

27 March 2017
F500-L17-044

Lic. Federico Patiño
Director General
Grupo Aeroportuario de la Ciudad de México (GACM)
Insurgentes Sur 2453, Piso 2
Col. Tizapán, Del. Álvaro Obregón
C.P. 01090, México, D.F.,
México

Subject: Technical Letter: Summary of Work Completed or Ongoing During the Period 16 January 2017 through 31 March 2017

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 2017 through 31 March 2017.

Reports

At the outset, before proceeding with a full description of activities, please find below a list of the documents included with this Technical Letter, some of which have already been delivered in advance to various Parties throughout the concluding quarter.

1. Cancún Airport Terminal Maneuvering Area Redesign - Procedural Separation, Sectorization, and Human-In-The-Loop Workshop in Cancún: Summary of Key Activities. See MITRE document F500-L17-033, dated 30 January 2017.
2. Technical Letter: Comments on the ILS Specifications. See MITRE document F500-L17-042, dated 3 March 2017.
3. Enclosure 1 to this Technical Letter (F500-L17-044): Mexico Area Control Center Enroute Airspace Redesign - Performance-Based Navigation Metrics: Analysis of Current Sectors, dated 23 March 2017.

The document designated as an Enclosure, is described below:

- **Enclosure 1: Mexico Area Control Center Enroute Airspace Redesign - Performance-Based Navigation Metrics: Analysis of Current Sectors.** This document describes MITRE's analysis of the current Mexico Area Control Center (ACC) enroute structure with Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM)-proposed Performance-Based Navigation (PBN) routes. The objective of the document is to obtain feedback from SENEAM so that MITRE can conduct follow-on Mexico ACC enroute-related analyses.

Activities

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

- Cancún Airport (hereinafter referred to as Cancún) is serving as a test-bed location where Mexican air traffic controllers can obtain an understanding of the issues associated with independent operations and gain valuable experience for the future implementation of such procedures at Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM). To support the Cancún project, a large team of MITRE engineers conducted an intense five-day workshop in Cancún from 12 through 16 December 2016 to assist SENEAM in the redesign of the Cancún airspace to support dual independent test-bed operations.

The objectives of the workshop were as follows:

- To solidify the Cancún and Cozumel Terminal Maneuvering Area (TMA) routes considering procedural separation and Air Traffic Control (ATC) sectorization
- To develop scenarios to be used to evaluate the Cancún/Cozumel TMA airspace design during the Human-In-The-Loop (HITL) 1 dry-run simulations that was to be conducted at MITRE's Air Traffic Management (ATM) Laboratory from 30 January 2017 through 3 February 2017 (described in more detail farther below).

MITRE prepared a document that described the key activities that occurred during the above-mentioned 12 through 16 December 2016 workshop, highlighting key decisions that were made by the SENEAM and MITRE teams. The document was also intended to allow the SENEAM team to review the Cancún/Cozumel TMA routes considering procedural separation and ATC sectorization, as well as the HITL scenarios that were developed during the workshop prior to the HITL 1 dry-run simulations. The document was sent to SENEAM on 30 January 2017 and is being sent along with this Technical Letter as a reference (see MITRE document F500-L17-033).

- While MITRE's project does not include provisions to review equipment specifications, in the summer of 2016, Ing. Luis Sánchez, then a member of GACM, made a request that MITRE double check Instrument Landing System (ILS) specifications issued by GACM. MITRE accepted to review those specifications to be supportive, but only regarding matters that pertain to MITRE's work, namely, initial ILS signal coverage requirements to support NAICM.

On 12 August 2016, MITRE provided comments on the specifications through Technical Letter F500-L16-041, which was sent to all appropriate aviation organizations in Mexico. However, despite several requests by Dr. Bernardo

Lisker to Ing. Sánchez to close the loop, MITRE never received an integrated, corrected ILS specifications document.

During MITRE's recent visit to GACM's office in Mexico City (described in more detail farther below), it became clear that despite repeated warnings by MITRE alerting against runway construction before ILS testing is conducted, not even a mobile, ILS Category III, with the required characteristics had been purchased yet. Furthermore, MITRE's comments were never fully integrated to the specification tender (and the tender was not issued).

Therefore, on 3 March 2016, MITRE sent a letter to Ing. Enrique Lavin that provided an explanation of the situation, and resubmitted MITRE's August 2016 comments on the ILS specifications. That document is being sent along with this Technical Letter as a reference (see MITRE document F500-L17-042).

It is important that the ILS specifications are treated carefully. It is also urgent that the ILS equipment is acquired as soon as possible, especially since NAICM site preparation work is underway, so that pre-runway construction flight validation and flight inspection activities can be conducted.

