



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 3, 2018

Attachment 16 – Air Canada’s Simulator Evaluation

OPERATIONAL FACTORS/HUMAN PERFORMANCE

DCA17IA148

Simulator Work

1.1 Simulator Test Plan¹

Location: CAE Simulator Building adjacent to Air Canada Headquarters
Date: August 9, 2017
Time: 0530 EDT

Overall Objectives:

- Document simulator fidelity, systems and alerts
- Document aircraft avionics set up for approach
- Document normal FMS Bridge Visual approach procedures for the Airbus A-320-211 aircraft without GPS
- Document procedure for input of ILS frequency when the FMS is loaded with the FMS Bridge Visual approach
- Document known flight profile characteristics for the incident flight
- Replicate the incident flight (flight below MDA)

Aircraft: Airbus A-320 simulator #3
Airport: CYYZ
Participants: Captain John Horrigan
FO Christine Lyon
Sim operator Chris Gillan

Due to limitation of the simulator space the group divided into two separate groups. Group 1 consisted of Shawn Etcher (NTSB); Missy Rudin-Brown (TSBC); and Gordon Heisis (ACPA) the group began at 0530 and exited the simulator at 0745

Group 2 consisted of Sathya Silva (NTSB); Robert Hendrickson (FAA); Christy Helgeson (FAA) and Beverley Harvey (TSBC) the group began at 0745 and concluded at 0930.

Group 1's session began at the gate with an engine start and taxiout for departure including a full set up of the FMC.

Group 2's session began about the waypoint of F101D with the airplane in a bank towards the airport on profile.

It should also be noted that the simulator personnel suggested flying an FMS generated course traffic pattern to reduce the potential of simulator technical difficulty for repositioning

The simulator also utilizes lat and longs to be able to adequately fly the approach and according to simulator personnel there was no disengaging that function so the simulator was not an exact replica of the incident airplane.

¹ Test plan was designed to be accomplished in one simulator session.

Initial Simulator Setup:

- San Francisco International Airport (KSFO) – FMS Bridge Visual approach 28R
- Position freeze: on decent for the DYAMD 3 Arrival 2 miles prior to FLOWZ at 16,000 feet msl.
- Cockpit navigation: per Air Canada procedures.
- Captain is Pilot Flying (PF), Co-pilot is Pilot Monitoring (PM)
- Weather:
 - o KSFO 080556Z 29012KT 10 SM CLR 17/09 A2993 RMK AO2 SLP134 T01720094
 - o ACARS Q

Message Length = 676

<CR><LF>

<SOH>QU DDLXCXA<CR><LF>

.ATSACXA 080621<CR><LF>

<STX>DAI<CR><LF>

AN C-FKCK<CR><LF>

- /ATSACXA.TI2/KSFO ARR ATIS Q<CR><LF>

0556Z SFO ATIS INFO Q 0556Z. 31012KT 10SM CLR 17/09 A2993 (TWO NINER NINER THREE).<CR><LF>

QUIET BRIDGE VA IN USE. LNDG RWYS 28R. DEPG RWYS 1L. NOTAMS... RWYS 28L, 10R<CR><LF>CLSD, RWYS 1R, 19L CLSD. TWY J CLSD, TWY S1 CLSD. TWY F CLSD BETWEEN TWY L, RWY<CR><LF>

1L, TWY F1 CLSD BTWN TWY L, RWY 1L. RY 28L ALS OTS, RY 28L/10R CL LGTS OTS.<CR><

LF>MULTIPLE CRANES UP TO 275 FEET, WEST AND SOUTH OF SFO AIRPORT. ASSC IN USE AC TVT<CR><LF>

TRNSPNDR WITH MODE C ON ALL TYS AND RWYS. READBACK OF ALL RWY HOLDING<CR><LF> INSTRUCTIONS IS REQUIRED. ALL ACFT ARE RQRD TO INCL ACFT CLSGN IN ALL RDBKS AND< CR><LF>ACKMTS. ...ADVS YOU HAVE INFO Q.281B<CR><LF>

<CTV> <COT>

- Turn off runway and approach lighting to Runway 28L
- Insert 4 aircraft holding on taxiway Charlie

Weight and Balance:

Performance information was obtained from ACARS Traffic Log_120717_144222, pg. 4. The ACARS data was based on Takeoff Weight; however, once the takeoff performance was entered the MCDU computed the landing speed based on the weight at the time of landing which was 60,309 kg (132,958.59 lbs.).

