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Col. Tizapán, Del. Álvaro Obregón
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México

Subject: Technical Letter: Summary of Work Completed or Ongoing During the Period 16 January 2018 through 31 March 2018

Dear Lic. Patiño:

This letter respectfully submits to your attention a summary of the most significant MITRE project activities conducted or being conducted during the period 16 January 2018 through 31 March 2018. At the outset, please note that MITRE is sending this Technical Letter ahead of time as it relates to the execution of Amendment Number 1 to the Agreement between GACM and MITRE, which is described later in this document.

Reports

Along with this Technical Letter, two Enclosures are included. The Enclosures are described in a very summary manner below:

- **Enclosure 1: Toluca Airport—Assessment of International Civil Aviation Organization Annex 14 Obstacle Limitation Surfaces.** This document describes MITRE's assessment of International Civil Aviation Organization (ICAO) Annex 14 Obstacle Limitation Surfaces (OLSs) for the existing single runway at Toluca Airport (hereinafter referred to as Toluca). The ICAO Annex 14 OLSs are based on instrument approach and departure procedures developed by MITRE for Toluca (see Enclosure 2 below). MITRE's assessment considered data from a satellite-based photogrammetric survey of Toluca (procured by MITRE) that was completed in September 2016.
- **Enclosure 2: Development of Instrument Approach and Departure Procedures at Toluca Airport.** This report describes MITRE's development of instrument approach and departure procedures for the existing single runway at Toluca. The instrument procedures developed by MITRE take into consideration the airspace and procedures being planned for the Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM) in order to avoid capacity-limiting airspace interactions and other complications that could affect operations at the new airport. MITRE's procedure development work considered the above-mentioned satellite-based photogrammetric survey of Toluca.

Activities

The following list describes the activities conducted by MITRE during this reporting period:

- A large team (ten MITRE engineers) visited Mexico City from 15 through 19 January 2018 to conduct an intense airspace design workshop to assist Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) with its redesign of the Mexico City Terminal Maneuvering (Control) Area (TMA) and Mexico Area Control Center (ACC) to support operations at NAICM and Toluca. Controllers from Toluca also participated in the workshop and provided valuable input and feedback.

The primary objectives of the workshop were as follows:

- To review the NAICM TMA, Toluca TMA, and Mexico ACC procedures and airspace designs, and address any outstanding issues so that the designs can be solidified and “frozen”. As a result, the MITRE team will be able to appropriately and efficiently prepare for upcoming NAICM-related Human-in-the-Loop (HITL)-1 simulation activities intended to be conducted at MITRE’s facilities in May 2018 and June 2018.
- To advance on the examination of the Minimum Vectoring Altitude Chart (MVAC) for the NAICM and Toluca TMAs and discuss radio and radar coverage matters.
- To discuss the upcoming HITL-1 simulation activities as well as scenarios to be evaluated.

Prior to the workshop, the MITRE team spent a significant amount of time re-examining and re-checking the NAICM TMA, Toluca TMA, and Mexico ACC airspace designs to support the workshop. Additionally, several presentations were prepared.

The following presentations and discussions were conducted during the workshop:

- Preliminary MVAC to Support NAICM and Toluca: Radar and Radio Coverage Considerations
- Overview of Preliminary NAICM and Toluca Instrument Procedure Development, Including ICAO Annex 14 OLS Findings
- NAICM and Toluca TMAs and Mexico ACC Airspace Design: Review, Discussion, and Solidification
- Introduction to HITL Simulations

- Overview of HITL Simulation Scenario Development
- Proposed Plan for NAICM- and Toluca-Related HITL Simulations
- HITL-1 Simulation: Scenario Crafting
- Next Steps

The workshop was very successful as it resulted in a solidified overall NAICM TMA, Toluca TMA, and Mexico ACC procedures and airspace design, which is now being used by MITRE to prepare for the upcoming HITL-1 simulation activities.

- Three MITRE engineers visited *Centro México* on 6 March 2018 to observe operations and conduct discussions with controllers in preparation for upcoming HITL-1 simulations. A visit to SENEAM's training facility located at *Centro México* was also conducted. The objectives of the visit were:
 - To become familiar with current Mexico City TMA and Mexico ACC operations from a HITL simulation perspective, and observe aircraft operations and performance.
 - To observe SENEAM's air traffic controller training environment and simulation pilot functionality.

While visiting the training center, the MITRE team conducted an in-depth review of the capabilities of the simulation pilots with the goal of ensuring that the pseudo-pilot software at MITRE's HITL Laboratory can perform similarly to what SENEAM controllers are used to. Afterwards, the MITRE team observed and interacted with the Air Traffic Control (ATC) displays in the safe environment of the training simulation facility.