- MITRE's NAICM enroute airspace design team spent a significant amount of time advancing on its analysis of the current Mexico ACC sectors considering the proposed SENEAM-developed PBN routes. Refer to Enclosure 1 of this Technical Letter for details. The objective of the enclosure is to obtain feedback from SENEAM on Mexico ACC related matters. This is important so that MITRE can provide further guidance to SENEAM in its assessment of the Mexico ACC enroute structures ability to accommodate increased traffic levels on opening day at NAICM, and to determine if there are any capacity-limiting issues.

Note that this analysis only considers the current Mexico ACC enroute sectors that are in place today with SENEAM-proposed PBN routes. The analysis does not consider the increased volume of traffic that is expected once NAICM opens or an increase in traffic at other airports within the Mexico ACC, which will require additional sectors to be established to efficiently accommodate demand. Furthermore, on-going analyses and airspace design workshops, to be conducted in close coordination with SENEAM, are required to determine the future number of additional sectors needed when NAICM opens.

- During this quarter, the MITRE HITL simulation team completed preparation efforts to support the Cancún HITL 1 dry-run simulations that were conducted at MITRE's facilities from 30 January 2017 through 3 February 2017 (described in more detail below). The HITL simulation evaluations are essential to support the implementation of dual independent (test-bed) operations at Cancún Airport. For example, the following HITL 1 dry-run simulation preparatory tasks were conducted:

- Development of the evaluation traffic scenarios, including the incorporation and programming of aircraft on the appropriate routes
- Completion of the design and testing of the HITL system software adaptation and hardware, including a Final Monitor Aid (FMA) prototype
- Finalization of human factors questionnaires
- Preparation of airspace and route reference packets, which were to be used as visual aids by the controllers during the dry-runs at MITRE
- Development of several presentations to provide an overview of the overall HITL 1 dry-run process, traffic scenarios, as well as human factors questionnaires and surveys

These preparatory activities required a *major* MITRE effort, including internal testing at MITRE's ATM Laboratory. It is important to add that these are all out-of-scope activities. Per contract, SENEAM was to acquire specialized equipment and support most of the HITL effort. In a spirit of collaboration, MITRE is providing equipment and support for the Cancún HITLs at no extra cost to Mexico. **In lieu of any payment or amendment to the contract, MITRE would appreciate formal acknowledgment of this effort by GACM.**

- Five air traffic controllers, including CTA. Augusto Gómez, from the SENEAM Cancún dual independent test-bed operation design team, visited MITRE's facilities in McLean, Virginia from 30 January 2017 through 3 February 2017. The reason for their visit was to participate in a full week of HITL 1 simulation dry-runs at MITRE's ATM Laboratory.

A dry-run is an essential step to ensure that all elements are appropriately prepared and ready for *actual* HITL 1 simulation evaluations, which occurred from 27 February 2017 through 3 March 2017 (described in more detail farther below). The objectives of the HITL 1 simulation dry-runs were as follows:

- Verify and validate simulation hardware/software components (e.g., displays, keyboards, communication equipment, video maps, etc.), data collection mechanisms, traffic files (e.g., demand levels, aircraft performance, etc.) and scenarios
- Review airspace and route designs during scenarios to ensure consensus on designs, and identify any adjustments that need to be made or considered
- Review appropriateness of airspace design reference packets
- Ensure that questionnaires and surveys are clear and understandable

During the HITL 1 simulation dry-runs, the MITRE and SENEAM teams reviewed the HITL scenarios, as well as the ATC sectorization and airspace design resulting from the previous SENEAM/MITRE airspace design workshop held in Cancún from 12 through 16 December 2016. This allowed the SENEAM and MITRE teams to identify and discuss any changes that needed to be made prior to the actual HITL 1 simulation evaluations later on.

Following the dry-runs, the MITRE team worked intensely for several weeks to address issues and changes that had to be made to support an actual (not a dry-run) HITL 1 simulation evaluation. Figure 1 shows the Cancún Approach Control layout at MITRE's ATM laboratory, showing the SENEAM and MITRE teams working together at various controller positions.



Figure 1. Cancún HITL 1 Dry-Run Approach Control Layout at MITRE's ATM Laboratory

- On 8 February 2017, Ing. Ricardo Tapia, representing GACM through Parsons/FOA, visited MITRE for a full-day of detailed presentations, demonstrations, and discussions regarding MITRE's NAICM-related work. A tour of MITRE's ATM Laboratory, including flight demonstrations, was also provided.

