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## EXECUTIVE SUMMARY

This document defines the lighting and small power philosophy applied to bv facilities.

The CONTRACTOR shall adhere to the requirements as described in this document. All exceptions require approval from the COMPANY.

## DEFINITIONS/ABBREVIATIONS

Within this specification the following definitions shall apply:

### **COMPANY**

### **CONTRACTOR**

The CONTRACTOR is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation/maintenance of a facility.

### **SUPPLIER**

Company/organization supplying equipment, materials or services.

## 1. SCOPE

- 1.1. This document establishes the philosophy and basic criteria to be adopted for the lighting and small power systems associated with BV facilities.
- 1.2. For lighting and small power, IEC standards shall generally be followed unless more stringent Republic of Kazakhstan Codes and Standards exist.
- 1.3. Equipment and materials must be approved by the recognised national certifying authorities of the country of origin and by the Kazakhstan authorities. Any deviation from the codes and regulation shall only be permitted after obtaining written approval of the national authorities or the COMPANY.

## 2. DEFINITIONS

Within this philosophy document the following definitions shall apply:

### **COMPANY**

#### **CONTRACTOR**

The CONTRACTOR is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation/maintenance of a facility.

#### **SUPPLIER**

Company/organization supplying equipment, materials or services

## 3. CODES AND STANDARDS

- 3.1. Electrical equipment shall be designed, manufactured and tested in accordance with the latest applicable sections of the IEC codes and standards detailed in the specifications unless more stringent Kazakhstan regulations exist and shall be approved for use in the Republic of Kazakhstan. Other standards may only be used with the consent of the COMPANY. Where no appropriate IEC or Republic of Kazakhstan standard exists, British Standards shall be used.
  - 3.2. Equipment and materials must be approved by the recognised national certifying authorities of the country of origin and by the Kazakhstan authorities. Any deviation from the codes and regulation shall only be permitted after obtaining written approval of the national authorities.
  - 3.3. Although not supplied for installation in a member country of the European Union, the equipment shall be supplied in accordance with all applicable European Community Directives. Particular attention shall be paid to:
    - Electromagnetic compatibility
    - Low voltage equipment
    - Machinery
    - Safety
    - CE marking
-

- Directive ATEX 2014/34/EU Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres” shall apply.
- 3.4. Where the Data Sheet indicates that the equipment is for use in a hazardous area, it shall comply with the requirements of an approved certifying authority and shall bear the labels and markings in accordance with the relevant sections of the applicable IEC specification.

## 4. DESIGN CRITERIA —LIGHTING

### 4.1 General

- 4.1.1. The lighting system must be designed and implemented according to the following criteria:
- Ambient temperature
  - Environmental conditions such as exposure to chemicals or saltwater.
  - Type of location: Outdoor, indoor, hazardous and safe areas.
  - Classification of equipment.
  - Compliance with local regulations and applicable standards.
  - Satisfactory lighting levels based on usage such as intermittent or constant.
  - Colour rendering.
  - Accessibility and ease of maintenance (replacement of luminaires).
  - Power consumption and energy efficiency.
  - Appearance.
- 4.1.2. Lighting design shall be in accordance with the requirements of PUE, Rules for the Arrangement of Electrical Installations, and SP RoK 2.04-104-2012, Natural and Artificial Lighting.
- 4.1.3. Luminaires located in Zone 1 and Zone 2 areas shall be EEx 'de IIB, T3 type in accordance with Electrical basis of design (23858-00L-3PS-E000-00001) section 8.

### 4.2 Illumination Levels

- 4.2.1. The following intensity levels, after allowing for a 0.7 maintenance factor and normal degradation (generally based on 2000h lamp burn in), measured 1m above the floor level in a horizontal plane, shall form the basis for the lighting design:

**Table 3: Illumination Levels**

Type of Location	lux
<i>Control Rooms</i>	
- Operational areas	100 - 500
- Rear of instrument panels and auxiliary rooms	150
- Outside, near main entrances	50

