



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 081

Lighting

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1. Scope

The purpose of this specification is to define the main lighting criteria in order to specify:

- The COMPANY lighting installations,
- The minimum requirements for manufacturing/inspection/testing of luminaires and associated accessories.

This specification shall cover:

- Onshore installations,
- Offshore platforms,
- Floating Units (FPSO, FSO, PSO, FPU,...),
- COMPANY offices and buildings.

In hazardous areas, the luminaire type shall be selected in accordance with the COMPANY general specification **GS ELE 079**.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Design, construction and inspection shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws, and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and regulations shall be used,
- COMPANY Particular Specifications and data sheet (if any),
- COMPANY General Specifications,
- Applicable International Organisation of Standardisation (ISO) Standards,
- Applicable International Electro-technical Commission (IEC) Standards,
- Applicable CENELEC Standards,
- Applicable International Commission on Illumination (CIE) Technical Reports.

Standards

Reference	Title
IEC 60050-845	International Electro-technical Vocabulary (IEV) – Chapter 845: Lighting
IEC 60064	Tungsten filament lamps for general service
IEC 60081	Tubular fluorescent lamps for general lighting service
IEC 60155	Glow-starters for fluorescent lamps
IEC 60188	High-pressure mercury vapour lamps
IEC 60400	Lamp-holders for tubular fluorescent lamps and starter-holders
IEC 60432	Safety specification for incandescent lamps. Tungsten filament lamps for domestic or similar general lighting purposes
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60598	Luminaires
IEC 60662	High pressure sodium vapour lamps
IEC 60921	Ballasts for tubular fluorescent lamps – Performance requirements
IEC 60923	Ballast for discharge lamps (excluding tubular fluorescent lamps) – Performance requirements
IEC 60925	DC supplied electronic ballasts for tubular fluorescent lamps – Performance requirements
IEC 60927	Starting devices (other than glow starters) – Performance requirements
IEC 60929	AC supplied electronic ballasts for tubular fluorescent lamps - Performance requirements
IEC 60968	Self-ballasted lamps for general lighting services – Safety requirements
IEC 60969	Self-ballasted lamps for general lighting services – Performance requirements
IEC 61000-3-2	Electromagnetic compatibility (EMC) - Part 3-2: Limits – Limits for harmonic current emissions (equipment input current up to or equal at 16 A per phase)
IEC 61167	Metal halide lamps
IEC 61347	Lamp control-gear
IEC 61547	Equipment for general lighting purposes – EMC immunity requirements
IEC 62035	Discharging lamps (excluding fluorescent lamps) – Safety specification

Reference	Title
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
ISO 3864	Safety colours and safety signs
EN 1838	Lighting applications – Emergency lighting
EN 12464	Light and lighting – Lighting of work places - Part 1 : Indoor lighting
prEN 12464	Light and lighting – Lighting of work places - Part 2 : Outdoor lighting
EN 13032	Light and lighting – Measurement and presentation of photometric data of lamps and luminaires - Part 1 : Measurement - Part 2 : Presentation of data for indoor and outdoor work places
EN 12665	Light and lighting – Basic term and criteria for specifying lighting requirement

Professional Documents

Reference	Title
CIE 17	International lighting vocabulary
CIE 97	Maintenance of indoor electric lighting system
CIE 129	Guide for lighting exterior work areas

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS ELE 079	Electrical apparatus for explosive gas atmospheres

3. Definitions

General light and lighting terms are defined in the following standards:

- [IEC 60050 – 845](#) : International Electro-technical Vocabulary (IEV) – Chapter 845: Lighting,
- [EN 12665](#) : Light and lighting – Basic term and criteria for specifying lighting requirement,
- [CIE 17](#): International lighting vocabulary.

3.1 Light

Light is the universal and essential attribute of all perceptions and sensations that are peculiar to the visual system.

3.2 Lighting

Lighting is the application of light to a scene, objects or their surroundings so that they may be seen. This term is also used colloquially with the meaning “lighting system” or “lighting installation”.