The visit by Ing. Tapia was important because, per discussions between you and Dr. Lisker, Ing. Tapia will act as MITRE's routine Point-of-Contact (POC) between MITRE and GACM. Therefore, it was necessary to provide a detailed overview of MITRE's scope of work, the status of the project, pending matters, and to discuss with Ing. Tapia roles and responsibilities. MITRE's visit to GACM on 15 and 16 February 2017 (described farther down) was planned and coordinated

with Ing. Tapia. Moreover, during MITRE's visit to GACM, Dr. Lisker met with you to discuss various topics, including Ing. Tapia's role. During that discussion, you reconfirmed Ing. Tapia's role and that he should communicate with anyone as necessary at GACM, with Ing. Lavin as his main coordinator.

The visit by Ing. Tapia was very successful. Since then, Ing. Tapia has been assisting MITRE with various important project-related matters.

- On 15 and 16 February, Dr. Lisker, Ing. Elizabeth A. McQueen, and I travelled to Mexico City to participate in two full days of meetings and discussions regarding the NAICM project at the offices of GACM.

The objective of the 15 February meeting was to provide an introduction and overview of MITRE and its work, and to discuss in detail with GACM the situation of the NAICM project. A tour of the NAICM site, which included several presentations regarding civil engineering and construction matters was also conducted for the benefit of the MITRE team. The tour was extremely interesting.

The objective of the 16 February meeting was to meet with other key project stakeholders and introduce them to MITRE. The situation of the NAICM project and important pending matters were also discussed. Additionally, MITRE presented a briefing that provided relevant feedback and opinions regarding Arup's Master Plan. The meeting was very useful and allowed both MITRE and other stakeholders to obtain a better understanding of work being conducted, issues and concerns, and important items to address.

Finally, in the afternoon of 16 February, Dr. Lisker had a separate meeting with you to discuss important project related matters, including those related to Ing. Tapia as described before in this letter. Following that meeting, Dr. Lisker spoke with Ing. Lavin to discuss matters of future coordination. Last, he met Lic. Mario Ruiz, who requested MITRE's opinion on several topics, including NAICM system integration project management concepts/structures. Although system integration is outside of MITRE's scope of work and not within MITRE's area of expertise, Dr. Lisker agreed to investigate the matter.

- On 17 February, Dr. Lisker met with Lic. Yuriria Mascott, Undersecretary of Transportation, and CTA. Miguel Peláez, Director General of the Dirección General de Aeronáutica Civil (DGAC), to update them about the meetings of the previous two days.
- A large team of MITRE engineers visited Mexico City from 20 through 24 February 2017 to conduct an airspace design workshop to assist SENEAM with its redesign of the Mexico City TMA and Mexico ACC to support operations at NAICM. Controllers from Toluca Airport also participated in the workshop and provided valuable input and feedback.

The primary objectives of the workshop were as follows:

- Discuss and solidify the altitude and speed restrictions on the Mexico City TMA procedures to procedurally separate routes
- Discuss and develop an initial sectorization for the new Mexico City TMA, including the shape of the TMA/ACC boundary
- Discuss MITRE's task to assist SENEAM with its analysis of the Mexico ACC enroute airspace structure in support of NAICM, and review the initial enroute-related work that MITRE has been conducting, including an initial sectorization for the Mexico ACC
- To observe operations at the Mexico ACC to obtain a better understanding of routes and sectors, as well as existing operational practices, issues and challenges that controllers face today

Prior to the workshop, the MITRE team spent time examining altitude and speed restrictions along with preliminary sectorization concepts for the new Mexico City TMA and the Mexico ACC. Additionally, several presentations regarding MITRE's Mexico ACC work and preliminary baseline analysis were prepared.

In MITRE's opinion, the workshop was very successful and significant progress was made. Some routes were modified, including altitude and speed restrictions. Furthermore, a route to be used by satellite airport traffic (e.g., Puebla, Querétaro, etc.) that should be deconflicted with NAICM and Toluca Airport operations was established. Additionally, an initial shape for the Mexico City TMA was agreed upon for further consideration.

- Five air traffic controllers from SENEAM visited MITRE's facilities in McLean, Virginia from 27 February 2017 through 3 March 2017. The reason for their visit was to participate for a full week of HITL 1 simulation evaluations at MITRE's ATM Laboratory.

The five air traffic controllers included CTA. Gómez and four controllers from Cancún who had not been involved in the airspace redesign project. It was necessary to include controllers who had not been involved in the airspace redesign work so that unbiased opinions and feedback regarding the appropriateness of the design could be obtained.

