



FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

Agenda Item 3: Air Navigation System Performance Improvement

3.1: Proposals to improve the efficiency of air navigation services contributing to LTAG

COORDINATION REQUIREMENTS FOR RE-ENTRY OF SPACE OBJECTS AFFECTING INTERNATIONAL AIR NAVIGATION

(Presented by South Africa)

EXECUTIVE SUMMARY

The increase in expansion of satellite-based technology including the maintenance of networks and infrastructure requires enhanced coordination and management in the launch and re-entry operations of satellites orbiting networks and associated infrastructure.

This paper presents the potential impact of the re-entry of space objects affecting South African Airspace and the need to improve coordination between all stakeholders in the management of these activities

Action: The Conference is invited to:

- a) consider the potential impact of space objects re-entry affecting international air navigation;
- b) request ICAO to develop guidance for the coordination and exchange of satellite launch and re-entry activities to promote automated exchanges between agencies and States who manage these satellite launches and re-entries and the States who provide Air Traffic Services (ATS) and associated services in accordance with Annex 11 — *Air Traffic Services*; and
- c) request ICAO to facilitate the development of regional plans to enhance and strength current agreements, processes, and procedures associated with space object re-entry operations on a global level with all relevant stakeholders, in line with recommendations of the workshop referred to in paragraph 1.6 of this paper.

1. INTRODUCTION

1.1 The day-to-day functioning of satellites and the intricate infrastructure established in Earth's orbit is crucial to almost every global industry and business. Numerous industries, including aviation, defence, maritime, agriculture, science, etc., are supported by satellite technology.

1.2 The Federal Aviation Administration (FAA) announced to the Africa and Indian Ocean Region (AFI) Planning Implementation Regional Group (APIRG) 26 meeting, which took place in Cotonou, Benin, from 6 to 10 November 2023, that APIRG needed to coordinate in order to reduce the safety risks that space launch and re-entry operations pose to airspace users.

1.3 The FAA emphasized the need for coordination with various stakeholders in the identification and communication of Aircraft Hazard Areas (AHA) in the form of danger areas to affected FIRs, as well as the use of NOTAM to disseminate information to airspace users, noting that the impact of these operations is not limited to one country or Flight Information Region (FIR).

1.4 In order to ensure that everyone involved is aware of upcoming space activities that affect the airspace, the FAA asked the meeting to consider the following: States conducting or supporting space launches should consider coordination using direct email and ATS message handling system (AMHS) in addition to diplomatic notifications; the ICAO should add Space Coordination contact information to the current list of regional experts; and the States affected by the operations should be urged to provide feedback so that the coordination process can be further refined and improved.

1.5 APIRG therefore developed the following, conclusion to support the requirements highlighted by FAA:

APIRG/26 & RASG-AFI/9 Conclusion 5/01: *Space Launch Activities*

That to ensure adequate coordination during space launch activities,

- a) States conducting, supporting space launches or affected by the launches, consider establishing a single email distribution list to ensure all concerned parties are aware of impending space activities affecting the airspace;
- b) States launching or supporting the launches should establish a direct email and AMHS in addition to diplomatic notifications for coordination; and
- c) ICAO to include Space Coordination contact information in the current regional experts list.

1.6 South Africa developed a working paper for consideration by the 39th Session of the ICAO Assembly, Legal Committee, to address the Re-entry of space objects affecting International Air Navigation. The focus of the paper was to align terminology and definitions contained within the International Space Law and Treaties with what is contained in the Convention on International Civil Aviation (Chicago Convention) and related Annexes including consideration of recommendations emanating from the joint workshop on the risks to airplanes in flight from re-entering space debris, hosted by the Outer Space Institute of the University of British Columbia; Institute of Air and Space Law of McGill University; and International Association for the Advancement of Space Safety between 17 – 18 February 2023. The workshop named, “Ensuring the safety of aviation when there are uncontrolled space object re-entries”, developed a number of recommendations as per link below: <https://unitingaviation.com/news/safety/ensuring-the-safety-of-aviation-when-there-are-uncontrolled-space-object-reentries/> .

2. DISCUSSION

2.1 The world is becoming more and more dependent on space-based technology to run its daily operations. Many different businesses, such as aviation, defence, maritime, agriculture, science, etc., are supported by satellite technology.

