GENERAL SPECIFICATION

LIGHTING SYSTEM

ENGINEERING TECHNICAL STANDARDS & PROCEDURES

PT KILANG PERTAMINA INTERNASIONAL

DIREKTORAT PROYEK INFRASTRUKTUR

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5 of 30	12/21	Add: section 1. INTRODUCTION Penambahan : Bagian 1 PENGANTAR	RH/PRY

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DAFTAR ISI

1. INTRODUCTION

1.1 This General Specification establishes the minimum requirements for safe and reliable Lighting System that meets the needs of the Project.

1. PENGANTAR

1.1 Spesifikasi umum ini menetapkan persyaratan minimum untuk sistem pencahayaan/ penerangan yang aman dan mempunyai nilai keandalan serta memenuhi persyaratan dari Proyek.

2. SCOPE

2.1 This specification defines minimum requirements for lighting system design which will be applied in the Directorate of Infrastructure Project of PT. Kilang Pertamina Internasional (KPI).

2. LINGKUP

2.1 Spesifikasi ini mendefinisikan persyaratan *minimum* untuk *lighting system design* yang akan diterapkan dalam Direktorat Proyek Infrastruktur dari PT. Kilang Pertamina Internasional (KPI).

3. CONFLICTS AND DEVIATIONS

3.1 Any conflicts between this standard and other applicable Engineering Technical Standards & Procedures (ETSP), or OWNER standard, codes, and forms shall be resolved in writing by OWNER.

3.2 All direct requests to deviate from this standard (ETSP) in writing to OWNER, who shall follow internal OWNER procedure and forward such requests to OWNER for approval.

3. KONFLIK DAN DEVIASI

3.1 Apabila terdapat konflik antara standar ini dengan *Engineering Technical Standards & Procedures* (ETSP) yang berlaku lainnya, atau standar PEMILIK, *codes* dan formulir, maka harus diselesaikan secara tertulis oleh PEMILIK.

3.2 Semua permintaan penggunaan standar yang berbeda/ menyimpang dari standar ini (ETSP), harus diajukan kepada PEMILIK secara tertulis dengan mengikuti prosedur *internal* PEMILIK untuk mendapatkan persetujuan.

4. ABBREVIATIONS

4.1 Abbreviations used for this document shall have the following definitions:

AC	Alternating Current
IEC	International Electro technical Commission
IP	Ingress Protection
ISO	International Organization for Standardization

4. SINGKATAN

4.1 Singkatan yang digunakan pada dokumen ini harus memiliki definisi sebagai berikut:

AC	*Alternating Current*
IEC	*International Electro technical Commission*
IP	*Ingress Protection*
ISO	*International Organization for Standardization*

LED	Light Emitting Diode
MCB	Miniature Circuit Breaker
MV	Medium Voltage
PVC	Polyvinyl Chloride

LED	*Light Emitting Diode*
MCB	*Miniature Circuit Breaker*
MV	*Medium Voltage*
PVC	*Polyvinyl Chloride*

5. DEFINITIONS

5.1 The following words shall have these special meanings when used herein:

OWNER	Owner of the Plant is defined as PT Kilang Pertamina Internasional
CONTRACTOR/ CONSULTANT	Defined as the Organization to which PT Kilang Pertamina Internasional assign the work
shall	Indicates that the statement is mandatory
should	Indicates a recommendation
PURCHASER/ BUYER	Defined as the Company / Organisation that placed the material requisition for equipment, materials or services
VENDOR/ SUPPLIER/ MANUFACTURER	Defined as the company selected to supply the equipment and service detailed in this specification.
SUB-VENDOR/ SUB-SUPPLIER	Defined as any SUPPLIER of equipment and support services for a particular

5. DEFINISI

5.1 Penggunaan kata-kata berikut harus memiliki arti khusus sebagai berikut:

PEMILIK	Pemilik Kilang didefinisikan sebagai PT Kilang Pertamina Internasional
KONTRAKTOR/ KONSULTAN	Didefinisikan sebagai Organisasi yang ditunjuk oleh PT Kilang Pertamina Internasional untuk melakukan suatu pekerjaan
shall	Menunjukkan bahwa pernyataan itu wajib
should	Menunjukkan rekomendasi
PEMBELI	Didefinisikan sebagai Perusahaan / Organisasi yang menempatkan *material requisition* untuk peralatan, material atau servis
VENDOR/ PEMASOK/ PEMBUAT	Didefinisikan sebagai perusahaan yang dipilih untuk memasok peralatan dan *service* yang dirinci dalam spesifikasi ini.
*SUB-VENDOR/ SUB-*PEMASOK	Didefinisikan sebagai PEMASOK peralatan dan servis penyangga untuk peralatan/ paket

piece of equipment/ package to a VENDOR/ SUPPLIER.

tertentu kepada *VENDOR*/ PEMASOK.

6. CODES AND STANDARDS

The following Codes, Standard and Specifications apply to this specification. When an edition date is not indicated for a code or standard or any update in codes and standards in this specification document, the latest edition and addendum in force at the time of purchase shall apply. Material & equipment shall be as a specification or an equal approved by OWNER.

6.1 Code and Standards Title 2

API RP 540	Electrical Installation in Petroleum Plants
ICAO Annex 14	Aerodromes: Obstruction Lights Installation
ISO-1461:2009	Hot Dip Galvanised coatings on Fabricated Iron and Steel Articles – Specifications and Test Method
IEC 60079	Explosive atmospheres - All Parts
IEC 60364	Electrical Installations for Buildings
IEC 60529	Degree of Protection Provided by Enclosures (IP Code)
IEC 60598	Luminaires
IEC 61914	Cable Cleats for Electrical Installations
IEC 62444	Cable glands for Electrical Installation

6. KODE DAN STANDAR

Kode, standar, dan spesifikasi berikut berlaku untuk spesifikasi ini. Kode dan standar harus menggunakan edisi yang terbaru atau edisi yang berlaku pada saat pembelian. *Material* & peralatan harus sesuai spesifikasi atau setara dengan yang disetujui oleh PEMILIK.

