Egyptian
Atomic Energy Authority

Paper Title

A Proposed Design for Illumination and Cameras Surveillance System for Optimum Supervision at a Perimeter Area of Nuclear Facility

ICONS2020

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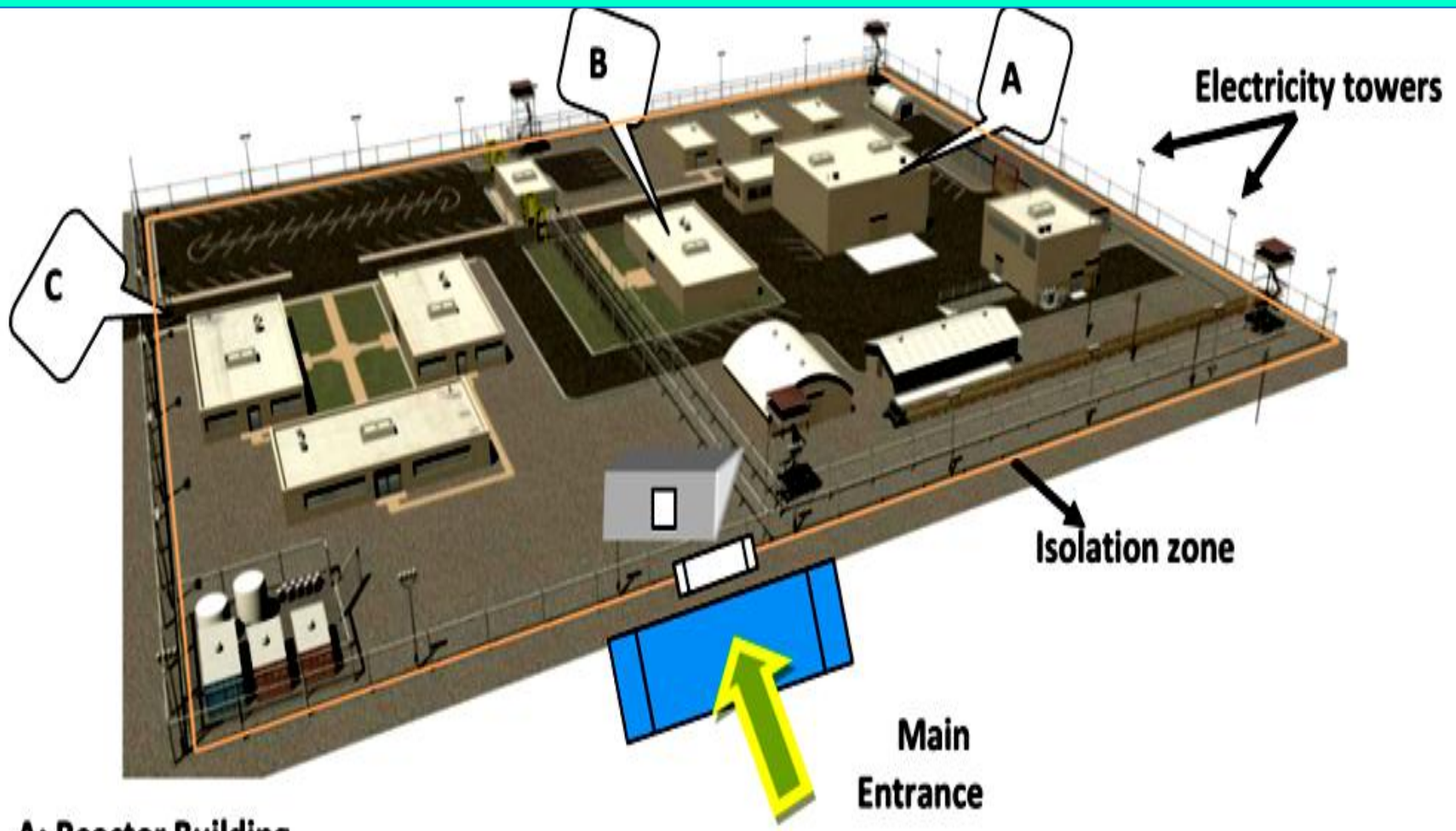
Introduction

The nuclear facilities which have big site; like Research Reactors Complexes have an **Isolation Zone (IZO)** surrounded by **double fences long distances (km)** around the perimeter areas of the facility.

