I. Program Overview

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<tr>
<th>Name of Program:</th>
<th>Wideband Global SATCOM (WGS) Satellite Program</th>
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<tbody>
<tr>
<td>Your Name/title:</td>
<td>Mark Spiwak, WGS Program Director</td>
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<td>Customer:</td>
<td>USAF Space and Missile Systems Center</td>
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<tr>
<td>Program Category</td>
<td>System-level Production/Sustainment program or project</td>
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Program Background: What is this program all about? (No more than one page)

- The overarching need for this program
- History of the program
- The product that is created by this program
- Current status of the program

**Overarching need:** The U.S. DoD urgently needs a next-generation satellite system that can deliver high data rate communications services to military troops in the field, U.S. allies and the nation’s leadership.

**History of the program:** The WGS program was conceived as a “gap-filler” to provide a bridge between the existing wideband SATCOM capability, known as the Defense Satellite Communications System (DSCS), and a “future wideband” system, which never materialized. Fiscal constraints, rapidly growing war fighter demand for wideband SATCOM services, and recognition that the commercial market was driving the relevant space and ground segment technologies, drove a decision to buy military satellites using best commercial practices. The original “Wideband Gapfiller Satellite” contract for three satellites was awarded to Boeing in January 2001. In 2006, the program name was changed to Wideband Global SATCOM, and plans were put in place to buy three additional satellites (six total), reflecting the program’s strategic importance as an essential part of the DoD’s communications backbone. Today, because of the success of the program and the critical capabilities it provides, the Air Force intends to release a solicitation to acquire up to six more of these powerful communications satellites.

**Product Created:** WGS supports the DoD’s information exchange requirements, enabling execution of tactical command and control, communications, and computers, intelligence, surveillance, and reconnaissance (C4ISR) activities; battle management and combat support information services. The WGS system also enables the transmission of streaming video and sensor data from unmanned aerial vehicles (UAVs).

**Current Status:** The scope of the contract includes three “Block I” configuration satellites, three “Block II” satellites with payload enhancements, plus associated ground-based command and control products, operator training and logistics support. As of June 2009, Boeing has launched and delivered two satellites that are meeting or exceeding all requirements. A third satellite is ready for launch, and the three Block II satellites are in production.

I. **VALUE CREATION = 10 POINTS**
**Value:**
What is the value and competitive advantage created by this program to your:
- Customers
- Company and shareholders

**Excellence:**
Why should this program be awarded the Program Excellence Award?

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**Value:** WGS is the U.S. **DoD’s highest capacity communications satellite.** As the first new military SATCOM system to be deployed in the last 15 years, WGS is rapidly becoming the communications workhorse for all of the armed forces. Each WGS satellite provides more communications capacity than the entire predecessor DSCS constellation, while maintaining compatibility with legacy user terminals. This transformational system provides tremendous operational flexibility and delivers the capacity, coverage and connectivity needed for the most demanding military operations. With satellites in operation over the Pacific and Middle East regions, WGS is already providing substantially increased communications capabilities for military users and has eased bandwidth constraints for deployed troops. For U.S. taxpayers, **WGS is very cost-effective compared to commercial alternatives. Each satellite pays for itself and the associated launch and operations costs more than four times over,** based on a nominal 14-year mission life. The WGS production program is a key element of Boeing’s strategy to maintain leadership in cutting-edge communications payload technologies and high-power satellite systems. The program’s future sales potential and inherent evolution capabilities provide exciting career opportunities for employees and a growing business base for Boeing shareholders.

**Excellence:** Considered a **“model program”** within the Air Force’s space acquisition portfolio, WGS is successfully executing through the establishment of **best-in-class processes for DoD acquisition programs,** while enabling and developing a strong program leadership team. The WGS program’s **Mission Assurance framework, Integrated Baseline Review and Management process, and its Risk, Issue and Opportunity Management** activities are just a few examples of the highly successful WGS approach. The success of the program has been facilitated through an exceptional customer-contractor partnership in a unique, co-located work environment.

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### 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

The strategic plan for WGS centers on leveraging Boeing’s core competencies in satellite system technologies and using **tailored commercial practices to provide a best-value solution for our government customer and the nation’s taxpayers.** Boeing’s proposal for WGS substantially exceeded the system’s requirements for key performance parameters, while adhering to the government’s specified
strategy

budget line. WGS blends **leading edge commercially developed technologies** – such as phased array antennas, a digital channelizer and the high-power Boeing 702 satellite platform – with the required **strong Program Management and Mission Assurance approach**. As the program has progressed, customer evaluation scores have steadily increased, reflecting solid performance and excellent teamwork. Another measure of success is the growing number of WGS satellites on order, which has already doubled from the original three – to six today – plus the potential for procurement of up to six additional satellites.

