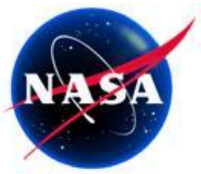
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE-R (GOES-R) SERIES PROGRAM

BASELINE REPORT TO CONGRESS

Pursuant to section 105(c)(2) of Public Law 112-55



U.S. Department of Commerce (DOC)
National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite, Data, and Information Service (NESDIS)
Geostationary Operational Environmental Satellite – R Series (GOES-R)

January 2013

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United States Department of Commerce
National Oceanic and Atmospheric Administration
Geostationary Operational Environmental Satellite – R (GOES-R) Series Program

Baseline Report to the:

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

Report Date: January 2013

In accordance with the Consolidated and Further Continuing Appropriations Act, 2012, Public Law No. 112-55, Division B, Title I, Section 105(c)(2), 125 Stat. 552 at 600 (November 18, 2011) (amending 33 U.S.C. § 878a), the Under Secretary of Commerce for Oceans and Atmosphere submits this Baseline Report for the Geostationary Operational Environmental Satellite – R Series (GOES-R) program to the Senate Committee on Appropriations, Senate Committee on Commerce, Science, and Transportation, House Committee on Appropriations, and House Committee on Science, Space, and Technology. This report is based on the cost, schedule, technical data as of the May 16, 2012 Key Decision Point II.

The GOES-R Series program is baselined as a four-satellite program at $10,860.3 million, with the following launch dates of GOES-R in October 2015, GOES-S in February 2017, GOES-T in April 2019, and GOES-U in October 2024.

Annual updates and reports on any deviations from this Baseline Report will be reported to the above-referenced appropriate Committees pursuant to the requirements of Public Law No. 112-55, Division B, Title I, Section 105, 125 Stat. 552 at 599 (Nov. 18, 2011)(amending 33 U.S.C. § 878a),

Submitted by:

Jane Lubchenco, PhD
Under Secretary of Commerce for
Oceans and Atmosphere, and
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FEB -8 2013
Date

Table of Contents

EXECUTIVE SUMMARY

This document is the Baseline Report required by the Consolidated and Further Continuing Appropriations Act, 2012, Public Law No. 112-55, Division B, Title I, sections 105(c)(2), 125 Stat. 552 at 600 (Nov. 18, 2011)(amending 33 U.S.C. § 878a).

The Geostationary Operational Environmental Satellite R Series (GOES-R) Program completed its Key Decision Point (KDP)-II (also known as KDP-C in NASA Procedural Requirements - NPR 7120.5), which is the decision for the GOES-R Program to move into detailed design. The GOES-R Standing Review Board, NASA Management, and NOAA management have recommended approval of KDP-II and approved the readiness of the GOES-R Program to enter into the next phase of its development.

On May 16, 2012, the KDP-II Decision Memo was approved by the Under Secretary of Commerce for Oceans and Atmosphere with concurring signatures from the GOES-R Program Manager, the National Environmental Satellite, Data and Information Service (NESDIS) Assistant Administrator, NASA Associate Administrator, NASA Center Director, NASA Science Mission Directorate Associate Administrator, and NOAA Deputy Under Secretary for Operations (DUS/O). All cost, schedule, and technical data in this report are from the May 16, 2012 KDP-II. See Appendix C.

This Congressional report satisfies the requirement of section 105 (c)(2) of Public Law No. 112-55, Division B, Part I, to submit a Baseline Report that shall, at a minimum, include:

(A) the purposes of the program and key technical characteristics necessary to fulfill those purposes;
(B) an estimate of the life-cycle cost for the program, with a detailed breakout of the development cost, program reserves, and an estimate of the annual costs until development is completed;
(C) the schedule for development, including key program milestones;
(D) the plan for mitigating technical, cost, and schedule risks identified in accordance with subsection(b)(1)(A); and
(E) the name of the person responsible for making notifications under subsection (d), who shall be an individual whose primary responsibility is overseeing the program.

A. PURPOSES OF THE PROGRAM AND KEY TECHNICAL CHARACTERISTICS NECESSARY TO FULFILL THOSE PURPOSES:

Since October 1975 the National Oceanic and Atmospheric Administration (NOAA), under the U.S. Department of Commerce (DOC), has operated a system of environmental satellites in geostationary orbits to provide continuous weather imagery and monitoring of meteorological data for the United States, Latin America, much of Canada and most of the Atlantic and Pacific Ocean basins. The Geostationary Operational Environmental Satellite (GOES) program is a key element of NOAA's operations and supports the agency's contribution to DOC's strategic goal to observe, protect, and manage the Earth's resources to promote environmental stewardship. GOES satellites provide critical atmospheric, oceanic, climatic, and solar products supporting weather forecasting and warnings, climatologic analysis and prediction, ecosystems management, and safe and efficient public and private transportation. The GOES satellites also provide a platform for space environmental observations, and auxiliary communications services that provide for GOES data rebroadcast, data collection platform relay, imagery, emergency weather communications, and satellite aided search and rescue.

The next series of GOES satellites, GOES-R, is a collaborative development and acquisition effort between NOAA and the National Aeronautics and Space Administration (NASA) as documented in a Memorandum of Understanding, dated June 15, 2007. Under a multi-contract acquisition strategy, NOAA has overall mission and programmatic responsibility for the GOES-R Series Program, and will procure the Ground Segment, while NASA will procure the Space Segment (including launch services), provide systems engineering, and act as the Safety and Mission Assurance lead. Program activities occur at the co-located Program and Project Offices at Goddard Space Flight Center (GSFC), in Greenbelt, MD. All GOES-R activities between NOAA and NASA are governed by the GOES-R Series Management Control Plan (MCP) Version 1, dated December 4, 2007. An updated MCP is currently in the review process. GOES-R is managed as a single-project program, as defined in NASA Procedural Requirement 7120.5D NID (NM 7120-81).

The GOES-R series satellites will replace the GOES-N series, which will be nearing the end of their expected operational life in 2017. The GOES-R series will sustain and improve upon the GOES capabilities into FY 2036, as shown in Figure 1. GOES-R, the first satellite in the series with a planned first quarter FY 2016 launch readiness date, is being developed to meet requirements validated through a rigorous screening and verification process.

The GOES-R series will incorporate new instruments with increased capability and provide for enhanced product generation and distribution architecture. GOES-R improvements will result in more timely and accurate weather forecasts and improve the detection and observations of meteorological phenomena that directly affect public safety and protection of property. The GOES-R architecture is based on a total of two operational satellites (East and West), an on-orbit spare and a supporting ground system providing mission management, product generation, product distribution, and enterprise management. GOES-R improvements over the earlier generation GOES series are listed in Tables 1 and 2. The baseline products to be generated from the GOES-R data are listed in Table 3.