6.1 Judul Standar dan Kode 2

API RP 540	*Electrical Installation in Petroleum Plants*
ICAO Annex 14	*Aerodromes: Obstruction Lights Installation*
ISO-1461:2009	*Hot Dip Galvanised coatings on Fabricated Iron and Steel Articles – Specifications and Test Method*
IEC 60079	*Explosive atmospheres - All Parts*
IEC 60364	*Electrical Installations for Buildings*
IEC 60529	*Degree of Protection Provided by Enclosures (IP Code)*
IEC 60598	*Luminaires*
IEC 61914	*Cable Cleats for Electrical Installations*
IEC 62444	*Cable glands for Electrical Installation*

6.2 This specification shall also be read in conjunction with all other specifications and data sheets attached to the material requisition. Any conflicts between the referenced documents shall be identified to the PURCHASER in writing for resolution. In general, when resolving conflicts the following order of precedence shall apply:

a. Data Sheets
b. Material Requisition
c. This specification
d. Referenced Standards

7. ENVIRONMENTAL CONDITIONS

7.1 Equipment shall be suitable for the relative humidity conditions as stated in IEC standards.

7.2 The atmosphere is to be considered saliferous and dusty.

8. GENERAL

8.1 All outdoor fittings shall be Exd or Exde in Zone 1 and Exe or ExnR in Zone 2 and industrial type for non-hazardous areas respectively. Gas Group shall be IIB with a temperature class of T3 as a minimum.

8.2 Escape luminaires shall have integral Ni-Cad batteries, chargers and inverters to provide lighting during power supply outages. The autonomy time for the batteries shall be a minimum of 90 minutes on loss of power to enable adequate time for evacuation.

8.3 Street lighting systems shall employ LED fixtures mounted on poles.

8.4 Flood lighting shall have a tempered glass lens, be weatherproof and gasketed to

6.2 Spesifikasi ini juga harus dibaca bersama dengan semua spesifikasi dan *data sheet* lain yang dilampirkan pada *material requisition*. Setiap konflik antara dokumen yang dirujuk harus diidentifikasi kepada PEMBELI secara tertulis untuk diselesaikan. Secara umum, ketika menyelesaikan konflik, urutan prioritas berikut akan berlaku:

a. *Data Sheets*
b. *Material Requisition*
c. *This specification*
d. *Referenced Standards*

7. KONDISI LINGKUNGAN

7.1 Peralatan harus sesuai dengan kondisi kelembaban relatif seperti yang dinyatakan dalam standar IEC.

7.2 Atmosfer harus dianggap *saliferous* dan *dusty*.

8. UMUM

8.1 Semua *outdoor fitting* harus Exd atau Exde di Zona 1 dan Exe atau ExnR di Zona 2 serta jenis industri untuk masing-masing *non-hazardous area*. *Gas Group* harus IIB dengan *class* suhu T3 sebagai minimum.

8.2 Penerangan *escape* harus memiliki Ni-Cad *batteries* bawaan, *charger* dan *inverter* untuk memberikan pencahayaan selama tidak ada *power supply*. *Autonomy time* untuk baterai harus minimum 90 menit ketika tidak ada *power* untuk memungkinkan waktu yang cukup untuk proses evakuasi.

8.3 Sistem penerangan jalan harus menggunakan *fixture* LED yang dipasang di tiang.

8.4 *Flood lighting* harus memiliki karakteristik *glass len*, *weatherproof* dan *gasket* untuk

prevent dust and moisture from entering.

8.5 All enclosures shall be provided with an internal earthing terminal to accommodate the third core of the lighting cable.

8.6 All light fittings shall have robust external fixing lugs for surface mounting equipment individually or in combination as stated in the material requisition.

8.7 Diffusers and lamp covers of all luminaires shall be coated with an anti-static solution applied by the MANUFACTURER.

8.8 Lighting fittings ratings and wattage shall be as stated in the material requisition.

8.9 Light fixtures for escape lighting shall be suitable for a 4 wire system (un-switched live).

8.10 Every cable entry shall have thread pipe taps for compression type cable glands.

8.11 The number of different types of lighting fixture used to simplify maintenance work in an area shall be restricted as follows:

a. For outdoor area lighting: LED lamp equivalent to High pressure sodium lamp 70W, 100W, 150W, 250W, 400W

b. For street lighting: LED lamp equivalent to High pressure sodium lamp 70W, 100W, 150W, 250W, 400W

c. Emergency lighting: LED lamp equivalent to High pressure sodium lamp 70W, 150 W

d. For socket outlets: 15 Amps, 2 poles + 1 ground.

mencegah masuknya debu dan kelembaban.

8.5 Semua *enclosure* harus dilengkapi dengan terminal *internal earthing* untuk mengakomodasi ketiga *core* dari kabel pencahayaan.

8.6 Semua *fitting* penerangan harus memiliki *fixing lug* eksternal yang kuat untuk pemasangan permukaan peralatan secara individual atau dalam kombinasi seperti yang dinyatakan dalam *material requisition.*

8.7 *Diffuser* dan penutup lampu dari semua *luminaire* harus dilapisi dengan larutan anti-statis yang diterapkan oleh PEMBUAT.

8.8 *Rating fitting* lampu dan *watt* harus sebagaimana dinyatakan dalam *material requisition.*

8.9 *Fixture* lampu untuk *escape lighting* harus sesuai untuk sistem 4 *wire* (langsung tanpa sakelar).