The objectives of the HITL 1 simulation evaluations were as follows:

- Evaluate the new routes, procedures, altitude restrictions and sectorization associated with the airspace
- Identify issues and discuss potential modifications to the airspace design to resolve those issues

- Collect objective and subjective metrics data from HITL participants for further review and analysis
- Hold detailed discussions following each HITL scenario evaluation to obtain valuable feedback

The HITL simulation evaluations were very successful and all objectives were met. Overall, the Cancún controllers were pleased with the airspace design. However, they did identify some areas of the airspace design that they felt should be modified. The MITRE team is now in the process of addressing those areas, which will be evaluated in the summer during the HITL 2 simulation evaluations. Lastly, the MITRE HITL team has started evaluating the metrics gathered during the HITL 1 simulation evaluations. Figure 2 shows a close-up of a controller managing high-volume traffic in the Cancún Arrival South sector.



Figure 2. Cancún HITL 1 Simulation Evaluation: Arrival South Sector

- During the previous quarter, per a request, on a priority basis, by Lic. Mascott and CTA. Peláez, MITRE designated a team of experts to conduct an assessment of the potential impact of a proposed facility named *Centro de Gestión de Residuos Sólidos en el Bordo Poniente* to be constructed near NAICM. Refer to Enclosure 1 to Technical Letter F500-L17-030: *Assessment of Centro de Gestión de Residuos Sólidos en el Bordo Poniente: Options 3, 4.1, 4.2, and 5*, dated 11 January 2017. One of MITRE's recommendations to authorities was that at least one airline should conduct analyses of the facility (at all locations) on their respective engine failure practices and procedures for operations at both AICM and NAICM to

determine if the facility would cause any issues and/or restrict aircraft payload and range capabilities.

This matter was discussed between CTA. Peláez and Dr. Lisker during their 17 February meeting in Mexico City. At that time, it was agreed that MITRE would provide information to CTA. Peláez to assist with the coordination of an appropriate engine failure analysis by Aeroméxico. The MITRE team compiled relevant information needed by Aeroméxico to conduct the analysis and sent it to CTA. Peláez on 6 March 2017. A few days ago, MITRE received the results of Aeroméxico's analyses, for an opinion.

- Under Task 8 of the GACM-MITRE contract, 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 in the future modifications concerning NAICM airside and aeronautical matters).

This task commenced in 2015 with the preliminary identification by the Mexican authorities of the airport to be studied. The task was discussed with Lic. Mascott and other officials, including CTA. Peláez, during their 20 November 2015 visit to MITRE. During that visit, the following preliminary airports were identified:

- Guadalajara Airport
- Puerto Vallarta Airport
- Tijuana Airport (expansion and/or new airport site examination)

MITRE received a letter from ASA on 13 May 2016, which offered options for MITRE's consideration on how to address the selection of an airport. Based on the information and considerations described in that letter, MITRE agreed to discuss the matter directly with the DGAC.

Therefore, MITRE contacted CTA. Peláez via e-mail in September 2016 regarding the selection of an airport for MITRE to analyze. CTA. Peláez provided a priority airport order, as MITRE's budget would not allow MITRE to perform analyses for three airports simultaneously. MITRE then performed a pre-analysis for all three airports to help CTA. Peláez decide what can be done realistically under MITRE's budget and most benefit Mexico.

On 31 December 2016, MITRE submitted a document to CTA. Peláez describing MITRE's ideas and opinions regarding the airport(s) to be selected and the type of analyses that could be conducted for the airport(s). See MITRE document F500-L17-025. CTA. Peláez responded to MITRE that Guadalajara Airport made sense but that he would like SENEAM's vetting, too. That vetting took place during a conversation between CTA. Martín García and Dr. Lisker during the previously mentioned meeting at GACM's offices in Mexico City on 16 February.

CTA. García indicated that Guadalajara Airport was the most appropriate airport for MITRE to study. Afterwards, Dr. Lisker informed CTA. Peláez about SENEAM's vetting. As a result, MITRE considers the Task 8 airport selection matter to be closed, and will start preparatory activities for its work on Guadalajara Airport next quarter.

