CHAPTER 6 CIRCUITRY

6.1 Interleaving of aerodrome lighting circuits

6.1.1 Article 8.2 of Annex 14 specifies that for a precision approach runway the electrical circuits be designed so that the failure of one circuit will not leave the pilot without visual guidance and will not result in a misleading pattern. To this end, every approach and runway lighting system should be interleaved with at least two circuits. Examples of circuit interleaving to improve integrity are shown in Figures 3-1 to 3-5. Each circuit in an interleaved service should extend throughout the whole of that service and be so arranged that a balanced symmetrical lighting pattern remains in the event of failure of one or more of the circuits.

6.1.2 Care should be taken to properly label cables and AGL transformers where interleaving is applied to the installation.

6.2 Arrangement in the electrical vault

Interleaving is often thought of as just the connections made in the field. It is recommended that the principle of interleaving be carried to the electrical vault and beyond. As shown in Figure 6-1, the circuits and associated regulators are fed from separate buses such that each circuit is supplied from a separate CCR and arrangement be made such that a spare CCR is available to be placed in operation within a minimum amount of time. The Figure 3-1 below illustrates the use of switches to connection of a spare CCR. The buses are provided with automatic tie breakers for use in case of failure.

Figure 6-1. Arrangement of circuit supply

*note 1. Each electrical vault may contain 10 to 20 CCRs.*
*note 2. Interleaved circuits*
As a further means of assuring availability in case of failure, arrangement is made to enable the switching in of a spare regulator, as shown in Figure 6-2. A similar result can be obtained through the use of constant current regulators of a plug-in design.

![Figure 6-2: Use of a Spare CCR](image)

### 6.3 Provision of Interleaving.

Interleaving should be provided for those lighting facilities listed in Annex 14, Table 8-1 and as indicated in Annex 14, article 8.2.1. The below describes the manner of application where "other facilities", might be provided with more than one circuit.

#### 6.3.1 Approach Lighting

The interleaving of approach lighting Type A and Type B is illustrated in Figure 6-3. Both the Category 1 system and supplemental lighting for Category 2/3 operations are shown.

Threshold lights are composed of those associated with the runway and that associated with the approach lighting system. The threshold lights for the runway are runway end/threshold lights with red and green signals [facing opposite] at each light station. In Figure 6-3, six runway threshold lights are shown for a Category 1 installation. A category 3 installation would have more runway end/threshold lights ... refer Figure 5-21 in Annex 14. In the case of the runway end/threshold lights, these are usually interleaved as part of the runway edge lighting system. Interleaving for the approach lighting system involves the unidirectional green threshold lights and the wingbar lights.

#### 6.3.2 Runway centreline and touchdown zone lighting systems

Annex 14 requires that runway centreline lights show; variable white to a distance of 900m from the threshold, then alternating variable white and red from 900m [or from the mid-point of the runway] to 300m from the runway end after which only red is shown to the pilot. Figure 6-5(b) illustrates the interleaving for the first white only portion of the system. Similar interleaving would be used for the final all red portion.
Figure 6-4 illustrates various means to provide interleaving for the coded white/red portion of the system and selection is that prescribed by the local Civil Aviation Authority. Where it is necessary to preserve the colour coding, Figure 6-4(a) should be used. However, this interleaving would increase the spacing in failed segments to 3 times the normal value. Figure 6-4(d) illustrates an interleaving arrangement where lights are installed with 7.5m spacing and couplets of single colour are installed. The Figure 6-4(b) does not preserve the coding [with circuit failure the lights are either all red or all white], but does maintain an acceptable spacing for provision of a pattern of lights for centreline guidance [the spacing is doubled with circuit failure].

Figure 6-4 (c) is a preferred arrangement where the use of 3 circuits preserves both the colour coding and an acceptable spacing increase.

The Figure 3-5 also illustrates the interleaving of runway touchdown zone lights. The interleaving of 3-5(d) is preferred because it maintains the longitudinal spacing between barrettes upon loss of one circuit.

6.3.3 Taxiway centreline lighting

Taxiway centreline lighting circuits should be interleaved on those parts of the taxiway system that are considered as essential in Category II and III conditions, but for economic reasons a single circuit may be used for other taxiways.

Where the taxiway centreline lighting is colour coded green/yellow to indicate the distance of the aircraft exit from a runway in relation to the ILS critical area, the system may be interleaved by one of the methods illustrated in Figure 6-4 as directed by the local Civil Aviation Authority. As for runway centreline lighting 6-4 (a) preserves colour coding but leaves failed segments that are 3 times the normal light spacing. Figure 6-4(b) causes an increased spacing which is twice the normal, but also does not preserve the coding such that the exiting pilot would see either a line of green or yellow lights. The method of Figure 6-4(c) preserves minimum spacings but is more costly .The method of Figure 6-4(d) is an alternative which preserves the colour coding and leaves a normal spacing if the lights are installed at half the normal spacing [e.g. at 7.5m instead of 15m].