Type of Location	lux
- OutSide, near secondary entrances	50
<i>Pump and Generator Houses</i>	
- At or near equipment -including Instruments & Control Panels	150
- General	50
- Entrances	50
<i>Compressor Houses</i>	
- At or near equipment -including Instruments & Control Panels	150
- General	50
Entrances	50
<i>Switchrooms and PIBs</i>	
- Operational Areas	150
- Switchboards (front and rear)	150
- General	50
- Entrances	50
- Battery Room	150
- Transformer Room	150
<i>Outdoor Operational Areas</i>	
- Furnace and Boiler Areas	100
- Pumping Area	100
- Remote Manifold Stations	20
- Wellhead Area	20
<i>Plat]orms, Walkways, Ladders and Stairways</i>	
- Frequently used (see below)	100
Infrequently used	10
<i>Rail and Road Loading</i>	
- Loading/unloading gantries	50
- Siding coupling/uncoupling areas	10
- General sidings (at grade)	10
- Road Loading Gantries	50
<i>Offices and Medical rooms</i>	
Drawing Offices	500
- General Offices	500
- First-Aid Rooms	500
- Toilets and Locker Rooms	150
<i>Workshops</i>	
- Interior Work Surfaces	300
- General	150
- Entrances	50
<i>Indoor Storage</i>	
- Between racks	100

Type of Location	(ux
- Bulk Materials	50
- Storage Yards (at grade)	20
- Tank Farms (at grade)	20
<i>Street Lighting and Outdoor non-Operational Areas</i>	
- Road	10
- Car Park	25
- Walking Areas	10
- Other Frequently Used Areas	10
- Other Infrequently Used Area	5
- Fences (other than identified as sensitive to Act of Terror)	10
- Perimeter Fences - Facilities Sensitive to Acts of Terror	100

4.2.2. Operational areas are defined as being where an operator is normally present, or where an operator would normally visit two or more times per shift during the hours of darkness.

4.2.3. Frequently used stairways are defined as being used two or more times per shift during the hours of darkness. Care should be taken to avoid placing luminaires where persons climbing stairs look directly at the light.

#### 4.3 Lighting Calculations

The design of the lighting system shall be based on calculations using lighting levels and parameters detailed in this philosophy.

#### 4.4 Voltage Drops

The maximum permissible voltage drop on lighting circuits shall be 2% from the distribution board to any fitting. Where distribution boards are located at a significant distance from the supplying switchboard the maximum voltage drop on the distribution board feeder shall be not more than 3%.

#### 4.5 Service Conditions

Equipment and materials conforming to this document shall be suitable for operation at their nameplate ratings in the conditions stated above and as follows:

Design temperature for electrical equipment, lighting fittings etc:

minus 45°C to plus 40°C

Design temperature for electrical equipment in heated indoor locations:

minus 5°C to plus 40°C

Design temperature for cable rating:

Air: 40°C

Ground: 15°C

Shipping temperature:

minus 45°C to plus 40°C

Generally electrical equipment including lighting fittings intended for outdoor installation shall have minimum protection to IP 55. Street light fittings shall have minimum protection to IP54. Electrical equipment intended for indoor installation shall have minimum protection to IP 31.

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## **5. LIGHTING**

### **5.1 Lighting Category**

Three groups of lighting shall be provided, which shall be categorised according to the security of their power supply as follows:

- Normal lighting
- Emergency lighting — Category 1
- Emergency lighting — Category 2

### **5.2 Normal Lighting**

- 5.2.1. Normal lighting is supplied from the normal services distribution boards fed from the main power supply only.
- 5.2.2. In general, luminaires for open area illumination at grade and on operating platforms shall be 400W high pressure sodium (SON) type floodlights or equivalent LED fittings. Refer to Section 5.5 for non-process heated industrial building lighting.
- 5.2.3. Floodlights shall be mounted on plant structures where possible. They shall be mounted at sufficient elevation for reasonable accessibility and directed so as not to be objectionable or dazzling to personnel. Re-lamping and servicing shall be with the use of mobile lifting equipment. Where plant structures are not available, floodlight poles or towers shall be provided. Where floodlight towers are used, they shall be provided with a working platform and access ladder for servicing and re-lamping.
- 5.2.4. Where appropriate, high bay type 250W or 400W high pressure luminaires or LED equivalents shall be used for equipment houses, warehouses, workshops, etc.
- 5.2.5. Subsidiary lighting in plant areas shall generally be of SON bulkhead or well glass type or LED equivalents mounted under pipe racks, on platforms and elsewhere as required allowing safe plant operation and maintenance.
- 5.2.6. Luminaires for general illumination shall be located as close as possible to items such as instruments and gauges, so that additional dedicated lighting is unnecessary.
- 5.2.7. Lighting in external areas shall be arranged to minimise shadows and glare on control panel faces.
- 5.2.8. Indoor lighting in areas classified as non-hazardous shall be by fluorescent bi-pin, switch-start and industrial type
- 5.2.9. Lighting for areas where computers and control stations are located shall be designed, including the selection of fittings, to avoid glare and reflections on monitor screens.
- 5.2.10. Luminaires shall be located to avoid stroboscopic effects produced by light shining directly through rotating plant. The lighting in such areas shall be interleaved and wired from different phases to mitigate the effect of the stroboscopic effect.