Next, the MITRE team moved to a conference room where SENEAM ATC managers provided information on procedures that the controllers are currently using. Afterwards, the team began direct observations of live ATC operations, rotating through various controller positions, including ACC, approach, arrival, and departure sectors. Once the live ATC observations were complete, the team again met with ATC managers for a question-and-answer session. The ATC managers provided valuable and useful information.

As a result, the MITRE team has a more complete understanding of how controllers currently utilize their hardware and software, which will assist in applying any necessary targeted upgrades to the MITRE HITL Laboratory software and in refining flight models to better represent aircraft performance in the Mexico City operational environment. Additionally, the MITRE engineers are now familiar with SENEAM's current training environment and simulation pilot

functionality, which will assist in making appropriate changes so that SENEAM HITL participants feel more at ease at MITRE.

- The MITRE HITL simulation team worked on a variety of efforts in preparation for the upcoming HITL-1 simulations. A variety of software design and implementation, as well as human-factor tasks and other pre- and post-HITL simulation planning and coordination matters (e.g., HITL simulation scenarios, pseudo-pilots, HITL simulation participant questionnaires, etc.), were conducted by the team. Accordingly, the following HITL-1 simulation preparatory tasks are among the principal activities being conducted at MITRE:
 - Development of the HITL-1 simulation traffic scenarios, including the incorporation and programming of aircraft on the appropriate routes.
 - Finalization of human factors questionnaires.
 - Preparation of airspace and route reference packets, which are to be used as visual aids by the controllers during the HITL-1 simulations.
 - Development of several presentations to provide an overview of the overall HITL-1 simulation process, traffic scenarios, as well as human factors questionnaires and surveys.

The numerous and on-going HITL-1 preparatory activities are currently requiring a *major* MITRE effort, including internal tests at MITRE's Air Traffic Management (ATM) Laboratory.

- MITRE, in collaboration with SENEAM, has been working on the development of new MVACs for Toluca as well as NAICM. In Mexico, sector altitudes must consider radio and radar coverage. As radio and radar coverage matters are not within MITRE's area of expertise, MITRE has been coordinating with SENEAM to ascertain where coverage, both radio and/or radar, does or does not exist. This is important as changes to MVAC sector altitudes can affect the overall airspace design for the new Mexico City TMA to support operations at Toluca and NAICM.

In August 2017, MITRE received radio coverage results based on six radio repeater sites from SENEAM. In December 2017, MITRE received radar coverage results based on five radar sites from SENEAM. Of the five radar sites, only three exist currently. The other two are planned to be located at or near NAICM. MITRE completed its examination of the radar coverage results in mid-December 2017, identifying areas where radar and/or radio coverage was lacking at altitudes that were needed to support the proposed SENEAM-MITRE developed MVACs for both Toluca and NAICM.

During the previously-mentioned mid-January 2018 airspace design workshop, MITRE presented a briefing describing areas where there was a lack of radar and/or radio coverage based on the proposed sector altitudes of each MVAC. Throughout the visit, several meetings with SENEAM engineers were held to review MITRE's findings and discuss practical options to mitigate the lack of coverage.

During those meetings, MITRE was asked to define in more detail those areas lacking radar and/or radio coverage and to confirm the minimum altitudes necessary to maintain the appropriate amount of obstacle clearance and support the overall NAICM-Toluca airspace design. This work is on-going and MITRE expects to provide the information to SENEAM in the April/May 2018 timeframe. This will assist SENEAM in conducting additional examinations to determine what is required (e.g., additional radars and radio repeaters may need to be acquired) to provide the appropriate coverage to support the MVAC sector altitudes and the overall NAICM-Toluca airspace design.

- The MITRE team conducted an assessment of ICAO Annex 14 OLS for the existing single runway at Toluca to identify potential obstacles to air navigation in preparation for the development of instrument approach and departure procedures (described in more detail below). Refer to Enclosure 1 of this Technical Letter for details. The key results of MITRE's ICAO Annex 14 OLS assessment for Toluca was presented to SENEAM during the previously-mentioned mid-January 2018 airspace design workshop.

With the above-mentioned deliverable, MITRE's contractual obligations concerning the assessment of ICAO Annex 14 OLS for Toluca have been completed and delivered. MITRE, however, remains available for consultation.

- Throughout the quarter, MITRE's procedure design team spent a significant amount of time developing instrument approach and departure procedures for the existing single runway at Toluca. Instrument Landing System (ILS) Category (CAT) I, II, and III approaches, Required Navigation Performance (RNP) Authorization Required (AR) approaches, conventional departures, and Area Navigation (RNAV) departures, in both runway directions, were examined.

