AVGEN LIMITED

HEATHROW OPERATIONAL FREEDOMS TRIALS PHASE I

INDEPENDENT MONITORING REPORT

Prepared for:

LAHANWG (Local Authorities' Heathrow Air Noise Working Group)
LAANC (Local Authorities' Aircraft Noise Council).

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Introduction

This document describes Phase I of the Operational Freedoms trials at London Heathrow Airport and details AvGen's independent monitoring regime, which produced results and statistics from the trial.

Operational Freedoms

BAA (the operators of Heathrow Airport) and NATS (the ANS provider) jointly ran a trial of Operational Freedoms at Heathrow from November 2011 to February 2012. The trial was a one of the recommendations of the Southeast Airports Task Force (SEATF) with the intention of improving resilience i.e. the airport's ability to recover from operational disruption.

Phase I of the trial made provision for the following measures:

TEAM*:	operating arrivals on the designated departures runway after the end of the existing TEAM arrangements at 0700
TED:	operating departures from the designated arrivals runway

Both of the above measures were applied reactively, i.e. when triggered by actual or anticipated delays, or by the weather

Phase I also included a number of proactive measures, during part of the trial period:

Airbus A380 flights landing on the designated departures runway

Small aircraft landing on the designated departures runway

Terminal 4 flights landing and taking off on the southern runway

All of the above reactive and proactive measures, by definition, involved landings or takeoffs using the opposite runway from that implied by the published alternation programme.

AvGen Limited

AvGen is an independent consultancy and aviation software developer based in Reading, some 20 miles west of Heathrow Airport.

AvGen has considerable expertise in ATC surveillance technologies, and operates DARTS (Departure & Arrival Route Tracking System), a continuous monitoring system which captures and tracks aircraft using London's airports, in particular Heathrow. AvGen was able to use its experience with DARTS to construct a monitoring regime for Phase I of the Operational Freedoms trials.

The Need for Independent Monitoring

The parties involved in the running and oversight of the trial have published statistics at intervals during and after the trial. To date, these have consisted of:

a) daily statistics on total and out-of-alternation movements, delays, track-keeping performance, etc (BAA)

b) monthly reports on 3 of the 4 months (November, December, January, but not February) of the Phase I trial (BAA)

c) final report on Phase I (BAA)

d) interim report on Phase I oversight (CAA)

e) final report on Phase I oversight (CAA)

AvGen's independent monitoring results have helped in identifying (and in a number of cases, rectifying) errors and omissions in the above reports and statistics. These include:

a) incorrect statistics on numbers of de-alternated flights

b) failure to document retrospective changes to the published daily stats

c) publication of the wrong days' results in the daily statistics

d) ambiguity and confusion over the applicability of Operational Freedoms to easterly operations

e) failure to run basic sanity checks on data, e.g. more post-0700 flights than daily total

Some, but not all, of these errors have subsequently been amended in the published statistics.

AvGen Phase I Monitoring

AvGen made use of a number of in-house and external data sources to monitor Phase I of the trial. The principal source of data was AvGen's DARTS system, using automated navigational transmissions from aircraft (ADS-B, EHS and Mode S), which allowed an accurate 3D flightpath to be constructed for almost all departing and arriving flights, including data on which runway was used by each movement. A number of AvGen's in-house reference databases were used to correlate and enhance the received data by adding information such as airline, flight number, aircraft type and registration, route, etc.

AvGen captured data continuously throughout the 4 months of the Phase I trial. Data for selected weeks was analysed on behalf of LAHANWG (Local Authorities' Heathrow Air Noise Working Group) and LAANC (Local Authorities' Aircraft Noise Council).

The weeks analysed were selected to give a representative sample of the different trial regimes and different wind directions (which affect the runway used), as follows:

Trial regime: Reactive freedoms/Proactive freedoms/Non-trial regime
Wind/runway: Westerly/Easterly

In some cases, because of wind variability, composite weeks were constructed from days falling in different actual weeks, such that each analysis week contained 7 days with the same conditions.