The lighting system is split into three systems:

- Normal lighting.
- Essential lighting:
 - 100% of luminaires inside technical and control rooms
 - 30 % minimum of total number of luminaires in other areas,
- Emergency lighting: Selected luminaires of the above essential system, which illuminate escape routes, emergency exits and ladders and panels used for re-starting operation.

3.3 Lamps

Lamp is the source made in order to produce an optical radiation, usually visible.

There are 2 lamp types:

- Incandescent lamps;
- Discharge lamps.

3.4 Luminaires

Luminaire is the apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes all the parts necessary for supporting, fixing and protecting the lamps, but not the lamps themselves, and where necessary circuit auxiliaries (lamp control gears) together with the means for connecting them to the supply .

The term “lighting fitting” is to be prohibited.

3.5 Lamp control gears

One or more components between the supply and one or more lamps which may serve to transform the supply voltage, limit the current of the lamp(s) to the required value, provide starting voltage and preheating, prevent cold stating, correct power factor or reduce ratio interference.

3.6 Work plane; working plane

Work plane or working plane is the reference surface defined as the plane at which work is usually done. In indoor lighting and unless otherwise indicated, this plane is assumed to be a horizontal plane 0.85m above the floor and limited by an obstacle as walls or structure for instance. For outdoor lighting, this plane is the floor level. The work plane is composed of the task area and the surrounding area.

Task area is a partial area in the work place in which the visual task is carried out. This task area shall be the work plane and shall be illuminated as uniformly.

Surrounding area is a band surrounding the task area within the vision field. The illuminance of surrounding areas may be lower than the task area but sufficient to avoid visual stress and discomfort. Also, the surrounding areas illuminations shall be established in conjunction with the attached task area ones.

3.7 General lighting terms

Initial illuminance (E_{in} in lux) is the average illuminance on the task area or the surrounding area, based on initial lamp lumens (ϕ_{in}) when the installation is new and the room surfaces are clean.

$$E_{in} = (\phi_{in} \times n \times N \times UF) / A$$

ϕ_{in} : the initial luminous flux or the initial lamp lumens of the light source;

n : the number of lamps per luminaire; N : the number of luminaries;

UF : utilization factor [845-09-64] for the luminaire in the room which is the ratio of the luminous flux received by the reference surface to the sum of the rated lamp luminous of the lamps of the installation;

A : area to be illuminated.

Glare is the condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or extreme contrasts.

Reflectance is the ratio of the reflected luminous flux to incident flux in the given condition.

3.8 Lighting criteria

Lighting shall be designed and measured in accordance with an illuminance grid system.

This illuminance grid system shall be established for task and surrounding areas which define the studied work plane. It shall indicate the points where the calculated and measured lighting criteria are applied. It is composed of identical square cells.

The cell size is defined by:

$$p = 0.2 \times 5^{\log d}$$

where d is the longest dimension (m) of the studied area (task or surrounding area).

Four criteria are required to define lighting:

- **Maintained illuminance (E_m):**

Minimum average value to be maintained between two scheduled maintenance operations.

- **Illuminance uniformity (U):**

Ratio of the minimum illuminance to average illuminance on a outdoor work plane.

- **Glare Rating limit (UGR_L for indoor and GR_L for outdoor):**

Limit of glare to avoid errors, fatigue and accidents. This limit is established by the International Commission on Illumination (CIE).

- **Minimum colour rendering indices (R_a):**

Ratio that quantifies the visual performances and provides an objective indication of the colour rendering properties of a light source.

The maximum value of R_a is 100 and it decreases up to 20 (minimum safety indices) with decreasing colour rendering quality. The lamp type choice allows to assure a R_a minimum value for the studied areas:

- $R_a < 20$ shall not be considered,
- $20 \leq R_a < 40$: High pressure sodium lamps,
- $40 \leq R_a < 60$: Mercury lamps,
- $60 \leq R_a < 80$: Fluorescent and metal halide lamps,
- $R_a \geq 80$: Incandescent, fluorescent and metal halide lamps.

