MITRE

29 July 2016
F500-L16-040

CTA Miguel Peláez
Director General
Dirección General de Aeronáutica Civil (DGAC)
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Subject: Technical Letter: Assessment of *Centro de Gestión de Residuos Sólidos en el Bordo Poniente*

Dear CTA Peláez:

This document is in response to your conversations with Dr. Bernardo Lisker regarding an assessment by MITRE of the proposed *Centro de Gestión de Residuos Sólidos en el Bordo Poniente* (hereinafter referred to as the "facility"). The facility would include both solid waste management and bio-digester operations. The proposed facility would be located in an area immediately south of the western runways of the Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM).

Such close proximity raised concerns on the part of Undersecretary of Transport Yuriria Mascott and yourself regarding potential impacts on future aircraft operations and procedures. As per your request, and that of Lic. Mascott, Dr. Lisker authorized my creation of an ad hoc MITRE team to conduct an assessment of the potential impacts of the facility on future aircraft operations at NAICM. Given that this analysis took about one month to perform and it is contractually out-of-scope, we requested and obtained from Lic. Mascott, through you, authorization to prioritize this work over other tasks. However, MITRE will gladly absorb all costs. We all feel here that it was an intelligent decision to ask MITRE about the facility impact.

MITRE's assessment included a determination of whether the facility would impact key instrument approach and departure procedures and International Civil Aviation Organization (ICAO) Annex 14 Obstacle Limitation Surfaces (OLS). Other important items such as One-Engine Inoperative (OEI) procedures (also known as "engine-out" operations), potential impacts from exhaust plumes, and issues pertaining to wildlife attractants were also considered.

This technical letter provides a summary of MITRE's assessment of the facility. It is important to mention that MITRE intends to distribute a copy of this letter, as it does quarterly, to other Mexican aviation agencies. Depending on time availability, MITRE may also provide a description of the assessment in more detail. Nevertheless, the information contained in this letter should be useful to the authorities in making a decision on how to proceed on matters pertaining to the facility in relation to future aircraft operations at NAICM.

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Facility Location

For conservative analytical purposes, MITRE assumed that the facility could be located anywhere within the proposed site for development, with the site itself being defined by the ground elevation and coordinate information provided in INFO DGAC 180716_V2.pdf, dated 18 July 2016, provided to MITRE by the DGAC. In addition, MITRE assumed that the five stacks (i.e., chimneys) that are part of the facility could be located anywhere within the site. As per the information provided in INFO DGAC 180716_V2.pdf, the likely height of the stacks will be 70 m Above Ground Level (AGL). However, earlier information provided to MITRE indicated that the stacks could have a height of up to 80 m AGL (which for reference purposes, is 13 m higher than the top of the *Monumento a la Revolución* or close to half the height of the terrace on Floor 44 of the *Torre Latinoamericana,* both in Mexico City). In the end, MITRE analyzed a range of stack heights varying from 65 m (based on information provided by DGAC via e-mail) to 80 m AGL.

It is important to note that the facility would be only 432 m west of the extended runway centerline (nominal final approach track) of Runway 35L/17R (NAICM's western-most runway), respectively. Therefore, the facility would be located in an important aircraft operational area.

Aeronautical Analyses

To support NAICM planning and implementation efforts, MITRE spent a significant amount of time examining the feasibility of instrument approach and departure procedures. In doing so, MITRE developed Instrument Landing System (ILS), Required Navigation Performance Authorization Required (RNP AR) approaches, as well as conventional and Area Navigation (RNAV) instrument departures on the basis of United States (U.S.) Standard for Terminal Instrument Procedures (TERPS). Parallel approach obstruction assessment surfaces, which are required for conducting independent ILS approaches, were also analyzed.

The first conclusion of the above-mentioned analysis was that the facility would not have adverse effects over instrument approach procedures and surfaces and nominal departures.