Outputs from the monitoring activity included the following:

a) detailed runway logs showing runway usage for each individual aircraft movement

b) hourly runway charts showing the distribution of landings and takeoffs from the two runways within each 60-minute period

c) daily charts showing hourly movement totals for arrivals and departures per runway

d) daily tabulations showing numbers of hourly arrivals (i) on the designated landing runway and (ii) out-of-alternation

e) daily activity summaries showing total numbers of landings and takeoffs per runway, split by wake vortex classification

f) daily charts showing hourly movement totals and runway used for flights eligible for proactive freedoms: A380 and small aircraft arrivals, Terminal 4 movements

g) weekly respite charts showing the distribution and duration of respite periods under the two westerly approach flightpaths

These outputs are described in more detail below.

Detailed Runway Logs

London Heathrow Airport typically sees around 1300 aircraft movements per day, with a 50:50 split on average between arrivals and departures.

A chronological Daily Movements Listing was produced for each of the analysis days. These contained the entire day's runway movements, and showed the following information for each:

- Time (local)
- Aircraft Type (ICAO designator and description)
- Airline operator
- Flight number
- ATC callsign
- Route
- Aircraft registration
- Runway used and type of movement - arrival (red) or departure (green)
- Terminal used

The listing used highlighting to allow easy identification of movements which were candidates for Proactive freedoms:

- Airbus 380 arrivals
- Small/light aircraft arrivals
- Terminal 4 arrivals and departures

Hourly Runway Charts

In order to see more easily where out-of-alternation movements had occurred, and how they were grouped throughout the day, a set of Daily Movements Charts were produced for each of the analysis days.

These showed, for each hour, the distribution of both arrivals and departures on the runway(s) in use, and this allowed the following aspects of Heathrow's operation to be readily identified:

- Single-runway (e.g. night-time) operations
- Regular early morning "TEAM" operations (use of both runways for landing 0600-0700)
- Swapping of arrival and departure runways at 3pm on westerly operations
- "De-alternated" movements:
  - TEAM
  - TEAM* (use of TEAM after 0700)
  - Runway de-alternation due to wind conditions or other factors
- Go-arounds (during the main trial period only)

Daily Movement Totals per Hour

As a further aid to visualising the distribution of out-of-alternation movements, a set of charts was produced showing, in bar chart form, numbers of movements per hour per runway.

These provided an overview of a complete day, with separate charts for arrivals and departures, and corresponding charts were also produced for the subset of movements that qualified for application of Proactive freedoms (A380, small/light aircraft and T4 movements).

Hourly & Daily Out-of-Alternation Totals

Given the published landing runway alternation schedule, it was possible to identify, for every landing, whether it used the designated landing runway or landed out-of-alternation. A tabulation was produced for every day analysed, showing numbers of landings for every hour, relative to the alternation programme, and daily totals for arrivals on the designated runway and out-of-alternation landings up to 0700 (regular TEAM) and after 0700 (mostly TEAM*).

N.B. A small number of out-of-alternation landings were attributable to other reasons, such as temporary runway closure – further analysis of these will only be possible once BAA have published their detailed movements data.

Daily and Overall Activity Summaries

Each day's movements per runway were also segmented according to aircraft weight category, using the different classification systems from ICAO (Heavy or Medium) and NATS (Super/A380, Heavy/Medium and Small/Light).

For each category, daily landings, takeoffs and (for the trial period only) go-around totals were produced

Runway Alternation and De-Alternation

Heathrow has two parallel runways, aligned east-west, and the way that these runways are used is subject to pre-defined rules.

As a general rule, aircraft normally land or take off into the wind, so the wind direction affects the runway usage. On average, winds at Heathrow have a westerly component around 70% of the time and an easterly component the remaining 30%, although this average can vary significantly over extended periods. Heathrow uses the westerly runways when the wind is in that direction and also, during the day, in a light easterly wind provided that the runway is dry and there is no strong crosswind component. The remainder of the time (day or night) the easterly runways are used.

