

# PLANNING FOR THE EXPECTED AND UNEXPECTED

A Special Event and Disruption Planning  
Reference for ANSPs  
*Volume 1*

SHAPING  
OUR  
FUTURE  
SKIES

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# 1. EXECUTIVE SUMMARY

Throughout the history of commercial aviation, disruptions caused by special events and unforeseen circumstances have been an inevitable part of the air transportation system. Unique challenges from natural disasters, State events, space or military operations can occur and disrupt air traffic management on any given day. Mismanagement of these challenges can have far-reaching and potentially devastating impacts on air traffic management. It is for this reason that the ATM industry, especially the Air Navigation Service Providers (ANSPs), needs to be aware of, and ever ready for, disruptions arising from both planned and unplanned events.

To aid ANSPs in preparing for such special events and disruptions, this *Planning for the Expected and Unexpected: A Special Event and Disruption Planning Reference for ANSPs (Vol. 1)* brings together case studies examining how ANSPs planned for and managed several types of special events and disruptions ranging from large-scale planned airspace closures to unplanned weather phenomena. These case studies, and the lessons learned from them, can serve as references for ANSPs should they face similar aviation disruptions.

This document starts with a set of common key considerations for the management of events and disruptions identified through the case studies and lessons learned outlined in Chapter 3. In Chapters 4 to 13, case studies are provided covering the management of both planned events and unforeseen crises or disruptions. Each case study is preceded by a short synopsis describing what lessons can be learned from it. These synopses are there to help readers determine which of the case studies are most relevant to their needs.

Updates to this document will occur as the wealth of knowledge in special event and disruption management continues to grow in the coming years.

## 2. INTRODUCTION

### BACKGROUND

On 11 March 2011, a massive earthquake – the Great East Japan Earthquake – occurred approximately 70 kilometres off the coast of the Tohoku region in the north-eastern part of Japan. The magnitude 9.0 earthquake occurred at a depth of 24 kilometres, triggering a massive Tsunami that swept into the north-eastern part of Japan facing the Pacific Ocean. The earthquake and subsequent Tsunami caused significant disruption to air traffic in Japan and the surrounding areas for hours, creating challenges for the Japanese air navigation service provider to navigate.

Eleven years later, following the death of Her Majesty Queen Elizabeth II in September 2022, a different kind of challenge emerged in London. To honour the Queen, a State Funeral was planned which included a funeral procession that would pass by London's Heathrow Airport, during which noise abatement had to be observed and aircraft would not be permitted to overfly the procession. As completely limiting aircraft operations at Heathrow, one of the busiest airports in the world, for a long period would have been disruptive, the British air navigation service provider decided on a precisely planned operation that would minimise the limitations on aircraft operating in and out of the airport and optimise the flow of air traffic around the funeral procession period down to the minute, a Herculean task to be undertaken by all involved.

These two events serve as a stark reminder that special events and unforeseen disruptions have been, and will continue to be, an inevitable part of the air transportation system.

From a major sporting event such as the Super Bowl, to a large-scale State event such as a Head-of-State's funeral, and from a planned joint military air exercise to an unplanned hurricane or typhoon, the potential impacts of mismanagement for these inevitable disruptions can be devastating and the resilience of the ATM system in the face of such disruptions is of paramount importance. For this reason, the ATM industry, especially the ANSPs, needs to be aware of, and ever ready for, disruptions arising from both planned and unplanned events.

Planning for such major disruptions can seem daunting for ANSPs without prior experience. Fortunately, the ATM industry has gained a wealth of knowledge over the decades, with many ANSPs and regional groups across the globe having successfully managed all types of special events and disruptions. These collective experiences can be a rich source of information for ANSPs when they must plan for similar events for the first time.

In *Planning for the Expected and Unexpected: A Special Event and Disruption Planning Reference for ANSPs*, expert members of the CANSO ATFM/A-CDM Workgroup bring together a series of case studies involving the planning and management of several types of special events and disruptions ranging from large-scale planned and unplanned airspace closures to significant weather phenomena. These case studies, and the lessons learned from them, can serve as references for ANSPs as they prepare to face similar aviation special events and disruptions.

# DOCUMENT STRUCTURE

This reference document comprises 10 case studies written by experts from ANSPs and aviation organisations with direct experience managing special events and disruptions. The document covers both the management of planned events and unforeseen crises/disruptions. Table 1 lists the case studies included in the document.

Event Type	Case Study Title	Country/Region
<b>Pre-Planned Events</b>		
State Event	G20 Summit 2014	Australia
State Event	Funeral of Queen Elizabeth II	United Kingdom
Sporting Event	Super Bowl	USA
Planned Closures	Singapore Airshow	Singapore
Planned Closures	COBRA GOLD Military Exercise	Thailand
Planned Closures	Air Defender 2023	Germany
Space Operations	Space Launches	USA
<b>Unforeseen Crises/Disruptions</b>		
Weather Disruption	Typhoon	Hong Kong China
Significant Natural Disaster	The Great East Japan Earthquake	Japan
Contingency Planning	CADENA Contingency Management	Latin America

Table 1: List of Case Studies

While there is no one-size-fits-all formula for managing all types of special events and disruptions, some common basic considerations can still be identified from the case studies and associated lessons learned. These common considerations have been synthesised and included in Chapter 2.

## HOW TO READ THE DOCUMENT

This document is meant to be used as a reference, with readers choosing to read the case studies most relevant to what they are planning for. Ahead of each case study is a short synopsis describing what the case study is about and what event/disruption management is discussed. These short synopses can be used to identify the case studies that will be relevant for the readers' purposes.

It is not possible for this document to capture every possible type of special events and disruption, and every possible response and management technique. As time passes, the wealth of experience among CANSO members will continue to grow and more case studies may be identified. CANSO therefore envisions that this document will be updated, with more case studies and new considerations/lessons included to reflect the growing pool of knowledge in the coming years.

## 3. KEY CONSIDERATIONS: PLANNING FOR THE EXPECTED AND THE UNEXPECTED

The key considerations outlined in this chapter are distilled from the lessons learned included in the 10 case studies in this document. The key considerations are split into two sections, one for the planning of pre-planned events and one for the management of unplanned disruptions. The split is to recognise that planning for pre-planned events can differ significantly from preparing for unplanned disruptions, each with their own set of considerations to heed.

The key considerations outlined are by no means an exhaustive list. The guidance here should be adjusted to fit the specific operating environment and requirements and be complemented with local knowledge/context.

### **KEY CONSIDERATIONS FOR MANAGING PRE-PLANNED EVENTS**

#### **Obtainment of information**

Detailed information of the event should be obtained as far in advance as possible, while ensuring the information is always current. This will require the ANSP to coordinate closely and regularly with the event organiser; in some cases, the ANSP may need to be involved as part of the organising team.

Detailed information of the event should include at least the following:

1. Date and time of the event;
2. Event duration;
3. Airspace/aerodrome to be affected, including any closure requirement(s) and associated closure period(s);
4. Likelihood of increased traffic demand due to factors such as popularity of the event and the expected size of event participants/audience;
5. Special flight operations such as expected VIP movements and numbers;
6. Military and security service participation and associated airspace requirement(s) for their mission;
7. Contingency plans in case of weather or other disruptions to the planned event.

#### **Methodical approach to planning**

Once the detailed information about the event has been obtained, a methodical approach should be used to plan for it. It is recommended that the phases of ATFM contained in the ICAO Manual on Collaborative Air Traffic Flow Management (Doc 9971) be used for planning purposes. The following is a recommended process, which can be used as a starting guide for ANSPs when making their plans. Note that this list is not exhaustive and should be used only as a starting guide.

1. Ensure appropriate time is given to planning for the event and that appropriate qualified personnel are resourced to plan and manage the event.
2. A similar event has probably been managed by another ANSP sometime in the past, so it is beneficial to consult with other ANSPs on their experience of such an event.
3. Decide what stakeholders need to be included in the planning.

4. Assess the impact the event will have on ATM resource capacity. This may require creating scenarios which may occur during the event, such as an expected increase in traffic demand, decrease in capacity and/or a required closure of airspace/aerodrome.
5. Use historical data from similar events or similar days of operation to assess the impact of the event on resources.
6. Negotiate with the event organiser if the impact is severe, collaboratively seeking ways to minimise the impact through adjustments such as changing of dates, times, location, or impact/hazard area.
7. If there is a significant decrease in ATM resource capacity, consider enacting appropriate ATFM measures.
8. If there is an increase in traffic demand, investigate possibilities of increasing capacity for the duration of the event, such as extra manpower for the ATS units or utilisation of otherwise restricted airspace.
9. If the affected aerodrome is not already a slot-coordinated<sup>1</sup> airport, consider implementing airport slot coordination at least for the duration of the event. This has proven to be very effective in managing increased demand at previous events.
10. Should an aerodrome servicing the event have restricted parking, consider enacting a “drop and go” concept as a gridlock at an aerodrome needs to be avoided. Ensure that ground handling facilities are available for the increased demand and unusual aircraft requirements. Involve all relevant stakeholders in the planning process from the outset. Getting stakeholders’ acceptance of procedures from the outset is easier than obtaining it later in the planning process.
11. Plan for inclement weather but hope for good weather.
12. Ensure the closing of airspace and/or airports is limited to the shortest possible time, this often needs close liaison with users of the airspace during the event.
13. Planning should include timely information sharing with the aviation community through AIP supplements, NOTAMs and ATFM Daily plans.

### **Consistency of stakeholders**

It is important for the ANSP and event organiser to insist on consistent representation and participation among stakeholders who are part of the planning process. In many past events, stakeholders have sent inconsistent/new representatives to the planning meetings, thus requiring the ANSP to ‘re-educate’ the new representatives repeatedly and in some cases requiring a repeated ‘restart’ of the planning. By ensuring consistency in stakeholders’ representatives, planning continuity and effective use of time and resources can be ensured.

### **Clear communication of roles and responsibilities**

Clear determination of roles and responsibilities of all stakeholders is important. The roles and responsibilities should be collaboratively developed and once assigned, communicated to all stakeholders involved to ensure understanding. It is recommended that all plans and processes are detailed in a Concept of Operations.

### **Regular communications with stakeholders during the event**

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<sup>1</sup> Airport slot coordination is the process that allocates scarce airport capacity to airlines in advance of each scheduling season. This process is based on IATA’s Worldwide Airport Slot Guideline and is governed by a Slot Committee in each country.

Updated information of the event and relevant ATM arrangement(s) and ATFM measure(s) should be readily communicated to all stakeholders. To accomplish this, formal communication channels such as AIP Supplements and NOTAMs should be used. The use of an ATFM Daily Plan (ADP) – with regular updates – is also a good means of pre-tactical/tactical communication especially when ATFM measures are required. Regular teleconferences can and should also be used to exchange information, and its frequency can be increased during the event. Supplementary channels suitable for local context, such as the use of an instant messaging group, may also be used as a complementary means of communication, but should not be a replacement of official documentations.

### **Regular/daily post-event analysis**

If the event is scheduled over an extended period, regular/daily post-event analysis should be considered. Regular/daily post-event analysis can help to ensure continual improvement of procedures and to inform stakeholders of required changes to their roles and responsibilities. It is recommended that ANSPs develop 'playbooks' for such events should they be regular occurrences.

## **KEY CONSIDERATIONS FOR MANAGING UNPLANNED DISRUPTIONS**

### **Timely and consistent communication with stakeholders**

Whenever an unplanned disruption occurs, a communication line between the ANSP and relevant stakeholders should be established as soon as possible. It is recommended that communication lines be established before disruptions and be documented in the contingency plans. The flow of current information among all relevant ATS units should be ensured during the contingency operation to enable prompt and optimised reactions to the changing environment. Communication channels may include web-based platforms or teleconferences, exchange of timely ATFM Daily Plan(s), prompt publication of NOTAMs, and other channels suitable for the local context. Consistent communication allows stakeholders to be involved in the decision-making process and, in some cases, enable a reduction in delays or restrictions.

### **Leveraging of regional partners**

A disruption, such as large-scale weather or political event, can have far-reaching impacts beyond the Flight Information Region (FIR) directly affected. Responses to such disruptions may also require cross-border coordination, as exemplified in the case studies on typhoon management in Hong Kong FIR and hurricane management in the Latin American and Caribbean (LAC) region. In both of those cases, the affected ANSPs used existing regional collaborations (AMNAC and EATMCG in the Asia-Pacific (APAC) and CADENA in LAC regions) to enable application of ATFM measures across the borders. Such collaboration allowed traffic management measures to be effectively applied without being constrained by FIR boundaries and/or ANSP jurisdictions.

### **Active anticipation of the disruptions**

Some disruptions, while not being as definite as a pre-planned event, can still be anticipated. Examples are seasonal or regularly-occurring weather events in some areas of the world, which may be anticipated – if not predicted – months in advance. Based on historical knowledge and operational experience, ANSPs can anticipate these events and implement measures – procedures, collaboration channels, pre-

defined traffic management tools – ahead of time. Initiatives such as the Large-Scale Weather Deviation (LSWD) procedure in Hong Kong, the communication hotline between Japan’s ATMC and the FAA’s ATCSCC, and the Planned Airways System Alternatives (PASA) used by the CADENA group in Latin America and the Caribbean are good examples of measures implemented in anticipation of regularly occurring weather events.

### **Contingency planning**

While many disruptions cannot be planned for, ANSPs should consider developing contingency plans for possible disruptions in advance even if it may appear they are unlikely to happen. Examples of possible disruptions that may be considered in advance include total radio/surveillance system failure, aircraft accident requiring closure of runway or airport, political closure of the airspace, industrial action, unusual weather conditions, etc. It is recommended to have a decision matrix in the contingency plan so in the event of a disruption, personnel will know when to make a decision or to seek a higher authority level.



## 4. CASE STUDY 1: G20 SUMMIT 2014 (AUSTRALIA)

<b>Event/Disruption</b>	G20 Summit 2014
<b>Date &amp; Location</b>	November 2014, Brisbane, Australia
<b>Type</b>	State Event
<b>Synopsis</b>	This case study discusses the coordination and management in Brisbane during the 2014 G20 Summit. During the event, special procedures were implemented to manage the civil air traffic amid a large contingent of VIP movements, ensuring the safety and security of Heads-of-States in attendance. Details on the airspace structure, the ATM procedure, and most importantly the coordination between relevant authorities and stakeholders for a smooth operation are given in this case study.
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### BACKGROUND

The 2014 G20 Brisbane Summit was the ninth G20 Heads of Government/Heads of State meeting. It was held in Brisbane, the capital city of Queensland, Australia, on 15–16 November 2014. The hosting venue was the Brisbane Convention & Exhibition Centre at South Brisbane, and the event was the largest ever peacetime police operation in Australia.

On 1 December 2013, Brisbane became the official host city for the 2014 G20. Prior to 2013, planning for the event had already been underway, following an ‘in-principle’ agreement made in 2011. It was predicted that up to 4,000 delegates would be expected to attend the event, with around 2,500 media representatives.

In addition to the leaders of Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, United States, and the European Union, the leaders of Mauritania, Myanmar, New Zealand, Senegal, Singapore, and Spain were also invited to this summit.

Brisbane was chosen as the venue to host the meeting in part because Brisbane Airport was best equipped to cater to significant increases in arriving traffic.

The event involved a complex security operation. Event organisers needed to ensure appropriate security measures were in place to protect visitors, while minimising disruptions to inner-city residents and businesses. Around 6,000 police were deployed at the event.

Roads between the central business district and the Brisbane Airport were temporarily closed and a great many other on-ground, temporary, civil management procedures were put into action. This model of processing surface transport was also employed to manage the aviation logistics and security arrangements.

## **EVENT RESPONSE**

Airservices Australia was the ANSP responsible for managing the airborne and airside response to the G20 Summit.

### **Stakeholders**

Overall coordination of the event was led by the Australian Federal Department of Prime Minister and Cabinet (PMC).

Civil aviation planning responsibility lay principally with Airservices Australia. Two workstreams were involved here. The first was the ground-based package which was developed in association with Brisbane Airport Corporation and covered VIP arrivals, receptions, dispersals, refuelling, aircraft parking plan, re-stocking, airside security, and aircraft access by non-airport agencies.

The second workstream package was the development of an Air Traffic Management (ATM) plan integrating the arrival of VIPs to the event, facilitating appropriate priority, minimising the impact to other airspace users, and facilitating access by accredited police, Defence Force and other first responder type aircraft (surveillance and helicopter).

The Australian Defence Force was represented in the planning development by the Royal Australian Air Force, although elements of the Army and the Navy also attended several planning sessions as either observers or participants.

The Queensland Police Service was responsible for security and participated in all formal planning sessions.

### **Planning considerations**

As discussed above, overall coordination responsibility for the event lay with the PMC. They carried significant veto or demand powers across all Government agencies (Federal and State by agreement)

With respect to the logistics of the project, there were several aspects, each of which became a sub-set of the event. These included ground-based logistics (car motorcades, routes, alternative routes, hotel and other venue security, catering), airport ground logistics (VIP reception and arrival facilities, aircraft parking areas, access to airside areas for non-airport security staff, media, limousines, VIP processing including customs, quarantine, border security, etc.), Air Traffic Management (fitting the additional VIP and support aircraft into existing traffic while minimising delays to the public), and facilitation of Police, Defence and other first responders to the airspace and event locations.

This briefing will touch on the airport ground logistics, ATM, and Defence liaison aspects.

Broadly, the VIPs arrived over the course of several days before the event. They were provided with advice from the Department of Foreign Affairs through the PMC to try and avoid successive VIPs arriving too close together due to the difficulty of processing them through the temporary VIP reception area located on the former international terminal building at the Old Brisbane airport.

The event was scheduled to be held in mid-November 2014, the time of year when Brisbane often experiences hot conditions and when thunderstorms are common. A typical day may begin with light winds from the east-southeast, backing to the

northeast as the day heats and a sea breeze develops. This can back further to the north or north-west and result in late afternoon or evening thunderstorms or heavy showers.

At the time of the event, noise abatement procedures for Brisbane Airport stipulated that traffic arriving from the north, north-west, and west tracked via a STAR (Standard Terminal Arrival Route) visual segment to join the final approach course known as the 'River Track'. At night, and during periods of low clouds or reduced visibility, these aircraft would be processed via the ILS (Instrument Landing System) to Runway 01.

Arriving traffic from the west often tracked via the city to a left base circuit entry to Runway 01 or 19, depending on the wind direction.

Traffic from the south and east tracked via a STAR which terminated with either a visual segment to join the final approach or to join the ILS approach for Runway 01.

If Runway 19 was in use, jet departures followed SIDs (Standard Instrument Departures) which kept them clear of the most sensitive meeting venues such as the Brisbane Convention Centre.

Non-jet aircraft departures from Runway 19 could be vectored by ATC to be kept clear of the most sensitive areas using existing SIDs.

Aircraft departing or arriving Archerfield Airport, located just south of Brisbane, or operating in the Archerfield circuit area would potentially operate near the most sensitive event venues.

During planning, it became evident that:

1. Runway 14/32, a now retired crosswind runway, would not be available, as it would be used for VIP aircraft parking and support parking. The parking plan had to be developed to allow any Head of State to depart at any time, without the need to have State aircraft from another State moved;
2. Advice was received that due to international tensions, some State aircraft and security details had to be separated to avoid incidents;
3. The normal processing of arriving aircraft would not be sufficiently predictable for rigid Defence and other security agency planning;
4. From a security perspective, there would be a need to control all traffic to make sure anything not conforming with the airspace plan would be identified at the earliest opportunity;
5. Different agencies involved in the event would require different levels of alerting when the VIPs were inbound to the event. These agencies included police (road closures for VIP car convoys), Customs and Border Force (barrier processing), fuel trucks (refuelling), aircraft services (baggage, aircraft cleaning), limousines (VIP and official party pick up), media (coverage of VIP arrivals), defence, and other security units (launch or deployment of surveillance platforms and teams);
6. Some of the larger delegations such as the United States of America, Russian Federation, the People's Republic of China, Kingdom of Saudi Arabia, and others had numerous support aircraft arriving well ahead and departing well behind the event. Other parking arrangements needed to be identified at nearby airports and locations found for some of these aircraft.

## Broad procedures

To address the issues identified in the planning sessions, the following measures were put in place in the development of the actual procedures:

1. Aircraft would always be processed via an ILS approach to Runway 01 or Runway 19, depending on wind direction. This improved predictability for all parties;
2. A series of Restricted Areas (R900 series) were jointly developed between Airservices Australia and Defence, imposing escalating levels of control and sensitivity as aircraft approached the most sensitive areas enclosing the event venues and accommodation areas;
3. Increased flight planning requirements and restrictions were imposed on General Aviation (GA) aircraft operating to and from other airports in the greater Brisbane area. This was supported by outreach to the GA industry through information sessions that were provided to potentially affected pilots at nearby aerodromes such as Redcliffe, Archerfield, Caloundra, Southport, and others;
4. Two operational coordination and liaison positions were developed – the MLO (Military Liaison Officer) and CLO (Civil Liaison Officer) who operated on adjoining consoles within the Airservices Australia Air Traffic Control Centre in Brisbane;
5. The MLO and CLO coordinated directly with each other. The MLO interacted with Defence and police agencies, while the CLO interacted with the civil ATC agencies processing the VIP traffic. The CLO also worked directly with a designated contact in the PMC to provide specific times for their onwards coordination with other agencies including the airport, at the VIP Reception Terminal;
6. A spreadsheet of times and events was developed to manage arriving VIP flights. This was developed by the PMC and included the following information:
  - a. confirmed departure times for VIP flights inbound to Australia;
  - b. estimated landing times (ELDTs);
  - c. FIR entry times and hence when Brisbane ATC could be expected to have direct communications;
  - d. expected Top of Descent times along with updated estimated time of arrivals (ETAs);
  - e. other relevant flight information (e.g., delays, change of expected arrival runway, operational problems); and
  - f. parking locations.
7. A similar spreadsheet was developed to manage the coordination of departing VIP flights.

Several NOTAMs and an AIP Supplement were issued to support the industry leading into the event. A copy of the actual AIP Supplement used is included in Appendix 1.

## Airspace structure

There were several significant temporary changes to normal operations that were introduced to manage aircraft operating within the vicinity of the Temporary Restricted Areas that were established.

First, there was a new temporary requirement established for the duration of the event which required all VFR aircraft to submit flight plans to operate in Class G airspace. Second, all aircraft were required to be equipped with and operate transponders; those without a transponder or a radio were not permitted.

Significant restrictions on overflight approvals were put in place for flights over the Brisbane City and adjacent areas due to the sensitivity of event venues and accommodations for VIPs.

Specific additional airspace blocks were developed to allow the deployment of fighter aircraft in a CAP (Combat Air Patrol), in-flight refuelling areas, and a loitering area for surveillance aircraft that were clear of the main routes and holding areas for Brisbane-bound civil aircraft.

### **Air traffic management**

All arriving aircraft were processed via a full ILS approach to Runway 01 or 19. As it happened, the weather remained hot and clear throughout the weekend and the period leading up to the event, and Runway 01R was therefore used throughout the event. No ATFM measures were required.

Additional holding fuel (traffic) requirement was promulgated for the duration of the event.

### **Arrival sequencing**

Significant coordination took place with the airport operator, Brisbane Airport Corporation (BAC), to develop the parking plan and VIP reception terminal processing. This plan and the spacing required for the marshalling of aircraft were the primary input to the spacing requirement that was established between subsequent VIP flights both arriving and departing. This spacing was VIP-to-VIP specific and operated independently to the spacing required between other aircraft in accordance with standard ICAO separation provisions. VIP-to-VIP spacing between arrivals, and later departures, was based on apron and embarkation/disembarkation requirements. This was determined through diplomatic engagement early in the planning process.

### **Stakeholder roles**

#### **The Civil Liaison Officer (CLO)**

The CLO provided a conduit for flight information between the Airservice Australia's civil ATC and other agencies including the PMC and Defence. The CLO's knowledge of the current aviation operational environment and its impact on the arrival plan of the VIPs, the updating of specific information related to those flights to the PMC, and the addressing of any requests for information from them were crucial. The position was staffed by ATCs or former ATCs with broad knowledge and experience who were able to self-source information from the system and not rely overly on the passing of information from in-position ATCs during busy periods.

#### **Air Traffic Controllers (ATC)**

The procedures developed for use by the Brisbane ATC units were framed to minimise any significant changes to existing workload, and to avoid adding unnecessarily to their workload while being able to obtain any information required by the PMC. There was minimal involvement for Enroute ATC with the exception that they were made aware of the expected operating times of the VIP flights and the changed flight planning requirements. The aim in the development of the ATC procedures was to ensure they understood their role in the provision of ATM to the event and had confidence in the process.

Training materials including briefings and simulator exercises were used for some units. One of the key elements to the training was for the ATC to provide a standard broadcast advising all aircraft that a military fast jet was operating in their vicinity and to respond to all commands provided by that aircraft when military intervention occurred due to a perceived threat.

## KEY CHALLENGES

Some of the key challenges in developing the procedures were:

1. The late engagement by some Australian and other security related agencies expecting carte-blanche access to airspace at levels conflicting with other traffic;
  - Managing expectations was a critical element in the planning process and Australian Defence and PMC were very supportive of the established plan.
2. Building confidence in the ATC that the airspace releases used for fighter CAP and re-fuelling operations were important. It was also important to train ATC to manage a possible interception/interdiction event. As mentioned above, interdictions occurred several times during the event and ATCs were required to use their newly acquired skills. Because of the unusual nature of the required transmissions, guides were provided to ATC from which they could read from the script when required;
3. Developing a plan involving severe weather and how spacing of arriving and departing VIP flights could be managed with in-flight deviations;
4. Tight timelines to develop and finalise the AIP Supplement with up to 43 iterations required before final approval was provided;
5. Timelines and workload associated with development of the Eurocat RMAP displays (ATC radar maps) and configuration of specific ATC radio and intercom facilities, which involved a great deal of coordination.;
6. During the preparation for the event, there were several controlled airspace intrusions by special forces as those units trained for all eventualities. These intrusions challenged the confidence of the ATCs that Defence, security, and other agencies would comply with all requirements responsibly.

## KEY ENABLERS

The use of the Australian Defence Force (ADF) within Australia, to exercise potentially lethal force, is prescribed under various sections of the Defence Act. These are significant powers which can only be enabled by the Governor-General in Council. This required significant work by the ADF legal team to prepare for this eventuality.

An excellent professional working relationship was developed and maintained between the Civil and Defence event planners throughout the process. This relationship ensured that although discussions could be robust, they were always respectful and productive, ensuring that the major parties were consistently on the same page as planning developed. This was crucial in ensuring other agencies were harmonised with the plan.

The establishment of the MLO/CLO positions, and their own communication webs, were essential. It maximised information exchange, reduced ambiguity and kept workload under control.

Trust was given early on by the ATC management team, and specialists were tasked to focus clearly on the project with sufficient resources and responsibility. This was much appreciated. Removing the key specialists from their routine air traffic control duties and allocating them sufficient time to plan this large body of work was essential.

## LESSONS LEARNED

Lessons learned from the management of the event include:

1. There never seems to be enough time. It is essential to identify the processes needed to see through the planning phases and toward implementation;
2. Take someone along on the journey. If one person is carrying all the knowledge in their head and they become incapacitated, this can spell disaster for the entire project;
3. Plan for the worst, hope for the best. But plan for the worst. For example, during the actual event, several interdiction actions were taken by Defence fast jets on suspicious aircraft operations, but they later proved to be innocuous errors by the civil pilots;
4. Keep records and document everything. Tasks done, tasks yet to be completed, tasks not yet started, out of the box ideas. Keep a list of people, their contact details and who they work for or represent;
5. Ensure the project has a final arbiter – a programme manager with the power or authority to listen objectively to parties experiencing a conflict or blockage and impose a solution across all involved agencies. For this event, the programme manager reported directly to the Prime Minister of Australia. He had the authority to impose outcomes and expectations upon all agencies. If there isn't one on this type of project, establish one;
6. Before the planning phase starts in earnest, seek information or records of any previous comparable projects or events your organisation was involved in. What went right? Why? What went wrong? Why? What was learnt?
  - In this event the team drew on the experience of a previous Commonwealth Heads of Government Meeting held at the Sunshine Coast in 2000, and another event held in Western Australia several years later. Both had planning problems and significant inter-agency coordination issues. The MLO/CLO roles were a direct attempt to address the learning outcome of those events.



## 5. CASE STUDY 2: FUNERAL OF QUEEN ELIZABETH II (UNITED KINGDOM)

<b>Event/Disruption</b>	Queen Elizabeth II's Funeral Procession
<b>Date &amp; Location</b>	September 2022, United Kingdom
<b>Type</b>	State Event
<b>Synopsis</b>	This case study looks at the air traffic management at London Heathrow International (EGLL) during the Funeral of Her Majesty Queen Elizabeth II. For this State Event, well-planned and precise measures were implemented to ensure an absolute silence above the procession of Her Majesty's body and the funeral while allowing civil air traffic to still operate to and from London Heathrow without too much capacity disruption. Details are given in this case study on the 10-day planning process and the vital use of an accurate data-driven support tool throughout the process.
<b>Contributors</b>	<b>Pete Glass</b> , General Manager Air Traffic Services, Heathrow Airport, NATS <b>Kate Francis</b> , Product Manager, NATS

### BACKGROUND

Following the passing of Her Majesty Queen Elizabeth II in September 2022, a precisely planned operation was designed to achieve noise abatement during the funeral. A data-driven tool called Demand and Capacity Balancer was used to minimise operational disruption as well as model real-time changes during the event itself.

Out of respect for Her Majesty the Queen and in recognition of what was an event of historic significance, it was agreed that aircraft would not overfly any part of the funeral or the procession from central London to the Windsor Castle, a distance of 36.85 kilometres or 22.9 miles over a period of over nine hours via a route that would take it to within just a few metres of the perimeter of London Heathrow International Airport (EGLL).

Due to the unique operational requirements needed to accommodate the funeral, it quickly became clear that delivering an effective plan with minimal disruption would require developing new operating procedures at the airport – from the airspace to the tower and the terminals.

What followed were 10 days of incredibly intense preparation, as teams from across NATS, Heathrow Airport Limited and the airlines worked against the clock to create a minute-by-minute plan, with the DCB tool fulfilling a vital role.

The procedures for managing departures and arrivals on the day of the funeral procession were broken down into six timed phases, which were further detailed with minute-by-minute plans. Such was the need for precise timing that location updates were provided by the helicopter pilot covering the event for the world's media. Event planning went so far as to calculate the lag between these live updates and the British Broadcasting Corporation's on-demand iPlayer service, to further inform operations planning with accurate location information.

