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A-SMGCS AS MAIN INSTRUMENTAL OF AIRCRAFT MOVEMENT ON THE MANEUVERING AREA

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The systems described in the ICAO Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) are not always capable of providing the necessary support to aircraft operations in order to maintain required capacity and safety levels, especially under low visibility conditions. An advanced surface movement guidance and control system (A-SMGCS), therefore, is expected to provide adequate capacity and safety in relation to specific weather conditions, traffic density and aerodrome layout by making use of modern technologies and a high level of integration between the various functionalities.

Due to the availability and development of new technologies, including automation, it is possible to increase aerodrome capacity in low visibility conditions and at complex and high-density aerodromes. In order to avoid a technology-driven approach, generic operational requirements were developed which, irrespective of the technology used, provide guidelines for the analysis and development of local requirements.

SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEM (SMGCS) OPERATIONS

Current SMGCS procedures are based primarily on the principle “see and be seen” to maintain spacing between aircraft and/or vehicles on the aerodrome movement area. However, the number of accidents and incidents during surface movements, including runway incursions, is increasing. Contributing factors include the increasing

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number of operations that take place in low visibility conditions,* the progressive increase in traffic, the complexity of aerodrome layouts, and the proliferation of capacity enhancing techniques and procedures. Therefore, advanced capabilities are needed to ensure spacing when visual means are not adequate and to maintain aerodrome capacity in all weather conditions.

Generally, operations at an aerodrome are dependent on-air traffic controllers, pilots and vehicle drivers using visual observations to estimate the respective relative positions of aircraft and vehicles. Pilots and vehicle drivers rely on visual aids (lighting, markings and signage) to guide them along their assigned routes and to identify intersections and holding positions. During periods of low visibility, controllers must rely on pilots' reports and surface movement radar to monitor spacing and to identify potential conflicts. Under these conditions, pilots and vehicle drivers find that their ability to operate "see and be seen" is severely impaired. There are no prescribed separation minima, and controllers, pilots and vehicle drivers share the responsibility that operations will not create a collision hazard.

All aerodromes have some form of SMGCS. Commonly used systems that have been installed in the past are described in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476). In their simplest form, SMGCS consist of painted guidelines and signs, while in their most advanced and complex form, they employ switched taxiway center lines and stop bars. All SMGCS provide guidance to aircraft from the landing runway to the parking position on the apron and back to the runway used for take-off, as well as for other movements on the aerodrome surface such as from a maintenance area to an apron, or from an apron to an apron. In addition, SMGCS provide some guidance to vehicles. Normally, control of the activities and the movement of aircraft and vehicles rests with air traffic control (ATC) with respect to the maneuvering area. In the case of aprons, such responsibility sometimes rests with the apron management. Lastly, SMGCS may also provide guidance to, and control or regulation of, personnel authorized to be on the movement area of an aerodrome.

For low visibility operations, plans of SMGCS prescribe the operational procedures that must be followed during surface movements. Procedures vary from aerodrome to aerodrome depending on factors such as the regulations and policies of air traffic services (ATS), the organizational responsibilities, and the aerodrome configuration and facilities.

Low visibility SMGCS procedures are put into effect when the runway visual range (RVR) decreases to a predetermined value (usually between 400 m and 600 m). Notifications are then issued to the aircraft operators, and checklists are used to implement the low visibility procedures.

In low visibility, designated low visibility taxi routes may be used and depicted on aerodrome charts available to pilots and vehicle drivers. Lighting systems such as stop bars and runway guard lights are used to assist ATC in controlling access to active runways. Landing aircraft exit the runway at specific taxiways and follow the taxi instructions from the ground controller. Access of ground vehicles is strictly controlled, and only essential vehicles are permitted on the movement area.

At present, procedures permit aircraft to land in conditions down to zero visibility and to take off when the RVR is reduced to approximately 75 m. Although some States use sophisticated taxiway guidance systems with stop bars to control movements, there are no ICAO provisions for the operation of an SMGCS which can provide for expedition and safety in all weather conditions.

