



# **GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R-SERIES (GOES-R)**

## **DETERMINATION OF READINESS REPORT TO CONGRESS**



**October 2008**

U.S. Department of Commerce (DOC)  
National Oceanic and Atmospheric Administration (NOAA)  
National Environmental Satellite, Data, and Information Service (NESDIS)  
National Aeronautics and Space Administration (NASA)

**Geostationary Operational Environmental Satellite – R Series (GOES-R)  
Major Program Determination of Readiness Report to Congress**

**Submitted by:**



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OCT 31 2008

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**Date**

**United States Department of Commerce  
National Oceanic and Atmospheric Administration  
Geostationary Operational Environmental Satellite Program, R-Series**

**Determination of Readiness Report to the:**

**Senate Committee on Appropriations  
Senate Committee on Commerce, Science, and Transportation  
House Committee on Appropriations  
House Committee on Science and Technology**

**October 2008**

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## 1. INTRODUCTION/EXECUTIVE SUMMARY

In accordance with the Consolidated Appropriations Act, 2008, (P.L. 110-161) Division B, Title I, Section 112(b), the Under Secretary of Commerce for Oceans and Atmosphere has determined the Geostationary Operational Environmental Satellite Series R (GOES-R) program's readiness to award prime development contracts for: 1) the Spacecraft and 2) the Ground Segment. This report documents the GOES-R program's readiness based on the satisfaction of the following criteria:

- A. Identification and management of technical, cost, and schedule risks.
- B. Demonstration of all required technologies in a relevant laboratory or test environment.
- C. Compliance with all relevant policies, regulations, and directives of the National Oceanic and Atmospheric Administration (NOAA) and the Department of Commerce (DOC).
- D. High likelihood of accomplishing its goals.
- E. Value to accomplishing NOAA's mission.

This report satisfies the requirement in the Consolidated Appropriations Act, 2008, Division B, Title I, Section 112(b) paragraph 2, which states: "The Under Secretary shall transmit a report describing the basis for the determination required...to the appropriate congressional committees at least 30 days before entering into a contract for development under a major program."



## 2. TECHNICAL, COST, AND SCHEDULE RISK MANAGEMENT

The GOES-R program is managing risk through its comprehensive Risk Management program documented in a GOES-R Series Risk Management Plan. The plan details the functional structure and responsibilities for identifying and reporting program risks. The GOES-R Risk Management program is a proactive process to identify, communicate, assess, and mitigate risks effectively. In addition to the GOES-R Series Risk Management Plan, specific initiatives taken to keep the GOES-R development effort on schedule and within budget include:

- **Risk Reduction:** The procurement strategy has been structured to address the highest risk areas of the GOES-R program early and to ensure the technology required for GOES-R is sufficiently mature. NOAA conducted a lengthy Program Definition and Risk Reduction (PDRR) effort through a series of contracts with leading aerospace companies in order to leverage industry expertise early in the program development and design process. NOAA recognized early that the GOES-R instruments are a technical risk area for the program. To address this, NOAA partnered with the National Aeronautics and Space Administration (NASA) to leverage its strength; NOAA has placed NASA in charge of acquiring the space segment (spacecraft, instruments, and launch), and NOAA is in charge of fielding the ground segment. The GOES-R program initiated the development efforts prior to committing to full scale system procurement to lower the risk of development issues affecting the larger program's cost and schedule.
  
- **Management Oversight:** NOAA studied a number of management strategies and commissioned independent reviews to develop the management approaches that best suit the program and NOAA's ability to manage the risk to overall program success. This approach is documented in a GOES-R Management Control Plan (MCP) and is patterned on proven NASA space acquisition processes. NOAA has established a robust program office that uses the expertise and experience of both NOAA and NASA, their support contractors, and the best of each agency's processes to ensure active and in-depth oversight of the development contractors. Key elements of this program office include:
  - 1) Fully integrated NOAA and NASA program office located at Goddard Space Flight Center
  - 2) Significant systems engineering, other discipline engineering (e.g., thermal, mechanical, electrical, software), scheduling, earned value, and cost analysis resources to oversee contractor activities
  - 3) On-site representatives at the prime and subcontractor facilities to increase awareness of program status
  - 4) NOAA System Program Director that aggressively manages NOAA and NASA Project Managers to ensure key risks and technical challenges are identified and dealt with early, before they create a risk to overall cost, schedule, and performance of the program.
  
