Australian Government
Civil Aviation Safety Authority

Baro-VNAV/RNP-AR simulator validation

Presented by Steven Kreusser (Aviation Safety Inspector)

B737 simulator – Boeing Brisbane

Custom coded database

- Coding tables given to Boeing
- Boeing create custom coding for use in the simulator

PROPOSED NAVIGATION DATABASE CODING TABLE

PATH DESCRIPTOR OR TERMINATOR	FIX TYPE (ID)	WAYPOINT IDENTIFIER (NAME)	FLYOVER	COURSE / TRACK °M (°T) - 000°	MAGNETIC VARIATION	DISTANCE (NM)	TIME (MIN)	TURN DIRECTION	ALTITUDE (FT)	SPEED (KT)	VPA / TCH (0.00/00)	NAVIGATION SPECIFICATION	RNP (NM)	ARC CENTRE ID (NAME)
TRANSITION														
IF	IAF	KLCEC	N	-	2 E	-	-	-	+2300	-210	-	RNP APCH	1	
TF	IF	KLCEI	N	003°M (005°T)	2 E	5.00	-	-	+2300	-	-	RNP APCH	1	
TRANSITION														
IF	IAF	KLCEB	N	-	2 E	-	-	-	+2300	-210	-	RNP APCH	1	
TF	IF	KLCEI	N	293°M (295°T)	2 E	5.00	-	-	+2300		-	RNP APCH	1	
TRANSITION														
IF	IAF	KLCEA	N	-	2 E	-	-	-	+2300	-210		RNP APCH	1	
TF	IF	KLCEI	N	223°M (225°T)	2 E	5.00	-	-	+2300			RNP APCH	1	
FINAL APPROACH														
IF	IF	KLCEI	N	-	2 E	-	-	-	+2300	-	-	RNP APCH	1	
TF	FAF	KLCEF	N	293°M (295°T)	2 E	5.00	-	-	+2200	-	-3.0	RNP APCH	1	
TF	MAPt	RW29	Y	293°M (295°T)	2 E	5.13	-	-	@563	-	-3.0	RNP APCH	0.3	
DF	MAHF	KLCEH	N	-	2 E	4.00	-	-	-	-	-	RNP APCH	1	
CA	-	-	-	293°M (295°T)	2 E	-	-	-	+2300	-	-	RNP APCH	1	

WAYPOINTS INFORMATION - WGS84

Waypoint / Fix	Latitude	Longitude	Notes	Published Y / N
KLCEC	-16° 16' 58.26"	123° 53' 48.48"		N
KLCEB	-16° 14' 03.00"	123° 58' 56.81"		N
KLCEA	-16° 08' 23.20"	123° 57' 51.74"		N
KLCEI	-16° 11' 57.96"	123° 54' 13.15"		N
KLCEF	-16° 09' 52.81"	123° 49' 29.59"		N
RW29	-16° 07' 44.23"	123° 44' 38.62"		N
KLCEH	-16° 06' 03.95"	123° 40' 51.92"		N

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Airport Id/ProcId: YKLC R11 F CAS

Rte Id	Seq No.	PT	Fix Id	Fix Ind	Fix Latitude	Fix Longitude	FO	TD	Mag Crs	Alt Cd	Alt A	Alt B	Vert Ang	RNP	Spd Lmt	Rec Nav	Ds/Tm/ Theta Rho	Ctr Fix	R T Alt	P T Alt	Eff Cycle
	10	IF	KLCWI		S16-03-03.47	E123-34-04.40				+	2300			1.00						11000	New
	20	TF	KLCWF	F	S16-05-08.97	E123-38-47.66				+	2200		3.00	1.00							New
	30	TF	RW11	M	S16-07-15.82	E123-43-34.36	Y				587		3.00	0.30							New
	40	DF	KLCWH		S16-08-56.07	E123-47-20.87	Y							1.00							New
	50	CA							113.0	+	2300			1.00							New
KLCWD	10	IF	KLCWD	A	S16-06-38.03	E123-30-25.75				+	2300			1.00	-210					11000	New
KLCWD	20	TF	KLCWI		S16-03-03.47	E123-34-04.40				+	2300			1.00							New
KLCWE	10	IF	KLCWE	A	S16-00-57.87	E123-29-21.33				+	2300			1.00	-210					11000	New
KLCWE	20	TF	KLCWI		S16-03-03.47	E123-34-04.40				+	2300			1.00							New
KLCWG	10	IF	KLCWG	A	S15-58-03.22	E123-34-29.28				+	2300			1.00	-210					11000	New
KLCWG	20	TF	KLCWI		S16-03-03.47	E123-34-04.40				+	2300			1.00							New