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QU DDLXCXA
.QAGCSAC 080048
M4P
AN C-FKCK/FI AC0759/GL YYZ/MA 7901
- - TXN PA01 08JUL/0048 C-FKCK/220/AC0759
CEWTL/220/YYZ/05 /023/1 /N/
/0765/2971/N/N/N/N/N/N/ /N/N/N
A320-211 FIN 220
YYZ CYYZ / RWY 05
TORA 10775 FT
FLAP : 1 PACKS : OFF
TEMP : 23 ENG A/I : OFF
PRESS : 29.71 WING A/I : OFF
WEIGHT : 76.5 RWY COND : DRY

WIND THRUST WEIGHT V1-VR-V2 TOGA
-5 TOGA 75.6 WEIGHT ABOVE MAX

0 TOGA 76.8 159-159-161 1200
TOGA 76.5 156-156-157 1200
29 75.9 152-152-154 1200

10 TOGA 77.4 156-156-158 1200
TOGA 76.5 153-153-154 1200
29 76.5 154-154-155 1200
30 75.9 153-153-155 1200

FMGC THR RED/ACC ENG OUT ACC
NADP 1 2070/3570 1570
NADP 2 1570/1570 1570

END

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1.1.1 Run 1: Normal FMS Bridge Visual Approach 28R to Go-Around – Chart 19-3-1

Procedure

1. Document cockpit:
 1. Cockpit panels
 2. Photo Document location of autopilot/vertical speed knob, barometric altimeters, radar altimeter, engine thrust gauges, EGPWS test and alerts, ECAM, FMC, ND visual depiction.
 - To Go-Around
 - Set up with airplane on taxiway C (perpendicular to runway 28R) if possible
2. Vref: 139
 1. *FDR Data shows indicated airspeed of 138 knots until about AP disconnect then reduced to about 129 knots indicated airspeed.*

Time	Notes
	1. Photo Document location of autopilot/vertical speed knob, barometric altimeters, radar altimeter, engine thrust gauges, EGPWS test and alerts, ECAM, FMC, ND visual depiction, and moving map (if applicable). 2. SOPs: FMC and mode control panel set up, A/P procedure used to disconnect and manually fly. 3. Timing (seconds): - At JANYY to F101D – 134 seconds - F101D to Go-Around (prefer about 100 feet) – 88 seconds 4. After PM calls Go-around note: - Altitude Loss – was less than 50 feet when based on radar altimeter but was greater than 40 feet - GA Procedures – were done within Air Canada Standards 5. Other Notes: -- Airplanes on taxiway C had landing lights illuminated as that was the limitation of the simulator -- Lead in approach were illuminated by mistake -- Tuning in ILS resulted in an alert tone (simulator limitation)



Photo 1: Approximate location near the JANNY Intersection

1.1.2 Run 2: Normal FMS Bridge Visual Approach 28R

Reposition

- Full traffic pattern flight path navigated by FMS to a point to allow a base turn to line up on the FMS Bridge Visual approach
- Flaps 1
- Speed 210 knots
- Vref: 139
 - o FDR **PRELIM** Data shows indicated airspeed of 138 knots until about AP disconnect then reduced to about 129 knots indicated airspeed.
- Set up with airplane on taxiway C (perpendicular to runway 28R)
- Redo due to lead in lights being illuminated on first attempt

Procedure

1. Normal visual approach procedures (Air Canada)
2. Disconnect autopilot 1 mile outside of F101D
3. Execute a go-around at 100 feet

