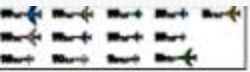


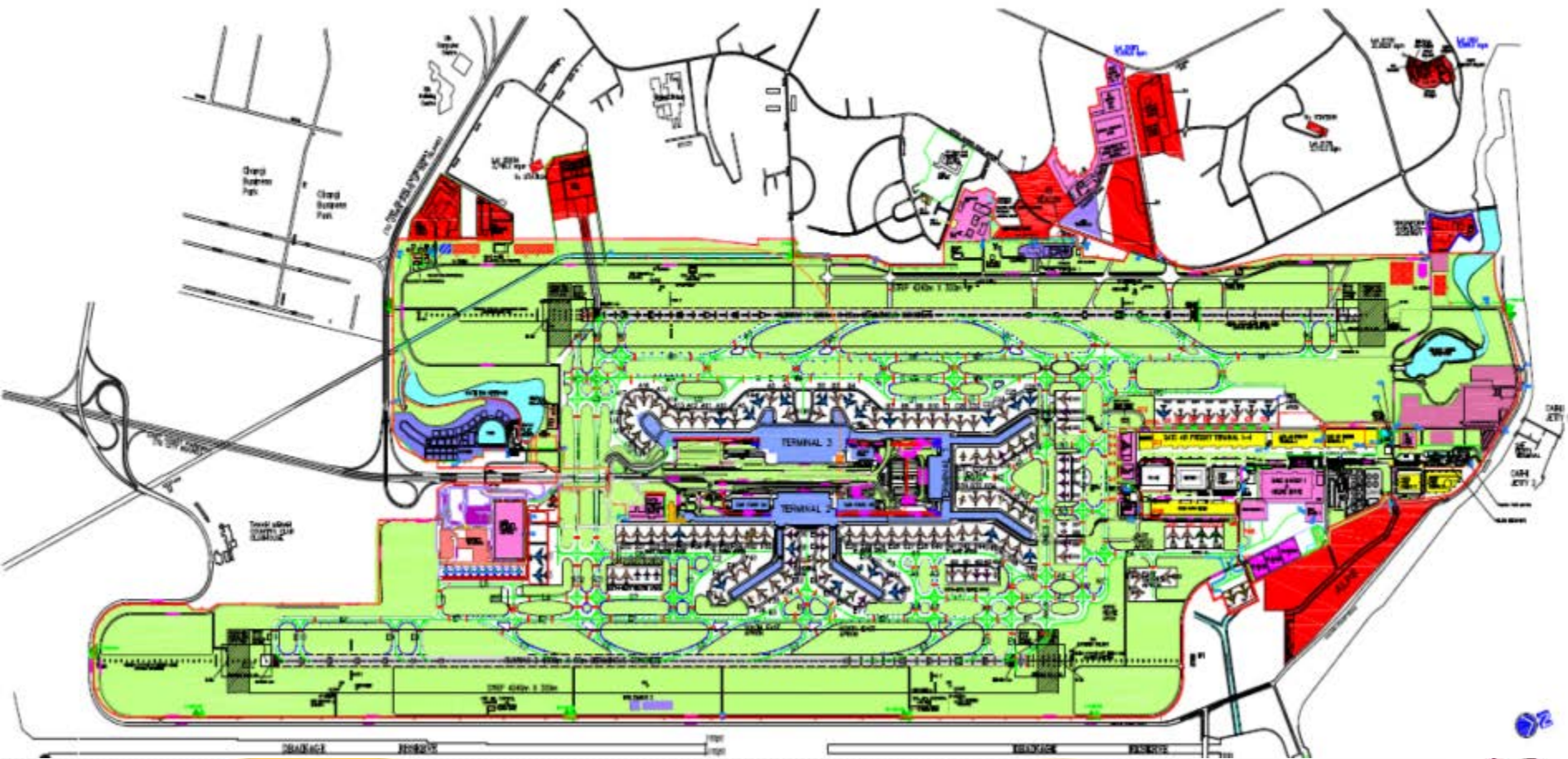
# AIRFIELD LIGHTING SYSTEM in Changi





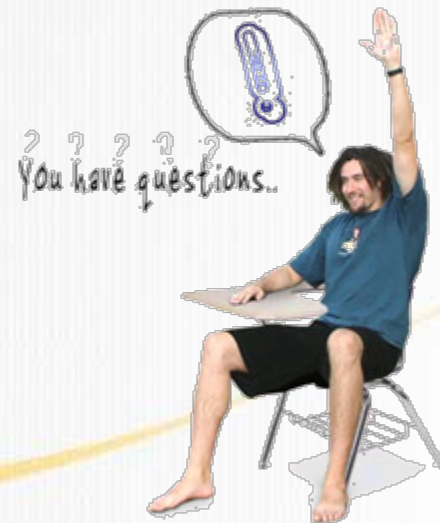


# LAYOUT OF CHANGI AIRPORT



# Contents

- Introduction to Airfield Lighting
- Taxiway Guidance Signs
- Electrical Supply for Airfield Lighting Systems
- Airfield Ground Lighting Control and Monitoring System (AGLCMS)
- Runway, Taxiway & AFLCC Inspection & Maintenance
- Airfield Lighting Projects





# Why is there a need for Airfield Lighting System ?

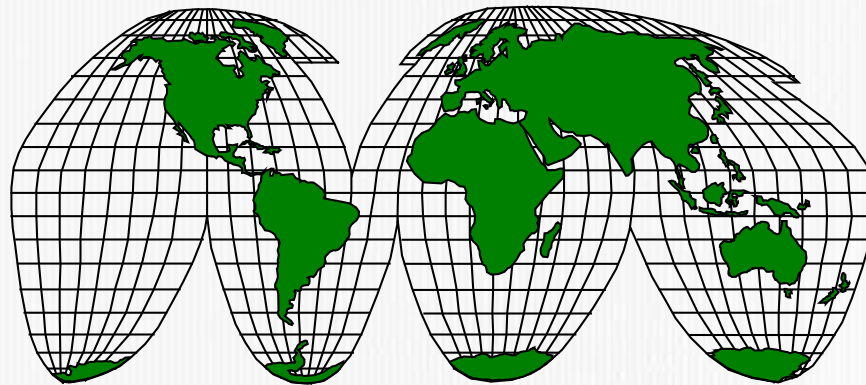
Ans: help guide planes using the runways and taxiways at night or in bad weather condition



Video on landing in CAT IIIa Condition in Oslo Gardermoen Airport, Norway

## International Standards & References:

- (i) International Civil Aviation Organization (ICAO)
- (ii) Federal Aviation Administration (FAA)
- (iii) NATO & other military requirements



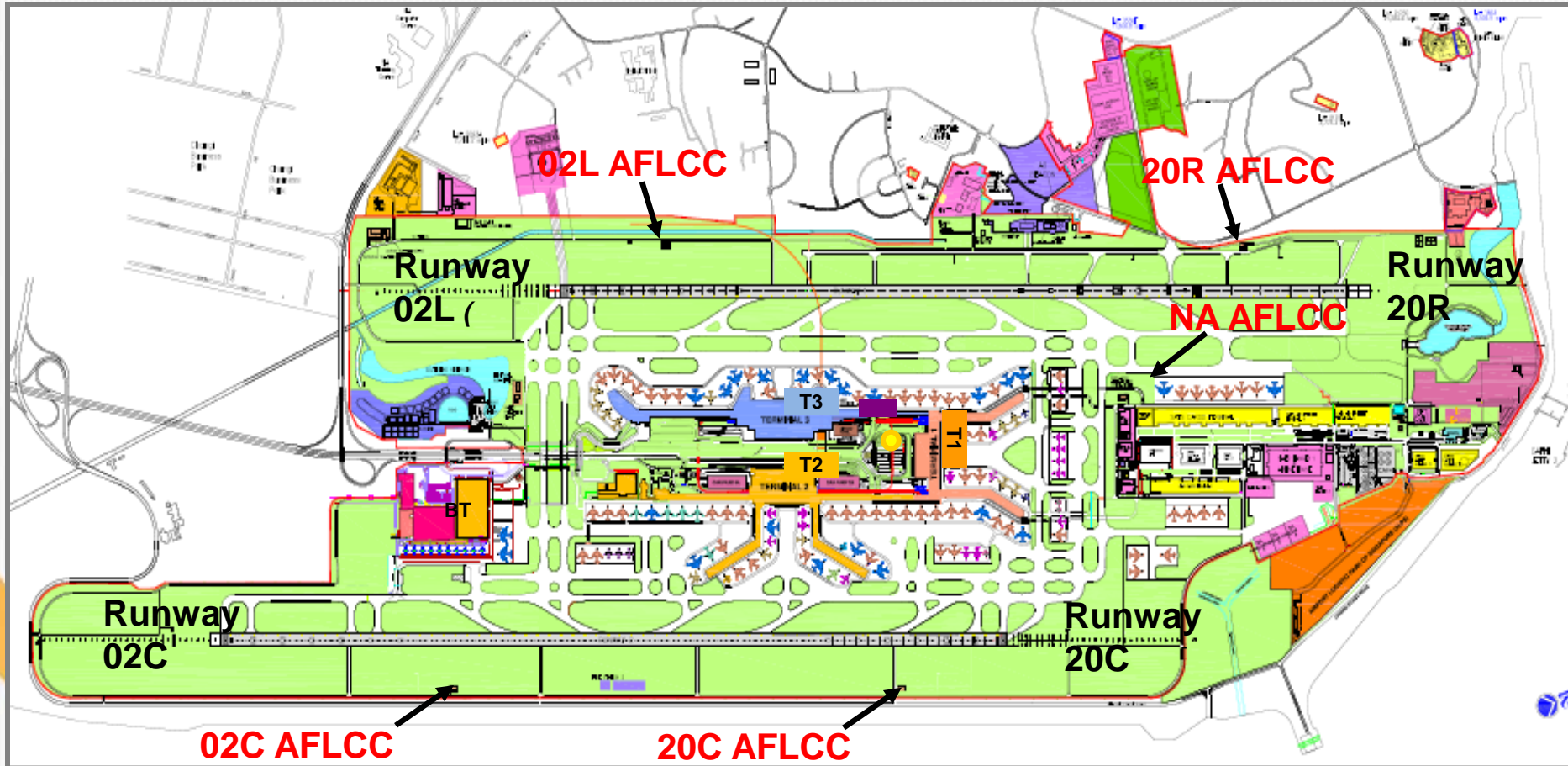




## References pertaining to Airfield Lighting System:

- ICAO Annex 14 - Aerodromes  
(International Standards & Recommended Practices)
- ICAO Aerodrome Design Manual Part 4 - Visual Aids
- ICAO Aerodrome Design Manual Part 5 - Electrical Systems
- ICAO Airport Services Manual Part 9 - Airport Maintenance Practices
- ICAO Manual of Surface Movement Guidance and Control Systems
- FAA Advisory Circulars AC 150/5340, 5345 covering approach lighting, approach slope indicator systems, runway and taxiway centre line and edge lighting, touch-down zone lighting, specifications for light fixtures, power and control equipment, and other accessories