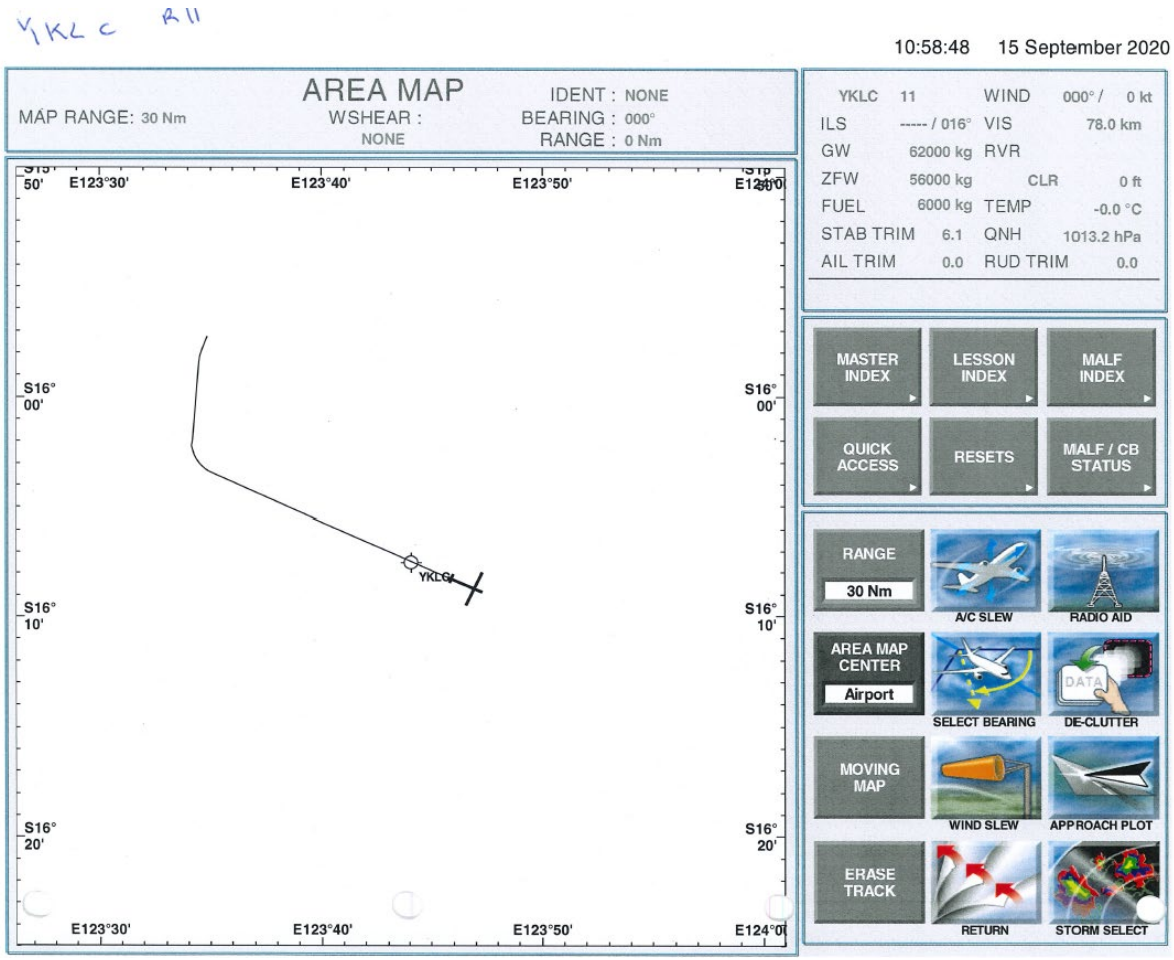
Reviewed OK

Airport Id/ProcId: YKLC R29 F CAS

Rte Id	Seq No.	PT	Fix Id	Fix Ind	Fix Latitude	Fix Longitude	FO	TD	Mag Crs	Alt Cd	Alt A	Alt B	Vert Ang	RNP	Spd Lmt	Rec Nav	Ds/Tm/ Theta Rho	Ctr Fix	R T Alt	P T Alt	Eff Cycle
	10	IF	KLCEI		S16-11-57.98	E123-54-13.08				+	2300			1.00						11000	New
	20	TF	KLCEF	F	S16-09-52.82	E123-49-29.52				+	2200		3.00	1.00							New
	30	TF	RW29	M	S16-07-44.27	E123-44-38.49	Y				563		3.00	0.30							New
	40	DF	KLCEH		S16-06-03.97	E123-40-51.78	Y							1.00							New
	50	CA							293.0	+	2300			1.00							New
KLCEA	10	IF	KLCEA	A	S16-08-23.22	E123-57-51.72				+	2300			1.00	-210					11000	New
KLCEA	20	TF	KLCEI		S16-11-57.98	E123-54-13.08				+	2300			1.00							New
KLCEB	10	IF	KLCEB	A	S16-14-03.01	E123-58-56.73				+	2300			1.00	-210					11000	New
KLCEB	20	TF	KLCEI		S16-11-57.98	E123-54-13.08				+	2300			1.00							New
KLCEC	10	IF	KLCEC	A	S16-16-58.28	E123-53-48.39				+	2300			1.00	-210					11000	New
KLCEC	20	TF	KLCEI		S16-11-57.98	E123-54-13.08				+	2300			1.00							New