- **External Reporting:** The GOES-R program and project teams routinely report to DOC, NOAA, and NASA management regarding program and project status at a series



of management reviews. Regularly-scheduled contractor technical and program management reviews are underway for the on-going procurement activities and the results of these reviews are presented in the DOC, NOAA, and NASA management reviews. NOAA has established a Program Management Council (PMC) to provide oversight to the major acquisition programs, and the GOES-R program and projects are regularly reviewed by the PMC. The GOES-R program and projects are also reviewed on a regular basis by the Goddard Space Flight Center (GSFC) management and quarterly by the DOC Chief Financial Officer and Assistant Secretary for Administration. In addition, the Deputy Secretary is briefed semi-monthly. The GOES-R program is implementing the program control directive contained in the Fiscal Year (FY) 2008 Consolidated Appropriations Act and will provide annual and quarterly program status reports to Congress.

- **Realistic Cost Estimating and Budget:** The GOES-R program has developed a realistic Program Office Estimate (POE) and reconciled this estimate with a separate NOAA Independent Cost Estimate (ICE) effort. Based on recent space acquisition reviews and NOAA's experience with the National Polar-orbiting Operational Environmental Satellite System (NPOESS), NOAA is basing the budget for GOES-R on the 80 percent confidence cost estimate. This level of budget will provide for most likely program costs and provide about 25 percent management reserve. Experience has shown this level of management reserve will be required to address the types of issues likely to arise in a space system development. The baseline for the GOES-R program is reflected in the FY 2009 President's Budget request, which is in excess of the baseline estimated in the FY 2008 President's Budget request and established in Section 112 of the Consolidated Appropriations Act, 2008.
- **Baseline Review and Earned Value Management:** For Spacecraft and ground segment and all other procurements, the GOES-R program will establish technical, cost, and schedule baselines. The earned value management system is used to report against those baselines. The Program has in place a robust capability to review contractor baselines and earned value management activities. Additionally, NOAA is using independent experts to provide additional oversight in these areas.
- **Incentive Structure:** The GOES-R spacecraft and ground segment procurements will use an award fee incentive structure consistent with recommendations by GAO and OIG to provide the Government the flexibility to adjust the incentive priorities as the program progresses in response to specific issues that may arise. A key feature is there is no base fee associated with the GOES-R program procurements, only award fee. The GOES-R fee structure includes incentives that aim to minimize cost growth while providing incentive to the contractors to meet program technical requirements and major program milestones.
- **Independent Reviews:** NOAA has used and will continue to use an independent team of experienced space program experts that will regularly review the GOES-R program to ensure program readiness at key decision points and program execution status on an annual basis.



Program risk reduction activities are continuing with the identification and management of risks associated with the on-going development activities and the spacecraft and ground segment procurement activities.

The remaining technical risk reflects the GOES-R program's recognition that continued vigilance is required to ensure the successful interface between the GOES-R system and the system users. The GOES-R program maintains close coordination with the National Weather Service (NWS) to ensure that interfaces with the Advanced Weather Interactive Processing System (AWIPS) and transition responsibilities are well defined and clearly understood.

The GOES-R program continues to make risk identification and management a priority. The GOES-R program Office maintains a consolidated program-wide risk list and uses this list in the regular internal and external reviews of the program. The System Program Director (SPD) reviews the risks monthly and briefs the NOAA Program Management Council (PMC) monthly on the top risks and the strategies for mitigating and/or resolving them. The following is a summary of the technical, cost, and schedule risk posture of the GOES-R program in supporting the positive readiness assessment.

Each month, a cycle of risks and issues reporting is conducted. As shown in the figure below, risks and issues reporting cycles through a hierarchical review process beginning at the Instrument/Spacecraft/Sub-system Risk Management Board (RMB) with progressive reviews and elevations as required through the Flight Project RMB or the Ground Segment RMB, and then merging at the Program Integration RMB. This culminates at the monthly Program RMB where risks and issues elevated to the program-level are reviewed and decisions are made as needed.