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<th><strong>Operational:</strong> Monitoring and Controlling</th>
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<tr>
<td>How do you monitor your program’s progress and make corrections to keep the program on track?</td>
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| The program follows a “battle rhythm” for monitoring and controlling program performance, composed of daily, weekly, monthly and quarterly reviews with program and functional leadership present and full participation of customer representatives. The program employs a **rigorous Earned Value Management System (EVMS)** while optimizing performance utilizing **Critical Chain Project Management (CCPM) execution methodologies and processes**. Weekly reviews of earned value, percent of tasks completed versus planned, and percent of buffer consumed along the critical chain provide clear indications of areas that are performing well, and those that require management attention. A **“Help Needed” process** provides each subsystem leader with the opportunity to ask for leadership’s aid in removing barriers to performance. Trend data is visibly displayed in the program management work area, providing continuous feedback to the co-located Boeing and customer teams.

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<th><strong>Operational:</strong> Supply Chain</th>
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<td>What processes, tools and relationship-building methods have you used to develop, refine and improve supply chain integration? This is one of the most imperative needs of our industry – please provide in specifics and with data that assist you in gauging the effectiveness.</td>
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| **Key Processes:** The program leverages Boeing Program Management Best Practices (PMBP) with **Lean principles** at its foundation to achieve continuous improvements in supply chain integration. A **standard “Buy-To Package”** was implemented on the Block II program to provide a comprehensive set of documents for subcontract bidding and execution, which substantially reduced subcontract omissions and errors. Each month, all key suppliers are graded relative to five focus areas (quality, management, technical, schedule and cost) and immediate corrective actions are taken as appropriate. Key supplier performance trends are reviewed at monthly customer and Boeing executive program reviews. **Tools:** WGS also employs a **Development Supplier Assessment Model (DSAM)** to identify and track supplier strengths, weaknesses and risks relative to management, technical, schedule, cost and quality elements. Risks, Issues and Opportunities are identified early and improvement plans are documented, tracked, and closed within the DSAM tool. A **Supplier Data Transmittal tool (SDT)** is used to streamline
day-to-day supplier interactions via a paperless, web-based system that allows the Integrated Product Teams (IPTs), the Supply Management leaders, and the engineering areas to access and react to subcontract documentation and data.

**Relationship Building:** WGS supplier relationships have been enhanced further through the deployment of dedicated Supplier Program Managers (SPMs). Each major supplier has a Boeing SPM that represents the WGS program, which provides suppliers with a single point of contact into Boeing for their products. This process ensures consistency and alignment with company and program priorities and strategic objectives. The processes, tools, and relationships incorporated across the WGS supply base provide early indicators of risks and they allow management to take the necessary actions to minimize quality problems. The result has been a substantially reduced number of non-compliance reports, fewer component failures and less rework.

### Operational: Risk Management

Describe the processes used to identify risk and avoid future/potential issues or risks.

The program has been at the forefront of risk management process implementation within Boeing. A monthly risk management board is chaired by the program manager. Membership includes Level 1 integrated product team (IPT) leads, systems engineering, and customer representatives. Identification of risks is driven to all levels of the program with each IPT lead working with their team (including customers and suppliers) to identify, create, and manage mitigation plans to closure. Lessons learned from each phase of the program along with identified issues and risks from other Boeing satellite programs are assessed for potential future risks to WGS.

### Operational: Opportunity Management

Describe how your program team identifies opportunity and manages this opportunity.

A robust process is employed to identify and realize opportunities that simplify complex processes, provide enhanced quality and Mission Assurance, and yield cost and schedule savings. The program manager also chairs a monthly Opportunity Management meeting that includes Level 1 IPT leads, systems engineering, and customer representatives. At these meetings, capture plans and resources are reviewed to ensure full staffing, funding and support by the program leadership. All IPT leaders are held accountable by program management to generate and capture opportunities.

### Team Leadership: Team Motivation

Describe how you accomplish full team integration, motivation, and inspiration.

**Team Structure and Integration:** Team motivation begins with how the team is organized and designed to fully engage everyone in decision making. This creates a sense of pride and ownership in the delivered products. The IPTs have full responsibility, accountability and authority to manage the cost, schedule, risks and opportunities for their respective areas. This team ownership and the availability of help when
requested from management, other teams, or the Boeing enterprise; provide a powerful motivational force.  

