ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6 : Aeronautical navigation issues

MLS — THE CASE FOR INSTALLATION AT SPECIFIC AIRFIELDS

(Presented by United Kingdom)

SUMMARY

The United Kingdom has started installation of microwave landing systems (MLS) at Heathrow Airport in order to meet operator requirements, initiate transition planning, combat the effect of reduced movement rate during low visibility procedures, and to mitigate against future degradation in the instrument landing system (ILS) resulting from building works. MLS operations are expected to begin in Winter 2004.

This paper gives an overview of the air traffic control (ATC) procedures, details some of the benefits of MLS and some limitations of ILS.

1. INTRODUCTION

1.1 This paper gives an overview of the air traffic control (ATC) procedures developed to support mixed mode (instrument landing system (ILS) and microwave landing system (MLS)) operations at London's Heathrow airport.

1.2 As there are no longer plans for transition from ILS to MLS, this paper demonstrates and informs the business drivers that make MLS installation worthwhile for many airports world-wide using the case of Heathrow airport which is currently in the process of installing MLS.

1.3 In addition the paper describes how MLS will be used in conjunction with ILS to meet operational demands.

2. ICAO STRATEGY

2.1 The ICAO strategy for the introduction and application of non-visual aids to approach and landing[1] was developed by the All Weather Operations Panel in the early 1990s and approved at a global ICAO meeting in 1995[2]. The strategy replaced the previous mandatory planned transition from the ILS to the MLS with a more general strategy.

2.2 The new strategy allowed ILS to continue in operation as long as it is operationally acceptable and economically beneficial, and for MLS and global navigation satellite system (GNSS) to be introduced when and where they become operationally and economically beneficial.

3. THE ADVANTAGES OF MLS

3.1 The United Kingdom safety regulator, Civil Aviation Authority, airlines, air traffic service providers, and airport owner are still investigating the potential advantages that MLS may bring. These advantages are:

a) MLS is, by design, almost immune from multipath interference and the azimuth sensitive area is very small in comparison to that of the equivalent ILS localizer sensitive area;

b) with MLS it is possible during low visibility conditions for aircraft on final approach to be spaced closer than with ILS. This translates to an improvement in the landing rate in low visibility conditions (dependent on the number of aircraft equipped with MLS);

c) aircraft can be cleared to land on a mixed mode (arrivals and departures) runway as soon as the departing aircraft has taken off, rather than having to wait until the departing aircraft has flown beyond the localizer array; and

d) when MLS is used in conjunction with Mode S multilateration based advanced surface movement guidance and control system (A-SMGCS[3]) it is possible to determine the point and time of lift-off for departing aircraft providing ATC with clear information in order to give early landing clearance for aircraft on the final approach. This facility enables later landing clearance delivery and hence has the potential for providing capacity benefits.

3.2 Studies based on the potential improvements detailed in paragraph 3.1 have shown that even with only 40% of arrivals equipped with MLS, the airport arrival flow rate may be increased by over 20% in low visibility. Significant benefits are also available on a mixed mode (arrivals and departure runway) where

---

[1] Annex 10, Volume I, Attachment B. Strategy for Introduction and Application of Non-visual Aids to approach and Landing

[2] Special Communications/Operations Divisional Meeting (1995)

[3] A-SMGCS primary role is to provide better awareness of surface movements

restrictions imposed by the need to protect the ILS signals are avoided, so increasing runway utilisation. The use of MLS will therefore enable the airport to balance the flow of arrivals and departures even in low visibility procedures, and is the most efficient use of available runway capacity.

3.3 Although Heathrow MLS is co-located with the ILS, the ILS services will be maintained to the highest category available. This will increase the flow rate for both ILS and MLS equipped aircraft giving some benefit to both ILS and MLS equipped aircraft.

4. ILS ISSUES

4.1 ILS continues to be the primary global precision approach system. New ground facilities are still being installed, both to meet new operational requirements and to replace obsolescent equipment. All new commercial civil aircraft are delivered with an ILS capability, often to the most stringent Category III requirements. In many cases the ILS avionics installation is based on the multi-modal receiver (MMR) architecture to simplify the addition of alternative landing systems in the future (such as MLS or GNSS based landing systems).

4.2 Although ILS has provided a very good service in the past, and is likely to continue in operational use for many years, it does suffer from some limitations.

4.3 One such limitation is the vulnerability to multipath interference from building developments on or around airports and from aircraft and vehicle movements. This has the following impacts:

a) the landing rate in low visibility conditions is constrained due to the need to protect the ILS signal from multipath interference from other aircraft;

b) the signal is vulnerable to interference from various sources, e.g. electro magnetic interference (EMI) from commercial broadcast FM radio which has already caused the down-grade of at least one non-Europeans airport ILS;

c) a level ground plane is required in front of the radiating antennas to achieve an acceptable course structure and meet coverage criteria;

d) limited operational channels are available for future runway developments - frequency planning and allocation is taking on even greater importance; and

e) pressure from external development on or around airports is continuing to threaten operational capabilities of installed ILS equipment's and making future ILS installations harder to achieve.

4.4 Whilst GNSS landing system (GLS) may in future be capable of resolving the issues that face ILS, it is not expected to become available commercially in near the near future to support Category III operations.