Figure 1: GOES Fly-Out Chart

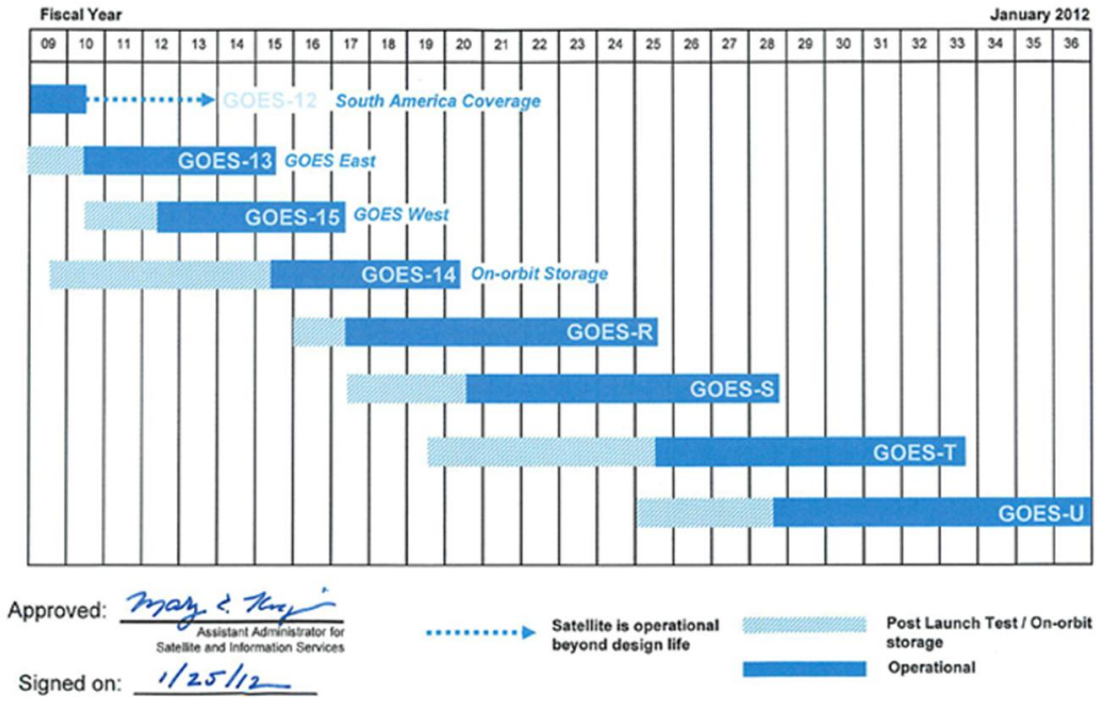


Table 1: GOES-R Series Performance Comparison with Earlier Generation GOES Series

	GOES I-M	GOES N-P	GOES R
Performance Capability			
Imaging:			
Visible Resolution	1 km	1 km	0.5 km
IR Resolution	4-8 km	4-8 km N 4 km O/P	1-2 km
Full Disk Coverage Rate	30 min	30 min	5 min
# of Channels	5	5	16
Solar Monitoring	GOES-M only	Yes	Better Imager (UV over X-Ray) and improved heavy ion detection
Lightning Detection	No	No	Yes
Operate through Eclipse	No	Yes	Yes
Ground System Backup	Limited	Limited	Yes
Archive and Access	Limited	Limited	Yes
Raw Data Volume per spacecraft	2.6 Mbps	2.6 Mbps	75 Mbps

Table 2: GOES-R Series Space Weather Instrument Capabilities and Improvements

Measurement	Specifications	Impacts
Magnetospheric Plasma (SEISS-MPS) & Energetic Heavy Ion Sensor (SEISS-EHIS)	Electrons and Protons 30eV to 30 keV; Heavy Ions in 4 mass bands 10-200 MeV/n	Improved understanding of the space particle threat to spacecraft electronics and how to design the electronics to avoid operational outages impacting communications, GPS, and other space systems support
Earth's Magnetic Field (MAG)	Data sampling goal 8 Hz instead of 2 Hz	Improved monitoring of critical physical process affecting energetic particles
Soft x-ray emissions from integrated solar disk (EXIS/XRS)	Dynamic Range 200,000 (was 100,000)	Improved quality covering full solar dynamic range
Extreme ultraviolet emissions from the integrated solar disk (EXIS/EUVS)	Include new options to meet spectral requirements with alternative techniques	Improved height resolution in calculations of thermospheric heating rates and ionization rates; critical components in the modeling of the ionosphere and thermosphere
Solar Ultraviolet Imager (SUVI)	Increase dynamic range from 100 to 10,000; double sensitivity; Improve spatial resolution	Improved discrimination of solar features spatially, spectrally, and temporally

Table 3: Baseline Products of the GOES-R Series

Advanced Baseline Imager (ABI)
Aerosol Detection (Including Smoke and Dust)
Aerosol Optical Depth (AOD)
Clear Sky Masks
Cloud and Moisture Imagery
Cloud Optical Depth
Cloud Particle Size Distribution
Cloud Top Height
Cloud Top Phase
Cloud Top Pressure
Cloud Top Temperature
Derived Motion Winds
Derived Stability Indices
Downward Shortwave Radiation: Surface
Fire/Hot Spot Characterization
Hurricane Intensity Estimation
Land Surface Temperature (Skin)
Legacy Vertical Moisture Profile
Legacy Vertical Temperature Profile
Radiances
Rainfall Rate/QPE
Reflected Shortwave Radiation: TOA
Sea Surface Temperature (Skin)
Snow Cover
Total Precipitable Water
Volcanic Ash: Detection and Height

Geostationary Lightning Mapper (GLM)
Lightning Detection: Events, Groups & Flashes
Space Environment In-Situ Suite (SEISS)
Energetic Heavy Ions
Magnetospheric Electrons & Protons: Low Energy
Magnetospheric Electrons: Med & High Energy
Magnetospheric Protons: Med & High Energy
Solar and Galactic Protons
Magnetometer (MAG)
Geomagnetic Field
Extreme Ultraviolet and X-ray Irradiance Suite (EXIS)
Solar Flux: EUV
Solar Flux: X-ray Irradiance
Solar Ultraviolet Imager (SUVI)
Solar EUV Imagery

Weather Mission

The new improvements and capabilities in the Advanced Baseline Imager (ABI) and the addition of the Geostationary Lightning Mapper (GLM) to the GOES instrument suite will lead to improved observations and improved forecasts and warnings for a host of environmental hazards, including severe thunderstorms, tornadoes, hurricanes, lightning, flash floods, winter storms, fog, wildfires, and air quality. The ABI is a 16 channel imager with two visible channels, four near-infrared, and ten infrared channels that will provide three times more spectral information, four times the spatial resolution, and an increase in temporal refresh that is more than five times the current imager. The GLM introduces the capability to continuously detect and locate up to 90 percent of the total lightning, with near uniform spatial and temporal performance, day and night over the western hemisphere.