**Co-Located Program Team:** A strong team environment and excellent working relationship between Boeing and the Air Force customer is enabled by the co-location of the program teams at the Boeing satellite integration and test facility in El Segundo, CA. More than 50 Air Force officers and support contractors share common work areas with the Boeing program office and systems engineering teams. This arrangement is unique to the WGS program and is being considered as a best practice for other programs to follow. Having the program leadership and the technical and business teams’ working in such close proximity significantly enhances the ability to communicate and quickly drive issues to closure. Co-location has yielded tremendous teamwork, cooperation and camaraderie on the program. Working as a co-located team has instilled a high degree of commitment to the program and the mission, and has enabled the voice of the customer and the needs of the war fighter to be heard and clearly understood by all involved. Team members feel a sense of pride and inspiration because they are not just producing an incredible satellite – they are making a real difference by providing communications services that are saving the lives of men and women in harm’s way.

| Team Leadership: Knowledge Management | Implementation of Best Practices: Program Management
| Knowledge Management | Best Practices (PMBP) provides a framework for key areas such as Integrated Planning, Earned Value Management, Program Communications, Leadership Accountability, and Risk, Issue and Opportunity Management. The PMBP toolkit is continually refined through years of successful program execution both within the WGS program and across Boeing.
| Describe how knowledge, best practices, lessons learned are shared and used across the team to improve performance. | Knowledge Management and Lessons Learned Culture:
Production of multiple satellites affords the opportunity to use Six Sigma and Lean principles to increase the quality of subsequent units and drive down production cycle times. The program has a strong lessons learned culture that promotes structured “Lean Events” after every major manufacturing or test event, to immediately capture the thoughts of the team that performed the operation. The results of these efforts have been realized through significant reductions in spacecraft thermal vacuum test durations, from 110 days for the first satellite, down to 60 days for the third satellite.

| Team Leadership: Leadership Development | The program employs a robust people development process that uses formal and informal mentoring, stretch assignments, educational opportunities and succession planning. All senior leaders on the program are required to mentor at least 3 |
| Leadership Development | |
| How do you develop team's skills and build future leaders | |
individuals and all program leaders and employees are strongly encouraged to participate either as a mentor or protégé. To ensure critical skills are developed, nurtured and maintained on the program, the leadership team works with the functional homerooms to assess existing skills and developmental needs of key personnel and develop retention strategies to ensure the WGS program maintains the talent base needed for success. As developmental needs of employees are identified, training is provided through the Boeing Leadership Center in St. Louis, as well as through leaders-teaching-leaders classes and seminars provided through local universities or industry organizations. Training records are maintained and reviewed annually to ensure developmental training objectives are met. Succession plans for all key positions on the program are reviewed annually to ensure successors are identified and are making the required developmental progress.

Lessons Learned:
Describe how you collect lessons learned and how they are shared with your team and company

The program has a strong lessons learned culture that has proven beneficial in terms of improved product quality and reduced production cycle times. Lean Events after every major manufacturing or test event are used to capture improvement ideas from the team that performed the operation. The program’s “Gated Practice” provides a framework for rigorously tracking progress across all areas on the program as well as capturing and sharing relevant lessons learned for use on future satellites. The WGS satellite production and delivery timeline is divided into 16 gates that provide a means to methodically monitor and assess process effectiveness and product quality throughout the program life cycle. Each gate checklist requires lessons learned to be documented in what is known as the Corrective Action Lessons Learned (CALL) web-based system. Before passing through each gate to the next phase of the program, relevant lessons learned are reviewed by the team that is responsible for the next program phase. Several processes exist to ensure that lessons learned are exchanged between WGS and all other “sister” programs within Boeing. These include Boeing-internal processes such as the Electronic Product Assurance Record (EPAR) system, Product Assurance (PA) Alerts and Issue Notifications (INs); in addition to industry processes such as the Government-Industry Data Exchange Program (GIDEP). Additionally, change control boards facilitate documenting and sharing corrections and improvements to engineering documentation on WGS and across the Boeing 702 satellite product line.

Best Practices:
Identify one or two specific

The program’s success is based on an optimal balance that uses commercial technologies and practices, while meeting
Best Practices that you applied in your program and that you believe to be unique approaches.

The rigorous Mission Assurance needs of the U.S. military. This is fostered by a unique co-location approach that allows all Boeing and customer program office personnel, including system engineering and business operations teams, to interact freely within a single floor at the Boeing facility. This high degree of co-location increases program efficiency and significantly reduces the time to resolve issues as they arise. The arrangement instills a “One Mission, One Team” mentality throughout the program. Another best practice that is highly leveraged involves use of Lean program execution processes including Theory of Constraints (ToC) and Critical Chain Project Management (CCPM) methodologies. Lean tools, which include use of ToC, CCPM, and Six Sigma processes, have been used in all program phases to enable execution ahead of the baseline plan with appropriate schedule and cost reserves in place.

