MALDIVES CIVIL AVIATION AUTHORITY
Republic of Maldives

AIR SAFETY CIRCULAR
ASC 139 - 19

Guidance for Aerodrome Electrical Systems

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1. Regulatory Compliance

1.1 This ASC shall be used as a guidance material.

2. Related Regulations

2.1 This Circular relates specifically to MCAR 139 and ASC 139-5.

3. Applicability

3.1 This Guidance Material applies to all persons or entities operating and/or maintaining aerodromes certified under MCAR 139.

4. Purpose

4.1 This Air Safety Circular has been developed to provide guidance to the aerodrome operator on testing for compliance with the requirements related to electrical power supply systems, and monitoring systems for operation of Visual Aids.

5. Glossary of Terms

In order to clarify some concepts and terms used in this Advisory Circular, the following definitions apply:

a) **Primary sources**: It is that power supply from which energy is provided in the normal operation of a system.

b) **Secondary source**: It is the power supply that provides power in the event of a failure in the supply of the primary source. There may be different secondary sources defined for different systems. Switching times will depend on the entry into service of the secondary source, and must be independently verified in each system. In cases where a system is equipped with several secondary cascade sources, the required switching times must be met with the entry into operation of the first of the secondary sources that replenishes the supply. It should be checked in the tests that the switchover occurs according to the design of the system in relation to the sequence of secondary sources established.

c) **Inadequate or misleading visual guidance**: A situation in which the visual aid or lighting systems give no indication, or the indication they provide is different from the one for which they are conceived (either by configuration, colour or defect in any other of their characteristics), and / or may be misleading.

d) **Change of operational state of a lighting system**: Any change occurring in a lighting

system in which the information provided by that system in the new state implies a change in its operating conditions, such as: absence of indication, misleading indication or loss of functionality of the system, both by voluntary action and by failure.

e) **Lighting systems for aircraft control**: Any lighting system which, according to the certification specifications/technical standards applicable at the aerodrome, is necessary for the safe development of the operation of aircraft.

f) **Failure that may affect control functions**: Any failure in a lighting system that must be brought to the attention of the air traffic service (Control Tower-TWR) of the aerodrome, so that these services can execute the actions that are appropriate.

g) **Untimely Failure**: Disconnection that occurs in a system due to an out-of-time operation of any element of the system, or due to the failure of any secondary device or human error.

6. FREQUENCY OF TESTS

All the tests detailed in this Advisory Circular should be carried out with the periodicity determined for each of them. The procedure for carrying out any of the tests should be as detailed and specified in the equipment user manual.

The tests and their frequency need to be observed as part the operational maintenance of the facilities and equipment.

The tests may be requested during the on-site inspection by the Authority. The request by the Authority may be communicated in advance in accordance with the established inspection schedule, and the necessary personnel should be available to carry out the required tests.

7. REQUIRED TESTS AND GENERAL CRITERIA

7.1. Required Tests

In order to verify continuous compliance with the regulatory requirements, a number of tests have been established. Four (4) tests related to the operation of the control panel and a fifth test related to the failure of the main power supply have been defined, which are listed below:

a) Tests related to the Control panel:

- Test 1 - Regulator failure test.
- Test 2 - Testing commands on the control panel.
- Test 3 – Failure to test power regulator control system.

- Test 4 - Control Panel Communications Failure Test.

b) Tests related to the failure of the main power supply

- Test 5 - Secondary source switching test

8. General Criteria

The tests are designed to meet one or more of the regulatory requirements, although it must be taken into account that: due to the design of the systems and characteristics of operation of such systems, failures that can occur (the failure of the installation can occur on different computers, and therefore it is necessary to perform the check on all possible points of failure), for the complete verification of each of the requirements, more than one test might be necessary.

The test protocols detailing each of the tests carried out should be developed including the steps to follow, communications, periodicity with which it is carried out, technical characteristics to be taken into account, cut-off points, compliance criteria and other aspects that are considered necessary for the development of the test and the interpretation of the results.

In the event that breaches occur during the execution of any of the tests, troubleshooting should be carried out and the actions that are considered appropriate to achieve compliance with the requirements should be carried out. Once the origin of the non-compliance has been located, and the corrections that may be necessary have been implemented, the test should be so that compliance is effectively verified, providing evidence of it.

The periodicity of the tests varies depending on the runway category.

a) Semi-annual for runways with precision approach and / or takeoffs with visual range less than 400m

b) Annual for runways with approaches that are not precision and/or visual.