- MITRE is in the process, through the assistance of CTA. Peláez, of coordinating a visit by officials from Comisión Nacional del Agua (CONAGUA) to MITRE. The purpose of the visit is to discuss the proposed development of reservoirs near Lago Nabor Carrillo, as well as bird hazards and mitigation matters. MITRE has expressed repeatedly concern about lack of mitigation experimentation over the years.
- MITRE's procedure design experts have spent a significant amount of time preparing obstacle data files, based on the satellite-based photogrammetric survey of Toluca Airport and its surroundings, for insertion into MITRE's procedure design software. Once completed, the MITRE team will be able to develop preliminary approach and departure procedures for Toluca Airport to support the overall design of the Mexico City TMA considering NAICM.
- In early 2015, ASA issued a stop-work order to MITRE's work concerning a second runway for Toluca Airport (on the basis that this is a long-run target), despite the fact that the approved contract's plan and budget included a second parallel runway. MITRE immediately expressed in many ways that this was an error because in designing NAICM's airspace, Toluca Airport operations need to be considered.

During the 20 November 2015 visit to MITRE by Lic. Mascott and other officials, the topic of the second parallel runway at Toluca Airport was discussed. MITRE expressed its opinion that Toluca Airport should be planned and protected for long-term growth along with NAICM's growth. As a result, the officials present at the meeting, including Lic. Mascott, Ing. Roberto Kobeh, Director General of SENEAM, and Lic. Alfonso Sarabia, Director General of ASA, agreed that a second parallel runway at Toluca should be considered, as originally planned. However, MITRE never received ASA's revocation of the stop-work order despite repeated requests over a one-year time period.

The entire Toluca Airport work is now delayed (both runways need to be analyzed simultaneously) and this is already starting to impact other NAICM-related airspace and procedure design work. Furthermore, part of the MITRE Toluca Airport team has been reassigned to work on other tasks. See the Contractual Matters section below.

- Contractual Matters
 - **Toluca-Related Work** – As mentioned above, MITRE requires formal authorization to re-instate consideration of a second parallel runway at

Toluca Airport. This formal notification is now urgent to avoid further work delay in both, the Toluca Airport work and part of the NAICM airspace design. Once GACM indicates (even informally) that it plans to re-instate this work, MITRE will be able to designate a team to move on within five months or so and provide a new calendar to complete this work. Additionally, at that time, MITRE is going to require feedback from appropriate authorities on the preferred location of a second parallel runway for Toluca Airport. Note that runway spacing standards keep changing.

- **Hidalgo-Related Work** – ASA issued a stop-work order on all of MITRE's work in the state of Hidalgo, on the basis of the Fuerza Aérea Mexicana's (FAM's) preference to relocate Santa Lucía Air Bases' fixed-wing non-transport aircraft operations to Querétaro Airport.

MITRE informed ASA that FAM operations at Querétaro Airport, 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.

Since this work is not contained in MITRE's current contract, a modification of the contract will be required, possibly exchanging the Hidalgo work, never completed, for the new work for Querétaro. Before that happens, it is essential that MITRE meets with officials from FAM to discuss the specific work to be conducted for Querétaro Airport once the NAICM airspace and procedure design reaches an appropriate stage. CTA. Peláez, per instructions of Lic. Mascott, is currently coordinating a visit by officials from FAM to MITRE.

- Note that due to the recent assignment of MITRE's contract to GACM, the above-mentioned Toluca and Hidalgo contractual matters will need to be addressed by GACM.

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:

Three documents (including one Enclosure)

cc: Ing. Enrique Lavin, 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 2017 TECHNICAL LETTER DISTRIBUTION

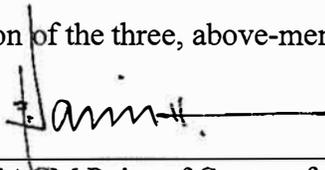
MITRE requests that the documents enclosed with this Technical Letter are distributed as follows.

1. Cancún Airport Terminal Maneuvering Area Redesign - Procedural Separation, Sectorization, and Human-In-The-Loop Workshop in Cancún: Summary of Key Activities. See MITRE document F500-L17-033, dated 30 January 2017.
 - GACM: 5 copies
 - SENEAM: 5 copies
 - DGAC: 5 copies

2. Technical Letter: Comments on the ILS Specifications. See MITRE document F500-L17-042, dated 3 March 2017.
 - GACM: 5 copies
 - SENEAM: 5 copies
 - DGAC: 5 copies

3. Enclosure 1 to this Technical Letter (F500-L17-044): Mexico Area Control Center Enroute Airspace Redesign - Performance-Based Navigation Metrics: Analysis of Current Sectors, dated 23 March 2017.
 - GACM: 5 copies
 - SENEAM: 5 copies
 - DGAC: 5 copies

The distribution of the three, above-mentioned documents, was completed.



Signature of GACM Point of Contact for MITRE

03/30/2017
Date

Enrique Lavín Higuera
Name of GACM Point of Contact for MITRE