Time	Notes
	1. Photo/video document ECAM, FMC, ND visual depiction, and moving map. 2. Photo/video document Sim fidelity of runway/taxiway from: - F101D 400 feet agl 100 feet agl 3. After PM calls Go-around note: - Altitude Loss – less than 50 feet per the radar altimeter but greater than 40 feet - GA Procedures – 4. Other Notes: ■ Go around was not an abrupt maneuver when based on change in pitch degree of approximately 3 seconds from beginning of pitch until stabilized in a climb ■ Received a glideslope alert as it was not deselected from the previous approach and reselected. Simulator limitation error.



Photo 2: Approximate position over the San Mateo Bridge (VID 0024)



Photo 3: Approximate 1 Mile Final (Vid 0024)



Photo 4: just prior to go-around (Vid 0024)

1.1.3 Run 3: Normal FMS Bridge Visual Approach 28R

Reposition

- Full traffic pattern flight path navigated by FMS to a point to allow a base turn to line up on the FMS Bridge Visual approach
- Flaps 1
- Speed 210 knots
- Vref: 139
 - o FDR PRELIM Data shows indicated airspeed of 138 knots until about AP disconnect then reduced to about 129 knots indicated airspeed.
- Set up with airplane on taxiway C (perpendicular to runway 28R)
- Redo due to lead in lights being illuminated on first attempt

Procedure

4. Normal visual approach procedures (Air Canada)
5. Disconnect autopilot 1 mile outside of F101D
6. Execute a go-around at 100 feet

Time	Notes
	1. Photo/video document ECAM, FMC, ND visual depiction, and moving map. 2. Photo/video document Sim fidelity of runway/taxiway from: - F101D 400 feet agl 100 feet agl 5. After PM calls Go-around note: - Altitude Loss – less than 50 feet per the radar altimeter but greater than 40 feet - GA Procedures – 6. Other Notes: ■ Go around was not an abrupt maneuver when based on change in pitch degree of approximately 3 seconds from beginning of pitch until stabilized in a climb ■ Received a glideslope alert as it was not deselected from the previous approach and reselected. Simulator limitation error.



Photo 5: Aligned with Taxiway C (Vid 0025)