- **IZO** are the first Security barriers against the adversaries , and works **like a skin** for human body so, it very important, further,
- **IZO** contains the Intrusion Detections Systems and surveillance camera system for early detection and alarm assessment.

Surveillance Camera System and Guards on-site needs suitable illuminations for monitoring the perimeter areas.

Research Reactors Complexes



A: Reactor Building

B: Isotope Production Facility

C: Fuel Manufacturer Plant

Many types of Cameras

- IP/IR cameras
- Day &Night
- Thermal
- High sensitivity

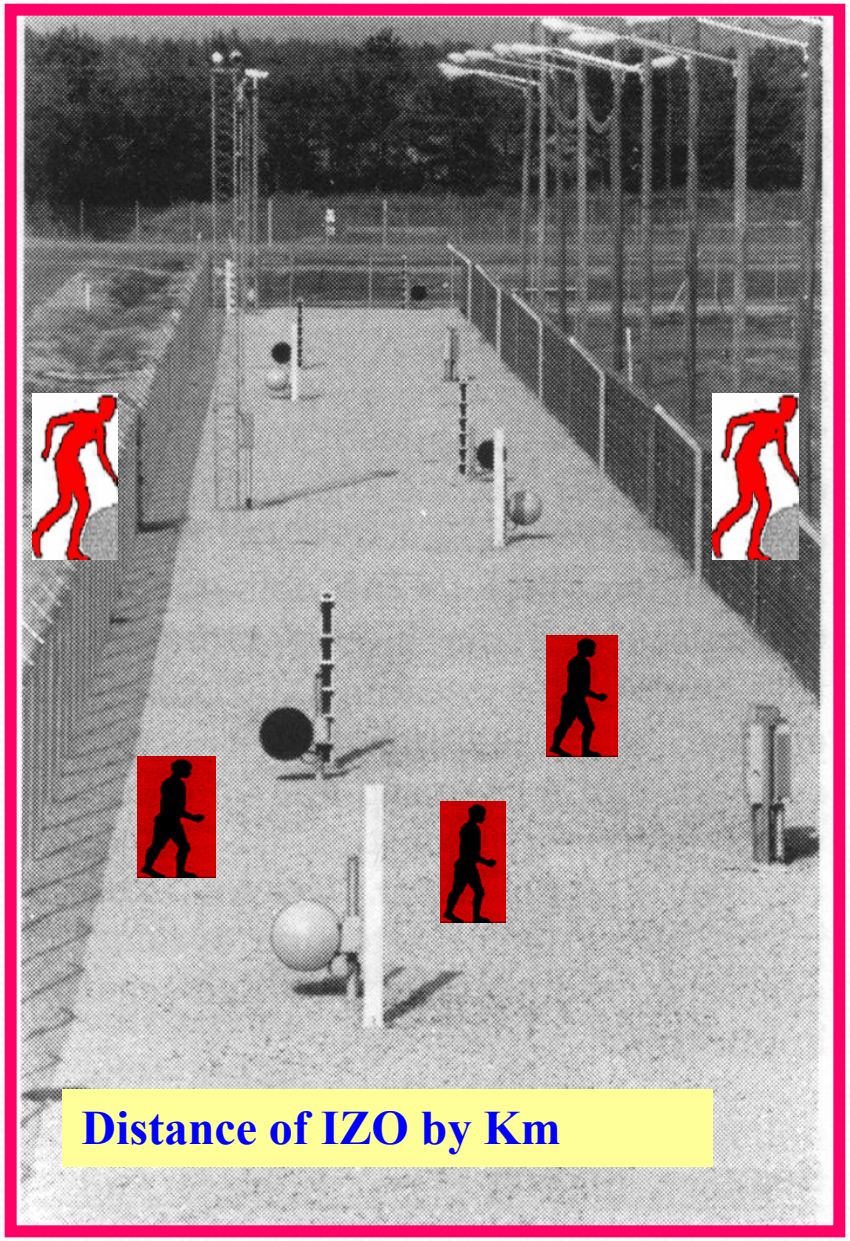
Many different Types of Lampas

- Fluorescent
- Incandescent
- Mercury Vapor
- Metal Halide
- High Pressure Sodium (HPS)
- Low Pressure Sodium (LPS

The long distances of IZO forms a challenge because it needs:

Big Numbers of Cameras and Lamps units . It costs us a lot

(IZO) at Perimeter Area



Determination of optimum cameras and light, and using of a suitable light and cameras, and exact numbers

this will save and reduces the cost,

if select a regular and low cost cameras and Exact light this will

- ❑Reduce the installation cost
- ❑Reduce maintenance cost and Running cost

This Paper Presents:

- **The Exact and calculations for IZO**
  - ❑Sufficient illumination and Lux amount needed
  - ❑Determination of Suitable type of Security light
  - ❑Cameras Parameters Calculations