# OPERATIONAL IMPACT AT HEATHROW AIRPORT

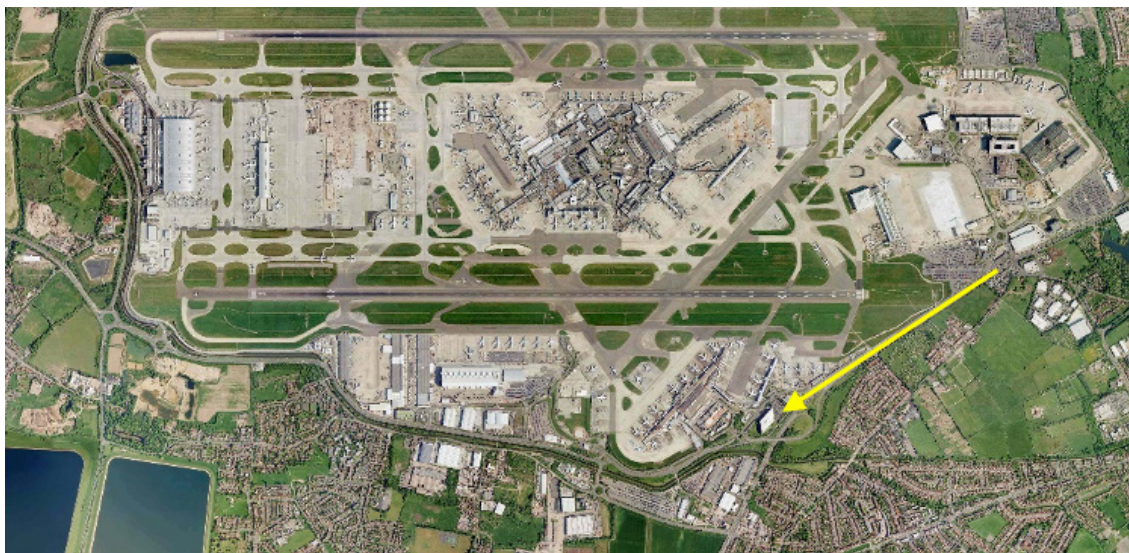


Figure 1: Direction of travel and proximity of funeral procession to Heathrow airport

Heathrow Airport operates on two runways, normally using one for arrivals and one for departures. To accommodate the needs of the funeral day, a totally new plan was devised including flexible use of the runways and alternating the direction of aircraft movements.

To avoid overflying the procession at any time (see Figure 1) a gap in either departures or arrivals was also required, designed to be enacted as the procession passed specific waypoints. At one point, a runway was excluded from use altogether and all departures were stopped (see Figure 2).

Despite the complexity of the operational impact, closing the airport entirely was never a consideration. As the UK's main international gateway, closing the airport would have unduly disrupted the travel plans of thousands of passengers and created knock-on disruption that would have been felt for days afterwards. What was needed was a plan that found the right balance between delivering the silence required while keeping air traffic disruption to a minimum.

## Easterly Operations

**No landings on Runway 09R.**

## Westerly Operations

### Arrivals

**When the Procession has passed Crooked Billet Roundabout landings may recommence on Runway 27L.**

**Missed approaches from Runway 27L should be vectored to avoid the Procession.**

### Departures

**MATS Pt. 2 Air Departures, Chapter 3, 3.3.1 outlines that aircraft may be deviated from the Minimum Noise Routes (MNRs) due to Police helicopter flights CAT E priority and above.**

**Note:** Controllers are reminded of their responsibility to pass appropriate traffic information between departing traffic and helicopter traffic supporting the Procession.

Figure 2: NOTAM on the Use of EGLL Runway

# DATA-DRIVEN SUPPORT TOOL: DEMAND-CAPACITY BALANCER (DCB)

In planning for and managing the event, one key support tools used by NATS and Heathrow was the Demand-Capacity Balancer (DCB), a data-driven forecasting tool that provides airports and ANSPs with evidence-based models on which to make and support delivery of coordinated, resilient strategic and tactical plans.

## DCB development and capability

DCB is an airport digital twin, created by NATS and Frequentis Orthogon working with key data providers such as the UK Met Office and EUROCONTROL. Digital twins provide a mirrored version of a schedule that can help airports build a picture of outcomes based on particular parameters. DCB predicts the aircraft movements and airport key performance indicators (KPIs) under different conditions, which constitutes the rolling DCB plan, a core part of an Airport Operations Plan (AOP).

DCB considers up to 50,000 variations of its input data using a process similar to that used to predict the weather. This gives users a much more likely range of possible outcomes and their probabilities, resulting in increased accuracy and confident decision making. Flexible ‘what if’ testing allows users to fully explore alternative scenarios and test mitigations much further in advance, as well as in the moment, to make the best choices for the circumstances and stakeholder priorities (see Figure 3).

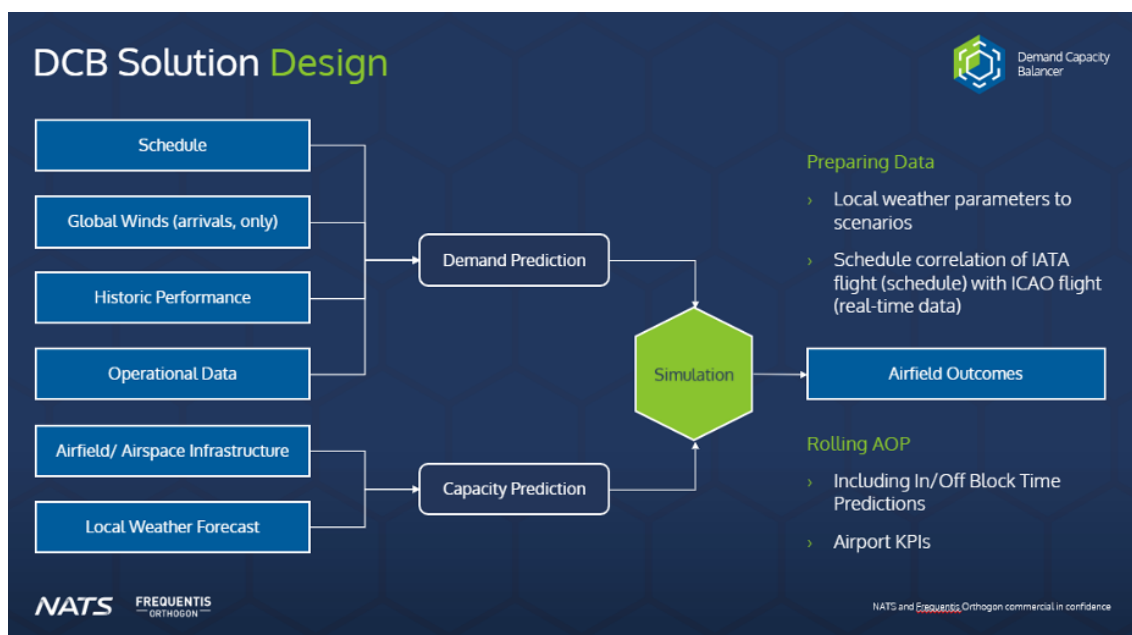


Figure 3: DCB Solution Design

## Heathrow Operations Efficiency Cell (HOEC)

DCB is used by the Heathrow Operations Efficiency Cell (HOEC) – a unique operational planning team made up of Heathrow Traffic Coordinators who sit side-by-side with Heathrow’s Airport Operation Centre (APOC). DCB plays a vital role within the airport’s planning process, identifying the impact of external factors, or mitigations on the overall deliverability of the daily flying schedule (see Figure 4).

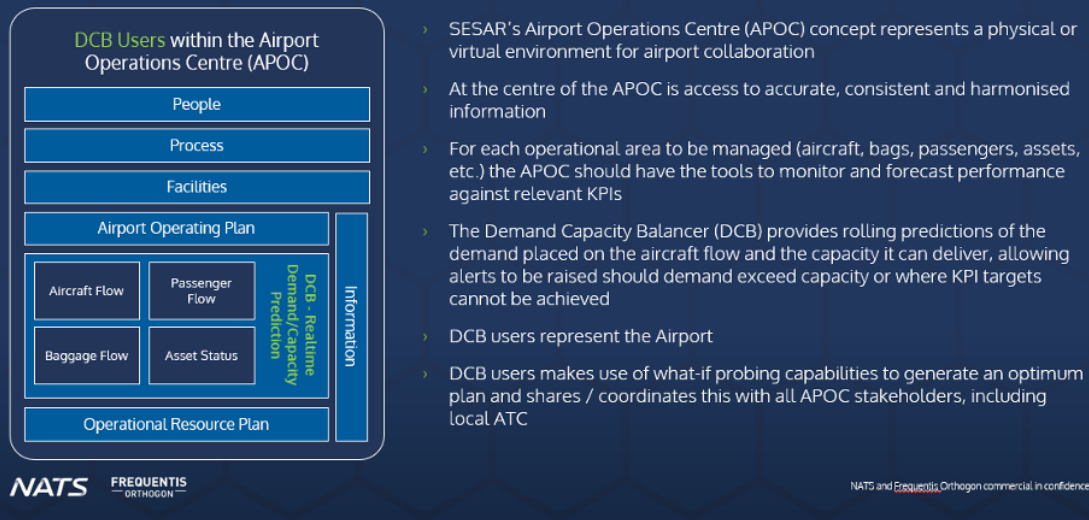


Figure 4: DCB Users and the APOC

## EVENT PLANNING AND MANAGEMENT PROCESS

This section describes how the DCB tool was used to plan for and manage the event (see Figure 5).

### 10 Days before the event (D-10)

Plans for the death of The Queen – known as Operation London Bridge – had been well established, including the period of lying in state, a service at Westminster Abbey and a procession to Windsor Castle. What was needed was a detailed understanding of how those activities would impact the operation and how the airport and air traffic teams would need to adapt the schedule to accommodate them. DCB was used to model various options to get the balance right.

### 5 Days before the event (D-5)

Using DCB models, Heathrow Airport and the airlines agreed on the changes to the flight schedule that would be necessary. The aim was to reduce traffic to levels that could be carefully timed to allow for the precise gaps needed to ensure the no overfly zone during the funeral procession. These parameters were fed into DCB to address impact on delay, risk of night jet movements, delivery of the remaining schedule, and mitigations required.

### 3 Days before the event (D-3)

Heathrow Airport and NATS refined the operational plan, considering traffic demand regulation rates and times and determining the balance of arrival/departure delays. Using DCB, the team finalised the plan and shared the outcomes with the airlines. Clarity and confidence in the DCB modelling allowed for constructive discussions to take place and further precision logistics and mitigations were agreed with the airlines to ensure completion of the schedule. Advance notice of precise scheduling provided the airlines with the information they needed to assess any impact on their wider operations and to act accordingly.



## Event day (D-0) – review and refine

On the day of the event, DCB was constantly used to evaluate changes to the plan following a delay in the progress of the funeral procession. To ensure no aircraft overflowed the procession, the last aircraft landing at Heathrow Airport was timed to the minute as the procession reached the outer edges of the airport itself. DCB calculated exactly which flight should be the last landing aircraft before arrivals were stopped altogether to allow the procession to pass the airport in total silence. Doing this meant the maximum number of aircraft were able to land before the stoppage, minimising delays and airborne holding, while ensuring silence over the procession itself.

## Event day (D-0) – reactive planning

In addition to the procession delays, a security incident was reported which required additional safety measures to be put in place. A vehicle abandoned adjacent to a runway necessitated putting in place an exclusion zone, which initially suspended arrivals.

Several scenarios were immediately run through the DCB, integrating the approved funeral schedule with the new mitigations including using one remaining runway as well as accounting for a closure of all runways. DCB used aircraft data, weather data, runway availability and scheduling information to provide clarity on potential next steps given the unique variables at that point in time. While staff worked tactically to switch movements between available runways, the ability to run ‘what if’ scenarios featured strongly at this point, accounting for stoppages of varying lengths and outages on particular runways, preparing the airport and operational teams for different potential outcomes. Fortunately, the situation was quickly resolved with no additional cancellations or significant scheduling changes required.

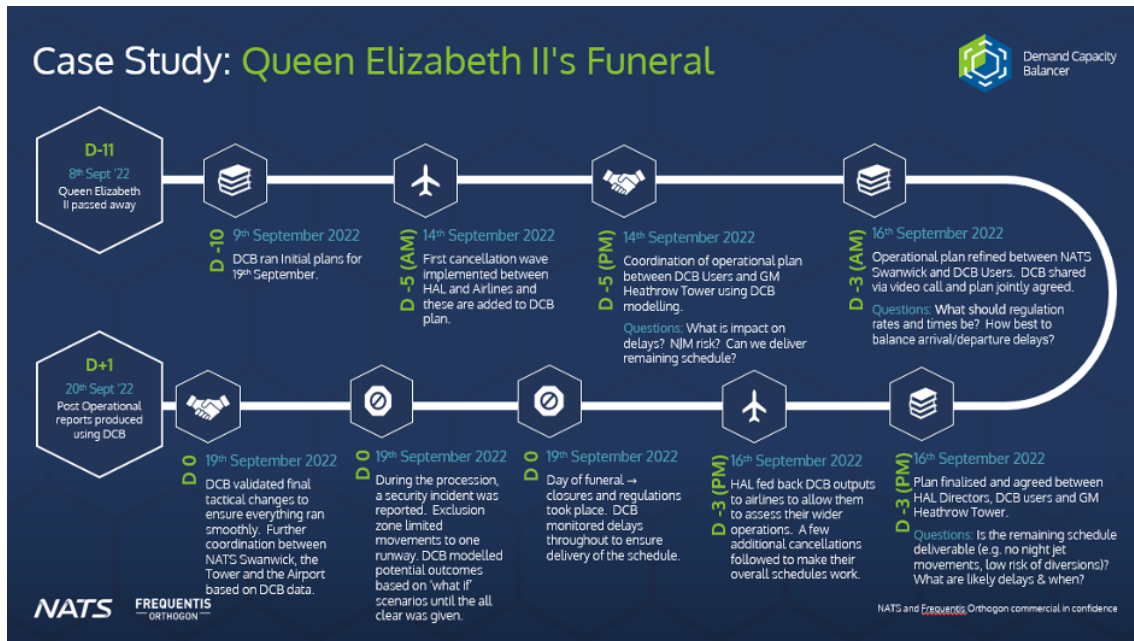


Figure 5: Ten-Day Planning Process

## **COMMUNICATION FLOW**

The information provided by DCB enabled advanced planning by all stakeholders with a level of confidence not previously possible. The process by which information was exchanged, and the accuracy of the modelling provided, made a huge difference for both strategic and tactical planning. Stakeholders were given more time to plan accordingly as DCB effectively moves the starting line back in time and brings the recovery stage forward.

DCB users, based within Heathrow's APOC, played a key role by providing accurate modelling to stakeholders which then enabled prompt actions to be taken. The collaboration between the ANSP, with its direct link to ATC, and the Airport, which is underpinned by a shared physical space at the airport, enables an innovative and logical approach to longer term planning and scheduling up to six months in advance. This collaborative foundation can then be adapted for events as required, whether they are planned or unplanned.

Through DCB modelling, Heathrow was confidently able to assess the impact of the forecast NATS regulations for the Queen's Funeral and reduce the schedule accordingly to meet this requirement. This ensured that an appropriate number of flights were cancelled.

## **PERFORMANCE ACHIEVED THROUGH THE PLANNING PROCESS**

Whether dealing with a planned special event or a tactical emergency intervention, the data-driven insights made possible by the DCB modelling and its ability to proactively run, what if" scenarios enabled confident decision making.

The benefits associated with the use of the digital twin and the data-driven DCB tool extended well beyond that small space in time when aircraft were airborne. It allowed ATC to take predictions and turns them into a reality. The DCB is a tool that enables teams to plan strategically for events they know are on the horizon or to respond tactically to unexpected occurrences.

Having a high level of confidence in the DCB algorithm has resulted in lower interventions than pre-DCB, allowing the maximum deliverable schedule to be realised every day and providing a level of certainty not previously available to stakeholders.

For the Queen's Funeral, Heathrow delivered a flawless performance in protecting the silence of an historic event. Using DCB, it was able to deliver 84% per cent of its schedule. Without the responsive modelling provided by DCB, it is estimated that flight cancellations would have doubled. Furthermore, there were only three Night Jet Movements (flights after 2330L), none of which were due to the impact of the regulation. This is indicative that DCB's data was both accurate and consistent across the days leading up to the event.

Overall, DCB provides a precise way of managing planned and unplanned tactical events while minimising disruption to passengers and airlines.

## LESSONS LEARNED

Key lessons from the event include:

1. Collaboration and communication among planning stakeholders – Communication was enhanced by use of reliable modelling which enabled effective collaboration to take place;
2. Data-driven approach to modelling – Increased data inputs have a direct, positive relationship to the accuracy of predictive modelling, providing confidence in the decision-making process;
3. Strategic planning – The capability to increase the planning window frame minimises disruption and provides increased capacity and resource to manage tactical challenges that may arise on the day;
4. Application of historical models/events – Parameters and mitigations for events should be available to apply to future events, providing the ability to continually improve and learn from the approaches taken;
5. Scenario modelling for decision making – The ability to quickly run “what if” scenarios in response to rapidly changing situations enables a proactive approach to be taken to situations as they arise and evolve.



## 6. CASE STUDY 3: SUPER BOWL (USA)

<b>Event/Disruption</b>	The NFL Championship Game (The Super Bowl)
<b>Date &amp; Location</b>	Annual, United States of America (USA)
<b>Type</b>	Sporting Event
<b>Synopsis</b>	This case study discusses the Federal Aviation Administration (FAA)'s management of the National Football League (NFL) Championship Game (the Super Bowl). This flagship event in the United States generates significantly increased air traffic demand and considerable complexity in and around the city where the game takes place, which changes each year, bringing a unique set of challenges to each planning round. This case study provides an insight into the advanced and comprehensive planning that takes place before each year's game, demonstrating the coordination required among stakeholders ranging from the ANSP (ATS unit, ATFM unit) to airspace users and airport operators in both the commercial and general aviation sector.
<b>Contributors</b>	<b>Vern Payne</b> , Manager CDM and International Operations, FAA

### GENERAL

The FAA annually plans for a significant special event that occurs in early February of each year: the Super Bowl.

The National Football League (NFL) Championship Game (the Super Bowl) attracts scheduled air carriers, charter, business aviation, fractional ownership and general aviation to the city that is hosting the game. Additionally, if the game site is in reasonable proximity to Las Vegas, there is a large, short-distance air shuttle operation flying attendees back and forth between the game site and the attractions of Southern Nevada.

The week leading up to the Super Bowl usually has many activities for attendees. As a result, much of the air traffic demand at the host city arrives over several days, generally allowing the traffic surge to be more manageable. On the contrary, departure traffic demand usually surges immediately after the event and during the following day and can cause a larger concern for air traffic management.

### BACKGROUND

The Super Bowl has grown over 70 years to become the most significant special event from an aviation perspective in the United States that the FAA plans for each year. The site moves around the country as chosen by the NFL. The future sites are known three years in advance. As the event grew in popularity, so too did the accompanying air traffic demand, and so has the associated strategic planning required.

The strategic planning for the event involves many stakeholders which can change each year based on the location of the event. The consistency is maintained through the FAA Air Traffic Control System Command Centre (ATCSCC) as the unit

is involved every year, while the other parties that change include the overlying Area Control Centres (ACCs), Approach Control Units and Tower Control Units. Airport Authorities and Fixed Base Operators (FBO)<sup>2</sup> are key to the process. Collaboration and information exchange takes place between the FAA and Industry Trade Organisations such as Airlines for America (A4A), the National Business Aviation Association (NBAA), Aircraft Owners and Pilots Association (AOPA), and the International Air Transport Association (IATA). The NFL establishes their Travel Office to coordinate with the airport authorities and FBOs, assisting in planning and disseminating information to corporate aviation.

## **PLANNING PROCESS**

The planning process for the next Super Bowl begins as soon as the current year's event concludes. There is a hand-off between FAA facilities of lessons learned and best practices.

Every Super Bowl location is unique in its airspace, resources, number, and location of servicing airports. Some of the common considerations are listed below:

1. How many large commercial airports can accommodate scheduled and large charter flights?;
2. How many of the large commercial airports also have a significant FBO presence with aircraft parking spots?;
3. Number of smaller general aviation airports and number of aircraft they can handle. The primary concern is not only the number of operations they are capable of servicing, but also the parking capacity as a percentage of these airframes remain there for several days;
4. Operating hours of the smaller airports, with consideration given to extending their hours and possibly staffing;
5. Events leading up to the game and the expected traffic demand are evaluated;
6. Additional staffing is scheduled at the impacted ACCs. This may include additional staffing at ACCs surrounding the host stadium and potentially at those ACCs near the cities where the competing teams are coming from;
7. For the Super Bowl, history has shown that additional traffic demand can be expected every year at the New York area business aviation airports and at Las Vegas (KLAS) and its two General Aviation airports (KHND, KVGT). The Super Bowl is a significant corporate event that drives traffic between New York and the Super Bowl location. Las Vegas is a popular destination to observe and gamble on the game even if the Super Bowl location is not near Las Vegas;
8. Within the United States airspace, sporting events normally have Temporary Flight Restriction (TFR) NOTAMs issued to prevent unscheduled flight operations from operating within a certain distance of the event during specific time frames. The TFR usually overlies some of the local general aviation airports (see Appendix 2 for an example);
9. With the increase in unscheduled operations, are the existing normal procedures for arrivals and departures adequate to handle the traffic demand? Do special procedures need to be created or routes specified to handle the volume?;

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2 FBOs provide aircraft parking, fueling, maintenance, and other services to the private aviation community. Many of the General Aviation aircraft involved with the Super Bowl goes to the FBO areas of the airports.

10. How will unscheduled operations be handled at smaller airports? Possibilities include:

- a. The NFL Travel Office can manage parking reservations. The NFL has a vested interest in ensuring that their fans receive a high level of service commensurate with the popularity of the product and typically engage airports and FBOs to develop a unified plan;
- b. Airport Authorities can require prior permission and reservations, thus moderating the traffic flows;
- c. FBOs may have their own programmes for parking reservations;
- d. FAA could use a Special Traffic Management Programme (STMP) such as a Slot Reservation Programme to handle arrival and departure reservations. The STMP is a short-term initiative to reserve arrival and departure slots at smaller airports for a special event.

The planning meetings include not only the FAA, but also airport authorities, FBOs, interested airlines, NFL and local government officials. As the planning matures, and the information is ready to be shared, several methods are used to disseminate the plan including the following:

- 1. Aviation advocacy groups (A4A, NBAA, AOPA, IATA) reach out to their member community;
- 2. System Impact Reports (SIRs) are created and published (see Figure 6);
- 3. NOTAMs are published for all affected airports;
- 4. Normally the NFL or host city has a web site and aviation related information is also shared there;
- 5. Planning continues and is refined as the final two teams become known through the NFL playoff system. Historically, certain teams generate more air traffic volume than others.

**Event Information**

<p><b>NAS ID:</b> LAS  <b>ARTCC:</b> ZLA  <b>Duration:</b> 7 days 8 hours 59 minutes  <b>Flight Check:</b> No  <b>Fac. Recall:</b> No</p>	<p><b>Start Date:</b> 02/06/2024 1500 (Zulu)  <b>End Date:</b> 02/13/2024 2359 (Zulu)  <b>Remaining:</b> 7 days 8 hours 59 minutes  <b>Activity:</b> <input type="radio"/> Daily <input checked="" type="radio"/> Continuous <input type="radio"/> Nightly  <b>Fac. Recall Time:</b> N/A</p>
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**Coordination Information**

**Proj./Event:** Las Vegas Area High volume operations due to NFL Super Bowl.  
**Description:** The NFL Super Bowl is expected to yield higher than normal traffic in the Las Vegas terminal area.

Scheduled dates/times:  
Higher than normal air traffic demand is expected to occur from 02/06/2024, 15:00z through 02/13/2024, 23:59z.  
Higher than normal departure demand can be expected in the evening of 02/11/2024 and all day on 02/12/2024 and 02/13/2024; with departure delays potentially exceeding 45min.

**Operational Impact:** There will be a significant increase in general aviation flights. Capacity at LAS, HND and VGT FBOs will be monitored closely each day. Clark County Department of Aviation will be running a general aviation PPR system throughout this event as well as a managed slot reservation program which will be in effect from 2/7 through 2/13. Both the slot reservation system and PPRs will be managed by individual FBOs for all general aviation flights.

**Delays:**

<b>Airborne:</b> 30	<b>Departure:</b> 45	
Delays of 15 minutes or more at LAS, HND and VGT are likely. Expect 30-minute delays or more if LAS needs to use configuration 1 or 4. These CONFIGs will be strictly wind and weather driven. Departure delays may exceed 45 minutes during peak departure demand if the slot reservation system integrity is not maintained.		

**Traffic Management Initiatives:**

<input type="checkbox"/> Altitude	<input type="checkbox"/> Tunneling	<input type="checkbox"/> Capping	<input type="checkbox"/> LAADR	<input type="checkbox"/> AFP	<input type="checkbox"/> GRND STOP
<input type="checkbox"/> MIT	<input type="checkbox"/> MINIT	<input type="checkbox"/> Fix Bal	<input type="checkbox"/> Holding	<input type="checkbox"/> GDP	
<input type="checkbox"/> ASP	<input type="checkbox"/> ESP	<input type="checkbox"/> DSP	<input type="checkbox"/> CTAS/TMA	<input type="checkbox"/> Reroutes	

Aircraft landing HND and VGT will enter Los Angeles Center at or below FL220. Possible Mile in Trail (MIT) for traffic arriving VGT or HND. Fix balancing and runway changes within TRACON airspace will likely be used to balance demand. Call for release, time based metering, ground stops and ground delay programs may be utilized at LAS, HND and VGT to manage overall impacts due to increased terminal traffic and throughout Los Angeles Center (ZLA)

**Customer Coordination:** SIR and briefings via WSA telecom and PERTI.

**General Information:** A Domestic Notice has been filed for the Super Bowl containing the preferred routes which may be found at: [https://www.faa.gov/air\\_traffic/publications/domesticnotices/](https://www.faa.gov/air_traffic/publications/domesticnotices/) A Letter to Airmen is also available at: [https://www.faa.gov/superbowl/LTA\\_SBLVIII](https://www.faa.gov/superbowl/LTA_SBLVIII)

**Contact Information:** TMO N Kevin Schlieper (725) 600-7032 L30 STMC Willie Hollie (725) 600-7010 ZLA STMC Felipe Cuevas (661)-265-8255 TMO S Thomas Gordon (858) 537-5809

**Scheduled Telcons:** None

Coordination:  Pending  Coordinated

Figure 6: Example of a System Impact Report (SIR) Issued for the NFL Super Bowl

## EXECUTION

On the days leading up to and following the Super Bowl, the plans are implemented. Depending on the venue and plans, several ATFM measures may be used such as:

1. Ground Delay Programmes;
2. Airspace Flow Programmes;
3. Required Arrival and Departure Routes;
4. Ground Stops;
  - a. Implemented as a last resort, i.e., only if necessary.
5. Departure Stops;
  - a. In some Super Bowl locations, there are multiple General Aviation airports where simultaneous departures conflict with each other, especially during Instrument Meteorological Conditions (IMC). When this occurs, Airport A may have departures stopped for a period, while Airport B free flows departures. Then the process reverses and airport A has an opportunity to free flow departures while airport B has its departures stopped. The ATFM unit in the overlying ACC or Approach Control coordinates this alternating activity.

The ATCSCC hosts an ATFM hotline so all aviation parties can receive real time updates and get questions answered.

The FAA will typically assign Air Traffic Security personnel to assist in managing the TFR and to assist other agencies in counter-UAS activities.

## REVIEW

After the event, the planning group reviews what worked, what improvements are needed, and lessons learned. Those findings are passed on by the FAA ATCSCC Airspace and Procedures office to those planning the next event.

## LESSONS LEARNED

Over the years, key lessons that have been learned include the following:

**Advanced planning:** It is important to start as early as possible, as every year new problems are encountered. Even for those locations that have hosted the event in the past, new teams participating and changing economics mean there will be different considerations. Starting the planning process as early as possible is key to identifying all the stakeholders and considerations.

**Inclusion of airport stakeholders:** Airport authorities and FBOs must be included from the very beginning of the planning process. They are key parts of the solution and need time to ramp up operations to handle the influx of flights and people for the event.

**Communication and outreach:** Communication and outreach to the appropriate industry segments is vital. Monthly planning and communication meetings occur for about six months leading up to the event. Outreach through industry representatives helps get the key information to all the participants.

**Plan and hope:** Plan for bad weather (e.g., IMC), and hope for good weather.

## 7. CASE STUDY 4: SINGAPORE AIRSHOW (SINGAPORE)

<b>Event/Disruption</b>	Singapore Airshow
<b>Date &amp; Location</b>	Bi-Annual, Singapore
<b>Type</b>	Planned Airport/Airspace Closures
<b>Synopsis</b>	This case study discusses the management of air traffic during the bi-annual Singapore Airshow. During this large aviation event, flying displays are one of the key features, requiring the closure of the airspace around Singapore's Changi International Airport during the practice and the live display sessions. The closure of the airspace requires the Civil Aviation Authority of Singapore (CAAS) to implement various ATFM solutions to facilitate civil traffic movements while catering to the needs of the flying displays. Additionally, during the 2018 Airshow, a contingency event occurred during which the flying display required further adjustments to the planned ATFM measure. These ATFM solutions and the added coordination that occurred during the contingency are discussed in this case study.
<b>Contributors</b>	<b>Civil Aviation Authority of Singapore (CAAS)</b>

### INTRODUCTION

The Singapore Airshow is one of the most significant aviation events in Asia, held every two years at the Changi Exhibition Centre. The event attracts industry leaders, government officials and military delegations from around the world. As one of the largest aviation events in Asia, leading aerospace companies and emerging players gather at the Singapore Airshow to contribute to dialogues, exchange ideas and advance interests in the global aerospace and defence sector.

Flying displays are one of the key features at the Singapore Airshow. To ensure the flying displays are conducted safely, a series of practices leading up to the actual flying display would be carried out. As the flying display area is located close to Singapore Changi International Airport (WSSS), the airspace around Changi Airport would be closed to ensure safety to aircraft that are not part of the flying display.

In 2019, Singapore Changi Airport managed an average of 1,050 movements per day. The closure of airspace inevitably disrupts scheduled movements at Changi. Even with advanced coordination with the Airport Operator (AO) and Airspace Users (AUs) to adjust their schedule away from the closure period, Civil Aviation Authority of Singapore (CAAS) anticipated a build-up of air traffic intending to operate into and out of Singapore Changi Airport immediately before and after these closure periods.

This case study focuses on the planning for and resolving Demand-Capacity Balancing (DCB) issues during the Singapore Airshow at the strategic, pre-tactical and tactical levels to optimise ATM capacity and achieve a safe, orderly and expeditious flow of air traffic.

# PLANNING AND NOTIFICATION FOR SINGAPORE AIRSHOW

The flying displays and practice sessions for the Singapore Airshow would typically span across 10 days, with each session ranging from 60 to 90 minutes.

The duration and timing of airspace closures are usually confirmed at least 2-3 months before the event. CAAS then publishes an AIP Supplement to notify AUs of the event and information on the airspace closures. Early notification of airspace closures is critical, as it allows affected AUs more lead time to adjust their operating plans.

Through the AIP Supplement, AUs are also informed of the expectation for Air Traffic Flow Management (ATFM) measures to be put in place to regulate the flow of air traffic to match the prevailing capacity before, and after, the re-opening of Singapore Changi Airport and the surrounding airspace.

## MANAGEMENT OF REDUCED ATC CAPACITY

The closure periods not only reduce airport capacity, but they also induce a backlog in air traffic demand following the re-opening of the airport and airspace. To address demand-capacity imbalance issues, the planning for ATFM measures begins once the duration and timing of airspace closures are known.

### **Strategic ATFM phase (up to three months before Singapore Airshow)**

Following the publication of the AIP Supplement, CAAS works with the airport operator, Changi Airport Group (CAG), to identify scheduled flights affected by the airspace closures. CAG then engages and coordinates with the affected flights to be re-scheduled outside of closure periods. The parameters used for re-scheduling also ensures that demand will never exceed capacity throughout the duration of the airshow.

Up to one month before the Singapore Airshow, the ATFM Unit (ATFMU) starts developing the implementation plan for Ground Delay Programmes (GDPs) which are the primary ATFM measure to be deployed during situations when there is an imbalance of demand and capacity. Through modelling and simulations of historical data using CAAS' ATFM system, the ATFMU would derive an initial set of parameters for the GDP to be implemented (i.e., Airport Arrival Rate (AAR) and duration) during the closure periods. The participation rate of the GDP, which is the proportion of flights which can be potentially regulated by the GDP under the regional ATFM initiative<sup>3</sup>, can also be estimated.