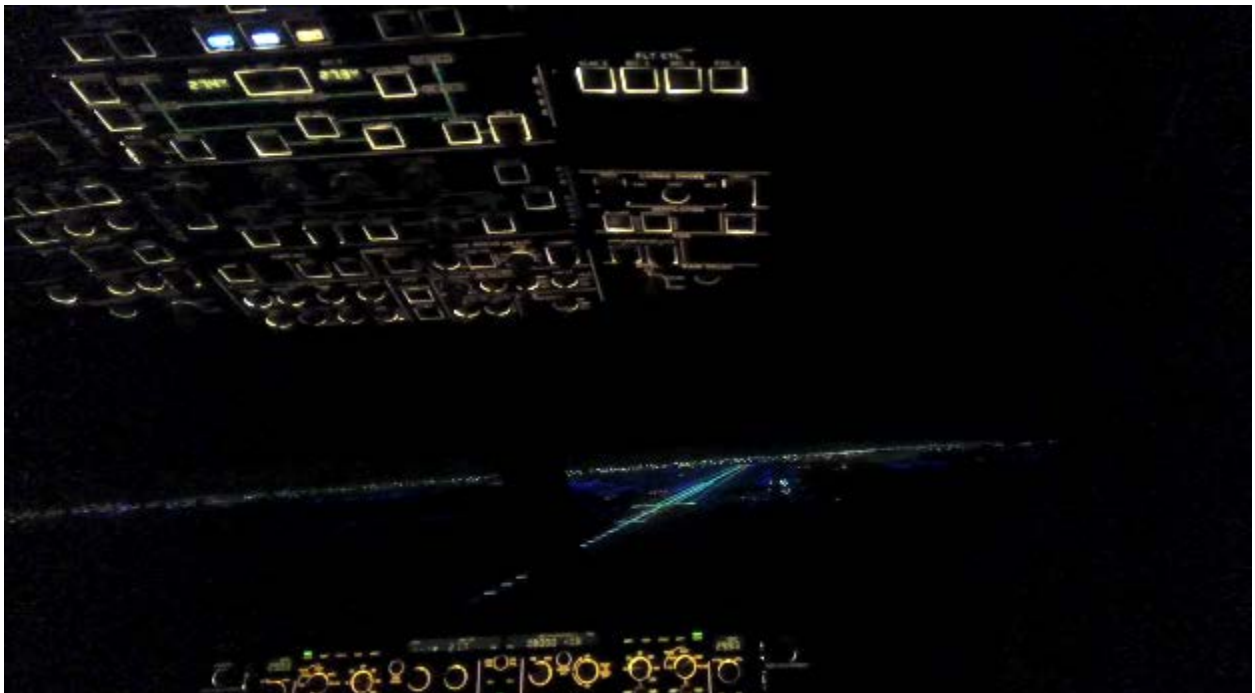


Photo 6: Aligned with Taxiway C Less than 1 Mile final (VID 0029)



Photo 7: Approximately abeam runway Threshold just prior to go around at 100 feet (Vid 0029)



Photo 8: View from Flightdeck at the Start of the Go-around (VID 0029)

1.1.4 Run 4: Normal FMS Bridge Visual Approach 28R

Reposition

- Full pattern flight from go around until a vector to final approach
- Speed 210 knots
- Vref: 139
 - o FDR **PRELIM** Data shows indicated airspeed of 138 knots until about AP disconnect then reduced to about 129 knots indicated airspeed.
- Set up with airplane on taxiway C (perpendicular to runway 28R) if possible

Procedure

1. Normal visual approach procedures (Air Canada)
2. Disconnect autopilot 1 mile outside of F101D
3. Flight freeze about F101D for next group

Time	Notes
	1. Photo/video document ECAM, FMC, ND visual depiction. 2. Photo/video document Sim fidelity of runway/taxiway from: F101D turning final and flight freeze Notes: - The flight deck is illuminated to easily photo document the ND and other cockpit instrumentation - The ND was documented showing that airplane aligned with the runway - The ND also showed terrain indication - The PFD showed a right bank of about 3 degrees to align with the runway after the left bank past F101D



Photo 9: Inside F101D turning final to 28R on Flight Freeze to illuminate cockpit to document the ND (VID 0031)

1.2 Air Canada Approach Procedures²

1.2.1 RNAV Visual Approach

RNAV VISUAL APPROACH

Applicable to: **ALL**

Ident.: 1-04-11-40-00016048.0001001 / 27 JUL 16

GENERAL

The aircraft navigates using the RNAV system, but the position is monitored by visual reference to the ground, obstacles and other traffic.

RNAV visual approach must be stored and retrievable from the Navigation Database.

² Extracted from the A319/A320/A32 Aircraft Operating Manual – Volume 1 Chapters 11 and 12

Applicable to: ALL

Ident.: 1-04-11-40-00016049.0001001 / 27 JUL 16

EQUIPMENT REQUIRED

- 1 FMS
- 1 GPS or 2 DME to update FM position
- Additional requirement if indicated on the approach chart.

Applicable to: ALL

Ident.: 1-04-11-40-00016050.0001001 / 27 JUL 16

FMGC GUIDANCE MODE

- **If no required accuracy is published:**
The use of FMGC guidance mode is at flight crew discretion.
- **If RNAV 1 or RNP 1 is required on the published approach chart:**
The flight crew should use adequate FMGC guidance modes.

NOTE: *The use of lateral and vertical managed guidance modes reduces the crew workload and improves energy management.*

For RNAV VISUAL approach including RF legs, Refer to SI- 110 RF Legs for RF leg flying technic.