# Changi Airport Layout







4000 X 60 metres

**02L**  
**approach**  
(CAT II)



**20R**  
**approach**  
(CAT I)



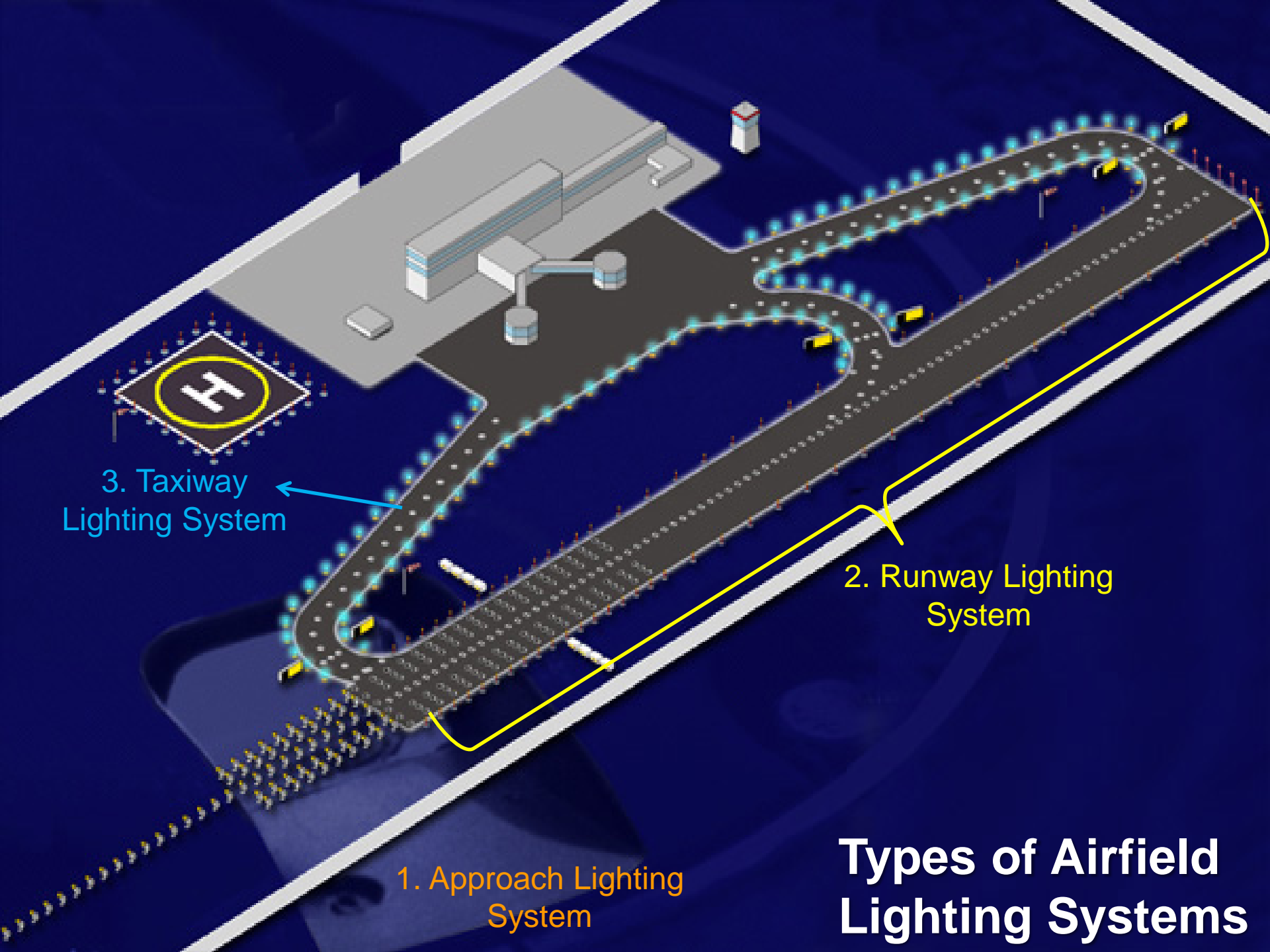
4000 X 60 metres

**02C**  
**approach**  
(CAT I)



**20C**  
**approach**  
(CAT II)





3. Taxiway Lighting System

2. Runway Lighting System

1. Approach Lighting System

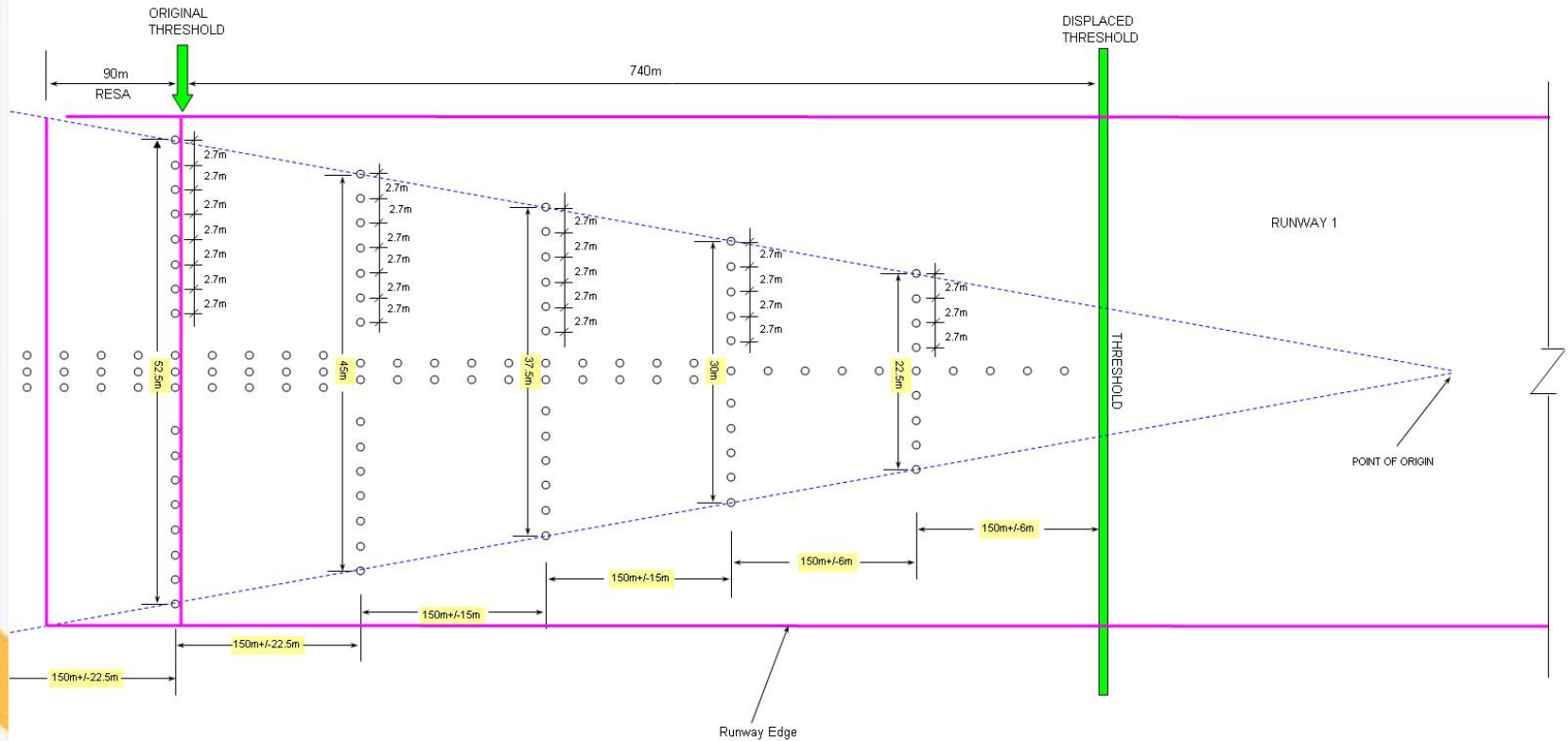
# Types of Airfield Lighting Systems

# 1. Approach Lighting System



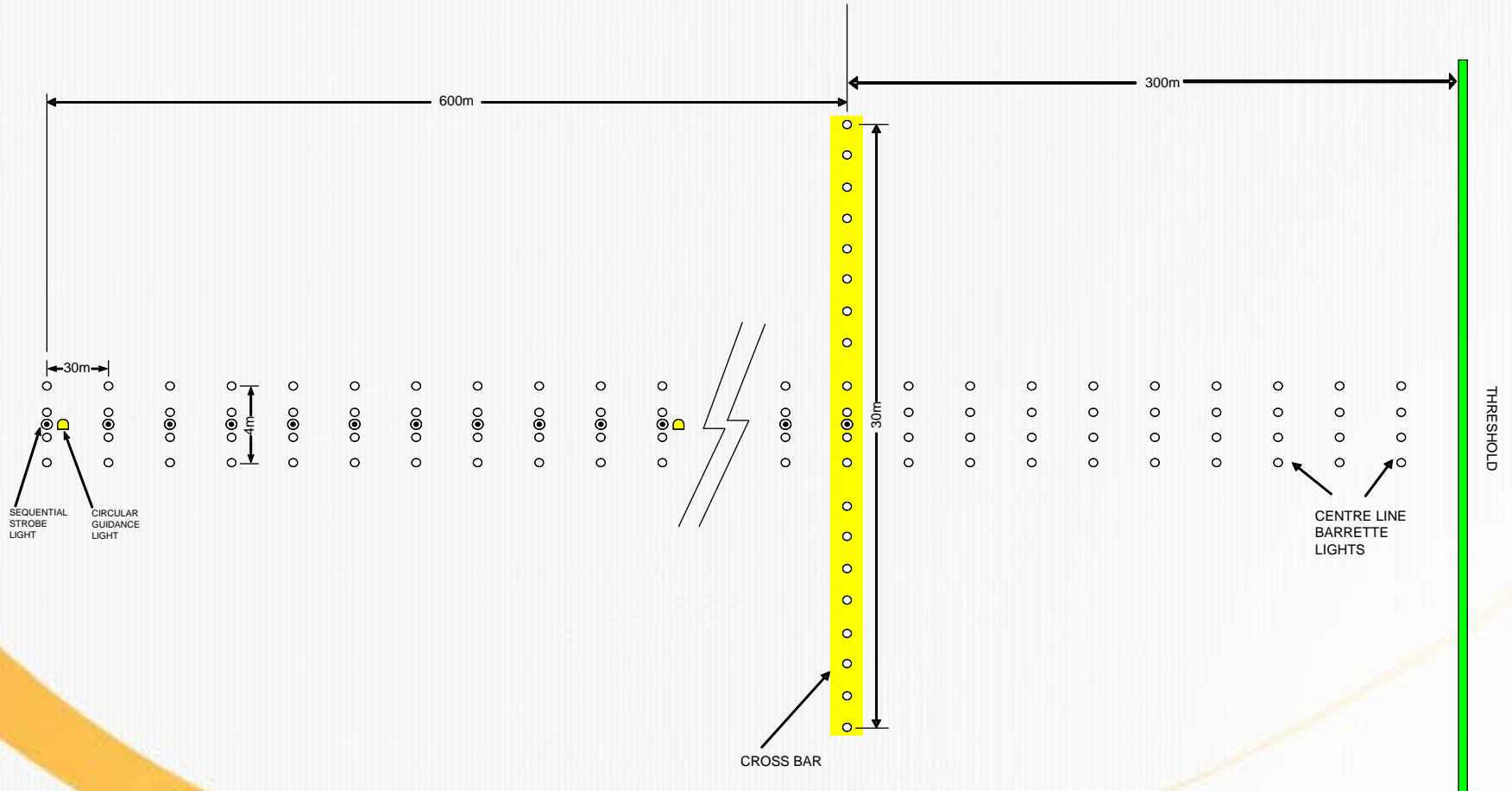
# 20R - Distance Coded Approach (Cat 1)