### **Pre-tactical ATFM phase (up to one week before the Singapore Airshow)**

The parameters defined in the GDP implementation plan during the strategic phase is continually reviewed and fine-tuned by the ATFMU up to one week before the day of airport/airspace closure. This ensures the initial set of parameters for the GDP stays relevant and effective in managing the demand-capacity imbalances.

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<sup>3</sup> The *Asia-Pacific Cross-Border Multi-Nodal ATFM Collaboration (AMNAC)* is the regional ATFM initiative on which the implementation process of ATFM is based. The ATFM measures are disseminated and facilitated as guided by procedures agreed among the initiative's members, which currently comprises 11 ANSPs and 47 airports.

## **Tactical ATFM phase (up to 24 hours before the Singapore Airshow)**

On the day of the closure, the Flow Management Planners (FMPs) in the ATFMU obtain the weather forecast from Singapore's meteorological agency, Meteorological Service Singapore (MSS), before the implementation of the GDP. In the event weather activities are forecasted and assessed to likely further reduce the AAR for Singapore Changi Airport, FMPs re-model the initial set of parameters for the GDP and make the necessary adjustments (i.e., reduce the AAR, extend GDP duration).

Prior to the implementation of a GDP, the ATFMU initiates a teleconference call for Collaborative Decision Making (CDM) with all relevant ATFM stakeholders including ATC units, AUs and other ATFMUs within the Asia-Pacific Cross-Border Multi-Nodal ATFM Collaboration (AMNAC). This will provide opportunities for stakeholders to address their operational limitations or challenges in supporting and facilitating the proposed GDP. The CDM channel normally stays open throughout the entire GDP duration to facilitate other requests such as Calculated Take-Off Time (CTOT) changes.

After the GDP has been implemented, the ATFMU continues to monitor the prevailing situation (e.g., changes to weather forecast, ad-hoc extension of closure periods, etc.) and implement other ATFM measures such as Ground Stops (GSt) to further regulate the traffic, if needed.

The FMP is also responsible for active coordination with various ATC units, when necessary. Information on flights which were largely non-compliant to the GDP (i.e., departing much earlier than the assigned CTOTs) would be communicated to the relevant ATC units. These flights are then considered for airborne holdings by the ATC units, when the need for airborne holding arises.

## **Post-operations analysis (POA)**

After the GDP concludes, Post-Operations Analysis (POA) are conducted internally to assess stakeholder compliance to CTOTs and the effectiveness of the GDP in regulating the air traffic. Through POA, the ATFMU can identify potential issues and make the necessary adjustments or improvements to the current operational procedures.

For issues associated with CTOT non-compliance, the ATFMU engages and follows-up with the respective AUs, normally via emails, to understand the difficulties they might have experienced, which resulted in their non-compliance to the GDP.

The results of the POA are also consolidated and shared during regular AMNAC meetings as an update to monitor the performance of the network.



# MANAGEMENT OF AIR TRAFFIC DURING UNFORESEEN DISRUPTIONS

While ATFM measures and necessary mitigating actions could be planned and executed in anticipation of planned airport/airspace closures, they may not necessarily be sufficient to mitigate demand-capacity imbalances arising from an unplanned situation or occurrences such as abnormal operations.

One example occurred during the Singapore Airshow in 2018. On 6 February 2018, a runway excursion occurred when one of the aircraft participating in the flying display was departing from Singapore Changi Airport enroute to the flying display area. The incident resulted in a closure of the affected runway for a prolonged duration. The unplanned closure reduced overall runway capacity by 50 per cent and Singapore Changi Airport had to operate mixed-mode operations on a single runway for approximately 5.5 hours.

Following the runway incident, the GDP which was initially put in place for the planned closure of Singapore Changi Airport and airspace had to be revised as it was no longer effective in managing the air traffic flow due to the sudden drastic reduction in runway capacity. While preparation for a revised GDP was underway, a GSt was imposed for one hour for flights arriving to Changi that were departing from the airports in Hong Kong China, Indonesia, Malaysia, and Thailand. The GSt provided a 'breather' by temporarily stopping the influx of arrivals to enable the transition from GSt to the revised GDP, which was implemented for another 4.5 hours. The operational runway capacity had to be shared between the Airport Arrival Rate (AAR) and Airport Departure Rate (ADR) to cater to the flights departing from Singapore Changi Airport. The revised GDP was eventually terminated when Singapore Changi Airport resumed normal runway operations.

Although a NOTAM was issued to inform AUs of the single runway operations in Singapore Changi Airport, the notice was not issued with enough time ahead of the event for AUs to properly plan, which meant it was insufficient for them to assess the impact on their operations and to make alternative arrangements to reschedule their flights. The majority of the affected flights therefore, opted to continue with their scheduled operations, with only a small handful (approximately seven per cent of the flights who participated in the GDP) cancelling their flight operations for that day.

From the POA of the events on 6 February 2018, CTOT compliance for the revised GDP was relatively low, with a compliance rate of approximately 55 Per cent. A more thorough review of the POA revealed these flights were not able to comply with the revised CTOT because there was insufficient reaction time for the stakeholders to comply with it. The lack of an automated exchange of ATFM information and integration between ATFM systems between ANSPs likely resulted in the lag time for information to reach the intended recipients. However, the POA also revealed the amount of time required to enable the exchange of essential ATFM information more effectively could possibly be shortened with the introduction of System Wide Information Management (SWIM) network.

## **LESSONS LEARNED**

### **Strategic planning for better predictability and responses**

Once confirmed, the plans established to manage air traffic could have been implemented during the strategic ATFM phase – weeks, or months before the planned airport/airspace closure. Notifications on airport or airspace closures could have also been published in advance (approx. two to three months before closure period) to enable airport operators and AUs to re-schedule flights out of the closure period to minimise delays on the day of operations.

### **CDM as an important part of tactical operations**

On the day of ATFM operations (tactical ATFM phase), it is essential to conduct CDM with the various ATC units, ATFMUs, and AUs, as it provides an avenue for them to highlight their operational challenges or constraints. This enables the initiating ATFMU to have a better overview of the situation and devise appropriate ATFM measures to effectively manage the demand-capacity imbalances.

### **Development of a contingency plan pre-event**

It is also essential to have contingency plans in place to ensure business continuity in the event of unforeseen circumstances. It is recommended for stakeholders, such as the airport operator and ANSP(s) to collaborate and develop a set of contingency plans which could be activated during instances where the airport capacity is foreseen to be reduced for an extended period.

## 8. CASE STUDY 5: THE COBRA GOLD MILITARY EXERCISE (THAILAND)

<b>Event/Disruption</b>	COBRA GOLD Joint Military Exercise
<b>Date &amp; Location</b>	Annual (February), Thailand
<b>Type</b>	Planned Airport/Airspace Closures
<b>Synopsis</b>	This case study looks at Aeronautical Radio of Thailand's (AEROTHAI) management of civil air traffic during the COBRA GOLD military exercise. The COBRA GOLD military exercise is the largest joint military exercise in the Indo-Pacific region taking place in Thailand in February each year. The aerial part of the exercise requires a large portion of airspace to be closed to civil air traffic over an extended period, requiring AEROTHAI to coordinate with the Royal Thai Air Force and implement several types of ATFM solutions to manage the traffic. This case study discusses the coordination process as well as the implementation of the ATFM solutions for this annual event.
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### INTRODUCTION

COBRA GOLD is the largest joint military exercise in the Indo-Pacific region and has been held in Thailand since 1982. The exercise had started as a bilateral activity between Thailand and the United States in 1982 before expanding to 27 participating nations in 2023. The exercise is generally scheduled for two weeks in February each year and covers all aspects of military operations including ground, aerial, and naval activities. Activities during the exercise include table-top strategy planning exercises, live-fire exercises, and humanitarian assistance training.

Main exercise participants currently include the United States, Thailand, Singapore, South Korea, Indonesia, Japan, and Malaysia. Several other nations are invited to participate in the planning exercise or as observers, including Australia, Brazil, Brunei, Cambodia, Canada, Fiji, France, Germany, Israel, Laos, Nepal, New Zealand, Pakistan, the Philippines, Sri Lanka, Sweden, the United Kingdom, and Vietnam.

With the large scale of COBRA GOLD, approximately 120 – 150 aircraft from participating nations are deployed for the activities, and the aerial exercise area normally covers approximately one third of the Bangkok Flight Information Region (Bangkok FIR) as shown in Figure 7. Areas in green are transition corridors used to facilitate transition of exercise aircraft between the exercise areas and to/from aerodromes. Other colours are used to help delineate between different exercise areas, each with slightly different altitude limits and periods of activity. These are discussed in the associated AIP Supplement.

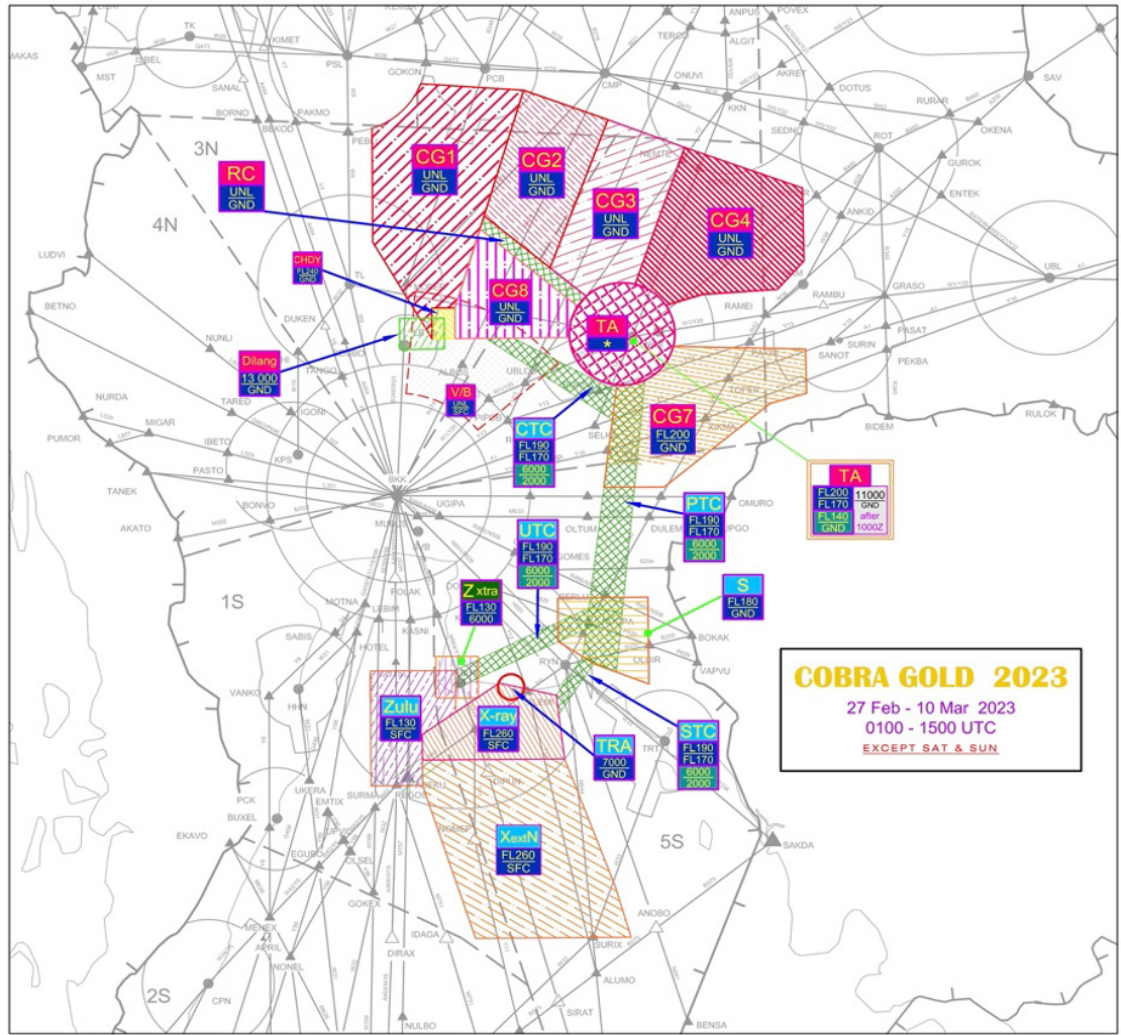


Figure 7: Map of COBRA GOLD 2023 Exercise Area

The large aerial exercise area significantly impacts civil air transportation within the Bangkok FIR during the two-week period each year. Specifically, several ATS routes are closed and airspace capacity for civil aircraft is reduced. This has considerable impact to civil operations as February is still within the high travel season for Thailand and the demand remains generally high. Consequently, several strategic, pre-tactical, and tactical ATFM measures are activated to manage the disrupted civil air traffic demand. This case study focuses on the planning and the management of these measures to enable safe and efficient civil air traffic operations while enabling the military air activities to continue.

## EXERCISE AIRSPACE PLANNING

### Planning conferences

Two airspace planning conferences are conducted before COBRA GOLD each year: the Initial Planning Conference (IPC) and the Final Planning Conference (FPC). The IPC is held approximately six months before the commencement of the exercise, during which some aerial activities are still under discussion and will be confirmed later during the FPC. The FPC, held approximately three months before the exercise, serves as the final confirmation of all activities and planned airspace management measures. AEROTHAI is invited by the Royal Thai Air Force to be involved in the Airspace Control Section during these planning conferences. At the conferences, all

stakeholders requiring the use of the airspace inform the Airspace Control Section of their activities, which can include projectile ammunition firing, low-level flights, UAS/ RPAS operations, and large-scale air operations. The Airspace Control Section is then responsible for balancing stakeholders' requirements, deconflicting, and assigning airspace uses, taking into consideration both civil and military requirements.

### Airspace plan publication

Following the FPC, AEROTHAI and the Royal Thai Air Force (RTAF)'s Air Operation Control Command coordinate with the Civil Aviation Authority of Thailand (CAAT, Thailand's aviation regulator) to publish an AIP Supplement. Efforts are taken to ensure the AIP Supplement is effective on one of ICAO's prearranged Aeronautical Information Regulation and Control (AIRAC) cycles, although in some cases, a NON-AIRAC AIP Supplement must be published due to operational needs. In developing the AIP Supplement, the RTAF is responsible for the information regarding the exercise area and military-related information, while AEROTHAI is responsible for information related to civil air traffic operations including ATS route closures and required ATFM measures to be implemented. An example AIP Supplement is included as an Appendix for reference (see Appendix 3).

## MANAGEMENT OF REDUCED CAPACITY WITH ATFM MEASURES

The aerial activity portion of the COBRA GOLD exercise is a large-scale military air exercise requiring the use of approximately one third of the Bangkok FIR (see Figure 7). Several ATS routes are closed to civil air traffic, significantly limiting the airspace capacity. Consequently, several ATFM measures – ranging from strategic to tactical – are used as shown in Table 2. This section discusses the details of the measures implemented.

ATFM Measures	Implementation Phase	Information Distribution Method
Strategic Re-Routing (Playbook Routes)	Strategic	AIP Supplement
Level Capping	Strategic	AIP Supplement
Temporary FL Orientation Scheme	Strategic	AIP Supplement
Ground Delay Programme	Pre-Tactical/Tactical	ATFM System (ATFAS)

Table 2: ATFM Measures during COBRA GOLD

### Strategic re-routing (playbook routes)

With several ATS routes closed for air activities, civil aircraft must be re-routed away from the area. In the early years of COBRA GOLD, AEROTHAI air traffic service unit – the Bangkok Area Control Centre (BACC) – vectored or re-rerouted the traffic tactically. In recent years, however, traffic demand has increased significantly and BACC's tactical re-routing became untenable.

To cope with the increasing traffic demand, AEROTHAI developed a strategic re-routing catalogue ('Playbook Routes') to enable a more orderly arrangement and to reduce BACC's workload. Airspace Users planning to operate flights through the area during the exercise period were required to file their flight plans in accordance

with the established re-routing procedure, thereby eliminating the needs for tactical re-routing except in unforeseen circumstances such as weather deviation and minor vectoring for traffic congestion. Initially, due to the limited availability of ATS routes and non-PBN airspace design, temporary waypoints were created and strung together as alternate routes. The challenge fell on the airspace users (AU) as they were required to manually update their aircraft's onboard Flight Management Computers (FMC) themselves. As years passed and Performance-Based Navigation (PBN) was adopted in the country, many new Area Navigation (RNAV) routes were implemented. These RNAV routes enabled the COBRA GOLD strategic re-routing catalogue to be entirely based on existing ATS routes, eliminating the needs for AUs to manually update their aircraft's FMC and enabling better planning for all involved.

To develop the re-routing catalogue, AEROTHAI analysed traffic data to determine the groups of flights and city-pairs that were affected by the airspace closures. Generally, those groups most affected were arrivals and departures to and from Bangkok (Bangkok Suvarnabhumi International Airport: VTBS and Don Mueang International Airport: VTBD) as well as traffic overflying "BKK" (VOR). The shortest available routes that could serve the various city-pairs (while avoiding closed airspace and creating minimum airspace complexity) were then selected. To further minimise the complexity, both RNAV and non-RNAV aircraft operate on different routes but in the same general direction, creating a uniform traffic flow for the ATCOs to manage. Figure 8 shows an example of the route catalogue.

Departure/Overfly	Routing	Destination/Overfly
VTCC	W9 PANTA Y7 TL W9	BKK
	W9 PANTA Y7 TL DCT NAKON	VTBD
	W9 PANTA Y7 TL DCT NORTA	VTBS
VTCT	W22 PSL W9	BKK
	W22 PSL W9 TL DCT NAKON	VTBD
	W22 PSL W9 TL DCT NORTA	VTBS
VTPO	THS DCT PSL W9	BKK
	THS DCT PSL W9 TL DCT NAKON	VTBD
	THS DCT PSL W9 TL DCT NORTA	VTBS
VTCL	W13 PAE W22 PSL W9	BKK
	W13 PAE W22 PSL W9 TL DCT NAKON	VTBD
	W13 PAE W22 PSL W9 TL DCT NORTA	VTBS

Figure 8: Example of Re-Routing Catalogue for COBRA GOLD 2023

Figure 9 graphically depicts some of the routes in the re-routing catalogue, with the blue lines showing the arrival routes to Bangkok and the yellow lines showing the departure routes. Figure 9 also depicts AEROTHAI's attempt to segregate Bangkok arrival and departure flows, thereby minimising airspace complexity and the need for tactical vectoring. It should also be noted that some routes still traverse the air exercise areas, although with additional altitude restrictions to segregate civil traffic from those areas.



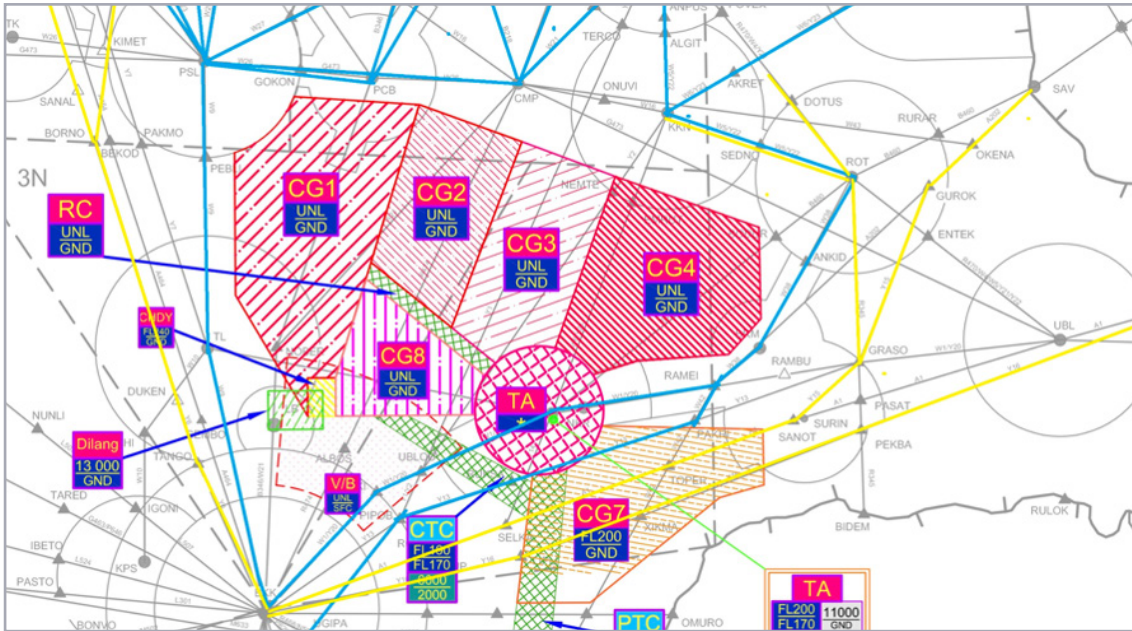


Figure 9: Graphical Depiction of Re-Routing Catalogue for Bangkok Arrival and Departure Flows

### Level capping

Level capping is another tool to reduce traffic complexity in the airspace and is used to segregate different flows of traffic through the area. During the COBRA GOLD exercise period, domestic flights are restricted to operate at FL320 or below, while international flights overflying Bangkok FIR are assigned FL320 or above; this separation between domestic and international traffic was put in place to minimise aircraft track crossings during climbs and descents. The measure reduced much of BACC ATCOs' workload, enabling them to concentrate on managing the increased traffic that was re-routed into their sectors.

### Temporary flight level orientation scheme

Normally, the cruising flight levels (FL) are assigned based on aircraft headings (i.e., the mnemonic “East Odd, West Even”) in accordance with the standards in ICAO Annex 2 – Rules of the Air. This results in a nominal FL assignment on routes around Bangkok (BKK) shown in Figure 10. Note waypoint ‘PSL’ (red circle), where Bangkok-inbound flights flying westbound to PSL must change (climb/descend) their FLs from even to odd before continuing southbound toward BKK.

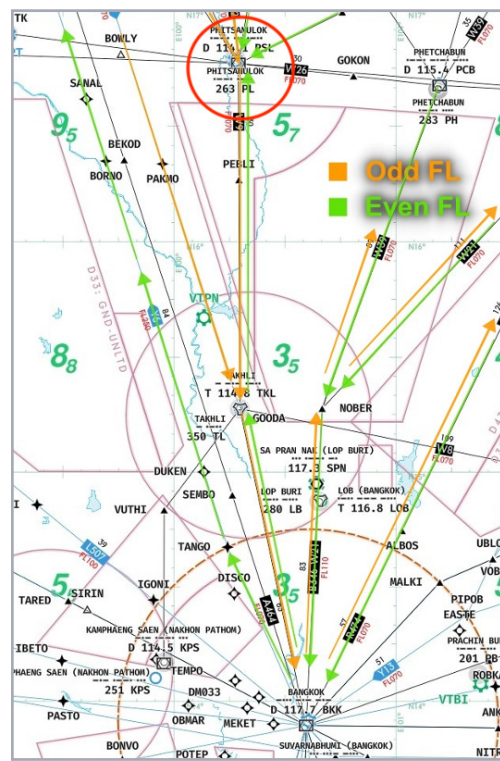


Figure 10: Normal Flight Level Scheme



During the COBRA GOLD exercise, flights departing and arriving Bangkok were re-routed as discussed in the previous section and shown in Figure 9. Figure 11 (left side) zooms in on the routes serving traffic to/from the area north-west of Bangkok. From the figure, the re-routed Bangkok inbound traffic will converge at waypoint PSL (red circle) before continuing southbound on the ATS route (W9) while outbound traffic going to the north-northeast will follow Y6 to waypoint BORN0, then diverge toward BOWLY (blue circle), crossing another ATS route (Y7), to their destinations. If the re-routed flights were to use the normal FL allocation scheme as shown in Figure 11 (left side), Bangkok inbound traffic would have to climb or descend at PSL, while outbound traffic would have a potentially conflicting FL with southbound traffic on Y7. This would create a heavy workload for the ATCOs managing traffic around these hotspots, especially since more traffic converges/diverges at these waypoints during the exercise. To reduce the workload for ATCOs working that area, BACC implements a temporary change in the FL orientation scheme as shown on the right side of Figure 11 which will minimise altitude changes at the hotspots and reduce safety risk.

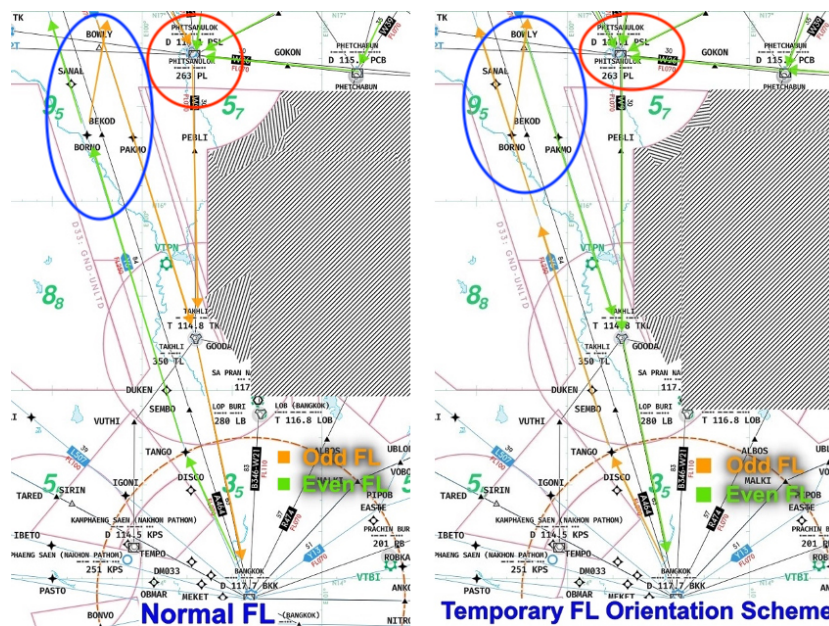


Figure 11: Example of Re-Route and Flight Level Scheme

### Ground Delay Programme (GDP)

Even with strategic measures implemented, traffic congestion can still occur, as is the case for sectors 3N and 6N which are outlined in purple and green dotted lines (respectively) in Figure 12. These sectors contain multiple converging routes serving traffic in and out of Bangkok during the re-routing scheme.

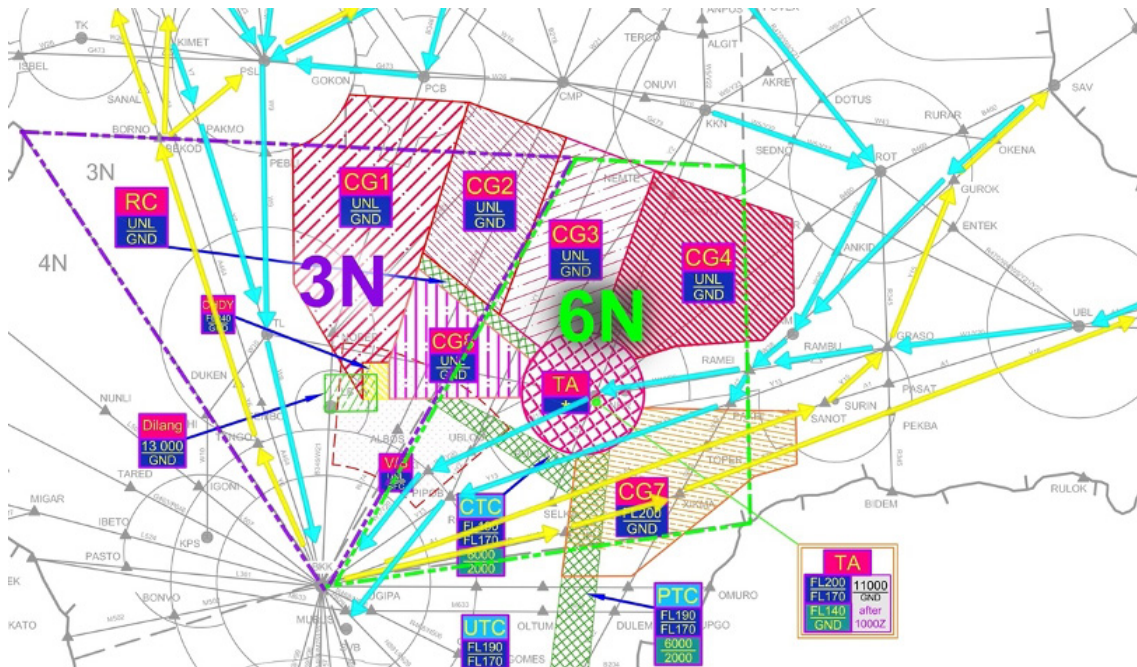


Figure 12: Re-Routed Traffic Pattern and Affected Sectors

To further relieve ATCOs' workload, Ground Delay Programs (GDP) are pre-tactically implemented for sectors 3N and 6N during the most congested period. When implemented, Calculated Take-Off Times (CTOTs) are assigned to flights transiting these two sectors using AEROTHAI's ATFM support system (the Air Traffic Flow Advisory System: ATFAS). CTOTs are delivered to both the AUs and the ATS units serving airports of departure in accordance with the established local GDP procedure. The local GDP procedure was developed based on the Common Operating Procedure (COP) of the Asia-Pacific Cross-Border Multi-Nodal ATFM Collaboration (AMNAC), a regional cross-border ATFM implementation project in the Asia-Pacific region. Figure 13 shows an example of CTOT distribution via the ATFAS webpage.

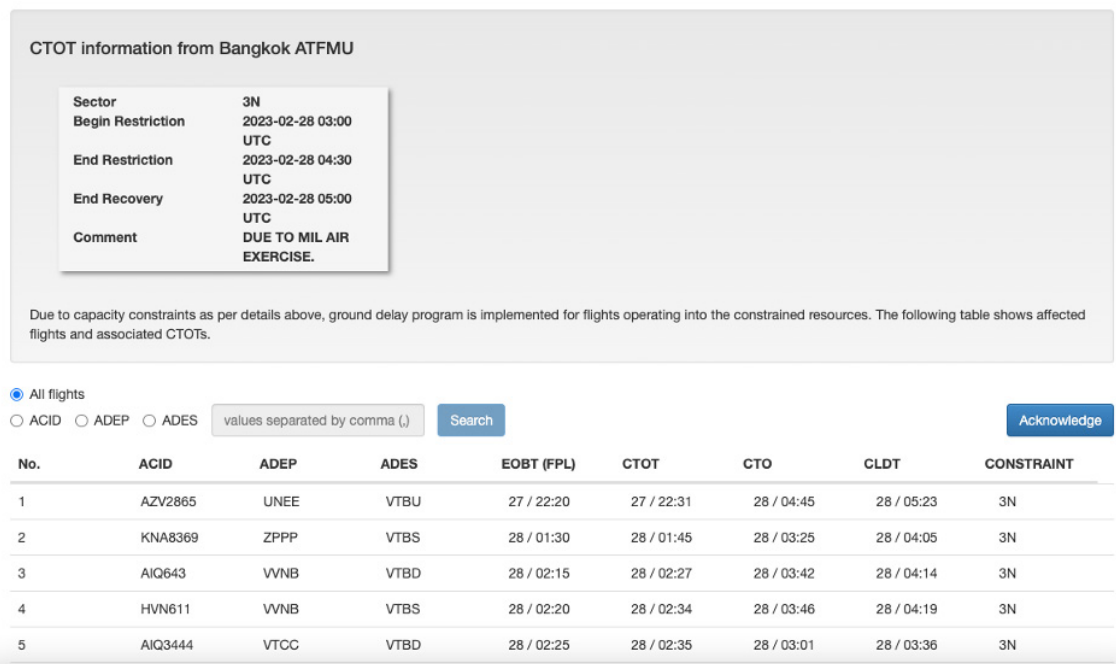


Figure 13: CTOT Distribution Webpage during COBRA GOLD 2023

During the COBRA GOLD exercise, approximately 90 per cent of the traffic affected by the GDP were domestic flights and flights departing from airports of AMNAC members States. This meant the GDP could be implemented effectively. The average ATFM delay assigned was approximately five minutes, which was acceptable to most AUs. The GDP programme regularly saw at least an 80 per cent compliance rate.