Applicable to: ALL

Ident.: 1-04-11-40-00016051.0001001 / 13 APR 17

DESCENT PREPARATION

For approach data insertion in the FMS, set 500' AGL on the PERF APPR Page.

Applicable to: ALL

Ident.: 1-04-11-40-00016052.0001001 / 27 JUL 16

DESCENT

For RNAV VISUAL approaches requiring GPS, check that GPS PRIMARY is available on at least 1 FMS.

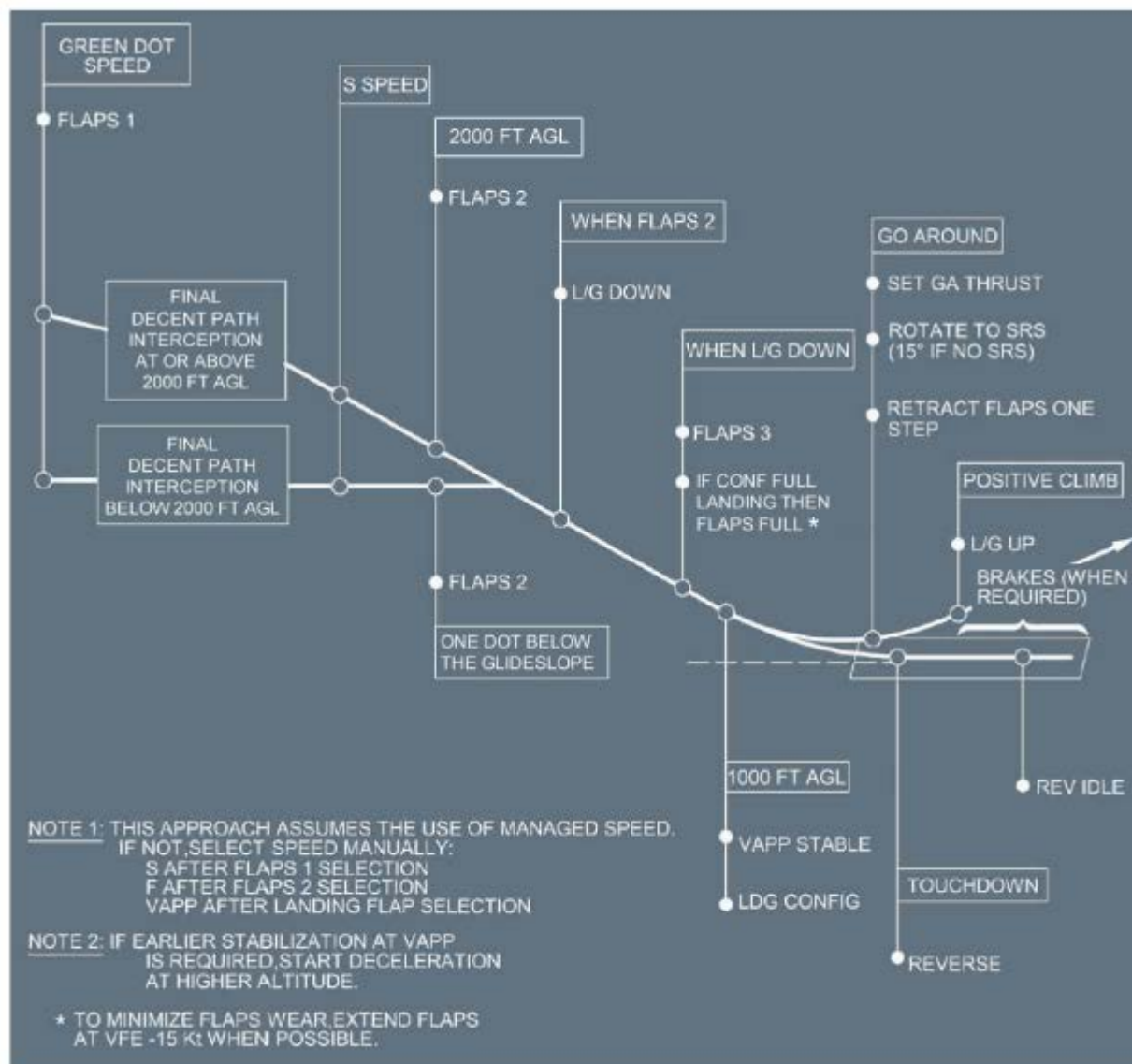
Applicable to: ALL

Ident.: 1-04-11-40-00016053.0001001 / 27 JUL 16

FINAL APPROACH

The flight crew must disconnect the AP at the latest at the Minimum Use Height of the AP.

1.2.2 ILS Profile



1.2.3 Go Around

PF	PM
Select Thrust Levers to TOGA	
Call "GO-AROUND, FLAPS" Commence rotation to SRS bar on the PFD. (15 ° if no SRS).	Select Flap Lever up one step. When established in a definite climb: Call "POSITIVE RATE" (when vertical speed is positive and radio altitude has increased).
Call "GEAR UP" Engage Autopilot above 100 ft if manually flying.	Select Gear Up and disarm Spoilers. Confirm TOGA and G/A modes on FMA.
WHEN ESTABLISHED IN A CLIMB AT OR ABOVE 400 FT AGL, MIN Vapp	
Select HEADING PUSH or HEADING PULL as required. Ensure FMA annunciations are correct	Monitor flight path and/or profile for deviations and advise PF.

PF	PM
AT THRUST REDUCTION / ACCELERATION ALTITUDE	
<u>NOTE:</u> If FDs are not in use: Call "SET GREEN DOT" Select Thrust Levers to CL detent. Monitor Target Speed increases to Green Dot. If Target Speed does not increase to Green Dot PULL ALT Knob and confirm OPEN CLB on the FMA. Ensure FMA annunciations correct	<u>NOTE:</u> The Set Green Dot call is a request to select a speed higher than the current speed, close to Green Dot speed to ensure A/THR engages with an increase in speed command.
AT OR ABOVE F SPEED	