6.3.4 Stopbars

Stopbars should be controlled independently of each other and of the taxiway centreline lights. The electrical circuits should be interleaved so that all of the lights of a stop bar will not fail at the same time.

Stopbars are normally associated with taxiway centreline lead-on lighting. The green lead-on lighting provides a confirmation of voice instruction for the aircraft to proceed once the stopbar is turned off. When the stopbar is illuminated, the taxiway centreline lights installed beyond the stopbar are extinguished for a distance of at least 90m, and vice versa. Control and monitoring of the lead-on lights can be accomplished through means of addressable switches whilst the power supply and possible interleaving is that of the taxiway centreline lighting. Should the supply to the lead-on lights be other than a dedicated circuit, it is necessary to ensure that the circuits to which these lights are connected will be active when the lead-on lighting is required.
6.3.5. Other Lighting

The following facilities are not required to be interleaved, but are described here should interleaving be required by the local Civil Aviation Authority.

6.3.5.1 Visual approach slope indicator systems

Visual approach slope indicator systems should have two circuits per runway end when operated with an ILS system.

Normally the PAPI is installed on the left side of the runway. When the visual approach slope indicator system is a full PAPI or T-VASI and installed on both sides of the runway, the power to all light units on one side of the runway should be supplied by the same circuit. This arrangement ensures that should one circuit fail a complete pattern will be retained on the other side of the runway.

When approach slope indicators are installed on only one side of the runway as with the PAPI, and AT-VASI, part of the lamps in each light unit should be connected to one circuit and the remainder to the other circuit in order to maintain the integrity of the pattern. Loss of one of the lamps within a light unit will result in reduced intensity. Visual approach slope indicator systems should be deenergized when a misleading signal results from the failure of a complete light unit.

6.3.5.2 Runway Holding Position Signs

Where interleaving is provided, runway holding position signs should be installed such that separate circuits are used for the signs on each side of the taxiway.

6.3.5.3 Runway Exit Taxiway Indicator Lights (RETILs)

The RETIL system is composed of a pattern of inpavement fixtures used to indicate the approach to a runway exit. In as much as the system has a small quantity of fixtures and each is necessary for the distance coding, the RETIL is not provided with interleaving but is has a single circuit fed from a separate constant current regulator.

In as much as the functionality of the RETIL system is dependent upon the number of lights in consecutive barrettes, the failure of one light within a barrette results in a malfunction of the system. Therefore, it is recommended that the system be provided with a means to automatically turn off the entire system should there be a lost of a single light unit.

6.3.5.4 Runway guard lights

Runway guard lights (RGL) should be provided with separate circuitry from that of the associated runway or taxiway. They should not be connected for supply from the adjacent taxiway or runway circuit for reason of an incompatibility of brightness level as well as that the runway guard lights would be required when runway or taxiway lighting are not illuminated.
Where interleaving is provided, the RGL configuration A (elevated) are interleaved such that one circuit is used for each side of the hold position.

Where interleaving is provided, the RGL configuration B (inpavement) are interleaved with the connection made in couplets of lights such that the alternate flashing characteristic is maintained. For example as, c1, c1, c2, c2, c1, c1, c2, c2.

6.3.5.5 Taxiway/Runway Lead-on Lights. Green taxiway/runway lead-on lights need not be interleaved as the function of this lighting is to provide a confirmation of voice instruction to proceed. However, if interleaved, they may be provided with two circuits as for runway centreline of single colour as shown in Figure 6-5(b).

6.2 Selective switching of taxiway circuits

In order to provide route guidance to pilots, taxiway centreline lighting should be circuited to permit selective lighting of segments of the taxiway lighting system on the airfield. This capability may be obtained by using an individual constant-current regulator for each segment or by connecting several segments to a single regulator and using selector relays, either in the field or at the regulator. Selective switching may be obtained in several ways. Among these are:

(1) the use of a control switch for each segment. The preferred location of such switches is on a facsimile diagram on the control panel in the control tower with each switch located on the segment which it controls. This may also be accomplished with use of a touch-sensitive screen which presents a diagram of the airport routing system;
(2) interconnecting the controls which energize the regulators or selector relay so that actuating a single switch will cause all segments on a designated route to be lighted; and
(3) using a minicomputer programmed to automatically light the optimum route after the operator designates the runway exit to be used and the gate destination of the aircraft
Figure 6-3: Precision approach lighting system interleaving
Figure 6-4: Interleaving of colour coded lights
(a) Runway edge lighting

(b) Runway centreline (refer figure 3-4 for coded section)

(c) interleaving by barrettes with two circuits

(d) interleaving by horizontal lines with three circuits

Figure 6-5: Runway edge, centreline and touchdown zone lighting