The advanced ABI capabilities will improve cloud analysis, improving accuracy for the determination of a hurricane's storm center, and its motion, direction, and speed. The ABI will also show significant small-scale circulations within the eye, which can yield valuable information related to intensification. In addition, water vapor and dust detection due to the ABI's additional visual and infrared channels will allow for identification of dry air intrusions which can stifle hurricane development, especially in the Atlantic basin. The ABI will provide more precise measurements of sea surface temperatures, which in turn will allow a better evaluation of the available energy that strengthens or weakens hurricanes. The observation of lightning activity from the GLM will provide additional information on storm physics and input to numerical models. As a result, the ABI and the GLM together will contribute to an improvement in the hurricane intensity and track forecast accuracy.

The GLM's ability to measure the total lightning flash rate and changes to it is expected to help forecasters identify those storms that are likely to become severe in nature (i.e., produce tornadoes, hail, and damaging winds), which would improve aviation safety and efficiency by allowing aviation users to better avoid thunderstorm hazards.

The GLM detects both in-cloud and cloud-to-ground lightning allowing the opportunity to provide advance lightning warnings before the first cloud-to-ground lightning strike. Since in-cloud lightning location and horizontal extent are not shown by current long-range ground-based detection systems, this new capability increases the potential to provide advance lightning warnings. The 2006 NOAA Economic Statistics report indicates that lightning causes approximately $4-5 billion in losses each year in the civilian sector and has consistently been one of the top three causes of weather related deaths in the country. Lightning kills approximately 100 people and injures hundreds more each year. Lightning also impacts airline costs by about $2 billion annually in increased operating expenses and passenger delays.

Space Weather Mission

The GOES-R Series Program will continue and provide enhanced space weather coverage through a series of instruments. These data are required by the National Weather Service's Space Weather Prediction Center (SWPC), NASA, and the Department of Defense operational Weather

Agencies to provide advance warning of space weather phenomena that could affect humans, aviation, the electric grid or telecommunications networks. For example, geomagnetic storms can result in hazardous radiation exposure for astronauts, satellite electronics, and aviation flight crews and disrupt power, navigation and communications systems. GOES-R will provide better monitoring of the space environment to improve forecasts and warnings of geomagnetic disturbances that affect Earth.

The Solar Ultraviolet Imager (SUVI) will image the sun to monitor the entire range of solar features, including coronal holes and solar flares with increased dynamic range, resolution and sensitivity (Table 2). It will provide one of the most important observations for early warning of space weather events. It will continue the imaging observations of the Sun's atmosphere by NOAA that began in 2001 and will allow the NOAA SWPC to provide continuous, real-time alerts and warnings to critical customers such as commercial satellite operators and NASA.

The Extreme Ultraviolet and X-ray Irradiance Suite (EXIS) will monitor the sun's flares and severe variations, which often disrupt communications and navigation, and will also monitor severe variations in the sun's light. This sensor will continue 30+ years of NOAA observations of solar X-ray emission from the sun and will allow NOAA's SWPC to provide continuous, real-time alerts and warnings to critical customers such as the FAA and commercial airlines.

The Space Environment In-Situ Suite (SEISS) will monitor the protons, electrons, and heavy ion fluxes and will provide the spectral characteristics of solar energetic particles and their penetration threat to orbiting satellites, astronauts and airlines. This sensor will improve the sensitivity and dynamic range of the energetic particle sensors carried by the GOES-N series, providing data to improve the understanding of the space particle threat to spacecraft electronics and how to design the electronics to avoid operational outages impacting communications, GPS, and other space systems support.

These space weather instruments together with other space weather observations will mitigate the impact of space weather events on electric power distribution, communication, navigation, and astronaut and airline safety.

B. AN ESTIMATE OF THE LIFE CYCLE COST FOR THE PROGRAM, WITH A DETAILED BREAKOUT OF THE DEVELOPMENT COST, PROGRAM RESERVES, AND AN ESTIMATE OF THE ANNUAL COSTS UNTIL DEVELOPMENT IS COMPLETED:

Development Costs

The original GOES-R Program Baseline, directed by the Consolidated Appropriations Act, 2008, was $6,960 million for the original two-satellite program. The FY 2009 President's Budget requested a revised GOES-R budget and provided a new program life-cycle cost estimate of $7,672 million based on input received and reconciliation efforts with an Independent Cost Estimate (ICE) and acceptance by the November 2007 Independent Review Team (IRT). This revised estimate reflected a better understanding of the two-satellite program content, allocated funds necessary to manage program risks, and provided for a budget phasing more consistent with the program schedule.

In November 2007, the IRT supported the inclusion of two additional satellites (GOES-T and GOES-U) into the GOES-R Series as the least expensive option to extend observational continuity. NOAA concurred, and in January 2008 directed that the spacecraft and instrument contracts include options for GOES-T and GOES-U. In 2010, the IRT Readiness Assessment validated the need and readiness to execute the spacecraft options, and that implementation would support procurement and sub-contract synergies with GOES-R and GOES-S.

The Administration proposed to move to a four-satellite program with the FY 2012 President's Budget. Following the consideration of technical and financial impacts, and coordination with the National Weather Service, the requirement to support an advanced sounder on GOES-T or GOES-U was removed from the GOES-R Series Level 1 Requirements Document in 2011.

In 2011, the Program Office Estimate was updated to reflect changes to date and the addition of options for GOES-T and GOES-U. Concurrently, an Independent Cost Assessment was also performed and the two estimates were reconciled under the oversight of the Technical Director of the Space Division of the Air Force Cost Analysis Agency. The reconciled cost estimate was determined along with the phasing required to support the GOES-R launch readiness dates. The current costs for space and ground system development are reflected in Table 4.

As part of its efforts to ensure that satellite investments generate the best possible value for taxpayers, the Administration is assessing potential cost savings options that may reduce the life-cycle costs for NOAA's next-generation weather satellite systems. In particular, areas under consideration include reducing program management costs; modifying technical requirements; implementing cost saving acquisition strategies and contracting approaches; implementing more efficient systems and/or a shared system for multiple satellite ground systems; and reassessing reserves funding, particularly as risks are retired. While cost savings estimates are still being refined, the Administration is optimistic that meaningful savings leading to a reduction in the current life-cycle estimates for weather satellite procurements are achievable.

Table 4:
GOES-R Series Program Reflected in FY 2013 President's Budget

(Dollars in thousands)	FY 2012 & Prior Enacted	FY 2013 PBR	FY 2014	FY 2015	FY 2016	FY 2017	Cost to Complete	Total
Total GOES-R System*	**3,408,537**	**802,000**	**950,761**	**844,744**	**781,653**	**706,251**	**3,366,318**	**10,860,266**
Space & Ground System Development	3,408,537	802,000	948,378	837,443	773,987	689,912	2,201,591	9,661,848
Operations and Sustainment			2,383	7,301	7,666	16,339	1,164,727	1,198,416

* Future requests will be determined through the annual budget process. Numbers may not add due to rounding.