Call "FLAPS 1"	Select Flap Lever to 1
AT S SPEED	
Call "FLAPS ZERO"	Select Flap Lever to 0 When Slat/Flap retracted: Call "FLAPS ZERO, GEAR'S UP"

1.2.4 Air Canada Stable Approach Criteria

STABLE APPROACH TOLERANCES

Flight parameters are closely monitored by both pilots. The PF announces any FMA changes. Throughout the final approach the PM shall call out any deviation which exceeds the parameters established below. Policy defining whether to continue an approach or to go around based on these parameters is contained in the FOM.

■ Tracking

		<u>Deviation:</u>
• LOC/VOR approaches	– Lateral deviation within	1 dot
	– Vertical deviation (if available) within	½ scale deflection
• CAT I approaches	– LOC and G/S within	1 dot
• CAT II/III approaches	– LOC within	1/4 dot
	– G/S within	1 dot
• RNAV approaches	– Lateral tracking within	the RNP requirement
	– Vertical deviation (if available) within	½ scale deflection
• NDB approaches	– Bearings within	± 5 °
	– Vertical deviation (if available) within	½ scale deflection
• Visual approaches and approaches without vertical path guidance:		
– Lateral tracking as close as possible to the extended runway centerline or published inbound course;		
– Vertical tracking on approximately a 3 degree glide path and using visual approach slope indicators (i.e. PAPI, VASIS) if available.		

- Vertical Speed not exceeding 1000 fpm
- Airspeed within +10/ -5 knots of Target.

Unusual circumstances or conditions may require allowances for momentary variations due to weather and turbulence.

Applicable to: 201-213, 215-222, 225-226, 228, 232, 235-242, 258, 260-261, 264-271, 274-275, 280, 282, 285-287, 401-405, 408, 411, 415-416, 451-460, 464, 473

Ident.: 1-04-11-50-K20150415-1618231823.0001001 / 13 APR 17