**CATEGORY I APPROACH LIGHT SYSTEM (DISTANCE CODED CENTRE LINE at DISPLACED THRESHOLD)**





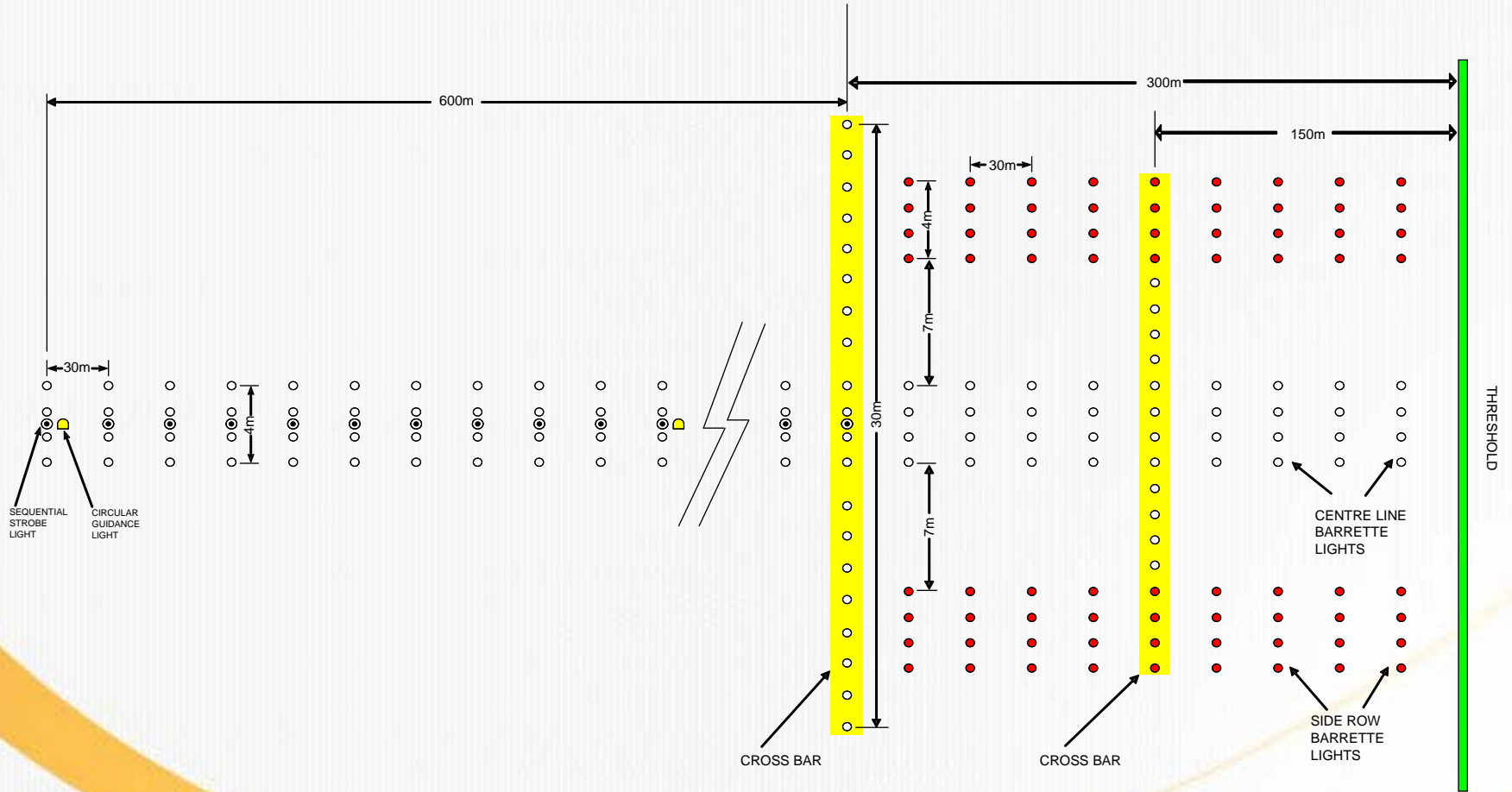
# 02C - Barrette Approach (CAT 1)

