



ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION

**Twenty-Sixth Meeting of the Africa-Indian Ocean Planning and Implementation Regional Group (APIRG/26) & Ninth Meeting of the Regional Aviation Safety Group for the AFI Region (RASG-AFI/9) – Joint sessions
6 and 10 November 2023**

Agenda Item 3: APIRG and RASG-AFI Coordination

**THE UNITED STATES FEDERAL AVIATION ADMINISTRATION
SPACE ACTIVITY COORDINATION**

(Presented by the United States of America)

SUMMARY	
This paper presents information about a proposed process for the timely coordination of space launch and re-entry activities in the Africa-Indian Ocean Region.	
The action by the Meeting is in paragraph 3	
Strategic Objectives	This working paper relates to the Strategic Objectives

1. INTRODUCTION

1.1 The under-coordinated integration of space launch and re-entry of operations pose a hazard to airspace users. Decades ago, infrequent launches and lower aviation volume made these events less disruptive. The recent increase in space operations highlights the need for streamlined coordination between States and airspace users to assure the continued safe and efficient operations of both space and aviation activities.

2. DISCUSSION

2.1 Space Launch Overview

2.1.1 Over the last three years, there has been a marked increase in space operations from the United States (U.S.). As depicted in **Error! Not a valid bookmark self-reference.**, there was a 32% increase in operations between the years 2019 and 2020, and a 53% increase between 2020 and 2021. Between 2021 and 2022, we saw an additional 33% increase and have already passed the 100 operations milestone in 2023 with two months remaining in the year. It is important to note, this increased activity is not

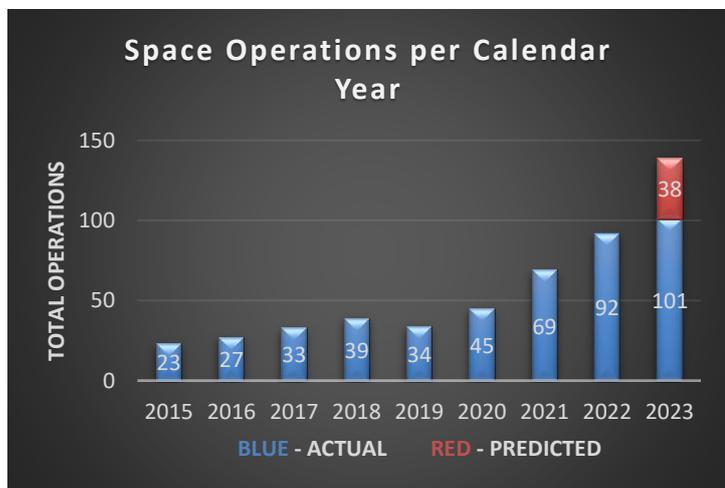


Figure 1

limited to North America but reflective of the entire space industry in South America, Europe and Asia and impacts airspace globally to include Africa.

2.1.2 Safe and efficient integration of space operations into airspace systems requires evaluation, identification and clearance of areas bounded by predetermined risk tolerances based on system standards. The space launch authority determines the tolerance of risk associated with space operations, while the Air Navigation Service Provider (ANSP) determines the acceptable level of safety in an airspace system. Aircraft Hazard Areas (AHAs) are used to characterize geographic areas subject to higher risk during space operations, which are defined by a series of points, associated dates, times, and duration. Once developed, ANSPs receive AHAs for assessment related to operational impact and the development of mitigation measures. Dissemination of AHAs to airspace users occurs via NOTAMs as Danger Areas.

2.1.3 During launch and re-entry operations, AHAs segregate launch or re-entry vehicles from non-participating operations. Launch and re-entry AHA locations and durations meet the U.S regulatory and internationally accepted requirement of 1×10^{-6} probability of individual casualty (fatality or serious injury) per aircraft per launch. Application of this standard permits airspace users and ANSPs a consistent metric to determine level of risk and impact to non-participating airspace.

2.1.4 In the standard U.S. process, ANSPs have ten days to assess and coordinate AHA requests within their FIRs and stakeholder organizations, depending on mission complexity and requirements. ANSPs develop route structures around AHAs through collaboration with affected air traffic facilities. Parallel discussions take place among airspace user forums and military entities to circulate information related to the launch window, AHA coordinates, and backup dates.

2.1.5 For US-based launches affecting non-US managed airspace, the Federal Aviation Administrations (FAA) leads and/or assists in coordinating required international NOTAMs. Upon receipt of mission specific AHAs, FAA develops NOTAM requests for each affected Flight Information Region (FIR). Once refined in-house, FAA uses Aeronautical Message Handling System (AMHS) to deliver requests and follows up with email notification for added situational awareness.