Next, MITRE assessed if the facility would be located within OEI lateral obstacle clearance requirements considering both U.S Federal Aviation Administration (FAA) and ICAO standards. These standards require that if an engine fails at any point during takeoff, the flight can be safely concluded either by stopping on the remaining runway or by continuing the takeoff and clearing all obstacles that may be in the departure flight path. If obstacle clearance cannot be assured, the planned takeoff weight must be reduced to the point that all obstacles can be cleared, thus impacting payload and/or range capabilities.

Typically, airlines develop their own specific departure paths to follow in the event of an engine failure. Therefore, MITRE had to make some assumptions regarding potential OEI procedure departure paths. When considering a straight-out OEI procedure using FAA standards, the facility is outside the OEI lateral obstacle clearance requirements. However, it is possible, that if a turning OEI procedure were developed, the facility could fall within the OEI lateral obstacle clearance requirements. Similarly, when considering a straight-out OEI procedure using ICAO standards, the facility would be located within the OEI lateral obstacle

clearance requirements. Given that the stacks also could be located within OEI lateral obstacle clearance requirements they could adversely impact aircraft takeoff weight.

The second conclusion, therefore, was that all airlines would have to consider the facility as a potential obstacle for vertical clearance in their respective OEI procedure development (as indicated before, "engine out" procedures), given the close proximity of the facility to NAICM. Clearly, this means that the facility may restrict aircraft payload and range for some airlines and equipage.

Next, MITRE determined the need to raise any of the planned NAICM Minimum Vectoring Altitude (MVA) sectors in order to ensure appropriate clearance of aircraft over the facility.

The third conclusion was that the facility would not require modifications of the planned MVA sectors.

MITRE then evaluated the potential impact from the facility on ICAO Annex 14 OLS. MITRE determined that there is a penetration to the ICAO Annex 14 Conical surface within the polygon, even for a stack with a 65 m AGL height, worse for higher stacks (see Figure 1). It is also important to note that any changes in the ground elevation of the facility site could affect the results of MITRE's overall OLS assessment.

