Enclosure 1

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MITRE

Center for Advanced
Aviation System Development

Cancún Airport

Conventional Departure Procedures

Prepared for

Aeropuertos y Servicios Auxiliares

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TERPS	Standards for Terminal Instrument Procedures
U.S.	United States
VOR	Very High Frequency Omni-directional Range
WGS84	World Geodetic System 1984

2. Background

MMUN is a major coastal airport with two parallel runways, designated 12L/30R and 12R/30L, that are typically used to conduct segregated operations (i.e., arrivals to one runway and departures from the other runway). CAT I ILS approaches are published for Runways 12L/R. There are no vertically guided approach procedures published for Runways 30L/R.

There are a number of conventional departures from all runway ends that track runway heading to intercept a 9-nautical mile (NM) Distance Measuring Equipment (DME) arc for northbound departures or 7 NM DME arc for southbound departures. Departures then transition at specific points along the arcs to their destination.[1] There are also some published Area Navigation (RNAV) departure procedures from Runways 12R/30L.

Both MITRE and SENEAM are developing proposed dual independent conventional and RNAV departure procedures, respectively, in support of a new airspace design for MMUN, as well as upcoming HITL simulations.

3. Methodology and Other Key Considerations

The following subsections provide general information on MITRE's instrument procedure development practices, obstacle databases, assumptions, and other important considerations pertaining to the development of the instrument departure procedures described in this document.

3.1. Methodology

The first step in the development and examination of any instrument procedure is the collection of relevant data. A current survey of terrain and obstacles at and surrounding MMUN was not conducted. However, SENEAM did provide MITRE with a collection of obstacle data for MMUN from a survey conducted by the United States (U.S.) Federal Aviation Administration (FAA). The other key data source used for the development of procedures at MMUN was the Mexico Aeronautical Information Publication (AIP). See Section 3.2 for additional information regarding data.

MITRE is transitioning to a highly advanced and completely automated procedure design software (Global Procedure Designer or GPD). There are four components to the software: a procedure designer, a data manager, a chart designer and an automated evaluation, which is used to identify changes to procedures or charts when new data has been introduced into the system. This software was used for the development of these procedures.

[1] There are a few additional SIDs that either turn back to the VOR or track straight-out, but most are designed to track to an arc and then exit the arc at a location appropriate to the aircraft's destination.

provided to MITRE. Furthermore, MITRE did not receive information on accuracies associated with the data. Therefore, the obstacle data were used "as is." Nevertheless, MITRE feels that the data is useful for the level of preliminary procedure design work being conducted for MMUN to support upcoming HITL simulations, especially since the obstacle environment surrounding MMUN is not a significant problem.

It is important to mention that the FAA obstacle data indicates that the elevation of MMUN's Air Traffic Control Tower (ATCT) is 105.64 meters (m). MITRE assumed this elevation includes the top-height of any structures located on top of the ATCT itself. MITRE was informed by SENEAM, however, that the elevation of the ATCT is 102 m. For conservative planning purposes, MITRE used the higher ATCT elevation (i.e., 105.64 m).

MITRE strongly recommends that the MSL elevation of the ATCT as well as all data contained in the FAA database be validated. Finally, MITRE recommends that a detailed obstacle survey be conducted in advance of any final instrument procedure development, along with necessary flight inspection activities at the appropriate time (i.e., before test-bed operations commence) to ensure that unknown obstacles are not a problem for future procedures and/or airspace designs.

- **Shuttle Radar Topography Mission (SRTM) Data**: SRTM is MITRE's primary source of digital terrain data. The SRTM horizontal and vertical datums are WGS84 and Earth Gravitational Model 96 respectively. SRTM can be represented a number of ways for analytical and presentation purposes. It is important to note that SRTM terrain postings are based on a fixed grid system and, therefore, a higher elevation between postings may not be accounted for.

  Where appropriate, MITRE used post-processed 3-arc second (~ 90 m postings) SRTM data from the National Geospatial-Intelligence Agency. This post-processed SRTM data has been subjected to a number of steps to provide a seamless and complete digital elevation model of the world. For controlling obstacles, MITRE applies a 16 m vertical accuracy adjustment to any SRTM terrain identified as a segment controlling obstacle. In addition, if a penetration is terrain-based MITRE also adds an Adverse Assumption Obstacle (60 m) in areas where the FAA obstacle data did not extend. This was accomplished to account for any unidentified obstacles.

- **Electronic Airport Layout Plan**: MITRE received a rendering of the airport layout plan in AutoCAD (Plano Cancún proyectado.dwg) from SENEAM through Grupo Aeroportuario del Sureste, S.A.B. de C.V. The information within the AutoCAD drawing needed to be slightly modified to reconcile data discrepancies and geo-referencing issues.

