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Subject: Guidelines for Upcoming Airspace and Procedure Design

Dear CTA. Gómez:

I respectfully submit to you this document that describes a few collaboration guidelines pertaining to upcoming Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) and MITRE airspace- and procedure-design related work under MITRE's contract with Mexico's government.

SENEAM and MITRE have worked for many years extremely well, especially given the complexity of their projects. In particular, as SENEAM and MITRE continue to advance on the design of the airspace of Mexico City to accommodate dual- and triple-independent operations at the Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM), project complexity is bound to grow. Therefore, it is important that the two organizations strengthen their modus operandi. The NAICM airspace environment is significantly more complex than the Cancún airspace, which is the most intense previous work completed in a collaborative manner. NAICM is going to have more sectors, many more routes, additional controller positions, higher volume of traffic, and procedures. Much of this work is going to be based on procedural methodologies that were developed with MITRE's assistance for Air Traffic Control (ATC) in the United States (U.S.). Mexico is going to be the first nation outside the U.S. to utilize such methodologies.

Thus, the objective of this document is to describe guidelines to enable SENEAM and MITRE to work together smoothly as the ever more complex work progresses, thus minimizing adverse results or delays.

The collaboration guidelines described below are identical to those that have been utilized by MITRE all over the world for many years, yet slightly adapted to ensure that they match MITRE's obligations under its contract with Mexico's government. These guidelines have grown over decades of work experience and the assistance of multidisciplinary experts with many years of involvement in controlling traffic and managing airspace at very busy airports in the U.S. and the world, along with engineers with very diverse backgrounds who have worked on major airspace design and implementation projects around the world.

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The guidelines are hereby provided in a concise manner through five items shown below.

1. Standards for Airspace, Procedure Design, and ATC Management

Triple independent approach procedures are only conducted in the U.S., using criteria prescribed by the U.S. Federal Aviation Administration (FAA). This type of decidedly complex procedure has been conducted in the U.S. for many years, where MITRE was at the forefront of its development and implementation. It is important to add that MITRE modeled the necessary runway centerline separation of NAICM not just for triple but also for dual procedures.

The Secretaría de Comunicaciones y Transportes (SCT) requested from the very beginning that MITRE utilize tried and proven criteria and practices for designing all procedures. In fact, MITRE's contract states that all of its work should be based on U.S. FAA Standard for Terminal Instrument Procedures (TERPS) criteria¹, which, in any case, MITRE knows best and it is highly tested. This includes work for airports other than NAICM within the contract, thus avoiding compatibility issues. This extends to other U.S. ATC-related criteria, including U.S. FAA Area Navigation (RNAV)/Required Navigation Performance (RNP) procedures as well as reduced divergence requirements between departures from the same runway to increase capacity. Under the contract, RNAV/RNP methodologies should be as advanced as possible, as long as they are proven, never experimental.

The Global Procedure Designer (GPD) software tool, utilized by MITRE and to be acquired by SENEAM before the current version expires (two licenses are strongly recommended for the SENEAM experts to work and verify procedures simultaneously), will bring about increased versatility to SENEAM. MITRE will fully support SENEAM in the use of this advanced tool, not just at NAICM but to help training its personnel through procedure design at other airports. Furthermore, this should ensure avoiding differences and/or confusion between SENEAM and MITRE. In summary, SENEAM and MITRE need to continue, as in the past, developing jointly, airspace- and procedure-design related work.

2. Human-in-the-Loop (HITL) Simulation Evaluations

HITL simulation evaluation schedules should be set at approximately six months (depending on HITL complexity) in advance to provide necessary time for preparation and programming of MITRE's Air Traffic Management (ATM) Laboratory equipment

¹ The International Civil Aviation Organization (ICAO) does not provide standards for conducting triple independent approach procedures or combinations of dual and triple approach procedures. Few nations in the world require such procedures.

and software.² This is because HITL simulation evaluations are very complex undertakings requiring a large team of experts with unique specialties to spend a significant amount of time preparing for the HITL simulation evaluation. Additionally, numerous international and U.S. FAA ATC facilities use MITRE's ATM Laboratory to test airspace and procedure designs, as well as verify future concepts and technologies. Therefore, laboratory space must be reserved well in advance to ensure the availability of resources. As a result, it is difficult to change HITL simulation evaluation schedules.

Since preparation for a HITL simulation evaluation activity is a very time-consuming and complex undertaking, it is essential that SENEAM and MITRE coordinate and plan NAICM and Toluca Airport airspace- and procedure-design matters closely, and agree to strict guidelines. This will avoid having to make any changes during the HITL simulation evaluation preparatory work that, even if only minor, can create complications and introduce the possibility for errors that could adversely affect the HITL simulation evaluation plan, outcome, and overall schedule.

Sections 3 and 4 below describe principles to avoid those types of risks.

