



## NOAA REPORT ON SPACE DEBRIS/COLLISION MITIGATION MEASURES

**Action 38.03:** CGMS Members to report on their activities related to Space Debris/collision mitigation measures.

NOAA-WP-06 informed CGMS that NOAA actively engages in space debris and collision avoidance mitigation activities from early design and acquisition through operations and end-of-mission disposal operations. NOAA implements international outer space treaties and related U.S. best practices for all design and on-orbit flight safety activities. NOAA subject matter experts participated as working group members for a U.S. Government-wide task to implement the August 2010 National Space Policy. As necessary, NOAA continues to assist EUMETSAT's operational interface with the U.S. Strategic Command's Joint Space Operations Center (JSpOC) for real-time exchange of collision avoidance information. NOAA offers similar assistance to other CGMS members if desired.

Action/Recommendation proposed: None.

## **NOAA REPORT ON SPACE DEBRIS/COLLISION MITIGATION MEASURES**

### **1 INTRODUCTION**

As a civil space agency currently responsible for on-orbit operations for 17 satellites in three different orbital regimes, NOAA is a full U.S. government participant in all areas of space debris mitigation and orbital collision avoidance. NOAA complies with all international policy and domestic best practices regarding space debris mitigation and collision avoidance. NOAA's activities can be identified by several broad areas:

- Subject matter expert participation in domestic and international policy development, and best practices implementation for debris mitigation and collision avoidance;
- Life-cycle debris mitigation and collision avoidance best practices from acquisition to end-of-mission; and,
- Assistance to international partners as requested.

### **2 Policy Development**

NOAA provides subject matter experts for domestic and international policy development. For example, President Obama's August 2010 National Space Policy placed emphasis on orbital flight safety and debris mitigation. In response to the new policy, NOAA provided a knowledgeable individual to participate on an interagency working group developing a strategy for improving the U.S. space situational awareness capability and the scope of support to other space-faring nations. NOAA also provides representation on the Space Situational Awareness Expert Group which was established by the UN Committee on Peaceful Uses of Outer Space (UNCOPUOS).

An additional area of policy development emerged from NOAA's role as the licensing agent for U.S. commercial remote sensing satellites. In 2010, NOAA proposed that the U.S. Federal Aviation Administration (FAA), in its role as the commercial space launch licensing authority, require all U.S. remote sensing applicants to document end-of-mission planning for commercial remote sensing satellites. The FAA accepted NOAA's recommendation as well as a NOAA's suggested regulatory language to be added to the FAA licenses.

#### **2.1 Life-Cycle Debris Mitigation and Collision Avoidance Activities**

NOAA incorporates space debris and collision avoidance best practices for all phases of a satellite's acquisition and operational life. Since NOAA partners with NASA for design, manufacturing, and launch of a satellite program, NASA is responsible for requiring that spacecraft contractors design debris mitigation features into NOAA spacecraft. NASA and its launch contractor are also responsible for launch and early orbit collision avoidance until formal handover to NOAA for operations. NASA, as a routine design function, will conduct an end-of-life analysis and recommend a course of action to NOAA, which may include a controlled deorbit of a low-altitude spacecraft, a geostationary orbit decommissioning operation, or other methods which comply with U.S. and international best practices in place during the years in which the satellite was being designed and built.

### **3 Polar Satellite Acquisition**

For present-day NOAA POES and NOAA-operated DMSP satellites, policies in place in the 1970s and early 1980s permitted a spacecraft to remain in its operational orbit and decay into an uncontrolled reentry if an analysis confirmed that the spacecraft would not pose a hazard to human life or property. As a result of these analyses, NASA determined that controlled deorbits of POES and DMSP spacecraft were not required. Consequently, POES and DMSP spacecraft will remain in orbit for approximately 350-400 years before reentering. Since this end-of-life option is no longer allowed, NOAA and NASA will conduct end-of-life analyses for the new Joint Polar Satellite System (JPSS) and implement the results of the analysis.

#### **3.1 Polar Satellite Operations**

On a daily basis, NOAA receives conjunction warning messages from the United States Strategic Command (USSTRATCOM) Joint Space Operations Center (JSpOC). If a detailed conjunction analysis is required, NOAA performs the analysis in-house. If a close conjunction is predicted, NOAA's only option is to monitor the close approach because neither POES nor DMSP spacecraft can maneuver. NOAA ruled out techniques such as rotating the spacecraft in order to present the smallest cross-sectional area in the direction of the approaching debris object as too risky to the spacecraft and instruments. NOAA requests that the JSpOC provide two successive radar "skin tracks" following the time of closest approach in order to determine if a collision occurred.

### **4 Geostationary Satellite Acquisition**

NASA is the acquisition agency for NOAA's geostationary weather satellites. NASA develops requirements and procedures for decommissioning and boost to a super-geostationary orbit for which NOAA assumes responsibility following launch, activation and test, and operational handover from NASA.

#### **4.1 Geostationary Satellite Operations:**

For geostationary satellites, NOAA conducts orbital collision avoidance operations similar to polar satellites. NOAA receives conjunction warnings from the JSpOC and conducts assessment if necessary. If required, NOAA GOES spacecraft do have the capability to perform a collision avoidance maneuver.

During the life of a geostationary satellite, NOAA routinely conducts a fuel consumption analysis in order to determine mission life expectancy. When established fuel minimums are being approached, NOAA begins planning decommissioning operations. Decommissioning is executed according to established practices. The satellite is boosted to a super-geostationary orbit, the subsystems are shut down, and propellant tanks depleted and depressurized to the maximum extent possible. NOAA performed its most recent decommissioning operation on December 1, 2009, when GOES-10 was decommissioned.

## **5 Assistance to International Partners**

NOAA actively assists its international partners who desire access to U.S. space situational awareness capabilities. Over a period of two years, NOAA worked with U.S. Department of Defense officials to respond to a EUMETSAT request for conjunction support. NOAA's efforts were successful and EUMETSAT began receiving JSpOC conjunction summary messages in June 2010 for the polar MetOP-A and for all Meteosat geostationary satellites. NOAA encourages CGMS members who desire similar conjunction support to register on the JSpOC website: <http://www.space-track.org>. NOAA is pleased to assist other CGMS members as requested.

NOAA worked with USSTRATCOM to plan two conjunction workshops for international and commercial space operators. Identical conferences were held in Fairfax, Virginia, USA, in July 2010 and in October 2010 at the European Space Agency Operations Center (ESOC) in Darmstadt, Germany. Both conferences were very-well attended and received positive feedback.

## **6 Conclusions**

NOAA fully implements U.S. Government and international space debris mitigation best practices during all phases of satellite design, acquisition, and mission operations. NOAA is pleased to assist CGMS members who desire to obtain conjunction support for the U.S. Joint Space Operations Center (JSpOC).