3.3. Assumptions

To determine the feasibility of the instrument departure procedures, certain assumptions regarding important aeronautical factors were made:

(CZM) Very High Frequency Omni-directional Range (VOR) and UN401. These fixes were selected or created based on SENEAM's decision to design conventional departures routes considering the typical tracks that aircraft fly today (i.e., based on vectors). The following sections discuss the SIDs from each of the four runway ends.

4.1. Runway 12L Departure Procedures

This section describes the results of MITRE's assessment of the five SIDs from Runway 12L. There were no penetrations to any of the departure OCSs for any of the SIDs from this runway. Figure 1 depicts the routing of each SID to its termination point.

Takeoff Minimums: Standard (see Table 1 above)

- NOSUG: Climbing left turn to intercept CUN VOR/DME R-355 to NOSUG, to 10,000
- ROTGI: Climbing left turn to intercept CUN VOR/DME R-012 to ROTGI, to 10,000
- UN403: Climbing left turn to intercept Nichupte (NCP) VOR/DME R-069 to UN403, to 6500
- CZM VOR: Climbing right turn to intercept CZM VOR/DME R-005 to CZM VOR to 10,000
- UN401: Climbing right turn to intercept CUN VOR/DME R-256 to UN401, to 10,000

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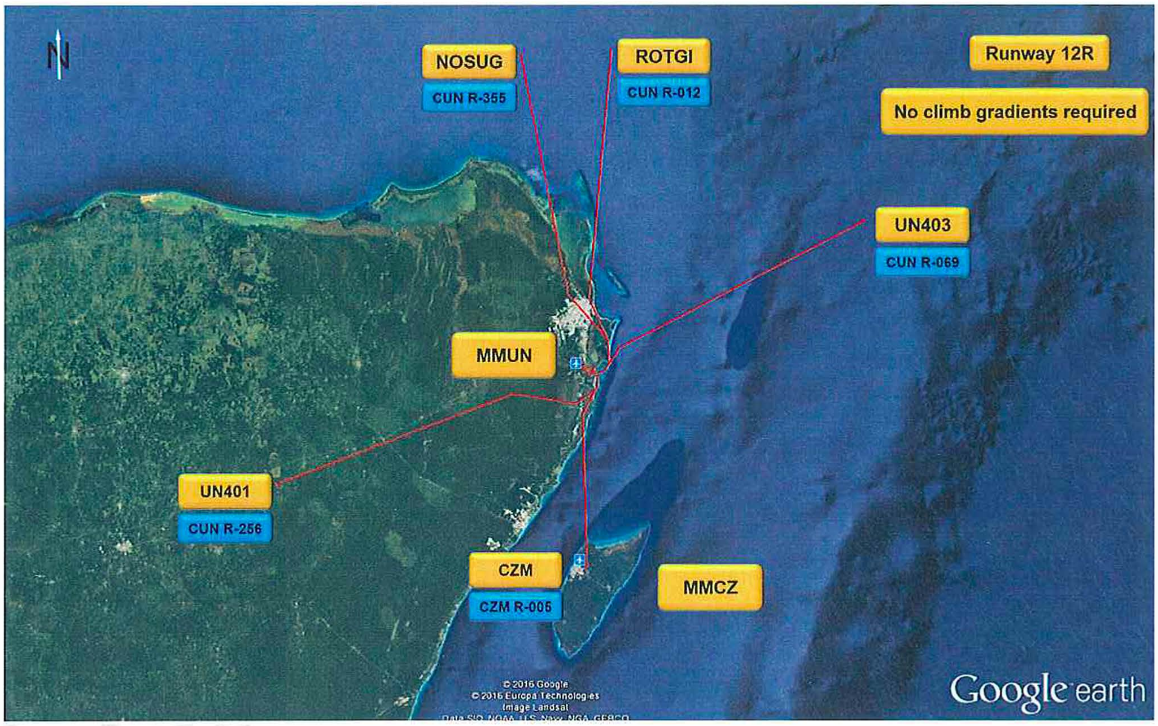