2.1.6 Through the decades of space activity, several long-standing relationships and coordination processes with military and State or regional space agencies remain efficient and effective in assuring timely notification of affected airspace users and ANSPs. Many of the best practices are reflected in the proposals contained within this paper.

2.2 U.S. Intragovernmental Challenges

2.2.1 Traditionally, the military or the National Aeronautics and Space Administration (NASA) managed U.S. government sponsored space operations. Stakeholders for these operations included launch proponents, and the Federal Range, who coordinated with other government agencies for airspace and mariner notifications on behalf of the launch proponent. Due to changes in U.S. policy, interests of the government are no longer exclusively carried out on State-owned vehicles. Payloads brought to orbit on commercially licensed vehicles require the involvement of the U.S. commercial space regulator, the FAA's Office of Commercial Space (AST). The U.S. developed an internal process to assure a unified approach to, and mutual awareness of, U.S. space activity affecting airspace outside the U.S. FIR.

2.3 Frequently Affected Geographic Areas

2.3.1 While uncontrolled re-entries occur on occasion, most re-entries are planned, controlled and pre-coordinated. Re-entry locations are determined based on downstream impacts of the ground track after completing mission requirements. For final rocket stages that enter orbit with their payloads, best practice is to identify a safe location in the ocean, and perform a controlled reentry over such uninhabited areas. Re-entry trajectories impose the lowest acceptable risk to air and surface traffic while avoiding land and populated areas. These parameters result in the majority of re-entry events occurring in the southern portions of the Pacific, Indian and Atlantic Oceans (see figure 2). Similarly, orbit inclination requirements, including satellite placement needs and planetary alignment, dictate azimuth on ascent while also considering any reduction in risk to non-participants. Assessments for all missions occur prior to mission approval; therefore, precluding operations over land due to exceeded risk tolerances. Therefore, the coordination process must address the concerns and needs of relatively few States.

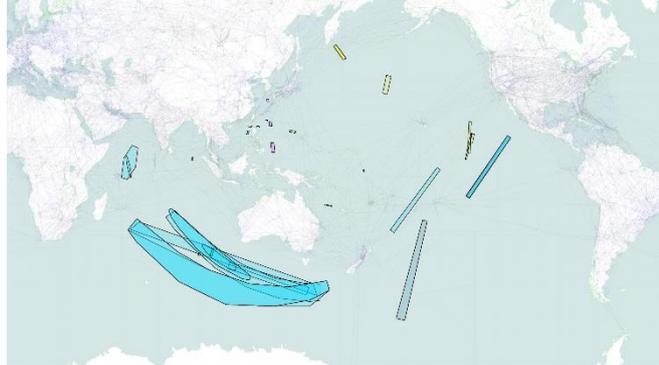


Figure 2

2.3.2 Figure 3 shows AHAs for missions coordinated by the U.S. during the year 2022. FAA conducted extensive outreach during the development of space NOTAM coordination procedures, particularly with regions affected most frequently. Since the beginning of 2022, FAA has coordinated space activity with countries including Uruguay, Argentina, Mexico, Ecuador, Chile and others. States including Argentina, Australia, Fiji, Mauritius and Tahiti, now use AMHS as the primary means for operational coordination of NOTAMs, with supplemental awareness materials sent through email and briefed through weekly telcons on Civil Air Navigation Services Organisation (CANSO) ATFM Data Exchange Network for the Americas (CADENA) conferences. Due to the frequency of coordination with these States, the streamlined process has increased efficiency and reduced overall workload, while utilizing existing infrastructure at no additional cost.



Figure 3

2.4 U.S. Coordination with Other States

2.4.1 In the United States, challenges related to coordination may become strenuous due to multiple stakeholders involved in planning and execution of space operations. Primary considerations are who the space operator is, e.g. government or commercial space provider, and where the operation is occurring, e.g. a federal facility, or a privately run facility. Historically, when operations occurred from US-government-sponsored facilities, the facility would execute coordination on behalf of the operator whether they were commercial or government, and if operations were taking place elsewhere the onus would fall to the launch service provider.

2.4.2 Beginning in 2022, the U.S. government sponsored launch facilities restructured coordination processes, developing distinct pathways for missions carried out exclusively for the State, and missions licensed as commercial space operations. In cases of commercial operations, the

commercial space operator maintains primary responsibility for NOTAM coordination per their license. This change identified a need for updated and streamlined coordination procedures between space operators, the FAA, and other impacted ANSPs.

2.4.3 The United States maintains a database of coordination requirements for ANSPs related to space operations, as well as contact lists for each FIR typically affected by space operations. When coordinating NOTAM requests in the Americas Region, FAA sends a detailed request via AMHS including the proposed dates, times and coordinates of areas impacted, and follows up by email and telephone communication as needed. These dual pathways assure regulators, Aeronautical Information Services (AIS) and ANSP have the timely details of the planned activity. The FAA also briefs out upcoming space operations on the CADENA weekly teleconference, and updates contacts via CADENA messaging platforms.