GOALS FOR IMPROVING SMGCS

The following high-level goals provide a basis for considering what capabilities are required, and may be useful in developing improvements for surface movement operations:

a) controllers, pilots and vehicle drivers should be provided with systems of the same level of performance;

b) controllers, pilots and vehicle drivers should have clearly defined roles and responsibilities that eliminate procedural ambiguities which may lead to operational errors and deviations;

c) improved means of providing situational awareness should be available to controllers, pilots and vehicle drivers, taking into consideration visibility conditions, traffic density and aerodrome layout;

d) improved means of surveillance should be in place; e) delays in ground movements should be reduced, and growth in operations, including runway capacity, should be accommodated;

f) surface movement functions should be able to accommodate all classes of aircraft and necessary vehicles;

g) improved guidance and procedures should be in place to allow:

1) safe surface operations on the aerodrome, taking into consideration visibility, traffic density and aerodrome layout;

2) pilots and vehicle drivers to follow their assigned routes in an unambiguous and reliable way;

h) improved aerodrome visual aids providing guidance for surface movements should be an integrated component of the system;

i) automation and Human Factors engineering should provide the linkage between the surface and the terminal and between the terminal and the en-route airspace to create seamless operations with reduced controller and pilot workload;

j) SMGCS improvements should be developed in a modular form to accommodate all aerodrome types;

k) conflict prediction and/or detection, analysis, and resolution should be provided.

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A-SMGCS CONCEPT

An A-SMGCS differs from an SMGCS in that it may provide a full individual service over a much wider range of weather conditions, traffic density and aerodrome layouts. A-SMGCS are to use common modules in all circumstances. The modules to be used in any particular circumstance are determined by the specific requirements of each aerodrome. The use of an A-SMGCS will lead to reallocation of responsibilities for various system functions. Less reliance will need to be placed on the ability of the pilot or control authority to provide visual surveillance. Some functions will use automation to provide routing, guidance and control.

The main benefits to be accrued from the implementation of an A-SMGCS will be associated with, but not limited to, low visibility surface operations. Significant improvements in aerodrome capacity can also be achieved under good visibility conditions.

The significant distinctions between the functions of a current SMGCS and an A-SMGCS are that the latter should provide more precise guidance and control for all aircraft and vehicles on the movement area, and should also be able to ensure spacing between all moving aircraft and vehicles, especially in conditions which prevent spacing being maintained visually. It is therefore important to recognize that, except where the total number of aircraft and vehicles permitted to operate on the movement area at any one time is kept very low, such tasks are beyond the capability of a controller even if aided by conventional surface movement radar (SMR). Therefore, an A-SMGCS should provide situation awareness not only to ATC but also to those aircraft and vehicles that are liable to come in proximity to each other.

Complex traffic flows may require an A-SMGCS to function as a surface management system by providing for the planning and management of all aircraft and authorized vehicles on the movement area while interfacing with the air traffic management (ATM) system. An A-SMGCS addresses future increases in surface movement operations that would lead to increased surface congestion and system delays unless new techniques were made available to the air traffic controller to reduce workload. From the flight dispatch/apron management perspective, more sharing of information will be needed to manage the availability of stands/parking areas, thereby reducing taxi delays to a minimum.

An A-SMGCS will reduce voice communications, improve surface guidance aids and increase reliance on avionics in the cockpit to help guide the pilot to and from the runway. The ATC capability for surveillance by electronic means will also improve. Automation will play a greater role to assist in monitoring the surface operations. Communications will migrate into a mix of voice and data link capabilities, with automated data communications between system components providing situation information between the users, including from the ground to the cockpit. Voice communications will continue to be used where necessary.

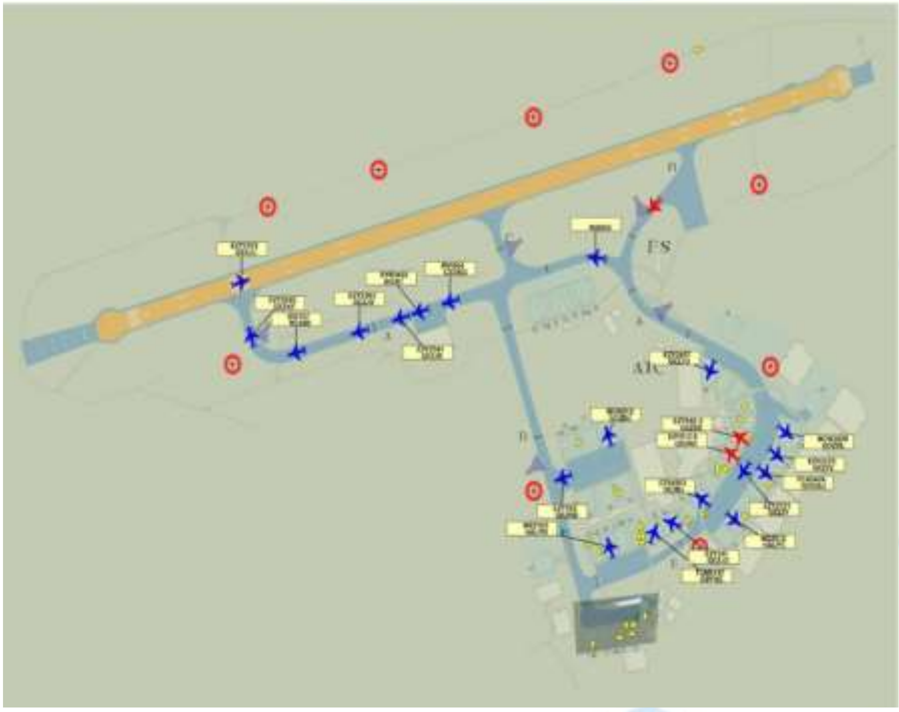
Surface guidance will include improved visual aids for automated guidance and control along the assigned route. However, for low visibility conditions, the pilot may need suitable avionics, such as a moving map, to monitor progress and compliance with the assigned route. These avionics may also be used to display surface traffic information. Improved ATC surveillance will provide accurate information on the position and identity of all aircraft and vehicles operating on the movement area. This will be used to enhance the automated functions associated with conformance monitoring and conflict alert. Also, the surveillance information will be useful in refining the traffic planning functions associated with predicting taxi throughput and arrival/departure times. Automated functions will include the monitoring of conformance with taxi instructions and the detection of potential conflicts and their resolution. Automation will also be used to control ground visual aids based on controller and surveillance inputs. Thus, the ground visual aids will be set up for the runway configuration in use, and runway/taxiway intersections will be controlled based on precise knowledge of the location and movement of aircraft and vehicles.