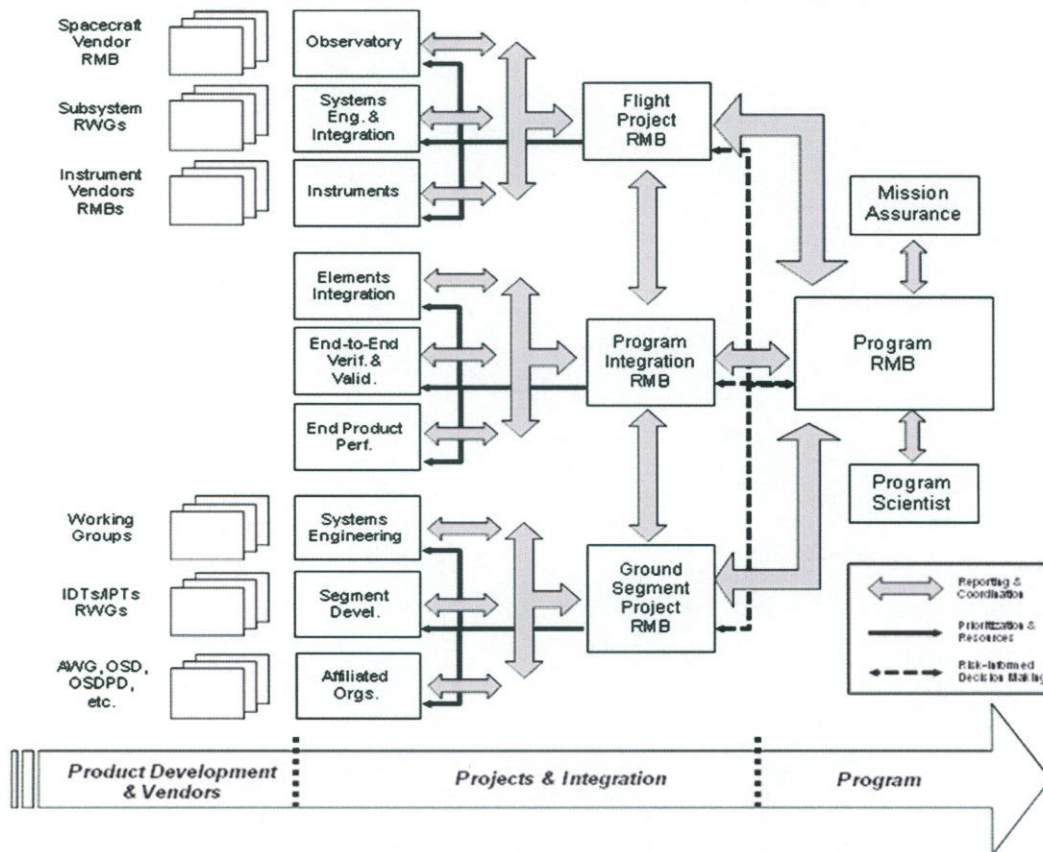


Figure 1: Risk and Issue Reporting and Elevation Flow



Using the Flight Project risk and issue information flow as an example, each instrument vendors' risk lists and issues are reviewed at the Instrument RMB in detail with the Instrument Manager, Risk Manager, and Instrument Systems Engineer at least once a month. Instrument vendors provide formal management status reporting to Flight Project Management during the Payload Management Status Review (PMSR), including detailed discussion of risks and issues. Next, each Instrument Manager provides Flight Project Management with overall monthly instrument status, including risks and issues reports and summarizing and expanding on the vendor report status. At the Flight Project RMB, the status of all project-level risks and issues are reviewed and updated as needed. Each of the reported lower-level risks (Systems Engineering, Instruments, and Observatory) is assessed for relevance and/or elevation to the project level. Inputs from this meeting are used to prepare the project's Monthly Status Review (MSR) to be reported to the GOES-R program RMB, and the NASA GSFC Center Management Council (CMC) and summarized at the NOAA PMC. Concurrently, the status of program-level risks are reviewed and updated at the Program Integration RMB. Risk and issue information is coordinated throughout the process and through active participation of representatives from pertinent organizations. At the GOES-R program RMB, program-level risks are reviewed and current status of risks and issues is reported by Flight Project, Ground Segment Project, and Program Systems Engineering. GOES-R program-level risks are reported at the PMC.

#### **A. TECHNICAL RISK**

NOAA has determined the level of technical risk is at an acceptable level to proceed with the next phase of procurement and manageable within the program's resources identified in the FY 2009 President's Budget.

##### Flight

While the competitive selection of the spacecraft bus has not been finalized, the Program Definition and Risk Reduction (PDRR) phase confirmed the potential vendors all have an existing spacecraft bus that, with minor modifications, could fulfill the GOES-R mission. Furthermore, a number of Government and commercial programs also use geosynchronous spacecraft similar to the GOES-R requirement. The mature starting point for the GOES-R spacecraft bus, the geosynchronous spacecraft experience of the likely vendors, and the risk mitigation work for the spacecraft accomplished during PDRR have reduced the technical risk. We expect this will result in a spacecraft bus with substantial operational heritage. The GOES-R Program has issued separate contracts for five instruments to be delivered to the spacecraft contractor as Government Furnished Equipment.