3.9 Maintenance ratio and criteria

Two maintenance criteria are required to define lighting:

- **Maintenance schedule:**

Set of instructions specifying maintenance cycle and servicing procedures. Maintenance cycle is a repetition of lamp replacement, lamp/luminaire cleaning and room surface cleaning intervals;

- **Maintenance Factor (MF):**

Ratio of illuminance (E_m) produced by the lighting system after a certain period to the illuminance (E_{in}) produced by the system when new:

$$MF = LLMF \times LSF \times LMF \times RSMF = E_m / E_{in}$$

Lamp Lumen Maintenance Factor (LLMF) : ratio of the luminous flux of a lamp at a given time in its life to initial luminous flux in accordance with the lamp type.

Lamp Survival Factor (LSF): fraction of the total number of lamps which continue to operate under defined conditions and switching frequency at a given time in accordance with the lamp type.

Luminaire Maintenance Factor (LMF): ratio of the light output ratio of a luminaire at a given time to the initial light output ratio in accordance with the luminaire type and the dust environments.

Room Surface Maintenance Factor (RSMF): ratio of room surface reflectance at a given time to the initial reflectance value in accordance with the room indexes and the dust environments.

In particular:

LLMF and LSF shall be given by Lamp MANUFACTURER in accordance with the lamp types and the re-lamping schedules.

LMF and RSMF shall be given by Luminaire MANUFACTURER in accordance with the luminaire enclosures and cleaning intervals.

For outdoor lighting, RSMF = 1.

4. Lighting criteria requirements

Lighting criteria requirements shall be specified in accordance with:

- service conditions: environmental, design and operating constraints,
- type of location: outdoor, indoor, hazardous and safe areas.

4.1 General requirements

CONTRACTOR shall prove by calculation notes that the E_m , U , UGR_L / GR_L and R_a meet the required limit values.

The surrounding area is defined as:

- for indoor location: 0,5 m,
- for outdoor location: 3 m .

Location	Maintained illuminance E _m (lux)		U	UGR _L / GR _L	R _a
	Task area	Surrounding area			
A - Outdoor lighting					
General Process and utility areas	50	NA	0.4	45	20
Process and utility areas					
Compressors, pumps, collectors, exchangers, separators, generator areas	100	50	0.5	45	40
Sampling points and other working points	200	50	0.5	45	40
Ladders and stairs	100	50	0.4	45	40
Furnace	50	50	0.4	50	40
Instruments	200	50	0.5	45	40
Local control panels	200	50	0.5	45	40
Onshore storage area					
• * General area	10	NA	0.4	50	20
• * Tank ladders, access and gauge areas	10	10	0.4	50	20
Loading area (truck, boat)					
• * General area	50	NA	0.4	50	20
• * Loading point	200	50	0.5	45	40
Port					
General area	20	NA	0.25	55	20
Handling areas	50	20	0.25	55	20
Loading station	100	50	0.4	45	40

Location	Maintained illuminance E _m (lux)		U	UGR _L / GR _L	R _a
	Task area	Surrounding area			
Special areas					
Boat landing	100	50	0.4	45	40
Life boats / muster areas	200	50	0.4	50	40
Helideck	100	20	0.4	45	40
Street lighting					
Road	10	10	0.4	45	20
Fences	10	10	0.4	50	20
Security fence and junction points (note 1)	50	20	0.4	50	20
Car park	20	20	0.4	45	20
Walking areas	10	10	0.4	45	20
B - Indoor lighting					
• Living quarters					
• Bathrooms	200	200	N.A.	25	80
• Bedrooms	100	100	N.A.	22	80
• Lounges, bars and restaurants, TV lounges (note 2)	200	200	N.A.	22	80
• Kitchens	500	200	N.A.	22	80
• Laundry rooms	300	300	N.A.	22	80
• Air locks	100	100	N.A.	22	80
• Offices - Meeting rooms (note 2)	500	300	N.A.	19	80
• Lockers rooms – Showers – toilets	200	200	N.A.	22	80
• First aid rooms	500	300	N.A.	19	80
• Prayer rooms (note 2)	500	300	N.A.	19	80
• Stairs	150	150	N.A.	25	40