The Toluca procedures were developed based on NAICM's airspace design, which necessitates changes to Toluca procedures to avoid causing capacity-limiting impacts on operations at NAICM due to airspace conflicts and other complications. Refer to Enclosure 2 of this Technical Letter for details. The key results of MITRE's instrument procedure design work for Toluca was presented to SENEAM during the previously-mentioned mid-January 2018 airspace design workshop. Additionally, MITRE's procedure design experts reviewed the Toluca procedures with SENEAM's procedure design specialists.

With the above-mentioned deliverable, MITRE's contractual obligations concerning approach and departure procedures (both conventional and satellite-based) for Toluca have been completed and delivered. MITRE, however, remains available for consultation.

- As mentioned in MITRE's previous quarterly Technical Letter, MITRE is not an expert in bird hazard and/or mitigation matters. However, MITRE has been in discussions with GACM, Comisión Nacional del Agua (CONAGUA) and others, including Lic. Yuriria Mascott, Undersecretary of Transportation, regarding mitigation experimentation plans and ideas to deal with bird hazards in the Texcoco area. As a result, MITRE contracted the services of Dr. Richard Dolbeer and Environmental Resource Solutions (ERS), Inc. The objective of MITRE is carefully surveying birds on a monthly basis, while other entities work on mitigation measures.

During this quarter, the ERS, Inc. team continued to conduct its bird survey work. The ERS, Inc. team conducted three separate one-week visits to Mexico City, as shown below:

- 8 through 12 January 2018
- 5 through 9 February 2018
- 5 through 9 March 2018

The following bodies of water in the Texcoco area were surveyed:

- Lago Nabor Carrillo
- Laguna Facultativa
- Laguna Recreativa
- Lago Churubusco

The following bodies of water north and south of the Texcoco area were surveyed:

- Lago de Guadalupe
- Laguna de Zumpango
- Presa Cuevecilla
- Tláhuac Wetlands
- Xochimilco Wetlands and Open Water Habitats

Finally, it is important to mention that, with the support of Secretaría de Comunicaciones y Transportes officials, MITRE, through ERS, Inc., will conduct additional monthly avian surveys of the four above-mentioned lakes in the Texcoco area starting in early April 2018 and continuing through early November 2018. This will allow authorities to have an independent understanding of the bird population throughout the entire year.

- MITRE is to assist the Mexican aviation authorities in the examination of problems relating to airport expandability in Mexico so that, in the process, Mexican engineers and other analysts practice and learn how to reexamine modifications concerning NAICM airside and aeronautical matters in the future. In February 2017, after consultation with MITRE, the Mexican aviation authorities selected Guadalajara Airport (hereinafter referred to as Guadalajara) for MITRE to study. Therefore, MITRE will work on a runway-related solution regarding the expandability of Guadalajara.

Specifically, during this quarter, the MITRE team received initial data from GACM (provided through the Dirección General de Aeronáutica Civil [DGAC]) that was previously requested by MITRE (originally expected by 31 July 2017) in order to conduct many of the early project tasks. The MITRE Guadalajara team is in the process of reviewing the data.

- MITRE is responsible for the procurement of a satellite-based photogrammetric survey of Guadalajara and its surrounding areas in order to support the above-mentioned runway expandability analysis work. Some of the Guadalajara data that MITRE recently received provided information on the proposed location of a second parallel runway. This was helpful information that allowed MITRE to more appropriately determine the extent of the areas at and around Guadalajara that need to be included in the survey.

As a result, MITRE was able to conduct and coordinate technical and contractual preparatory activities and discussions with MDA Geospatial Services Inc. (MDA), the company that will perform the survey work. Areas to be surveyed have been identified and refined, and attempts are now being made to acquire appropriate satellite imagery of the areas to be surveyed. This is important so that appropriate satellite imagery can be obtained before the rainy season in Mexico begins.

- As mentioned in previous quarterly Technical Letters, Aeropuertos y Servicios Auxiliares (ASA) issued a stop-work order on all of MITRE's work in the state of Hidalgo based on Fuerza Aérea Mexicana's (FAM's) preference to relocate Santa Lucía's fixed wing non-transport aircraft operations to Querétaro Airport (hereinafter referred to as Querétaro). FAM's operations at Querétaro, along with the establishment of Special Use Airspace (SUA) to support those operations must be thoroughly examined to ensure that the airport is feasible and, more importantly, that FAM's operations do not interfere with future operations at NAICM. Such investigation must be conducted in close coordination with FAM and SENEAM officials.

During this quarter, the MITRE-Querétaro team started preparatory work. Specifically, as in the case of Guadalajara, MITRE was able to conduct and coordinate technical and contractual preparatory activities and discussions with MDA. Areas to be surveyed were identified and refined, and attempts are now being made to acquire appropriate satellite imagery of the areas to be surveyed. As with Guadalajara, this is important so that appropriate satellite imagery can be obtained before the rainy season in Mexico begins.