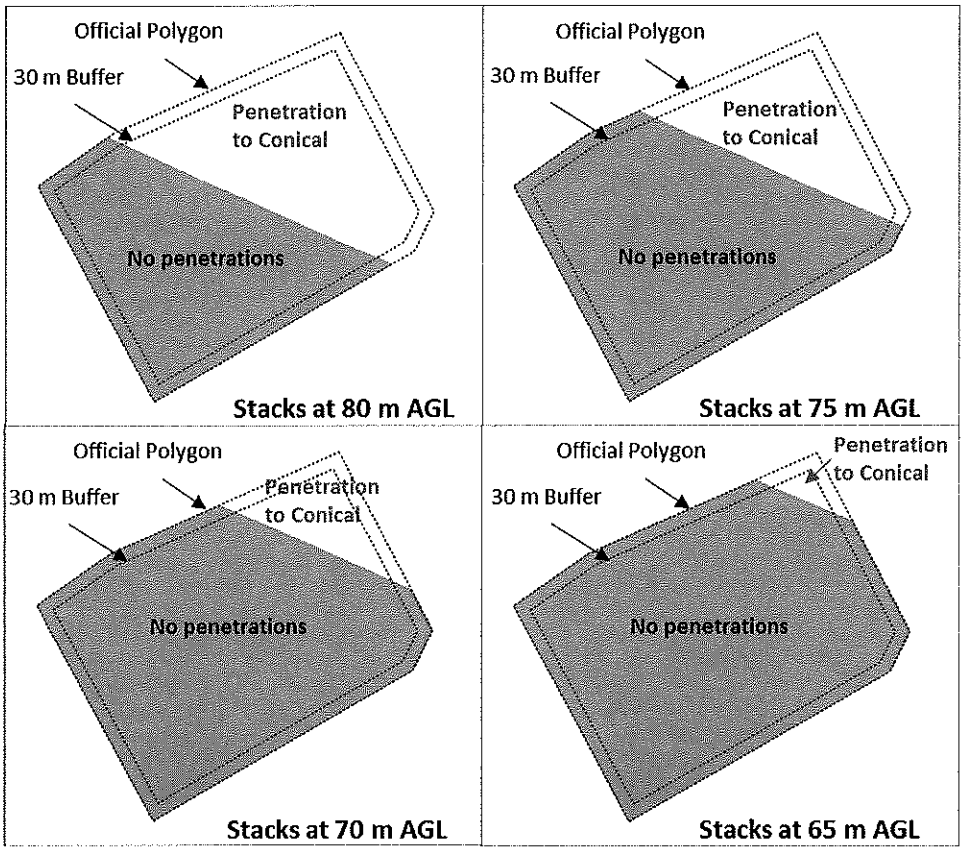

Figure 1. Penetration to ICAO Annex 14 Conical Surface by Stacks at the Facility

The fourth conclusion is that the ICAO Annex 14 Conical surface is penetrated somewhere within the polygon even for stacks as short as 65 m AGL.

Plumes

The facility has five stacks through which exhaust plumes will be emitted. In general, such plumes can adversely impact aircraft operations, including creating turbulence and affecting visibility. Therefore, a multitude of factors must be examined to more specifically determine potential impacts from exhaust plumes from the facility, including: stack size and height, the number of stacks, type of plume, plume temperature and velocity, the presence of certain particulates, the extent of the plumes beyond the stack, etc. Section 7–5–15 of the FAA's Aeronautical Information Manual (AIM) provides useful information on the flight hazards that exist around exhaust plumes. See the appendix at the end of this letter for details.

Most reported plume-related incidents in the U.S. involve stacks located under or close to approach and departure paths. Based on the close proximity of the facility to the runways at NAICM, it is possible that aircraft operations (including helicopters) could be adversely impacted from exhaust plumes being emitted from stacks at the facility. Wind and weather conditions could also potentially strengthen the impact of exhaust plumes on aircraft.

DGAC provided MITRE with information on the expected temperature (130° Celsius), velocity (up to 20 meters per second), and gaseous composition of the exhaust plumes.

The fifth conclusion is that due to operational concerns, the Mexican aviation authorities and other stakeholders should conduct more detailed analyses to assess the potential impacts from exhaust plumes to future aircraft operations at NAICM.

With increasing concerns over plumes, in 2015, the FAA Office of Airport Safety and Standards, with MITRE's assistance, released the Exhaust Plume Analyzer tool, which provides a means of assessing various aspects of exhaust plumes, such as mean flow of the plume, aircraft turbulence upset, etc. However, conducting detailed technical plume analyses for specific sites is outside of MITRE's area of expertise. It may be possible for Mexican authorities to obtain access to this tool, but license matters would need to be investigated as distribution outside of the U.S. is approved on a case-by-case basis.

Wildlife Attractant

As previously mentioned, the facility would include both solid waste management and bio-digester operations. Based on information provided by DGAC, the solid waste operation would be conducted in a closed facility and would not produce odors and, therefore, would not become a bird attractant. However, it is not clear to MITRE what kind of solid waste would be transported to the solid waste facility. If the waste products are a food source to birds (e.g., organic material), even their transportation to the solid waste facility (trucks often leak and/or spill waste products) and dumping of the waste products (which would not be conducted in a fully enclosed area of the facility) could attract birds to the area. Bio-digesters also have the potential to be wildlife attractants.

Both ICAO and the FAA provide standards and recommended practices to assist with the siting and operation of airports. Some of these guidelines pertain to the recommended separation distances between an airport and certain types of land use that have the potential to attract wildlife that could be hazardous to aircraft operations, including birds. Key FAA separation criteria state that vulnerable airport areas (e.g., aircraft movement areas, loading ramps, or

aircraft parking areas) should be located at a distance of at least 3 km from wildlife attractants (the facility is approximately 4 km from the western-most runway and, while this is an independent factor, the facility would be located merely 432 m west of the extended final straight approach track to Runway 35L/17R). Additionally, FAA criteria mentions that airport aircraft operating areas (e.g., runways and taxiways) should be separated by 8 km (5 statute miles) from wildlife attractants, if the attractants could cause wildlife movement into or across the approach or departure airspace. Furthermore, Mexico may have its own standards regarding the location of solid waste management and bio-digester operations in relation to airports.