  - ❑Tech., Specifications for Light pulps and Cameras

Determination of Suitable Security light

Many different types of lamps used in modern protective lighting systems

Depends on some factors

- **Fluorescent (high flicker rate)**
- **Incandescent**
- **Mercury Vapor**
- **Metal Halide**
- **High Pressure Sodium (HPS)**
- **Low Pressure Sodium (LPS)**

Requires special disposal methods and it is Tend to Distort colors

Some factors must be considered in selecting lamp type such as:

- **The lumens per watt**
- **Color Rendering**
- **Focusing Capability**
- **Warm-up Time**
- **Restrike Time**
- **Flicker Rate وميض**
- **Lamp Life**

In this paper presents a comparison between different types of lamps to select the suitable and optimum lighting for cameras surveillance systems, each of fluorescent and LPS types , are

Comparison of Lamps Types Properties

Property	HP Sodium Lamps	Metal Halide	Mercury Vapor	Incandescent
Watt	35-1000	50-2000	40-1250	To 3000
LM/Watt	80-140	80-100	45-63	10-38
Warm up time	2-5 Minute	5-8 Minute	5-8 Minute	0 Minute
Restrike Time	1 Minute	10-20 Minute	10-20 Minute	0 Minute
Color Rendition	Fair to Good	Excellent	Fair to Good	Excellent
Focusing	Good to Excellent	Good	Good	Good to Excellent
Cost	Medium	High	High	Low
Lamp Life	2.5-6	1.3-5	3-6	0-25-0.875

According the comparison between lamps types and depending factors: HP lamps are the suitable light for the IZO at perimeter area