8.10 Setiap kabel entri harus memiliki *thread pipe tap* untuk *cable gland* tipe kompresi.

8.11 Jumlah *fixture* lampu dengan jenis berbeda yang digunakan untuk menyederhanakan pemeliharaan di suatu *area* harus mengikuti ketentuan sebagai berikut:

a. Untuk penerangan luar ruangan*: LED lamp* setara dengan lampu *sodium* yang bertekanan tinggi 70W, 100W, 150W, 250W, 400W

b. Untuk penerangan jalan: lampu *LED* setara dengan lampu *sodium* bertekanan tinggi 70W, 100W, 150W, 250W, 400W

c. Penerangan *emergency*: lampu *LED* setara dengan lampu *sodium* bertekanan tinggi 70W, 150 W

d. Untuk *socket outlet:* 15 *Amp,* 2 *pole* + 1 *ground.*

8.12 Lighting fixtures in hazardous areas shall be of suitable type as per applicable codes and standards for each classified area.

8.13 LED fixtures shall have the following features:

a. LED fixtures shall have instant illumination and restrike features.

b. LED fixtures shall be able to work in the specified environmental conditions with no warm up requirements.

c. LED fixtures shall have redundancy in drivers with multiple series circuits connected to each driver to avoid complete loss of illumination upon failure of a driver.

d. Drivers within LED fixtures shall be field replaceable.

e. External drivers in LED fixtures shall have a minimum separation from LED PCB for effective heat dissipation and increased reliability.

f. Lens cover for LED fixtures shall be made of heat and impact resistant glass.

g. LED fixtures shall be provided with internal surge protection.

h. LED fixtures including the driver shall have a minimum operational life of 60,000 hours (L70/B10) at 40 deg. C.

8.14 All light fixtures shall be provided with an internal grounding terminal to

8.12 *Fixture* lampu di *hazardous area* harus sesuai dengan standar yang berlaku di masing-masing *area*.

8.13 *Fixture* lampu LED harus memiliki fitur-fitur berikut ini:

a. *Fixture* lampu LED harus memiliki fitur *instant illumination*/ penerangan dan *restrike*.

b. *Fixture* lampu LED harus dapat bekerja dalam kondisi lingkungan yang ditentukan tanpa perlu melakukan *warm up*.

c. *Fixture* lampu LED harus memiliki redundansi pada *driver* dengan beberapa sirkuit seri yang terhubung ke setiap *driver* untuk menghindari kehilangan *illumination*/ penerangan secara menyeluruh saat terjadinya kegagalan pada *driver*.

d. *Driver* dalam *Fixture* lampu LED harus dapat diganti di lapangan.

e. *Driver* eksternal dalam *Fixture* lampu LED harus memiliki pemisahan minimum dari LED PCB untuk menghilangkan panas yang efektif dan peningkatan reliabilitas.

f. Penutup *lens* untuk LED *fixture* harus terbuat dari kaca tahan panas dan benturan.

g. *Fixture* lampu LED harus disediakan dengan proteksi *surge internal*.

h. *Fixture* lampu LED termasuk *driver* harus memiliki masa operasional minimum 60,000 jam (L70/ B10) pada 40 deg. C.

8.14 Semua *fixture* lampu harus dilengkapi dengan terminal *grounding internal* untuk

accommodate the ground core of lighting cables.

8.15 Circuit breakers rated at 20 amperes shall preferably be used for lighting circuits and socket outlets, as branch circuit protection. Circuit loadings shall not exceed 80% of the circuit breaker rating.

8.16 Outlets shall be of independent circuit from lighting fixtures.

8.17 Cable used for Lighting shall be XLPE insulated, steel wire or tape armored PVC outer jacket cable with a minimum 2.5 mm^2 cross-section conductors.

mengakomodasi *ground core* dari kabel pencahayaan.

8.15 *Rating circuit breaker* 20 *ampere* sebaiknya digunakan untuk sirkuit pencahayaan dan *socket outlet*, sebagai proteksi sirkuit cabang. Pembebanan sirkuit tidak boleh melebihi 80% dari *rating circuit breaker.*

8.16 *Outlet* harus terpisah dengan sirkuit dari *fixture* lampu.

8.17 Kabel yang digunakan untuk pencahayaan harus memiliki insulasi XLPE, *steel wire* atau *tape armored* PVC *outer jacket cable* dengan *cross-section conductor* minimum 2.5 $mm^{2.}$

9. LIGHTING POWER SUPPLY

9.1 Low-voltage circuit breakers shall be as follows:
- a. Lighting circuit : Molded case thermal magnetic type
- b. Receptacle circuit : Molded case thermal magnetic type with earth fault protection

9.2 Branch circuit loads of lighting panel boards shall not exceed 80% of the circuit breaker rating.

9.3 Each panel board shall have at least 1 (one) spare branch circuits.

9.4 The nominal system voltage and utilization voltage of each lighting system shall be as follows:

9. *LIGHTING POWER SUPPLY*

9.1 *Circuit breaker* tegangan rendah harus sebagai berikut:
- a. Sirkuit pencahayaan: Tipe Molded case thermal
- b. Sirkuit *receptacle*: Tipe Molded case thermal magnetic dengan proteksi *earth fault*

9.2 Beban sirkuit cabang dari *lighting panel board* tidak boleh melebihi 80% dari *rating circuit breaker.*

9.3 Setiap *panel board* harus memiliki setidaknya 1 (satu) cadangan *branch circuit*.

9.4 Sistem tegangan nominal dan pemanfaatan tegangan setiap sistem *lighting* harus adalah sebagai berikut:

Lighting Description	Phase / Wire	Utilization Voltage
Outdoor lighting	3 ph, 4 wire, 380/220V	1 ph, 220V
Flood lighting and street lighting	3 ph, 4 wire, 380/220V	1 ph, 220V
Indoor lighting and receptacle	3 ph, 4 wire, 380/220V	1 ph, 220V
Socket Outlet (for Outdoor)	3 ph, 4 wire, 380/220V	1 ph, 220V

Note: The 220V system for lighting circuits shall be operated solidly earthed

Catatan: Sistem 220V untuk sirkuit pencahayaan harus *operated solidly earthed*

10. LIGHTING IN PLANT

10.1 Lighting fixtures shall be designed and installed in accordance with applicable parts of IEC 60364-5-55 section 559, parts of IEC 60598-2, and API RP 540 (for illumination designs).