A combination of ATFM measures helped reduce traffic complexity, allowing ATCOs to safely manage the traffic under the reduced capacity environment with no undue delays on the flights.

## **LESSONS LEARNED**

### **Full ANSP involvement in the operations planning**

While the COBRA GOLD exercise is a military activity, the limitations it causes to airspace capacity and ATS route availability has a significant impact on civil air transportation. It is therefore important for the ANSP (AEROTHAI) to be involved in the operations planning from the initial phase and to stay involved throughout the entire process. By being involved, the ANSP (AEROTHAI) can ensure civil AUs needs are met and civil air traffic can operate safely while allowing the military activity to continue.

### **Analytical use of traffic data and airspace users' information**

In developing the combination of ATFM measures used during the exercise, AEROTHAI analysed historical and projected traffic data, and additional information collected from the AUs, such as their operational intentions (e.g., flight scheduling, preferred routes, and flight levels). With the analytical view of the data and information, AEROTHAI developed a combination of measures that were effective for air traffic management purposes and met the requirements of airspace users.

### **Use of strategic ATFM measures to enhance planning**

A key factor in reducing traffic and airspace complexity was the use of several strategic ATFM measures, including the re-routing catalogue, level capping, and the temporary FL orientation scheme. These measures enabled traffic to be re-routed away from closed airspace and allowed different traffic flows to be separated well in advance of the live operations. By publishing the re-routing and FL requirements in the AIP Supplement well ahead of the exercise period, airspace users could prepare their operational plans and perform any required system configuration changes (e.g., flight management computer) before their operations. ATS Units (e.g., BACC) were also able to prepare as needed, to support the changed operational environment (e.g., adjust staffing to ensure sectors 3N and 6N had the required capacity for added traffic demand). Such advance planning reduced the need for tactical adjustments on the days of operations, thereby reducing ATCOs' workload and increasing safety.

### **Use of pre-tactical/tactical ATFM measures to complement strategic arrangements**

Even with several strategic traffic management measures implemented before the exercise, tactical traffic congestion can still occur. Pre-tactical/tactical ATFM measures such as a GDP implemented on the days of operations can therefore be helpful to address tactical congestion while still allowing more predictable operations for airspace users.

### **Close collaboration between stakeholders**

From the initial exercise planning phase to the management of live operations and on through the post-exercise phase, AEROTHAI's ATS Units, ATFM Unit, and the military units worked together closely to ensure current information was constantly exchanged. The continuous exchange of updated airspace use plans was especially important. This collaboration among key stakeholders helped ensure common situational awareness among the stakeholders and enabled effective planning and responses to the ever-changing situation.

### **Refinement of procedures based on past experiences**

The COBRA GOLD exercise has been conducted annually for many years, creating a wealth of experience among stakeholders involved including AEROTHAI, the Civil Aviation Authority of Thailand, the Royal Thai Air Force, and AUs. Operational challenges, unforeseen disruptions, and past complexities have all been used to refine airspace management plans and operating procedures over the years. Advancements in technological capabilities, such as the establishment of the Bangkok ATFM Unit and the development of the ATFM support system, have also been included in procedure development.

## 9. CASE STUDY 6: AIR DEFENDER 2023 (GERMANY)

<b>Event/Disruption</b>	Air Defender 2023 Joint Military Air Exercise
<b>Date &amp; Location</b>	12 – 22 June 2023, Germany
<b>Type</b>	Planned Airport/Airspace Closures
<b>Synopsis</b>	In this case study, the pre-planning, coordination, and management of a major exercise in the German and neighbouring airspace is discussed. During the event, which comprised 25 nations and more than 10,000 soldiers, special airspaces designed for this purpose were used and special procedures were implemented to ensure the military mission effectiveness while minimising the impact on civil air traffic flow. The case study also demonstrates the lessons learned during the execution of the exercise.
<b>Contributors</b>	<b>Osman Saafan</b> , Director Corporate Civil-Military Affairs and Director Corporate Safety and Security Management, DFS <b>Lieutenant Commander René Bansemer</b> , Head of Military Competence, DFS <b>Robert Winker</b> , Airspace Design ENR & NRC, DFS <b>Michael Schwaderer</b> , ATM Performance, DFS

### BACKGROUND

Germany has extensive experience in civil-military cooperation, culminating in the integration of civil and military enroute air traffic services in DFS Deutsche Flugsicherung GmbH, the German ANSP, in 1993.

On this basis, it was possible to establish essential agreements (see Appendix 4), committees and processes guaranteeing that the military and civil demands are constantly balanced. Following these prerequisites, the German Air Force (GAF) informed DFS two years in advance about the framework of the Air Defender 2023 exercise. A cross-functional DFS team was then established and started preparing for this exercise.

#### **Air Defender 2023 exercise background**

Germany hosted and executed the major joint military exercise known as Air Defender from 12-22 June 2023. The objective of the exercise was to demonstrate the ability to defend NATO territory in Europe according to Article 5 of the North Atlantic Treaty. Germany's geographic location, capability, and readiness, among other factors offered the country the opportunity to demonstrate that it was best suited to act as a central hub for collective defence in the heart of Europe. 25 nations participated in the exercise with more than 220 aircraft. Most of the aircraft were deployed from the USA in advance, and more than 10,000 troops were needed to support and operate the air force fleet.

While the fulfilment of military airspace requirements was the top priority of the exercise, it was also important to minimise restrictions to civil air traffic since it was vacation season and there were also other major events happening in Europe like



the Special Olympics World Games which were being held in Berlin at the same time. DFS, EUROCONTROL and neighbouring ANSPs controlled exercising aircraft to and from the exercise areas, unless there was a shared boundary between the respective airfield and the exercise area. Tactical control within the military exercise areas was performed by the German Luftwaffe Tactical Control Service (Air Defence) and other nations/NATO. Exercise areas could be crossed by civil non-participating aircraft after coordination with ATC, as long as certain conditions were also met. A liaison concept was established to ensure the safe and orderly communication and coordination between the responsible players.

Military coordination with DFS was provided by the German Joint Forces Air Component (JFAC) including a Joint Airspace Coordination Cell (JACC). Planning and coordination with the civil stakeholders, especially the airlines, were provided by a Civil-Military Air Defender 23 Coordination Cell located at DFS Headquarters. For the coordination cell, DFS provided the infrastructure and basic procedures for DFS crisis management. This enabled the use of tested and fit-for-purpose tools and procedures.

## EXERCISE AIRSPACE PLANNING

### Planning process and conferences

After the overall framework of the exercise regarding airspace requirements and time frames were announced, the Ministry of Defense and the Ministry of Transport were informed. An Airspace Syndicate was founded by the German Civil-Military Airspace Coordination Steering Group. The Airspace Syndicate consisted of all relevant civilian and military stakeholders and met about every two months for a total of seven times. It negotiated the horizontal and vertical limits of the exercise airspace areas, the coordination procedures and it determined necessary deviations to civil-military agreements. Additionally, the Syndicate also held three (the Initial, Main and Final) international planning conferences to inform all exercise participants about the status of work. The transparent involvement of all relevant stakeholders was ensured from the very beginning, which was a major contributing factor to the success of the overall exercise.

In summary, the Syndicate created three exercise areas (see Figure 14), two temporary deviation letters of agreements, a contract to determine the coordination process to be followed between the JFAC and the DFS Civil-Military Air Defender 23 Coordination Cell and a liaison concept.

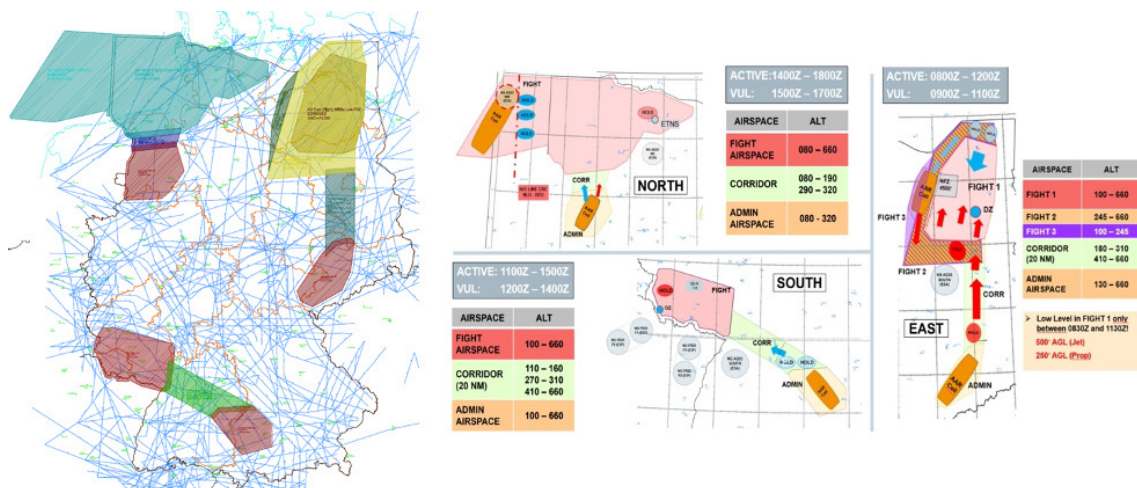


Figure 14: Exercise Airspace for Air Defender 2023

In addition to supporting the German Air Force with the exercise airspace and coordination requirements, DFS also helped them commission and deliver a PHOENIX Tower, air traffic control system<sup>4</sup> for a military airfield so the airfield would be able to handle the tremendous amount of expected military traffic.

Previously completed exercise impact assessments had revealed there was a need for additional training. DFS therefore, organised a simulator training day with personnel from the involved military airfields, Luftwaffe tactical control services and civil and military air traffic controllers. Additionally, an 'Operations Day' took place in an Upper Airspace Centre (UAC) and an Area Control Centre (ACC) where military experts briefed civil air traffic controllers about military aspects of the exercise. There was also intensive communication with airline operators to ensure awareness and allow for an understanding of available preventive ATFM measures that could be implemented, if deemed necessary.

In the final planning phase, the composition and tasks of the Civil-Military Air Defender 23 Coordination Cell were agreed upon and the personnel briefed accordingly.

## **MANAGEMENT OF REDUCED CAPACITY**

The timing chosen for the exercise was extremely unfavourable for the DFS. The implementation of a new ATM system (iCAS) at the ACC in Munich, coupled with staff shortages at the ACCs in Bremen and Karlsruhe, posed a major challenge.

The objective of DFS was to minimise the impact of the exercise on civilian air traffic while supporting the execution of the military exercise to the greatest extent possible. To accomplish this, additional sector openings and up to 70 additional ATCO work shifts were offered per day. As a result, throughout the exercise period, all available and required sectors were consistently staffed at the agreed capacity.

However, the activation of very large exercise airspace areas with overlapping active timeframes (see Figure 15) directly impacted arrivals and departures at some major international airports. Furthermore, due to the unpredictable nature of the onload traffic from participating military aircraft in the affected sectors, the overall capacity for the safe conduct of civilian air traffic had been reduced. Together, these factors all contributed to the need for a series of rerouting and flight level capping measures to be implemented.

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4 The DFS PHOENIX is a Linux based air traffic surveillance data processing system (SDPS) suitable for many air traffic control use cases. It was designed and implemented to process surveillance and flight plan data and display it to the controller. It was initially developed as an in-house system at DFS and is used as a fallback system for lower and upper airspace in Germany. In recent years, additional components have been added to the system. A broad range of functions and flexible expansion options have already convinced numerous international partners to use the system. Meanwhile, the modular PHOENIX system, with its 50 components, contains a wide range of functionalities in the field of tracking, flight plan processing and information processing combined with a modern and intuitive HMI.



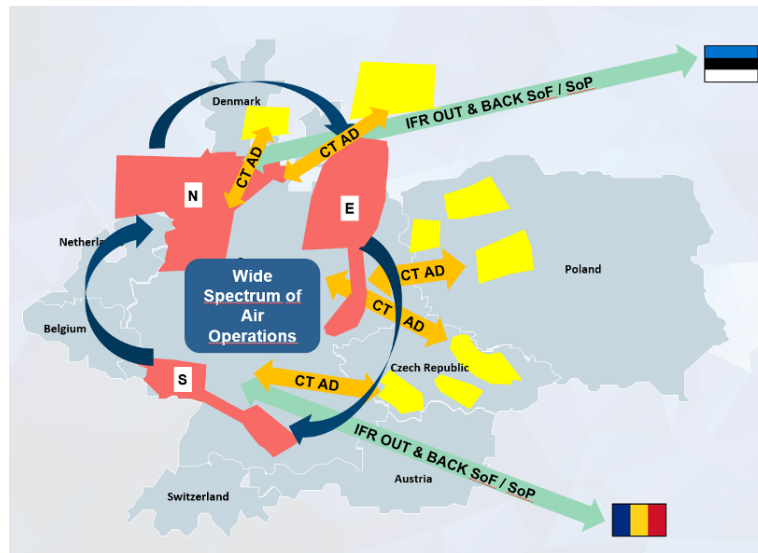


Figure 15: General Overview of Traffic Flows

During the strategic exercise planning period, it was assumed that a considerable number of arrivals or departures would be delayed to an extent that their operation would be jeopardised by local noise abatement rules prohibiting aircraft from operating at night.

Within the framework of the Airspace Syndicate, fundamental procedures were initially agreed upon with the affected ACCs/UACs. Subsequently, a catalog of rerouting measures was developed, which was continuously refined until the last day before the exercise. Figure 16 show flight tracks with and without the rerouting measures.

To ensure smooth transitions between civil ATC and military control units, IFR routings for participating aircraft stationed mainly across Germany and partly in other central European States were established and published in the exercise Air Task Orders (ATO).



Figure 16: Flight Tracks without (blue) and with (red) Re-Routing Measures

The rerouting measures were published as a Special Route Availability Document (RAD) and the necessary airspace sector capacity limitations resulting from onloading traffic were all shared with EUROCONTROL so they could run accurate exercise simulations.

EUROCONTROL then conducted three simulations, during which the RAD and the reduced airspace sector capacities were continually adjusted based on the latest findings. As a result, the simulated negative effects were significantly reduced from one simulation to the next which can be seen in Figure 17.



Figure 17: Delay Simulation (DFS)

Simultaneously, numerous information sharing, and coordination events were held with airlines, airport operators, and other stakeholders to emphasise the necessity of relaxing the strict night curfews at airports during the exercise period. Finally, at all airports, the strict night curfews were slightly relaxed, at least for home-based airlines.

### Air Traffic Flow and Capacity Management (ATFCM)

In the context of the exercise, the following practice was agreed upon in accordance with the existing procedures outlined in the ATFCM Operational Manual:

1. Rhein FIR (EDUU): Implementation of ATFCM regulation<sup>5</sup> at two days before each exercise day (D-2) for the whole day. If updates result from the ATFM Daily Plan (ADP), then adjustments are made. (D-2 is made in the back office). Further updates at D-1 and tactically;
2. Bremen FIR (EDWW) and München FIR (EDMM): Implementation of ATFCM regulation at D-1 until 10:00 UTC for the whole next day. Further updates on a tactical basis;
3. EDGG: Existing Pre-Tactical and Tactical processes will be applied;
4. As an additional/fallback solution to web services provided by the EUROCONTROL Network Manager (NM) for system-to-system access to its services and data, pre-tactical ATFCM regulations could be listed in an Excel file to be sent to the Network Manager (NM) by email;
5. On days with high impact foreseen, a morning tactical call between the Network Manager Operations Centre (NMOC) and impacted Flow Management Positions (FMPs) to assess possible mitigation measures;
6. In case of multiple changes/application of regulations and other measures, prefer direct contact to avoid volatility. This is also important for neighbouring FMPs at Maastricht (MUAC) and Reims (LFEE) ACCs;

<sup>5</sup> ATFCM "regulation", in the context of European ATFCM operations, refers to an instrument of the European Air Traffic Network Management Operations and represents an ATFCM measure implemented by means of a departure slot (affected flights are assigned Calculated Take-Off Times or CTOTs) to balance traffic demand against available ATC capacity.

7. Regulation reason code: SPECIAL EVENT – AIR DEFENDER 23 to be used during the exercise by DFS and MUAC (for the sectors directly affected by the exercise);
8. Regulation reason code: OTHER – Remark AIR DEFENDER 23 to be used during the exercise by other ANSPs and MUAC (for the sectors NOT directly affected by the exercise);
9. Implementation of regulations in the period in between the activation of the three major areas and at times outside the exercise windows to smooth the effect of regulations applied during the exercise windows;
10. Data on sector capacities, available sectors, and sector configurations to be sent by DFS to EUROCONTROL NM for operational planning and operations analysis as soon as practicable;
11. In general, the extension of the so-called ATFM Slot Tolerance Windows and/ or Airport Slot Departure Tolerance Windows (mandatory timeframes for departures) is only permissible in exceptional cases. It was agreed that at so-called CDM airports (where all stakeholders are interconnected via NM-B2B and have established common operational procedures), any potential capacity constraints that may arise should preferably be addressed through the adjustment of taxi times. Any airspace management related changes to be treated and published via the standard existing Airspace Use Plan (AUP) and Updated Airspace Use Plan (UUP) which contain the temporary allocation of the airspace for a specific time period;
12. Coordination meeting with military counterpart at 06:30 LT and a further four coordination meetings per day (9:00, 12:00, 15:00 before activation of each of the three major exercise areas + one last day debrief) in German between Coordination cell, DFS FMPs, MUAC FMP and other relevant stakeholders in Germany;
13. Daily NM Conference to be organised on an ad-hoc basis.

### **Impact (reroute extensions and delays)**

The impacts of the exercise, contrary to the previous expectations derived from the simulations, were quite minimal. Through continuous coordination among the operational partners, sector capacity values could be promptly adjusted to current conditions, mostly increasing them. ATFCM control measures were coordinated between the ACCs, optimising the use of available airspace capacities.

This close alignment and coordinated approach, facilitated by open communication among all parties involved, ultimately resulted in the exercise having acceptable effects on civilian air traffic.

In the end, no flights had to be cancelled due to the exercise, and only 78 flights were compelled to use the mitigated night curfew regulations. A significant portion of these occurrences (57) appeared at Frankfurt International Airport (EDDF) on 20 June 2023 when, in addition to passing thunderstorms, there were also restrictions imposed by Air Defender.

The total network delay attributable to Air Defender was kept to a very reasonable 23.59 minutes on average per day (18 per cent of the total network delay), with no flights needing to be cancelled before the exercise. In total, 12,474 flights were delayed due to Air Defender for the whole period with an average delay per delayed flight of 17 minutes; a very reasonable amount compared to the total of 293,928 flights which operated across the European aviation network over those nine days.

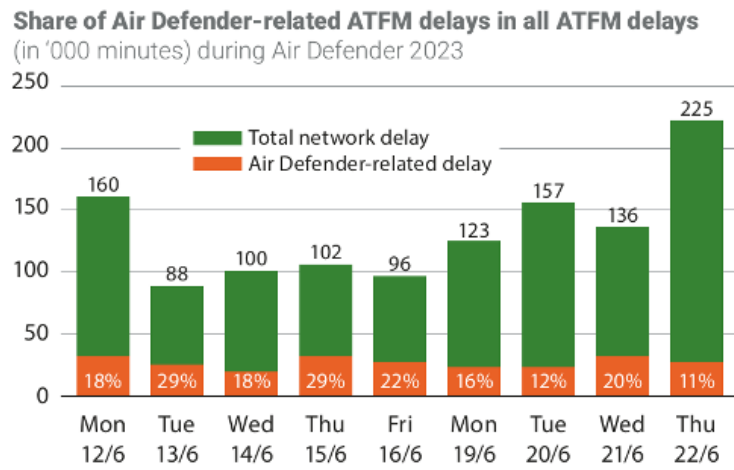


Figure 18: Share of AD'23-related ATFM Delays

Approximately 800 civil flights had to be rerouted daily around the exercise airspaces and, on average, covered an additional 10 nautical miles compared to their usual routes (Figure 19).



Figure 19: Rerouting Flight Tracks



# **LESSONS LEARNED**

## **Planning phase**

The establishment of the Airspace Syndicate one and a half years before its execution was just sufficient to fulfill all requirements. However, some changes could not be incorporated into the agreements in due time and had to be finalised 'last-minute', just before the start of the exercise. Therefore, a planning start of two years before such major cross-border exercises is recommended in the future.

New agreements and deviations to existing agreements should be finalised and signed three months before the start of the exercise to ensure that all parties involved are informed in due time. Simulations before the exercise proved to be very helpful and should be extended to all control personnel involved, if possible.

The communication strategy with the airlines, General Aviation and the public should be better coordinated between the ANSPs and the military since their planning lead times are fundamentally different. Therefore, adjusted time approaches are necessary.

During execution, the procedures agreed upon during the planning phase were well suited to ensure military and civil flight operations. However, there were differing expectations regarding flexibility and responses to emerging weather events and the procedures for activation and deactivation of exercise areas. Procedures should therefore be more clearly formulated to ensure a common understanding of how to handle those issues exists in advance. Every effort should be made to conduct business with maximising transparency between all relevant stakeholders from the outset. This contributes to the development of mutual trust, mutual understanding, and results in acceptable compromises, which eventually turned out to be a very important success factor.

## **Airspaces**

The agreed training airspaces were assessed very positively by the military users. The military mission was always fulfilled, and the airspaces were made available to the agreed extent.

However, the evaluation of the exercise airspace use showed that not all areas and corridors were frequently used, so further optimisation in favour of civil airspace use seems possible. Specifically, there were differing points of view regarding the optimum activation and deactivation times and how much advance notice ANSPs had to give before the airspaces could be used for military purposes.

## **Flight plans**

The automatic data exchange regarding flight strips did not work consistently because of deviations between military planning documents and flight plans. Thus, different callsigns (tactical versus flight plan) and deviating routes from the agreed route plan were challenges for the controllers.

Additionally, automatic data transfer of flight plans did not always work, so alternative solutions, which were much more labour intensive, had to be used.

## **Operational experience**

Although air traffic control was conducted with few safety incidents and no restrictions on civil airlines, due to deviations from standard procedures and difficult weather conditions, the Civil-Military Air Defender 23 Coordination Cell

was sometimes addressed prematurely by various players. In this case, particular attention must be paid to managers in the Cell to avoid micromanagement and to enforce coordination at the appropriate level while still ensuring optimal operational support. To avoid such friction, rules of communication (who coordinates with whom on the tactical, operational, and strategic level) should be laid down in the respective agreements as part of the planning process.

In the neighbouring countries, the exercise airspaces were apparently not known to all military forces. This resulted in disruptive bookings of non-available training areas and military air traffic that were not participating in the exercise, unexpectedly crossing AD23-airspaces.

### **Civil-military Air Defender 23 coordination cell**

The cell proved to be an efficient coordination body and a good source of information. Due to excellent and proactive coordination at the appropriate levels, the agreed assignment as a veto power to terminate the exercise for urgent safety reasons was never needed.

## **OVERALL CONCLUSION**

Excellent, trustworthy cooperation and collaborative decision making in all areas during preparation and execution of the exercise underlines again the excellent construct of the civil-military cooperation in Germany and its positive effects for international cooperation. All parties agreed that repetitions of such exercises are desirable and necessary to train ANSP and military personnel the required procedures in the event they are ever needed to accommodate extraordinary situations.

DFS was able to mitigate the impact on civil air traffic not least through an intensive DFS staffing approach (+20 per cent extra manpower) and flexible reaction on traffic demands. The estimated delay could be avoided by more than 25 per cent. No flights involving civil aircraft were cancelled or kept from reaching their destination airport.

# 10. CASE STUDY 7: SPACE LAUNCHES (USA)

<b>Event/Disruption</b>	Space Vehicle Launches and Recoveries
<b>Date &amp; Location</b>	Annually, United States of America (USA)
<b>Type</b>	Space Operations
<b>Synopsis</b>	This case study discusses the Federal Aviation Administration's (FAA) management of space launches and re-entry operations. In the United States (US), space vehicle launches are becoming more frequent as the space sector experiences dramatic growth due to the emerging commercial space industry. Each launch impacts the US National Airspace System (NAS) and civil air traffic, and the FAA is required to manage the airspace use around the launch and reentry Aircraft Hazard Areas (AHAs) to enable a safe and efficient use of the airspace surrounding the launch sites and time windows. This case study provides an insight into the collaborative decision making (CDM) and information dissemination conducted by the FAA during these space operations.
<b>Contributors</b>	<b>Vern Payne</b> , Manager CDM and International Operations, FAA <b>Michael Murphy</b> , Director ATFM Business Development, Metron Aviation

## GENERAL

The FAA's Air Traffic Organization, Space Operations Office ensures space launch and re-entry operations are safely and efficiently integrated into the US National Airspace System (NAS). The Space Operations Office is part of the FAA's Air Traffic Control System Command Centre (ATCSCC), which has responsibility to monitor, coordinate and balance traffic demand with capacity across the NAS. The ATCSCC collaborates with Flight Operators, Area Control Centres (ACCs), Approach Control facilities and major Air Traffic Control Towers to accomplish this task.

## BACKGROUND

Since the late 1950s, launch and re-entry operations have occurred in the United States. In the US, space operations are no longer considered special events since they occur frequently, sometimes to the point of having multiple launches in a single day. The US space sector has experienced dramatic growth in the past decade due to the emerging commercial space industry, including new space companies and spaceports (see Figure 20).



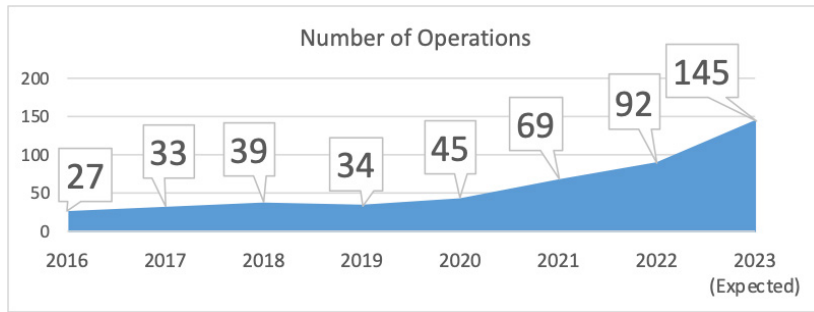


Figure 20: Space Operations over the Years in the US.

## PROCESS

The Air Traffic Organization (ATO), Space Operations Office follows a comprehensive and repeatable process to prepare for activities by Launch and Re-entry Operators (LROs) as shown in Figure 21:

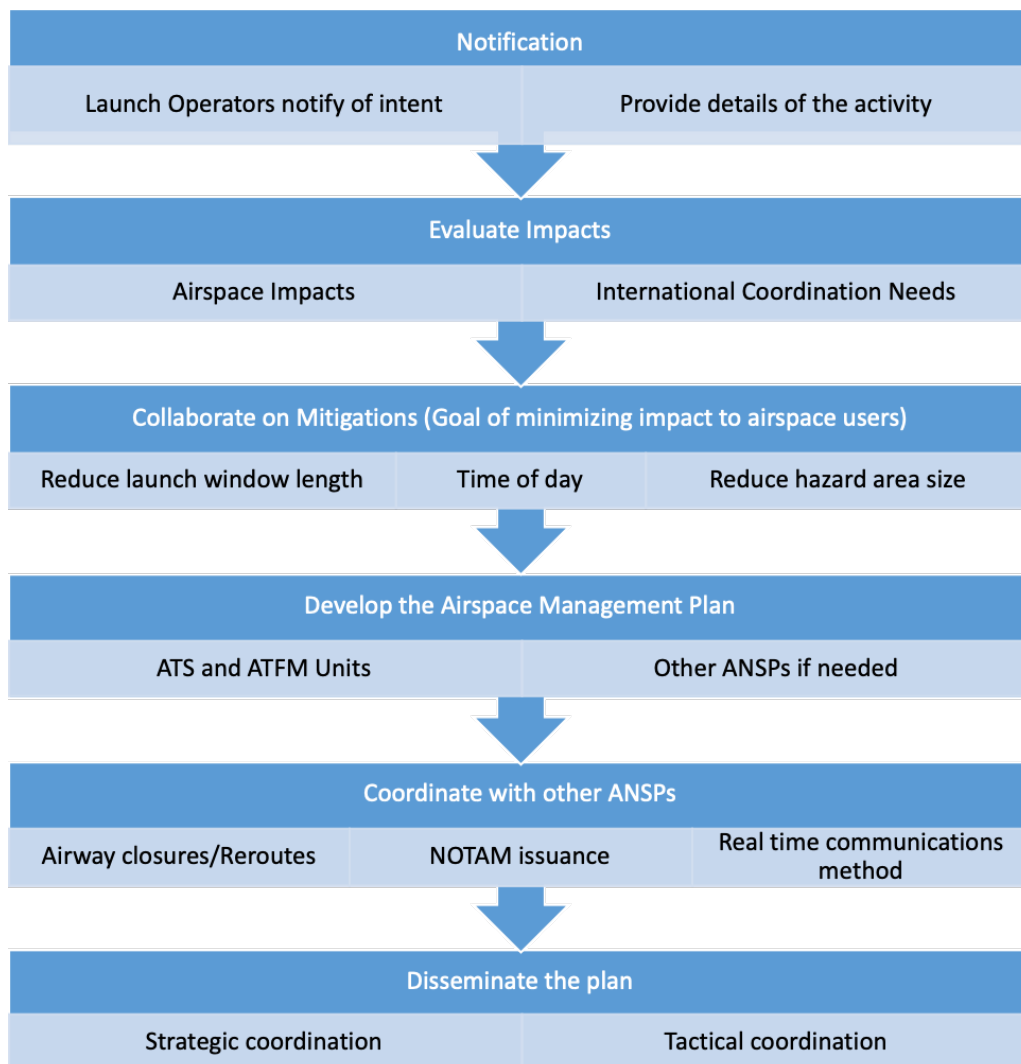


Figure 21: Space Launch Management Process

# **STRATEGIC PLANNING**

## **Notification**

Space operators are required to notify the Space Operations Office well in advance of the planned launch with details of the planned operation.

## **Evaluation**

The Space Operations Office determines potential impacts to the airspace from the various stages of a space operation including pre-launch fuelling, launch and re-entry while being mindful of potential off-nominal events such as malfunction of propulsion and guidance systems causing catastrophic results. Aircraft Hazard Areas (AHAs) are calculated by the Space State Regulator (SSR).

## **Mitigation**

Impacts to traditional aviation are reviewed by analysing traffic patterns against the geographical extent of the AHAs and the planned timing of the launch. Mitigations are frequently achieved by collaborating with the LRO to reduce the time of launch windows, adjust the time of day the launch is planned for (if orbital mechanics permit), reduce the size of the AHAs (if approved by the SSR). Note: ANSPs should work with LRO and Space State Regulator (SSR) to see if a reduction in the size of AHAs can be safely achieved.

## **Develop the airspace management plan (AMP)**

The ATCSCC collaborates with the affected Air Traffic Service (ATS) facilities and Flow Management Units (FMU) on Air Traffic Flow Management Measures (ATFM Measures) required. For some launches, collaboration extends to cross border ATS/FMUs. Measures can include closing airways or airspace, rerouting flights around the AHAs, methods of real-time communication to coordinate airspace reopening, development and publication of NOTAMs.