Isolation Zone Illumination Calculations

IZO Length=1180 meters, Wide=10meters, the equations of

- **Poles Span "S ":** Distance between two Electric Poles

S /2 = 2 (1.05H), H=8 from Isolox curve of light distribution

S = 4 (1.05H) = 4 * 1.05*8 = 34 meters

- **Total Number of Poles =IZO Length/ Pole's Span**

No of Poles = 1180meters /34 meters = 35 Poles

- **Average Lighting Level Calculations**

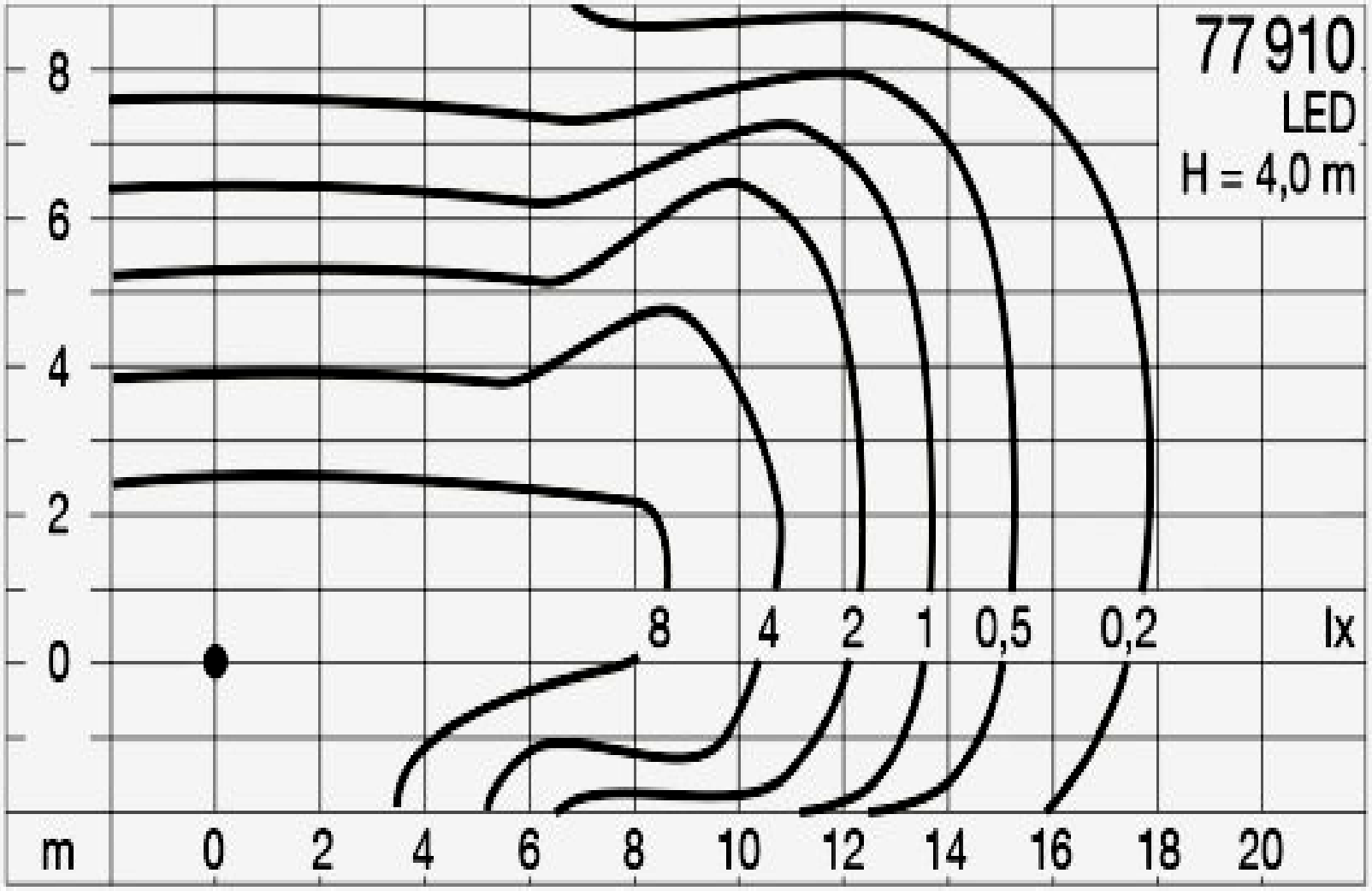
Eav= (U.F* M.F* Lumen) / (D* W) ,

Eav : (Average Lighting Level)
D : Distance between two poles in meter **W** : Area width in meter
Lumen : Flux per lamp (26000 from the selected lamp characteristics)
U.F : Utilization factor (= 0.35 from utilization curve)
M.F : Maintenance factor (= 0.8 from selected lamp characteristics)