Source: GoogleEarth Pro

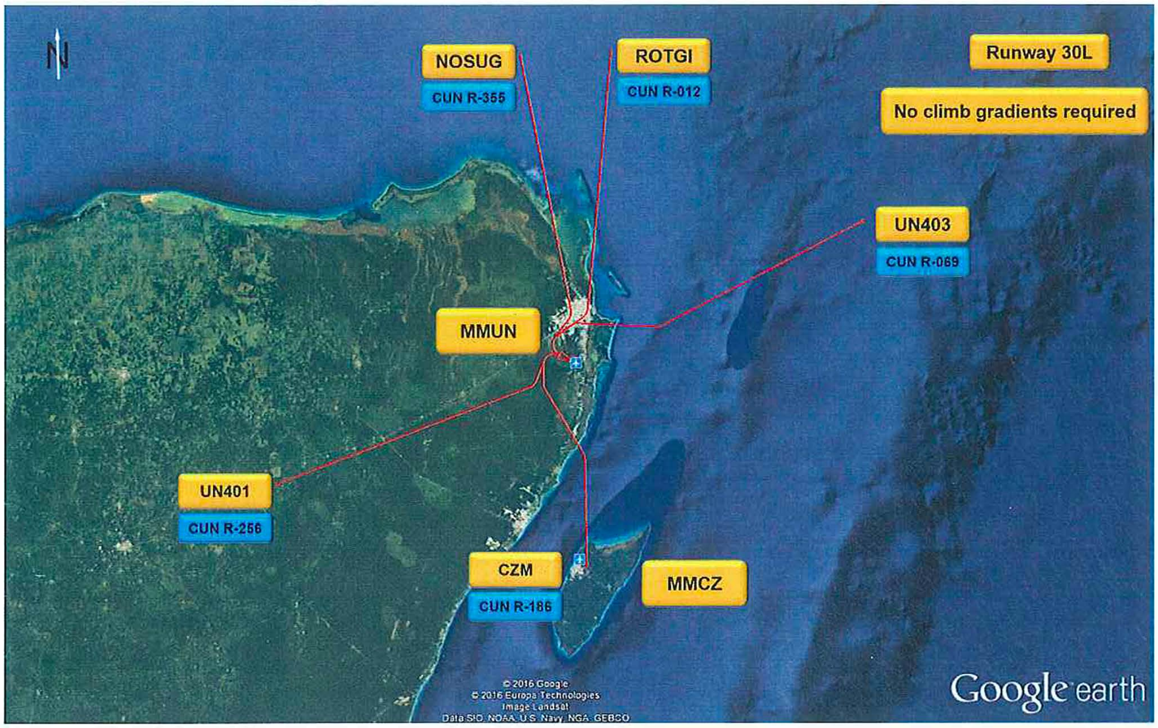
Figure 2. Runway 12R Nominal Departure Flight Tracks

4.3. Runway 30R Departure Procedures

This section describes the results of MITRE's assessment of the five SIDs from Runway 30R. There were no penetrations to any of the OCSs for any of the SIDs from this runway. Figure 3 depicts the routing of each SID to its termination point.

Takeoff Minimums: Standard (see Table 1 above)

- NOSUG: Climbing right turn to intercept CUN VOR/DME R-355 to NOSUG, to 9700
- ROTGI: Climbing right turn to intercept CUN VOR/DME R-012 to ROTGI, to 9800
- UN403: Climbing right turn to intercept CUN VOR/DME R-069 to UN403, to 10,000
- CZM VOR: Climbing left turn to intercept CUN VOR/DME R-186 to CZM VOR to 6800
- UN401: Climbing left turn to intercept CUN VOR/DME R-256 to UN401, to 10,000



Source: GoogleEarth Pro

Figure 4. Runway 30L Nominal Departure Flight Tracks

5. Summary

The SID procedures that were developed by MITRE and presented in this document are all feasible. Based on the available data, MITRE conducted a diverse departure assessment from each runway. While there were penetrations, they were all considered to be "close-in" obstacles[3] and, therefore, do not require that a CG be published. As a result, ODPs are not required. However, to support MMUN airspace redesign efforts, air traffic control flow management, and upcoming HITL simulations, MITRE examined five conventional SIDs from each runway end.

Takeoff minimums for all SIDs from all runways ends are Standard with visibility requirements dependent on the number of engines (i.e., 1-2 engine aircraft require 1-sm visibility and 3 or more engine aircraft require ½-sm visibility).

Other factors of importance pertaining to the final assessment of the departure procedures described in this document are as follows:

- The final step, prior to publication of the instrument procedures, will be a flight inspection by the Mexican aviation authorities to ensure that any undetected

[3] Close-in obstacles are those obstacles whose CG termination altitude is to a height 200 ft or less above the departure obstacle clearance surface start elevation (i.e., DER elevation). These types of obstacles are not considered penetrations.

References

FAA, 2015, Departure Procedure (DP) Program, FAA Order 8260.46F, FAA, Washington, District of Columbia, U.S.A.

FAA, 2016, United States Standard for Terminal Instrument Procedures (TERPS), FAA Order 8260.3C, FAA, Washington, District of Columbia, U.S.A.