When operations are easterly, aircraft normally land on the northern runway (designated 09L) and take off from the southern runway (09R). During westerly operations, the northern and southern runways are designated 27R and 27L, respectively, and again one runway is normally used for landings and the other for takeoffs, subject to a published alternation programme. The alternation programme designates, for example, the northern runway for landings and the southern runway for takeoffs from 0700 (local time) to 1500, at which point the roles are reversed and continue in that configuration until the last departure of the day. On alternate weeks, the morning and afternoon programmes are swapped, the object being to distribute noise and emissions more fairly between the communities under the northern and southern runway approaches.

A similar night-time alternation programme operates, but with a 4-week cycle consisting of 2 weeks' use of the northern runway, for both landings and takeoffs (1 week easterly and the following week westerly), then 2 weeks' use of the southern runway similarly. Westerly and easterly operations may vary, depending on the wind direction.

"De-Alternation" is the term used to describe use of the runways in the opposite sense to that specified by the published alternation programme, i.e. arriving aircraft landing on the other (departures) runway and/or departing aircraft taking off from the designated landing runway. Prior to the trial, operations were de-alternated under specific circumstances such as severe delays which necessitated using both runways at the same time for (usually) arrivals and (occasionally) departures. Other reasons such as weather or technical problems could also lead to the runway roles being swapped.

Weekly Respite Charts

The issue of respite periods for communities under the westerly approach flightpaths was examined in detail, together with different ways of portraying this. The CAA's suggested approach of taking each clock hour and recording whether or not there were arrivals on 27L and/or 27R during that hour was discarded on the grounds that it was both crude and unwieldy, and instead a frequency-based approach was taken.

In order to compare respite offered to communities under the westerly approach paths to the two runways, it is necessary to establish a baseline. This was done by analysing data for selected weeks prior to the start of the trial, specifically a 2-week period from 3-16 August 2011 when Heathrow was on westerly operations.

With no de-alternation at all, the expected pattern of respite during westerly operations would be as follows:

0600-0700:	aircraft landing on both runways
0700-1500	aircraft landing on only one runway (e.g. northern)
1500-last departure*	aircraft landing on the other runway (e.g. southern)
last departure*-0430	normally few, if any, movements
0430-0600	aircraft landing on one runway

* the last scheduled departure is at 2245 local, although a number of flights are scheduled to push back just prior to that time, some of which will not normally get airborne until after 2300; the last scheduled arrival is due on stand at 2305.

As described above, in the pre-trial regime, some arriving flights can be de-alternated (i.e. land on the "wrong" runway) for operational reasons, or where severe delays are being experienced or anticipated. With de-alternation, the effects on respite will be seen between the start of segregated operations at 0700 and the last arrival of the day. Typically a number of flights (up to 6 in any one-hour period) may be landed on the departure runway, thereby interrupting the anticipated respite period.

During both the reactive and proactive trial regimes, the triggers for de-alternation were relaxed, and the proactive regime also allowed for specific categories of aircraft to be de-alternated without requiring any delay triggers.

The approach taken to illustrating the effects of de-alternation on respite was as follows:

capture details of all arriving flights 0700-2300

calculate the interval between every pair of consecutive flights

segment the delay intervals into the following bands:

under 5 minutes between flights
5-10 minutes between flights
10-15 minutes between flights
15-30 minutes between flights

30-60 minutes between flights
1-2 hours between flights
2-4 hours between flights
3-6 hours between flights
6-8 hours between flights
over 8 hours between flights

calculate the respective proportions of the 16-hour period for each category, for example 45% of the day had flights at under 5-minute intervals

Appendix 1 – Detailed Runway Logs

See accompanying CDROM.

Appendix 2 – Hourly Runway Charts

See accompanying CDROM.

Appendix 3 – Hourly Movement Charts

See accompanying CDROM.

Appendix 4 – Daily Out-of-Alternation Totals

See accompanying CDROM.

Appendix 5 – Daily Activity per Runway by Wake Vortex Classification

See accompanying CDROM.

Appendix 6 – Hourly Runway Charts – Proactive Freedoms

See accompanying CDROM.

Appendix 7 – Respite Charts

See accompanying CDROM.