Next Practices: To what extent and how can your practices be shared with other programs and become “Next Practices”?

Boeing has other processes that facilitate transfer of best practices and lessons learned across the enterprise. For example, all major programs within Boeing participate in the PMBP process, which offers a unique ability to create, capture and transfer new best practices to other programs throughout the company. The WGS program submits unique programmatic processes and successes to the Program Management Process Council for consideration and use as “Next Practices”. Functional organizations also have a responsibility to ensure best practices and lessons learned on one satellite program are implemented across other programs.

IV. Adapting to Complexity: (How do you deal with your program’s unique complexities) = 30 Points

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<tr>
<th>Identify the Program’s Market Uncertainty level using the definitions below. Then describe how you deal and address this specific uncertainty:</th>
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<td>- Is it a <strong>Derivative</strong> of existing product/system?</td>
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<tr>
<td>- Is it a <strong>New Generation</strong> of existing product line/system applied to new market segment?</td>
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<tr>
<td>- Is it a <strong>Breakthrough Program</strong> (new to the world product or system)</td>
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WGS is a **Breakthrough Program** that provides unprecedented communications flexibility, capability, and capacity to the warfighter. Each WGS satellite provides more than 10 times the communications capacity of the predecessor DSCS satellites. WGS’s ability to tailor the communications capability by geographical region to meet the ever changing needs of the military, and its ability to enable troops using different and disparate user terminals to communicate with each other provides a new and unprecedented capability for our military. Although “breakthrough” programs often find it difficult to gain full market acceptance, there is no shortage of demand for these highly capable satellites as evidenced by the exceptional support for the WGS program within Congress and the DoD.

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<th>Identify the Program’s Technological Uncertainty using the</th>
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WGS employs a mix of **High** and **Super-High technology**. The program is based on the industry-leading Boeing 702 satellite platform that provides the mass, power, propulsion
definitions below. Then describe how you deal and address this uncertainty:

- **Low-tech**: application of mature, well-established technology
- **Medium Technology**: existing technology adopted to meet new design requirements
- **High-Technology**: recently developed new technology
- **Super High-Technology**: non-existing technology that needs to be developed during the program.

and heat rejection capability to efficiently accommodate the highly complex WGS digital communications payload. Special technologies that were developed on the WGS program specifically for the military mission include multi-beam X-band phased array antennas and a digital signal processor (digital channelizer) that enables point-to-point, broadcast and multicast capabilities. The channelizer also provides the capability to connect users operating at X-band, with users at Ka-band, and vice versa. Boeing develops these enabling technologies for both our commercial and government customers. Being able to share some of these **enabling technological developments across market segments** enables efficiencies and economies of scale, workforce stability, and provides Boeing customers with the **very best capability available for their mission needs**.

Identify the level of your **System Complexity** using the definitions below. Then explain how you are dealing with this complexity:

- An **Assembly** performing a single function.
- A **Sub-system** fitting within a larger collection of systems?
- A **System** – a collection of subsystems performing multiple functions?
- An **Array** – a “system of systems”; a widely dispersed collection of systems serving a common mission?

WGS is a global satellite communications **System** that includes a constellation of high-power geosynchronous satellites and ground-based command and control elements provided by Boeing. Each satellite contains more than 2,000 unit **Assemblies** that are integrated into seven satellite **Subsystems** (Payload, Power, Attitude Control, Telemetry and Command, Propulsion, Structure and Thermal). The satellites are required to be compatible with government-furnished launch vehicles, a vast number of existing and planned user terminals and the space environment. The deliverable ground software and databases must interface with many other ground-based government systems and subsystems. Interfaces between the various systems and subsystems are controlled via formal specifications and interface control documents. This complexity is managed via a rigorous requirements traceability tool called Dynamic Object Oriented Requirements System (DOORS).

Identify the **Pace** of your team’s effort using the definitions below. Then describe how you deal with the program’s pace requirements:

- **Regular timing** based on past efforts
- **Fast Competitive** – the pace is driven by desire to be first to market
- **Time Critical** – there is an absolute and critical-to-success deadline
- **Blitz** – there is a crisis element driving immediate response

The program pace can best be described as **Fast Competitive** for two reasons. First, there is an underlying urgency to deliver this transformational communications capability to the war fighter as soon as practical. Military operations rely on information superiority in order to prevail over adversaries’ worldwide. WGS plays a key role in delivering critically needed information. The program team understands the compelling need to field the first six satellites in order to provide full operational capability to the user community. Secondly, Boeing recognizes the competitive pressures to deliver quality hardware, on cost and on schedule. **Performance to plan is much more than an obligation to the customer and to our shareholders** – it is essential for maintaining a competitive advantage in the marketplace.
### Other Complexities

Describe other complexities faced by this program team and how you address them.