4.5 Although these limitations have not, as yet, proved to be significant at the vast majority of locations throughout the world, there are some locations where ILS performance has deteriorated due to

multipath interference from building developments. Further, the reduction in landing rate in low visibility conditions is also a serious constraint at many airports where capacity of operation is at a premium.

4.6 The original intention was for ILS to be replaced by MLS through a mandatory transition plan that allowed for a period when both ILS and MLS would be available at all locations. This allowed aircraft operators to move from ILS to MLS at any convenient time during the transition period.

4.7 The current ICAO strategy, which replaced this mandatory transition plan, calls for MLS to be installed where operationally required and economically beneficial. There are two main reasons why MLS might be required: either because it is no longer possible to sustain ILS operations to the required category of operation, or because it provides benefits not available with ILS. A recent decision to install MLS at London's Heathrow Airport (LHR) provides a good example of the second case.

5. ATC MIXED MODE (ILS/MLS) PROCEDURES

5.1 ATC procedures have been developed at Heathrow to support ILS and MLS operations in a mixed mode environment. They are consistent with the European Guidance Material on Aerodrome Operations under Limited Visibility Conditions (EUR Doc 013) developed by the ICAO All Weather Operations Project Group (AWOG) Project Team on Low Visibility Procedures (PT/LVP).

5.2 In brief summary the procedures are as follows:

a) MLS equipage is identified via a 'K' in Item 10 of the ICAO flight plan;

b) inbound aircraft confirms intent for "Microwave" approach at first contact with ATC;

c) approach controller clears aircraft for ILS or "Microwave" approach;

d) crew report "established ILS" or "established Microwave";

e) the objective is to give landing clearance to an aircraft conducting a Microwave approach by 1 mile from touchdown (landing clearance for an ILS aircraft should normally be given by 2 miles from touchdown.);

f) landing clearance for arrival on the departures runway can be given as soon as the preceding departure is airborne;

g) enhanced flow management methodology may be applied to MLS equipped aircraft;

h) MLS azimuth and elevation are referred to as localiser and glideslope to simplify crew and ATC procedures.

6. HEATHROW MLS IMPLEMENTATION PLANS

6.1 MLS has been installed on runway 27R at Heathrow and is radiating. MLS will be installed on 27L and 09R runway ends by the end of 2003 leaving 09L to be accomplished when the ILS is replaced, planned in the spring of 2004. All four runway ends are anticipated to reach Cat III by autumn 2004. In addition, an MLS has already been installed by STNA at Toulouse Blagnac and will be used for aircraft and ground system certification.

6.2 Airborne data collection begins on an in-service British Airways Airbus A320 in Spring 2004 with delivery of the first Cat IIIb certified Airbus 321 expected in Autumn 2004 with operational approval given in Winter 2004. Other operators have also been involved in the MLS project at Heathrow.

6.3 Once the system is being used on a daily basis, it is expected that other major Heathrow operators will follow suit. With more operators equipped, the benefit to the airport should increase from the initial 6 additional movements per hour of low visibility to up to 10 or more movements thereby greatly improving the robustness of the Heathrow operation.

6.4 The MLS system is being certified at this time as an "ILS Look-a-like" system and will therefore not be required to support curved and segmented approaches, as these procedures will be accomplished through the use of the aircraft's flight management system.

6.5 Airports in other European States have also expressed interest in MLS as they face similar issues to London - Heathrow. As sufficient numbers of MLS equipped aircraft start to use London Gatwick then MLS may also be installed there.

7. GNSS LANDING SYSTEM

7.1 Although GNSS should eventually support Category II and III precision approach operations this capability may not be generally available on new build and retrofit aircraft before the 2010 - 2015 time frame. In the meantime ILS will continue to be the primary precision approach aid at most airports in the world. MLS however, is now an alternative option at those locations where it is no longer feasible to provide an ILS service, or where it may provide operational and economic benefits.

7.2 Given that ILS serves the majority of the busier airfields and the aircraft are already equipped, the key question may be whether there will be an operational or financial imperative for widespread replacement of ILS with a GNSS based landing system. Even with the introduction of the multi-mode receiver the costs associated with integration of a Cat III GNSS landing capability on to an in-service aircraft will be substantial. This may leave operators unable to substantiate the investment unless there are particular locations within their network where the system provides substantial benefits, which cannot be supported by ILS. Therefore it may require the large scale retirement of the in service aircraft before a GNSS landing system equipped fleet reaches a critical mass allowing for ILS retirement. In the interim and prior to GNSS Cat III approval, individual airports and their operators may decide that there remains a case for MLS installation.

8. CONCLUSION

8.1 The paper concludes that:

a) revised transition strategy initially conceived at the Special Communications/Operations Divisional Meeting (1995) is appropriate;

b) the business drivers at individual airfields may support MLS implementation ahead of any eventual move towards a GNSS landing system;

c) ILS will continue to be required for some considerable time to come, until such time as the business case can be made to replace the airborne equipage;

d) the current ICAO strategy for precision approach systems should be maintained; and

e) MLS should be implemented where operationally required and economically beneficial.

— — — — — — — —