** Describe how your program identifies opportunity and manages this opportunity.

The BAMS UAS program actively solicits opportunities team wide to reduce schedule, cost, and risk. Opportunity is built into the Earned Value (EV) Cost Account Management methodology, a tool has been developed to categorize and manage the opportunity database.

**Operational:**
**Planning, Monitoring, and Controlling -** Describe your planning and resource allocation processes. How do you monitor and review your program’s progress and make corrections to keep the program on track

The BAMS UAS program uses a disciplined rhythm to monitor and proactively review progress, deploying a forward-looking approach to managing risk defined by either cost, schedule or performance or a combination of thereof. Weekly EVMS, program metrics, issues, risks and opportunities are reviewed with emphasis on where performance will be in six months as opposed to reacting to past EVMS data. The use of the Integrated Management Operating Model (IMOM) allows for this and its use has been contractually flowed to the major subcontractors on the program. Technical and Change Control Boards (CCB) are also held weekly for potential changes to the baseline followed by Joint boards with the customer to ensure all stakeholders are in agreement. These changes are constantly assessed for future impacts with the key focus being on proactive rather than reactive management.

**Operational:**
**Supply Chain Management --** What processes, tools and relationship-building methods have you used to develop, refine and improve supply chain and stakeholder integration? This is one of the most imperative needs of our industry – please provide

NGC employs a Subcontract Management Team (SMT) to vertically synchronize all BAMS UAS industry partners. The makeup of the team includes NGC, the respective supplier and the Navy customer. The team meets weekly and all aspects of the program are discussed, from cost and schedule to risks and opportunities. Specific tools that are incorporated into the SMT’s include weekly EV reporting, cost reporting, Risk and Opportunity Management and the Integrated Management Operating Model (IMOM). A
Specific details and data that assisted you in gauging the effectiveness.

Continuum of preparations for contractual reviews identifies shortfalls and ensures timely correction. The SMT has been a cornerstone of the BAMS UAS to ensure customer confidence in program execution.

**Operational:**
System Integration, Testing & Reviews -
Describe the activities and processes used to succeed in your system design, integration, and testing. How did you conduct system design and technical reviews?

BAMS UAS completed a PDR in February 2010. The PDR was recognized by the NAVAIR Technical Review Board for the transparency and openness that allowed a thorough and comprehensive review of the preliminary design and identification of potential trouble spots. The team met PDR entry criteria, validated by a successful event including closure of resultant Supplier and Segment Request for Actions (RFAs).

**Operational:**
Risk Management
Describe the processes used to identify risk and avoid future/potential issues or risks.

BAMS UAS has aggressively managed program risks since the inception of the program. The formal process is documented in a Risk Management Plan that includes the use of a Risk Management System Database accessible by both NGC and the customer. Regular meetings are held both internally within NGC and also jointly with the customer to review and monitor program risks. Risks that have been realized are quickly identified and effectively managed. Preparations for successful system and subsystem PDRs demonstrated the benefits of this process. Ongoing risk mitigation activities are tracked weekly.

**Team Leadership:**
Team Spirit and Motivation
Describe how you created your team spirit and culture, and accomplished full team integration and team member motivation.

The BAMS UAS team is unique in that IPTs are spread across the country with work locations in Florida, California, New York, Maryland, and Connecticut. The weekly meeting rhythm is held via IT techniques inviting team members to discuss current issues and share ideas for solutions, fostering a program environment that has been praised by the customer for its transparency. This enables the flexibility to use the best resources available to meet the requirements for the program with different skills and areas of expertise across the corporation. This flexibility generates an overall sense of trust and inclusion amongst the different elements of the team and an environment at each work location of being an important part of something bigger. This serves as a tremendous motivator to the team leads and the employees.

**Team Leadership:**
Lessons Learned and Knowledge Management
Describe how you collect lessons learned and best practices, and how they are shared with your team and company to improve performance.

Regular BAMS UAS senior leadership meetings are held specifically to collect and review lessons learned and best practices. Information is distributed to team members and the company as applicable. Going forward, team members are cognizant of prior lessons learned and best practices and are held accountable to apply the lessons in future business. The team also includes employees at all levels, from management to specific engineering skills, from other recent ACAT-1D programs.
### Team Leadership:
**Leadership Development**
How do you develop team’s skills and build future leaders

NGC mentor and diversity programs develop junior members of the team via skill development workshops, online and classroom courses related to engineering, program management and defense industry lessons. A variety of extremely good classes and programs have been developed to take the most recent lessons learned and best practices across the corporation such as the IPT Lead Development Seminar, Lead1ng One Northrop Grumman, Program Management Course, many of which include members from the Government acquisition community. Additionally, members of the BAMS UAS Program have participated in many of the Defense Acquisition University (DAU) courses in Program Management, Systems Engineering, Test and Logistics.

### Best (& Next) Practices:
Identify your program’s specific Best Practices that you believe are unique, and could be shared with others and become industry’s Next Practices.