Elements of the AMP include:

1. Background of the vehicle
2. Launch schedule
3. Aircraft Hazard Area (AHA) information
4. Illustrations of the AHAs
5. Traffic Management Measures (TMMs) to mitigate to the impact of the AHAs

## **Coordinate NOTAMs**

Some launches require multiple ANSPs to issue NOTAMs. These should be coordinated in advance, so all ANSPs are working together to mitigate the impact.

## **Disseminate the plan**

To ensure a safe operation, strategic and tactical coordination occurs between the ATS/FMUs and the affected ANSPs and Flight Operators so all are aware of the actions expected of them during the launch and re-entry.

## TACTICAL EXECUTION

On the day of the launch or re-entry, mission information, including any updates, are communicated via the following Collaborative Decision Making (CDM) methods:

1. Planning webinars every two hours
2. Aviation hotline for significantly impactful launches with aviation operators
3. Operational Information System (OIS) displays for FAA, CADENA and if applicable, Nav Canada OISs
4. The Space Operations Office activates the Mission Hotline for LRO and affected ATS/FMUs. Participants include the Space Operations Office, spaceport/range facility, LRO, ATS facilities, ATCSCC. The Mission Hotline is used to communicate the following:
  - a. Provide operational status of the mission,
5. Communicate safety critical information,
6. Manage the real-time response in the event of a space vehicle malfunction/debris generating event.

**Note:** for the FAA ATO, CDM includes the ATCSCC, ATO field facilities (ACCs, APPs, TWRs), flight operators, appropriate military units and neighbouring ANSPs.

### **Post launch/re-entry**

The Space Operations Office monitors mission progress and facilitates coordination via the Mission Hotline to reopen airspace and resume normal operations including cancellation of NOTAMs.

Flight operators are also notified via the Aviation hotline as soon as flights can make use of the AHAs.

## POST-OPERATIONS ANALYSIS

The Space Operations Office reviews execution of the AMP with the intent of improving efficiency and safety for future launches. These reviews are regularly shared with Space CDM and Aviation CDM groups but they are also shared with air traffic facilities when applicable.

## LESSONS LEARNED

Communication and collaboration are the key elements to effective management of a space launch or reentry. The AHAs often span FIR boundaries and therefore, airspaces managed by neighbouring ANSPs. They are very impactful to airspace systems and subsequently, to flight operations. Without thorough and effective communication, not all ACCs, ANSPs, and flight operators will know what to do at different times throughout the process.

As experience was gained, the key data points were identified and leveraged to return the airspace as soon as possible. This resulted in reducing the impact of launch and recovery operations to traditional aviation.

Timely cancellation of NOTAMs is the key to allowing flight operators to resume flight operations in those areas.

Lessons can be learned about LRO mission execution that allow ANSPs to make operational decisions. For example, when one LRO starts loading liquid oxygen, they are locked into a T-0 launch time and will either launch or scrub their mission within a certain number of minutes, which can be verified with the LRO before operation. That allows for tactical reduction of the launch window and the length of time airspace is closed.

Review of each launch, looking for efficiency and mitigation improvements is key to reducing future impacts and allowing aviation and space operations to coexist in the same airspace.

## **SAFETY CONSIDERATIONS**

All parties in the CDM communities (both Space and Aviation CDMs) are involved in the safety of an event. The following are activities that require active participation and are key components to ensure safety.

### **Pre-operational safety activities:**

- NOTAM coordination that occurs between ANSPs
- Potential required route development and mitigations through ATFM Measures

### **Operational activities:**

- Monitoring hotline
- Monitor AHAs where surveillance is available to ensure aircraft are not entering the area defined by the NOTAM

### **Post-operational activities:**

- Participating in post-operational reviews of airspace related initiatives
- Incorporating lessons learned discussions into future operations

## **SPECIFIC EXAMPLE OF LAUNCH ATFM MEASURES AND TOOLS**

Prior to recent improvements, launches and recoveries required the closure of large blocks of airspace for hours at a time. For example, the map below shows the large warning area created by a launch from Cape Canaveral in Florida. This potentially closes the Atlantic or AR routes, one of which is depicted by the blue line. These have become very busy routes over the past 20 years and closing this airspace for several hours impacts hundreds of flights (see Figure 22).

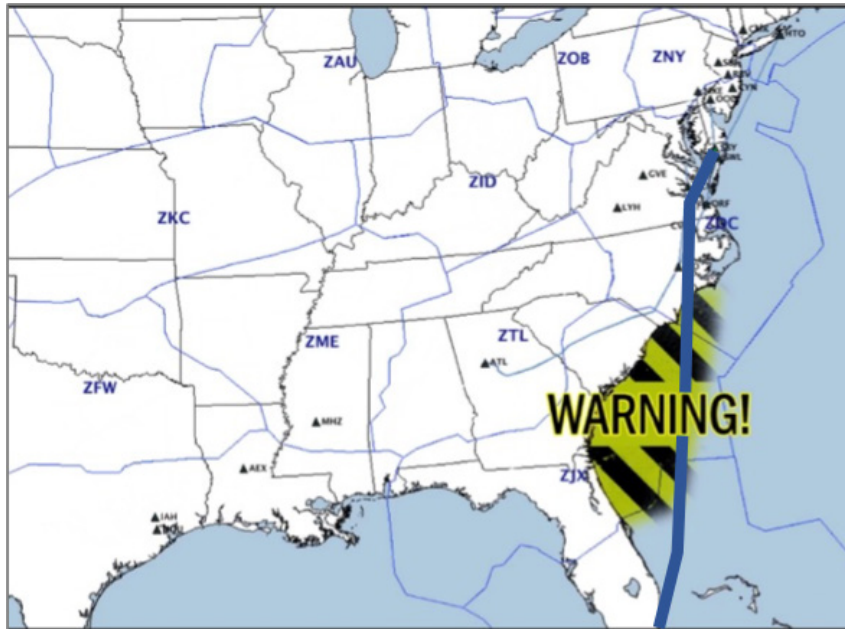


Figure 22: Warning Area

More recently, the SSR, LRO and ATO have been able to reduce the size and duration of the AHAs. LROs are sharing better and tighter probabilistic computations on potential debris fields, thereby reducing AHAs to the minimum size needed.

The ATO uses time-based management of route closures to reduce the amount of time needed for a safe launch. The goal of this approach is to limit the amount of time a closure will be required and to collaboratively share data and information with all the stakeholders in the National Airspace System (NAS). This allows all participants the best predictability and planning available on how to safely operate in the vicinity of a launch area with the least impact to and loss of efficiency in their operations.

From the LRO and SSR information, the ATO calculates a time window for the AHA that ensures all flights are clear of the hazard areas (see Figure 23).

**2. SAFETY LETTER**

The following area is considered hazardous to air traffic and should remain closed to air traffic for the indicated time period.

Description (Area Number)	Hazardous Area (Area enclosed by connecting following points in order)	Closure Time (Minutes From Liftoff, Normal)	Closure Time (Minutes From Liftoff, Malfunction)
(1) Launch Danger Zone (LDZ) Aircraft Hit Probability Contour	28° 35' N 80° 38' W 28° 59' N 80° 10' W 29° 06' N 80° 01' W 29° 05' N 79° 58' W 28° 43' N 80° 11' W 28° 30' N 80° 22' W 28° 27' N 80° 32' W and to the beginning.	9	25 (if malfunction occurs during flight)
(2) Jettisoned Items (1st Stage, MVAC Skirt Ring, Dragon Nosecone) Impact Area (b)	30° 08' N 79° 06' W 32° 05' N 76° 55' W 31° 48' N 76° 36' W 29° 55' N 78° 49' W and to the beginning.	25	25

**3. SAFETY LETTER**

**Restricted Areas**

Restricted Areas	Closure Time (Minutes From Liftoff, Normal)	Closure Time (Minutes From Liftoff, Malfunction)
R2932	9	25
R2933	9	25

Figure 23: Proposed Hazard Area

For the launch, traffic managers at the ATCSCC build a Flow Constrained Area (FCA), which depicts the airspace on the Traffic Flow Management System (TFMS) Traffic Situation Display (TSD). The FCA is a line, circle, or polygon with an altitude range that depicts the unavailable airspace and its duration. The TSD allows the ATCSCC to see which aircraft will transition the FCA. Flight operators can see the FCA using a web-based variant of TSD.

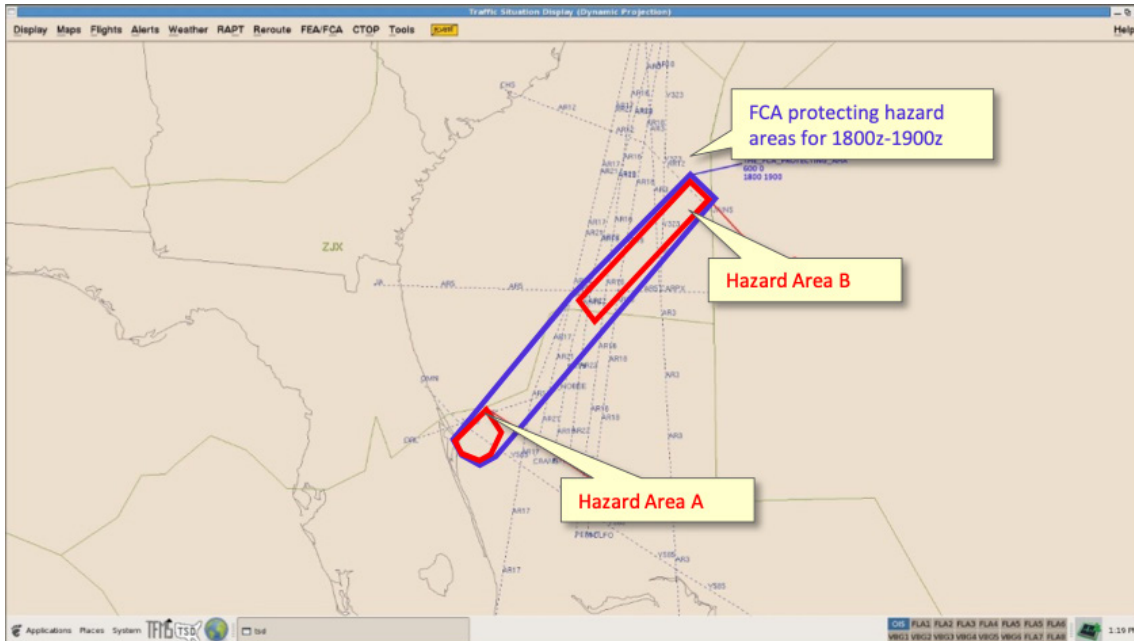


Figure 24: Creation of FCA

The TSD display as shown in Figure 24 above, depicts two critical hazard areas (or AHAs) identified as areas A and B (red), and the FAA has developed the appropriate FCA (blue) to encompass all the safety-critical airspace that must be protected for the launch. This FCA provides all system users with the definition of the airspace and what times the airspace will be closed. From this, all users can access a list of flights that will be impacted so they can make dispatch decisions for these flights.

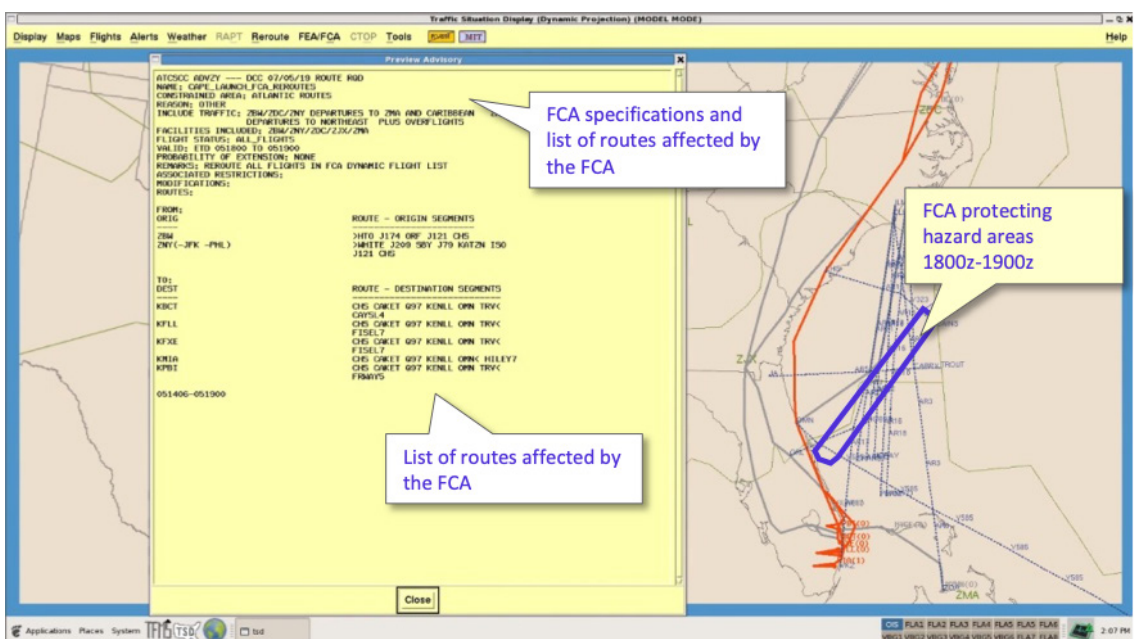


Figure 25: Rerouting of Flights

The ATCSCC issues required reroutes that flight operators are required to use to avoid the protected launch airspace (see red routes in Figure 25). By defining the FCA, showing the users the airspace that will be closed, and providing the start and end times of the FCA along with the reroutes to avoid both the launch safety area and other airspaces that may not be able to handle the increased traffic, the flight operators are made aware of the options and alternatives they can choose from to safely conduct their flight.

In 2015, the ATO introduced a Space Data Integrator (SDI) to efficiently integrate Launch and Recovery operations into the NAS. The SDI receives telemetry from CDM partner LROs and overlays it onto the TSD. The SDI provides a situational display of:

- Vehicle position
- Mission event status (e.g., ready for launch)
- Vehicle performance: actual versus planned trajectory of launch and reentry operations
- Aircraft Hazard Areas (AHAs)

The SDI was developed in collaboration with the Space CDM stakeholders.

## **CONCLUSION**

Space launch and reentry operations can be completed in a safe and efficient manner while minimising the impact to other airspace users. The keys to accomplishing this include using data to drive decisions and implementing collaborative decision-making processes to guarantee timely, consistent, and transparent communication across all stakeholder groups. The challenge is to ensure this happens across FIR boundaries with ANSPs who may not always be familiar with space operations so they can close and reopen their airspace in a timely manner.



# 11. CASE STUDY 8: TYPHOON (HONG KONG CHINA)

<b>Event/Disruption</b>	Typhoon (Tropical Cyclone)
<b>Date &amp; Location</b>	Seasonal; Hong Kong, China
<b>Type</b>	Disruption
<b>Synopsis</b>	This case study discusses the Hong Kong Civil Aviation Department's (HKCAD) management of seasonal tropical cyclones (typhoons). During the passage of a typhoon, severe inclement weather is experienced both around Hong Kong International Airport (HKIA) and within the Hong Kong FIR. The weather conditions often result in reduced capacity and necessitate the use of ATFM measures to balance traffic demand. This case study provides details on how HKCAD's ATFM unit coordinates the situation and the ATFM measures, as well as how requirements and restrictions from adjacent FIRs are managed.
<b>Contributors</b>	<b>Anfernee Poon</b> , Senior Operations Officer (Strategic Planning), HKCAD <b>Alex Leung</b> , Conversion Training Officer, HKCAD <b>Wicko Fok</b> , Project Officer, HKCAD <b>Jimmy Tong</b> , Air Traffic Control Specialist (Evaluation), HKCAD

## OVERVIEW

Severe weather associated with the passage of a tropical cyclone (typhoon) is hazardous to aircraft operations. ATC provides every assistance possible to facilitate pilots to avoid it. Depending on its relative location and movement, operations at the Hong Kong International Airport (HKIA) or in various parts of Hong Kong FIR (HKFIR) may be impaired.

Depending on the degree of impairment, availability of HKIA and/or ATS routes in HKFIR may be affected. To ensure the safe provision of ATC services, the respective demand of air traffic needs to be appropriate for the reduced capacity.

Such capacity reduction can be extensive and rapidly changing. Air traffic flow, if not adequately managed, may lead to wasted resources, and more importantly, can be unsafe if ATC is overwhelmed.

To ensure the remaining capacity is best used and not overloaded, an ATFM plan must be formulated in advance based on various factors, including the meteorological forecast. However, as Hong Kong Observatory (HKO) – the meteorological services provider of Hong Kong – has agreed, providing an accurate forecast of a tropical cyclone track and intensity is a major challenge.

## **EVENT RESPONSES**

HKO is the meteorological department responsible for providing aviation MET services within HKFIR. They publish and share with all concerned stakeholders current and forecasted information pertaining to typhoons, such as their projected track, intensity, and probability of having gale or storm force winds, etc.

### **Pre-typhoon**

As the ANSP, HKCAD, in collaboration with HKO, is responsible for assessing the potential impact of typhoons to air traffic at HKIA and in HKFIR. Once the pre-typhoon planning phase begins, HKCAD determines the appropriate Airport Acceptance Rate (AAR) at HKIA and, if necessary, regulates traffic flow in the FIR. HKCAD and HKO will conduct meetings with all concerned stakeholders, including Airline Operators (AOs), in accordance with the CDM process, to enhance their situational awareness. HKCAD also actively participates in the Airport Emergency Centre (AEC), which works closely with all concerned stakeholders to share information needed by each of them in a timely manner. AOs then determine if they need to reschedule or cancel their flights accordingly.

Within HKCAD, an Air Traffic Flow Management Unit (HK ATFMU) is responsible for monitoring traffic demand and capacity at HKIA and in the FIR, and initiating appropriate ATFM measures, if necessary. The same weather system (i.e., the typhoon) may also affect operations in adjacent airports and/or FIRs, the HK ATFMU may thus need to collaborate ATFM measures with its overseas counterparts on a regional basis.

Once developed, the ATFM Daily Plan (ADP) is disseminated through email to all stakeholders (see Figure 26). With the possibility of a reduced AAR at HKIA and/or reduced capacity in the HKFIR, ATFM measures such as Ground Delay Programmes (GDP) or Airspace Flow Programmes (AFP) may be initiated and Calculated Take-Off Times (CTOTs) may be issued to relevant ATFM units if necessary.

### ATFM Daily Plan (ADP)

<b>ATFM DAILY PLAN</b>		<b>HONG KONG</b>			
DATE / TIME OF ISSUE		02 NOV 2022, 2306 UTC			
STATUS / REFERENCE		EFFECTIVE – 03 NOV 2022 HK 01			
CONSTRAINTS AND IMPACT					
LOCATION	PERIOD (UTC)			DETAILS	REMARK
VHHH	03 NOV 2022	0000	0400		AAR=32
		0401	0759		AAR=34
ATFM MEASURE					
LOCATION	ATFM MEASURE PERIOD (UTC)			ATFM MEASURE	
POSSIBLE / DEVELOPING ISSUES					
LOCATION	PERIOD (UTC)			REMARK	
WEATHER BRIEFING					
Significant convection associated with Nalgae will be affecting the northern part of HKFIR before 0400. TEMPO visibility 4000m in passing showers, low level windshear and moderate turbulence FCST before 0400.					
AIRSPACE STATUS BRIEFING					
OTHER INFORMATION					
Declared Dual Rwy AAR=34 Hong Kong International Airport Runway Closure Programme (AIP SUP 13/22)					
Ground Delay Programme (GDP) for aerodrome - CTOT compliance window -5/+10 minutes. Airspace Flow Programme (AFP) for waypoint/airspace - CTOT compliance window -5/+5 minutes.					
FOR CHANGES TO FLIGHTS, PLEASE CONTACT: Primary: Hong Kong Flow Manager Phone Line: +852 2910 6859 (Operational) Email: atmdfm@cad.gov.hk Secondary: Hong Kong ATFMU Phone Line: +852 2910 6275 Email: hkatfmu@cad.gov.hk					

Figure 26: ATFM Daily Plan (ADP) from HK ATFMU

### During the typhoon

During the passage of a typhoon, HK ATFMU regularly monitors traffic demand and available capacity at HKIA and in the FIR with respect to the changing weather conditions and situation.

Additionally, the HK ATFMU also coordinates the implementation of various ATFM measures (e.g., GDP, AFP, Minutes-in-Trail (MINIT), Large Scale Weather Deviation (LSWD) contingency procedures), initiated by ATFMUs in adjacent FIRs. Examples can be seen in Figure 27.

## VHHK – HONG KONG FIR

A1015/22 NOTAMR A1014/22  
Q) VHHK/QARLT/IV/NBO/E/000/999/2003N11500E214  
A) VHHK B) 2211011506 C) 2211022359  
E) DUE TO ACTIVATION OF LSWD CONTINGENCY PROCEDURES:

(1) ON L642 BTN CH AND EPKAL FLIGHT LEVEL AVAILABILITY IS LIMITED TO FL280, FL320, FL360 AND FL400.

(2) ON M771 BTN DOSUT AND CH FLIGHT LEVEL AVAILABILITY IS LIMITED TO FL270, FL310, FL350 AND FL390.

AIP HONG KONG ENR1.8 PARA 15 REFERS.

GG VHZZNMXX  
010750 ZBBBYNYX  
(A2502/22 NOTAMN  
Q) ZSHA/QFFCA/IV/NBO/E/000/999/  
A) ZSHA B) 2209031400 C) 2209052359  
E) DUE TO TYPHOON, FOR REROUTE ACFT:

1. ACFT OVERFLYING SHANGHAI FIR (VIA BEKOL TO PANLONG VOR 'PLT' ALONG ATS RTE A599) TO THE DIRECTION OF JAPAN OR KOREA , SHALL KEEP 20 MIN SEPERATION,REGARDLESS OF ALT.
2. ACFT OVERFLYING SHANGHAI FIR (VIA TEBAK TO PANLONG VOR 'PLT' ALONG ATS RTE A599) TO THE DIRECTION OF JAPAN OR KOREA , SHALL KEEP 20 MIN SEPERATION,REGARDLESS OF ALT.
3. ACFT OVERFLYING SHANGHAI FIR (VIA DOTMI ALONG ATS RTE A470) TO THE DIRECTION OF JAPAN OR KOREA , SHALL KEEP 30 MIN SEPERATION,REGARDLESS OF ALT.
- 4.ACFT OVERFLYING SHANGHAI FIR (VIA MIDOX ALONG ATS RTE R343) TO THE DIRECTION OF JAPAN OR KOREA, REGARDLESS OF ALT SHALL KEEP 30 MIN SEPERATION.

)

Figure 27: Example Flow Restriction NOTAMs during the Typhoon

When MINIT requirements such as those shown in Figure 27 are imposed by ATC units in the adjacent FIRs, HK ATFMU may convert those requirements into GDP/AFP by determining the Calculated Time Over (CTOs) waypoints for flights overflying HKFIR into the FIRs constrained by the requirements. The CTOs, which are aimed at helping flights satisfy the MINIT requirements, are further translated into CTOTs for better efficiency and predictability for the AOs and upstream ANSPs. This MINIT conversion process is based on the following workflow:

1. As demonstrated by the NOTAMs above (Figure 27), HK ATFMU initially sorts out the FPLs of flights affected by such ATFM measures (i.e., filed flight plan of aircraft overflying Shanghai FIR via DOTMI A470 & BEKOL to PANLONG VOR 'PLT').
2. By applying EOBT + Standard Taxi-out Time (STT) of the departure airport + Estimated Elapsed Time (EET) to DOTMI/BEKOL in the flight plans, affected flights' Estimated Time Over (ETOs) DOTMI/BEKOL were determined.
3. Calculated Time Over (CTOs) DOTMI/BEKOL in 20-minute intervals would then be assigned to each affected flight. Finally, corresponding CTOTs were determined by reverse calculation and dispatched to the respective ATFMUs and AOs for their actions.

An increase in route/track deviations, missed approaches, and diversions are likely but hardly predictable. In collaboration with HKO, tactical changes to the ADP, AAR, GDP, AFP, etc. will be implemented accordingly.

Regular collaboration among HK ATFMU, HKO and AOs based on the CDM process ensures everyone has the same situational awareness. CTOTs for flights departing from HKIA will be entered into the A-CDM platform through the established ATFM/A-CDM integration capability for dissemination to all relevant stakeholders, including the AOs, Airport Authority Hong Kong (AAHK), Ground Handling Agents, Ramp Control Officers, etc.

HKCAD also works closely with AAHK on the activation of the Flight Rescheduling Control System with the goal of resuming normal operation in an orderly manner

after the typhoon. Traffic schedules at HKIA are tactically handled by AAHK in accordance with factors such as, the latest weather forecast, AAR, etc., and the recovery of delayed traffic will be slowly absorbed into the revised schedules.

## Post-event

A Post Operation Analysis (POA) is carried out when normal operation have resumed. Findings from the POA are sent to and discussed with relevant stakeholders (see Figure 28). These discussions allow for the exchange of ideas among stakeholders and also often result in the identification of areas for improvement which can then be implemented in the future.

DATE	CALLSIGN	ADEP	ADES	EOBT	CTOT	CLDT	Revised EOBT	Revised CTOT (1st)	Compliance ATOT - CTOT	Absolute Compliance	ATOT	ALDT	Facilitating ATFMU	ATFM Delay CTOT - (EOBT + STT)	STT	FPL Time	Difference (EOBT - FPL Time) (AIP ENR 1.10 Para 4.2)	
24 Feb	CPA501	RIAA	VHHH	24/0135	24/0153	24/0630			9	9	24/0209	24/0645	Japan	0	21	23/2201	214	
24 Feb	CPA728	WMKK	VHHH	24/0200	24/0215	24/0526			4	4	24/0219	24/0545	Malaysia	0	15	23/2201	239	
24 Feb	CPA658	WSSS	VHHH	24/0200	24/0227	24/0537			-1	1	24/0226	24/0539	Singapore	0	20	23/2201	239	
24 Feb	CPA2740	VVNB	VHHH	24/0240	24/0252	24/0415			14	14	24/0306	24/0427	Vietnam	0	12	23/2240	240	
24 Feb	CPA906	RPPL	VHHH	24/0250	24/0302	24/0441	24/0322		9	9	24/0311	24/0456	Philippines	0	12	23/2250	240	
24 Feb	CPA480	RCTP	VHHH	24/0245	24/0305	24/0428			8	8	24/0313	24/0437	Taipei	0	20	23/2245	240	
24 Feb	CPA766	VVTS	VHHH	24/0415	24/0430	24/0638			8	8	24/0438	24/0647	Vietnam	0	10	24/0055	200	
24 Feb	CPA910	RPPL	VHHH	24/0435	24/0500	24/0637	24/0514	24/0500	-2	2	24/0454	24/0634	Philippines	0	12	24/0035	240	
24 Feb	CPA750	VTBS	VHHH	24/0440	24/0500	24/0703			14	14	24/0514	24/0722	Thailand	0	20	24/0040	240	
24 Feb	CPA433	RKSI	VHHH	24/0450	24/0510	24/0837			1	1	24/0509	24/0840	ROK	0	20	24/0139	191	
24 Feb	CPA405	RCTP	VHHH	24/0520	24/0540	24/0701			-2	2	24/0538	24/0700	Taipei	0	20	24/0120	240	
24 Feb	CPA770	VTSP	VHHH	24/0530	24/0548	24/0850			71	71	24/0659	24/0904	Thailand	0	18	24/0147	223	
24 Feb	CPA634	VTBS	VHHH	24/0635	24/0655	24/0859			9	9	24/0704	24/0912	Thailand	0	20	24/0135	240	
Total no. of VHHH ARR in GDP				33				Large early Non-compliance		2-15 mins								
No. of compliance flight				71				Slight early Non-compliance		From >5 mins mins to -15 mins								
Overall compliance %				63.6%				Compliant		CTOT window [-5 mins to +10 mins]								
								Slight late Non-compliance		From >+10 mins to +20 mins								
								Large late Non-compliance		>+20 mins								

Figure 28: Example Post-Ops Analysis Result Distribution

## KEY CHALLENGES

### Accuracy of weather forecasts

Accurate weather forecasts of the rapidly changing convective activity associated with typhoons are important to air traffic operations. For HK ATFMU, given the relative location of HKIA in relation to other major airports overseas, a minimum of six to 8 hours prediction is necessary for the efficient implementation of ATFM measures such as a GDP. However, as discussed above, HKO has agreed that providing accurate forecasts of a tropical cyclones track and intensity is one of their major challenges. Prediction errors also generally increase the further out into the future forecasts are made.

### Increased workload in coordination

Weather conditions change rapidly during the passage of a typhoon. Various stakeholders have different challenges in complying with ATFM measures such as the CTOTs. As a result, an enormous number of requests to change CTOTs (or any other ATFM measure) can arise, and the ensuing coordination required between HK ATFMU and other ATFMUs can significantly increase their workload.

## KEY ENABLERS

### Effective and efficient communication channel between stakeholders

To exchange information efficiently between different stakeholders, a good and reliable communication channel is necessary. Traditional means, such as telephone and email, often take a long time to reach the person at the other end, especially during a crisis like a typhoon when everyone is busy. Although A-CDM platforms are more efficient in disseminating essential information within the local airport

community, communication with overseas parties like adjacent ATC units, remains a great challenge. Automated means of data exchange such as SWIM-based technologies, can greatly reduce the time required to exchange operationally relevant information.

### **Effective facilitation of CTOT coordination**

To balance traffic demand and best use available capacity in accordance with ATFM, high CTOT compliance is vital. The ATFM unit initiating the ATFM measure must endeavour to provide every support necessary for stakeholders (AOs, ATCU/ATFMU at departure points etc.). Requests from flight operations to change CTOT should also be handled in a timely manner in order to minimise possible impacts to them.



## 12. CASE STUDY 9: THE GREAT EAST JAPAN EARTHQUAKE (JAPAN)

<b>Event/Disruption</b>	The Great East Japan Earthquake
<b>Date &amp; Location</b>	March 2011, Japan
<b>Type</b>	Significant Natural Disaster
<b>Synopsis</b>	This case study looks at Japan Air Navigation Services' (JANS) response to the Great East Japan Earthquake and the consequent Tsunami. The earthquake occurred on March 2011, and was one of the largest ever recorded in Japan. The earthquake immediately forced one airport in the Tohoku region to close and impacted two major airports located in the Tokyo metropolitan area. Several ATFM measures were implemented to manage demand/capacity imbalances resulting from the damage to the airports. This case study provides details on how the Japan Air Traffic Management Centre (ATMC) coordinated the responses and applied ATFM measures amid the confusion that followed the disruption.
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### BACKGROUND

On 11 March 2011, at 14:46 JST (05:56 UTC), the massive Great East Japan Earthquake occurred in Japan. The epicentre of the quake was located approximately 70 kilometres off the coast of the Tohoku region in the north-eastern part of Japan at a depth of 24 kilometres. The 9.0 magnitude earthquake was one of the largest ever recorded in Japan. The earthquake triggered a massive tsunami that swept into the north-eastern part of Japan facing the Pacific Ocean (Figure 29).



Figure 29: The Epicentre and Major ATM Facilities

Sendai Airport (RJSS), the main airport in the Tohoku region, was hit by the tsunami and closed for more than a month.

Two of Japan’s major airports, Narita International Airport (RJAA) and Haneda International Airport (RJTT) in Tokyo, were not damaged by the earthquake nor the ensuing tsunami. However, both airports were closed temporarily due to the evacuation of the air traffic control tower (at RJAA) and the need to inspect the facilities (at RJAA and RJTT).

Table 3 provides a summary of the damages to these three airports.

