SHORT (& MEDIUM) TERM MEASURES - EXECUTIVE SUMMARY

MEASURE SET	**Airspace operations**			
MEASURE TITLE	Arrival management			
MEASURE SUMMARY	This measure includes multiple proposals to improve airport arrival management processes to deliver efficiency, noise and resilience benefits.			
MEASURE INVOLVES	☒	Behavioural Change	☒	Infrastructure Change
	☒	Operational Change	☐	Regulatory Change
	☒	Technical Change	☐	Policy Change

WHAT DOES THIS ADDRESS?

This measure addresses the tactical management of flights from their departure airport through to touch-down at destination. At busy airports the runway and local airspace is a capacity constraint and queue management techniques are applied to manage holding whilst maximising runway throughput. Currently holding delays take two principal forms: (i) holding on the ground at origin airport, Air Traffic Flow Management (ATFM), currently administered in Europe through Eurocontrol; and (ii) holding in the air, most familiar as the four stacks used to buffer inbound aircraft to Heathrow. Inbound delays are exacerbated during periods of bad weather when the runway throughput is reduced, principally because of the need to maintain safe separation between sequential aircraft in an arrivals stream. In high (head) winds and low visibility, the separation between aircraft needs to be increased: in the first case to maintain the separation standards defined in terms of distance between aircraft; and in the second case to ensure the safe functioning of the Instrument Landing System (ILS). Heathrow operating its runways in segregated mode (one runway for arrivals, one for departures) is generally more prone to this type of weather disruption than airports operating in mixed mode where arrivals and departures can be interspersed on a single runway facilitating increased spacing between successive arrivals. Also, because normally one runway is used for arrivals and the other for departures, the systems and processes are not set up for simultaneous arrivals on both runways (independent parallel approaches) with the result that when both runways are used for arrivals, the traffic streams are inter-dependent and must be offset, meaning that the flows are not optimised.

On approach aircraft are guided along an intermediate approach path, which can be used by the ATC to manage the traffic sequence by changing the distance flown. There are, therefore, a multitude of intermediate approach paths distributed over a relatively wide volume. The aircraft then joins the single, final approach path, at the ILS joining point, typically 6 - 8 nm out. The approach is then a straight flight path, normally at an angle of descent of approximately 3°.

WHAT WOULD BE DONE?

The first proposal included under this measure would improve the management of the queue of inbound traffic to reduce airborne delays (stack holding): this is one of the specific actions being undertaken as part of the Future Airspace Strategy (FAS) Programme. Inbound traffic streams are sequenced as far upstream as possible, including on the ground at origin, through speed control en route (which is more efficient, e.g. in terms of fuel burn, than holding in stacks) and by assigning required times of arrival at metering points near to the destination. The second set of proposals would address impacts of high winds on runway throughput at LHR and LGW by moving to time-based separation between successive aircraft rather than distance based as at present. The negative impact of low visibility at Heathrow would be addressed by transitioning to the Microwave Landing System (MLS) already used by British Airways, and ultimately to GPS based systems, to overcome the shortcomings of the current Instrument Landing System (ILS). Use of MLS / GPS would also enable multiple curved final approaches to the runway, instead of a single straight-in approach. Enhanced navigation capability would be used navigate to allow multiple joining points for final approach paths. Routes could provide noise respite. In addition to modifying the lateral approach paths, the proposal would also modify the descent angle, either as a steeper angle continuous throughout the approach, e.g. 3.2° or as stepped approaches, initially with a steeper angle (e.g. 3.5° to 5°) and then at a shallower angle (e.g. 3° up to 3.25°) for final approach. Finally, at LHR systems / processes would be modified to allow both runways to be used simultaneously for arrivals, allowing independent parallel approaches.

WHAT IS THE IMPACT?

The impacts of the measure are expected to be:

- reduced airborne holding for arrivals at busy airports, principally LHR and LGW at times
- reduced negative weather (high winds and low visibility) impact, again principally at LHR and potentially at LGW,
- reduced noise footprints under arrival paths (steeper approach) and the potential for noise respite (multiple approach)
- increased runway throughput during normal operating conditions (particularly at LHR, LGW) due to multiple approaches to a single runway and specifically at LHR increased arrival rates during periods when both runways are

used for arrivals enabled by independent parallel approaches.