Seamless Communication is a major objective of the BAMS UAS team. A weekly Joint Program Management Review (JPMR) is held to ensure effective communication between the Customer/NGC IPTs. Weekly IPT meetings with the PMA-262 counterparts review risks, issues and EV. The NGC contracts team continues to be proactive in resolving contractual issues via biweekly meetings with the Government and providing "Contracts Working Status Notes" to ensure that all business issues are rapidly resolved. NGC has completed necessary excursions in support of PMA-262 budget activities with the goal of minimizing impacts to either program schedule or system capability. Models for optimizing these efforts have been developed and applied to the benefit of the program and others to follow. Similar models have been applied to the IMS to provide modifications to the linkages and even the sequencing of tasks in a way that capitalizes on a better understanding of the program and in the execution of Schedule Risk Assessments (SRAs). The participation and transparency also include all of the major suppliers, to include Raytheon, Curtis Wright, Sierra Nevada, and Rolls Royce where they can benefit from the practices employed on their other programs. The coordination of obligations and expenditures, use of management reserve and predictive forecasting of EV data while there is still time to affect its outcome are just a few of the best practices along with 100% transparency of the management of the program and every technical aspect therein make this program truly unique and sets the standard for industry/Government teaming.

### IV. Adapting to Complexity: (How do you deal with your program’s unique complexities) = 20 POINTS

**Identify the Program’s**

Although BAMS UAS is a derivative of the RQ-4 Global
Market Uncertainty level – How new is your product to your market and users, based on the definitions below. Then describe how you deal and address this specific uncertainty:
- **Derivative** – an improvement of an existing product/system.
- **Platform** – a new generation in an existing product line.
- **New to the Market** – a product or system adopted from another market.
- **Breakthrough** – new to the world product or system.

Hawk systems, it represents a breakthrough in fully meeting Federal Aviation Administration (FAA) requirements for flight in the National Airspace. This has required the BAMS UAS to team with industry partners and academia to engineer sense and avoid technology that will revolutionize UAS operations both in the United States and abroad. This change will have a universal and lasting impact on the way unmanned platforms are employed and operate around the world. Because of its complementary mission with the P-8 manned patrol aircraft, BAMS UAS will leverage Maritime Patrol and Reconnaissance Forces (MPRF) efficiencies through a division of labor based on the attributes of each system, allowing each asset to maximize its unique capabilities: P-8 in anti-submarine warfare, BAMS UAS in surface surveillance. The breakthrough element of the BAMS UAS program is its role as the first global primary functional replacement of a manned capability by an UAS. The ability of BAMS, in concert with the P-8, to remove legacy aircraft from the U.S. Navy inventory and replace them with a unmanned force of 68 BAMS UAS focusing on maritime ISR and a manned force of 117 P-8s with a primary mission focus on anti-submarine warfare will increase the fidelity, breadth and scope of the common operating picture and reduce the total cost of ownership to the Navy of executing this critical mission. These challenges are dealt with by a closely coordinated industry/Government team who look for the opportunities that exist while simultaneously identifying the potential risks and mitigating them.

BAMS UAS introduces high technology revolutionary systems in unmanned air vehicle and sensor systems:
- **Sense and Avoid Radar**: BAMS UAS will incorporate a sense and avoid radar system to better support Due Regard missions and further safeguard flight in controlled airspace while migrating to an autonomous capability post-Initial Operational Capability.
- **Anti-ice/De-ice**: BAMS UAS is the first UAS system designed to have congruent icing safeguards as manned aircraft. This improvement will allow for altitude flexibility in icy conditions, thus supporting the entire mission envelope and increasing availability to the warfighter.
- **MFAS Radar**: BAMS UAS will be the only surface surveillance and classification system in the US Navy equipped with a 360-degree radar system. This radar will
**Broad Area Maritime Surveillance Unmanned Aircraft System**

| Highly automate surface unit detection and classification and will be critical in generating a complete surface picture. **Maritime Communications System:** BAMS UAS is being developed to capitalize on both X and Ka satellite systems availability. Each has challenges of their own in the development of medium and high technology systems, but through a rigorous systems engineering process, the combination of these systems to operate solely via communications links for extended periods of times is currently being designed and will be accomplished very near term. |

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<th>Identify the level of your <strong>System Complexity</strong> using the definitions below. Then explain how you are dealing with this level of complexity:</th>
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<tr>
<td>- <strong>An Assembly</strong> performing a single function.</td>
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<tr>
<td>- <strong>A Sub-system</strong> fitting within a larger system.</td>
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<tr>
<td>- <strong>A System</strong> – a collection of subsystems performing multiple functions.</td>
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<tr>
<td>- <strong>An Array</strong> – a “system of systems”; a widely dispersed collection of systems serving a common mission.</td>
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**BAMS UAS** is a system of systems that NGC manages by employing a variety of organizational and communication tools. For example, the BAMS UAS team is migrating data to one central repository for ease of retrieval and configuration control. Supplier ICD data is held in the Teamcenter Enterprise, where it is controlled and available to both internal and external users. Weekly CDM counterpart discussions address key changes, their status and any issues related to processing. Also, the program has integrated with the Global Hawk team to take advantage of the economies of scale in ordering materials for the SDD manufacturing. The BAMS UAS APL (Advance Parts List), critical to the baseline BAMS UAS Configuration, provides a current number of BAMS UAS unique and common parts used in the broader RQ-4 family of systems. |