### **5.3 Emergency Lighting**

#### **5.3.1 Category Definition**

Emergency lighting shall be provided in all process and utility plant areas and in all buildings as required split into two (2) categories:

- Category 1 ensures that personnel are able to reach a place of safety immediately following loss of the normal power supply.
-



- Category 2 ensures plant operating safety and personnel safety following loss of the normal power supply when emergency generator is online.

The percentage of emergency luminaires, category 1 and 2, to normal luminaires shall be as Table 4.

**Table 4: Number of Emergency Luminaires in Relation to Normal Luminaires.**

Type of Location	Category 1	Category 2
Within process areas		10%
Escape routes within process areas or under pipeworks	20a(note 3)	
Outdoor utility areas or equipment houses		10%
Road/Rail loading gantries		10
Switchrooms, equipment rooms and PIBs	5%(note 1)	20a
Control and medical rooms	10%	40
Main corridors	5%	
Offices and administration areas	10a(note 1)	
Industrial Areas - workshop, warehouse, plantroom etc.		20
Outside lighting above all building exit doors		100a(note 4)
Fire exit doors	100	
Stairways - frequently used	20%(note 1)	
Stairways - infrequently used	10a(note 2)	
Main switchgear building required during black start	10	50%
Muster Areas	100	

**Notes:**

1. There shall be a minimum of two light fittings.
2. There shall be at least one light fitting.
3. Applies only to escape routes designated by Risk, Safety and Environmental Group, and ends once a road is reached. A minimum lighting level of 2 Lux shall be maintained for escape routes.
4. In addition to the specified lighting level (50lux) for main entrances, as a minimum, secondary entrances around buildings shall be provided with

### 5.3.2 Category 1

- 5.3.2.1. Emergency lighting, category 1, in heated areas only, shall comprise fluorescent or LED luminaires with integral battery/charger/inverter, supplied from dedicated Essential Services distribution boards.
- 5.3.2.2. Upon loss of main power supply to the distribution board, an automatic transfer to an emergency generator supply shall occur. On total loss of main and emergency power, the integral battery will supply power for minimum 3 hours autonomy.
- 5.3.2.3. Emergency lighting, category 1, in other areas shall be high pressure sodium type luminaires or LED equivalents supplied from dedicated central battery/charger/inverter emergency lighting systems, providing a minimum of 30 minutes autonomy.
- 5.3.2.4. All heated buildings shall be provided with exit lights with integral battery. Battery autonomy for such fittings shall be 3 hours minimum.

5.3.2.5. Category 1 lighting for escape and evacuation shall consider following design criteria

- Muster point: 100 % UPS backed light fittings, 25 lux average, similar to car parking area.
- Secondary escape routes up to the road: 2 lux minimum at ground level when UPS fed lights are on and all other lights turned off.
- Primary escape routes up to the muster points: 2 lux minimum at ground level when UPS fed lights are on and all other lights turned off.
- Cables for escape route lighting shall be fire resistant and meet the requirements of IEC60331-11, IEC 60331-21, IEC60332-1-1, IEC 60332-1-2 and IEC60332-3-24.

### 5.3.3 Category 2

- 5.3.3.1. Emergency lighting, category 2, shall be fed from an Emergency Distribution Board supplied from the Emergency Generator in the event of loss of main power. In heated areas they shall be of the fluorescent or LED type. Elsewhere they shall be 'twin arc' high pressure sodium type or LED equivalent to provide a quick re-strike time when fed from an emergency generator.
- 5.3.3.2. Category 1 and 2 emergency luminaires shall be considered as part of the integrated lighting scheme design and shall contribute towards achieving the specified lighting levels under normal electrical supply condition.

## 5.4 Road and Perimeter/Security Lighting

- 5.4.1. Road lighting shall be provided on all permanent roads within the site plot limits as required for operations and maintenance access. Dedicated road and fence lighting shall be provided only when it is not possible to provide adequate illumination using area floodlighting.
- 5.4.2. Lighting shall not be provided to illuminate perimeter security fences except when applicable to facilities designated as sensitive to acts of terror as specified in Regulation #191 of the Republic of Kazakhstan Government decree for Protection of Facilities Sensitive to Acts of Terror.
- 5.4.3. Lighting shall be provided for facilities designated as sensitive to Acts of Terror to illuminate the perimeter security fences with minimum illumination level of 100lux. This shall be fed from a self-contained emergency power supply for the following durations:
- in towns and urban-type villages — for 24 hours minimum
  - in rural districts — for 48 hours minimum
  - in hard-to-reach areas — for 72 hours minimum

The power supply to road lighting circuits shall be switched by a photo-electric cell controlled relay with a manual override switch.