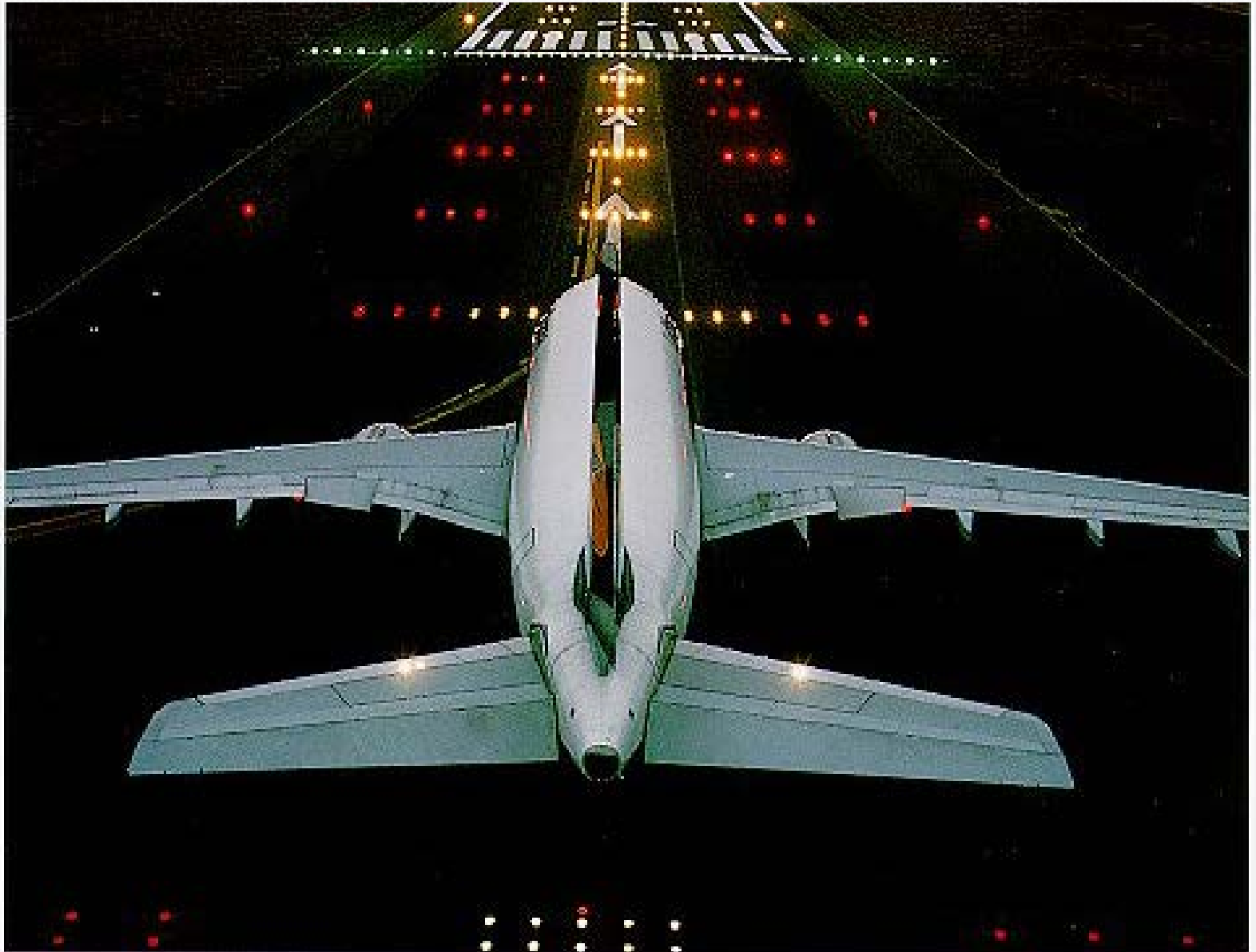




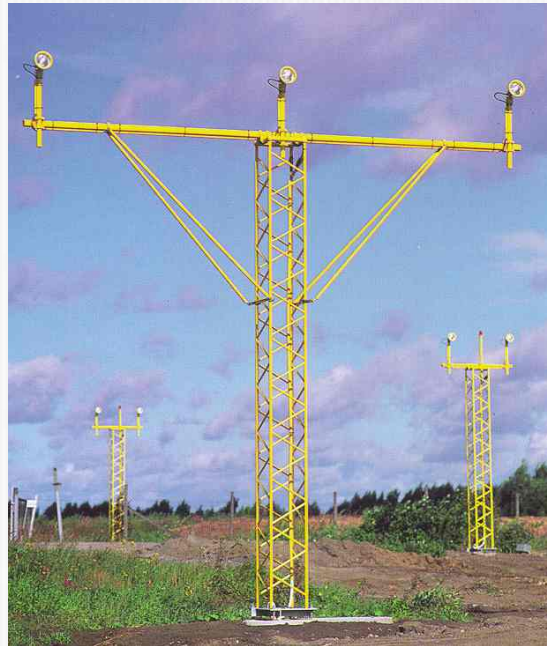


# 02L and 20C -Barrette Approach (Cat II & Cat III)





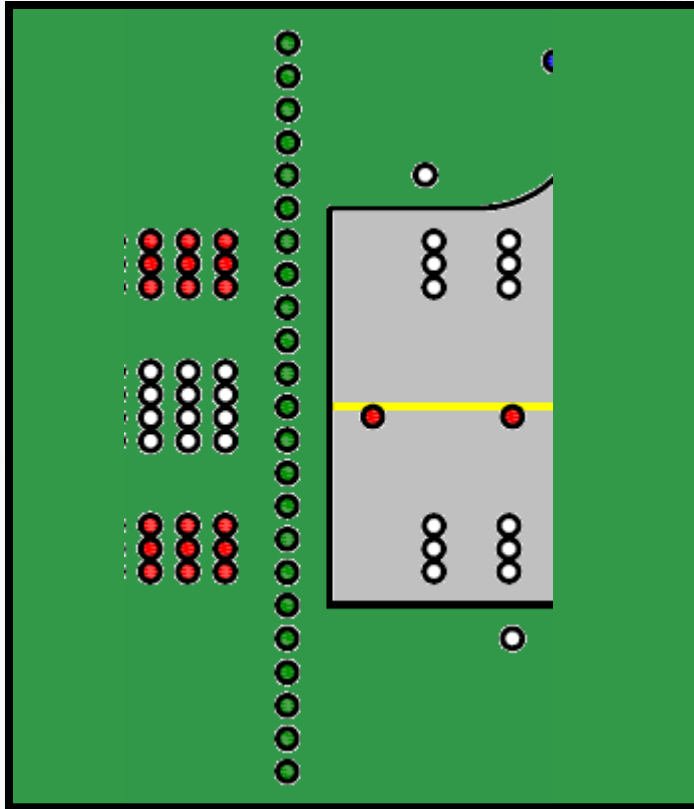
# Approach Lighting System





## 2. Runway Lighting System

# Threshold



Green in colour

Indicate start of the available landing distance

# Threshold

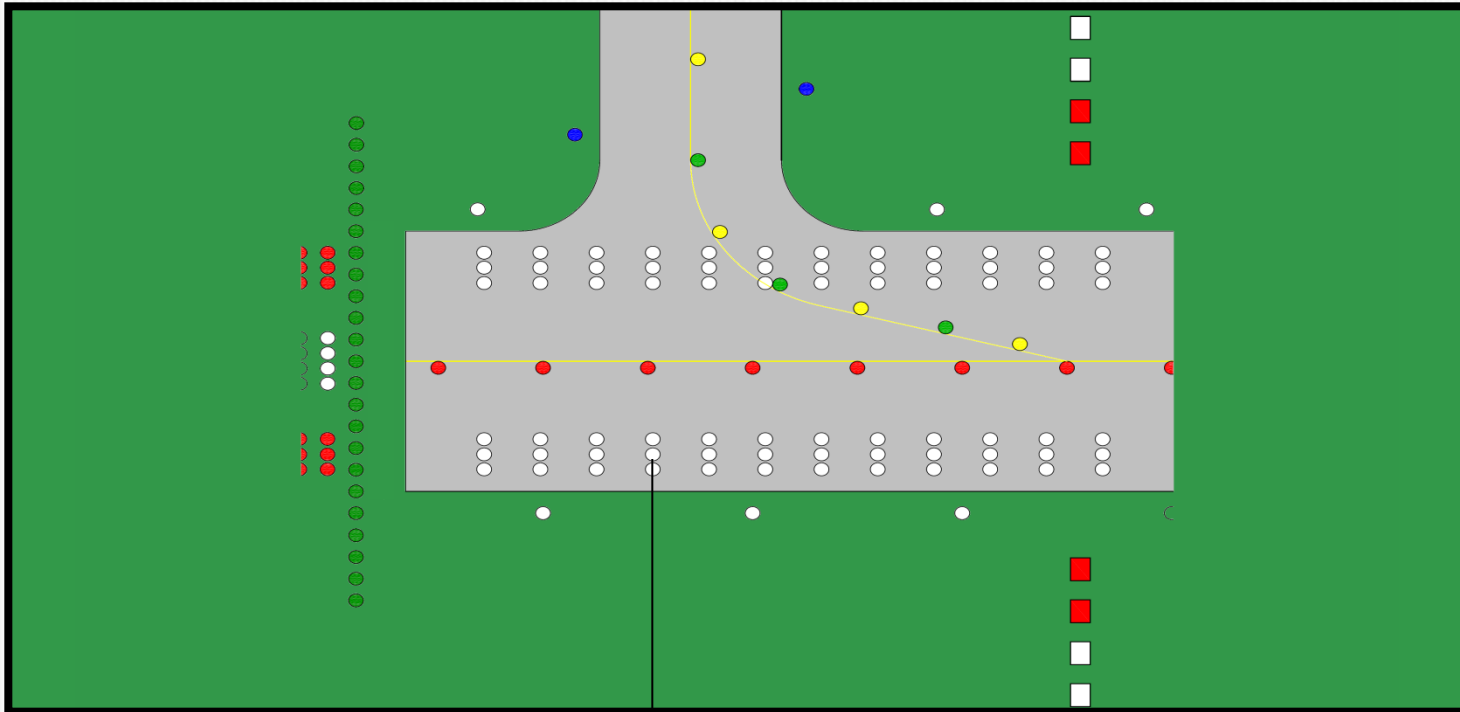
## *Inset Lights*



## *Elevated Lights*



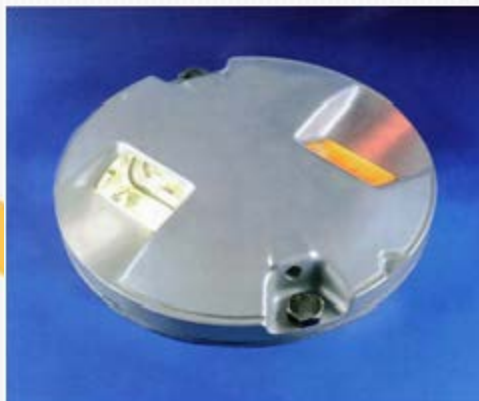
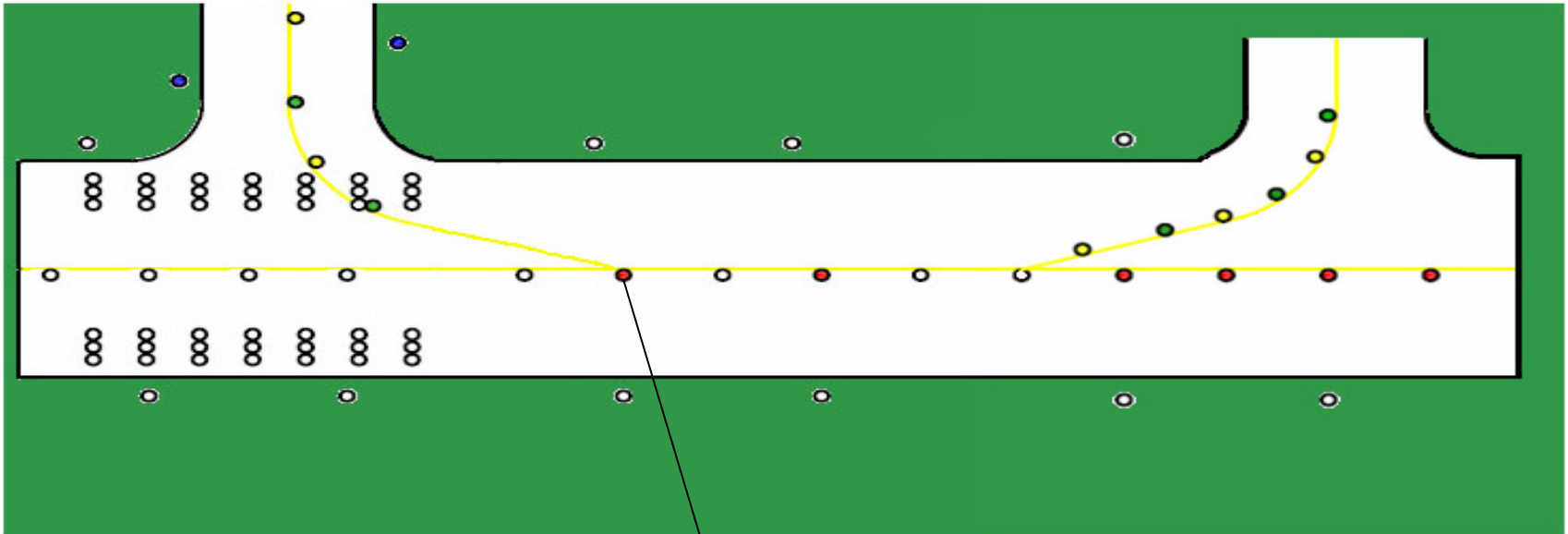
# Touch Down Zone



- Turn on only during Cat II
- 900m from the threshold
- 30m apart



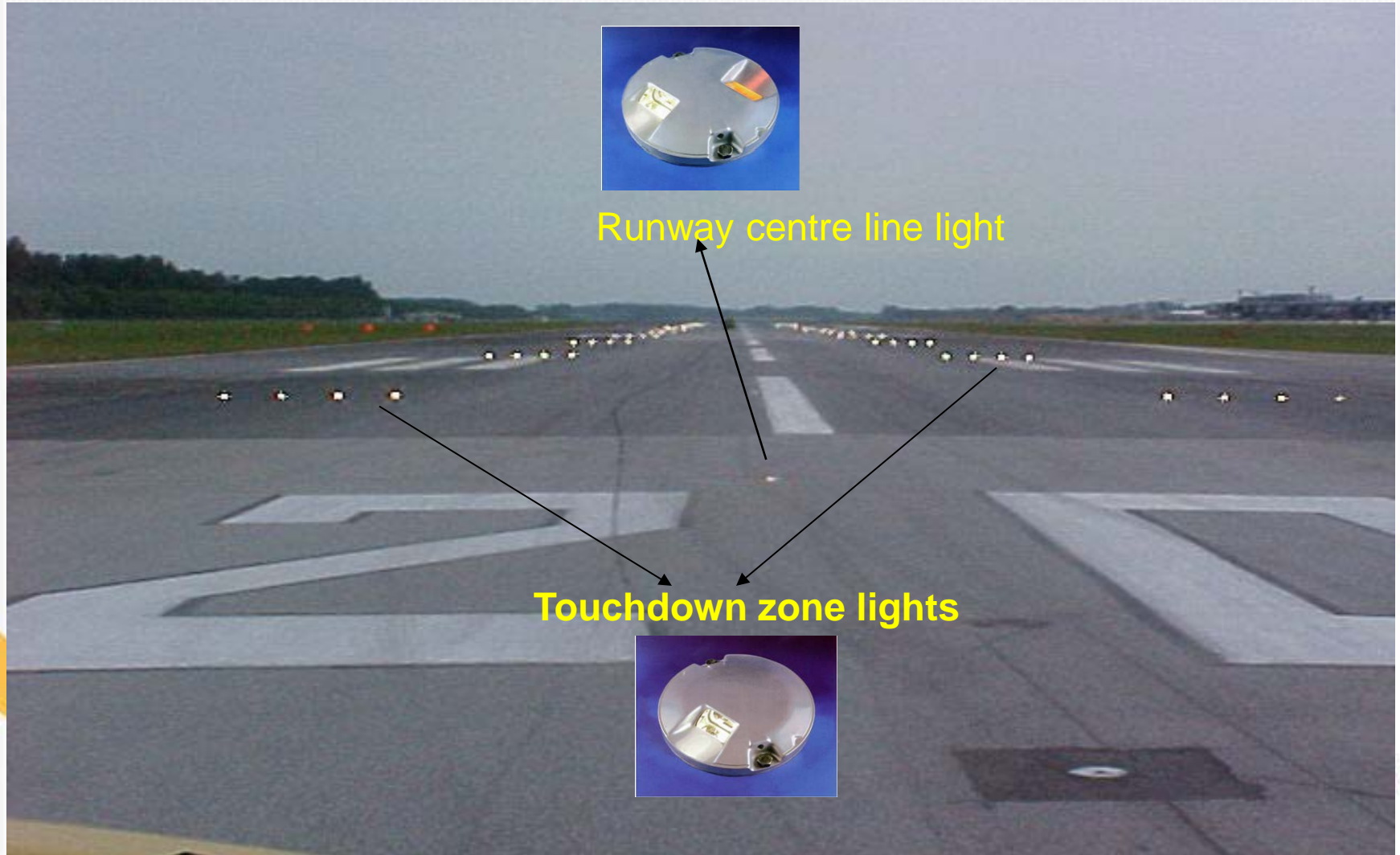
# Runway Centre Light



- Bi-directional inset lights
- Fitted 30m apart
- Landing : using white lights
- Take off : alternate between red/white for the initial 600m and red for the last 300m from the end of runway