2.2 The benefits of satellite technology for the aviation sector are substantial, but there are also growing concerns about the possible hazards caused increased launch activities including the controlled

and un-controlled re-entering of satellite-related objects (such as defunct satellites that must be deorbited, rockets used to launch new satellites, and other space objects made from damaged satellites in space debris).

2.3 Coordination for rocket re-entry within South African jurisdiction is managed by the Central Airspace Management Unit (CAMU) using the Flexible Use of Airspace (FUA) application process. This process involves submitting the necessary information on the FUA application form and arranging approval and publication of the relevant NOTAM through coordination with the South African Civil Aviation Authority (SACAA) and affected Johannesburg Oceanic (FAJO). This process is predominately manual due to no standardized message structure being available for automated integration into the Air Traffic Management (ATM) system.

2.4 There are various websites such as <https://aerospace.org/cords> and <https://orbit.ing-now.com/> which contain information on satellite orbiting including the re-entry. These websites contain information on more than 10 000 satellites (satellites in various Earth orbits, namely Low Earth Orbit (LEO), Medium Earth Orbit (MEO) and Geostationary/Geosynchronous orbit (GEO)). The United Nations Office for Outer Space Affairs (UNOOSA), list 11 330 individual satellites orbiting the Earth at the end of June 2023 in their index of objects launched into outer space, which was a 37.94 per cent increase since January 2022.

2.5 As the number of satellites in orbit is expected to grow exceeding 100 000, it can be anticipated that management of conjunctions between active orbiting satellites and other space objects will pose a significant challenge and become much more complicated to manage. Most of the satellites are found in the LEO with the near-Earth environment already starting to get congested. Objects orbiting at low enough altitudes continue to be affected by the topmost parts of Earth's atmosphere, as drag is created that eventually cause a re-entry, leading to uncontrollable re-entries. Together with possible conjunctions between various satellites and other space objects, the potential increase of uncontrollable re-entries can be expected to increase exponentially. There are many elements that make it difficult to predict these re-entries, including fluctuations in the atmosphere itself.

2.6 Although the recorded incidents of re-entries affecting aviation are minor, due to most of the new rocket elements being designed to disintegrate (burn-out) with re-entry operations, one of the recorded incidents according to the American Institute of Aeronautics and Astronautics, on Christmas Day, 1996, an object they believe was no bigger than a marble impacted the windshield of a Boeing 757 at a typical cruising altitude of just over 30,000 feet. Although the Boeing 757 windshield impact case was a rare event, over the course of 2022, there were several occasions when States around the world had to react to, and manage, similar associated safety risks. One country even went so far as to consider closing part of its airspace to mitigate the risk posed by a potential hazard.

2.7 With ICAO's drive towards Trajectory Based Operations (TBO), the conjunctions between uncontrollable/controllable re-entries becomes critical including the ability to share automated message exchanges between organizations and States managing these satellite constellations and the ATM system within each State, ensuring a dynamic real time picture.

2.8 Annex 19 – *Safety Management* to the Chicago Convention, defines safety as: “The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.” There is a need to quantify the potential risk of these re-entry operations on aviation and implement adequate measures to control and reduce the risk to an acceptable level. This should furthermore consider the recommendations of the joint workshop on Aviation Safety and Uncontrolled Space Object Re-entries referred to in paragraph 1.6 above and identify any operational aspects which requires further development.

3. **CONCLUSION**

3.1 There is a need to enhance, and strength current agreements, processes and procedures associated with space object re-entry operations on a global level with all relevant stakeholders, more specifically between the agencies and States who manage these satellite launches and re-entries and the States who provide Air Traffic Services and associated services in accordance with Annex 11.

3.2 There is a need to review and identify actions and activities to enable the development of regional plans for the development of standards for issuing and responding to precautionary safety warnings related to uncontrolled re-entries or related space activities, based on the recommendations emanating from the workshop as listed in 1.6 of this paper.

3.3 There is also a requirement to recognize and establish systems to guarantee the administration, management and automated information sharing of these activities, specifically the conjunctions between unmanageable/manageable re-entries and airspace users on global level, in a manner that can be seamlessly integrated into the ATM system through standardized message exchanges.

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