Wherever possible, lighting columns shall be sited in areas classified as non-hazardous.

Road lighting lanterns shall be of the industrial type employing high pressure sodium (SON) lamps with integral control gear or LED equivalent mounted on galvanised steel columns. Fuse cut-outs shall be located in the base compartment. Suitably certified MCBs shall be used instead of fuses in hazardous areas, and equipped with heater to ensure correct operation at very low temperatures.

Consideration shall be given in the design and selection of fittings to the requirement for efficient and effective maintenance of road lighting poles and luminaires. Changing a lamp shall be a simple process.

## **5.5 Buildings' Indoor Lighting**

In general, luminaires in process heated industrial buildings, such as compressor buildings shall be as per section 5.2 Normal Lighting. Luminaires for illumination in non-process, heated industrial buildings such as substations, PIBs and canteens shall be by industrial type ceiling mounted fluorescent type or LED type. Fluorescent fittings shall normally be twin 40W unless for special applications.

Luminaires in administration building offices, control rooms and similar locations shall be by flush ceiling mounted fluorescent luminaires or LED equivalents.

## **5.6 Aircraft Warning Lights**

Aircraft warning lights shall be supplied from the Category 1 emergency power supply and installed on tall structures in accordance with the requirements of the Ministry of Civil Aviation of Kazakhstan and document "GAS CA-86 — Guidelines on Airfield Services in Civil Aviation of USSR". Flare stacks shall be floodlit from the base. The main components shall comprise luminaires with long life lamps, automatic lamp changers, control and failure monitoring units. The aircraft warning lights shall be supplied from a UPS source.

### **5.7 Installation**

- 5.7.1. Adjacent luminaires shall as far as practical not be supplied from the same circuit.
- 5.7.2. Final number and location of lighting shall be checked and verified during the construction phases.
- 5.7.3. Following completion of the lighting installation, a lighting survey shall be conducted to measure lighting levels to verify design at commissioning stage.

## **6. SOCKET OUTLETS**

### **6.1 General**

- 6.1.1. Socket outlets of the types outlined in the following sections shall be provided for maintenance and inspection purposes and the location and number of outlets shall be based on the expected maintenance activity in that area.
- 6.1.2. Residual current devices with a 30mA setting shall be used to protect circuits for socket outlets.
- 6.1.3. Socket outlets shall be standardised for each rating throughout the plant facility.

### **6.2 Welding Outlets**

- 6.2.1. Outlets shall be provided in plant areas for portable welding supplies and other power requirements on the basis of a 50m extension lead.
  - 6.2.2. They shall be of the switched interlocked type, rated for 400V, 50Hz, 63A, three phase, neutral and earth connections with an IEC 60309 colour and pin configuration.
  - 6.2.3. There shall be a maximum of two welding outlets on each circuit. Each circuit shall be provided with 30mA, 30ms earth leakage protection.
  - 6.2.4. Socket outlets shall be of a single standardised hazardous area certified type in both hazardous and non-hazardous areas such that plugs used on portable equipment will be of a common pattern.
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### **6.3 Convenience Outlets**

- 6.3.1. General purpose, convenience socket outlets shall be provided in all plant areas located on the basis of a 25m extension lead. They shall be of the switched interlocked type, rated for 230V, 50Hz, 16A, double pole and earth connection with an IEC 60309 colour and pin configuration.
- 6.3.2. Socket outlets shall be of a single standardised certified type in both hazardous and non-hazardous areas such that plugs used on portable equipment will be of a common pattern.
- 6.3.3. Non-industrial, convenience socket outlets shall be provided in all administrative buildings, PIBs, switchrooms, equipment rooms, workshops and offices. They shall be of the two (2) pin and earth type, 230Volt, 16amp rated, with integral shutters. Sockets shall comply with IEC 60884.
- 6.3.4. 230V socket outlets shall be supplied from small power distribution boards with outgoing circuits incorporating 2 pole circuit breakers, each with 30mA, 30ms earth leakage protection. There shall be a maximum of eight convenience socket outlets per circuit on a radial feeder.