# Runway Centre Line & Touchdown Zone



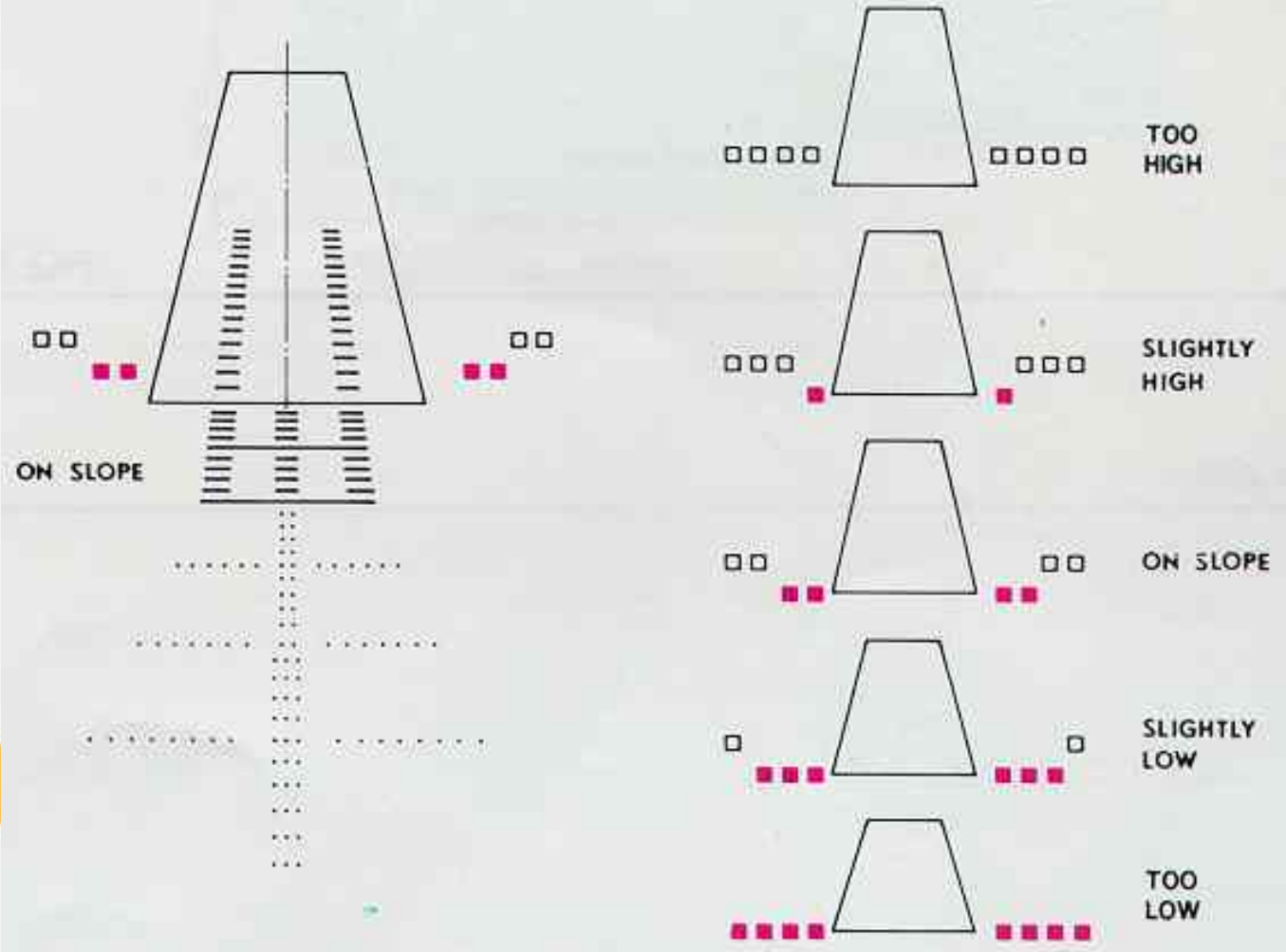
# Precision Approach Path Indicator (PAPI)



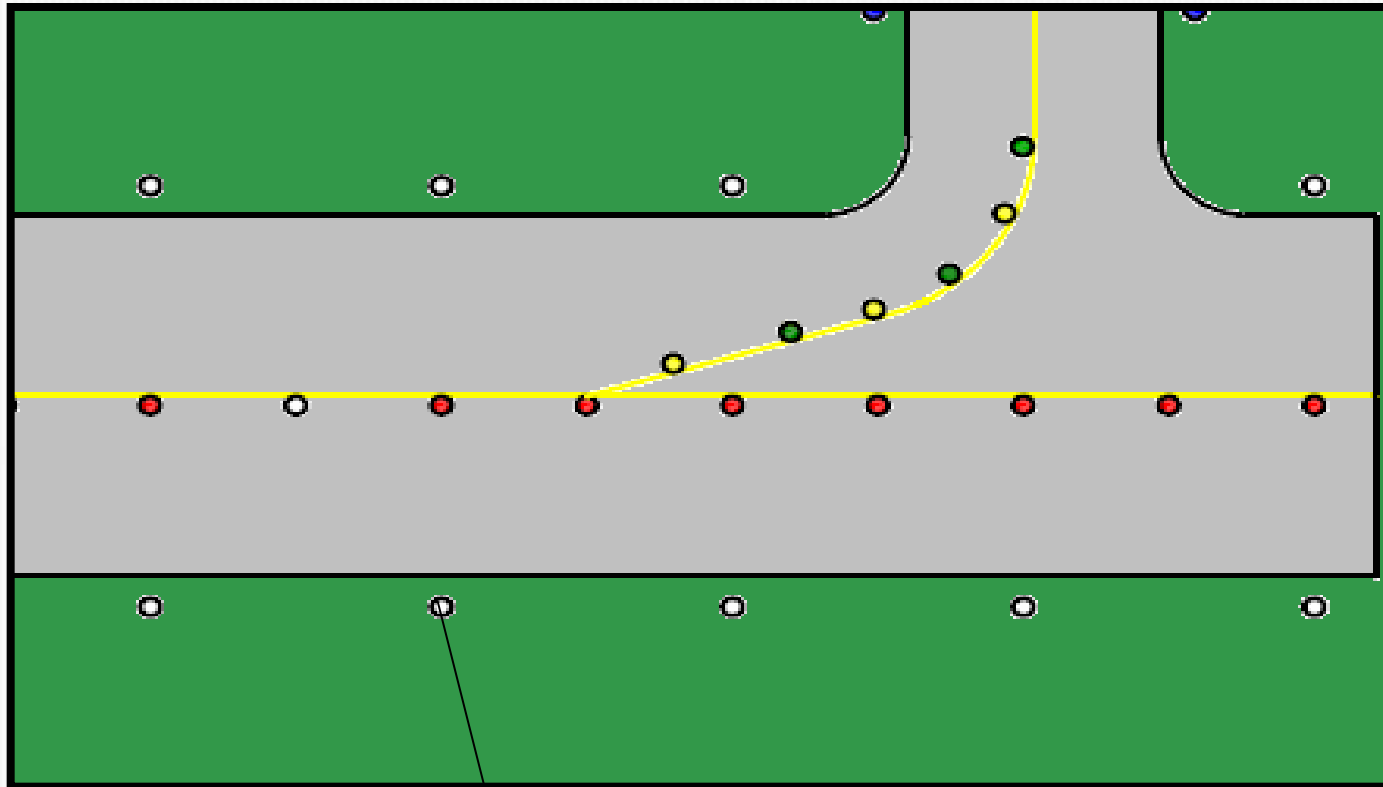
Provides visual guidance to pilots to achieve correct approach slope of 3° during landing

# PAPI

## WHAT THE PILOT SEES



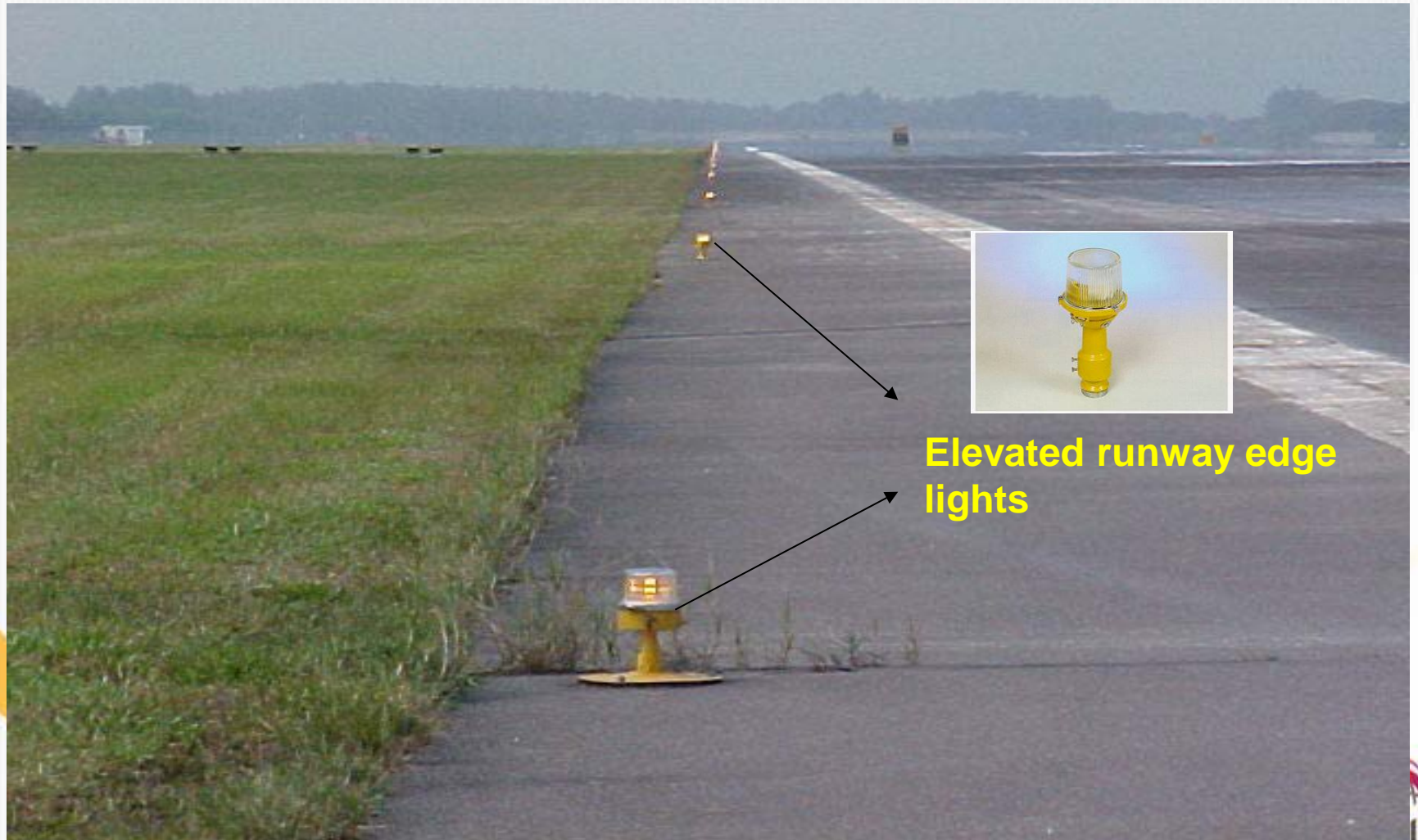
# Runway Edge



- Elevated Light
- Placed 60m apart
- White lights
- Yellow lights for the last 600m from runway
- Two rows of lights equidistant from runway centreline



