STATEMENT BY

MR. JEFFREY D. GRANT
SECTOR VICE PRESIDENT AND GENERAL MANAGER
SPACE SYSTEMS
NORTHROP GRUMMAN AEROSPACE SYSTEMS

BEFORE THE

SUBCOMMITTEE ON SPACE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

HEARING ON

JAMES WEBB SPACE TELESCOPE

FIRST SESSION, 114TH CONGRESS
MARCH 24, 2015

Statement by Jeffrey D. Grant, Sector Vice President and General Manager
Space Systems, Northrop Grumman Aerospace Systems

Before the Subcommittee on Space
Committee on Science, Space, and Technology
James Webb Space Telescope

Chairman Palazzo, Ranking Member Edwards, and distinguished Members of the Committee, thank you for inviting me to appear before you today on behalf of the men and women of Northrop Grumman supporting the National Aeronautics and Space Administration's (NASA) next great observatory, the James Webb Space Telescope (JWST). Before I begin, I would like to thank the Committee for its leadership of our nation's civil space programs. Your steadfast support, especially with regards to JWST, is critical not only to our success, but to that of the nation's scientific and exploration programs.

I am honored to appear before you today with two NASA leaders, Associate Administrator Dr. John Grunsfeld and Dr. John Mather, Nobel Laureate and Senior Project Scientist for JWST, both leading this tremendous scientific achievement for our nation. JWST represents a technological challenge in support of a scientific objective beyond anything attempted before, and without NASA's leadership, specifically the Goddard Space Flight Center, this would simply not be possible. I am also honored to appear with the Government Accountability Office (GAO) Director of Acquisition and Sourcing Management, Cristina Chaplain, whose agency's oversight helps ensure the success of this program. As with any program, especially one this technologically complex, independent reviews are essential. We have, and will continue, to benefit from GAO's candid and straightforward assessments. I appreciate the relationship we have developed and maintained during the course of this program.

I also need to recognize NASA's international partners on this effort, the European Space Agency and the Canadian Space Agency, who are providing key scientific instruments and the launch vehicle for JWST, and the invaluable contributions of the Space Telescope Science Institute, which serves as the Science and Operations Center for the mission. It is truly the dedication of thousands, who are contributing to the success of the mission.

It gives me a great deal of pleasure to appear before this committee for a second time on this program, the first time in December 2011. At that hearing, I told the Committee that we had restructured the program, added new technical and management talent and were frequently reviewing the program with the leadership of Northrop Grumman to ensure we brought all of the capabilities of the company and our partners to perform successfully. I am very pleased to report that over the last three years we have met almost every milestone we planned and remain on track for a launch in 2018.

Mr. Chairman, you requested that I provide testimony on four specific areas: 1) an assessment of the challenges facing the JWST program 2) an update on Northrop Grumman's efforts to meet these challenges 3) an overview of Northrop Grumman's contingency plans, should technical and programmatic continue to consume cost and schedule reserves and, 4) the steps Northrop Grumman is taking to ensure costs and schedules are met.

1) First, an assessment of the challenges facing the JWST program: The complexity of JWST is unrivaled in our history of space exploration. Unlike Hubble, JWST will deploy large optical systems after launch, and is designed to operate at extreme cryogenic temperatures. Also, the primary mirror is more than two and a half times the diameter of Hubble – over 7 times the light gathering capacity, and it will operate from the second Lagrange (L2) point, more than 930,000 miles away from Earth. I am extremely pleased to report that we have overcome all of the major technical challenges on the program and are now in the manufacturing, integration and test phase of the program. And since the rebaselining in 2011, the program has done this within cost and on schedule, meeting all critical milestones.

The Optical Telescope Element (OTE) is unlike any telescope ever built before, both in size and complexity. The surface of the 18 hexagonal beryllium mirrors that form the primary mirror had to be polished to smoothness where the largest surface irregularity was hundreds of times smaller than the diameter of a single bacterium. These 18 mirror segments have been completed and delivered. They will be installed at the end of this year onto a folding backplane, 21 feet in diameter, which will maintain the mirrors' stability to 1 percent of the width of a

human hair. This backplane is in its final stages of assembly and test in Redondo Beach before being delivered to Goddard Space Flight Center for mirror integration later this year.

The detection of infrared light from very distant stars and planets requires that the telescope operate at extremely low temperatures. Shielding the system from the sun's radiant heat required the design and development of a deployable sunshield the size of a tennis court. This sunshield consists of five layers of aluminum and silicon-coated Kapton – each of which are as thin as a human hair and must maintain precise separations upon deployment. Many of you may have seen the successful test deployment of the sunshield last July – truly an astounding accomplishment.

While the sunshield will protect the science instruments from the heat of the sun, these instruments must also be protected from themselves. The electronics, spectrographs, and cameras generate heat internally, which would interfere with the telescope's infrared sensors, specifically the mid-infrared sensor, if not cooled by other means. Cryocoolers are not unique to satellites, and Northrop Grumman has an outstanding record in building these types of cooling systems. The Mid Infrared Instrument (MIRI) however, requires a unique type of cryocooler in that it needs to cool to 6 degrees Kelvin (-449F) from a distance of 30 feet. We, Northrop Grumman, are building this cryocooler under a subcontract to NASA's Jet Propulsion Laboratory for delivery to them in 2015.