### **6.4 Portable Lighting and Tools**

- 6.4.1. Portable lighting and tools shall be supplied from the plant 230 volt sockets fitted with 30mA earth leakage protection. Such portable equipment shall have double or reinforced insulation and shall conform to class 2 of IEC 61140 and IEC 60364.
- 6.4.2. Within hazardous areas the portable lighting and tools must be supplied via transformer with a secondary voltage not higher than 50 volts AC. These safety isolating transformers shall be of double wound type complying with IEC 61558 (SELV system). And the portable equipment shall be Class 3 conforming to IEC 61140 and IEC 60364.
- 6.4.3. The 50 volt plugs for the portable equipment shall not be compatible with the 230 volt plugs.
- 6.4.4. Isolation transformers with standard ratings of 250VA, 630VA and 1600VA can be used as appropriate.
- 6.4.5. Battery powered hand lamps shall be installed inside the substations and switch rooms near all entrances. For plant substations, they shall be suitable for zone 1 use and provided with wall mounted bracket type battery charger.

## **7. LIGHTING AND SMALL POWER DISTRIBUTION BOARDS AND CIRCUITS**

### **7.1 General**

- 7.1.1. Lighting and small power distribution boards shall be located in substations, PIBs, and at strategic locations and shall be in accordance with project specification Doc. No. -00-ELT-SPC-00026 "Distribution Switchboards".
- 7.1.2. Outdoor distribution boards shall be avoided as far as is practical in the plant areas. However, where these are required, distribution boards shall be in accordance with project specification Doc. No. -00-ELT-SPC-00026 "Distribution Switchboards" and provided with anti-condensation heaters.
- 7.1.3. The distribution boards shall comprise MCB controlled outgoing final sub circuits with ~~RCDs where necessary for the protection of socket outlet and heating circuits. There~~

shall be suitable co-ordination between the MCC feeder and the distribution board MCBs.

- 7.1.4. Light fittings shall be supplied at 230V, 50Hz, single phase but main distribution may be by a 4 wire 400/230V system where this is appropriate.
- 7.1.5. All circuits feeding fittings in hazardous areas shall have both poles switched. Switch handles on MCBs on distribution boards shall be pad lockable in the 'off' position.
- 7.1.6. Distribution board circuit breakers shall be double pole for lighting circuits in all outdoor areas.
- 7.1.7. Lighting circuits shall generally be 16A, single phase. Maximum loading for each circuit shall not exceed 1.8 kVA.
- 7.1.8. All discharge fitting lighting circuits e.g. High Pressure Sodium Vapour lamps shall be protected by type C MCB's to allow for the high starting inrush current.
- 7.1.9. Lighting circuits shall be arranged such that in the event of a circuit failure, no area will be placed in complete darkness. Adjacent luminaires shall not be connected on the same phases or circuit.

## **7.2 Control**

- 7.2.1. Outdoor lighting circuits shall generally be controlled by a photo-electric cell controlled relay with a manual ON/OFF/Auto switch to permit maintenance.
- 7.2.2. Local lighting switches shall only be used in enclosed buildings.
- 7.2.3. Control rooms shall have a minimum of two independent lighting circuits which shall have dimmer control.

## **8. ENERGY EFFICIENCY**

Lighting design shall follow the latest International Energy Efficiency Guidelines and Recommendations, including compliance with RoK "Law n° 541-IV of 13th January 2012 of the Republic of Kazakhstan, concerning energy saving and increase of energy efficiency".

In order to meet the regulatory requirement above, for new projects, LED lighting shall be preferred over other type of light fittings to maximise the energy efficiency.

## **9. INTERNATIONAL & NATIONAL STANDARDS AND PROJECT SPECIFICATIONS**

IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60364	Electrical installation of buildings
IEC 60529	Degrees of protection provided by enclosures
IEC 60598	Luminaires
IEC 60662	High pressure sodium vapour lamps
IEC 60309	Plugs, socket-outlets and couplers for industrial purposes
IEC 60884	Plugs and Socket-Outlets for Household and Similar Purposes

IEC 61347	Lamp control-gear — All parts
EI 15	Hazardous Area Classification
EN 12464	Light and lighting - Lighting of work places - Parts 1; 2
PUE RoK	Rules for the Arrangement of Electrical Installations
SNiP RoK 4.04-06-2002	Electro-technical devices
GAS CA-86	Guidelines on Airfield Services in Civil Aviation of USSR
SNiP RoK 4.04-23	Electrical installations of residential and public buildings
SNiP RoK 2.04-05	Natural and Artificial Lighting
GOST 14254	Degrees of protection provided by enclosures (IP Code)
Regulation 191	Protection of Facilities Sensitive to Acts of Terror (RoK)
RoK "Law n° 541-IV"	Energy saving and increase of energy efficiency".