Life Cycle Cost

The FY 2012 President's Budget requested the addition of two more satellites in the series, extended the operational life of the series by 8 years, from 2028 to 2036, and provided a new program life-cycle cost estimate of $10,860 million. In January 2012, a NASA/NOAA team completed a comprehensive Joint Confidence Level (JCL) review of the GOES-R Program. The results of that review are shown in Table 5. Steps taken to address the risks identified by the JCL are discussed in Section D, Plan for Mitigating Identified Technical, Cost and Schedule Risks.

In May 2012, the GOES-R Program completed KDP-II, culminating a series of NOAA/NASA management reviews that recommended the cost and schedule baseline for the GOES-R Series (Table 5) and the budget profile necessary to support it (Table 4). The NOAA/NASA Program Management Council Decision Agreement documenting this baseline recommendation is in Appendix C.

Table 5: KDP-II Cost and Schedule Baseline Commitments
Reflecting Joint Confidence Level Assessment
Data as of: 16 May 2012

	Management Commitment
Cost – Life Cycle Cost Commitment / Cost Confidence Level	$10,860.3M / 73%
Schedule (Launch Readiness Dates):	
GOES-R / Schedule Confidence Level	10/2015 / 48%*
GOES-S / Schedule Confidence Level	2/2017 / 70%
GOES-T / Schedule Confidence Level	4/2019 / 86%
GOES-U / Schedule Confidence Level	10/2024 / 100%

* Less than NASA standard 70% schedule confidence level

Reserves

Program reserves are allocated in a dynamic process closely tied with the risk management program. Annual obligation authority, not directly associated with ongoing contracts, is tracked as contingency. The purpose of contingency is to allow for items, conditions or events for which the state, occurrence or effect is uncertain. As issues and risks are identified, contingency funds are allocated to assess, mitigate or respond to them.

The GOES-R Program contingency assessment from April 2012 is shown below in Table 6. The "contingency" row depicts the funds available at that point in time for the current fiscal year to address unexpected problems, and for future years represents the expected levels at the beginning of the year.

Contingency usage is continuously reassessed and adjusted and is reported monthly at the Management Status Reviews and the Program Management Councils.

Table 6:

GOES-R Program
Baseline Assessment - Contingency Assessment as of KDP II. 16 May 2012
($M)

	Prior Yrs	FY 12	FY13	FY14	FY15	FY16	FY17	FY18TC	Total
Develpoment	2,792.9	615.6	802.0	948.4	837.4	774.0	689.9	2,201.7	**9,661.9**
O&S	-	-	-	2.4	7.3	7.7	16.3	1,164.7	**1,198.4**
Total GOES-R NOA	**2,792.9**	**615.6**	**802.0**	**950.8**	**844.7**	**781.7**	**706.3**	**3,366.4**	**10,860.3**
Contingency	-	16.5	79.5	133.8	98.5	77.1	43.8	341.6	**790.9**
% Contingency		*3%*	*9%*	*20%*	*17%*	*14%*	*11%*		***17%***

C. SCHEDULE FOR DEVELOPMENT, INCLUDING KEY PROGRAM MILESTONES:

Major program milestones, the major phases for each satellite and the ground project, and the integrated master schedule for the GOES-R satellite are depicted in the following Figures 2-4. The GOES-S, GOES-T, and GOES-U launch readiness dates (LRDs) are planning dates and the official LRDs will be established by NOAA based upon the health of the constellation and budget profile. The NOAA/NASA management reviews preceding the KDP-2 recommendation evaluated the cost and schedule commitments for the program, and determined they were aligned with the content of the GOES-R Series level 1 Requirements Document. These reviews also recognized that schedule risk for the first GOES-R satellite remains, but that given the priority of minimizing gaps in geostationary coverage, progress made to date, and the recommendations from external review boards, the recommended course of action is to aggressively manage toward the planned October 2015 LRD.