Surface traffic planning automation functions will be integrated with approach/departure operations. For arrivals, the sequence for each runway and stand assignment will be used to make accurate estimates of arrival times at the stands. This information will improve aircraft handling and turn-around time. For departures, engine start and push-back times can be coordinated and managed to gain optimum departure sequencing, taking into account the planned route. Also, aerodrome configuration changes will be timed and implemented more efficiently, thereby minimizing any impact on the aerodrome utilization rate.

Development of complex systems and the differing needs of users will require a modular development and introduction of various elements (some of which are already in place). The expected evolutionary development of A-SMGCS and the varied needs of users will mean that not all aerodromes will introduce all provisions described in this manual. Additionally, this manual can only outline steps in the continuing enhancement of aerodrome operations. The technical standards implied in this manual are recognized to be the most demanding for the most critical conditions in terms of visibility, traffic density and aerodrome layout. Implementation of facilities and procedures to these levels will, therefore, not be appropriate at all aerodromes. Implementation of an A-SMGCS can only take place after an assessment of cost/benefit studies and consideration of evolving user requirements. There will be a continuing need for dialogue between the suppliers of services, the manufacturers and the users so that the operational requirements can be translated into technical requirements.

An A-SMGCS needs to be related to the operational conditions under which it is intended that the aerodrome should operate. Failure to provide a system appropriate to the demands placed on the aerodrome will lead to a reduced movement rate or may affect safety. It is important to recognize that complex systems are not required and are not economical at aerodromes where visibility, traffic density, aerodrome complexity and any combination of these factors do not present a problem for the ground movement of aircraft and vehicles.

For a particular aerodrome, an A-SMGCS is intended to mean one integrated system providing advanced surface movement guidance and control at that aerodrome. The accountability for the safety of operations associated with an A-SMGCS will ultimately lie with the service provider, the airlines and the airport authority. In this manual, the term “responsibility” applies only to the person or system and a designated role or function within an A-SMGCS.



Traffic Display at London Luton Airport

A-SMGCS is more than just a set of systems, it also includes complementary procedures and at the lower levels of implementation aims to deliver improved situational awareness to controllers. Higher levels of implementation deliver safety nets, conflict detection and resolution, planning and guidance information for pilots and controllers, and detecting and indicating the position of potential intruders.

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The design principle of an A-SMGCS should permit modular enhancements. The A-SMGCS at each aerodrome will comprise its own mix of modular components depending on the operational factors that are categorized in Appendix A. For example, some modules of an A-SMGCS will be required when one or more of the following conditions exist:

a) visibility condition 2, 3 or 4; and/or

b) heavy traffic density; and/or

c) complex aerodrome layout.

Surveillance should be provided for aircraft on approach to each runway at such a distance that inbound aircraft can be integrated into an A-SMGCS operation so that aerodrome movements, including aircraft departures or aircraft crossing active runways, can be managed. A seamless transition should be provided between the surveillance for an A-SMGCS and the surveillance of traffic in the vicinity of an aerodrome.

The A-SMGCS should detect any incursion into areas used for aircraft movement and the runway strips, and within any designated protected area as required by airport authorities. The surveillance system should also continuously indicate the position of unauthorized aircraft, vehicles and obstacles in the above areas.

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