2.4.4 The United States worked within the Informal South Pacific Air Traffic Services Coordinating Group (ISPACG) and Informal Pacific ATC Coordinating Group (IPACG) to refine the process outlined in the Asia/Pacific Planning Checklist for Ballistic Launch and Space Re-Entry. This collaboration led to development of the following guidelines the U.S. hopes to implement in other regions around the world:

- Establishment of a single email coordination address assures appropriate distribution within a State
- AMHS usage serves to satisfy systemic record requirements for operational coordination;
- Lead times of 10 days for planning and three days for publication are sufficient in most cases;
- AHAs should be defined by blocks of four, but up to six points within an FIR;
- AHAs crossing FIR boundaries must define separate areas wholly contained within each FIR with two shared points for each at the boundary;
- Events times must be the minimum required to meet mission needs and limit traffic disruption and include the primary and up to six back up times;
- AHAs should avoid dense traffic areas and times;
- Updates (mission success or postponed) via email and AMHS should occur within one (1) hour of event completion;
- Launch proponents and affected FIR stakeholders are to provide timely feedback during, and after the event to improve future activities.

2.4.5 Figure 4 is an example of a NOTAM request in the South Indian/Atlantic Ocean coordinated with Johannesburg, Mauritius, and Melbourne FIRs.

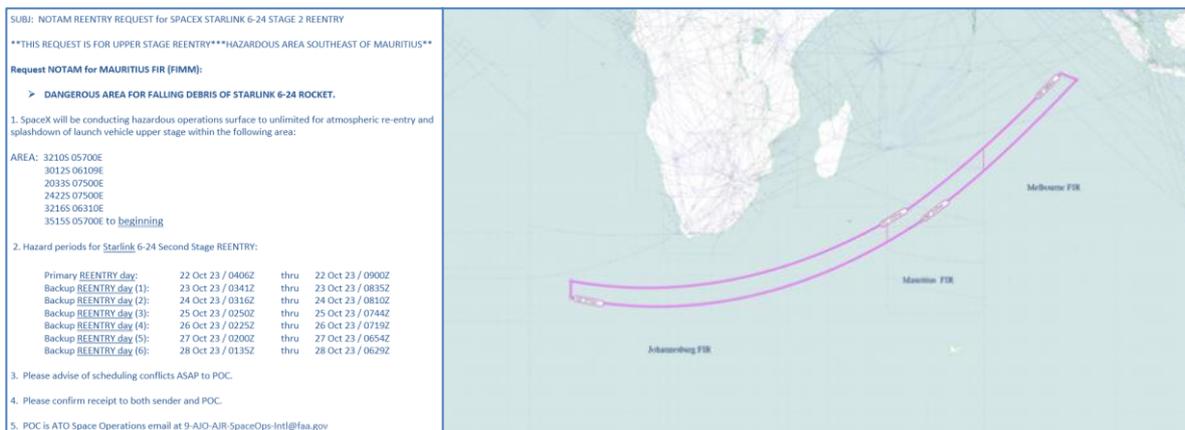


Figure 4

2.4.6 To address the potential to reschedule, launch proponents plan primary launch windows and several back-up days, outlining dates and times in their initial requests. Postponing generally affects

the day launch occurs, while the remaining pre-coordinated information, including AHAs, remain unchanged.

2.4.7 In April 2022, the United States conducted a live test with Fiji (NFOF) to validate AMHS as a means to coordinate NOTAMs for international launch and re-entry operations, for both the U.S. NOTAM Office and Fiji. During this test, both states were able to identify shortfalls and develop streamlined solutions associated with AMHS and procedures. USNOF and NFOF collaborated on the development of a standard request format for space launch and re-entry NOTAMs, as well as general guidelines that alleviate confusion or duplication of efforts.

2.4.8 The adoption of these processing procedures has resulted in increased efficiency and reduced workload at no additional cost using existing infrastructure. This process works and provides wider dissemination of information to interested parties and reduces coordination errors. The U.S. hopes to refine and implement space coordination procedures via AMHS throughout the Africa-Indian Ocean (AFI) Region.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper;
- b) discuss any relevant matters as appropriate;
- c) offer feedback to further refine and improve the process;
- d) consider for States routinely affected by space activity to establish a single email distribution list to assure all concerned parties are aware of impending space activities affecting the airspace;
- e) recommend that States conducting or supporting space launches consider coordination using direct email and AMHS in addition to diplomatic notifications; and
- f) recommend ICAO include Space Coordination contact information into the current regional experts list.

END