Results: Average Lighting Level (E_{av}) = 21 Lux equivalent 250watt

Minimum Lighting Level (E_{min}) = Eav/3=7 Lux

Isolox curve of light distribution



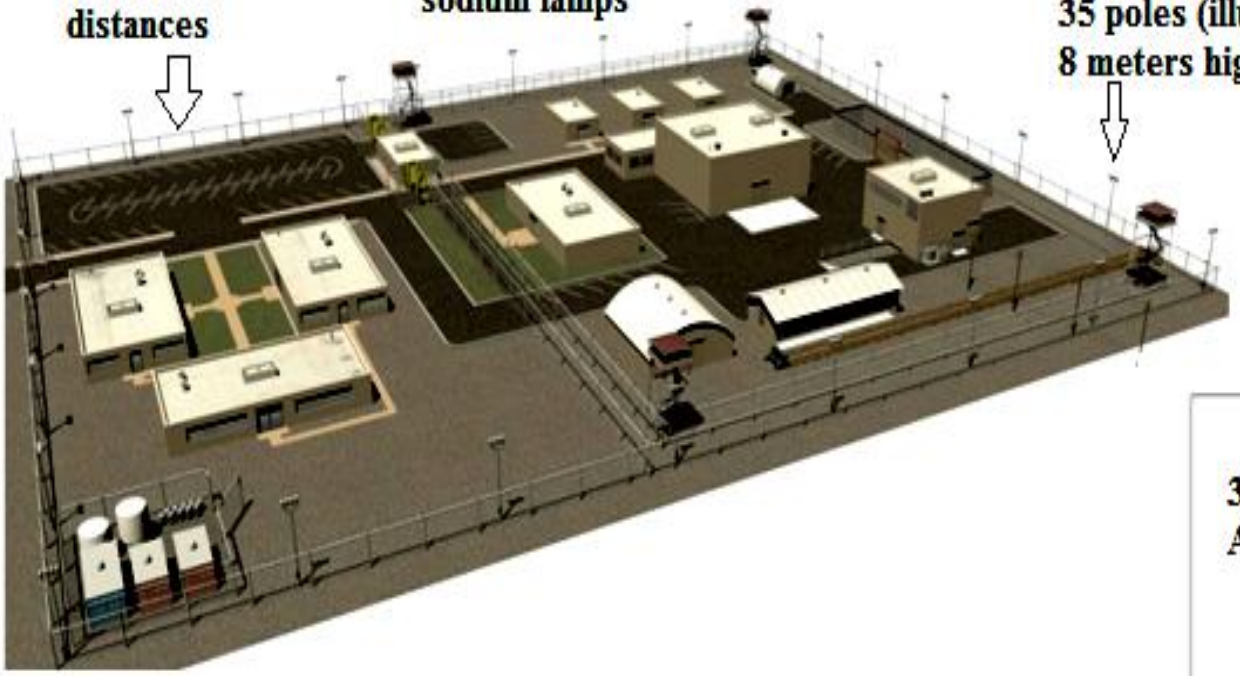
H=8

Illumination Distribution and Poles Types