10.2 All light fittings main components shall comprise luminaires with long life lamps.

10.3 Lighting shall be provided for the following areas:

a. Process areas
b. Utility areas
c. Tank areas
d. Jetty areas
e. Administration building areas
f. Material offloading facility (MOF) including the road to MOF
g. Roads, Streets
h. Security Fences
i. Fire Training Area
j. Auxiliary or low traffic volume roads
k. Boundary fences

10.4 Normal and Essential lighting shall be installed in all areas including process areas, columns, staircases, tankage areas, off-plot areas, street lighting, electrical substations, control rooms, jetty, pump stations, etc.

10.5 Lighting shall not be provided for the following outdoor areas, unless otherwise specified:

a. Plant property line

10. PENCAHAYAAN DI KILANG

10.1 *Fixture* lampu harus didesain dan dipasang sesuai dengan IEC 60364-5-55 *section* 559 yang berlaku, bagian dari IEC 60598-2, dan API Rp 540 (untuk desain *illumination*/ penerangan).

10.2 Semua komponen utama *fitting* lampu harus terdiri dari *luminaires* dengan lampu yang mempunyai waktu pakai lama.

10.3 Pencahayaan harus disediakan untuk *area* berikut:

a. Area Proses
b. Area Utiliti
c. Area Tangki
d. Area *Jetty*
e. Area Gedung Administrasi
f. *Material offloading facility (MOF)* termasuk jalan menuju MOF
g. *Road, Street*
h. Pagar *Security*
i. Area *Fire Training*
j. *Auxiliary* atau *low traffic volume roads*
k. Pagar Pembatas

10.4 Pencahayaan normal dan esensial harus dipasang di semua area termasuk area proses, kolom, tangga, area tangki, area *off-plot*, penerangan jalan, substation *electrical*, ruang kontrol, *jetty*, stasiun pompa, dll.

10.5 Pencahayaan tidak perlu dipasang untuk *area outdoor* berikut, kecuali adanya ketentuan lain, seperti:

a. *Plant property line*

b. Access road outside plant fence (except access road to main gate)

c. Slope to plant flare

d. Future area

10.6 Lighting design shall be performed so as to ensure adequate and efficient lighting facilities that contribute to the safe and efficient operation and maintenance of the plant.

10.7 The refinery shall be provided with normal, essential lighting and escape/ egress lighting system.

10.8 The normal, essential and egress/escape lighting fittings shall normally be energized to provide the required.

10.9 Egress/ Escape lighting

10.9.1. Egress/ Escape lighting shall be installed in all strategic areas such as escape ways, walk ways, exit doors, etc., to provide sufficient illumination to allow safe movement of personnel in the event of failure of main lighting. Escape lighting shall be arranged to provide the minimum illumination for personnel to identify and follow the escape routes to the designated muster and refuge areas as defined on relevant Process Safety layout drawings.

10.9.2. Escape lighting shall be suitable for Zone 1 in substations, power plant switch rooms, instrument satellite houses, operator shelters, and analyser shelters.

10.10 Emergency/ Essential Lighting

10.10.1. Emergency lighting shall be *LED* type fixtures, and shall be provided

b. Jalan akses di luar pagar kilang (terkecuali akses jalan ke *gate* utama*)*

c. *Slope* menuju *plant flare*

d. Area untuk yang akan datang

10.6 Desain pencahayaan harus dilakukan untuk memastikan pencahayaan yang memadai dan efisien sehingga menghasilkan operasi dan pemeliharaan kilang yang aman serta efisien.

10.7 Kilang harus dipasang pencahayaan normal, pencahayaan esensial dan sistem pencahayaan *escape*/ *egress*.

10.8 *Fitting* pencahayaan normal, esensial, dan *egress*/ *escape* biasanya harus diberi energi untuk memenuhi kebutuhan.

10.9 Pencahayaan *egress*/ *escape*

10.9.1. Pencahayaan *egress*/ *escape* harus dipasang di semua *area* strategis seperti *escape way*, *walk way*, *exit door*, dan lain-lain untuk memberikan penerangan yang cukup untuk memungkinkan perpindahan personel secara aman jika terjadi kegagalan pencahayaan utama. *Escape lighting* harus diatur untuk memberikan *minimum illumination*/ penerangan bagi personel untuk mengidentifikasi dan mengikuti *escape routes* ke area *muster* dan pengungsian yang ditentukan sebagaimana didefinisikan pada *process safety layout drawing*.

10.9.2. Pencahayaan *escape* harus sesuai untuk Zona 1 di *substation*, *power plant switch room*, *instrument satellite house, operator shelter*, dan *analyser shelter.*

10.10 Pencahayaan *Emergency*/ *Essential*

10.10.1. Pencahayaan *emergency* harus tipe LED *fixture*, dan harus

in outdoor areas to permit safe movement of personnel in normal operating areas during power outages.

disediakan di *area* luar ruangan untuk memungkinkan pergerakan personel yang aman di *area* operasi normal selama tidak ada suplai listrik.

10.10.2. Approximately 20% of the total number of lighting fixtures in the process and important utility areas such as around boiler, generator and air compressor shall be provided as emergency lighting. Emergency lighting shall not be required at operation stages of towers, vessels and tanks.