Figure 2:
GOES-R Series Major Program Milestones

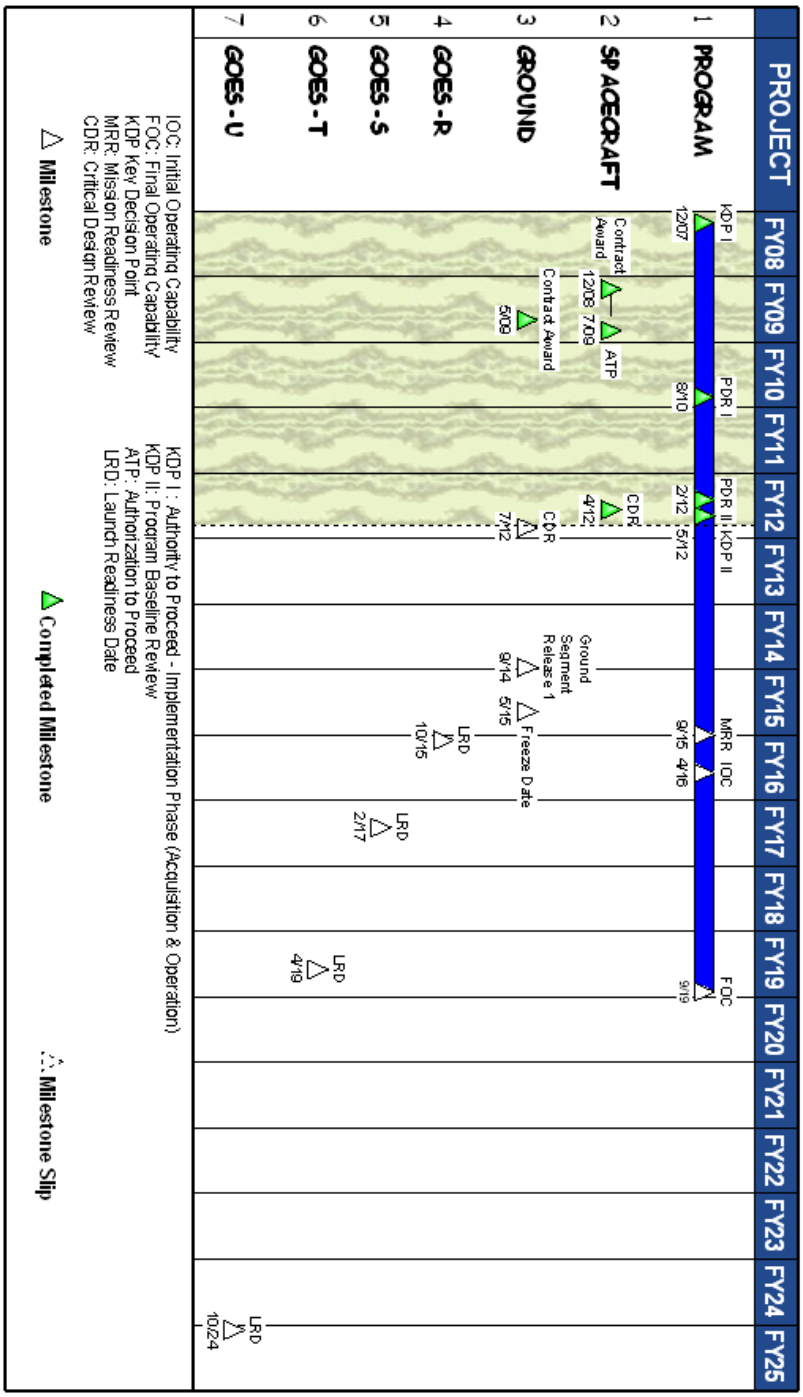


Figure 3:
GOES-R Series Major Phases by Satellite and the Ground Project

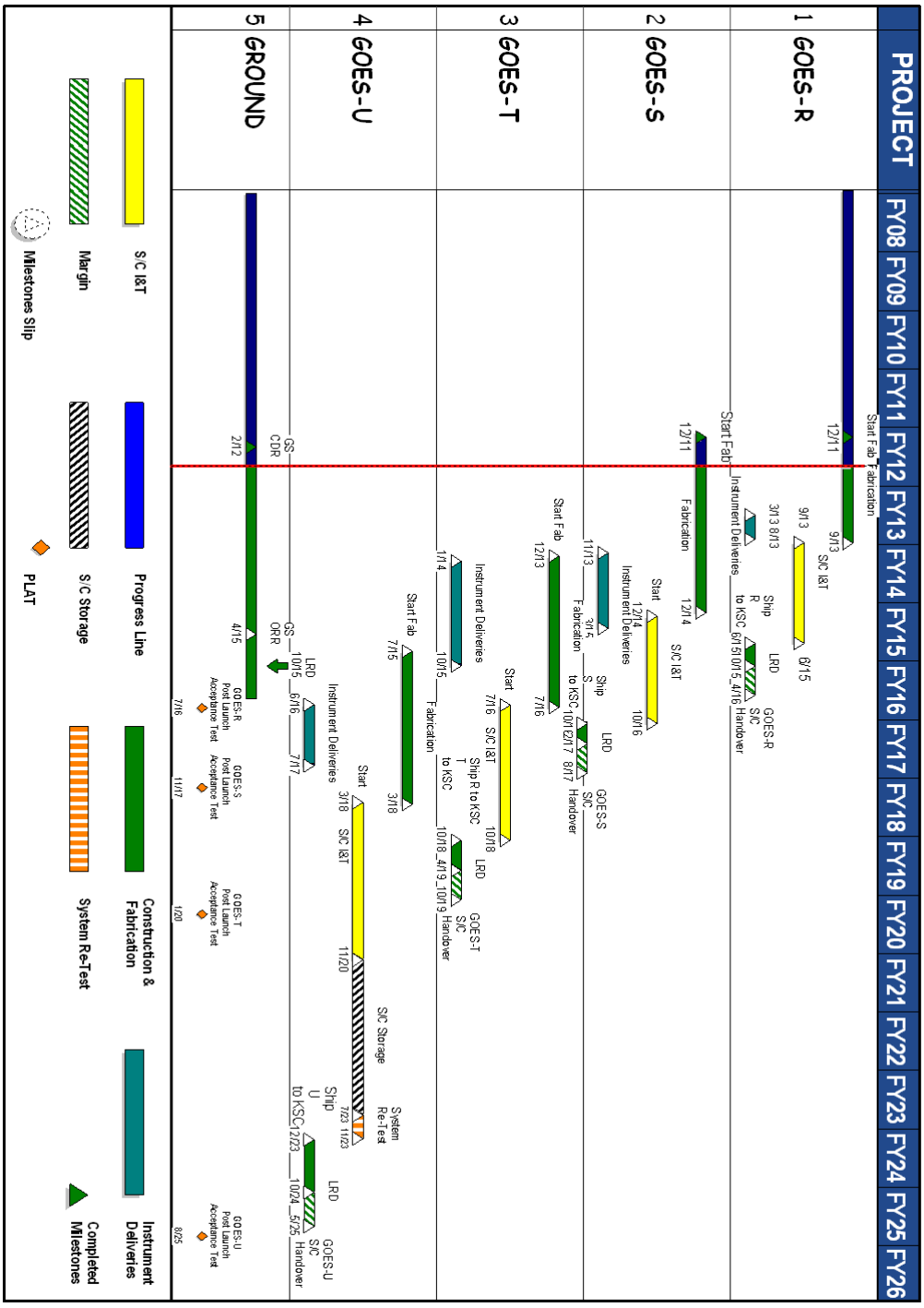
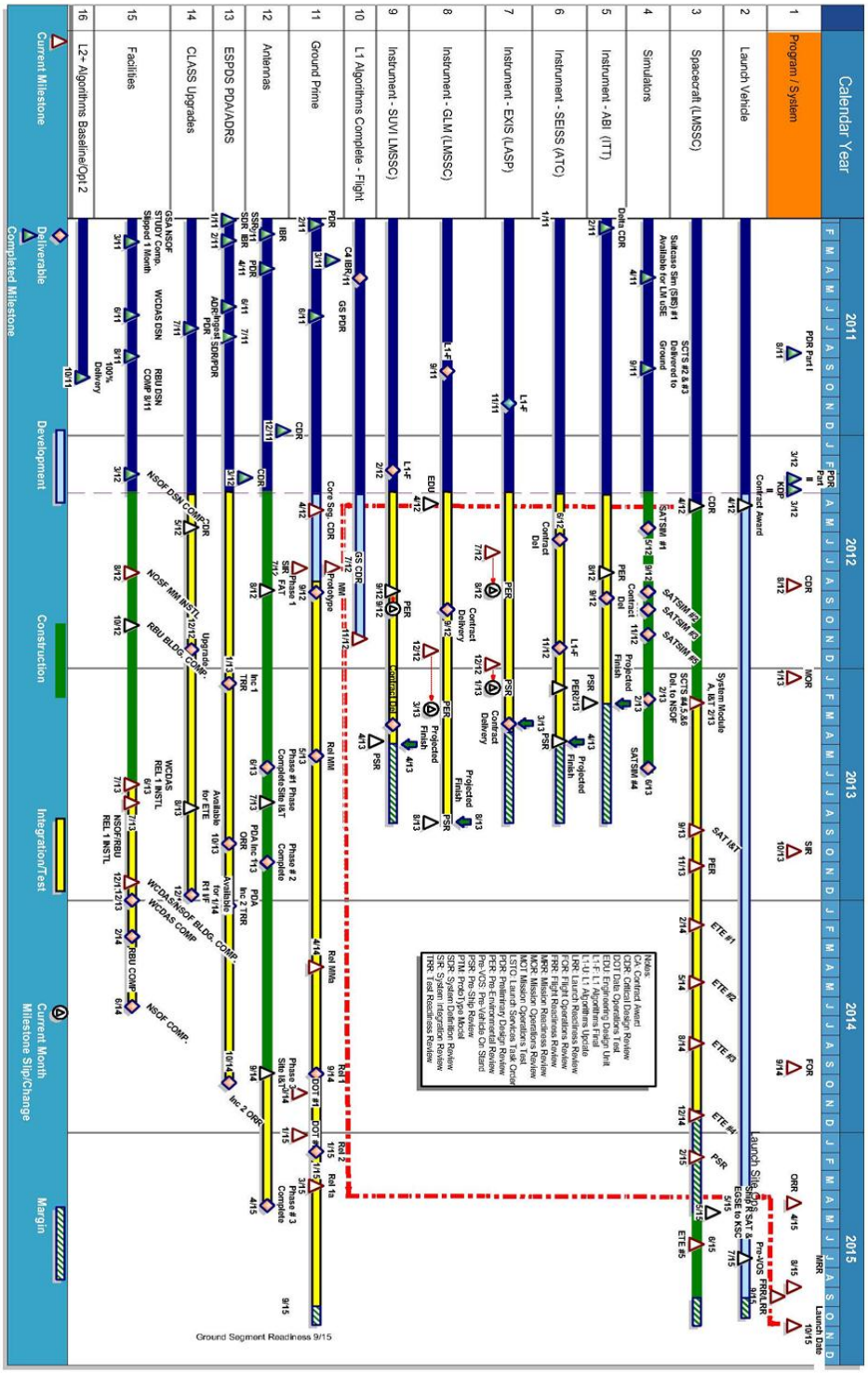