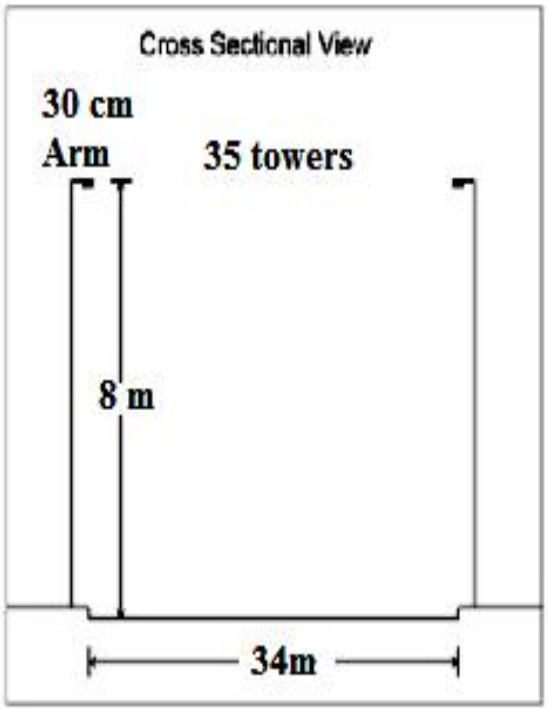
34 meters space distances

250 watts, high pressure sodium lamps

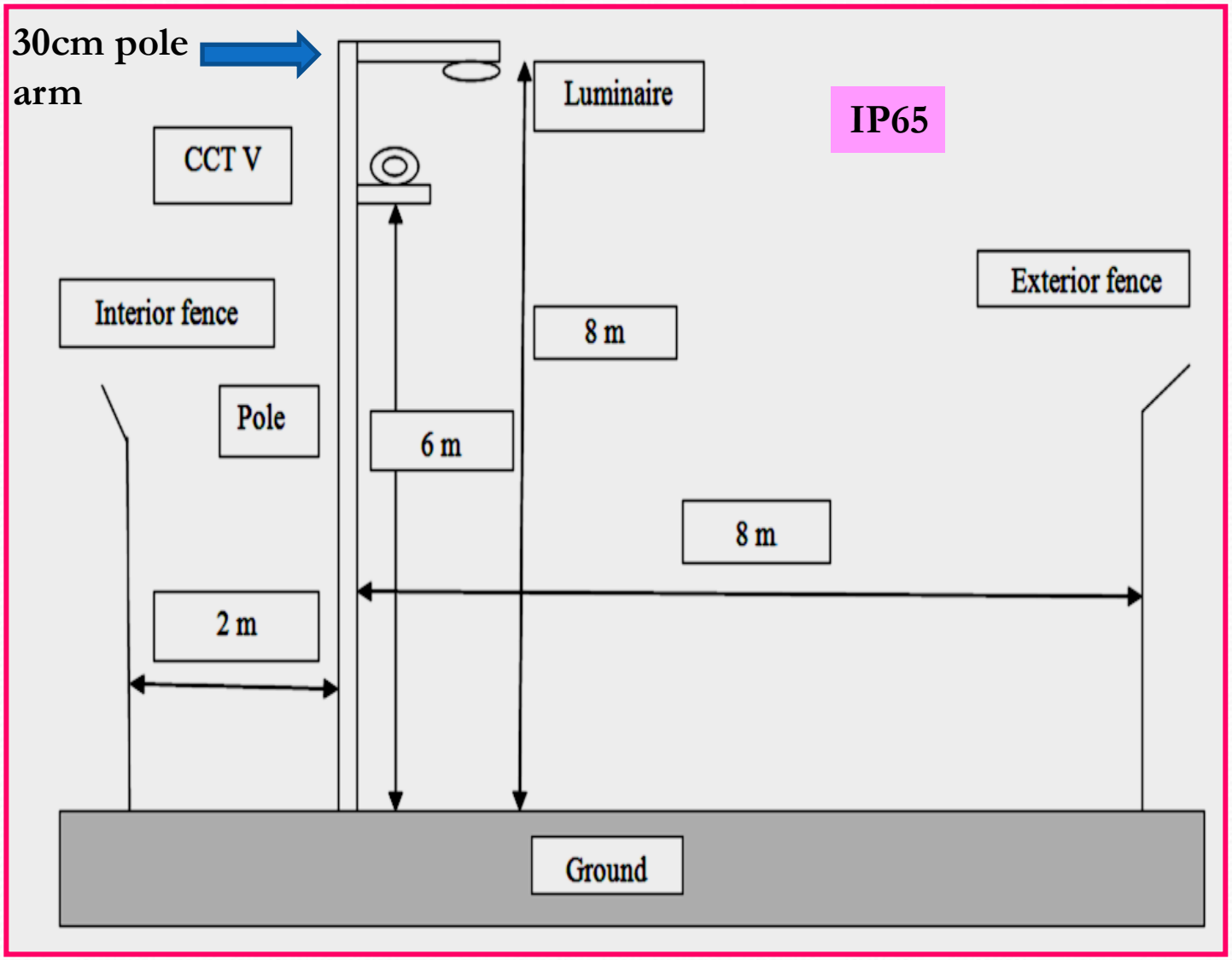
35 poles (illumination towers), 8 meters hights, 30cm Arm,