For some of the tests, the above frequencies may vary depending on different conditions, in the description of each test indications are collected in this regard.

In the case of having both types of runways at the same airport, being in most cases a single and general system, the most restrictive of both must be complied with.

9. TEST 01: REGULATOR FAILURE

The purpose of this test is to check how the system behaves in the event of an untimely failure of one of the regulators, and that changes in visual aids as a result of regulator

failure as reflected in the monitoring system at the Control Tower and within the interval of time established in the regulations.

The execution of the test will depend on the system installation. In most configurations, the power supply of the regulators will be cut off, either by means of the switch located in the regulator (including the cut-out) or by means of the switch located in the electrical panel that feeds the particular regulator.

After simulating the failure it is expected that at the monitoring device located in TWR this failure will be represented within the time limits established in the regulations. It may be identified by flickering of the affected lights and / or warning at the bottom of the screen, with or without descriptive message, or any other perceptible indication to the controller.

9.1. Checks and Compliance Criteria:

Measurement of the time difference between change of state of the visual aid in the movement area and when it is reflected in the control tower console. Compliance with the requirements is confirmed when the elapsed times between the change occurring in the lights and that same change being reflected in the TWR console are:

- less than 2 seconds for the stop bar system, and
- 5 seconds for the rest of the visual aids.

The appearance of alarm message or information provided in the tower console to indicate the failure of the regulator will be taken as valid for the verification of compliance with the regulatory requirements.

Additionally, when the failure occurs in any of the circuits of the systems, it will be possible to verify in the movement area if the requirements are achieved and verifying that the configuration complies even after simulating a failure of the regulator and does not provide misleading visual guidance.

10. TEST 02: COMMANDS/ACTION ON THE CONTROL PANEL

The main objective of the test is to verify that an operational change can be made on the visual in the airfield aids using commands or action on the control panel and that the change made is reflected in the tower monitoring system, within the time interval established in the requirements and that the configurations established do not mislead Pilots/other users.

The test will be carried out at the control panel in the control tower, from where a command will be given to change the operational status of any lighting systems, that

is, the on/off or brightness change of the selected systems.

10.1. Checks and Compliance Criteria:

a) Verification of the ability of the commands on the control tower panel to make changes on the operational status of the visual aids. It is required to check the status of visual aids whenever there are changes affecting the visual aids.

b) Measurement of the time difference from the time change of state of the visual aid in the area of movements, until it is reflected in the control tower. Compliance with the requirements is achieved when the elapsed times between the lights, and this change is reflected in the TWR console, are less than 2 seconds for the stop bar system and 5 seconds for the rest of the visual aids.

c) Additionally, when the switching off/on is carried out in any of the circuits, it will be possible to verify in the movement area the fulfillment of the requirements and verifying that the configuration that remains after the commanded action, does not provide a misleading visual guide. In addition, any irregularity in the sequence of change in the lights should be observed.

d) It should be noted that abnormally low, or even negative, time intervals between the change of state in the lights and their reflection on the console, may be indicative that the monitoring system receives the signal directly from the command and not from the status of the equipment. In such a case the system operation should be analyzed to detect or rule out any possible anomaly (a possible verification is to act manually on the regulators in a similar way to Test 01.

e) Additionally, it is advisable to analyze the time that elapses from when the command in the control system is affected, to when the change is affected in the operating state of the lights in the movements area, in order to determine if situations of deceptive visual guidance may occur, by significant time differences between different circuits (e.g. coexistence of stop bar lights with rear taxiway axis,)

11. TEST 03: REGULATOR CONTROL SYSTEM FAILURE

The purpose of this test is to check how the system behaves in case of untimely failure of the equipment/control system of the regulators, verifying that the visual aids adopt a predefined configuration set by the operator, which allows the system to continue safe operation of visual aids in the movement area. (Safe Conditions following control panel failure) and if the failure is reported with any type of signal or alarm.

The execution of the test will depend on the installation of the system manager, which

must have defined the sequence of actions that allow simulating the failure in the equipment / control system of the regulators, keeping the rest of the elements of the control panel operational.

In those airports where there are a number of control rooms, and therefore several control elements, the test must cover the different failure situations of each of the control systems, verifying that the configuration indicates the status of visual aids on the runways, taxiways and aprons.

Usually, the system of control of the Regulators is protected by means of one system of independent continuity and / or redundant equipment, so, in case of failure of the main source of the same, the continuity system (or redundant equipment) will keep the cabinet in operation control.