##### Ground

The Program Office has reduced technical risk for the GOES-R ground segment by defining an architecture based largely on the existing National Environmental Satellite, Data, and Information Service (NESDIS) infrastructure and accommodating increased capabilities of the GOES-R instrument with incremental, proven satellite ground command and control and data processing technologies. GOES-R will also use the existing NOAA primary ground facility and will have a new remote, back-up facility. While many of the data interfaces for GOES-R will be new or modified, they will use internet and other demonstrated technology. For example, the GOES-R Access Subsystem will use proven technology for storage area networks, large database applications, increased data rate local and wide area networks, and security firewalls.



A large portion of the GOES-R ground segment command and control, data processing and distribution, and enterprise management requirements can be met through the use of commercial off-the-shelf (COTS) ground hardware and software without a significant level of innovation. In addition, the new and modified ground GOES-R terminals will use proven COTS hardware for its satellite communications needs. The majority of the new data products are based on heritage GOES algorithms or algorithms developed to support other successful environmental sensing instruments, resulting in only a moderate level of associated development risk and managed through an extensive pre-launch verification program.

## **B. COST RISK**

NOAA has determined the cost risk is acceptable within the planned resource levels identified in the FY 2009 President's Budget.

The FY 2009 President's Budget (PB) request for a two satellite system GOES-R program is \$7,672 million; this is the baseline for the GOES-R Program. This budget represents an 80 percent confidence estimate of the most probable costs for the program and reflects inputs from independent assessments conducted by the Independent Review Team (IRT), and Independent Cost Estimate (ICE). The IRT report recommended budgeting the GOES-R program at the 80 percent confidence cost estimate with a minimum of 25 percent management reserve. NOAA believes this level of management reserve is required to support risk mitigation activities and timely responses to development issues, reducing the potential impacts associated with these issues. The GOES-R baseline is reflected in the FY 2009 President's Budget (PB) request.

Stability of the funding profile is necessary to mitigate cost risk. Because the NOAA FY 2009 budget will be under Continuing Resolution Authority (CRA) until at least March 6, 2009, at the FY 2008 funding level, the GOES-R program's cost is at risk should significant delays occur in awarding the space and ground segment contracts. Assessments to mitigate the impacts of the CRA are currently underway.

## **C. SCHEDULE RISK**

NOAA has determined the schedule risk to be acceptable within the planned resource levels identified in the FY 2009 President's Budget.

The GOES-R working Program Integrated Master Schedule is attached in Appendix B. The Program Office will establish the Baseline Integrated Master Schedule after the Program Preliminary Design Review (PDR). Appendix B is the un-baselined master schedule.



Each major component has sufficient margin built into the current schedule to minimize risk.

Based on reviews of similar completed NASA and Air Force programs, the schedule for GOES-R space and ground segment development is consistent with similar space system developments. The viability of the GOES-R schedule has been reviewed by the GOES-R Independent Review Team, GSFC Center Management Council, and the Program Management Council. All of these reviews concluded the GOES-R schedule is consistent with this type of development.

The GOES-R schedule includes margin consistent with the GOES-R Management Control Plan requirements and the guidelines described in NASA Procedural Requirements (NPR) 7120.5D, "Space Flight Program and Project Management Requirements." The schedule margin is appropriate for a program of this complexity.

Stability of the funding profile is necessary to mitigate schedule risk. Because the NOAA FY 2009 budget will be under Continuing Resolution Authority (CRA) until at least March 6, 2009, at the FY 2008 funding level, the GOES-R program's schedule is at risk should significant delays occur in awarding the space and ground segment contracts. Assessments to mitigate the impacts of the CRA are currently underway.

### **3. TECHNOLOGICAL MATURITY**

NOAA has determined the technological maturity risk is acceptable and poses no major risk in any area.

#### Spacecraft

The extensive PDRR effort validated the spacecraft specifications and identified available and technically mature existing spacecraft designs. It is anticipated that the spacecraft bus will be a modified existing design. Any contractor whose spacecraft/bus technology is less than Technical Readiness Level (TRL)-6 at Contract Award is required to show plans to achieve TRL-6 by PDR. Achievement of TRL-6 means that models or prototypes of all the components have been successfully tested in the environment in which the component will operate.