Figure 4:
Integrated Master Schedule for the GOES-R Satellite



D. PLAN FOR MITIGATING IDENTIFIED TECHNICAL, COST, AND SCHEDULE RISKS:

The GOES-R Series program is managed in partnership between NOAA and NASA, and follows NASA standards for Flight System Lifecycle Reviews. Both the flight and ground projects are supported by Integrated Independent Review Teams (IIRTs), the program level by a Standing Review Board (SRB), and at the enterprise level, the GOES-R program is reviewed along with the other NOAA environmental satellites by an Independent Review Team (IRT).

Technical Risk: The Mission Preliminary Design Review was completed February 29, 2012, and the SRB verified that the program met all requirements with acceptable risk and within the cost and schedule constraints. It also determined that the correct design options were selected, interfaces had been identified, verification methods had been described, and an integrated baseline cost and schedule, risk assessment, management system, and metrics had been presented.

The current program status, along with the findings of the SRB, was presented on March 13, 2012 to the Goddard Space Flight Center Management Council, on April 11, 2012 to the NASA Science Mission Directorate / NESDIS Program Management Council, and on May 16, 2012 to the NASA/NOAA Agency Program Management Council. Each council was unanimous in recommending that the program met the required success criteria for advancing into the detailed design phase. These criteria included:

- The GOES-R processes (design, implementation, interface controls, risk management, safety, test and verification, operations, etc.) used to develop and operate the system are at the expected maturity level. The preliminary design is expected to meet the requirements within the resource allocation.
- The GOES-R preliminary design is consistent with top-level requirements. The operations concept is technically sound. The defined technical interfaces are consistent with the overall technical maturity. Adequate margins exist with respect to technical performance. Any required new technology has been developed to an adequate state of readiness or viable options exist. New updates to major risks have been identified and viable mitigation strategies are defined.
- Safety, reliability, maintainability, quality, and electrical, electronic and electromechanical (EEE) parts have been adequately addressed in preliminary designs and any applicable safety and mission assurance (S&MA) products (i.e., hazard analysis, failure modes and effects analysis) have been identified.
- Design definition is sufficient to support initial parametric and bottom up cost estimating.
- Cost estimates, control processes, and schedule indicate the system will be ready on time (i.e., integration, delivery, launch, etc.) and within budget.

In addition, the GOES-R Program Office continues to manage risk through its comprehensive risk management program as documented in the June, 2010 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.

The GOES-R risk management program 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 NASA Management Status Review (MSR) and the NOAA Program Management Council (PMC) monthly on the top risks and the strategies for mitigating and/or resolving them.

The procurement strategy for GOES-R was structured to address the highest risk areas of the GOES-R program early and to ensure the technology required for GOES-R was sufficiently mature. Between October 2005 and April 2007, NOAA conducted an extensive Program Definition and Risk Reduction (PDRR) effort. This was executed through a series of contracts with leading aerospace companies in order to leverage industry expertise early in the program development and design process. Because the GOES-R instruments are new, NOAA started to anticipate and mitigate known technical risks well before initial procurement, initiating the instrument 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.

Schedule Risk: The GOES-R schedule includes a margin consistent with NASA GSFC guidelines, and as of April 2012, the program schedule margin was 171 days versus the requirement of 143 days. However, the JCL statistical analysis, which considers the potential range of cost and schedule outcomes for GOES-R development activities, indicated there was a 48 percent probability that GOES-R will launch on its scheduled launch readiness date (LRD). Program management monitors the schedules closely and NOAA has developed contingency approaches for events such as delayed instrument deliveries.

Cost Risk: The GOES-R Program Office has allocated the development budget across all contracts, and closely monitors each contract's estimate at completion (the sum of contract values, encumbrances, liens and external adjustments). In addition, each contract's earned value management indices, including current and long-term trends, and their completed versus scheduled milestones are also tracked and reported monthly. At the present time all contracts are below their allocated budget and the overall program has sufficient reserves on the cost to go.

Within the Flight Project, the instrument development is currently assessed as low risk. All instrument designs have been proven through prototypes or high-fidelity engineering development models, and their interfaces with the spacecraft are stable. Flight Model 1 (FM1) instruments (for GOES-R) are well into assembly and test, and most materials for FM2 through 4 have been procured and delivered. Many FM2 components are currently being integrated. The highest remaining instrument related cost concerns are with GLM execution and the support required for the coming spacecraft integration and test.

The spacecraft contract has experienced recent cost growth due to contractor manpower growth, complexity in design, the correction of deficiencies identified at the critical design review (CDR), the imposition of mission assurance requirements on subcontractors and material

suppliers, and the deferral of work from previous years due to funding constraints. Future cost concerns include elevated contractor manpower levels and potential schedule slips due to component availability. The spacecraft is assessed to be the primary cost and schedule risk as the program progresses.

The ground core contract is on cost and schedule. The antenna contract is also right on cost and schedule, with low risk assessed for cost growth. In addition, facility upgrades and all other related developments are also on cost and schedule.