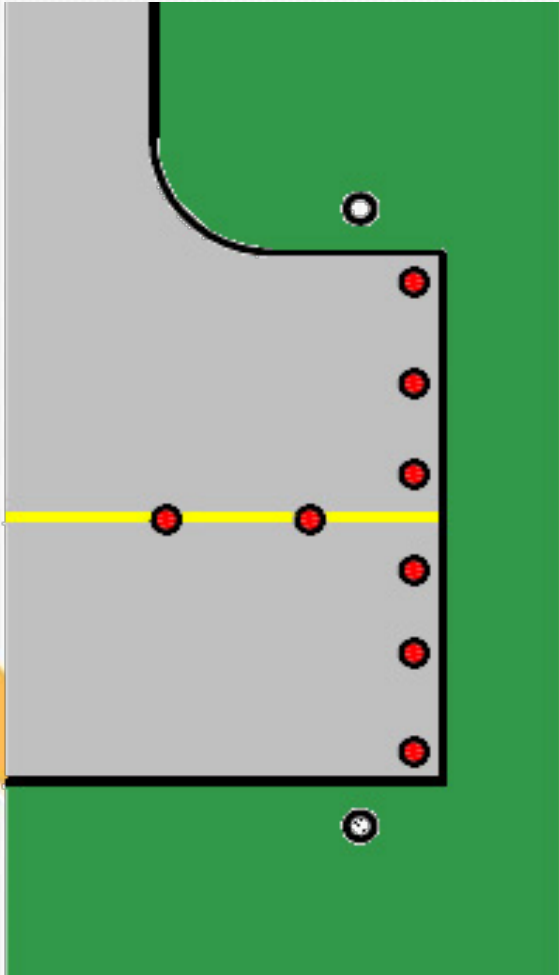
# Elevated Runway Edge



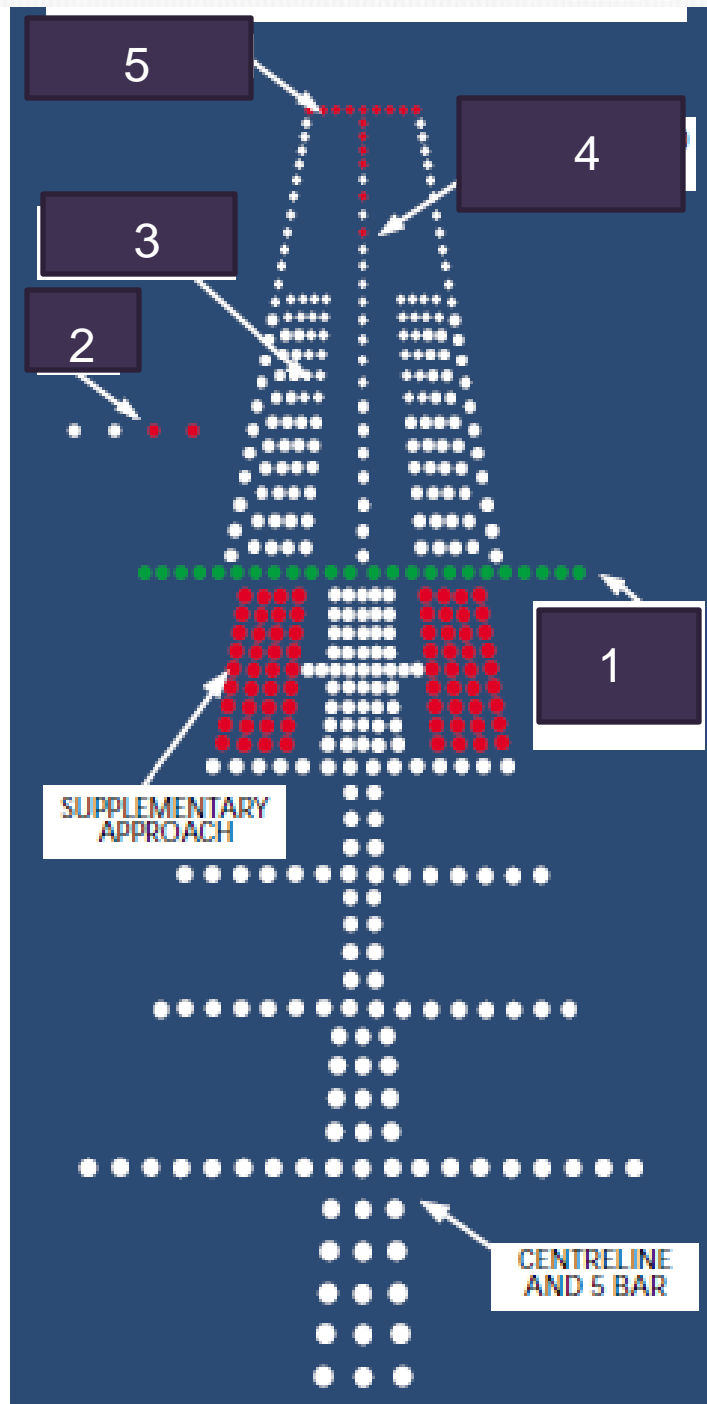
**Elevated runway edge lights**



# Runway End



Red in colour  
Indicates end of runway





# 3. Taxiway Lighting System



# TAXIWAY INSET LEAD-IN



Taxiway inset lead-in lights



# TAXIWAY EDGE LIGHTS / REFLECTIVE MARKERS



Taxiway Reflective Markers

Taxiway edge lights



# ✦ Guidance Signs

*Runway Sign – White on red background*



*Taxiway directional guidance sign – Black on yellow background*



PVO-Information Sign

FIG. 1

*Taxiway location sign – Yellow on black background*



PVO-Location Sign

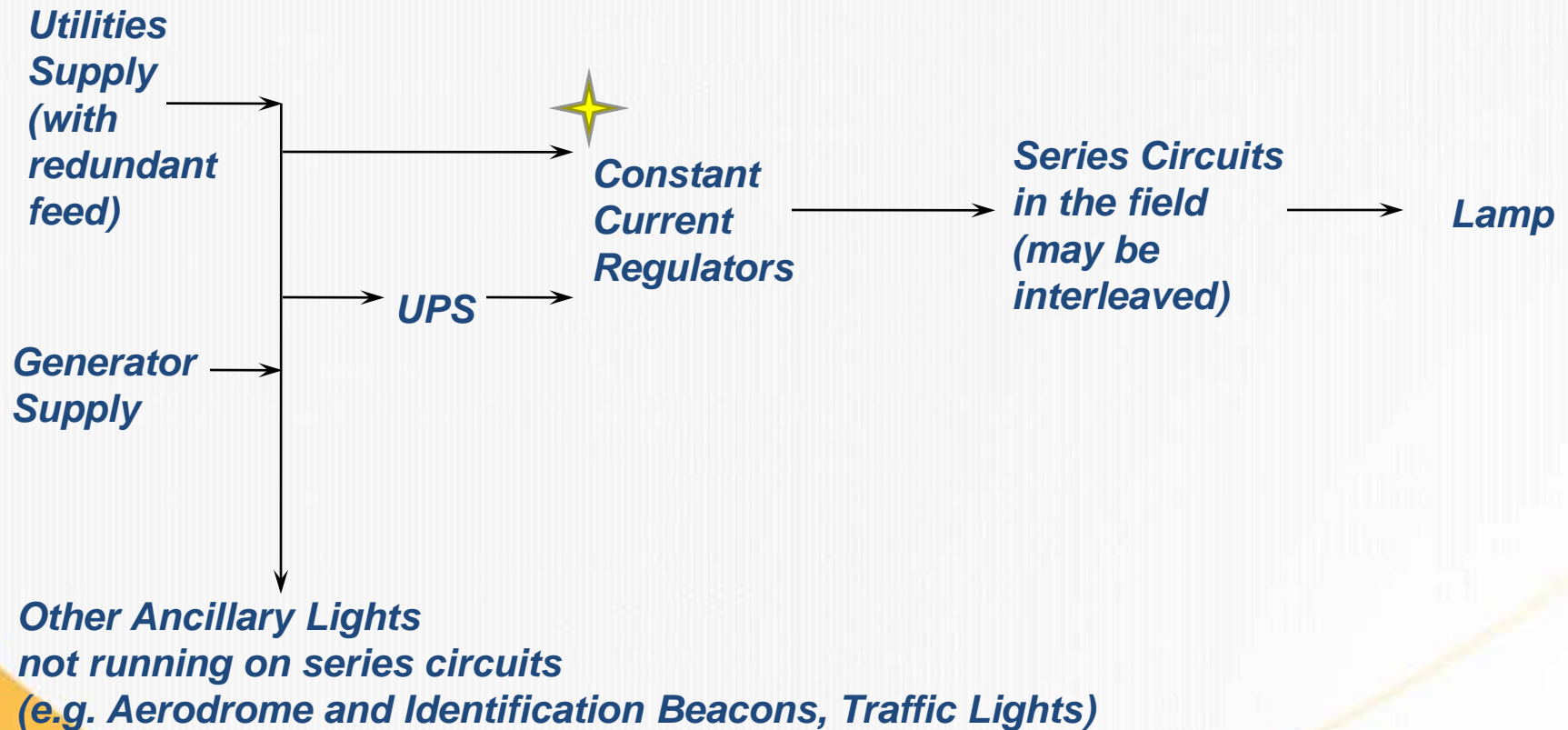
FIG. 2

Video on Introduction of the Airfield Lighting System

# Electrical Supply for Airfield Lighting Systems

# Electrical Supply

- Power Distribution



CAT I – require switch over time of 15 second

CAT II – require switch over time of 1 second

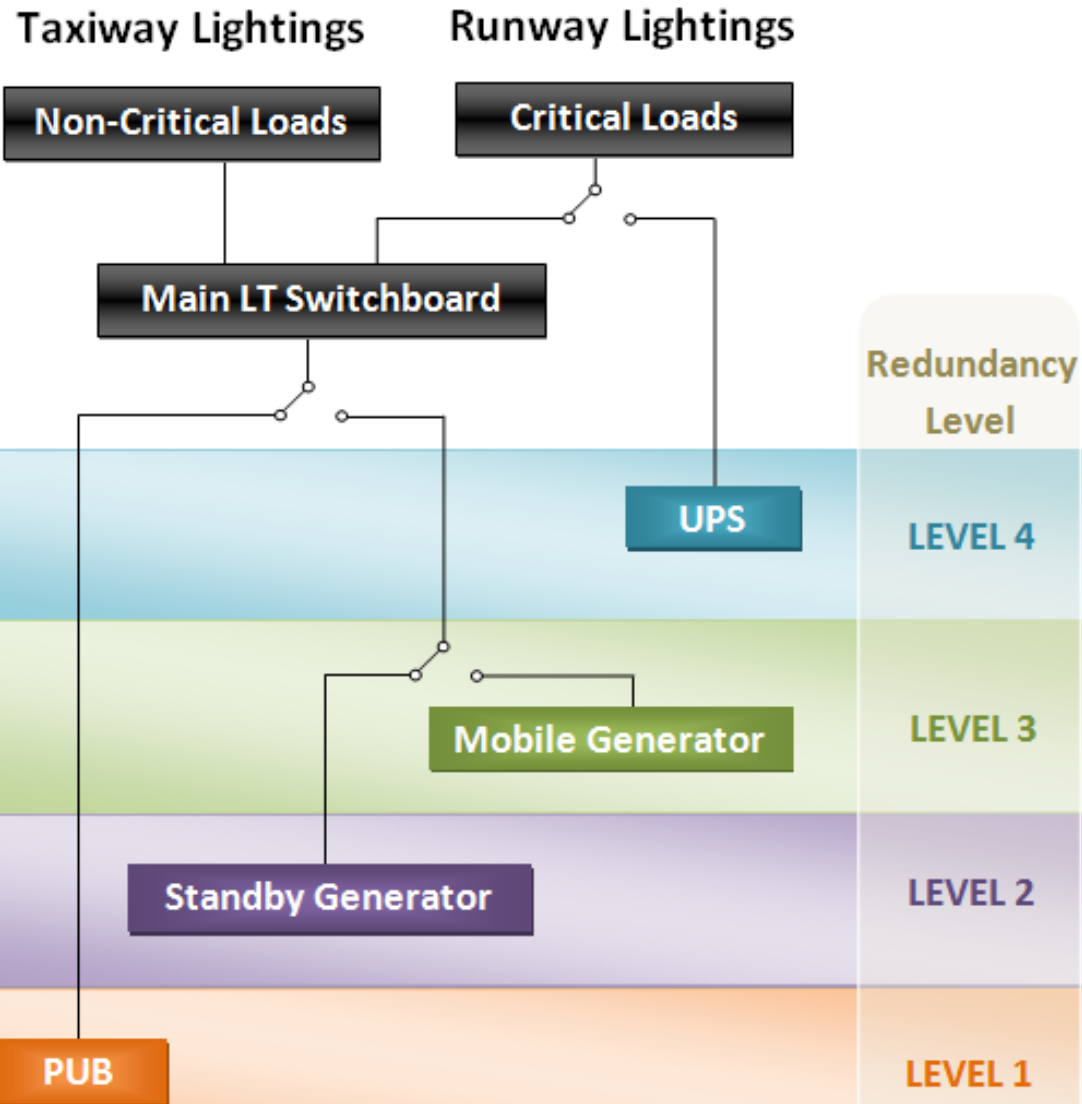


# ✦ Constant Current Regulator

- Provide constant current throughout the entire airfield lighting circuit
- Provide uniform lamp brightness throughout even in long distance circuit
- Enable ease of brilliancy control for airfield lights



