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**Subject: Special Technical Letter: Assessments of a Shift of Runways 1 through 6**

Dear Capt. López Meyer:

I respectfully submit to you this technical letter that provides information regarding the potential impact to aeronautical operations caused by the shifting of runways in the MITRE-Recommended Runway Configuration (July 2012) at Nuevo Aeropuerto Internacional de la Ciudad de México (NAICM), as proposed by Arup. MITRE acknowledges receipt of a letter from Ms. Jackie Coburn of Arup, dated 1 June 2015, transmitted to MITRE by you through Dr. Bernardo Lisker. The letter describes a number of runway shift options, including the shifting of runways 1 and 2 (as counted from west to east) a distance of 10 m to the west and the shifting of runways 3, 4, 5, and 6 a distance of 10 m to the east (described as Option 2 in Arup's letter). The above-mentioned runway shifts are being proposed to provide additional space between runways 2 and 3 to accommodate airfield/apron design matters in relation to the Master Architect's terminal design.

MITRE also reviewed Arup's letter with respect to proposed International Civil Aviation Organization (ICAO) taxiway and taxilane clearances, which are required along with the above-mentioned runway shifts to meet airfield/apron design objectives. Regarding ICAO's adoption of the proposed taxiway and taxilane clearances, MITRE is currently in the process of gathering information with respect to the process, timeframe, and likelihood for adopting these new clearances. This matter will be the subject of a separate letter.

### **Arup Option 2**

As mentioned above, Arup's letter describes a range of possible options to accommodate the Master Architect's terminal design and Arup's airfield/apron design. MITRE understands the importance of planning an efficient taxiway and terminal system, and wants to be as supportive as possible. Thus, a MITRE team reviewed the critical

dimensions associated with each option and assessed the potential aeronautical impact of Arup's preferred Option 2 runway shift proposal, as described above.

Based on Arup's preferred Option 2 runway shift proposal, the new shifted runway threshold coordinates are provided in Table 1. For comparison purposes, the runway threshold coordinates for the MITRE-Recommended Runway Configuration (July 2012) are also provided.

**Table 1. World Geodetic System 1984 (WGS84) and Universal Transverse Mercator (UTM) Coordinates of Runway Ends and Thresholds**

Runway	Runway End and Displaced Threshold (on Runway Centerline)	MITRE-Recommended Runway Configuration (July 2012)		Arup's Preferred Option 2 Runway Shift Proposal	
		WGS84 Coordinates	UTM X and Y Coordinates	WGS84 Coordinates	UTM X and Y Coordinates
17R/35L	17R Runway End	19 32 29.9N/99 00 27.8W	499190.7286/2160758.9760	19 32 29.9N/99 00 28.1W	499180.7348/2160759.3269
	35L Runway End	19 30 03.5N/99 00 33.2W	499032.8418/2156261.7466	19 30 03.6N/99 00 33.5W	499022.8480/2156262.0975
17L/35R	17L Runway End	19 32 39.3N/99 00 13.7W	499601.1598/2161049.0771	19 32 39.3N/99 00 14.0W	499591.1660/2161049.4280
	35R Runway End	19 29 56.7N/99 00 19.7W	499425.7300/2156052.1556	19 29 56.7N/99 00 20.0W	499415.7362/2156052.5065
18R/36L	18R Runway End	19 32 41.6N/98 59 15.0W	501311.7495/2161121.3721	19 32 41.6N/98 59 14.6W	501321.7433/2161121.0212
	36L Runway End	19 29 59.1N/98 59 21.0W	501136.3197/2156124.4506	19 29 59.1N/98 59 20.7W	501146.3135/2156124.0997
18L/36R	18L Runway End	19 32 31.3N/98 59 01.6W	501700.8294/2160803.3062	19 32 31.3N/98 59 01.3W	501710.8232/2160802.9553
	36R Runway End	19 30 05.0N/98 59 07.1W	501542.9426/2156306.0768	19 30 05.0N/98 59 06.7W	501552.9364/2156305.7259
19R/01L	19R Runway End	19 32 53.7N/98 58 15.9W	503032.7720/2161490.8303	19 32 53.6N/98 58 15.6W	503042.7658/2161490.4794
	19R Displaced Threshold (Tentative)	19 32 39.8N/98 58 16.4W	503017.7903/2161064.0932	19 32 39.8N/98 58 16.1W	503027.7841/2161063.7423
	01L Runway End	19 30 27.3N/98 58 21.4W	502874.8851/2156993.6009	19 30 27.3N/98 58 21.0W	502884.8789/2156993.2500
19L/01R	19L Runway End	19 32 53.2N/98 58 02.2W	503432.5283/2161476.8694	19 32 53.2N/98 58 01.9W	503442.5221/2161476.5185
	19L Displaced Threshold (Tentative)	19 32 39.3N/98 58 02.7W	503417.5466/2161050.1323	19 32 39.3N/98 58 02.4W	503427.5404/2161049.7814
	01R Runway End	19 30 26.9N/98 58 07.6W	503274.6414/2156979.6392	19 30 26.9N/98 58 07.3W	503284.6352/2156979.2883

Notes:

1. The runway coordinates for the MITRE-Recommended Runway Configuration (July 2012) contained in this table are associated with a runway configuration whose aeronautical feasibility has been proven through detailed aeronautical assessments. The coordinates for Arup's proposal are only being provided for reference purposes as MITRE only conducted limited, high-level aeronautical assessments for that runway configuration. See the Methodology part of this letter for additional information.
2. The coordinates are subject to change due to factors such as detailed civil engineering analyses, flight checks, final runway lengths and thresholds, and approvals that must be obtained from the appropriate aviation authorities of Mexico.
3. The MITRE UTM coordinates have a precision of 1/10,000<sup>th</sup> of a meter (0.0001 m). MITRE then uses MSP GEOTRANS 3.4, a geographic translator available from the U.S. National Geospatial-Intelligence Agency (NGA) Mensuration Service Program, to convert UTM Northing (Y) and Easting (X) to geodetic latitude and longitude for reporting purposes only. In general, the accuracy of the geodetic coordinate output by MSP GEOTRANS 3.4 has only been tested to a level of approximately 1 m (0.1 second).