10.10.2. Sekitar 20% dari jumlah total *fixture* lampu dalam proses dan *area* utilitas penting seperti di sekitar *boiler, generator*, dan *air compressor* harus dipasang sebagai *emergency lighting*. Pencahayaan *emergency* tidak diperlukan pada tahap operasi *tower, vessel*, dan tangki.

10.10.3. Power for emergency lighting shall be supplied from a distribution line backed up by an emergency diesel generator (EDG). There shall be separate distribution panels fed from the EDG.

10.10.3. *Power* untuk pencahayaan *emergency* harus disediakan dari jalur distribusi yang disuplai oleh *Emergency Diesel Generator* (EDG). Harus memiliki panel distribusi terpisah dari EDG.

10.10.4. Emergency lighting will be provided with self-contained battery backup at strategic locations such as platform, entrance, stairway, etc.

10.10.4. Pencahayaan *emergency* akan dipasang dengan cadangan baterai *self-contained* di lokasi strategis seperti *platform, entrance, stairway*, dll.

10.10.5. Minimum 10 lux shall be kept in operation areas where average 70 lux is required in the normal condition.

10.10.5. Pencahayaan harus dijaga minimum 10 *lux* di *area* operasi di mana rata-rata 70 *lux* diperlukan dalam kondisi normal.

10.11 In the control rooms including ISH, 30% of lighting shall be connected to the Essential lighting system. In substations, electrical switch rooms and outdoor areas 20% of the lighting shall be powered from essential supply.

10.11 Di *control room* termasuk ISH, 30% pencahayaan harus terhubung ke sistem pencahayaan *essential*. Di *substation*, *electrical switch room* dan *area* luar ruangan 20% pencahayaan harus dengan *power* dari suplai *essential.*

10.12 Lighting fixtures shall be arranged to uniform illumination on the working surfaces and normally should be symmetrically arranged.

10.12 *Fixture* lampu harus diatur untuk menerangi permukaan secara merata dan biasanya harus diatur secara simetris.

10.13 Lighting fixtures installed on tower

10.13 *Fixture* lampu yang dipasang pada *tower*

platforms shall be accessible from the floor of platforms or structure ladders.

platform harus dapat diakses dari lantai *platform* atau struktur *ladder*.

10.14 The lighting fixtures shall not be arranged directly over equipment having exposed moving parts or which emits appreciable heat or vapor.

10.14 *Fixture* lampu tidak boleh diatur langsung di atas peralatan yang bersentuhan dengan bagian yang bergerak atau yang memancarkan panas atau uap yang cukup.

10.15 Flood lighting fixtures shall be arranged at a sufficient elevation so as not to be objectionable or blinding to personnel.

10.15 *Flood lighting fixture* harus diatur pada ketinggian yang cukup agar tidak menyulitkan personel.

10.16 Flood lighting should be arranged for general illumination of outdoor open areas.

10.16 *Flood lighting* harus diatur untuk penerangan umum area terbuka di luar ruangan.

10.17 Flood lighting should be installed on the structures as far as practical.

10.17 *Flood lighting* sedapat mungkin harus dipasang pada struktur.

10.18 LED lights should be used in the buildings or shelters with very high roofs, such as in compressor shelters.

10.18 Lampu LED harus digunakan di bangunan atau *shelter* dengan atap yang sangat tinggi, seperti di *compressor shelter.*

10.19 Lighting fixtures for synchronous machines shall be designed to prevent stroboscopic effect (can not check motor running by eyes). The same phase circuits are not applied for the lighting fixtures side by side.

10.19 *Lighting fixture* untuk *synchronous machine* harus didesain untuk mencegah efek *stroboscopic* (tidak dapat memeriksa motor yang berjalan dengan mata). Fase sirkuit yang sama tidak diterapkan untuk *fixture* lampu yang berdampingan.

10.20 Outdoor general plant lighting and street lighting shall be controlled by a photocell located at each substation.

10.20 Penerangan umum kilang yang dipasang di luar ruangan dan penerangan jalan harus dikendalikan oleh *photocell* yang terletak di setiap *substation*.

10.21 Each lighting fixture shall be identified on the layout drawings with a number indicating the panel and circuit from which the fixtures are fed.

10.21 Setiap *fixture* lampu harus diidentifikasi pada gambar tata letak dengan angka yang menunjukkan *panel* dan ruang sirkuit tempat input *fixture.*

10.22 Wiring systems and lighting fixtures shall be routed and located to maintain sufficient overhead clearance for periodical maintenance and repair work on nearby equipment and structures.

10.22 Sistem *wiring* dan *fixture* lampu harus diarahkan serta ditempatkan untuk mempertahankan kelonggaran *overhead* yang cukup untuk pekerjaan pemeliharaan dan perbaikan berkala pada peralatan serta struktur terdekat.

10.23 Flood lighting may be used for general illumination of outdoor open areas such as

10.23 *Flood lighting* dapat digunakan untuk penerangan umum area terbuka luar

exchanger tube pulling areas.

10.24 Lighting fixtures for general illuminates shall be mounted 3.0 m (10 feet) or more above the finished floor or grade. (Minimum 2.0 m on Platform is acceptable. If headroom is limited, the minimum height shall be 2.4 m (8 feet). Any other exceptions shall be approved by Owner.

10.25 Aircraft obstruction lighting fixtures provided at Plant flare and Antenna tower shall have safe access for maintenance by means of permanent ladders and platforms.

10.26 Local lighting panels for lighting and socket outlets are centrally located in the area to be serviced and are conveniently accessible for operation.

10.27 When local lighting panels are installed in hazardous areas, they shall be suitable for the areas.

11. POWER SUPPLY

11.1 Lighting fixtures shall be economically supplied from low-voltage power systems, 3 phase 4 wire (R-N, Y-N, B-N) or single phase 2 wire (L-N).