MEASURE SUMMARY

Proposed by:	Heathrow Airport (024), Heathrow Hub (0250, GAPAN (067), Individuals, LACC/AOC (043), NATS (053)	
Proposal: AsOP-ARM-1 AsOP-ARM-2 AsOP-ARM-3 AsOP-ARM-4 AsOP-ARM-5 AsOP-ARM-6	There are six proposals to improve arrival management processes. The proposals are: • arrival queue management • enhanced processes against weather disruption, principally strong winds and low visibility • steeper approaches into airports, including both continuous and stepped • dual approaches to a single runway • multiple approaches to guarantee respite • independent parallel approaches at LHR. With the exception of multiple approaches to a single runway, all of these proposals have the potential to be enacted in the short-term. Using multiple, fixed approaches would likely require airspace and procedure changes that would make the proposal only feasible in the medium-term.	
Approach	The approach to each of the proposals included in the measure would be: • arrival queue management to sequence access to runways earlier in the flight path, reducing the need for localised holding in stacks or extended approach paths. A phased approach delivering some benefits in the short-term but with the majority of benefits arising in the medium term. Proposal could be enhanced by applying incentives to align airline behaviours with desired outcomes • weather disruption management to include amelioration of the impact of: (i) high winds (principally at LHR and LGW) through application of time-based separation (TBS); (ii) low visibility conditions using e.g. microwave landing system (MLS) at LHR (extending its current use by BA) and ultimately GPS-based operations • using steeper approaches (descent angle increased from 3° to 3.25° or 3.5° depending on aircraft capability and safety cases) to increase the height of aircraft on final approach at given distances from the threshold, thereby reducing noise. • using MLS systems to enable dual approaches to a single runway with differentiated path angles to reduce wake vortex constrained separation • enabling multiple arrival routes using enhanced navigation capability to fly a range of approach paths offering guarantee periods of noise respite • enabling independent parallel approaches at LHR to allow simultaneous, rather than offset, landings on both runways to maximise arrival throughput, either in mixed mode operations or during the application of TEAM.	Stated Capital Cost: NATS estimates the capital cost of TBS to be at £13m and the capital cost of Queue Management (which includes arrival management) to be at £6m. Capacity (mppa): Not stated Capacity (atm): Not stated
Benefits	The benefits of the measure are likely to be: (i) cost savings from enhanced queue management, associated with reduced fuel burn and time savings; (ii) reduced noise from steeper approaches; (iii) increased noise respite from multiple arrival routes at LHR; (iv) reduced night movement exemptions delivered by enhanced processes against weather disruption; (v) reduced GHG emissions from queue management and enhanced processes against weather disruption; (vi) additional runway capacity at constrained times through dual approaches to a single runway. Time Based Separation is primarily a resilience measure. Benefits of TBS have been shown to start when head winds exceed 5kts. TBS will allow controllers to deliver a consistent spacing in a much wider range of wind conditions. NATS have commented that there is evidence to suggest that typical benefits of dual approaches to a single runway	

	could be of the order of 3-4 additional arrival movements per hour – but is highly dependent on the mix of traffic. For an airport such as Heathrow, operating dual approaches to a single runway – the potential benefits, if any, are yet to be quantified but will be potentially constrained by other factors, most notably arrival runway occupancy time.
Issues & Risks	The main risks associated with the proposals are: (i) safety cases needed for new processes; (ii) aircraft on-board navigation capability, including MLS for non-Heathrow based carriers; (iii) dependence on upstream air traffic control providers, e.g. in Belgium, Netherlands, France, Germany and Eurocontrol, to facilitate queue management; (iv) changes in ICAO guidelines and the need for additional ground-based equipment to enable independent parallel approaches on Heathrow's runways. Overall capacity improvements in arrival management need to be balanced with similar improvements in departure management otherwise any arrival capacity increase is potentially of little net benefit to the airport system.
Mitigations	None needed.
Dependencies	Safety cases for new processes will need to be approved by the CAA. There are dependences on third parties, e.g. airlines to equip aircraft and train/certify crew and on upstream ATC providers to enable enhanced queue management.