## Methodology

MITRE's review of Arup's preferred Option 2 runway shift proposal includes an assessment of whether the proposed shifting of the runways has the potential to impact key instrument approach and departure procedures, ICAO Annex 14 Obstacle Limitation Surfaces (OLS), and other important aeronautical considerations. More specifically, with regard to ICAO Annex 14 OLS, MITRE also assessed potential impacts to Approach, Transitional, Conical, Inner Horizontal, and Take-off Climb Surfaces to each runway threshold.

With regard to instrument approach and departure procedures, a MITRE team assessed potential impacts to Category (CAT) I Instrument Landing System (ILS) final and missed approach segments (Section 1 and/or Section 2), CAT II/III ILS final and missed approach segments (Section 1 and/or Section 2), ILS precipitous terrain matters, conventional Standard Instrument Departures (SIDs), Required Navigation Performance Authorization Required (RNP AR) approaches, RNP AR precipitous terrain matters and Parallel Approach Obstruction Assessment Surfaces (PAOAS).

It is important to note that MITRE's assessment of Arup's preferred Option 2 runway shift proposal was limited in scope to only the runway shifts and their corresponding impact on the items listed above. MITRE did not fully design instrument procedures in its assessment, but rather investigated basic feasibility of OLS and instrument procedures for Arup's preferred Option 2 runway shift proposal by examining key surfaces and areas, and/or considering surfaces that were generated during previous work pertaining to the MITRE-Recommended Runway Configuration (July 2012). Additionally, given the urgency of this request and the desire to have early feedback, this assessment has not been thoroughly peer reviewed.

## Findings

Several MITRE analyses concerning the MITRE-Recommended Runway Configuration (July 2012) are currently in preparation and will be transmitted separately. In particular, the assessment of ICAO Annex 14 OLS and an examination of the feasibility of independent instrument approach and departure procedures at NAICM will be transmitted shortly (see MITRE Technical Letter F500-L15-021). Therefore, since the details of these assessments are forthcoming, the findings of MITRE's assessment of Arup's preferred Option 2 runway shift proposal are reported herein at a high-level.

With regard to the assessment of ICAO Annex 14 OLS, MITRE has determined that for Runways 1 and 2 (that shifted to the west), there were slight increases in the number of terrain, natural, and man-made penetrations at Sierra de Guadalupe to the Take-off Climb Surfaces. Similarly, for Runways 3, 4, 5, and 6 (that shifted to the east), there were slight penetrations as follows: for Approach Surfaces from the north for Runways 3, 4, 5, and 6, and Take-off Climb Surfaces to the north for Runways 3 and 4, there were slight increases in the number of terrain, natural, and man-made penetrations in the vicinity of the hill at Chiconautla; for Approach Surfaces from the south for Runways 5 and 6, there were slight increases in the number of terrain and natural penetrations in the vicinity of the hill at Chimalhuacán. Additionally, due to the shifting of Runways 1 and 2 to the west, the Conical Surface has a slight increase in the number of terrain, natural, and man-made penetrations at Sierra de Guadalupe.

MITRE found (however, once again as mentioned before, no peer-review took place):

- While there are increases in the number of penetrations relative to the MITRE-Recommended Runway Configuration (July 2012), there should be no significant impact on ICAO Annex 14 OLS.

- With regard to instrument approach and departure procedures, there was either no impact or insignificant impact on any of the previously-designed procedures. For example, climb gradients on a few missed approach and departure procedures increased slightly.
- Arup's preferred Option 2 runway shift proposal may cause changes to the results of MITRE's parametric analysis of runway threshold elevations that consider terrain at the hills at Chiconautla and Chimalhuacán (see MITRE letter F500-L15-018). For example, the volume calculations of soil ("dirt") required to be removed to avoid a penetration may change.

### Closing Statement

On the basis of MITRE's high-level assessment of Arup's preferred Option 2 runway shift proposal, it is MITRE's opinion that there should be no significant impact to aeronautical feasibility. Therefore, MITRE feels that Arup's preferred Option 2 runway shift proposal can be implemented. Of course, other actions such as flight inspections and the final review of instrument procedures and other key aeronautical work by Servicios a la Navegación en el Espacio Aéreo Mexicano (SENEAM) and other authorities must also be conducted before the runway locations and their associated procedures can be approved.

As previously mentioned, MITRE is still in the process of obtaining greater insight into the likelihood of the proposed ICAO clearances being adopted. Initial information obtained from ICAO is promising. However, the approval process is still on-going, with all that this entails. Therefore, MITRE does have some concern regarding the adoption of proposed ICAO taxiway and taxilane clearances that, along with Arup's preferred Option 2 runway shift proposal, are required in order to achieve airfield/apron design objectives. If the ICAO taxiway and taxilane clearances are not approved at a later date, there could be problems with the airfield/apron design that may be difficult to overcome. MITRE recommends caution and suggests that Arup and the Master Architect investigate a back-up plan in the event that some or all of the ICAO clearances are not adopted.

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

Sincerely,



Ing. Robert W. Kleinhans  
Project Technical Coordinator

cc:  
Lic. Manuel Ángel Núñez  
Dr. Bernardo Lisker