3. Modifications to Airspace, Sectors, and/or Instrument Procedures

At least four to six months (depending on HITL complexity) prior to a scheduled HITL simulation evaluation activity, any modifications to the airspace design, including sectorization, as well as Standard Terminal Arrival Routes (STARs), Standard Instrument Departures (SIDs), Instrument Approach Procedures (IAPs), and enroute airways should be discontinued (i.e., the procedures and airspace designs should be "frozen"). This would allow preparatory work of the HITL simulation activity to advance in an orderly and efficient manner. This is important because the MITRE HITL simulation evaluation engineers need a significant amount of time to prepare and program the routes, procedures, and airspace sectors into the ATM Laboratory software. All the routes, procedures, and airspace sectors then need to be appropriately tested to ensure they are loaded and setup correctly. Next, the MITRE and SENEAM agreed-upon HITL simulation evaluation scenarios need to be programmed into the software and additional testing conducted.

The above-mentioned four- to six-month period (again, depending on HITL complexity) should provide the MITRE team with sufficient time to accomplish these aforementioned complicated tasks. However, the introduction of changes during this time period could complicate the HITL simulation evaluation preparatory work and increase the potential for errors and problems, and possibly require the HITL simulation evaluation schedule to be delayed. Therefore, changes should be avoided once the procedure and airspace designs are "frozen", unless they are totally necessary.

² Note that the initial NAICM HITL1 dry-run with SENEAM is scheduled for 21 through 25 May 2018. The MITRE team has already started preparatory work for that activity.

Nevertheless, any proposed changes should be closely coordinated with MITRE to determine their appropriateness and potential impact on work schedules.

4. Communication of Airspace- and Procedure-Design Changes

SENEAM and MITRE have exchanged many different airspace designs associated with NAICM over the past few years and have established good procedures for the exchange of information regarding changes to airspace and procedure designs. To allow time for inputting changes into applicable software tools, and to provide adequate time for review, feedback, and necessary documentation, it is important that all proposed changes to the STARs, SIDs, IAPs, enroute airways, and sectorization, no matter how minor, be communicated immediately to MITRE.

Moreover, MITRE should be made aware of any additional procedures for either NAICM or Toluca Airport that are being proposed and/or designed by SENEAM that are not being specifically discussed or addressed in the overall airspace design. Likewise, MITRE will make SENEAM aware of any potential issues or modifications to routes, procedures, or airspace matters to discuss them appropriately with SENEAM.

The following standard operating procedures have functioned satisfactorily in the past and should remain as the acceptable means of communicating any changes in the future:

- From MITRE to SENEAM: airspace and procedures are transmitted to SENEAM via route and airspace definition documents, which are submitted at appropriate intervals, typically after airspace design workshops are completed and any changes are thoroughly discussed with SENEAM.
- From SENEAM to MITRE: airspace and procedures are transmitted to MITRE via Portable Document Format (PDF) files with associated route and airspace design supporting information (e.g., design graphics, waypoint names, altitudes and airspeeds, and textual documents, including latitude and longitude coordinates).

Teleconferences should be conducted as necessary, especially if the subject is technically complicated. Despite physical distance, SENEAM and MITRE should work as they constituted a single unit, thus avoiding surprises that may affect each other's work.

Input and feedback from other stakeholders who have an interest in the overall NAICM project are important elements that should be considered, as necessary (for example, the Dirección General de Aeronáutica Civil, the Fuerza Aérea Mexicana, airlines, general aviation operators, etc.). Stakeholder inputs, requests, and work could significantly impact the project. Therefore, such information should be communicated

early on by SENEAM to MITRE or vice versa, to ensure all relevant issues and proposed modifications, as necessary, are discussed.

It is important to mention that incorporating stakeholder feedback into HITL simulation evaluations depends on several important factors. For example, and this is but one example, before incorporating any stakeholder feedback into a HITL simulation evaluation, it must be appropriately reviewed and examined in relation to the overall NAICM and Toluca Airport airspace and procedure design. Depending on the complexity of the stakeholder feedback, it could take SENEAM and MITRE a significant amount of time to thoroughly review and examine it. Therefore, as mentioned above, it is important to obtain stakeholder feedback as early as possible. If stakeholder feedback is provided too late during a HITL simulation evaluation program, it is possible that the feedback and needs of the stakeholders will not be able to be considered, which would be unfortunate and leave unknown risks behind.

5. Future Implementation of Procedure and Airspace Design

While MITRE assists aviation organizations, such as SENEAM and Mexico's DGAC in solving a broad range of complex airport- and ATC-related problems, MITRE does not have the authority or ability to actually publish or implement airspace and/or instrument procedures. The instrument procedure and airspace design work being conducted by MITRE for the Mexican aviation authorities, while robust and at an appropriate level to demonstrate technical and operational feasibility, should always be considered preliminary, as it is not intended to be implemented and/or published.

Before proceeding with implementation-related matters, all of MITRE's aeronautical work need to be reviewed by the appropriate Mexican aviation authorities, based on their internal processes and practices (e.g., internal reviews, flight inspections, charting, etc.) to ensure that such critical work is correctly evaluated before it is finally approved and implemented.

Likewise, MITRE does not "field" equipment nor recommends equipage or brands, partly because this can lead to conflicts of interest and partly because MITRE is a system engineering research center, not a commercial organization. MITRE gladly assists its sponsors whenever possible as long as their ultimate aim or acquisitions are fully independent from MITRE.

Sincerely,



Ing. Robert W. Kleinmans
Project Technical Coordinator

cc: CTA. Martín García, SENEAM
Dr. Bernardo Lisker, MITRE