Usually a cryocooler is the standard size of a notebook, but this one stretches over 30 feet from the spacecraft up to the instruments stored behind the optics, resulting in a large distributed system that makes it even more complex. A deployable cryocooler that stretches across this span at this low of a temperature has never been done before in the cryocooler business. The technological design for the cryocooler has been approved and is complete, but manufacturing certain components to operate at such extreme temperatures has proven to be a challenge. The MIRI cooler we are building currently represents the largest technological challenge we are facing on the program.

Recognizing these challenges, Northrop Grumman reorganized the MIRI cryocooler program in early December 2014 to increase focus on systematic execution and schedule forecast accuracy, and also brought additional senior technical and management resources in engineering, manufacturing, mission assurance, and leadership, to enable the new organization to be rapidly and effectively implemented. I am pleased to report that as of this testimony, we have delivered all of the MIRI cooler subsystems to Goddard and JPL except one, and the last subsystem is currently in the final stages of integration and test. I am also very pleased to report that the thermal and vibration test data from the flight hardware has shown excellent performance and we remain confident in the hardware meeting not only its schedule requirement, but its technical and mission life needs.

2) An update on Northrop Grumman's efforts to meet these challenges: No program of this magnitude and complexity is without challenges, and we have expected, and experienced them from the beginning. The 2011 restructure of the program has been instrumental in our ability to navigate these challenges, managing cost and schedule reserves across the fiscal years while retiring significant risks. This distributed schedule slack has proven crucial in our ability to manage problems within the allowed reserves. And while we remain hopeful, realistically we understand that challenges on programs this complex will continue to present themselves. An example is the recently discovered workmanship issues with the cryogenic harnesses. Due to escapes in the manufacturing and inspection processes, we will need to replace or repair nearly three dozen of these harnesses on the backplane. We expect this issue to be resolved within the current schedule and cost reserves, but these are the type of challenges that arise during the manufacturing, integration, and test phase.

We also continue to invest resources in risk reduction activities by trailblazing the more complicated processes in advance of flight production increasing our confidence in executing the flight schedule. All of the major subsystems have maintained above-plan schedule margin due to these proactive risk mitigations. For example, the optical telescope pathfinder will be used to trailblaze the optical testing at the Johnson Space Center in 2017, and the sunshield full scale development article will undergo another full scale deployment this summer. Additionally, we will be performing an early mating of the OTE and the spacecraft this summer in advance of the

flight mate in 2017. If and when further challenges appear, we will attack them with the same determination and commitment that has brought us this far. At every level, Northrop Grumman is dedicated to overcoming these hurdles within cost and schedule reserves.

As we move closer to the 2018 launch date, the next few years will be critical. Our immediate focus is finishing fabrication and assembly of the spacecraft and sunshield, integrating optics onto the assembled backplane, and completion of the MIRI cryocooler. The focus will then shift to integration and testing of the OTE and Integrated Science Instrument Module (ISIM), and assembling the spacecraft and sunshield into a single system. This Committee's support is essential to keeping the program on cost and on schedule for a successful October 2018 launch date.

Specific to Northrop Grumman, we are employing over 700 engineers, scientists, technicians and support staff at our Space Park facility in Redondo Beach, California, and have partnered with 511 suppliers across 39 states to complete the work to date. The reach of JWST is nationwide, harnessing the best technical expertise in the nation for this unprecedented developmental and engineering effort. But it doesn't stop there. Like its predecessor, JWST is, and will continue to motivate and inspire the next generation of scientists.

3) An overview of Northrop Grumman's contingency plans, should technical and programmatic continue to consume cost and schedule reserves: We currently maintain 11 months of funded slack in our schedule. With less than three years to go before launch, this amount of schedule contingency is very conservative for a program of this type and, given our experience of more than 50 years developing spacecraft, there is adequate contingency for the unexpected challenges that may arise.

4) The steps Northrop Grumman is taking to ensure costs and schedules are met: A program of this importance and visibility has allowed the prime contract Program Manager Scott Willoughby and the MIRI cryocooler Program Manager Tim Martin to have frequent reviews with all of the senior leadership at Northrop Grumman Aerospace Systems and with the leadership of the corporation. This frequent engagement allows the JWST program managers to

have both top priority and access to the full range of skills required to complete the program. In addition, NASA and Northrop Grumman have involved major leaders in the space and science community to engage personally with the teams working on the program to provide inspiration and vision for how what we are doing is going to change our understanding of our place in the universe.

Mr. Chairman, I hope my pride and enthusiasm in JWST and our team of partners is evident. From the technicians in the clean room, to our CEO, Northrop Grumman is fully committed to the success of the mission, on-time and on-budget. I want to assure the Committee that Northrop Grumman takes it role seriously, and is doing our part to address the technical and programmatic challenges before us. We maintain a high confidence of launch in 2018 within the Congressionally-mandated $8 billion development cost cap. I look forward to continue working with NASA as it leads this amazing effort, and with the Committee, to ensure that JWST is a success.

I want to again thank you for asking me to appear before your Committee today, and welcome the Committee's questions.