11.2 The circuits shall be configured to balance load per each phase.

11.3 Power for outdoor lighting fixtures shall receive electrical power from a locally installed lighting panel board.

11.4 The branch circuits for lighting are provided in:

a. Lighting Panels

b. Local Lighting Panels in plant area

11.5 Power for street lighting or Area lighting are generally supplied from :

ruangan seperti *exchanger tube pulling area*.

10.24 *Lighting fixture* untuk penerangan umum harus dipasang 3.0 m (10 ft) atau lebih di atas lantai atau *grade*. (Minimum 2.0 m pada *platform* dapat diterima. Jika *headroom* terbatas, tinggi minimum adalah 2.4 m (8 ftt). Jika ada pengecualian lainnya harus disetujui oleh Pemilik.

10.25 *Fixture* lampu *Aircraft obstruction* yang disediakan di *Plant flare* dan *Antenna tower* harus memiliki akses yang aman untuk pemeliharaan melalui tangga vertikal serta *platform* permanen.

10.26 Panel pencahayaan lokal untuk pencahayaan dan *socket outlet* secara terpusat diletakkan di *area* untuk di servis serta mudah diakses untuk pengoperasian.

10.27 Ketika panel pencahayaan lokal dipasang di area *hazardous*, harus sesuai untuk area tersebut.

11. *POWER SUPPLY*

11.1 *Fixture* lampu harus disuplai secara ekonomis dari sistem *power* tegangan rendah, 3 *phase* 4 *wire* (R-N, Y-N, B-N) atau *phase* tunggal 2 *wire* (L-N).

11.2 Sirkuit harus dikonfigurasi untuk menyeimbangkan beban setiap *phase*.

11.3 *Power* untuk *outdoor lighting fixture* harus menerima *power* listrik dari *lighting panel board* yang dipasang secara lokal.

11.4 Sirkuit cabang untuk pencahayaan disediakan di:

a. Panel *Lighting*

b. Panel *Lighting* lokal di *area* kilang

11.5 *Power* untuk penerangan jalan atau penerangan *area* umumnya disediakan

a. The power for street lights are generally supplied from the low voltage distribution panels in the substation.

b. Street lighting shall generally be automatically controlled by a photocell on timer with override manual switch.

dari:

a. *Power* untuk lampu jalan umumnya disuplai dari panel distribusi tegangan rendah di *substation*.

b. Penerangan jalan umumnya harus secara otomatis dikendalikan oleh *photocell* pada *timer* dengan *override manual switch*.

12. LIGHTING CIRCUIT

12.1 Maximum 6 (six) numbers of convenience receptacles can be connected to a branch circuit.

12.2 Street lighting and outdoor area lighting shall preferably be automatically controlled by either timer switch or photocell switch.

12.3 When a timer switch or photocell switch is provided, an "Auto-Manual" switch shall be provided to override automatic control.

12. SIRKUIT PENCAHAYAAN

12.1 Maksimum jumlah *convenience receptacles* dapat dihubungkan ke sirkuit cabang adalah 6 (enam).

12.2 Penerangan jalan dan penerangan area luar ruangan sebaiknya dikontrol secara otomatis oleh *timer switch* atau *photocell switch.*

12.3 Ketika *timer switch* atau *photocell switch* disediakan, "*Auto-Manual" switch* harus disediakan untuk *override* kontrol otomatis.

13. CABLING (WIRING) METHODS

13.1 Cable system shall apply for lighting power supply and control, unless otherwise specified.

13.2 Cable (wires) installation in the following places should be avoided as far as practical.

a. Places where cables (wires) may be damaged by other construction work.

b. Places were crossed over foundations of structures and equipment.

c. Places where exposed to severe vibrations.

d. Places where cables may be corroded by leaked chemicals.

13. METODE *CABLING* (*WIRING*)

13.1 Sistem kabel harus berlaku untuk *lighting power supply* dan kontrol, kecuali ditentukan lain.

13.2 Instalasi kabel (*wire*) di tempat-tempat berikut ini sedapat mungkin harus dihindari.

a. Tempat di mana kabel (*wire*) dapat rusak oleh pekerjaan konstruksi lainnya.

b. Tempat-tempat yang menyeberangi struktur fondasi dan peralatan.

c. Tempat-tempat di mana terkena getaran yang rusak.

d. Tempat di mana kabel mungkin terkorosi oleh bahan kimia yang bocor.

14. LIGHTING POLE

14.1 Flood lighting poles shall be hot dipped galvanized steel. Height of the pole and swiveling requirement (if applicable), will be stated in the Material Requisition.

14.2 Street lighting poles shall be hot dipped galvanized steel. Height of the pole and swiveling requirement (if applicable), will be stated in the Material Requisition.

14.3 Perimeter Security fence lighting poles shall be hot dipped galvanized steel. Height of the pole will be stated in the Material Requisition.

14.4 Flood lighting, street lighting, and perimeter security fence lighting poles shall be complete with base plate, wiring compartment, all accessories for fixation and installation with a base board for junction box mounting. Junction box and internal components within the wiring compartment of the pole shall be suitable for the hazardous area the pole is required for.

14. TIANG LAMPU

14.1 Tiang *flood lighting* harus dari *hot dipped galvanized steel*. Ketinggian dari persyaratan tiang dan *swiveling* (jika berlaku), akan dinyatakan dalam *Material Requisition.*

14.2 Tiang *street lighting* harus *hot dipped galvanized steel*. Ketinggian dari persyaratan tiang dan *swiveling* (jika berlaku), akan dinyatakan dalam *Material Requisition.*

14.3 Tiang penerangan pagar keamanan *perimeter* harus *hot dipped galvanized steel*. Ketinggian dari tiang akan dinyatakan dalam *Material Requisition.*

14.4 *Flood lighting*, penerangan jalan, dan tiang penerangan pagar keamanan *perimeter* harus lengkap dengan *base plate*, *wiring compartment*, semua aksesori untuk fiksasi dan pemasangan dengan papan dasar untuk mounting *junction box*. *Junction box* dan komponen internal di dalam kompartemen kabel tiang harus cocok untuk *hazardous area* yang diperlukan tiang.