Changes in DoD program requirements and year-to-year funding fluctuations can pose challenges. The Boeing program management team works closely with government counterparts to maintain visibility of potential changes and develops plans to minimize impacts. These topics are discussed and tracked weekly at the Boeing and Air Force “Level 0” Program Management meetings.

### V. Metrics (How do you measure program’s performance) = 30 points

(Note: We are not looking for your scopes but the measures and metrics you are using)

| 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. | The program’s impact on the customer and their level of satisfaction are best characterized by frequent comments from Air Force senior leadership:


> “WGS-1 has performed beyond our expectations. In fact, feedback from users indicates the capabilities have exceeded their expectations as well and they just can’t get enough of it.” (Lt. Col. Brent McArthur, USAF/3 SOPS). Schriever Sentinel, April 9, 2009.

Formal customer feedback is received annually through the DoD Contract Performance Assessment Report (CPAR). The CPAR is reviewed and acted upon, with the program showing steady CPAR improvement for the past four years. In the most recent reports, **65% of the scored areas were rated as “Very Good” or “Exceptional,” with no areas less than “Green”**. A unique CPAR self-assessment process, which documents accomplishments and areas for improvement, is updated and discussed with the customer on a quarterly basis. |
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<td>How do you measure your program’s efficiency performance in terms such as schedule and budget?</td>
<td>The program employs rigorous Earned Value Management System processes to monitor cost and schedule performance. Schedule performance has been exemplary as a result of establishing an <strong>80% confidence baseline schedule against the contract requirements</strong>, and aggressively working to a forecast which is several weeks ahead of the baseline. Management focus is on areas in which overall forecast buffer/margin is threatened. Unique program management features include use of management reserve funds that are directly tied to program risks, and an opportunity management process to identify and capture cost and schedule savings.</td>
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<tr>
<td>How do you measure your program’s business</td>
<td>The measures of the program’s business success are the sales, revenues, margins and cash metrics which are reviewed</td>
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success (operating margin, earned value or other indicator that can be released publicly) | relative to plans on a monthly basis. The program has generated substantial new sales and contributed to the company’s long range business plan by growing from an **initial contract value of $157M** for engineering development and long lead procurement, to **nearly $2B today**.

How do you measure and assess the long-term contribution of your program to the corporation/organization? | The long term contribution of the WGS program to Boeing is evaluated using three key indicators: **customer satisfaction**, **sustained revenue growth and margins**. Customer satisfaction is formally gauged via the CPARs. **Follow-on orders are a direct result of the value proposition’s** that the WGS program offers, and a high degree of customer satisfaction. The program has grown from an initial order of just three satellites, to six today, with the potential for procurement of up to six more satellites. Through this sustained growth the **program has continued to build customer confidence** and has positioned Boeing to be the preferred supplier of wideband SATCOM systems for the DoD. Additionally, sustainment of this business enables career growth and development opportunities for the hundreds of Boeing employees that support the WGS program.

How do you measure and assess the impact of your program on your team development and employee satisfaction? | The results of an annual employee satisfaction survey are reviewed in small discussion groups that are lead by members of the WGS leadership team and include a broad cross-section of program personnel. This unique process ensures that results are understood and action plans are put in place to guide improvement initiatives. This process has proven effective, as evidenced by subsequent-year survey results showing a **30% increase in employee engagement scores**, a **17% increase in most positive survey scores**, with a **decrease in the most negative scores by a factor of three**. The program has a strong culture of employee development through cross-training and promotion from within. In fact, **18 of 25 leadership positions on the program are held by personnel who graduated into the position from within the program**. Also, the program serves as a spawning ground of top talent who have been deployed to other programs within Boeing.

Additional Metrics: Describe any additional metrics you are using to measure your program’s progress and success | Unreleased engineering or open Engineering Change Requests are both forms of work in process (WIP) that pose risks to successful program execution. Percent of on-time engineering release, age of engineering change requests, age of approval for supplier submittals, and age of test and process anomalies generated are all key metrics that ensure the execution of each area does not exceed control limits. For example, over the past two years, the Block II program has maintained the **average age of open test and process anomaly paperwork to less than 35 days**, thereby reducing overall program risk.