Safety and Airspace Regulation Group
Office of the Group Director

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Stewart Wingate
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By E-Mail : stewart.wingate@gatwickairport.com

Dear Stewart

August 2013 Airspace change introducing RNAV SIDs at Gatwick Airport.
Stage 7 CAA ACP process - Conclusions of Post-Implementation Review
Requirements for further action by GAL

I am writing further to my letter dated 28 September 2015 (attached as to this letter). That letter included required actions of GAL in relation to routes 2,4 and 5, the outcomes that the CAA required, and the next steps determined by the outcomes of those actions.

The table ***attached*** includes detail on modifications which in the CAA's view may achieve the outcomes required, as specified in our letter dated 28 September 2015. We will be meeting with you very shortly to give further detail on the CAA's view on the modifications which may achieved the required outcomes.
Please note, the requirements sent in our letter earlier this week, and the modifications set out in this letter relate only to the RNAV SIDs.

The CAA's PIR conclusions will include further requirements relating to the conditions in the CAA's decision letter dated 14 August 2013 and requirements and recommendations relating to review and modification of the conventional SIDs.

The CAA will be writing to you separately regarding these.

Yours sincerely

Mark Swan
Group Director Safety and Airspace Regulation

ROUTE 2, 4 & 5 TECHNICAL MODIFICATIONS IN RESPECT OF CAA REQUIREMENTS DATED 28 September 2015

This document must be read alongside the CAA's letter dated 28 September 2015 above

Route	SID/ Data used during analysis	Issue	SARG IFP Recommendations to meet the CAA PIR requirements specified in letter dated 28.9.15
2	Rwy 08 SFD 08SFD Altitude Bands. & Density Ppttx ERCD 08SFD Speed _ Data+ Wind Analysis	The concentrations of flight tracks into a narrower swathe can be seen with the RNAV 1 SID as compared to the conventional SIDs. The core of the RNAV 1 flight track swathe is slightly east of the NPR but well within the NPR swathe. This is very likely to be speed related where the turn at KKE03 is commencing closer to the WP than had been anticipated.	The analysis of the ERCD gate speed data provided evidence that the average speed before KKE03 was 203Kts and 263Kts after KKE03. This indicates that aircraft are accelerating in the turn at KKE03 which is confirmed with the slight "ballooning" in the turn. Therefore, the track keeping around the first turn at KKE03 could be improved with a speed restriction of 220KIAS max applied to the following waypoint at KKS08. This would prevent the potential for some 'ballooning' of some aircraft types during the turn and would be consistent with speed restrictions applied on other SIDs with similar turning characteristics. In the RNAV 1 SID applying a max 220KIAS speed constraint to KKS08 and 250KIAS to KKS12 could minimise the potential of any 'ballooning' in the turn at KKE03 of some aircraft types and would be consistent with speed restrictions applied on other SIDs with similar turning characteristics. Validate the modified SID in a flight simulator to ensure that the speed changes have the expected impact. A robust validation will be required where the flyability of the remedial SID is assessed in both Airbus and Boeing flight simulators. The parameters used to assess and stress the procedures must be recorded and must be agreed with the CAA before the validation (flyability assessment) process commences.
4	Rwy 26 LAM/ CLN/ DVR/ BIG 26LAM Altitude Bands. & Density Ppttx ERCD Route 4	For both the conventional and RNAV 1 SIDs the nominal track if flown at 220 KIAS leaves the NPR swathe at approximately 1.4 NM before KKN06. The nominal track of the RNAV 1 SID after KKE14 towards SUNAV is outside of the NPR swathe by approximately 0.12 NM. It is displaced north from the conventional SID nominal track by an approximate distance of 0.16 NM when both SIDs are flown at 220 KIAS and affected by the same winds. The conventional SID when flown at 220 KIAS also leaves the NPR swathe at approximately the same point as the RNAV 1 SID (approximately 1.4	**Modify existing RNAV 1 SID design** Alternative design options for different waypoints and path terminators should be considered during the RNAV 1 redesign process, along with the application of an additional speed restriction of 220kts max until KKE14 or a waypoint placed between KKN06 and KKE14 to better replicate the conventional SID. If successful, will reduce flight outside NPR swathe during the first and second turn; A revised design could bring the eastbound track further south after the completion of the first 2 turns (displaced slightly south of the westbound track of