15. LOCAL LIGHTING PANEL

15.1 Lighting panel shall be provided with one spare circuit space for every 5 (five) active circuits.

15.2 Neutral conductors should be of the same size as of the circuit line conductors.

15.3 If non-metallic junction boxes are used, internal bonding plates shall be incorporated when electrical continuity must be maintained.

15. PANEL *LIGHTING* LOKAL

15.1 Panel pencahayaan harus disediakan dengan satu ruang sirkuit cadangan untuk setiap 5 (lima) sirkuit aktif.

15.2 Konduktor netral harus memiliki ukuran yang sama dengan konduktor *circuit line.*

15.3 Jika *junction box* non-logam digunakan, *internal bonding plate* harus dimasukkan ketika kontinuitas listrik harus dipertahankan.

16. ILLUMINATION LEVEL

16.1 Unless otherwise specified, "Illumination Level" in **APPENDIX A** shall be considered as a design base.

16.2 The average illumination levels shall be obtained by calculation or isolux or iso footcandle chart provided by the manufacturer. For illumination level calculation, reference shall be made to other design manuals.

16.3 Unless otherwise specified, 0.7 of maintenance factor shall be applied for obtaining the specified illumination level in open area and 0.85 in covered area. For illuminating level calculation, reference shall be made to other design manuals.

16. LEVEL ILUMINASI

16.1 Kecuali ditentukan lain, "*Illumination Level*" **dalam LAMPIRAN A** akan dianggap sebagai dasar desain.

16.2 Level iluminasi rata-rata harus diperoleh dengan perhitungan atau *isolux* atau kurva *iso footcandle* yang disediakan oleh pembuat. Untuk perhitungan level iluminasi, referensi harus dibuat ke manual desain lainnya.

16.3 Kecuali ditentukan lain, 0.7 faktor pemeliharaan akan diterapkan untuk mendapatkan level iluminasi yang ditentukan di *area* terbuka dan 0.85 di *area* tertutup. Untuk perhitungan level iluminasi, referensi harus dibuat untuk manual desain lainnya.

APPENDIX A

LAMPIRAN A

1. ILLUMINATION LEVEL

ILLUMINATION LEVEL

1) PROCESS AREA

AREA PROSES

a) GENERAL

Umum

LOCATION LOKASI	ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
Pipe Rack *Pipe Rack*	50	Floor or Ground Surface Permukaan Lantai atau Tanah	With pump rows Dengan *pump row*
	20		Without pump rows Tanpa *pump row*
Pump Rows *Pump Row*	50		
Compressor Shelters/Room *Compressor Shelter*/ Room	200		
Furnace *Furnace*	30		
Operating Platforms *Operating Platform*	50		
Ordinary Platforms *Ordinary Platform*	20		
Walkways Ladders, Stairs *Walkways Ladder, Stair*	50		Used frequently Sering digunakan
	10		Used Rarely Jarang digunakan

Maintenance Area *Maintenance Area*	5		
General Work Area *Area* Kerja Umum	50		
Heat Exchanger Area Area *Heat Exchanger*	20		
Tank Yard *Tank Yard*	10	Grade *Grade*	
General Offices Kantor Umum	400	Desk Meja	

b) CONTROL ROOM

CONTROL ROOM

LOCATION **LOKASI**	**ILLUMINATION LEVEL (LUX)** ***ILLUMINATION LEVEL (LUX)***	**ELEVATION of ILLUMINATED SURFACE** **KETINGGIAN dari PERMUKAAN ILLUMINATION**	**REMARKS** **KETERANGAN**
Instrument / Control Panel *Instrument / Control Panel*	350	150 cm above floor 150 cm di atas lantai	Vertical Illumination *Illumination* Vertikal
	300	45 cm above floor 45 cm di atas lantai	
Control Consoles *Control Console*	350	75 cm above floor 75 cm di atas lantai	
Rear Side of Control Panels Sisi Belakang dari *Control Panel*	100	Floor Surface Permukaan Lantai	
Control Room in General *Control Room* di Umum	300		

LOCATION LOKASI	ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
DCS Room with CRT DCS *Room* dengan CRT	500	75 cm above floor 75 cm di atas lantai	Illumination as recommended by computer manufacture *Illumination* sesuai dengan rekomendasi dari pembuat

2) NON PROCESS AREA

***AREA* NON PROSES**

1) GENERAL

UMUM

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
Around outdoor pumps Sekitar *outdoor pump*		50	Floor or Ground Surface Permukaan Lantai atau Tanah	
Boiler/ Compressed *Boiler/ Compressed* Air Facility *Air Facility*	Indoor Plant Kilang *Indoor*	150	Floor or Ground Surface Permukaan Lantai atau Tanah	In The House / Shelter Dalam *House / Shelter*
	Outdoor Plant Kilang *Outdoor*	50		Operating Platforms only Hanya *Operating Platform*

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
Tank Yard *Tank Yard*	Tank (Stairs, Ladders Instrument) *Tank* (*Stair, Ladder Instrument*)	5	Floor or Ground Surface Permukaan Lantai atau Tanah	Only when specifically required Hanya jika ada ketentuan tertentu
	Valve Handling Points *Valve Handling Point*	20		
Land Loading Facility Fasilitas *Land Loading*	General Umum	20	Floor or Ground Surface Permukaan Lantai atau Tanah	Around Loading rack (including railway points) Grand Sekitar *Loading rack* (termasuk *railway point*) *Grand*
	Loading Points *Loading Point*	100		Around Loading Arm Sekitar *Loading Arm*
Marine Loading/ Crude	Road/Walk way *Road/ Walkway*	10		