## LIGHTING AND SMALL POWER PHILOSOPHY





## ABBREVIATIONS

[illegible]

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1.0 GENERAL INTRODUCTION

1.1 Definitions

Within this basis of design the following definitions shall apply:

COMPANY

CONTRACTOR            The CONTRACTOR is the party which carries out all or part of the design, engineering, procurement, construction,

SUPPLIER

commissioning or management of a project or operation/maintenance of a facility.

Company/organization supplying equipment, materials or services

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## 2.0 CODES AND STANDARDS

For electrical equipment the recommended IEC standards listed in the Project Codes & Standards Doc. No. 4TPFC-00C-3DG-0000-00001 shall generally be followed unless more stringent Kazak regulations exist. Where no appropriate IEC or Kazak standard exists, British Standards shall be used.

A list of main relevant Standards and Industry Codes has been extracted from the Project Standard as follows:

IEC 60079	Electrical apparatus for explosive gas atmospheres
IEC 60364	Electrical installation of buildings
IEC 60529	Classification of degrees of protection provided by enclosures
IEC 60598	Luminaires
IEC 60662	High pressure sodium vapour lamps
IEC 60309	Plugs, socket-outlets and couplers for industrial purposes
IEC 60884	Plugs and Socket-Outlets for Household and Similar Purposes
PUE, Rules for the Arrangement of Electrical Installations	
MSN 2.04.05-96	Natural and Artificial Lighting.
GAS CA-86	Guidelines on Airfield Services in Civil Aviation of USSR

Equipment and materials must be approved by the recognised national certifying authorities of the country of origin and by the Kazakhstan authorities. Any deviation from the codes and regulation shall only be permitted after obtaining written approval of the national authorities or the COMPANY.

Although not supplied for installation in a member country of the European Union, the equipment shall be supplied in accordance with all applicable European Community Directives. Particular attention shall be paid to:

- Electromagnetic compatibility
  - Low voltage equipment
-

- Machinery
- Safety
- CE marking
- Directive 94/9/EC (ATEX95) "Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres" shall apply.

### 3.0 DESIGN CRITERIA -LIGHTING

#### 3.1 General

Lighting design shall be in accordance with the requirements of PUE, Rules for the Arrangement of Electrical Installations, and MSN 2.04.05-96, Natural and Artificial Lighting.

Luminaires located in Zone 1 areas shall be EEx 'd' or EEx 'e' certified, whereas Luminaires in Zone 2 areas shall have EEx 'e' or EEx 'N' certification.

#### 3.2 Illumination Levels

The following intensity levels, after allowing for a 0.7 maintenance factor and normal degradation (generally based on 2000h lamp burn in), measured 1 m above the floor level in a horizontal plane, shall form the basis for the lighting design:

Table 3: Illumination Levels.

Type of Location	lux
Control Rooms	
- Operational areas	400 - 700
- Rear of instrument panels and auxiliary rooms	250
- Outside, near main entrances	150
- Outside, near secondary entrances	10
Pump and Generator Houses	
- At or near equipment	150
- General	50
- Entrances	50
Compressor Houses	
- At or near equipment	200
- General	50
- Entrances	50
Switchrooms and PIBs	
- Operational areas	150
- General	50
- Entrances	50
Furnace and Boiler Areas	50
Outdoor Operational Areas	50

Type of Location	lux
Outdoor Non-Operational Areas (e.g. Roads)	
- Frequently used	5
- Infrequently used	1
Platforms, Walkways, Ladders and Stairways	
- Frequently used (see below)	50



- Infrequently used	10
Rail	
Loading/unloading gantries	50
- Siding coupling/uncoupling areas	10
- General sidings (at grade)	1
Road Loading Gantries	50
Drawing Offices	700
General Offices	500
First-Aid Rooms	500
Toilets and Locker Rooms	150
Workshops	
- Interior work surfaces	300
- General	150
- Entrances	50
Indoor Storage	
- Between racks	150
- Bulk materials	50
Storage Yards (at grade)	5
Tank Farms (at grade)	0.5
Boundary Fences (security lighting is not required)	None

- Operational areas are defined as being where an operator is normally present, or where an operator would normally visit two or more times per shift during the hours of darkness.
- Frequently used stairways are defined as being used two or more times per shift during the hours of darkness.

## 4.0 LIGHTING

### 4.1 Lighting Category

Three groups of lighting shall be provided, which shall be categorised according to the security of their power supply as follows:

- Normal lighting
- Emergency lighting Category 1
- Emergency lighting - Category 2

### 4.2 Normal Lighting

Normal lighting is supplied from the normal services distribution boards fed from the main power supply only.

In general, luminaires for open area illumination at grade and on operating platforms shall be 400W high pressure sodium (SON) type floodlights. Refer to Section 4.5 for non process heated industrial building lighting.