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<th>Identify the <strong>Pace and Urgency</strong> of your team’s effort using the definitions below. Then describe how you deal with the program’s pace requirements:</th>
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<td>- <strong>Regular timing</strong> – no specific time pressures.</td>
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<td>- <strong>Fast/Competitive</strong> – time to market is important for competitiveness.</td>
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<td>- <strong>Time Critical</strong> – there is an absolute and critical-to-success deadline.</td>
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<td>- <strong>Blitz</strong> – there is a crisis element driving the need for immediate response</td>
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It is critical for BAMS UAS to achieve schedule IOC in 2015. The increasing costs of operating legacy aircraft and the Combatant Commander to regain Maritime Domain Information Dominance have BAMS UAS on a very aggressive SDD program. To sustain the time critical elements of the program, the BAMS UAS team has adopted the “design everywhere” engineering philosophy, allocating design work to elements in San Diego, CA, Bethpage NY, Hollywood, MD and Melbourne, FL. This distributed architecture is supported by a robust internal IT architecture that allows collaboration across four time zones to achieve key program milestones. |
Other Complexities & Uncertainties -
Describe other complexities and unknown factors faced by this program and how you address them.

| BAMS UAS faces challenges based on evolving UAS policy issues in the United States and internationally. Use of international airspace by UAS and the mechanics of certification for domestic and international flight remain important factors for BAMS UAS final configuration. Further, the integration of BAM UAS radar, infrared and electro optical imagery as well as Electronic Support measures and Automated Information System (AIS-shipboard identification system) data presents a significant challenge to existing C4I and analysis structures. |

V. METRICS (How do you measure program’s performance) = 30 points
(Note: We are not looking for $ results, but the relative percentage achieved. In particular indicate what specific metrics and data you are using that drive the program beyond standard measures of schedule, budget, and performance, and which have contributed to your program’s focus and its success.)

**Customer** - How do you measure the impact of your program on your customer and your customer’s satisfaction? Include a description of your metrics, as well as numerical evidence.

| BAMS UAS proactively monitors NavAir customer satisfaction via weekly leadership meetings to review performance data. Further, individual self assessments are shared with the customer regularly. Customer satisfaction is also gauged through quarterly IPARs and annual CPARs. NGC addresses weaknesses that are cited in the documents and formulates recovery plans as required. There are clear lines of communications at every level that are unimpeded by a traditional chain of command that would stall information based upon availability and perceptions of importance. |

**Performance** - How do you measure your program’s performance in traditional terms such as schedule, budget, requirements, and business results?

| The BAMS UAS program fiscal and budget performance is measured by an approved Earned Value Management System (EVMS). Joint USN / NGC weekly earned value reviews are conducted at IPT levels to facilitate timely management attention to augment the traditional monthly Cost Performance Reporting (CPRs). The use of IMOM on the program is by far the most predictive measure of technical, cost and schedule risks on the program. Where impacts to the cost or schedule baseline are predicted and worked to conclusion with full customer involvement from the onset of a problem. Technical Performance Measurements (TPMs) are tracked and managed relative to threshold and objective criteria. Business results are reviewed through monthly internal reporting (i.e. awards, sales, Return On Sales (ROS, operating margin) as well as quarterly reports at a division and sector level. |

**Preparing the Future** - How do you measure and assess the long-term contribution of your program to the corporation/organization?

<p>| BAMS UAS represents the largest growth potential in the Northrop Grumman RQ-4 family. The revolutionary role BAMS UAS will play in the Navy’s maritime ISR posture and the Department of Defense-wide applications of the RQ-4 air vehicle are critical to long term growth at NGC to include |</p>
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<tr>
<th><strong>Team</strong> - How do you measure and assess the impact of your program on your team development and employee satisfaction?</th>
<th>Follow-on capabilities in SIGINT and communication enhancements for the entire Naval force.</th>
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<tr>
<td>Employee development and satisfaction is measured via the semi-annual and annual PMP process. Employees participate and contribute to the review process that provides a measure of individual growth and job satisfaction as mutually defined by manager and employees with joint goals. This is used in conjunction with metrics on employee attrition and participation in employee resource groups to develop and assess employee satisfaction and growth. Inclusion on the BAMS UAS program is highly sought after by new employees and veterans alike.</td>
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| **Unique Metrics** - Describe any unique metrics you are using to measure your program’s progress and focus it for outstanding success | BAMS UAS develops and provides sector-wide Enterprise Dashboards which visually portray the health and performance of the program. These dashboards reflect our Portfolio Management, Bottom Line Performance, Top Line Growth and Program Protect Campaigns. Each area is segmented further and specific criteria are used to evaluate success. Additionally, it uses the Health and Visibility Management System to reflect program health at the IPT level. The primary focus of all of the metrics and new metrics that are being developed as the life cycle of the program moves from design into manufacture and test are metrics that serve as predictive tools. Whether they are as process improvements or execution-based, the metrics are designed to identify potential issues and deal with them before they become critical rather than reacting to them once the issue occurs. |