Airport	Impacts
<b>RJSS</b> <b>Sendai Airport</b>	Complete closure of the airport due to the tsunami. The airport remained closed for more than one month.
<b>RJAA</b> <b>Narita International Airport</b>	Takeoff and landing suspended until the runway and airport facility inspection was completed. Personnel in control tower were immediately evacuated for a while before resuming operations. This effect lasted from 0550 – 1455 UTC (nine hours five minutes)
<b>RJTT</b> <b>Tokyo Haneda International Airport</b>	Takeoff and landing suspended until the runway and airport facility inspection was completed. This effect lasted from 0550 – 0720 UTC (1 hour 30 minutes)

Table 3: Summary of the Impacts to Major Airports

## EVENT RESPONSES

At Narita Airport, the scale of the earthquake exceeded the specified limit, so the air traffic controllers were evacuated from the control tower. Takeoffs and landings were suspended for nine hours and five minutes to assess the extent of the damage.

At Haneda Airport, takeoffs and landings were suspended for 90 minutes to assess the extent of the damage.

Inspections revealed that facilities at both airports were almost unaffected but a total of 86 aircraft that were airborne or bound for the two airports required diversions to other destinations. Sixty one of these 86 aircraft belonged to Japanese airlines, the remaining 25 belonged to foreign airlines. At the time diversions were required, Japanese airlines could coordinate parking locations for their flights by themselves, so they could quickly determined alternate airports for the diversion. On the other hand, foreign airlines needed assistance. ATM Officers at Japan Air Traffic Management Centre (ATMC), which oversees Japan’s ATM network and ATFM operations, supported 25 foreign flights to coordinate their diversion destinations based on pilots’ requests.

The timeline of airport operations and ATFM measures on the day of the event are shown in Table 4.

Time (UTC)	Events	ATFM measure
05:46	The earthquake struck	
05:50	RJAA/RJTT (all runways) closed	Ground Stop for RJAA/RJTT, applicable to flights from domestic airports
06:00	RJTT: Two out of four runways re-opened	Flights for RJAA/RJTT from Incheon/Taipei FIRs suspended
06:05		Flights for RJAA/RJTT from Shanghai FIR suspended
06:17	RJTT (all runways) closed due to a second earthquake	
06:34		Flights for RJAA/RJTT from Manila FIR suspended
06:37		Flights for RJAA/RJTT from Oakland FIR suspended
06:38	Sharing information with FAA ATCSCC9 via Hotline	
06:49	Current number of aircraft in flight: 29 aircraft for RJAA 16 aircraft for RJTT	Flights for RJAA/RJTT from Anchorage FIR suspended
06:56	Most staff in RJAA office evacuated	
07:20	Communication lines between Russia and Japan intermittently unserviceable	
07:20	RJTT (all runways) re-opened	Ground Stop for RJTT cancelled GDP (CTOT) implemented Suspension for RJTT flights from Anchorage/Oakland FIRs cancelled
07:30	Current number of aircraft in flight in Fukuoka FIR: 231	Suspension for RJTT flights from Manila FIR cancelled
		Suspension for RJTT flights from Incheon, Shanghai and Taipei FIRs cancelled
07:49	AIDC and L/L between Anchorage/Oakland and Japan unserviceable	
09:52		GDP for RJTT terminated
10:53		Ground Stop for RJTT issued
11:00		Flights for RJTT from Taipei FIR suspended
11:05		Flights for RJTT from Shanghai FIR suspended
12:04		Suspension for RJTT flights from Shanghai/Taipei FIRs cancelled
14:55		Ground Stop for RJAA cancelled
15:00		Suspension for RJAA flights from Anchorage, Oakland, Manila, Shanghai, and Taipei FIRs cancelled.
15:23		Suspension for RJAA flights from Incheon FIR cancelled
18:37		Ground Stop for RJTT cancelled

Table 4: Event Response Timeline

## COORDINATION OF ATFM MEASURES

This section describes how the different ATFM measures were coordinated.

### Ground Stop (GSt)

Japan ATMC issued a Ground Stop (GSt) for all domestic flights to RJAA and RJTT for nine hours and three hours, respectively. ATFM systems sent GSt messages simultaneously to all ATC facilities in Japan and aircraft operators which joined the Collaborative Decision Making (CDM) group.

Japan ATMC also issued an initiative to close entry waypoints to the Japanese airspace (Fukuoka FIR) during the same period for international flights to RJAA/RJTT. The ATMC shared information with adjacent FIRs and aircraft operators that were

members of the CDM group regarding the damage caused by the earthquake and the closure status of RJAA/RJTT. ATFM measures consequent to the restriction were also coordinated.

### **Ground Delay Programme (GDP)**

After the GSt for RJTT was cancelled, Japan ATMC issued a Ground Delay Programme (GDP) to regulate traffic into RJTT. The maximum ATFM delay of the GDP was four hours 20 minutes. ATFM systems sent GDP messages simultaneously to all ATC facilities in Japan and aircraft operators in the CDM group. The ATMC held a web conference on the ATFM system to share information and answer questions from aircraft operators until the traffic conditions stabilised for the day.

## **KEY CHALLENGES**

### **Management of diverted aircraft**

During the closure of Narita and Haneda Airports, it was extremely difficult to distribute the large number of aircraft in the air, bound for both airports, onto the limited parking stands of small or medium-sized, normally operating airports. The air traffic control officers (ATCOs) confirmed intention of each diverting aircraft via radio communication, while ATMC officers confirmed alternate airport conditions before manually assigning an alternate airport for each aircraft. 14 out of 86 diverting aircraft declared an emergency, although all were able to land safely.

## **KEY ENABLERS**

### **Implementation of domestic ATFM measures**

Japan established domestic ATFM in operations since 1994, and air traffic management was performed for the entire Fukuoka FIR (the airports and ACC sectors). Specifically, ATFM operations for Narita and Haneda airports had matured to the level where GDPs were able to be immediately implemented with ATC facilities at relevant airports following the instructions promptly. Ground Stops were also able to be implemented through the ATFM system, enabling Japan ATMC to implement the measure without being disturbed by the confusion caused by the earthquake.

### **Establishment of CDM with domestic stakeholders**

Japan also has CDM with domestic stakeholders (ATC units, airlines, etc.). CDM meetings have been held daily, with an in-person communication system that does not rely on phone calls to share information, which made it possible to share information efficiently in an emergency. By using this CDM coordination, Japan ATMC could expeditiously share information with the operators regarding the GDP implementation and airport conditions.

### **Implementation of international ATFM measures**

While Narita and Haneda Airports were closed, the capacity of airports within Fukuoka FIR was also greatly reduced. As a result, it became necessary to close entry waypoints into Fukuoka FIR to maintain the demand/capacity balance of the entire Fukuoka FIR.

Japan ATMC coordinated with Incheon ACC and Taipei ACC to issue the ATFM measures in accordance with procedures contained in existing facility-to-facility Letters-Of-Agreement (LOAs). Fukuoka ACC, Oceanic Control Centre (located in Fukuoka), and the Naha ACC (located on Okinawa Island, Japan) coordinated with

other adjacent FIRs to close entry waypoints into Fukuoka FIR based on ATMCs requests.

### Establishment of CDM with adjacent FIRs

Japan has CDM not only domestically but also with neighbouring FIRs. Japan ATMC could minimise traffic disruption in the Fukuoka FIR by coordinating ATFM measures and restrictions, and sharing information with ACC/ATM authorities in the adjacent FIRs. The ATMC could also continue communication with the FAA by using the hotline that had been established for contingencies.

### Hotline with the FAA (ATCSCC)

Japan ATMC had an established hotline with the FAA's ATCSCC which had been used for routine teleconferences twice a week. The hotline was used to coordinate between the ATMC and the ATCSCC during the earthquake and the aftermath.

### Web-conferences with the airlines

Japan ATMC had been hosting regular web-conferences with airlines twice a day, normally at 23:45 UTC (08:45 JST) and 06:20 UTC (15:20 JST). This web-conference channel was used temporarily to share information with the airlines, which started at 08:50 UTC (17:05 JST) and lasted throughout rest of the day.

### Commercial phone in lieu of the inter-facility landline connection

The normal inter-facility landline connections between Japan/Russia, Japan/ Anchorage, and Japan/Oakland were not useable due to the earthquake. Commercial phone lines were used instead.

Figure 30 shows the status of ATFM coordination between ATMC and neighbouring facilities in 2011.

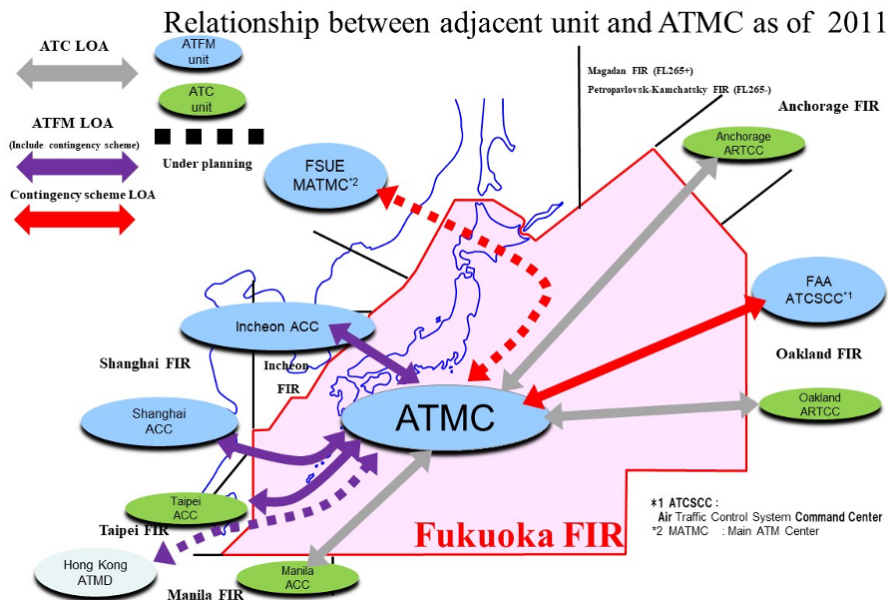


Figure 30: ATFM Relationship between ATMC and Neighbouring Facilities in 2011

## **LESSONS LEARNED**

### **Importance of CDM with neighbouring FIRs and related stakeholders**

In this case, Japan ATMC frequently shared information with the CDM group (adjacent FIRs, ATC units, airlines, and other stakeholders), which made it possible to coordinate immediate ATFM measures and ATC assistance.

It is important to share operational, situational and ATFM related information with neighbouring ATC units and relevant airspace users to avoid confusion in case of a disaster.

### **Importance of diversion airport coordination**

Based on this experience, in 2015, JANS introduced an emergency diversion support system that picks an appropriate diversion airport for each aircraft based partially on their remaining fuel level. It was designed based on a scenario during which a disaster occurred in the metropolitan region and both RJAA and RJTT were closed at the same time. It is important to establish the method for coordinating diversion airports while considering the remaining fuel on-board the aircraft when major airports are closed.

### **Importance of alternative means of communication**

In this case, Japan ATMC lost the communication tools used for coordination during normal times. Alternative means of communication made it possible to share information and coordinate ATFM measures with related stakeholders and adjacent FIRs in case of a disaster.

It is important to establish alternative means of communication and ensure personnel are trained to be able to use them in case of a disaster.

## **APPRECIATION FROM JANS**

Japan ATMCs immediate response after the earthquake was as described above. Sendai Airport, which was severely damaged by the tsunami, began repair work immediately after the earthquake. With great support, such as was provided by 'Operation Tomodachi ' (the immediate assistance on the repair work at Sendai Airport provided by the US forces), we were able to restart Sendai airport approximately one month later, on 13 April 2011.

With this opportunity, JANS would like to express our deep gratitude to various countries, regions, and international organisations that provided overseas support in the wake of the Great East Japan Earthquake.



# 13. CASE STUDY 10: CADENA CONTINGENCY MANAGEMENT (LATIN AMERICA)

<b>Event/Disruption</b>	Hurricanes and Other Cross-Border Contingency Events
<b>Date &amp; Location</b>	Seasonal, Latin America and Caribbean Region
<b>Type</b>	Contingency Planning
<b>Synopsis</b>	In this case study, the CANSO ATFM Data Exchange Network for the Americas (CADENA) Regional Implementation Group (RIG) provides an overview of contingency management among ANSPs in the Latin America and Caribbean region. The ANSPs, grouped together under the CADENA initiative, has developed a harmonised and collaborative approach to managing airport and airspace contingencies in the area based on a regional multi-nodal ATFM and Collaborative Decision Making (CDM) network. The use of planned contingency ATS routes, an information sharing platform, and CDM conferences are discussed in the context of a hurricane in this case study.
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## BACKGROUND

The CANSO ATFM Data Exchange Network for the Americas (CADENA) was established in 2016 to support the implementation of air traffic flow management (ATFM) based on collaborative decision-making (CDM) principles in the Latin America and Caribbean region. One of CADENA's many benefits is coordinating and exchanging information during contingency events, especially during the hurricane season. In collaboration with participating ANSPs and airlines, in August 2017, CADENA launched the [Operational Information System \(OIS\)](#), allowing ANSPs to easily share contingency and operational information via the web application. Since then, the CADENA OIS has been enhanced several times to provide more capabilities to exchange ATFM/CDM related information and to boost coordination opportunities. CADENA has also developed Planned Airway System Alternatives (PASA) contingency routes, organised quarterly contingency exercises, and developed ANSP Contingency forms and checklists related to specific emergency events.

The PASA contingency routes help to improve predictability, mitigate delays, and enhance safety during these exceptional events. The list of current PASA routes is

available in the CADENA OIS platform. It is reviewed and updated quarterly so that users can take advantage of these routes to avoid the impacted airspace when necessary.

As of 13 March 2023, the CADENA participating ANSPs and airspace users have held 335 weekly ATFM/CDM operational planning web conferences, 92 contingency ad-hoc, and 22 Space Launch and Recovery CDM web conferences.

One example of CADENA's achievements in dealing with hurricanes can be seen in the example of Hurricane Delta, which hit the Latin America and Caribbean region in October 2020. During the storm, the airlines requested the hurricane-avoiding route via the PASA route request function of the CADENA OIS, and through the OIS, ANSPs analysed and ultimately approved the requests. The affected airline was issued a contingency route like the one illustrated in Figure 31, allowing the flight to bypass the hurricane with a safe and viable choice of destination, saving both time and money, while the ANSPs obtained advanced notifications of the change in their overflight demand.

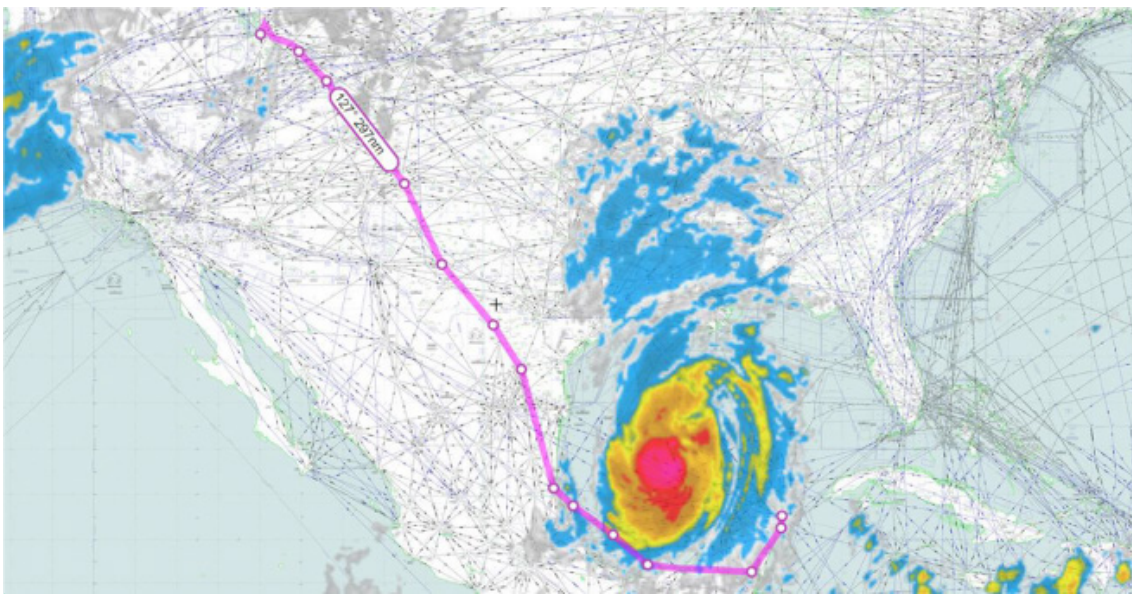


Figure 31: PASA Route Request on 7 Oct 2020

The CADENA participants understand the importance of preparing for special events and work closely with each other in quarterly contingency training exercises. The contingency training exercise goal is always to 'train as we respond' and simulate how critical it is to ensure good communication and teamwork. During the [CANSO Academy: Exclusive CADENA Training on ATFM Contingency Best Practice](#) webinar held in September 2020, the CADENA simulation shared best practices on handling the contingency situation of an ACC rendered completely out-of-service due to a lightning strike. Delegates from across the globe participated, including representatives from IATA and ICAO.

## HARMONISED APPROACH TO CONTINGENCIES

The CADENA initiative created measures and actions such as the quarterly contingency trainings, ad-hoc web conferences, contingency form templates for ANSPs, continuous updates of the CADENA ATFM-CDM Procedures Manual (Contingency Planning chapter), and the live-chat mechanism within the CADENA OIS to enable communications between ANSPs and/or airlines and ANSPs, among others. The measures and actions allowed the region to manage irregular operations caused by disruptive events, such as hurricanes or technology errors while maintaining safe and seamless skies. CADENA participants applied and activated procedures contained in the CADENA ATFM-CDM Procedures Manual when dealing with disruptions caused by earthquakes, lightning strikes, volcanoes, and/or power outages resulting in the complete loss of communications, navigation and/or surveillance capabilities. By following the ATFM-CDM Procedures, operational impacts during these events were reduced through excellent coordination and collaborative efforts.

The CADENA participants created a contingency communication method to harmonise how they deal with disruptions to air traffic operations in the region. As a result, when a rare event jeopardises air traffic operations, the CADENA contingency protocol is activated, and everyone now responds following a harmonised approach.

The CADENA participants' harmonised approach to responding to contingencies has been used to manage several unplanned events, including:

- the long-term impact of the lightning strike in 2017 at the Kingston ACC;
- the devastating effects of Hurricane Maria in September 2017;
- the power outage at Central America (CENAMER) ACC that resulted in the complete loss of communications, navigation, and surveillance in February 2020;
- the impact of active volcanoes in the regions including La Soufrière volcano eruption in April 2021;
- the radar outage at Panama ACC in March 2023.

Under a contingency event, CADENA participants gather and share via the OIS, information related to:

- Area Control Centres (ACCs)
  - Evacuation
  - Radar failure
  - Air/Ground (A/G) communication failure
  - Telephone or landline failure
  - Power failure
  - Flight data processing system (FDPS) failure
  - Staffing shortages
  - Work stoppages (strikes)
- Severe weather/natural phenomena
  - Hurricanes/tropical storms
  - Volcanic eruption
  - Earthquakes

- Airports
  - Aircraft accidents/incidents
- Flow Management Unit (FMU) outages
  - Equipment failure
  - Unavailable FMU services
- Off-Nominal (Unusual) Events
  - The COVID-19 global pandemic

Based on CADENA's experience with such events and the associated lessons learned, CADENA participants have recognised the key steps to help ANSPs prepare for the unexpected include the development of the following:

- A description of potential events that can disrupt air traffic operations;
- A checklist of initial ATFM/CDM steps for responding to a disruptive event;
- The process for evaluating the effectiveness of ATFM measures during an event and adjusting throughout the event;
- The ATFM/CDM-related steps necessary to recover from a disruptive event;
- A Points-of-Contact (POC) List, along with their roles, and responsibilities;
- The lessons learned documentation and post-event reports.

**Note:** These steps are based on the third edition of ICAO Manual on Collaborative ATFM (Doc 9971), Section 2.4.

As a result, CADENA participants have developed the following:

- The “Contingency Events and Checklists” reference guide (in the ATFM-CDM Procedures Manual) shown below (Figure 32), which helps mitigate the impact of unplanned events through a ready-reference checklist for use when the unexpected happens;
- A Point-of-Contact (POC) List of CADENA participants for each ANSP and the stakeholders (This list is available in the CADENA OIS as a ready reference);
- The Lessons Learned Document made available to CADENA participating ANSPs through the CADENA OIS.

**APPENDIX E: CONTINGENCY EVENTS AND CHECKLISTS**

There are fourteen checklists for the following events:

1. Evacuation of an ACC
2. Radar Failure
3. A/G Communication Failure
4. Telephone or Landline Failure
5. Power Failure
6. FDPS Failure
7. Staff Shortage
8. Work Stoppage (Strike)
9. Hurricane or Tropical Storm
10. Volcanic Eruption
11. Earthquake
12. Aircraft Accident/Incident
13. FMU Outage
14. Off-Nominal (Unusual) Event
15. AFTN Outage

<b>1: Evacuation of an ACC</b>	<b>Impacted Facility: ACC (Name)</b>
<b>Initial ATFM Action</b>	<b>Follow-Up ATFM Actions</b>
<ul style="list-style-type: none"> <li>• Whichever FMU receives the information first, notify your adjoining FMUs</li> <li>• Stop departure traffic under your FMU's jurisdiction that is filed to/through the impacted ACC's airspace</li> <li>• Coordinate airborne holding, if necessary</li> <li>• Coordinate re-routes for existing, airborne traffic, if necessary</li> <li>• Notify stakeholders, as able</li> <li>• Post an Urgent Advisory on the CADENA OIS</li> </ul>	<ul style="list-style-type: none"> <li>• Notify CADENA and ICAO leadership as soon as possible</li> <li>• Gather information on:                             <ul style="list-style-type: none"> <li>○ How long is the ACC expected to be out of service?</li> <li>○ What is the impact to demand and capacity?</li> <li>○ Have aircraft diverted?</li> <li>○ If so, how many and to which airports?</li> </ul> </li> <li>• CADENA leadership will, as soon as possible, schedule and conduct a CADENA CDM web conference, including airspace users, to relay available information and establish next steps</li> <li><i><b>NOTE:</b> The situation may require scheduling a daily webex for the first few days of the event</i></li> <li>• For a potential long-term evacuation, discuss and coordinate alternate routes</li> <li>• Evaluate potential demand on the alternate routes and coordinate TMMs, as applicable</li> </ul>
<b>2: Radar Failure</b>	<b>Impacted Facility: ACC (Name) or TMA (Name)</b>
<b>Initial ATFM Action</b>	<b>Follow-Up ATFM Actions</b>
<ul style="list-style-type: none"> <li>• Stop departure traffic under your FMU's jurisdiction that is</li> </ul>	<ul style="list-style-type: none"> <li>• Notify CADENA and ICAO leadership</li> </ul>

Figure 32: Excerpt from Contingency Events & Checklists

During an unplanned disruptive event, the CADENA support team, a group of selected CADENA participants, organises the Contingency Web Conference and uploads the related contingency event forms and identifying the impact. If the contingency is associated with severe weather, such as a hurricane or tropical storm, CADENA participants will conduct a daily 14:00 UTC (or at the time coordinated) CADENA Hurricane Web Conference.

The hurricane web conference provides a means to share important information that will aid ANSPs and stakeholders in planning and making appropriate decisions. Starting two or three days before a hurricane's landfall in an area managed by a participating ANSP, the web conference Host will be selected based on the hurricane's location and projected path. Only ANSPs affected by the storm, and those where traffic may be rerouted, will be required to participate in the hurricane web conference.

CADENA participants are then notified of the pending hurricane web conference through the CADENA OIS. The hurricane web conference is open to participating CADENA ANSPs and stakeholders. Participating CADENA ANSPs shall follow these procedures:



## CADENA hurricane web conference procedure

Impacted ANSPs will upload, through the CADENA OIS or as an email to the Host, a set of Hurricane/Tropical Storm slides (PowerPoint or .pdf) by 1200 UTC (during US daylight savings time) each day the hurricane web conference is conducted. A sample of the slide deck is provided in Figure 33.

### APPENDIX B: SAMPLE HURRICANE / TROPICAL STORM WEB CONFERENCE SLIDES

**HURRICANE (NAME) UPDATE – 1400 UTC – DATE**

**ANSP Name** Slide 1

PROJECTED PATH IN YOUR AIRSPACE
• THE CADENA HOST WILL ADD A GRAPHIC OF THE PROJECTED PATH

**HURRICANE (NAME) UPDATE – 1400 UTC – DATE**

**ANSP Name** Slide 2

PROJECTED IMPACT
<b>DAY 1</b> AIRPORT CLOSING (DATE/TIME) STAFFING ISSUES EQUIPMENT OUTAGES

**HURRICANE (NAME) UPDATE – 1400 UTC – DATE**

**ANSP Name** Slide 3

IMPACTED ROUTES	PLANNED TRAFFIC MANAGEMENT MEASURES
• ADD GRAPHICS, IF ABLE • ADD SLIDES, IF NEEDED	• FOR EXAMPLE: REROUTES, MIT, MINIT

Figure 33: Sample Slides for Contingency Web Conference

The Host for the hurricane web conferences may change to accommodate the expected movement of the storm. The Host for the following day will be announced at the close of each web conference.

### Host: pre-conference responsibilities

For hurricane and tropical storm web conferences, the Host prepares the 'Hostmaster' slide deck template with the correct date and time, current weather product snapshot, and other relevant information. Other pre-conference host responsibilities include:

1. Reviewing the weather forecast products and preparing a brief overview of regional weather and other constraints;
2. Retrieving and compiling the hurricane or tropical storm slides from the CADENA OIS into a single, comprehensive master slide deck for visual reference of the Flow Management Units (FMUs) participating in the web conference;
3. Logging into the web conference at least 15 minutes before the start of the meeting to ensure connectivity and to conduct a sound check.



### **Host: Web conference responsibilities**

1. Provides a short synopsis of the regional weather conditions and significant events.
2. Calls on each Flow Management Unit (FMU), in turn, to provide their briefing. The order of discussion will depend upon which track of the hurricane or tropical storm impacts participating ANSPs.
3. Listens carefully and takes notes of relevant discussions.
4. Ensures stakeholder questions and concerns are heard and addressed.
5. At the end of the web conference, provides a summary and thanks the participants for their contributions.
6. Announces the date and time of the next hurricane/tropical storm web conference.

### **Host: Post-conference responsibilities**

Prepares the hurricane/tropical storm master slide deck and uploads it through the CADENA OIS within one hour of completing the web conference.

Note: The hurricane/tropical storm master slide deck will be displayed on the CADENA OIS under 'Master Slide Deck for access by the public.

Participating FMUs are also tasked with pre-conference, web conference, and post-conference responsibilities. FMUs need to review the areas of concern and input the information into the ANSP slide deck template, participate in the web conference, and brief participants, answer questions, and brief their facility management on the outcome of the web conference, among other activities.

## **BENEFITS FROM THE HARMONISED APPROACH**

From 2016 until March 2023, CADENA participants have prepared for and hosted ad-hoc CDM web conferences to address a wide variety of operational situations, including:

- 29 hurricanes and tropical storms;
- 6 volcanic ash events;
- 32 ATC-Zero events (12 events in 2020)
- 26 equipment outages (e.g., radar failure, electric power failure, communication failure, NOTAM and weather system outages)
- 28 airport incidents and issues
- 9 high operational impact space launch coordination

Figure 34 shows real examples of savings realised by airlines during severe weather events, other emergencies, and in the trial of the PASA route optimisation initiative. All of which were coordinated and planned by CADENA participants using the CADENA OIS.

Airline	Event	Savings (USD)	Savings (minutes)	Fuel Savings	CO <sub>2</sub> Reduction
Airline 1	2017 Hurricane Maria Recovery Operation	\$1-5.4M	NA	NA	NA
Airline 2	2017 Return Home from Hurricane Maria	\$182,000	NA	NA	NA
Airline 3	2017 Loss of Radar Surveillance	\$225,000	NA	NA	NA
Airline 4	2017 Loss of Radar Surveillance	\$175,500	NA	NA	NA
Airline 5	2017 Loss of Satellite Communication	\$192,000	NA	NA	NA
Airline 6	2021 PASA Optimization Pilot Test	\$77,756	414 minutes	122,403 lbs.	175,403 kg
Airline 7	2021 PASA Optimization Pilot Test	\$35,053	194 minutes	52,702 lbs.	75,541 kg
Airline 8	2021 PASA Optimization Pilot Test	\$16,189	114 minutes	16,125 lbs.	23,113 kg
Airline 9	2021 PASA Optimization Pilot Test	\$16,772	129 minutes	11,900 lbs.	17,057 kg
Airline 10	2021 Filed Flight Plans via CADENA OIS during a regional Aeronautical Fixed Telecommunications Network (ATFM) outage	\$1.3M	NA	NA	NA

Figure 34: Example Benefits from CADENA Harmonised Approach

## KEY CHALLENGES

CADENA participants encountered many challenges while creating the contingency methodology now contained in the CADENA ATFM CDM Procedures Manual. Some of the key challenges include:

1. Preparing a contingency web conference takes time to coordinate, organise and brief; having the correct information to make proper decisions and communicate the decisions to stakeholders is essential;
2. Regular maintenance of the CADENA participant POC List;
3. Since published airspace structures change (e.g., newly establish, modified, or cancelled fixes; new published fixed ATS routes, etc.), regular maintenance of the PASA contingency route database is also needed;
4. During an emergency, the affected organisation might not have the communication channels or is overwhelmed handling the crisis. Therefore, the CADENA support team assists the entity, and its workload increases.

## **KEY ENABLERS**

The CADENA participants have developed several documents and templates which have proven to be key enablers to support the various operational activities. These documents and templates include:

1. CADENA ATFM/CDM Procedures Manual;
2. CADENA Operational Information System Manual;
3. CADENA Contingency Event Checklists;CADENA Hurricane and Tropical Storm Briefing PowerPoint Templates;
4. CADENA Volcanic Ash Briefing PowerPoint Templates;
5. CADENA Visual Support Team to support the operations during contingency or unusual events.

The CADENA participants have also developed the CADENA OIS, an information sharing web application.

## **CONCLUSION**

Using easy-to-understand contingency event handling procedures, timely information exchanges, and close collaboration among stakeholders, the CADENA participants demonstrated that many contingency events could be managed better. Better contingency event management then brings significant benefits to the aviation stakeholders.

# APPENDIX 1. AIP SUPPLEMENT FOR G20 SUMMIT (CASE STUDY 1)

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<b>E-mail:</b> AIM.Editorial@airservicesaustralia.com		<b>DATE:</b> 11 NOV 14	

## THE GROUP OF TWENTY (G20) 2014 LEADER'S SUMMIT AIRSPACE PROCEDURES - BRISBANE

### 1. INTRODUCTION

1.1 The Australian Government will host the Group of Twenty (G20) Leaders Summit in Brisbane from 15<sup>th</sup>-16<sup>th</sup> November 2014. The Department of the Prime Minister and Cabinet, Department of Defence and Airservices Australia have established air control measures to ensure that an appropriate level of airspace security exists to support the event. These airspace procedures are part of comprehensive security arrangements implemented by the Australian Government.

1.2 **ALL** aircraft and airspace users planning to conduct operations within 90NM of Brisbane Airport (BN), SFC-FL600 during 11<sup>th</sup>-18<sup>th</sup> November 2014 will be required to comply with the regulations referred to and the procedures detailed in this AIP Supplement (AIP SUP).

1.3 The G20 Leaders Summit will result in increased Australian Defence Force and Queensland Police Air Wing aviation activity in the Brisbane basin.

1.4 This AIP SUP details airspace management arrangements, including the establishment of Air Defence Identification Zones (ADIZ) and Temporary Restricted Areas (TRA), references to regulations, changes to procedures, restrictions and appropriate contacts to ensure security and the safety of aircraft, the public and visiting dignitaries.