#### Ground

The GOES-R program will use existing hardware and software technology to achieve the ground segment capabilities by using Commercial off the Shelf (COTS) products and basing the command and control, and enterprise management software on a pre-existing system. The instrument vendors are developing the ground navigation and registration algorithms of the instrument data, which will be verified prior to delivery to the ground contractor for incorporation into the operational software. The product algorithms are based on historical GOES algorithms or algorithms derived from other operational environmental sensing systems.

#### Summary

All technical components currently meet (or are on track to meet) the requirements for TRL-6 certification in compliance with standing NASA certification procedures and as required in the GOES-R Management Control Plan.



#### **4. COMPLIANCE WITH POLICIES, REGULATIONS, AND DIRECTIVES**

NOAA has determined compliance with applicable policies, regulations, and directives.

In preparation for the initiation of the GOES-R space and ground segment development activities, numerous reviews and approvals have been required to demonstrate the program has met the required NOAA, NASA, and DOC policies, regulations, and directives.

The GOES-R program has satisfied the provisions of the NOAA Administrative Order (NAO) 216-108 "Requirements Management" by rigorous documentation of program requirements through a tiered requirements documentation process.

##### **Documentation**

The NOAA allocated life cycle cost, launch date, and user/science requirements for the GOES-R program have been documented in the Level I Requirements Document (LIRD), which is controlled by NOAA's Deputy Under Secretary (DUS) for Oceans and Atmosphere. The technical requirements are further detailed in a Level II document called the Mission Requirements Document (MRD). This document defines the detailed performance characteristics of the system and is controlled by the System Program Director. The appropriate project manager controls the Level III requirements, which include Project Level Interface documents and Functional Specifications. The Level IV documents depict the contractor's system and subsystem specifications for the design, development, and testing of their components.

##### **Management**

In June 2007, the Deputy Under Secretary for Oceans and Atmosphere and the Associate Administrator for NASA signed a Memorandum of Understanding (MOU), which defined a relationship between NOAA and NASA to successfully plan, implement, and manage the GOES-R program. To further detail this arrangement, NASA and NOAA signed the Management Control Plan (MCP) dated December 4, 2007. The MCP documents the business processes, management controls, Information Technology security, and organizational structure of the GOES-R program. The MCP is derived from NASA Procedural Requirement (NPR) 7120.5D and outlines the specific implementation of NPR 7120.5D as it applies to the GOES-R program and projects. The GOES-R MCP's scope also satisfies the requirements of Department Administrative Order (DAO) 208-3, "Major System Acquisitions for the Department of Commerce," which requires major systems to document a program management and control structure that describes the Program's business processes.

##### **Key Decision Point (KDP) Authority**

While DOC delegated Milestone Decision Authority for GOES-R to the Under Secretary of Commerce for Oceans and Atmosphere (the NOAA Administrator), NOAA and DOC subjected the GOES-R program to numerous independent review/readiness assessments as described in the MCP before development efforts could begin. In addition, the GSFC Center Management Council reviewed the space and ground segment procurements to ensure their readiness and compliance with all appropriate GSFC and NASA requirements to start development activities. The ground segment also has been reviewed by the Department of Commerce Information Technology Review Board (CITRB) and the Department of Commerce Acquisition Review Board (ARB), which are



responsible for reviewing programs for compliance with appropriate information technology and acquisition requirements respectively. The GOES-R ground segment has successfully completed all these reviews.

## 5. LIKELIHOOD OF PROGRAM MEETING GOALS

NOAA needs GOES-R to maintain the continuity of the Nation’s operational geostationary observing system. As the Nation’s 24/7 sentinel in the sky, the geostationary operational environmental satellite system ensures the observation of natural hazards in time for appropriate response. The continuity of imagery, legacy sounding and solar monitoring is critical for the Nation. The addition of improved resolution in these observations and the addition of the lightning mapper represent important improvement to the mission. GOES-R needs to put in place the satellites and associated ground systems to ensure data is delivered to the National Weather Service in real-time to support its warning mission. With a high likelihood of the Program meeting its intended goal of an April 2015 launch, NOAA will have a 64% probability of maintaining two geostationary satellites on orbit. NOAA assessed the technical maturity, evaluated the realism of the cost and schedule, and mitigated risk elements leading to high probability of meeting program goals. In developing the program, NOAA has defined and documented a rigorous set of mission requirements in the LIRD. NOAA has set up the appropriate management structure to execute the program.