The GOES-R Program Office's principal plan for controlling cost risk is to apply reserves to problems early before they can grow and impact the schedule. In addition, the project offices attempts to efficiently procure materials, for example buying materials for all 4 instrument flight models at once. The GOES-R Program Office has also pursued changes in requirements where possible to reduce costs. For example, a small reduction in the required accuracy of the magnetometer enabled the deletion of a star-tracker on the magnetometer boom, reducing cost and deployment risks. As mentioned earlier, the removal of the requirement to accommodate a sounder on GOES-T or GOES-U also reduced cost and schedule risks for the spacecraft. Within the ground system, efforts to standardize the primary and back-up command and data acquisition hardware, and tailor software security provisions to just the required levels have also produced savings.

Currently, the greatest risk to the GOES-R program is funding stability. The GOES-R program office actively works with NOAA, DOC, other components of the executive branch, and congressional elements involved in budget formulation and oversight to ensure an understanding of the importance of funding stability and the cost and schedule consequences of not maintaining this stability.

Due to the planned increase in funding for FY 2013 to ramp up work on the second GOES-R Series satellite, GOES-S, and procure a launch vehicle, shortfalls in funding in the final FY 2013 appropriations bill could lead to work slowdowns or disruptions, which in turn could lead to launch delays. The FY 2013 Continuing Resolution (P.L. 112-175) permitted OMB to apportion funds for GOES-R as necessary to maintain the current launch schedule for the GOES-R satellite in October 2015. The GOES-R Series Program requires amounts in FY 2013 Budget request in order to maintain schedules outlined in the KDP-II document in Appendix C.

E. NAME OF THE PERSON RESPONSIBLE FOR MAKING NOTIFICATIONS AND WHOSE PRIMARY RESPONSIBILITY IS OVERSEEING THE PRIGRAM:

The responsible reporting official as required by Public Law No. 112-55, Division B, Title I, subsection 105(c)(2)(E) is: Gregory A. Mandt, NOAA GOES-R Series, System Program Director.

APPENDIX A – LIST OF ACRONYMS AND ABBREVIATIONS

ABI:	Advanced Baseline Imager
ADRS:	Ancillary Data Review System
ATC:	Assurance Technology Corporation (SEISS Contractor)
ATP:	Authorization to Proceed
CDR:	Critical Design Review
CLASS:	Comprehensive Large Array-data Stewardship System
DOC:	Department of Commerce
eV:	Electron-Volts
EEE:	Electrical, Electronic and Electromechanical
EHIS:	Energetic Heavy Ion Sensor
ESPDS:	Environmental Satellite Processing and Distribution System
EUVS:	Extreme Ultraviolet Sensor
EXIS:	Extreme Ultraviolet (EUVS) and X-ray Irradiance Sensor (XRS)
FAA:	Federal Aviation Administration
FOC:	Full Operational Capability (defined as a GOES-R series spacecraft operational at both east and west orbital locations)
GLM:	Geostationary Lightning Mapper
GOES:	Geosynchronous Operational Environmental Satellite
GSFC:	Goddard Space Flight Center
Hz:	Hertz (cycles per second)
ICE:	Independent cost estimate
IIRT:	Integrated Independent Review Team
IOC:	Initial Operational Capability (defined as one GOES-R series operational on orbit)
IR:	Infrared
IRT:	Independent Review Team
I&T:	Integration and Test
ITT:	ITT Industries (recently renamed Exelis)
JCL:	Joint Confidence Level
KDP:	Key Decision Point
KeV:	Kilo electron-Volts
Km:	Kilometer
KSC:	Kennedy Space Center
LASP:	Laboratory for Atmospheric and Space Physics
LMSSC:	Lockheed Martin Space Systems Company
L1RD:	Level One Requirements Document
LRD:	Launch Readiness Date
Mbps:	Million bits per second
MeV/N:	Million electron-Volts per Nucleon
MRR:	Mission Readiness Review
MSR:	Management Status Review
NASA:	National Aeronautics and Space Administration
NESDIS:	National Environmental Satellite, Data and Information Service
NID:	NASA Interim Document

NM:	NASA Manual
NOA:	New obligation Authority
NOAA:	National Oceanographic and Atmospheric Administration
NPR:	NASA Procedural Requirement(s)
NM:	NASA Manual
ORR:	Operational Readiness Review
O&S:	Operations and support
PDA:	Product Distribution and Access
PDRR:	Program Definition and Risk Reduction
PMC:	Program Management Council
S/C:	Spacecraft
SEU:	single event upset
SEISS:	Space Environment In-Situ Suite
S&MA:	Safety and Mission Assurance
SPD:	System Program Director
SUVI:	Solar Ultraviolet Imager
SWPC:	Space Weather Prediction Center (formerly known as Space Environment Center - SEC)
MAG:	Magnetometer
UV:	Ultraviolet
XRS:	X-ray Irradiance Sensor

APPENDIX B – LEGISLATIVE MANDATE

The Consolidated and Further Continuing Appropriations Act, 2012, Public Law No. 112-55, Division B, Title I, Section 105, 125 Stat. 552 at 599 (Nov. 18, 2011) (amending 33 U.S.C. § 878a),

Sec. 105. (a) For purposes of this section--

(1) the term `Under Secretary' means Under Secretary of Commerce for Oceans and Atmosphere;
(2) the term `appropriate congressional committees' means--
(A) the Committee on Appropriations and the Committee on Commerce, Science, and Transportation of the Senate; and
(B) the Committee on Appropriations and the Committee on Science, Space and Technology of the House of Representatives;
(3) the term `satellite' means the satellites proposed to be acquired for the National Oceanic and Atmospheric Administration (NOAA);
(4) the term `development' means the phase of a program following the formulation phase and beginning with the approval to proceed to implementation, as defined in NOAA Administrative Order 216-108, Department of Commerce Administrative Order 208-3, and NASA's Procedural Requirements 7120.5c, dated March 22, 2005;
(5) the term `development cost' means the total of all costs, including construction of facilities and civil servant costs, from the period beginning with the approval to proceed to implementation through the achievement of operational readiness, without regard to funding source or management control, for the life of the program;
(6) the term `life-cycle cost' means the total of the direct, indirect, recurring, and nonrecurring costs, including the construction of facilities and civil servant costs, and other related expenses incurred or estimated to be incurred in the design, development, verification, production, operation, maintenance, support, and retirement of a program over its planned lifespan, without regard to funding source or management control;
(7) the term `major program' means an activity approved to proceed to implementation that has an estimated life-cycle cost of more than $250,000,000; and
(8) the term `baseline' means the program as set following contract award and preliminary design review of the space and ground systems.

(b)(1) NOAA shall not enter into a contract for development of a major program, unless the Under Secretary determines that--
(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; and
(E) the acquisition of satellites for use in the program represents a good value to accomplishing NOAA's mission.

(2) The Under Secretary shall transmit a report describing the basis for the determination required under paragraph (1) to the appropriate congressional committees at least 30 days before entering into a contract for development under a major program.

(3) The Under Secretary may not delegate the determination requirement under this subsection, except in cases in which the Under Secretary has a conflict of interest.