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4 (cont)	Ground Speed analysis+ Wind data v2	NM before KKN06). On the conventional SID when the aircraft is established on the radial towards ACORN it will begin to re-enter the NPR swathe at approximately 1.2 NM before the Redhill area (KKE14 in the RNAV 1 SID), whereas the RNAV 1 SID does not. Therefore in the RNAV 1 SID the two straight leg segments after KKN06 are north of both the conventional SID and NPR swathe. The NPR on the Route 4 SIDs is predicated on the DET VOR R258.18°T; with magnetic variation of 0.7°W applied, this results in R259°M. This indicates a discrepancy of 1° with what is published today in the AIP of R260°M. This will have an impact such that the nominal tracks of the conventional SIDs on this route will be north of the NPR by approximately 0.5 NM. The effect of speed on the conventional and RNAV 1 SIDs can have very different impacts on the track flown. On the initial departure an aircraft has not yet accelerated to a speed of 220 KIAS. In the conventional SID this does not impact on where the aircraft will commence the turn north to intercept the DET VOR radial R260, as the turn point is predicated on a Fly-over waypoint at the D2.3 ILS DME. So an aircraft at a speed of <220 KIAS will commence the turn at D2.3 and then turn to intercept the DET radial and will be tighter than if the aircraft speed is at 220 KIAS. In the RNAV 1 SID the effect of a speed < 220KIAS will cause the aircraft to commence the turn closer to the Fly-by waypoint KKW04(after the D2.3 ILS DME fix) and this will place the aircraft towards the outer edge of the NPR swathe as demonstrated in the various heat plots. Therefore, in the initial departure of the RNAV 1 SID the aircraft commences the turn later as the speed is <220 KIAS. Then during the noise abatement (acceleration) phase of flight as the aircraft accelerates to the maximum of 220 KIAS, the radii of the turn increases	the Runway 08 Route 3 SID); **Add Information Note to RNAV 1 SID Chart** A note regarding crew intervention could be considered to be included on the revised RNAV 1 SID chart (if applicable to the design adjustments to be implemented) during south westerly high wind conditions exceeding 20 kts. By ensuring that operators are aware of the issues than can have an impact of the track adherence it should help to minimise deviations from the published nominal track. **Please note the CAA will provide information to Approved Procedure Designer (APD) engaged by GAL** SARG IFP will provide information to the APD engaged by GAL on issues which have come to light during the PIR. A pre-design meeting should be arranged between CAA, GAL and the APD at the earliest possible stage to explore the design options being considered. This will ensure that all stakeholders in the redesign process are aware of the issues of route 4 existing RNAV 1 design and that the result of the redesign will be a better replication of the conventional SID **SID Validation Requirements – (Mandatory)** Validate the SIDs in a flight simulator to ensure that the changes have the expected impact. A robust validation will be required where the flyability of the revised SID is assessed in both Airbus and Boeing flight simulators. The parameters used to assess and stress the procedures must be recorded and must be agreed with the CAA before the validation (flyability assessment) process commences. This process will ensure that the revised RNAV 1 SID is flyable in the various

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4 (cont)		causing the aircraft to fly even closer to the edge, and even deviate from the NPR swathe. Then at KKN06 where the speed increases at the bisector (mid-way through the turn) of the waypoint to a maximum 250 KIAS, the radii of turn increases still further to the point where the aircraft will be north of the expected nominal track. This effect will be further exacerbated when there is a strong wind from the south west which will provide a tailwind component to aircraft flying north towards KKN06 and subsequent waypoints on the SID. Ground speed can therefore easily exceed the procedure design allowance of 30 knots tailwind component. While the navigation systems will endeavour to correct to the intended track this can be limited and without further flight crew intervention by way of speed reduction the aircraft flight path will be wider and north of the intended tracks. It should be noted that airspeed has to be checked prior to the turn, as deceleration is difficult once the effect of the tailwind is encountered. Aircraft configuration is also a factor as the 220 KIAS is designed to allow a clean configuration for the narrow body aircraft to be achieved. If a lower speed has to be maintained, this will likely necessitate retention of one stage of flap during the turn manoeuvre. Ground speed and altitude data obtained from ERCD was assessed. The analysis was based on conventional, P-RNAV trial, and RNAV 1 SIDs where it was found that the average ground speed of aircraft at the I-WW D2.3 (ILS DME) conventional turn point varied between 185 to 195 knots. This ground speed concurs with the flights tracks of the RNAV 1 SID and explains why the RNAV 1 SID turn commences later than on the conventional SID as explained above.	wind conditions that can be expected at Gatwick. It would be expected that by assessing the SID in both Airbus and Boeing flight simulators issues of SID execution by aircraft FMS along with track adherence can be assessed to ensure no issues exist. This is a robust methodology to assess and ensure the revised SID is a satisfactory replication before being promulgated in the AIP.
5	Rwy 08 DVR/ CLN/	The track dispersion of the RNAV SID is slightly further south of the conventional SID dispersion and the RNAV	Reposition waypoint KKE02. During the design process an APD will need to consider the merits of using a fly over (FO) waypoint at either current KKE02

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	BIG 08CLN Altitude Bands. & Density Ppttx	1 tracks now over Dormansland. The NPR is based on the DVR VOR R269.99°T and by applying the DVR VOR mag var of 0.3°W results in a R270.3°M, whereas the published radial is R271°M. Therefore the conventional SID nominal track as flown would place an a/c approx 0.45nm north of the NPR. In the RNAV 1 SID the aerodrome mag var of 0.9°W is applied to the true track of 089.6°T which results in a track of 091°M. But as the turn commences before the turn point of the NPR R269.99°T, the track of the RNAV 1 SID is approx 0.24nm south of the NPR and over Dormansland.	position or at a repositioned fly by (FB) KKE02 WP. GAL should advise their APD to consider the design options discussed by the PIRG and determine which is optimal to improve the PBN replication. Validate that the change has the expected impact in a flight simulator. A robust validation will be required where the flyability of the remedial SID is assessed in both Airbus and Boeing flight simulators. The parameters used to assess and stress the procedures must be recorded and must be agreed with the CAA before the validation (flyability assessment) process commences.