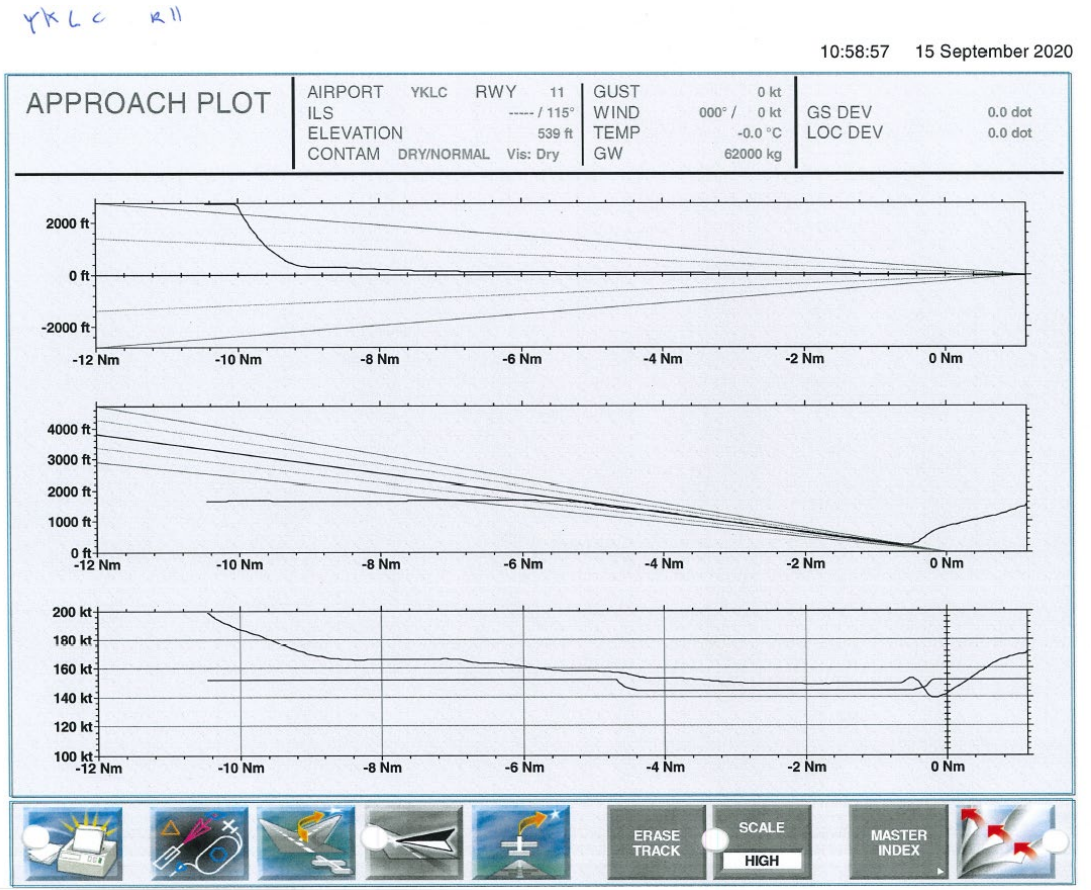
Fly the procedure

Record simulator tracks



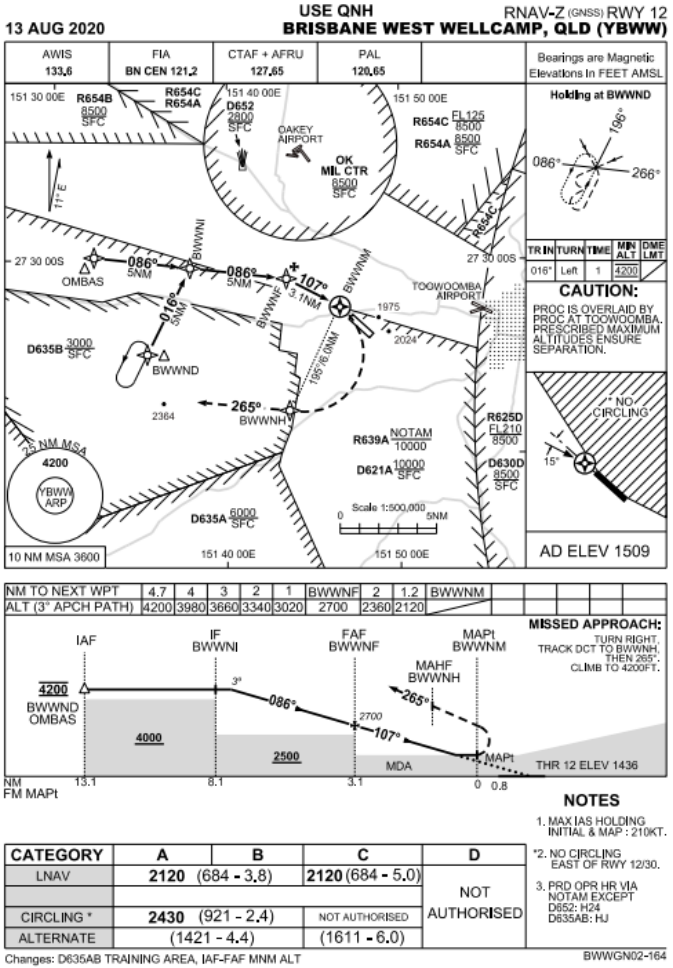
- Record of temperature set in simulator
- Record of wind (used for RNP-AR RF validation)
- Record of flight track

Record simulator tracks



- Record of temperature set in simulator
- Record of wind (used for RNP-AR RF validation)
- Record of vertical path flown

Simulator flyability – case study



- Final approach 15° offset – PANS-OPS compliant
- Turn at FAF 21 ° - PANS-OPS compliant
- MAPt 0.8nm from THLD – PANS-OPS compliant
- Originally proposed as CAT A/B/C/D approach
- Ground Validation – no issues
- Flight Validation – no issues
- Procedure Designer argued that simulator validation was not required as the procedure was fully PANS-OPS compliant.

Simulator flyability – case study

» Problems?

REMARKS:

- Procedures were flown at a high, statistically likely temperature, at maximum landing weight and up to maximum certified crosswind for the B747-400.
- RNAV RWY 30 offset was not a flyability issue, even with a 35kt crosswind from the South. Since flight validation IDS have received survey data which has allowed an approach to be designed without any offset and with minimum impact on the minima.
- RNAV-Z RWY 12 was demanding but flyable in benign weather conditions, however when strong crosswinds and poor visibility was introduced the approaches became unstable resulting in the pilots requiring to go-around.
- The MDA was too close to achieve runway alignment in a CAT D aircraft in a high crosswind situation.
- Depiction of MAPt is misleading.
- The approach not to be approved for CAT C aircraft without a check in a full-flight simulator.
- Simulator database/software not recorded. Waypoints and flight plan were entered manually.
- Equipment not available to record simulator tracks.
- Issues affecting this validation were:
  - Procedures were not coded; waypoints and flight plans were entered into FMS manually. Coded procedures may fly better, with VNAV advisories and flyover MAPt.
  - RTILs (runway threshold identification lighting) have been installed. These may assist in low vis conditions.
  - Validation was flown at Alice Springs which was in the Qantas simulator data base. XXX prepared waypoints and altitudes representative of the YBWW procedures.

PROCEDURE YBWW RNAV-Z RWY 12	~~SATISFACTORY~~	UNSATISFACTORY
PROCEDURE YBWW RNAV-Z RWY 30	SATISFACTORY	~~UNSATISFACTORY~~

Simulator flyability – case study

- Certain operators insisted it was flyable
- 2nd simulator validation conducted for CAT C

REMARKS:

- RNAV-Z RWY 12 was demanding but flyable in benign weather conditions, however when poor visibility was introduced the approaches either became unstable resulting in the pilots electing to go-around, or with high pilot work load to achieve runway alignment and landing. This approach flown with maximum certified crosswind was not considered a flyability issue for this aircraft.
- RTILs (runway threshold identification lighting) have been installed. These were of significant benefit in the simulator when trying to acquire the runway in low visibility conditions.
- Depiction of MAPt is misleading.
- Issues affecting this validation were:
  - Procedures were not coded; waypoints and flight plans were entered into FMS manually. Coded procedures may fly better, with VNAV advisories and flyover MAPt.
  - The programmed visibility in this simulator seemed to be in error. Programmed 7.0km visibility equated to 5.0km actual visibility.
  - Wellcamp aerodrome with representative infrastructure was programmed into the simulator data base.
- Minimum 5.0km visibility to be published for CAT C aircraft. This should allow the pilot to become visual by 2nm prior to the MAPt.

PROCEDURE: YBWW RNAV-Z RWY 12 CAT C	SATISFACTORY	~~UNSATISFACTORY~~

Thank You