The necessary funding to execute the program to achieve these goals has been detailed in the FY 2009 President’s Budget.

## 6. GOES-R CONTRIBUTION TO NOAA’S MISSION

NOAA’s mission from the 2008 NOAA Strategic Plan is, “To understand and predict changes in Earth’s environment and conserve and manage coastal and marine resources to meet our Nation’s economic, social, and environmental needs.”

GOES-R supports the NOAA mission, providing weather observations directly related to societal and economic impacts to the Nation. Given the rising costs of natural disasters and the need for increased warning lead times in order for the Nation to respond appropriately, forecasters need the improved resolution and continuity of observation. Examples of impacts are:

<b>Economic/Societal Impact*</b>	<b>GOES Capability</b>
Industries directly affected by weather, including agriculture, energy, and recreation account for nearly 10 percent of the Gross Domestic Product (GDP).	GOES provides the Nation continuous weather observations from space. GOES-R will greatly enhance the quantity, quality, and timeliness of weather observations.
Average annual damage from hurricanes, tornadoes, and floods is \$11.4 billion.	Sensors on GOES-R will improve our ability to predict and track severe weather with greater accuracy and timeliness of warnings.
Lightning causes a total of \$4-\$5 billion in losses each year in the civilian sector.	The GOES-R lightning mapper will provide our first lightning detection ability from space and will greatly improve detection of lightning in clouds and over the oceans, allowing for more and faster warnings.



Greater percentages of the population are locating on the coasts, and coastal storms account for 71 percent of recent U.S. disaster losses annually.

The GOES-R imager will allow us to forecast and track hurricane and coastal storm landfall on coastal areas with greater accuracy and timeliness.

*\* Economic Statistics for NOAA, April 2006*

The critical capability provided by geostationary satellites to detect, monitor, and track severe weather is crucial to protect lives and property. The Department of Homeland Security/Federal Emergency Management Agency (DHS/FEMA) has certified GOES-R as an “emergency preparedness activity.” Additionally, GOES-R’s mission will support countless environmental efforts, such as fisheries, and provide continuous data relay functions for search and rescue. The solar environmental capabilities also support communications and navigation satellite operations, astronaut safety, and utility company power grids.

## 7. SUMMARY

The Under Secretary of Commerce for Oceans and Atmosphere has determined with respect to the GOES-R program's readiness:

- A. The technical, cost, and schedule risks of the program are clearly identified and the program has developed a plan to manage those risks.
- B. The technologies required for the program have been demonstrated in a relevant laboratory or test environment.
- C. The program complies with all relevant policies, regulations, and directives of NOAA and the Department of Commerce.
- D. The program has demonstrated a high likelihood of accomplishing its intended goals.
- E. The program represents a good value to accomplishing NOAA's mission.



## APPENDIX A – ACRONYMS AND ABBREVIATIONS

ABI	Advanced Baseline Imager
ARB	Acquisition Review Board
AWG	Algorithm Working Group
CITRB	Commerce Information Technology Review Board
CMC	Center Management Council
COTS	Commercial off the Shelf
DOC	Department of Commerce
EXIS	Extreme-ultraviolet and X-ray Irradiance Sensors
FOC	Full Operational Capability
FY	Fiscal Year
G/S	Ground System
GAO	Government Accountability Office
GLM	Geostationary Lightning Mapper
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
HES	Hyperspectral Environmental Suite
ICE	Independent Cost Estimate
IDT	Integrated Development Team
IPT	Integrated Product Team
IOC	Initial Operational Capability
IRT	Independent Review Team
KDP	Key Decision Point
LRD	Launch Readiness Date
MCP	Management Control Plan
MRR	Mission Readiness Review
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information Service
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NPR	NASA Procedural Requirements
OIG	Office of the Inspector General
OSD	Office of Systems Development
OSDPD	Office of Satellite Data Processing and Distribution
PMSR	Payload Management Status Review
PDR	Preliminary Design Review
PDRR	Program Definition and Risk Reduction
PMC	Program Management Council
RMB	Risk Management Board
RWG	Requirements Working Group
SEISS	Space Environment In-Situ Suite
SPD	System Program Director
SUVI	Solar Ultraviolet Imager
TRL	Technology Readiness Level

# APPENDIX B - GOES-R MASTER SCHEDULE