Average Lighting Level=21 Lux
Minimum Lighting Level=7 Lux
Tilt Angle=15
Lumen=28000/Lamp

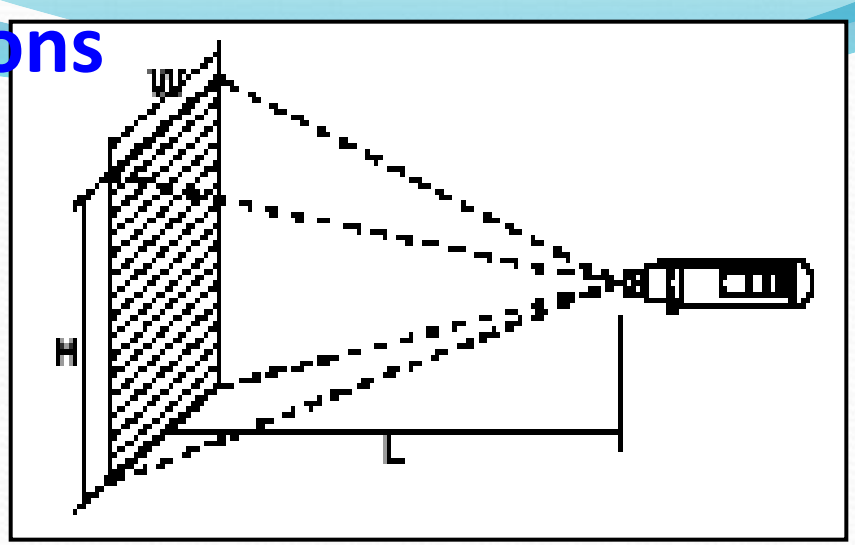


Electric Pylon Location and Dimensions



Camera Parameter Calculations

- Lens Format,
- Lens focal length calculation,
- F Stop-Number,
- Width of images sensitive area
- Angle of view calculation,



1.Lens Format of Cameras, 1/4-Inch format

2.Lens Focal Length W=3.6/f ×L (m); H=2.7/F× L (m)