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1.5 TRAs R900AB (Brisbane CBD), R900C (Brisbane Inner) and R900D (Brisbane Outer) and ADIZ ALPHA and BRAVO are described at section 2, 3 4 and 5 respectively. It is expected that TRAs R900AB, R900C and R900D and ADIZ ALPHA and BRAVO will be activated for periods of between 4 and 6 hours on 11<sup>th</sup> and 12<sup>th</sup> November and then H24 commencing 14<sup>th</sup> November through until 18<sup>th</sup> November. These times will, however, be confirmed by NOTAM.

1.6 Airspace procedures have been designed to be as permissive to civil aircraft operations as the security situation allows. Access to TRAs, however, will be restricted during NOTAM timings.

1.7 Police may be present at airports in the Brisbane Basin to monitor compliance with this AIP SUP. Non-compliance with regulations and airspace procedures may result in penalties being applied.

1.8 Military aircraft will operate in airspace clear of civilian traffic under normal air traffic rules except when the security situation warrants intervention. In such circumstances military aircraft may operate with Due Regard to other traffic and will accept responsibility for collision avoidance. AIP ENR 1.1-106 refers.

1.9 Any aircraft unable to comply with requirements in this AIP SUP will not be permitted to operate within the TRAs. Any aircraft which does not comply with the requirements of the ADIZ may be subject to intercept by a military aircraft.

## 2. TEMPORARY RESTRICTED AREA R900AB (BRISBANE CBD)

2.1 TRA R900AB (Brisbane CBD) will be activated at specified times during the period 11<sup>th</sup>-18<sup>th</sup> November 2014. These times will be confirmed by NOTAM.

2.2 The dimensions and activation periods are as follows:

### **Temporary Restricted Area R900AB (Brisbane CBD)**

#### **Lateral Limits**

#### **R900A - BN CBD**

**LATERAL LIMITS:** 27 27 10S 153 01 28E, 27 27 00S 153 01 40E

27 27 18S 153 02 21E, 27 27 48S 153 02 09E

27 28 39S 153 01 42E, 27 29 49S 153 01 09E

then along CORONATION DR to 27 28 52S 152 59 51E

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then along CORONATION DR to 27 28 07S 153 00 30E  
then along HALE ST to 27 27 28S 153 00 50E  
then along ICB to 27 27 10S 153 01 28E  
**VERTICAL LIMITS:** SFC-2000

**R900B - BN CBD**

**LATERAL LIMITS:** 27 29 49S 153 01 09E, 27 28 39S 153 01 42E  
27 27 48S 153 02 09E, 27 27 18S 153 02 21E  
27 27 55S 153 03 41E, 27 30 34S 153 02 10E  
27 30 06S 153 01 11E,  
then along CORONATION DR to 27 29 49S 153 01 09E  
**VERTICAL LIMITS:** SFC-2000

**Vertical Limits:** SFC – 2000  
**Activation:** NOTAM  
**Controlling Authority:** Queensland Police Service  
Contact Queensland Police Operations Centre via email  
[G20.TRAFlightRequest@police.qld.gov.au](mailto:G20.TRAFlightRequest@police.qld.gov.au)

2.3 R900AB is contained within the Brisbane CTR. Apart from the requirements of this AIP SUP, all extant airspace boundaries, classification, air traffic services and procedures within the confines of R900AB remain in effect. Aircraft in R900AB will receive a Class C air traffic service.

2.4 R900AB exists to afford G20 security aircraft freedom of movement in the vicinity of the Brisbane CBD. Operations within R900AB are restricted to:

- a. G20 security aircraft.
  - b. Approved aircraft involved with the preservation of life (including Search and Rescue (SAR) Medical (MEDEVAC) Flood and Fire Relief (FFR), Hospital (HOSP) and Police aircraft (not involved with G20 security operations).
  - c. G20 accredited media aircraft.
  - d. Other flights as approved by the Controlling Authority.
-



2.5 Aircraft other than G20 security aircraft require approval to operate within R900AB from the Police Operations Centre (POC). G20 accredited media shall make an initial request for access via [g20mediaapps@pmc.gov.au](mailto:g20mediaapps@pmc.gov.au) for operational approval before contacting the POC. Aircraft involved with the preservation of life and likely to require access to R900AB are encouraged to register with the POC and obtain 'pre-approval'. Flights involved in the preservation of life may request 'short notice' approval to operate within R900AB from the POC through ATC.

2.6 The following procedures apply within R900AB:

a. All aircraft shall flight plan. For G20 security aircraft, flights involved in the preservation of life, pre-approved media aircraft and other flights that are approved by the Controlling Authority the lodging of flight details with Airservices Australia via telephone on 07 3866 3694 shall satisfy the flight plan requirement.

b. All aircraft shall operate VFR where possible to do so.

c. All aircraft shall maintain communications with ATC.

d. Due to R900B's proximity to the instrument landing system for Runway 01 at Brisbane airport, operations within, R900B by day, and R900AB by night, may be restricted. Restrictions shall not apply to G20 security aircraft in the event of a security situation.

e. Aircraft shall not operate above 1000FT AMSL unless cleared by ATC to do so.

f. All aircraft shall carry and activate a transponder on a discrete code, as advised by ATC.

g. In the event of a security situation the Controlling Authority may exclude all non G20 security aircraft from R900AB.

### **3. TEMPORARY RESTRICTED AREA R900C (BRISBANE INNER)**

3.1 Temporary Restricted Area R900C (Brisbane Inner), will be activated at specified times during the period 11<sup>th</sup>-18<sup>th</sup> November 2014. These times will be confirmed by NOTAM.

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3.2 The dimensions and activation periods are as follows:

**Temporary Restricted Area R900C (Brisbane Inner)**

**Conditional Status: RA1**

**Lateral Limits:** 27 20 58S 153 00 08E, 27 19 17S 153 01 04E

then along the minor arc of a circle of 7.00NM radius centred on

27 22 29S 153 08 04E to 27 25 40S 153 15 04E

27 27 21S 153 14 08E,

then along the minor arc of a circle of 7.00NM radius centred on

27 24 10S 153 07 08E to 27 30 08S 153 11 15E

27 33 43S 153 04 48E, 27 30 11S 152 59 09E

27 28 40S 152 58 51E, 27 25 36S 152 58 14E

27 22 47S 152 59 23E,

then along the minor arc of a circle of 7.00NM radius centred on

27 24 10S 153 07 08E to 27 20 58S 153 00 08E

**Vertical Limits:** SFC – FL180

**Activation:** NOTAM

**Controlling Authority:** Airservices Australia 07 3888 3798

3.3 R900C contains the Brisbane CTR and a portion of airspace between the Archerfield CTR and the Brisbane CTR. Apart from the requirements of this AIP SUP, all extant airspace boundaries, classification, air traffic services and procedures within the confines of R900C remain in effect. Aircraft within Class C airspace will receive a Class C air traffic service. Aircraft in Class G airspace (that portion of R900C between the Archerfield CTR and the Brisbane CTR SFC to A010) will receive a Class C air traffic service and will require clearance.

3.4 R900C exists to limit operations to approved aircraft with known flight profiles. Operations within R900C are restricted to:

a. G20 security aircraft.

b. Flights departing Brisbane Airport (YBBN) which have flight planned and flights arriving YBBN which have flight planned and received a slot time.

c. Approved aircraft involved with the preservation of life (including SAR, MEDEVAC, FFR, HOSP and Police aircraft (not involved with G20 security operations).

d. G20 accredited media aircraft

e. Other flights as approved by the Controlling Authority.

3.5 The following operations within R900C are unlikely to be approved by the Controlling Authority: training flights, glider flights, parachuting, hang gliding, ultra light aircraft, hot air balloons, banner towing, moored manned and unmanned balloons, model rockets, model aircraft and civil unmanned aerial systems.

3.6 In addition to the requirements of AIP, the following procedures apply within R900C:

- a. All aircraft shall flight plan. For G20 security aircraft, flights involved with the preservation of life, pre-approved media aircraft and other flights that are approved by the Controlling Authority the lodging of flight details with Airservices Australia via telephone on 07 3866 3694 shall satisfy the flight plan requirement.
- b. All aircraft shall contact ATC prior to entering R900C.
- c. All aircraft shall maintain continuous communications with ATC.
- d. For flights entering Class C airspace, aircraft shall obtain an airways clearance prior to entering R900C and comply with ATC instructions.
- e. For flights remaining in Class G airspace, aircraft shall track in accordance with their lodged flight plan, unless amended tracking has been notified to ATC and an acknowledgement of the amended tracking has been received.
- f. All aircraft shall carry and activate a transponder on a discrete code, as advised by ATC.
- g. In the event of a security condition, the Controlling Authority may exclude all non G20 security related aircraft from R900C.

3.7 Scheduled aircraft planned to overfly the Brisbane area on published routes which may transit R900C will be accommodated where they can be de-conflicted with security related activities. Where this cannot be accommodated, ATC will issue amended route clearances. Normal flight planning, transponder and communication procedures for Class C airspace will apply.

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#### 4. TEMPORARY RESTRICTED AREA R900D (BRISBANE OUTER)

4.1 Temporary Restricted Area R900D (Brisbane Outer), will be activated at specified times during the period 11th -18th November 2014. These times will be confirmed by NOTAM.

4.2 The dimensions and activation periods are as follows:

**Temporary Restricted Area R900D (Brisbane Outer)**

**Conditional Status: RA1**

**Lateral Limits:** A circle of 30.00NM radius centred on 27 21 57S 153 08 21E (BN/VOR), excluding any active extant military restricted areas.

**Vertical Limits:** SFC – FL180

**Activation:** NOTAM

**Controlling Authority:** Airservices Australia 07 3866 3798

4.3 Apart from the requirements of this AIP SUP, all extant airspace boundaries, classification, air traffic services and procedures within the confines of R900D remain in effect. Aircraft in Class C airspace will receive a Class C air traffic service. Aircraft in Class G airspace will receive a Class G air traffic service. Specific clearances are still required to enter active extant military restricted areas.

4.4 In addition to the requirements of AIP, the following procedures apply within R900D:

- a. All aircraft shall flight plan.
  - b. All aircraft shall contact ATC prior to entering R900D.
  - c. All aircraft shall maintain continuous communications with ATC.
  - d. For flights entering Class C airspace, aircraft shall obtain an airways clearance prior to entering R900D and comply with ATC instructions.
  - e. For flights remaining in Class G airspace, aircraft shall track in accordance with their lodged flight plan, unless amended tracking has been notified to ATC and an acknowledgement of the amended tracking has been received.
-

f. All aircraft shall carry and activate a transponder on a discrete code, as advised by ATC.

**4.5 Non-G20 related Military Operations.** Military aircraft may operate within active extant military restricted airspace as per the DAH in accordance with normal local procedures. When operating outside active extant military restricted areas military aircraft not associated with G20 security operations are to comply with procedures in this AIP SUP.

**4.6 Archerfield (YBAF) operations.** YBAF is located within R900D. A portion of airspace between the Archerfield CTR and the Brisbane CTR is located within R900C. All aircraft arriving at, departing from or operating at YBAF shall comply with procedures promulgated for operations in R900D. Unless specifically approved by the controlling authority, aircraft arriving at, departing from or operating at YBAF are required to remain clear of R900C. In addition the following procedures apply specifically to YBAF operations:

a. Tower hours will be amended by NOTAM during the G20 activity. Aircraft operations at YBAF shall not be permitted outside the operating hours of YBAF Tower except for aircraft engaged on G20 support operations.

b. Due to its proximity to the sensitive areas contained within R900AB, YBAF may be closed to all operations at short notice if required for security purposes. This advice will be made available to aircraft by ATC and broadcast on the Archerfield ATIS along with the expected duration of the closure if known.

c. Irrespective of flight rules or intention to enter controlled airspace all aircraft departing YBAF are to flight plan and contact Brisbane Centre 125.7 for a discrete transponder code immediately prior to taxi. When ready to taxi, aircraft shall advise AF Tower of the SSR code received and confirm they are familiar with this AIP SUP. Aircraft not in receipt of an SSR code or acknowledging they are familiar with the AIP SUP will not be permitted to depart.

d. Aircraft that wish to conduct circuits at YBAF are still required to flight plan and carry and activate a transponder on the discrete code issued by ATC.

e. Circuit operations at YBAF will be restricted as follows during

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the periods of the activation of R900AB:

- Single runway operations only.
- Right circuit R10 left only
- Left circuit R28 right only
- Runway 04/22 left and right not available
- Certain parts of Archerfield aerodrome may be unavailable for use by non-G20 support aircraft.

f. Aircraft departing YBAF to conduct flying training in D666, D672 and D673 are required to flight plan and carry and activate a transponder on a discrete code.

g. The ARCHERFIELD RNAV-Z RWY 28 APPROACH is not available (except for Flights permitted to operate within R900AB and R900C - refer to paragraph 2.4 and 3.4). Aircraft requiring an instrument departure shall depart via an ARCHERFIELD ONE DEPARTURE (RADAR) and expect radar vectors or tracking instructions to return to planned track while remaining clear of R900C.

h. Wherever possible VFR aircraft tracking to or from YBAF within R900D are to utilise promulgated VFR routes. The northbound VFR route known as the "Northern Departure" (refer AIP ERSA FAC B-48) is not available during the periods of activation of R900AB . Airmen intending to depart YBAF to the north should plan via Lake Manchester (LMC- refer AIP Visual Terminal Chart Brisbane/Sunshine Coast) taking care to avoid R900AB and R900C to the east and the Amberley MCTR and associated restricted areas to the west. It is ESSENTIAL that accurate tracking is adhered to in order to avoid R900AB and R900C. Only authorised flights (refer paragraph 2.4 and 3.4) are authorised to enter R900AB and R900C. It is expected that the Amberley MCTR and restricted areas will be ACTIVE during this period.

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## 5. AIR DEFENCE IDENTIFICATION ZONE

5.1 Air Defence Identification Zones (ADIZ) ALPHA and BRAVO will be established at specified times during the period 11th - 18th November 2014. These times will be confirmed by NOTAM.

5.2 The dimensions and activation periods are as follows:

### **ADIZ ALPHA**

**Lateral Limits:** A circle of 30.00NM radius centred on 27 21 57S 153 08 21E (BN/VOR).

**Vertical Limits:** SFC-8500

**Activation:** NOTAM

### **ADIZ BRAVO**

**Lateral Limits:** A circle of 90.00NM radius centred on 27 21 57S 153 08 21E (BN/VOR).

**Vertical Limits:** 8500 – FL600

**Activation:** NOTAM

5.3 Apart from the requirements of this AIP SUP, all extant airspace boundaries, classification, air traffic services and procedures within the confines of ADIZ ALPHA and BRAVO remain in effect. For example, aircraft in Class G airspace will receive a Class G air traffic service, aircraft in Class E airspace will receive a Class E air traffic service and aircraft in Class C airspace will receive a Class C air traffic service. Specific clearances are still required to enter active extant military restricted areas.

5.4 ADIZ procedures are promulgated in AIP ERSA 5.

5.5 The following procedures apply in lieu of AIP ERSA EMERG 5.4 to 5.8.

5.5.1 ERSA EMERG 5.4. When a flight is intended to operate within an ADIZ, the pilot must:

- a. Lodge a flight plan covering flight within the ADIZ at least 60 minutes before entry into the ADIZ. G20 security aircraft, flights involved with the preservation of life, approved media flights and other flights that are approved by the Controlling
-

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Authority are exempt from the 60 minute requirement.

b. Contact ATC prior to entering the ADIZ.

c. For those flights entering Class C airspace, obtain an airways clearance and comply with ATC instructions in accordance with extant AIP procedures.

d. For those IFR flights in Class E airspace, obtain an airways clearance and comply with ATC instructions in accordance with extant AIP procedures.

e. For those VFR flights in Class E airspace, track in accordance with the lodged flight plan, unless amended tracking has been notified to ATC and an acknowledgement of the amended tracking has been received.

f. For those flights in Class G airspace, track in accordance with the lodged flight plan, unless amended tracking has been notified to ATC and an acknowledgement of the amended tracking has been received.

g. Maintain continuous communications with ATC.

h. Carry and activate a transponder on a discrete code, as advised by ATC.

5.5.2 ERSA EMERG 5.5. AIP ERSA EMERG 5.5 does not apply. There are no exemptions from AIP ERSA EMERG 5.4, replaced by paragraph 5.5.1 of this AIP SUP.

5.5.3 ERSA EMERG 5.6. Flight plans must be lodged in accordance with paragraph 5.5.1 of this AIP SUP. They must include all the detail specified in ERSA EMERG 5.6.

5.5.4 ERSA EMERG 5.7. Reporting points published in aeronautical charts must be used. There are no additional reporting requirements required by an Area Air Defence Commander.

5.5.5 ERSA EMERG 5.8. The requirement to immediately notify ATC of any deviation from flight plan, contained in ERSA EMERG 5.8 does not apply. Flights must track in accordance with the procedures contained in paragraph 5.5.1 of this AIP SUP.

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5.6 All remaining ADIZ and intercept procedures promulgated in ERSA EMERG 5 – 7 still apply.

5.7 Aircraft not complying with the procedures within this AIP SUP, or aircraft unable to be satisfactorily identified, may be subject to intercept by military aircraft.

5.8 Unidentified aircraft operating beneath ADIZ BRAVO and assessed as likely to enter ADIZ ALPHA or BRAVO may be subject to communications checks and visual inspection by military aircraft in order to determine their identity.

## 6. ADMINISTRATION

6.1 **Mass Air Briefing.** A briefing detailing G20 airspace and operating procedures will be conducted on a date closer to the event. Timings and venue will be notified through Southern Queensland RAPAC and the G20 website.

## 7. EMERGENCY PROCEDURES

7.1 Aircraft involved in the preservation of life are required to flight plan to operate in R900AB, R900C and R900D. The lodging of flight plan details with Airservices Australia via telephone satisfies this requirement. Operations within R900AB require POC approval. Aircraft involved with the preservation of life and likely to require access to R900AB are encouraged to register their details with the POC and obtain 'pre-approval'. Regardless, aircraft involved with the preservation of life may request 'short notice' approval to operate within R900AB from the POC through ATC.

7.2 Pilots should review emergency procedures detailed in AIP ERSA EMERG, in particular loss of radio procedures.

## 8. PRE FLIGHT BRIEFING AND SUBMISSION OF FLIGHT NOTIFICATION

8.1 No changes have been made to the methods for obtaining pre-flight briefings and submitting flight notifications.

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## 8.2 Contacts:

### a. Airservices Pilot Briefing website:

<http://www.airservicesaustralia.com/brief/>

*Note: A User name/ID and password is required to access briefing and flight notification database.*

### b. Pilot Briefing Office:

i. Tel: 1800 805 150

ii. Tel: 02 6268 5062

iii. Fax: 02 6268 5033

## 9. ADDITIONAL INFORMATION

9.1 Additional information will be promulgated by NOTAM as required and posted on the following websites:

[www.airservices.gov.au/pilotcentre/index.htm](http://www.airservices.gov.au/pilotcentre/index.htm)

<https://www.q20.org/>

<http://www.police.qld.gov.au/q20/>

9.2 For additional information concerning these arrangements and queries on operational matters, the Defence Joint Airspace Control Cell (e-mail [adf.airspace@defence.gov.au](mailto:adf.airspace@defence.gov.au) telephone 1800 562 222) is available as follows:

a. Normal business hours until 11<sup>th</sup> November 2014 (inclusive).

b. H24 from 102200Z to 180800 Nov 2014.

9.3 Queries regarding flight approvals within a TRA should be directed to the applicable controlling authority, as specified within paragraphs 2.1, 3.1 and 4.1 of this AIP SUP.

## 10. CANCELLATION

10.1 This AIP SUP self cancels on 1411180800.

## 11. DISTRIBUTION

11.1 By AVFAX and Airservices Australia website only.

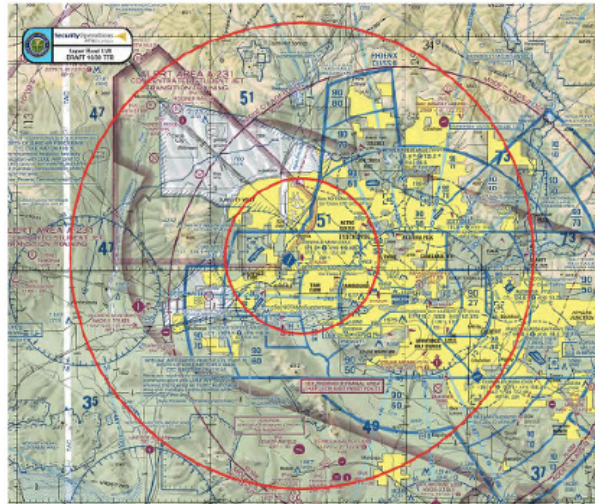
### Appendices:

1. Temporary Restricted Area R900AB (Brisbane CBD)
2. Temporary Restricted Area R900C (Brisbane Inner)
3. Temporary Restricted Area R900D (Brisbane Outer)
4. Air Defence Identification Zone ALPHA and BRAVO.

# APPENDIX 2. TFR EXAMPLE FOR THE SUPER BOWL (CASE STUDY 3)

Below is the example of the Temporary Flight Restriction (TFR) enacted in Glendale, AZ, USA for the Super Bowl LVII in February 2023

## TFR



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## TFR Information

- **TFR Center:** 33°31'48"N / 112°15'53"W
- **10 NM Radius:** Only scheduled air carrier, scheduled cargo, and aircraft that participate in one of seven TSA security screening programs.
- **30 NM Radius:** "Squawk and talk" Must have transponder code and talking to ATC
- **TFR Effective:** FEB 12<sup>th</sup> at 1430L until 2030L or one hour before kickoff until one hour after game's conclusion



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# APPENDIX 3. AIP SUPPLEMENT FOR COBRA GOLD 2023 (CASE STUDY 5)

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THE CIVIL AVIATION AUTHORITY OF THAILAND  
 Aeronautical Information Services Department  
 333/105 Lak Si Plaza, Khamphaeng Phet 6 Rd.,  
 Talat Bang Khen, Lak Si, Bangkok 10210 Thailand

NON-AIRAC  
 AIP SUPPLEMENT

A 02/23  
 12 JAN 2023

## JOINT MILITARY AIR EXERCISE IN BANGKOK FIR "COBRA GOLD 2023"

### 1 INTRODUCTION

Joint military exercise named COBRA GOLD 2023 will take place within the Bangkok FIR from 27 February - 10 March 2023 (except Saturday and Sunday) details are as follows.

### 2 EXERCISE AREAS

	Area (boundary)	Vertical limits	Period of activity (Except Saturday and Sunday)
2.1	<b>Charlie 1 (CG-1)</b> 145500N1005000E, 153300N1002700E, 161731N1002700E, then along a 30 NM arc counterclockwise from the Phitsanulok (PSL) VOR (164613.34N1001728.70E) to 163454N1004626E, 163200N1012700E, 150700N1005900E, 150700N1005000E then back to the point of origin.	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.2	<b>Charlie 2 (CG-2)</b> 163200N1012700E, 162000N1020000E, 152220N1013630E, 154255.80N1011046.48E then back to the point of origin.	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.3	<b>Charlie 3 (CG-3)</b> 162000N1020000E, 160840N1023000E, 151528.42N1020944.40E, then along a 20 NM arc counterclockwise around the Khorat (KRT) TACAN (145606.0N1020421.8E) to 151100.70N1015032.93E, 152220N1013630E then back to the point of origin.	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.4	<b>Charlie 4 (CG-4)</b> 160840N1023000E, 155200N1031600E, 152331N1031602E, 151234N1030528E, 151100N1023600E, 150656.88N1022144.04E then along a 20 NM arc counterclockwise from the Khorat (KRT) TACAN (145606.0N1020421.8E) to 151528.42N1020944.40E then back to the point of origin.  <b>Excluding: Buri Ram Terminal Control Area (TMA)</b>  <b>Buri Ram Approach Freq 123.6MHz</b>	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.

	Area (boundary)	Vertical limits	Period of activity (Except Saturday and Sunday)
	<p><b>NOTE:</b></p> <p><b>Buri Ram TMA</b></p> <p>The airspace enclosed by the following boundaries beginning at a point 152840N1033030E then clockwise along 20 NM arc from BRM DVOR/DME (151422.43N1031531.59) to 151633N1033522E and then clockwise along 25 NM arc radius centred on SURIN ARP (145209.4N1032920.0E) to a point 145132N1035548E and then direct to a point 144953N1035055E and then clockwise along 20 NM arc radius centred on SURIN ARP (145209.4N1032920.0E) to a point 143830N1031416E and then direct to a point 143652N1030924E then clockwise along 25 NM arc radius centred on SURIN ARP (145209.4N1032920.0E) to a point 145620N1030434E then direct to a point 145300N1024000E and then counterclockwise along 35 NM arc from KORAT TACAN (145605.94N1020422.11E) to a point 151135N1023700E then direct to a point 151224N1030024E then clockwise along 15 NM arc from BRM DVOR/DME (151422.43N1031531.59E) to a point 152918N1031751E then direct to 154407N1032620E and counterclockwise along 30 NM arc from ROT DVOR/DME (160700.59N1034619.45E) to 153849N1033630E then direct to starting point.</p> <p><b>Vertical limits: 2000 FT AGL - 11000 FT MSL</b></p>		
2.5	<p><b>Charlie 7 (CG-7)</b></p> <p>143609.97N1020159.36E then along a 20 NM arc counterclockwise from the Khorat (KRT) TACAN (145606.0N1020421.8E) to 145100.39N1022419.42E, 144900N1031600E, 143144N1031602E, 142800N1030145E, 135556N1021953E, 135605N1015626E then back to the point of origin.</p>	GND - FL200	27 Feb - 10 Mar 2023, Between 0100 - 1300 UTC.
2.6	<p><b>Charlie 8 (CG-8)</b></p> <p>153740N1010915E, 150700N1014715E then along a 20 NM arc counterclockwise around the Khorat (KRT) TACAN (145606.0N1020421.8E) to 145500N1014400E, 145500N1005900E, 150700N1005900E then back to the point of origin.</p>	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.7	<p><b>Recovery Corridor</b></p> <p>A 5 NM wide corridor bounded by a line joining points 150700N1014715E, 151055N1015040E, 154245N1011100E, 153740N1010915E then back to the starting point.</p> <p>The primary purpose of this corridor is to provide a safe departure/recovery route for aircraft transiting to and from areas CG-1, CG-2, CG-3, and CG-8.</p>	GND - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.

	<b>Area (boundary)</b>	<b>Vertical limits</b>	<b>Period of activity (Except Saturday and Sunday)</b>
2.8	<p><b>Transition Area (TA)</b></p> <p>A circle of 20 NM radius centred on Khorat TACAN (145606N1020421.8E).</p> <p>The primary purpose of TA is to provide a safe transition for aircraft transiting to/from one exercise area to another. Aircraft in transition area shall maintain the appropriate level conform to direction of flight.</p> <p>NOTE:</p> <p>Northeast bound aircraft use FL180 or FL200.</p> <p>Southwest bound aircraft use FL170 or FL190.</p> <p>The airspace will be available for civil aircraft departure or arrival to VTUQ airport subjected to prior coordination with "Combined Live Fly Cell Unit" Phone: +669 2081 0616, +668 1866 6522</p>	GND - FL140, FL170 - FL200	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.9	<p><b>Victor Blue / Aggressor Area</b></p> <p>A restricted area has been established to facilitate flying operations for His Majesty the King of Thailand. The VICTOR BLUE airspace lines between the Bangkok (BKK) VOR/DME (135336.8N1003546.3E) 005 and 050 radials from 40 NM to 80 NM arc.</p> <p>Air operations in the vicinity of Victor Blue are prohibited when active (Chandy Range, CG-8 and CG-1 South of 1520N).</p>	SFC - UNL	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.10	<p><b>Sierra</b></p> <p>131300N1021300E, 123900N1021300E, 124700N1015200E, 125600N1013800E, 131300N1013800E then back to point of origin. This area includes Ban Chan Krem (VTD70)</p>	GND - FL180	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.11	<p><b>X-Ray</b></p> <p>124000N1011500E, 123500N1013700E, 121000N1014000E, 121000N1004500E, 122000N1004500E then back to point of origin.</p>	SFC - FL260	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.12	<p><b>X-Ray Extended</b></p> <p>121000N1014000E, 112000N1015900E, 110000N1020500E, 110000N1010500E, 120000N1004500E, 121000N1004500E then back to point of origin.</p> <p>Caution: X-Ray Extended will not be scheduled for exercise flights on Tuesday, Wednesday, and Friday from 1430-1630 Local Time. This is to allow scheduled civilian air traffic to transit the area.</p>	SFC - FL260	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.13	<p><b>Zulu</b></p> <p>124500N1002500E, 124500N1005800E, 122843N1005800E, 122000N1004500E, 120000N1004500E, 120000N1002500E then back to the point of origin.</p> <p>ZULU LOW (SFC - 6000 FT MSL) will be primarily utilized by military aircraft in support of exercise Cobra Gold 2023.</p> <p>ZULU HIGH (6000 FT MSL - FL130) will be available for reservation and utilization by state aircraft on a 48 hours prior request to ICEPACK controlling agency through the "Combined Live Fly Cell Unit"</p>	<p>ZULU LOW: SFC - 6000 FT MSL</p> <p>ZULU HIGH: 6000 FT MSL - FL130</p>	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.

	Area (boundary)	Vertical limits	Period of activity (Except Saturday and Sunday)
2.14	<b>Zulu Extra</b> 125031N1005031E, 125024N1010652E, 123408N1010644E, 123415N1005023E then back to the point of origin.	6000 FT MSL - FL130	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.15	<b>Chandy Range</b> Chandy Range is located on KRT R-274/68 DME. Exact coordinates are as follows: 1507N10059E, 1507N10050E, 1455N10050E, 1455N10059E to point of origin.	GND - FL240	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
2.16	<b>Baan Dilang</b> An area within 150301N1003713E, 150302N1005447E, 145059N1005448E, 145057N1003714E	GND - FL130	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.

### 3 TRANSITION CORRIDORS

	Area (boundary)	Vertical limits	Period of activity (Except Saturday and Sunday)
3.1	<b>Primary Transition Corridor (PTC)</b> 143609.97N1020159.36E then along a 20 NM arc counterclockwise from Khorat (KRT) TACAN (145606.0N1020421.8E) to 143755.06N1021306.26E, 124346.84N1020027.68E, 124957.01N1014724.86E then back to the point of origin.	2000 FT MSL - 6000 FT MSL and FL170 - FL190	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
3.2	<b>U-Tapao Transition Corridor (UTC)</b> 124500N1005800E, 123800N1005800E, 130700N1020300E, 130900N1015000E then back to the point of origin.  NOTE: Exercise aircraft departed from U-Tapao must cross the BUT VOR (1240.5N10100.4E) R-065 at 20 DME at/or above FL130.	2000 FT MSL - 6000 FT MSL and FL170 - FL190	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.
3.3	<b>Chandy Transition Corridor (CTC)</b> 145500N1011000E, 145500N1012200E, 143342N1020138E, 142238N1020000E then back to the point of origin.	2000 FT MSL - 6000 FT MSL and FL170 - FL190	27 Feb - 10 Mar 2023, Between 0100 - 1400 UTC.

### 4 WARNING AREA

- 4.1 Flying over the Gas Separation Plant in Rayong (Ban Map Ta Phut) is hazardous. All aircraft are recommended to avoid area starting from 1241.2N10108.0E then clockwise along an arc of 2 NM radius from 1243.0N10109.0E to 1243.0N10111.0E then direct to 1238.5N10111.0E from this point make an arc of 5 NM radius from 1243.0N10109.0E clockwise to 1238.2N10108.0E then direct to the starting point, altitude 2000 FT MSL.
- 4.2 Flying over Tempo Restricted Area is prohibited. Aircraft will avoid flying within 5 NM radius centred on point 123823N1011931E, GND - ALT 7000 FT AGL.