Floodlights shall be mounted on plant structures where possible. They shall be mounted at sufficient elevation for reasonable accessibility and directed so as not to be objectionable or dazzling to personnel. Relamping and servicing shall be with the use of mobile lifting equipment. Where plant structures are not available, floodlight poles or towers shall be provided. Where floodlight poles or towers are used, they shall be provided with a working platform and access ladder for servicing and re-lamping.

Where appropriate, high bay type 250W or 400W high pressure luminaires shall be used for equipment houses, warehouses, workshops, etc.

Subsidiary lighting in plant areas shall generally be of SON bulkhead or wellglass type mounted under piperacks, on platforms and elsewhere as required allowing safe plant operation and maintenance.

Luminaires for general illumination shall be located as close as possible to items such as instruments and gauges, so that additional dedicated lighting is unnecessary.

Lighting in external areas shall be arranged to minimise shadows and glare on control panel faces. Lighting shall be designed, including the selection of fittings, to avoid glare and reflections on monitor screens.

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Luminaires shall be located to avoid stroboscopic effects produced by light shining directly through rotating plant.

#### 4.3 Emergency Lighting

##### 4.3.1 Category Definition

Emergency lighting shall be provided in all process and utility plant areas and in all buildings as required split into two (2) categories:

- Category 1 ensures that personnel are able to reach a place of safety immediately following loss of the normal power supply.
- Category 2 ensures plant operating safety and personnel safety following loss of the normal power supply.

The percentage of emergency luminaries, category 1 and 2, to normal luminaries shall be as Table 4.

Table 4: Number of Emergency Luminaires in Relation to Normal Luminaires.

Type of Location	Category 1	Category 2
Within process areas		10%
Escape routes within process areas or under piperacks	20a(note 3)	
Outdoor utility areas or equipment houses		10%
Road/Rail loading gantries		10%
Switchrooms, equipment rooms and PIBs	5%(note 1)	20%
Control and medical rooms	10%	40%
Main corridors	5%	
Offices and administration areas	10%(note 1)	
Industrial Areas - workshop, warehouse, plantroom etc.		20%
Outside lighting above all building exit doors		100%(note 4)
Fire exit doors	100%	
Stairways - frequently used	20%(note 1)	
Stairways - infrequently used	10a(note 2)	
Main switchgear building required during black start	10%	50%
Muster Areas	100%	

**Notes:**

1. There shall be a minimum of two light fittings.

2. *There shall be at least one light fitting.*
3. *Applies only to escape routes designated by Risk, Safety and Environmental Group, and ends once a road is reached. A minimum lighting level of 1 Lux shall be maintained for escape routes.*
4. *in addition to the specified lighting level (50lux) for main entrances, as a minimum, secondary entrances around buildings shall be provided with 10lux.*

#### 4.3.2 Category 1

Emergency lighting, category 1, in heated areas only, shall comprise fluorescent luminaries with integral battery/ charger/inverter, supplied from dedicated Essential Services distribution boards. Upon loss of main power supply to the distribution board, an automatic transfer to an emergency generator supply shall occur. On total loss of main and emergency power, the integral battery will supply power for minimum 30 minute autonomy.

Emergency lighting, category 1, in other areas shall be high pressure sodium type luminaries supplied from dedicated central battery/charger/inverter emergency lighting systems, they shall have a minimum of 30 minutes autonomy.

#### 4.3.3 Category 2

Emergency lighting, category 2, shall be fed from an Emergency Distribution Board supplied from the Emergency Generator where available or alternatively by battery/charger/inverter. In heated areas they shall be of the fluorescent type. Elsewhere they shall be 'twin arc' high pressure sodium type when fed from an emergency generator or high pressure sodium type when fed from a no-break supply. When supplied from a no-break supply the integral battery will supply power for minimum 30 minute autonomy.

Category 1 and 2 emergency luminaires shall be considered as part of the integrated lighting scheme design and shall contribute towards achieving the specified lighting levels under normal electrical supply condition.

#### 4.4 Road and Perimeter/Security Lighting

Road lighting shall be provided on all permanent roads within the site plot limits as required for operations and maintenance access. Dedicated road lighting shall be provided only when it is not possible to provide adequate illumination using area floodlighting.

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Lighting shall not be provided to illuminate the perimeter security fences.

The power supply to road lighting circuits shall be switched by a photo-electric cell controlled relay with a manual override switch.

Wherever possible, lighting columns shall be sited in areas classified as non-hazardous.