ASSESSMENT

Strategic Fit	Not stated – depends on long-term options. Aligns with direction indicated in the Government's Aviation Policy Framework and anticipated CAA guidance on environmental objectives of air navigation functions.
Economy	The overall economic impacts of the proposals are likely to be associated with improved resilience against disruption except for queue management. This is likely to deliver significant operational cost savings delivering small savings in the short-term (£4M pa), increasing in the medium term to £16M - £33M pa (see NATS proposal). In addition, dual approaches to a single runway might be expected to deliver additional capacity at periods when the runway is busy and is flow-rate limited however this is a complex operation and is yet to be assessed for UK airports.
Surface Transport	There would be little or no impact on surface transport.
Environment	The potential environmental impacts are as follows: • arrival queue management: in the short- and medium-term, potentially large reduction in GHG emissions due to reduced stack holding requirement, particularly for Heathrow. Ultimately an enabler for restructuring of London airspace and its associated environmental benefits • enhanced processes against weather disruption: will reduce the need for associated stack holding at LHR and reduce GHG emissions. Likely to reduce need for disruption led night flight exemptions • steeper approaches: reduced noise footprint outside of the airport perimeter due to greater height of approach path; greatest benefit for continuous rather than stepped approaches • independent parallel approaches at LHR: an enabler for optimised TEAM or mixed mode and associated benefits, although it would impinge negatively on respite • dual approaches to a single runway: reduced noise under the current approach paths would be redistributed to the new approach paths • multiple arrival routes: would concentrate noise under a set of well-defined approach paths which would then be used to guarantee periods of respite.
People	The principal impacts on people would likely be: • steeper approaches: would potentially reduce noise impact/footprint • enhanced processes against weather disruption: would potentially reduce the need for night flight exemptions both reducing night noise and enhancing the passenger experience • independent parallel approaches at LHR: this would depend on the application of the capability, e.g. in TEAM or mixed mode but would have a negative impact on respite • dual approaches to a single runway: redistribution of near-in noise from under the current flight path to under the differentiated approach paths • multiple arrival routes for LHR: would redistribute and concentrate noise more than at present but would also offer more predictable respite periods.
Cost	Heathrow and Gatwick airports are currently progressing TBS. NATS have estimated a capital cost of £13m for this aspect alone. Queue Management is estimated to have a capital cost of £6m which includes arrival queue management. Other aspects are predominantly revisions to existing capabilities and as such will incur far less capital investment.

MEASURE SET:	**Airspace operations**	**Short Term**	☒
MEASURE TITLE:	**Arrival management**	**Medium Term**	☐

Operational Viability	The main risks/operational issues are: • steeper approaches: (i) feasibility of modern aircraft to apply speed control/comply with separation minima on steeper approaches; (ii) not possible to land under low visibility conditions (Cat III) using steep final approaches; (iii) safety case requirement • arrival queue management: dependence on upstream and downstream non-UK air traffic control to apply arrival management procedures and would potentially require a culture change within airlines to comply with a required time of arrival • enhanced processes against weather disruption: (i) safety case and technology upgrades needed for Time Based Separation; (ii) reluctance for non-Heathrow based operators to fit MLS and train crews in its use • independent parallel approaches at Heathrow: (i) procedures and safety case needed; (ii) need for additional ground equipment or a change in ICAO guidelines • dual approaches to a single runway: (i) significant safety assurance work needed; (ii) requirement for high aircraft/crew navigation capability; (iii) potential impact on runway utilisation. • multiple arrival routes: requirement for high aircraft/crew navigation capability and training, although these capabilities with be required for performance based navigation (PBN) through the Future Airspace Strategy.
Delivery	Delivery will depend on definition and validation of new concepts of operation, development of safety cases, implementation of new processes and systems, as well as operator (ATC and flight crew) training. NATS is planning to deliver TBS and Queue Management during RP2 (2015-2019).