5 LIST OF CLOSED ATS ROUTES DURING THE COBRA GOLD 2023 EXERCISE PERIOD (27 FEB - 10 MAR 2023 Except Saturday and Sunday)

ATS Route	Closed Segment	Closed Levels	Remarks from ATC unit
W1/Y20	RAMEI - UBLOD	7000 FT - FL140 and FL170 - FL200	-
A1	SELKA - SANOT	MFA - FL200	ACFT DEP from VTBD, VTBS shall cross 70 NM FM BKK FL210 or above.
W6/Y23	KRT - KKN	MFA - FL460	-
R474	BKK - CMP	MFA - FL460	-
B460	KRT - BODUR	MFA - FL460	-
W8	TL - KRT	MFA - FL460	-
W21	BKK - CMP	MFA - FL460	1001-1400 UTC ACFT DEP/ARR to VTBD/VTBS shall cross 60 NM FM BKK FL130 or above.
W39	NOBER - PCB	MFA - FL460	-
W42	DULEM - RYN	MFA - FL190	Expect radar vectored by ATC to avoid exercise area.
B346	BKK - PCB	MFA - FL460	1001-1400 UTC ACFT DEP/ARR to VTBD/VTBS shall cross 60 NM FM BKK FL130 or above.
G474/L880	DOSBU - OMURO	FL170 - FL190	ACFT DEP/ARR to VTBD/VTBS shall cross 70 NM FM BKK FL200 or above.
M633	OLTUM - TUPGO	FL170 - FL190	ACFT ARR to VTBD/VTBS shall cross 70 NM FM BKK FL200 or above.
B204	GOMES - AGEDO	FL170 - FL190	-
R468/N506	GOMES - BOKAK	MFA - FL190	Expect radar vectored by ATC to avoid exercise area.
P629	DOLNI - VAPVU	MFA - FL190	Expect radar vectored by ATC to avoid exercise area.
B205	RYN - BOKAK	MFA - FL190	Expect radar vectored by ATC to avoid exercise area.
N891	DOLNI - RYN	FL170 - FL190	ACFT DEP/ARR to VTBD/VTBS shall cross 65 NM FM BKK FL200 or above or FL160 or below.
M644	RYN - ALUMO	MFA - FL260	-
Y1	UDN - UBLOD	MFA - FL460	-
Y2	KKN - UBLOD	MFA - FL460	-
Y11	BUT - RILVI	MFA - FL260	ACFT DEP from VTBD/VTBS shall cross 65 NM FM BKK FL200 or above and to cross BUT FL270 or above.
Y12	DOLNI - ALUMO	FL170 - FL190 (DOLNI - ALEMI), MFA - FL260 (ALEMI - ALUMO)	ACFT ARR to VTBD/VTBS shall cross 65 NM FM BKK FL200 or above and to cross ALEMI FL270 or above.
M904	KIGOB - SIRAT	FL170 - FL190 (KIGOB - BUT), MFA - FL260 (BUT - SIRAT)	ACFT DEP from VTBD/VTBS shall cross 65 NM FM BKK FL200 or above and to cross BUT FL270 or above.
R334	RYN - 20 NM South of RYN	FL170 - FL190	-
W33	RYN - SURIX	FL170 - FL190 (RYN - TRT), MFA - FL260 (TRT - SURIX)	ACFT DEP/ARR from TRAT on W33 below FL260 expect radar vectored by ATC to avoid traffic in X-ray Extended area.

ATS Route	Closed Segment	Closed Levels	Remarks from ATC unit
A464 / M751 / W19	GUTSO - REGOS	MFA - FL130	Expect radar vectored by ATC to avoid exercise area.
M757	KASNI - ASEKU	MFA - FL130	ACFT DEP from VTBD/VTBS shall cross 65 NM FM BKK FL140 or above.
Y98	SURMA - LEBIM	MFA - FL130	Expect radar vectored by ATC to avoid exercise area.

Remark: For the detail of closing period, please see in item-2 Exercise Areas of this AIP Supplement.

## 6 CLEARANCE RESTRICTIONS AND FLIGHT PLANNING PROCEDURES

For safety, en-route capacity and flight efficiency enhancements, temporary routes will be established for utilization during COBRA GOLD 2023's active period in the affected airspace and avoiding COBRA GOLD 2023's activities. Clearance Restrictions and Flight Planning Procedures will be as follows:

### 6.1 For RNAV capable aircraft

6.1.1 Departure/Overfly flights from VTBD/VTBS/BKK to the following Destination shall be file flight plan as follows:

Departure/Overfly	Routing	Destination/Overfly
VTBD/VTBS/BKK	Y6	VTCC
	Y6 CMA W20	VTCT
	Y6 BORNO DCT KIMET DCT THS	VTPO
	Y6 BORNO DCT THS DCT LPN	VTCL
	Y6 BORNO DCT THS W25	VTCP
	Y6 BORNO DCT THS W25	VTGN
	Y6 BORNO DCT PSL	VTTP
	Y6 BORNO DCT PSL W27	VTUL
	Y6 BORNO DCT PSL W26	VTPB
	Y6 BORNO DCT PSL W27 LOY W15	VTUD
	Y6 BORNO DCT THS W25 NAN R215 TOMIP	VLLB/LPB
	Y6 BORNO DCT PSL W27 LOY B218 VTN	VLVT/VTN
	A1 SANOT Y15 GRASO R345 ROT Y22	VTUK
	A1 SANOT Y15 GUROK DCT SKN	VTUI
	A1 SANOT Y15 GUROK DCT NKP	VTUW
	A1 SANOT Y15 GRASO R345	VTUV
	Y20 RAMEI W38 BRM (for FL150, FL160) or A1 SANOT DCT BRM (for FL210 or above)	VTUO
	Y20 (for FL150, FL160) or A1 (for FL210 or above)	VTUU
	A1 SANOT Y15 GUROK A202 SAV...	e.g. VHHH, etc
	Y16 BUTRA A1...	e.g. RJ., RC., RK., etc.

Remark: All aircraft concerned are to expect radar vectoring to suit the flow of traffic and/or avoid affected airspace.



6.1.2 Arrival/Overfly flights to VTBD/VTBS/BKK from the following Departure airports shall be file flight plan as follows:

Departure/Overfly	Routing	Destination/Overfly
VTCC	W9 PANTA Y7 TL W9	BKK
	W9 PANTA Y7 TL DCT NAKON	VTBD
	W9 PANTA Y7 TL DCT NORTA	VTBS
VTCT	W22 PSL W9	BKK
	W22 PSL W9 TL DCT NAKON	VTBD
	W22 PSL W9 TL DCT NORTA	VTBS
VTPO	THS DCT PSL W9	BKK
	THS DCT PSL W9 TL DCT NAKON	VTBD
	THS DCT PSL W9 TL DCT NORTA	VTBS
VTCL	W13 PAE W22 PSL W9	BKK
	W13 PAE W22 PSL W9 TL DCT NAKON	VTBD
	W13 PAE W22 PSL W9 TL DCT NORTA	VTBS
VTCP	W22 PSL W9	BKK
	W22 PSL W9 TL DCT NAKON	VTBD
	W22 PSL W9 TL DCT NORTA	VTBS
VTCN	W29 PSL W9	BKK
	W29 PSL W9 TL DCT NAKON	VTBD
	W29 PSL W9 TL DCT NORTA	VTBS
VTPP	W9	BKK
	W9 TL DCT NAKON	VTBD
	W9 TL DCT NORTA	VTBS
VTUL	W27 PSL W9	BKK
	W27 PSL W9 TL DCT NAKON	VTBD
	W27 PSL W9 TL DCT NORTA	VTBS
VTPB	W26 PSL W9	BKK
	W26 PSL W9 TL DCT NAKON	VTBD
	W26 PSL W9 TL DCT NORTA	VTBS
VLLB/LPB	YAKUA B346 PCB W26 PSL W9 (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 (for FL280 or below)	BKK
	YAKUA B346 PCB W26 PSL W9 TL DCT NAKON (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 TL DCT NAKON (for FL280 or below)	VTBD
	YAKUA B346 PCB W26 PSL W9 TL DCT NORTA (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 TL DCT NORTA (for FL280 or below)	VTBS
OVERFLY VTN	VTN B218 LOY W27 PSL W9	BKK
	VTN B218 LOY W27 PSL W9 TL DCT NAKON	VTBD
	VTN B218 LOY W27 PSL W9 TL DCT NORTA	VTBS

Departure/Overfly	Routing	Destination/Overfly
DEP VLVT	R470 UDN Y21 ROT W38 RAMEI Y20 (for FL150, FL160, and FL210 or above)	BKK
	R470 UDN Y21 ROT W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	R470 UDN Y21 ROT W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above) or R470 UDN Y21 ROT W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160)	VTBS
VTUD	Y21 ROT W38 RAMEI Y20 (for FL150, FL160 and FL210 or above)	BKK
	Y21 ROT W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	Y21 ROT W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above) or Y21 ROT W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160)	VTBS
VTUK	Y22 ROT W38 RAMEI Y20 (for FL150, FL160 and FL210 or above)	BKK
	Y22 ROT W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	Y22 ROT W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above) or Y22 ROT W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160)	VTBS
VTUI	SKN DCT ROT W38 RAMEI Y20 (FL150, FL160 and FL210 or above)	BKK
	SKN DCT ROT W38 RAMEI Y20 UBLOD DCT ENDUU (FL150, FL160 and FL210 or above)	VTBD
	SKN DCT ROT W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160) or SKN DCT ROT W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above)	VTBS
VTUW	Y23 SKN DCT ROT W38 RAMEI Y20 (for FL150, FL160 and FL210 or above)	BKK
	Y23 SKN DCT ROT W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	Y23 SKN DCT ROT W38 RAMEI Y20 UBLOD DCT EASTE (FL150, FL160) or Y23 SKN DCT ROT W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above)	VTBS
VTUV	W38 RAMEI Y20 (for FL150, FL160 and FL210 or above)	BKK
	W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160) or W38 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE (for FL210 or above)	VTBS

Departure/Overfly	Routing	Destination/Overfly
VTUO	W38 RAMEI Y20 (for FL150, FL160 and FL210 or above)	BKK
	W38 RAMEI Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W38 RAMEI Y20 UBLOD DCT EASTE (for FL150, FL160) or BRM DCT GRASO Y13 RUKSA DCT EASTE (for FL210 or above)	VTBS
VTUU	Y20 (for FL150, FL160 and FL210 or above)	BKK
	Y20 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	Y20 UBLOD DCT EASTE (for FL150, FL160) or Y20 GRASO Y13 RUKSA DCT EASTE (for FL210 or above)	VTBS
e.g. RJ..., RC..., RK..., etc.	A1 UBL Y20	BKK
	A1 UBL Y20 UBLOD DCT ENDUU	VTBD
	A1 UBL Y20 GRASO Y13 RUKSA DCT EASTE	VTBS
e.g. VHHH, etc.	A202 RAMEI Y20	BKK
	A202 RAMEI Y20 UBLOD DCT ENDUU	VTBD
	A202 RAMEI W42 PAKRI Y13 RUKSA DCT EASTE	VTBS

Remark: All civil aircraft planned to operate within exercise areas are expected delayed or radar vectored to avoid affected airspace.

**6.2 For NON-RNAV capable aircraft**

6.2.1 Departure/Overfly flights from VTBD/VTBS/BKK to the following Destination airports shall be file flight plan as follows:

Departure/Overfly	Routing	Destination/Overfly
VTBD/VTBS/BKK	A464	VTCC
	A464 CMA W20	VTCT
	A464 BEKOD DCT KIMET DCT THS	VTPO
	A464 BEKOD DCT THS DCT LPN	VTCL
	A464 BEKOD DCT THS W25	VTCP
	A464 BEKOD DCT THS W25	VTCN
	A464 BEKOD DCT PSL	VTPP
	A464 BEKOD DCT PSL W27	VTUL
	A464 BEKOD DCT PSL W26	VTPB
	A464 BEKOD DCT PSL W27 LOY W15	VTUD
	A464 BEKOD DCT THS W25 NAN R215 TOMIP	VLLB/LPB
	A464 BEKOD DCT PSL W27 LOY B218 VTN	VLVT/VTN
	A1 SANOT DCT GRASO R345 ROT W5	VTUK
	A1 SANOT DCT GRASO DCT GUROK DCT SKN	VTUI
	A1 SANOT DCT GRASO DCT GUROK DCT NKP	VTUW
	A1 SANOT DCT GRASO R345	VTUV
	W1 RAMEI W38 BRM (for FL150, FL160) or A1 SANOT DCT BRM (for FL210 or above)	VTUO
	W1 (for FL150, FL160) or A1 (for FL210 or above)	VTUU
	A1 SANOT DCT GRASO DCT GUROK R202	e.g. VHHH, etc.
	A1	e.g. RJ..., RC..., RK..., etc.

Remark: All aircraft concerned are to expect radar vectoring to suit the flow of traffic and/or avoid affected airspace.

6.2.2 Arrival/Overfly flights to VTBD/VTBS/BKK from the following Departure airports shall be file flight plan as follows:

Departure/Overfly	Routing	Destination/Overfly
VTCC	W9	BKK
	W9 TL DCT NAKON	VTBD
	W9 TL DCT NORTA	VTBS
VTCT	W22 PSL W9	BKK
	W22 PSL W9 TL DCT NAKON	VTBD
	W22 PSL W9 TL DCT NORTA	VTBS
VTPO	THS DCT PSL W9	BKK
	THS DCT PSL W9 TL DCT NAKON	VTBD
	THS DCT PSL W9 TL DCT NORTA	VTBS
VTCL	W13 PAE W22 PSL W9	BKK
	W13 PAE W22 PSL W9 TL DCT NAKON	VTBD
	W13 PAE W22 PSL W9 TL DCT NORTA	VTBS
VTCP	W22 PSL W9	BKK
	W22 PSL W9 TL DCT NAKON	VTBD
	W22 PSL W9 TL DCT NORTA	VTBS
VTCN	W29 PSL W9	BKK
	W29 PSL W9 TL DCT NAKON	VTBD
	W29 PSL W9 TL DCT NORTA	VTBS
VTPP	W9	BKK
	W9 TL DCT NAKON	VTBD
	W9 TL DCT NORTA	VTBS
VTUL	W27 PSL W9	BKK
	W27 PSL W9 TL DCT NAKON	VTBD
	W27 PSL W9 TL DCT NORTA	VTBS
VTPB	W26 PSL W9	BKK
	W26 PSL W9 TL DCT NAKON	VTBD
	W26 PSL W9 TL DCT NORTA	VTBS
VLLB/LPB	YAKUA B346 PCB W26 PSL W9 (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 (for FL280 or below)	BKK
	YAKUA B346 PCB W26 PSL W9 TL DCT NAKON (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 TL DCT NAKON (for FL280 or below)	VTBD
	YAKUA B346 PCB W26 PSL W9 TL DCT NORTA (for FL290 or above) or TOMIP R215 NAN W29 PSL W9 TL DCT NORTA (for FL280 or below)	VTBS
OVERFLY VTN	VTN B218 LOY W27 PSL W9	BKK
	VTN B218 LOY W27 PSL W9 TL DCT NAKON	VTBD
	VTN B218 LOY W27 PSL W9 TL DCT NORTA	VTBS

Departure/Overfly	Routing	Destination/Overfly
DEP VLVT	R470 ROT W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	R470 ROT W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	R470 ROT W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUD	W4 ROT W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	W4 ROT W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W4 ROT W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUK	W5 ROT W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	W5 ROT W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W5 ROT W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUI	SKN DCT ROT W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	SKN DCT ROT W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	SKN DCT ROT W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUW	W6 SKN DCT ROT W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	W6 SKN DCT ROT W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W6 SKN DCT ROT W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUV	W38 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
VTUO	W38 RAMEI W1 (for FL150, FL160) or BRM DCT GRASO W1 (for FL210 or above)	BKK
	W38 RAMEI W1 UBL0D DCT ENDUU (for FL150, FL160) or BRM DCT GRASO W1 UBL0D DCT ENDUU (for FL210 or above)	VTBD
	W38 RAMEI W1 UBL0D DCT EASTE (for FL150, FL160) or BRM DCT GRASO W1 UBL0D DCT EASTE (for FL210 or above)	VTBS
VTUU	W1 (for FL150, FL160 and FL210 or above)	BKK
	W1 UBL0D DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	W1 UBL0D DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS



Departure/Overfly	Routing	Destination/Overfly
e.g. RJ..., RC..., RK..., etc.	A1 UBL W1 (for FL150, FL160 and FL210 or above)	BKK
	A1 UBL W1 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	A1 UBL W1 UBLOD DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS
e.g. VHHH, etc.	A202 RAMEI W1 (for FL150, FL160 and FL210 or above)	BKK
	A202 RAMEI W1 UBLOD DCT ENDUU (for FL150, FL160 and FL210 or above)	VTBD
	A202 RAMEI W1 UBLOD DCT EASTE (for FL150, FL160 and FL210 or above)	VTBS

Remark: All aircraft concerned are to expect radar vectoring to suit the flow of traffic and/or avoid affected airspace.

## 7 ACTION IN EVENT OF EMERGENCY

In case of civil and non-exercise military aircraft experiencing an emergency that make it necessary to enter an active exercise area should immediately advise one of the following agencies:

### 7.1 Bangkok Area Control Centre (BACC) sector concerned are as follows:

Unit	Frequency	
BACC	SECTOR 1N	124.5 MHz or 256.3 MHz
	SECTOR 2N	126.5 MHz
	SECTOR 3N	128.1 MHz or 263.8 MHz
	SECTOR 4N	120.95 MHz
	SECTOR 5N	132.1 MHz or 268.5 MHz
	SECTOR 6N	133.1 MHz or 285.3 MHz
	SECTOR 1S	120.5 MHz or 256.6 MHz
	SECTOR 2S	118.35 MHz
	SECTOR 3S	125.7 MHz or 268.5 MHz
	SECTOR 4S	133.9 MHz
	SECTOR 5S	135.5 MHz or 285.5 MHz
	SECTOR 6S	123.95 MHz or 265.9 MHz
BANGKOK APPROACH	APP East 119.1 MHz, 122.35 MHz or 262.5 MHz APP West 128.95 MHz, 124.35 MHz, 125.2 MHz or 262.5 MHz	
PHITSANULOK APPROACH	120.7 MHz or 284.0 MHz	
KAMPHAENG SAEN APPROACH	127.75 MHz or 347.2 MHz	
OSCAR CONTROL	127.0 MHz or 331.3 MHz	
FOCAL CONTROL	127.0 MHz or 331.3 MHz	
U-TAPAO APPROACH	119.7 MHz or 273.3 MHz (Primary) 134.5 MHz or 238.3 MHz (Secondary)	
U-TAPAO TOWER	118.3 MHz or 227.0 MHz	
KHORAT APPROACH	129.75 MHz or 349.0 MHz	
KHORAT TOWER	122.2 MHz or 240.5 MHz	
KHON KAEN APPROACH	123.4 MHz or 240.0 MHz	

7.2 If unable to contact BACC an aircraft should contact OSCAR Control on Freq 127.0 MHz or any other GCI facilities. COBRA GOLD 2023 aircraft experiencing an emergency and unable to contact their appropriate control agencies shall contact OSCAR Control or any other GCI facility on Freq 331.3 MHz, 127.0 MHz or guard Freq 243.0 MHz and 121.5 MHz. During exercise period all VTD area those are overlapped by COBRA GOLD 2023 areas will be not active. aircraft not concerned with COBRA GOLD 2023 exercise wish to fly through the areas should be contact "Live Fly Cell" on phone number +669 2081 0616, +668 1866 6522 or "OSCAR Control" on phone number +662 534 4731 to get the permission before file flight plan.

## **8 AIR TRAFFIC FLOW MANAGEMENT DURING COBRA GOLD 2023 PERIOD**

In response to the capacity constraint caused by the Joint Military Air Exercise "COBRA GOLD 2023" the following ATFM measures will be implemented:

### **8.1 Level Capping**

Flights operating within Bangkok FIR during exercise period are requested to file flight plan with appropriate Flight Levels as follows:

- 8.1.1 Domestic flights – FL320 or below
- 8.1.2 International flights overflying Bangkok FIR – Between FL320 - FL460

Other restrictions and adjustments will be technically managed by ATC.

### **8.2 Temporary Flight Level orientation scheme**

Flights operating on the following routes are requested to use the following flight level orientation scheme:

- 8.2.1 Northbound flight from VTBD/VTBS/BKK via A464 (Portion BKK-CMA), Y6 – Odd FL  
and flight depart from VTPI, VTBL, VTBH, VTPP via W9.
- 8.2.2 Southbound flight to VTBD/VTBS/BKK via Y7 or W9 or – Even FL  
other airways joining W9.

### **8.3 Ground Delay Program (GDP) through the provision of Calculated Take-Off Time (CTOT)**

GDP will be implemented by Bangkok Air Traffic Flow Management Unit (BKK ATFMU) to balance the demand and capacity over congested area. CTOT will be issued to the flights using airways W1, W9, Y7, and Y13 to land at VTBD, VTBS and VTBU.

Specific timing of GDP periods each day will be published in the ATFM Daily Plan (ADP), which will be distributed via e-mail to all stakeholders that provided their e-mail to Bangkok ATFMU one day before operations.

When GDP is active, ATS units and aircraft operators are requested to adhere to the procedure published in the AIP Thailand ENR 1.9 and Bangkok ATFMU User's Manual.

### **8.4 BKK ATFMU Contact information**

- a) Phone: +662 287 8024
- b) E-mail: [atfm@bobcat.aero](mailto:atfm@bobcat.aero)
- c) Website: <http://atfm.aerothai.aero> (No password required)
- d) AFTN: VTBBZDZX

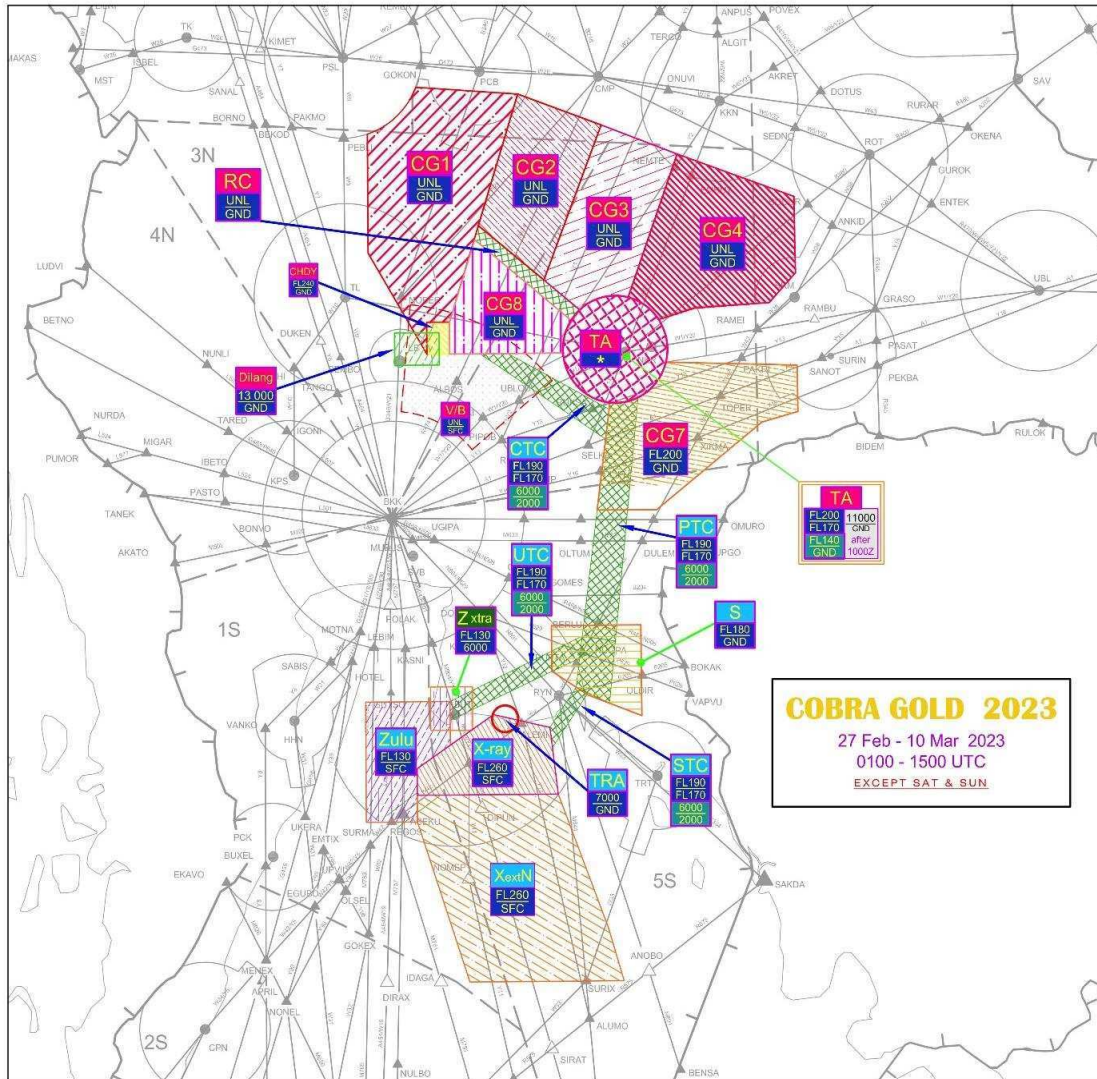
**9 POINT OF CONTACTS**

<b>Unit</b>	<b>Contact Details</b>
Live Fly Cell of Cobra Gold 2023	Sqn. Ldr Pidh Chukitkul Mobile: +669 2081 0616, +668 1866 6522 E-mail: pidh_chu@rtaf.mi.th
Bangkok Air Traffic Flow Management Unit For ATFM Measures during Joint Military Exercise	Phone: +662 287 8024 E-mail: atfmu@bobcat.aero Website: <a href="http://atfm.aerothai.aero">http://atfm.aerothai.aero</a> AFTN: VTBBZDZX
Aeronautical Information Service Department The Civil Aviation Authority of Thailand	Phone: +662 568 8831 Mobile: +666 3205 8831 Fax: +662 576 1903 E-mail: aisthai@caat.or.th or ais@caat.or.th
Airspace Management Cell (Thailand) For AUP/UUP	Phone: +662 307 2132 Mobile: +666 1402 4966 E-mail: taicmac15@aerothai.co.th Website: <a href="http://www.thaicmac.aerothai.aero">www.thaicmac.aerothai.aero</a>

**10 VALIDITY**

This AIP Supplement will remain current until 10 March 2023. Any change to this supplement will be promulgated by NOTAM.

11 EXERCISE AREA MAP



- END -

# APPENDIX 4. EXTRACT RELATED TO LARGE-SCALE EXERCISES

## General

[ANSPs] shall be informed at an early stage and be involved in the planning process if it is intended to conduct large-scale military exercises.

If necessary and mutually agreed through LoAs and special agreements, published ATS routes/ routings can be closed for the timeframes of the activities.

Special operating procedures to be applied during large-scale military exercises shall be agreed upon through LoAs.

## Annual planning of the German Air Force

The project conference of the Air Force takes place once a year in the third quarter [...] to finalise the exercise planning for the following year (X+1) and to update the initial plan for the year after next (X+2). The individual exercise plans [...] will be published [...] as an exercise calendar.

## Planning cycle of exercises

Many large-scale military exercises follow the same exercise schedule every year. It can roughly be divided into five phases which are similar to ATFM phases shown below:



The lead time to plan a large-scale military exercise heavily depends on whether it is repeated at regular intervals with similar exercise scenarios [...] or whether it is a new exercise. If the exercise is repeated regularly, a lead time of seven to nine months can usually be assumed. For new exercises, the lead time may be over 18 months, depending on the volume of the required planning. The planning officer will ensure that the invitations to the planning conferences are forwarded in good time.

## Initial planning phase

The initial planning phase usually starts with an airspace conference and/or an Initial Planning Conference [IPC] [...]. The objective of these events is to present the planned exercise to the participating/supporting units and, if possible, to identify the first framework conditions which are relevant in terms of civil-military matters:

- For recurring exercises, the results/experience of the post-exercise review phase will be presented;
- Objective and time schedule of the exercise;
- Aerodromes involved/forces involved/participants in the exercise;
- Airspace requirements (lateral, vertical, restricted areas, special areas, temporary air route closures);
- Additional or deviating requirements to published airspaces;
- Support requirements, e.g., Air-to-Air Refueling;
- Special training procedures/procedures planned;

- Restrictions/particularities with regard to airspace and procedures;
- C2 options (e.g., control agencies, control methods, link capabilities; liaison deployment);
- Commissioning the preparation of [...] (frequencies, IFF codes, etc.);
- Nomination of Points of Contact.

At the IPC, the further course of exercise preparations (follow-up meetings) will be determined and deadlines to be met will be pointed out.

### **Main planning phase (ATFM Strategic Phase)**

The Main Planning Conference [MPC] marks the beginning of the main planning phase. The main purpose of the MPC is for the participants to discuss the current state of the exercise preparations. It should take place at least four months before the start of the exercise. A key issue here is that an analysis of the interaction between the large-scale exercise and civil air traffic will be available at the MPC so that necessary adjustments can be made in the sense of collaborative decision making. Objectives of the MPC which are relevant in terms of civil-military matters are:

- Coordination with the national/international air traffic control units concerned and the Tactical Control Service units;
- General definition of the training airspace;
- Coordination of procedures (new or temporary deviations from letters of agreements);
- Identification of restrictions/conditions, where necessary;
- Planning of publications NOTAM – AIP SUP [...] etc.;
- In the follow-up to the MPC, various documents will be produced depending on the type/size of the exercise and the units involved;
- Exercise operations orders or comparable documents;
- New or temporary deviations from letters of agreement;
- Operational orders/operational information;
- Drafts for publications;
- Information summary;
- Draft [...] (frequencies, IFF codes, etc.);
- Draft risk analysis.

### **Final planning phase (Pre-tactical ATFM phase)**

The final planning phase starts with the Final Planning Conference [FPC] [...] and takes place two to three months before the exercise. It usually serves to confirm all agreements and update the planning data for the last time. The participants will present the results of their respective part in the preparation of the exercise. The FPC will finally clarify whether the exercise can be carried out as planned or whether changes/adjustments have to be made at short notice.

### **Execution phase (Day of operation ATFM phase)**

Before the exercise starts, it must be ensured that all participants have been briefed on the procedures and airspaces.

During the execution phase, the focus should be on the following issues:

- Compliance with agreements;
- Handling of flight safety-relevant occurrences;
- Airspace management handling;
- Refinement/modification of operational procedures, if necessary.

During the exercise, the operational units [...] as well as the planning units [...] must be involved centrally (ideally at the on-site exercise control unit of the exercise) in order to support and intervene, if required.

If necessary, a daily review process [...] needs to be established between those involved in conducting the exercise to evaluate and, if required, adjust operational procedures.

### **Post-exercise review phase (Post operational ATFM Phase)**

An exercise debriefing (validation) usually takes place four to eight weeks after a large-scale exercise. As part of the debriefing, evaluations of the exercise's organisation, the agreed and applied procedures, the results of the exercise and the fulfilment of its objectives will be discussed and agreed upon between the participants. For regularly recurring large-scale exercises, the post-exercise analysis may also take the form of a standardised process (exercise report). The results will be presented at the IPC of the following exercise.





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