(c)(1) Annually, at the same time as the President's annual budget submission to the Congress, the Under Secretary shall transmit to the appropriate congressional committees a report that includes the information required by this section for the satellite development program for which NOAA proposes to expend funds in the subsequent fiscal year. The report under this paragraph shall be known as the Major Program Annual Report.

(2) The first Major Program Annual Report for NOAA's satellite development program shall include a Baseline Report that shall, at a minimum, include--
(A) the purposes of the program and key technical characteristics necessary to fulfill those purposes;
(B) an estimate of the life-cycle cost for the program, with a detailed breakout of the development cost, program reserves, and an estimate of the annual costs until development is completed;
(C) the schedule for development, including key program milestones;
(D) the plan for mitigating technical, cost, and schedule risks identified in accordance with subsection (b)(1)(A); and
(E) the name of the person responsible for making notifications under subsection (d), who shall be an individual whose primary responsibility is overseeing the program.

(3) For the major program for which a Baseline Report has been submitted, subsequent Major Program Annual Reports shall describe any changes to the information that had been provided in the Baseline Report, and the reasons for those changes.

(d)(1) The individual identified under subsection (c)(2)(E) shall immediately notify the Under Secretary any time that individual has reasonable cause to believe that, for the major program for which he or she is responsible, the development cost of the program has exceeded the estimate provided in the Baseline Report of the program by 20 percent or more.

(2) Not later than 30 days after the notification required under paragraph (1), the individual identified under subsection (c)(2)(E) shall transmit to the Under

Secretary a written notification explaining the reasons for the change in the cost of the program for which notification was provided under paragraph (1).

(3) Not later than 15 days after the Under Secretary receives a written notification under paragraph (2), the Under Secretary shall transmit the notification to the appropriate congressional committees.

(e) Not later than 30 days after receiving a written notification under subsection (d)(2), the Under Secretary shall determine whether the development cost of the program has exceeded the estimate provided in the Baseline Report of the program by 20 percent or more. If the determination is affirmative, the Under Secretary shall--

(1) transmit to the appropriate congressional committees, not later than 15 days after making the determination, a report that includes--

(A) a description of the increase in cost and a detailed explanation for the increase;

(B) a description of actions taken or proposed to be taken in response to the cost increase; and

(C) a description of any impacts the cost increase, or the actions described under subparagraph (B), will have on any other program within NOAA; and

(2) if the Under Secretary intends to continue with the program, promptly initiate an analysis of the program, which shall include, at a minimum--

(A) the projected cost and schedule for completing the program if current requirements of the program are not modified;

(B) the projected cost and the schedule for completing the program after instituting the actions described under paragraph (1)(B); and

(C) a description of, and the projected cost and schedule for, a broad range of alternatives to the program.

(f) NOAA shall complete an analysis initiated under paragraph (2) not later than 6 months after the Under Secretary makes a determination under this subsection. The Under Secretary shall transmit the analysis to the appropriate congressional committees not later than 30 days after its completion.

APPENDIX C- SIGNED KEY DECISION POINT II DOCUMENT

Joint NOAA and NASA
Program Management Council
GOES-R Series Program KDP II/KDP C Decision Agreement

Summary: The GOES-R Series program is managed in partnership between National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics Space Administration (NASA). A Joint NOAA and NASA Program Management Council (PMC) met on May 16, 2012 and evaluated the GOES-R Series Program's Key Decision Point C of the life cycle as defined in accordance with the NASA Interim Directive (NID 7120-81) for the NASA Procedural Requirement (NPR) 7120.5D: Space Flight Program and Project Management Requirements and the GOES-R Management Control Plan. The Joint NOAA and NASA PMC determined that the GOES-R Series Program is ready to proceed to Phase C. The GOES-R Series Program is defined as a Single-Project Program in accordance with NID 7120-81 for NPR 7120.5D and is baselined to include GOES-R, S, T, and U.

Decision: Based on this review and the program readiness documents, the Joint NOAA and NASA PMC recommends approval for the GOES-R Series Program to continue into Phase C with the schedule and life cycle cost as specified in Table 1 with budget phasing per Table 2. The GOES-S, T and U launch readiness dates are planning dates and official LRDs will be established by NOAA based on the health of the constellation and budget realities. The cost and schedule commitments are aligned with the content described in the GOES-R Series Level 1 Requirements Document signed by the Deputy Under Secretary of Commerce for Oceans and Atmosphere on October 25, 2011.

This decision reaffirms actions taken to date to enable exercise of contract options for GOES-T and U in the FY13 and FY14 timeframes, respectively. These actions included technical and programmatic assessment by the GOES-R Independent Review Team (which supported the program conclusion that exercising the T and U options represented the least-cost and most feasible schedule for maintaining the operational geostationary constellation), the evaluation of costs by independent cost estimators, and the request for funds as a part of the President's FY12 budget.

Additionally, this decision recognizes the fact that schedule risk remains, as reflected in the 48% schedule confidence, which is below the NASA standard external commitment of 70% schedule confidence. However, given the priority placed on minimizing gaps in geostationary coverage, the progress to date in the program, and recommendations from external review boards, the PMC affirms that the highest potential for maintaining constellation availability is to aggressively manage schedule towards the October 2015 planned launch readiness date.

Table 1: KDP II Cost and Schedule Baseline Commitments

	Management Commitment
Cost – Life Cycle Cost Commitment / Cost Confidence Level	$10,860.3M / 73%
Schedule (Launch Readiness Dates):	
GOES-R / Schedule Confidence Level	10/2015 / 48%*
GOES-S / Schedule Confidence Level	2/2017 / 70%
GOES-T / Schedule Confidence Level	4/2019 / 86%
GOES-U / Schedule Confidence Level	10/2024 / 100%

* Less than NASA standard 70% schedule confidence level

Table 2: GOES-R Program Budget Profile

Prior Yrs ($M)	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FYTC	Total
2,792.9	615.6	802.0	950.8	844.7	781.7	706.3	578.7	2,787.6	10,860.3

Program Reporting: As part of the regular reporting on the GOES-R Series Program, NOAA and the GOES-R Series Program will continue to highlight for the Chief Financial Officer and Assistant Secretary for Administration actual or expected deviations from GOES-R's capability (including enhancements) and cost or schedule variances in all program elements – including ground systems, spacecraft, and instruments – exceeding 5% of the dollar amount or schedule currently established for that element.

Concurrence:

5/16/12
GOES-R Program Manager Date

16 MAY 2012
NASA Goddard Spaceflight Center Director Date

5/16/12
NOAA Assistant Administrator for NESDIS Date

5/16/12
NASA Science Mission Directorate Associate Administrator Date

5/16/12
NOAA, PMC Chair, Chief of Resources and Operations Management Date

5/16/12
NASA Associate Administrator (Acting) Date

Approval:

5/16/12
Under Secretary of Commerce for Oceans and Atmosphere & NOAA Administrator Date