For the complete performance of the test, the control system (communications cabinet) must be left without operation, and therefore the failure of said unit must be simulated.

11.1. Checks and Compliance Criteria:

Control Cabinet Power Cut: Verify that the continuity system or redundant equipment comes into operation without change in the state of the visual aids, complying with the requirement.

12. TEST 04: COMMUNICATIONS FAILURE OF THE CONTROL PANEL

The purpose of this test is to check how the system behaves in the event of a failure of the control panel communications system. Verifying what status, the visual aids of the movement area adopt (Degraded Conditions), and if the system reports the corresponding failure with any type of signal or alarm.

The communications system depends on the complexity of the airport being very different from each other (ring, redundant computer, etc.) so the necessary actions will vary according to the installation; being the main objective to make the cuts or disconnections necessary to leave the control panel without communications, being able to be achieved in different ways: Shutdown of computers, disconnection of communications (PLC cables). Therefore, in order to carry out the execution of the test, the disconnection method must be specified in the administrator protocol/user manual.

In those configurations that require two disconnections for the simulation of the communications failure, verifications of the correct operation in the consoles (TWR and CE) must be carried out after the first disconnection, and the definition of the

protocols must be adapted in cases where warnings are defined in the consoles after the first disconnection.

After the failure of the control panel communications, the visual aids must enter a predefined configuration of Degraded Conditions, which must be defined keeping updated in the test protocol.

12.1. Checks and Compliance Criteria:

a) Verify that the system reports the failure detected in communications properly and complies with the requirements.

b) When two disconnections are necessary, verify the correct operation after the first disconnection. Additionally, if warnings have been defined on any of the consoles after the first disconnection, check that they occur.

c) Check that visual aids fall within the Degraded Conditions predefined by the operator to comply with the requirements.

13. TEST 05: SECONDARY SOURCE SWITCHING

The main objective of the test is to verify that, in the event of a failure in the primary power source, the automatic switching of the secondary source occurs, and that the affected visual aids are out of service for only the time intervals within the limits of table S-1, or during a time interval "as short as practicable" for those systems not included in Table S-1 but included in the requirements.

For the purposes of this test, switching time is understood to be the time that elapses from the time the failure is reflected in the visual aids, until they return to the state prior to the failure (time in which the lights remain off). The switching time requirement is on the lights not on the secondary power source, therefore, the direct view of the visual aids to be checked will be necessary.

The way to carry out the test will vary depending on the complexity of the installation of each aerodrome, depending on the existing configuration and the distribution of power supplies seconded by the different systems, it will be possible and / or necessary, to make cuts at different points. In all cases, the chosen cut-off points must simulate the failure of the main power supply and cause the secondary power supply designated for each system to become operational. The procedure for making the cut and the conditions under which it must be done, should be detailed in the test procedure of the operator.

13.1. Checks to be Carried Out and Compliance Criteria:

a) Verify that the automatic switching of the secondary power source occurs and compliance with the requirements.

b) Check, depending on the runway category, that the switching times for the different visual aids do not exceed the maximum times stipulated in Table 1, in accordance with the regulatory requirements.

In cases where there are systems in Table 1 connected to different secondary power sources, and with different switching time requirements (for example runway lights versus essential obstacle lights), the disconnection point and compliance criteria are established with each system complying with the switch and the switching times that apply to it.

a) Verify that those systems whose requirements are not stipulated in Table S-1, are effectively provided with a secondary source of energy, and the switching times conform to the criterion "as short as practicable", complying with the requirements. This verification may require disconnection of the primary source at points other than those used for the systems in Table S-1.

Where outages of the primary sources are anticipated or known in advance, the Operator may schedule the conduct of the secondary source switching test.

In the event of cuts of the primary source, the cause of outage and its repetition must be recorded and analyzed, as well as the time at which the secondary sources come into operation.

In cases where the results of the analysis point to a non-compliance in the requirements of switching times, necessary correction actions must be carried out, and then an additional switching test of the affected secondary sources must be planned, which allows verification effective compliance with requirements.