f length focal lenth, W=width of subject, H=height of subject

1.F Stop-Number $=$Focal Length÷Lens/Aperture Opening in mm

Ratio between lens focal length (50mm) and aperture opening

If aperture opening is 27.7 the F-Stop = 1.8

4. Width of Images Sensitive Area: D=W (f/*w*)

5. Angle of view

$$\theta = 2\tan^{-1}\left(\frac{I/2}{f}\right)$$

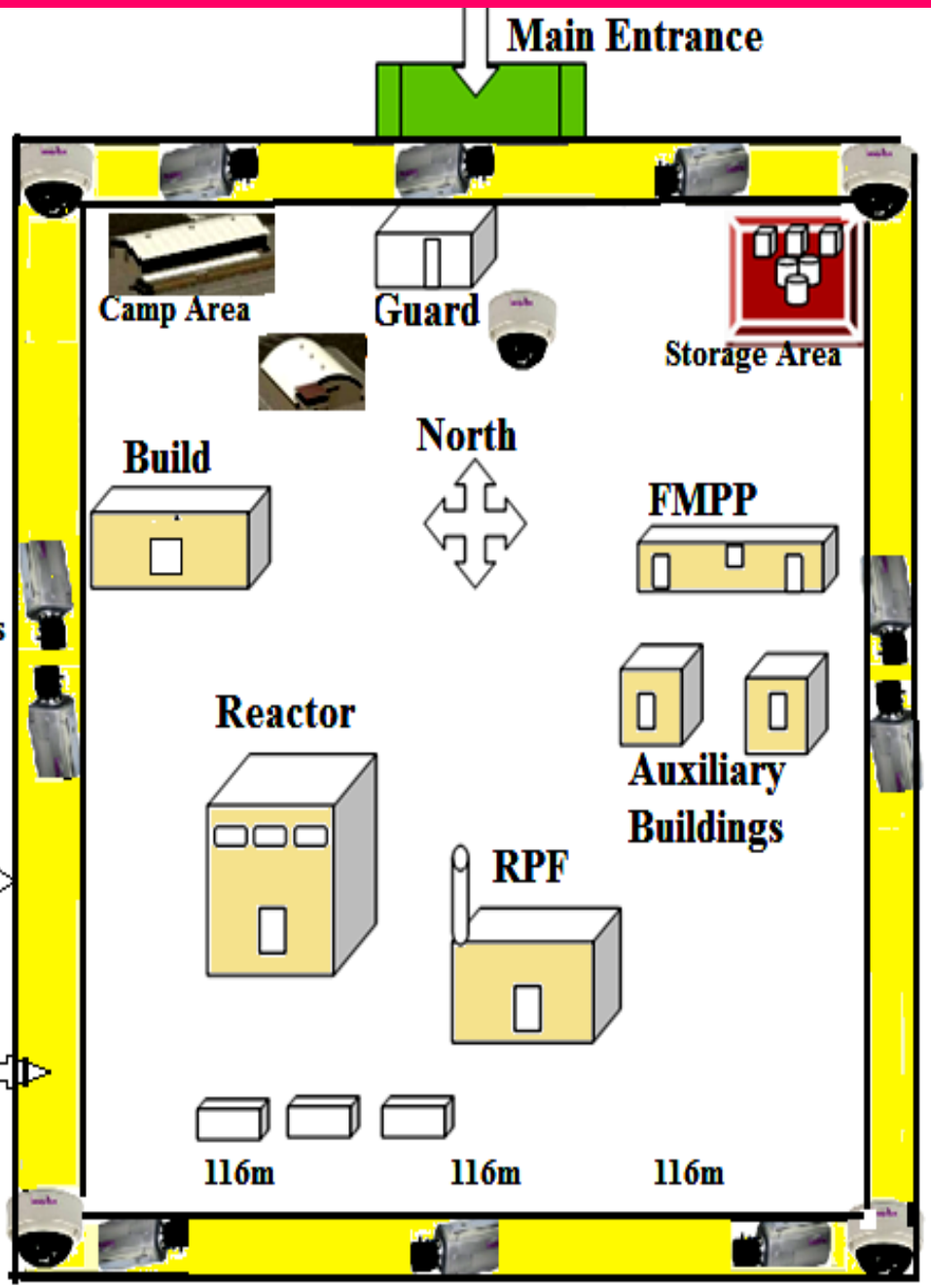
Results 1: Lighting Calculations (250watts HPS Lamp)

Item / Area	Pole height	Poles span	Tilt angle	Lighting level Eav (LUX)	Min/ Eav U1	Min/ Emax U2	No of Poles	Lighting level Emin (LUX)
Isolation zone	8	34	15	21 250watt HPS	32	0.16	35	7

Results 2: Camera Parameter Calculations (Day/Night)

Item / Area	Lens format	Lens focal length	F-Stop Number	subject Height (H)	Images sensitive area (*w*)	Angle of view (θ)	Cameras Number
Isolation zone	1/4'' Inch	50 mm	1.8	6.4 m	4.1	5.26 degree	15

Final Results Optimum Supervision Perimeter Area



Moving Camera

Pan-Tilt-Zoom Camera
1/4 inch format
1.8 f-stop
4.6 CCD, Angle= 5.2

Fixed Camera

50mm Focal lens
6 meters hights

1180 meter long
Double Fence
350 * 240 meter

10 meters
isolation zone

Camera Distributions and location

35 illumination towers, 8meter hights pole, 250 watts high pressure soduim lamp, 30cm arm, average lighting level= 21 Lux

Fixed Camera

50mm focal lens

1/4 Inch
lens format

Thank you for
Attention

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