- MITRE would like to mention again its recommendation (this has been suggested in writing many times before, actually for years) that a written document be prepared where the matter of clear and permanent closure of the runway at Santa Lucía is established and agreed-upon. While FAM considers that closure is the official position, there is still reluctance in some quarters about the major safety matter of not closing that runway. This was validated by an independent ICAO study. The current Mexican government should surely desire to close on this matter with FAM. As for MITRE, this is a matter of enormous concern.
- The MITRE team spent a significant amount of time during this quarter preparing Amendment Number 1 to the GACM-MITRE Agreement. This was an intense effort which required the preparation of several amendment-related documents, as well as detailed technical scope of work planning and coordination, including the consideration of new urgent work that is required and approval by the United States (U.S.) Federal Aviation Administration (FAA).

On 8 March 2018, Ing. Ricardo Tapia visited MITRE for a long day (13 or 14 hours) of detailed discussions regarding the preparation of Amendment 1 to the GACM-MITRE Agreement. The objective of the visit by Ing. Tapia was to thoroughly review all amendment documents to ensure that he understood and agreed to their purpose and contents. Corrections were made as necessary. The following amendment documents were reviewed:

- Amendment Number 1 to the GACM-MITRE Agreement: this document makes important changes to the GACM-MITRE Agreement, such as naming GACM as MITRE's "Customer", identifying key GACM and MITRE authorized representatives, incorporating Annex 1, Annex 2, and Annex 3 to the Agreement, and updating the sections on remuneration and payment schedule.
- Amendment Number 1 to Annex 1: this document updates in detail MITRE's Statement of Work, including new work that is urgently required. Information on tasks and sub-tasks that have been modified, eliminated, or added is included.
- Annex 2: this document explains the reasons for the above-mentioned changes to the original Annex 1.

- Annex 3: this document provides the basis for MITRE's signature authority of Amendment Number 1.

The visit by Ing. Tapia was very useful and successful, and all matters were discussed and reviewed to his satisfaction.

Since Ing. Tapia's visit, MITRE has received the amendment fully executed by both, GACM and MITRE. MITRE wishes to express its thanks to you and all the officials at GACM that helped in completing the amendment on time. It is a pleasure working with GACM, and the entire MITRE team looks forward to continuing its support on this important project for Mexico.

- Acquisition of a new procedure design software tool by SENEAM: MITRE was recently informed that SENEAM has decided to acquire a new procedure design tool (also used by MITRE) based on U.S. FAA Standard for Terminal Instrument Procedures (TERPS) criteria. This is excellent news as, once that tool is acquired, SENEAM and MITRE will be able to work efficiently together on important procedure design matters.
- In August 2017, during a visit to Mexico City, Dr. Lisker hand-delivered and presented to officials a MITRE-prepared document that provides a list of key pending items that should be addressed (see MITRE document F500-L17-094, dated 11 August 2017). Several copies of that document were provided to GACM, SENEAM, and DGAC. Many pending items have been fulfilled, but some important ones are still pending. For example, while MITRE is not an expert in the field of Flight Inspection and Flight Validation, it would like to be made aware of the schedule, plan and process being considered by the aviation authorities of Mexico for conducting these urgent activities, since they relate to MITRE's instrument procedure design work.

In order to stay organized, MITRE urgently requests that GACM prepare a document with feedback regarding the status of each pending item for review by MITRE by the end of April 2018.

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- At the time of writing this Technical Letter, Dr. Lisker and I have a scheduled visit to Mexico City in late March 2018 to conduct a high-level executive meeting to discuss important matters pertaining to the NAICM project. The following technical letter will formally inform about this visit.

Please do not hesitate to contact me if you need any clarification or assistance.

Sincerely,



Ing. Robert W. Kleinhans
Project Technical Coordinator

Included with this letter:

Two Enclosures

cc: Ing. Enrique Lavín, GACM
Ing. Ricardo Tapia, GACM
Dr. Bernardo Lisker, MITRE

This one-page return receipt (*acuse de recibo*) is to be scanned and e-mailed to Ing. R. Kleinhans as soon as possible

1 April 2018 TECHNICAL LETTER DISTRIBUTION

MITRE requests that the documents enclosed with this Technical Letter be distributed as follows:

1. Enclosure 1 to this Technical Letter (H560-L18-027): Toluca Airport—
Assessment of International Civil Aviation Organization Annex 14 Obstacle
Limitation Surfaces, dated 15 March 2018.
 - GACM: 5 copies
 - SENEAM: 5 copies

2. Enclosure 2 to this Technical Letter (H560-L18-027): Development of Instrument
Approach and Departure Procedures at Toluca Airport, dated 15 March 2018.
 - GACM: 5 copies
 - SENEAM: 5 copies

Distribution of the two, above-mentioned documents, was completed,

Signature of GACM Point of Contact for MITRE

Date

Name of GACM Point of Contact for MITRE