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
Terminal *Marine Loading/ Crude Terminal*	Loading and Unloading Structures or Racks *Loading* dan *Unloading Structure* atau *Rack*	50	Floor or Ground Surface Permukaan Lantai atau Tanah	Also applicable to valve handling rack Juga berlaku untuk *valve handling rack*
	Offices Kantor	350		
Drum or LPG Filling *Drum* atau LPG *Filling*	General Umum	10	Floor or Ground Surface Permukaan Lantai atau Tanah	
	Measuring Points Mengukur *Point*	100		
Substation *Substation*	Outdoor Substations *Outdoor Substation*	20	Floor or Ground Surface Permukaan Lantai atau Tanah	
	Indoor Substations *Indoor Substation*	150		
	Outdoor Starter Racks *Outdoor Starter Rack*	20		

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
Road Jalan	Heavy Traffic *Heavy Traffic*	4	Road Surface Permukaan Jalan	
	Light Traffic *Light Traffic*	4		Only when specifically req. Hanya jika ada ketentuan tertentu
Fence Pagar		*1	Ground Surface Permukaan Tanah	*1 refer to job specification *1 melihat spesifikasi pekerjaan
Parking Areas *Area* Parkir		2	Ground Surface Permukaan Tanah	

2) BUILDING

BANGUNAN

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
OFFICE, ETC	Room in which related or important business is executed (e.g. Drawing and Accounting Rooms, Library, etc)	700	75 cm above Floor 75 cm di atas Lantai	

	Ruang di mana bisnis terkait atau penting dijalankan (misalnya *Drawing* dan *Accounting Room*, *Library*, dll)			
	Normal Office (Office room, Conference Room, Telephone Operator's Room, etc) Kantor Normal (*Office room, Conference Room, Telephone Operator Room,* dll)	400		
	Executives's room, Reception Room *Executive room, Reception Room*	400	75 cm above Floor 75 cm di atas Lantai	Illumination for the above shall be applied as required
	Receptionist's desk, Stairs, Kitchen, Entrance, Hall, Corridor *Receptionist desk*, *Stair*, *Kitchen, Entrance, Hall, Corridor*	150	75 cm above Floor 75 cm di atas Lantai	
	Computer Room *Computer Room*	600		Illumination as recommended by computer maker *Illumination*/ penerangan seperti yang direkomendasikan oleh pembuat komputer
	Machinery/Tool Rooms (air			

	Conditioning Exchange, Electrical Rooms, etc) *Machinery/ Tool Room* (*Air Conditioning Exchange, Electrical Room,* dll)	150		
	Clinic Klinik	700		Spot illumination shall be applied as required Titik penerangan harus diterapkan sesuai kebutuhan
LABORATORY	Analysis, Experiment, Quality Control Rooms Analisis, Eksperimen, *Quality Control Room*	500	75 cm above Floor 75 cm di atas Lantai	Spot Illumination shall be applied as required Titik penerangan harus diterapkan sesuai kebutuhan
	Pilot Plant, Special Experiment Apparatus *Pilot Plant, Special Experiment Apparatus*	300	Floor Surface Permukaan Lantai	
	Wash Rooms *Wash Room*	300	75 cm above Floor 75 cm di atas Lantai	
	Storage Rooms *Storage Room*	150	Floor Surface Permukaan Lantai	
WAREHOUSE	Warehouse for bulky items *Warehouse* untuk *item bulky*	50	Floor Surface Permukaan Lantai	Spot Illumination shall be applied as required Titik penerangan harus diterapkan sesuai kebutuhan
	Outdoor stockyard	10	Floor Surface	

	Outdoor stockyard		Permukaan Lantai	
	Warehouse for Small Items *Warehouse* untuk *Item* yang Kecil	150	Ground Surface Permukaan Tanah	
	Storekeeper Countertops *Storekeeper Countertop*	300	75 cm above Floor 75 cm di atas Lantai	
MAINTENANCE SHOP	Machine Shop (Heavy) *Machine Shop* (*Heavy*)	250	Floor Surface Permukaan Lantai	
	Machine Shop (Medium), auto Parts Machine Shop *Machine Shop* (*Medium*), *auto Part Machine Shop*	300	75 cm above Floor	Spot Illumination Shall be Supplied as Required
	Machine Shop (Small) *Machine Shop* (Kecill)	300		
	Sheet Metal Work Shop *Sheet Metal Work Shop*	200		
	Electrical Repair Shop *Electrical Repair Shop*	350		
	Instrument Repair Shop *Instrument Repair Shop*	350		

CHANGE ROOM	Locker Room *Locker Room*	150	Floor Surface Permukaan Lantai	
	Toilet *Toilet*	100		

LOCATION LOKASI		ILLUMINATION LEVEL (LUX) *ILLUMINATION LEVEL (LUX)*	ELEVATION of ILLUMINATED SURFACE KETINGGIAN dari PERMUKAAN ILLUMINATION	REMARKS KETERANGAN
GUARD HOUSE	Time Card Rack *Time Card Rack*	100	Floor Surface Permukaan Lantai	
	Check Point *Check Point*	150		
	Guards Room *Guard Room*	300	75 cm above floor 75 cm di atas lantai	
MESS HALL	Dining Room *Dining Room*	300	75 cm above floor 75 cm di atas lantai Floor Surface Permukaan Lantai	
	Catering Room *Catering Room*	300		
	Kitchen *Kitchen*			

	Lounge *Lounge*	100	Floor Surface Permukaan Lantai	
GARAGE AND FIRE STATION	Garage *Garage*	100	Floor surface Permukaan Lantai	
	Driver's (Firefighters room) *Driver' (Firefighter room)*	200	75 cm above floor 75 cm di atas lantai	