The sixth conclusion, therefore, is MITRE's concern that the addition of potential wildlife attractants could exacerbate the already existing problem of bird activity near the runways at NAICM (e.g., from Lago Nabor Carrillo and other water bodies nearby the facility). Additionally, it is important to consider potential electromagnetic impacts and signal interference to navigational aids and other equipment.

Finally, MITRE recommends that Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) be made aware of this facility and conduct its own assessment of potential impacts on future aircraft operations at NAICM.

Closing Remarks

MITRE has previously assisted the Mexican aviation authorities in the assessment of several proposed developments in the vicinity of NAICM. In many cases, MITRE's analyses have determined that the proposed development could be constructed without impacting future aircraft operations at NAICM. For example, MITRE determined that a proposal by the State of Mexico regarding the construction of an auditorium near El Caracol was feasible.

However, in this case, MITRE's assessment of the facility has raised important operational and safety concerns. Therefore, in MITRE's opinion, if a decision has to be made at this time regarding this facility, MITRE would advise against its development.

MITRE strongly recommends that aircraft operational areas reserved for future approaches and departures at NAICM be clear of obstacles and other potential hazards to aircraft operations. MITRE also advises, as it has many times in the past, that Mexican authorities establish strict regulations to control construction in the vicinity of NAICM to prevent the development of obstacles to aircraft operations.

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

Sincerely,

Ing. Robert W. Kleinhans
Project Technical Coordinator

cc:
Lic. Yuriria Mascott Pérez
Dr. Bernardo Lisker

United States Federal Aviation Aeronautical Information Manual (Dated 26 May 2016)

Section 7–5–15. Avoid Flight in the Vicinity of Exhaust Plumes (Smoke Stacks and Cooling Towers)

The following is an excerpt from the above-mentioned document

a. Flight Hazards Exist Around Exhaust Plumes. Exhaust plumes are defined as visible or invisible emissions from power plants, industrial production facilities, or other industrial systems that release large amounts of vertically directed unstable gases (effluent). High temperature exhaust plumes can cause significant air disturbances such as turbulence and vertical shear. Other identified potential hazards include, but are not necessarily limited to: reduced visibility, oxygen depletion, engine particulate contamination, exposure to gaseous oxides, and/or icing. Results of encountering a plume may include airframe damage, aircraft upset, and/or engine damage/failure. These hazards are most critical during low altitude flight in calm and cold air, especially in and around approach and departure corridors or airport traffic areas.

Whether plumes are visible or invisible, the total extent of their turbulent affect is difficult to predict. Some studies do predict that the significant turbulent effects of an exhaust plume can extend to heights of over 1,000 feet above the height of the top of the stack or cooling tower. Any effects will be more pronounced in calm stable air where the plume is very hot and the surrounding area is still and cold. Fortunately, studies also predict that any amount of crosswind will help to dissipate the effects. However, the size of the tower or stack is not a good indicator of the predicted effect the plume may produce. The major effects are related to the heat or size of the plume effluent, the ambient air temperature, and the wind speed affecting the plume. Smaller aircraft can expect to feel an effect at a higher altitude than heavier aircraft.

b. When able, a pilot should steer clear of exhaust plumes by flying on the upwind side of smokestacks or cooling towers. When a plume is visible via smoke or a condensation cloud, remain clear and realize a plume may have both visible and invisible characteristics. Exhaust stacks without visible plumes may still be in full operation, and airspace in the vicinity should be treated with caution.

The best available information on this phenomenon must come from pilots via the PIREP[1] reporting procedures. All pilots encountering hazardous plume conditions are urgently requested to report time, location, and intensity (light, moderate, severe, or extreme) of the element to the FAA facility with which they are maintaining radio contact. If time and

[1] Pilot Report

conditions permit, elements should be reported according to the standards for other PIREPs and position reports (AIM Paragraph 7−1−22, PIREPS Relating to Turbulence).

FIG 7−5−2
Plumes