Road lighting lanterns shall be of the industrial type employing high pressure sodium (SON) lamps with integral control gear mounted on galvanised steel columns. Fuse cut-outs shall be located in the base compartment. Suitably certified MCBs shall be used instead of fuses in hazardous areas, and equipped with heater to ensure correct operation at very low temperatures.

Consideration shall be given in the design and selection of fittings to the requirement for efficient and effective maintenance of road lighting poles and luminaires. Changing a lamp shall be a simple process.

#### 4.5 Building Lighting

In general, luminaires in process heated industrial buildings, such as compressor buildings shall be as section 4.2 Normal Lighting. Luminaires for illumination in non-process, heated industrial buildings such as substations, PIBs and canteens shall be by industrial type ceiling mounted fluorescent type, normally twin 40W unless for special applications.

Luminaires in administration building offices, control rooms and similar locations shall be by flush ceiling mounted fluorescent luminaires.

#### 4.6 Aircraft Warning Lights

Aircraft warning lights shall be supplied from the category 2 emergency power supply and installed on tall structures in accordance with the requirements of the Ministry of Civil Aviation of Kazakhstan and document "GAS CA-86 - Guidelines on Airfield Services in Civil Aviation of USSR".

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## 5.0 SOCKETOUTLETS

### 5.1 General

Socket outlets of the types outlined in the following sections shall be provided for maintenance and inspection purposes.

Residual current devices with a 30mA setting shall be used to protect circuits for socket outlets.

### 5.2 Welding Outlets

Outlets shall be provided in plant areas for portable welding supplies and other **power requirements on the basis of a 50m extension lead.**

They shall be of the switched interlocked type, rated for 400V, 50Hz, 63A, three phase, neutral and earth connections with an IEC 60309 colour and pin configuration.

There shall be a maximum of two welding outlets on each circuit. Each circuit shall be provided with 30mA, 30ms earth leakage protection.

Feeders to welding socket outlets shall include a contactor to cut power to the sockets on receipt of an ESD signal.

Socket outlets shall be of a single standardised hazardous area certified type in both hazardous and non-hazardous areas such that plugs used on portable equipment will be of a common pattern.

### 5.3 Convenience Outlets

General purpose, convenience socket outlets shall be provided in all plant areas located on the basis of a 25m extension lead. They shall be of the switched interlocked type, rated for 230V, 50Hz, 16A, double pole and earth connection with an IEC 60309 colour and pin configuration.

Socket outlets shall be of a single standardised certified type in both hazardous and non-hazardous areas such that plugs used on portable equipment will be of a common pattern.

Non-industrial, convenience socket outlets shall be provided in all administrative buildings, PIBs, switchrooms, equipment rooms, workshops and offices. They shall be of the two(2) pin and earth type, 230Volt, 16amp rated, with integral shutters. Sockets shall comply with IEC 60884.

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230V socket outlets shall be supplied from small power distribution boards with outgoing circuits incorporating 2 pole circuit breakers, each with 30mA, 30ms earth leakage protection. There shall be a maximum of eight convenience socket outlets per circuit.

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## 6.0 LIGHTING AND SMALL POWER DISTRIBUTION BOARDS AND CIRCUITS

### 6.1 General

Lighting and small power distribution boards shall be located in substations, PIBs, and at strategic locations and shall be in accordance with project specification Doc. No. 4TPFC-00C-3PS-ES01-00010 "Distribution Switchboards".

Outdoor distribution boards shall be avoided as far as is practical in the plant areas, however, where these are required distribution boards shall be in accordance with project specification Doc. No. 4TPFC-00C-3PS-ES01-00010 "Distribution Switchboards" and provided with anti-condensation heaters.

The distribution boards shall comprise MCB controlled outgoing final sub circuits with RCDs where necessary for the protection of socket outlet and heating circuits. There shall be suitable co-ordination between the MCC feeder and the distribution board MCBs.

Light fittings shall be supplied at 230V, 50Hz, single phase but main distribution may be by a 4 wire 400/230V system where this is appropriate. All circuits feeding fittings in hazardous areas shall have both poles switched. Switch handles on distribution boards shall be padlockable in the 'off' position.

Distribution board circuit breakers shall be double pole for lighting circuits in all outdoor areas.

Lighting circuits shall generally be 16A, single phase. Maximum loading for each circuit shall not exceed 1.8 kVA.

### 6.2 Control

Outdoor lighting circuits shall generally be controlled by a photo-electric cell controlled relay with a manual override switch to permit maintenance.

Local lighting switches shall only be used in enclosed buildings.

Control rooms shall have a minimum of two independent lighting circuits which shall have dimmer control.

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