# Power Distribution and Redundancy for Critical Systems



# Electrical Supply (Changi)



*Mobile generator*



*standby generator*

# Airfield Ground Lighting Control and Monitoring System (AGLCMS)



# ✦ Introduction to AGLCMS

Primary Purpose:

- Remote control of taxiway & runway airfield lights at Control Tower
- Monitoring of airfield lights and related equipment at Control Tower
- Features include:
  - Taxiway lighting control
  - **Individual lamp control and monitoring for runway lights**
  - Aircraft position display on the lighting control panel



Control panels installed in the Control tower



Operations in the Control Tower

# Runway Lighting Circuits

## LEGEND

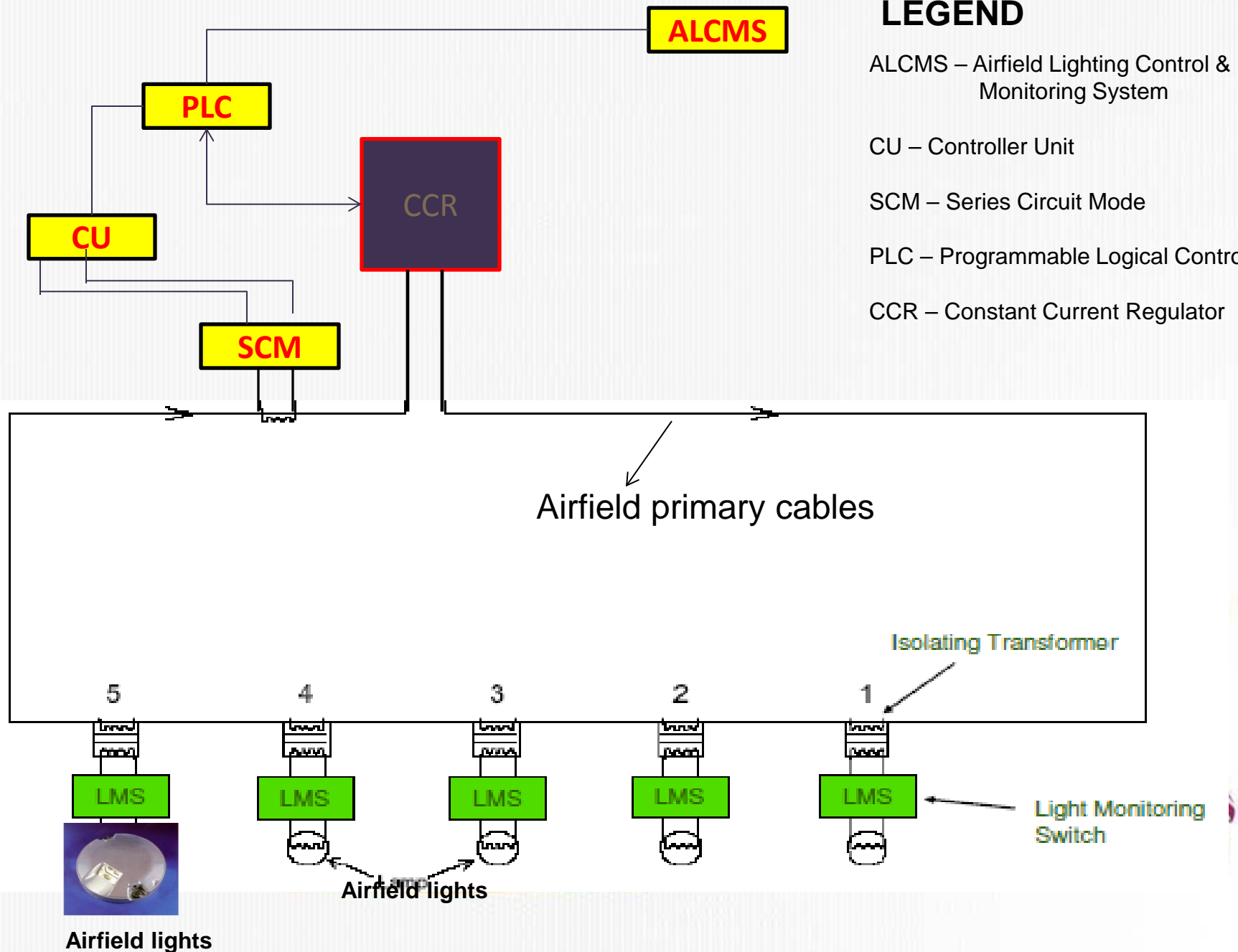
ALCMS – Airfield Lighting Control & Monitoring System

CU – Controller Unit

SCM – Series Circuit Mode

PLC – Programmable Logical Controller

CCR – Constant Current Regulator





# AGLCMS GUI Display

The screenshot displays the AGLCMS GUI interface. At the top, it shows the current UTC time as 13:41:02. The main area is a radar map of the airport, showing various runways, taxiways, and terminal buildings. The map is overlaid with radar tracks and various data points. A yellow arrow points to the 'UTC Time' label on the map. Another yellow arrow points to the 'Radar Tracks' label on the map. A third yellow arrow points to the 'Alarm List' label on the map. A fourth yellow arrow points to the 'Alarm List' table at the bottom of the screen.

**UTC Time**

**Radar Tracks**

**Alarm list**

Unackn. Alarms	Ackn. Alarms	Repaired	Group	ID	Text
!	Created	Deactivated			
!	2013-06-05 02:22:51			Sb_E6_ClassB	Stop bar E6 is U/S (3 or more lamps in error)
!	2013-06-05 02:22:38	2013-06-05 02:22:43		Stopbar_W9_Sensor	Sensors at stop bar W9 are U/S. Incursion detection not possible
!	2013-06-05 02:22:35			Stopbar_E10_Sensor	Sensors at stop bar E10 are U/S. Incursion detection not possible
!	2013-06-05 02:22:34			Stopbar_W1_Sensor	Sensors at stop bar W1 are U/S. Incursion detection not possible
!	2013-06-05 02:22:04			App_02L_Pattern_Error	APP 02L is U/S (Misleading Pattern)

Buttons at the bottom: Alarm List, Miscellaneous, Select Control, Display Options, Auto Route/Guide, Reposition Map, Views, A/GC Modification

Screenshot of a full airport display on the AGLCMS monitors.

# Manual route creation by selecting the starting and ending nodes

02L/20R: 02L CAT I    02L CAT I    02L CAT II    20R CAT I    01:35:42 UTC    02C/20C: 02C CAT I    02L CAT I    20R CAT I    02C CAT II

Enable Control    02L T0    02L LWT0    20R T0    02L T0    20R T0    02C T0    20R T0    02C LWT0

Rwy1

Execute selected route

Select 1st Node

Select 2nd Node

Route Window

#OR Off	Multiple Starts	Clear Route Point	Modify Route	Code F Restriction	Stop Bar Control	List	
Execute	Multiple Ends	Clear Selection	Split Route	Route Point Editing	All Routes Off	Closure Restriction	Edit Segment Cost

Max Wingspan 65m

Max Wingspan 61m

TERMINAL 2

TERMINAL 3

SASC0

W6 2600    W7 3050    W8 3850

FIRESTATION 1

Alarm List    Miscel-laneous    Select Control    Display Options    Auto Route/Guide    Reposition Map    Views    #OR Notification

# User Panel for Control of Brilliancy Level of AFL

The screenshot displays the 'Light Details 02L' user panel. It features a grid of controls for different lighting systems, each with an up/down arrow and a numerical value. The 'ALL' control is highlighted in yellow.

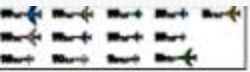
Control	Value
SFL	10
TIL	10
CGL	100
PAPI	10
TDZ	0
ASB	0
APL	3
THR	3
EDGE/END	3
RCL	3
ALL	3

Additional controls include: CAT II, Close Runway, Keep DIM, Pilots View, Show All Ctrl., Inspection (RWY), Master (WDI, RGL, Military/SASCO RGL, Beacon), TEL All, TEL (10), RET/LON (10), RSB (10), and Generators (02L/20R, NA).

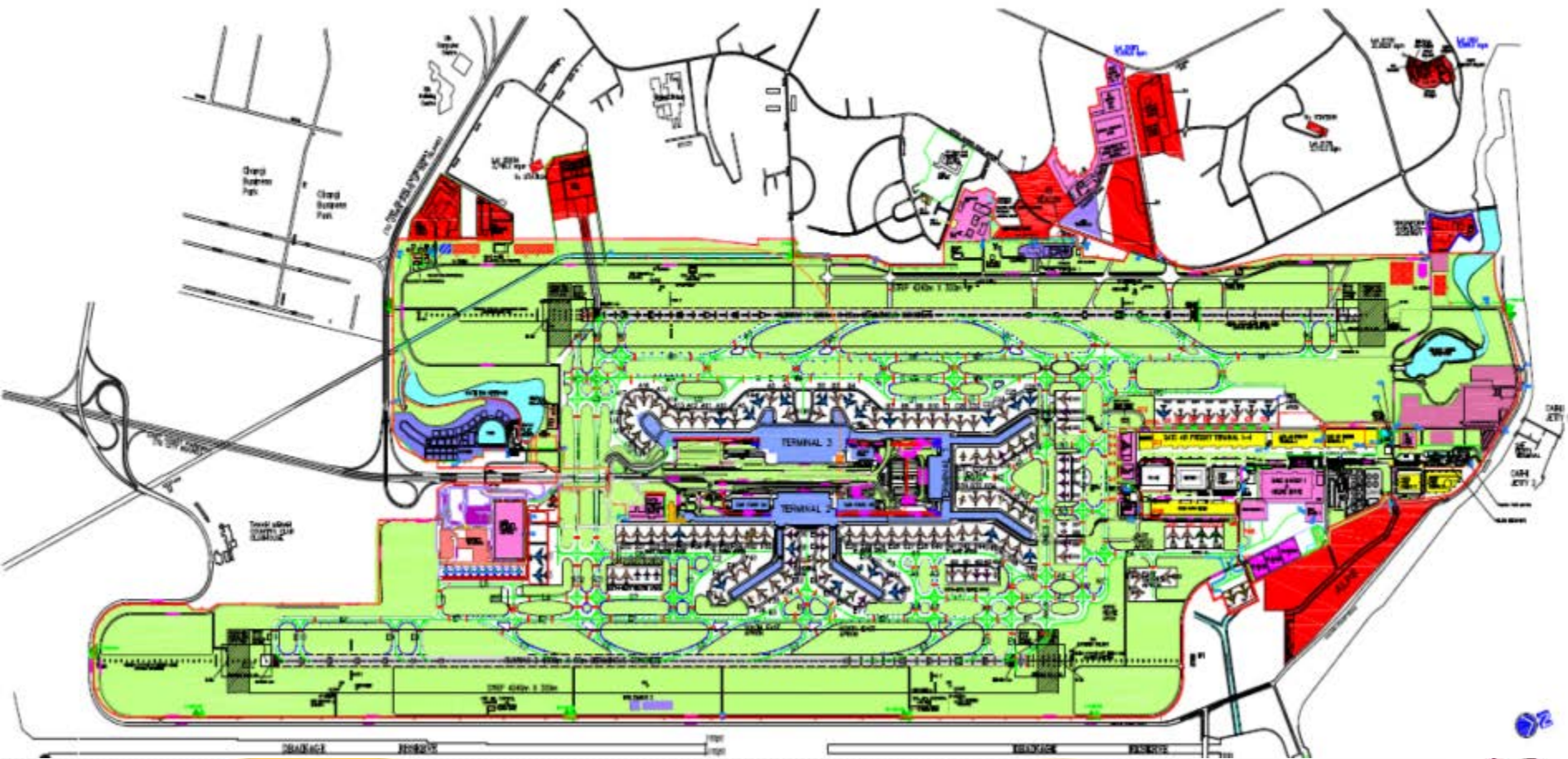
Control of the brilliancy level of the airfield lighting can be stepped up/down via the AGLCMS.