14. SECONDARY POWER SUPPLY REQUIREMENTS

Table 1: Secondary Power Supply Requirements

Runway Type	**Lighting aids requiring power**	**Maximum switch-over time**
Non-instrument	Visual approach slope indicators[a]	15 seconds
	Runway edge[b]	15 seconds
	Runway threshold[b]	15 seconds
	Runway end[b]	15 seconds
	Obstacle	15 seconds
Non-precision approach	Approach lighting system	15 seconds
	Visual approach slope indicators [a,d]	15 seconds
	Runway edge [d]	15 seconds
	Runway threshold [d]	15 seconds
	Runway end	15 seconds
	Obstacle [a]	15 seconds

Precision approach category I	Approach lighting system Visual approach slope indicators [a,d] Runway edge [d] Runway threshold [d] Runway end Essential taxiways [a] Obstacle [a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category II	Inner 300 m of the approach lighting system Other parts of the approach lighting system Obstacle [a] Runway edge Runway threshold Runway end Runway centre line Runway touchdown zone All stop bars Essential taxiway	1 second 15 seconds 15 seconds 15 seconds 1 second 1 second 1 second 1 second 1 second 15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.

b. See Part XIII of the Civil Aviation (Aerodromes) Regulations, Visual aids for air navigation, regarding the use of emergency lighting.

c. One second where no runway centre line lights are provided.

d. One second where approaches are over hazardous or precipitous terrain.

15. TESTING PROCEDURE REQUIREMENTS

15.1. Power Outage Test Procedure

The Aerodrome Operator should have a procedure for the measurement of times and performance of the switching of the power source, as a part of the preventive maintenance, and whose objective is to ensure that electrical installations are kept in such conditions that they cannot adversely affect the safety, regularity or efficiency of air navigation and verify that the maximum switching time for the secondary source established in Table 1 is met.

In the power outage test procedure, the tests on connection change of the primary energy source must be taken into account, in case of having more than one primary source.

As a minimum the procedure for performing the power outage test should contain:

a) Objective of the test

b) Responsible personnel in charge of:

- Performing the test; and
- The analysis of the results of the test and consequent follow-up.

c) Responsible personnel in charge of:

- Single-line diagrams of the installation in which all the elements of action referred to in the test are identified, and the cut-off points established therein.
- Details of how the test is performed.

Note: In the event that the test results are not satisfactory, the Operator should carry out a risk analysis within the framework of the Aerodrome Safety Management System.

i. Periodicity established for the performance of these tests.

d) Records associated with the test:

- Documentation proving that the test was carried out containing clear and precise information about the test result, as well as the incidents.
- Documentation proving that the results of the tests (non-compliance with the requirement, failures derived from the test, etc.) have been analyzed and the consequent measures taken for the elimination or mitigation of any identified deficiencies.

The minimum periodicity for carrying out power outage tests should be as follows:

a) Semi-annual for precision approach runways and/or takeoffs with visual range on the runway less than 400m:

b) Annual for non-precision approach runways and/or visual runways:

c) In the event that the results of the tests are not satisfactory, and once the appropriate corrective actions have been carried out, the repetition of said test will be carried out.

d) Records of all the airport primary source outages should also be kept.

15.2. Test Procedure For Visual Aid Control Panel

The aerodrome operator should have a test protocol for the visual aids control panel, as part of preventive maintenance, with the objective of ensuring that electrical installations are kept in such conditions that they cannot adversely affect the safety, regularity or efficiency of air navigation and verify that the requirements and times established are met.

At a minimum the testing procedure for the visual aids control panel should contain;

a) The objective of the test;

b) Personnel responsible for

- Performing the test
- The analysis of the results of the test and consequent follow-up.

Note: In the event that the test results are not satisfactory, a risk analysis should be carried out within the framework of the Aerodrome Safety Management System.

c) Description of the performance of the test:

- Detail of how the test is performed;
- Analysis of the test results; and
- Periodicity established for the performance of these tests.

d) Records associated with the test:

- Documentation that proves having carried out the tests, that contains clear and precise information about the result of the same, and that evidences the fulfilment or not of what was verified, as well as the incidents or failures that have occurred during the test. These records should be signed by the person responsible for the tests.
- Documentation proving that test results have been analysed (breaches of the standard, failures derived from the test, etc.) and consequent measures

adopted for the elimination or mitigation of the identified deficiencies.

The minimum periodicity of the visual aids control panel tests shall be as follows:

a. Semi-annual for precision approach Runways and/or take-offs with visual range on the runway less than 400m: and

b. Annual for non-precision approach Runways and/or runways for visual flight rules.

In the event that the results of the tests are not satisfactory, and once the appropriate corrective actions have been carried out, the test will be repeated.

For Civil Aviation Authority

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