# Runway Inspections and Maintenance





# LAYOUT OF CHANGI AIRPORT





# Runways Inspection and Maintenance

- 5 inspection closure per day per runway
  - 3 slots of 5 minutes
  - 1 slot of 10 minutes
  - 1 slot of 15 minutes
  - Inspect runway lightings, pavement & marking condition and FOD
  - Replace faulty light fittings if time permit, otherwise mark out and replace during daily night maintenance closure
- 1 night maintenance closure per night per runway
  - Closure duration- 1.5hrs/runway
  - Carry out faulty lights replacement, minor AFL fault rectification, runway marking painting and minor pavement defect rectification

# Maintenance Activities

AFLCC works



CCR calibration

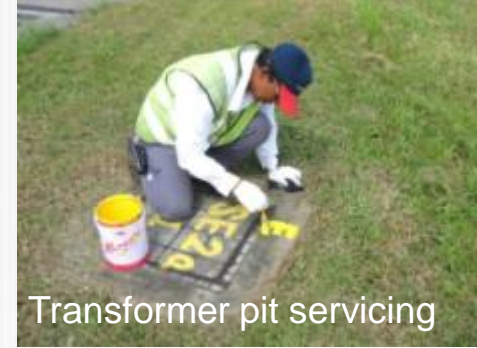


Fire protection

Airfield lighting cabling and pit servicing



Cable ducting works



Transformer pit servicing

Airfield lighting installation, taxiway sign and traffic light works



Runway light replacement



Airfield sign maintenance



Traffic light inspection



Pavement marking

Aircraft pavement maintenance



Runway pothole repair



Localised resurfacing

Airside inspection and FOD handling



Tyre carcass FOD



Bird strike handling

# ***AFLCC Inspection***

***standby generator***



***UPS***



***Megger  
primary  
cables***

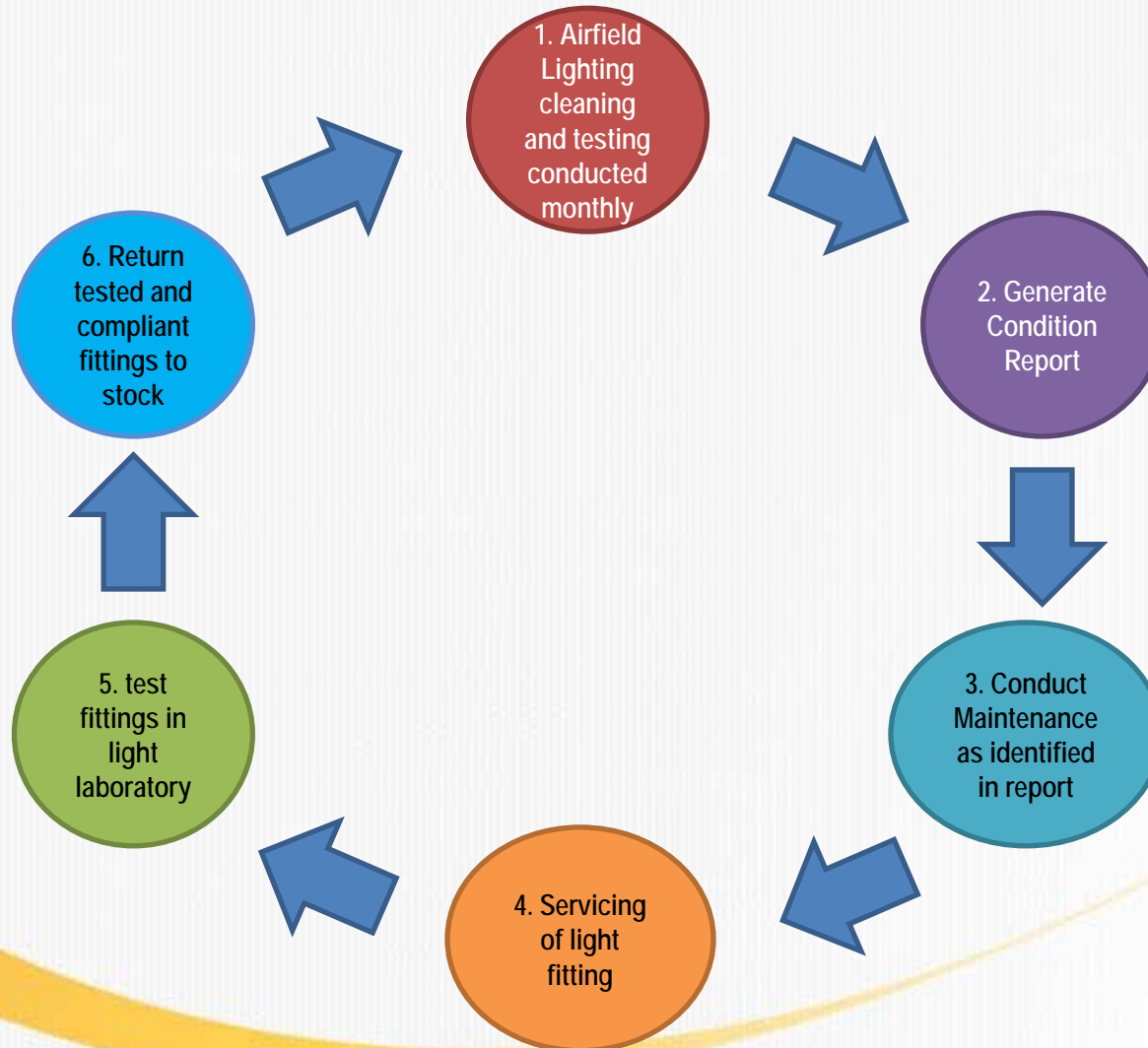




# Challenges faced

- Once a system has been installed, its usefulness is dependent on:
  - Its Serviceability
  - Effectiveness of the maintenance work carried out
- A light is deemed to be unserviceable when the main beam average intensity is less, than 50% of the value specified for that of a new light
- The Total degradation of light output can be attributed to:
  - Contaminants inside and outside the fittings
  - Degradation of optical components
- Limited access time to runways

# Airfield Lighting Maintenance Cycle





- Carry out scheduled AFL and Civil PM, BM and IM works
- Cleaning and tightening of runway inset lights
- Runway lights photometric testing

1. Airfield  
Lighting  
cleaning  
and testing  
conducted  
monthly





3. Conduct  
Maintenance  
as identified  
in report

4. Light  
fitting  
overhaul

## Servicing of Light fitting

- Light fitting(s) is removed from service due to serviceability levels
- The fitting undergoes an overhaul where any faulty or worn components are replaced. The lamp is also changed and the fitting fully cleaned
- Undergo water tightness test



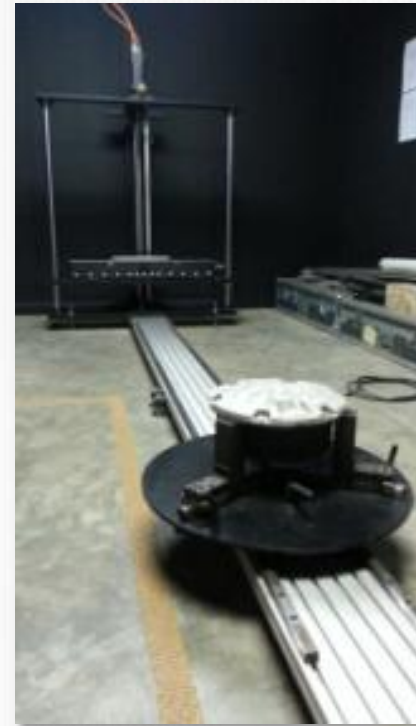
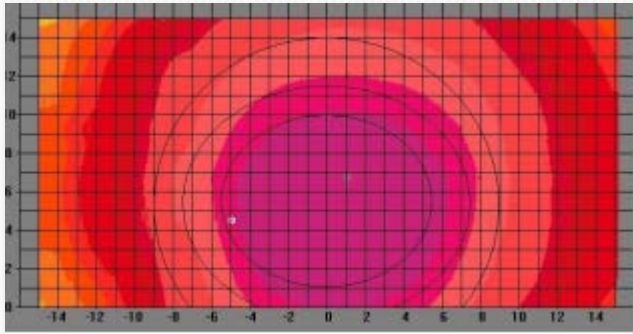
# Servicing of Light Fitting





# Photometric Test

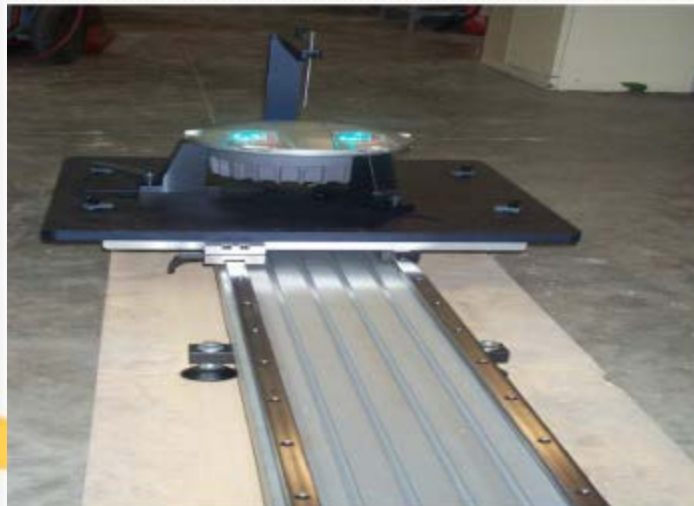
- The photometric laboratory enables to prove light fittings compliance to regulatory requirements
- Conducted in 'Darkroom'



- A report will be generated containing results for that particular fitting along with that are prescribed by the relevant requirements



## *Photometric testing inside the Darkroom ....*



## Returning to stock

- Once the light fittings have passed all testing requirements they are placed into the spares store ready to be installed as fully serviceable compliant light fittings for reinstallation required at a later date.



# Thank You