Location	Maintained illuminance E_m (lux)		U	UGR_L / GR_L	R_a
	Task area	Surrounding area			
Electrical & technical rooms	300	300	N.A.	22	80
Instrumentation rooms	500	300	N.A.	22	80
Control rooms (Note 2)	750	500	N.A.	16	80
Stores	300	200	N.A.	25	60
Laboratories	500	300	N.A.	19	80
Workshops	300	300	N.A.	25	60
Administrative buildings					
• Office	500	300	N.A.	19	80
• Gate house	500	300	N.A.	19	80
• Corridors	100	100	N.A.	25	80
• Fire station	200	200	N.A.	25	60

Note 1: Unless otherwise specified by local regulations.

Note 2: Dimmer controlled.

4.2 Particular requirements

4.2.1 Required lamp list

Lamp types required on COMPANY installations shall be limited to:

- Incandescent lamps: tungsten,
- Discharge lamps: high pressure mercury, high pressure sodium, metal halide and fluorescent.

4.2.2 Additional luminaires

When required, portable lighting shall be provided by CONTRACTOR but not considered for illuminance calculation.

4.2.3 Emergency lighting

The emergency lighting systems shall be:

- considered as a vital electrical system,
- suitable for use in zone 1 hazardous area,
- supplied by dedicated batteries with an autonomy of 90 minutes providing no delay to illuminate upon loss of normal or essential lighting.

The number and the sitting of emergency lighting points shall be such as:

- the maximum distance between an escaping person and an emergency lighting point or between an escaping person and an "EXIT" sign or any other sign (refer to [ISO 3864](#)) used to materialise the exit route is 15 meters;
- on the escape route, an escaping person can see at least one downstream illuminated wall;
- each obstacle or change in direction can be easily identified by shadows formed by the emergency lighting or specifically illuminated if not achievable;
- Inside technical and control rooms, appropriate number emergency lighting points shall be installed to provide 90 minutes illumination of panels/switchboards used for re-starting operation.

Maintained illuminance (E_m) of emergency exit paths shall be:

- 10 lux, with a minimum of 1 lux at any point when normal or essential lighting disappear;
- 6 lux, with a minimum of 0,6 lux at any point when normal or essential lighting have disappeared for 60 minutes.

Minimum luminescence of the [ISO 3864](#) signs shall be 60 lumens.

Minimum colour rendering indices (R_a) shall be 40.

The emergency lighting luminaires shall be:

- in accordance with the [IEC 60598-2-22](#),
- with fluorescent lamps,

- with integrated Ni-Cd battery,
- ATEX certified category 2.

5. Lighting maintenance criteria requirements

Lighting maintenance criteria requirements shall be specified in accordance with:

- service conditions: environmental, design and operating constraints,
- type of location: outdoor, indoor, hazardous and safe areas.
- lighting criteria requirements.

The two maintenance criteria (maintenance schedule and maintenance factor) shall be defined at the beginning of lighting study.

5.1 Maintenance schedule requirements

The following maintenance schedule shall be considered..

5.1.1 Work plane locations and cleanliness categories

Two of the three cleanliness categories are specified following the work plane locations listed in the 4th Chapter board:

- "D" (dirty) for outdoor lighting, stores and workshops,
- "N" (normal) for indoor lighting (except the previous listed rooms).

5.1.2 Luminaire cleaning intervals

Cleanliness categories are associated with recommended inspection intervals:

- 1 year for the "D" work plane locations,
- 2 years for the "N" work plane locations.

5.1.3 Lamp types and re-lamping schedules

The re-lamping schedule is based on:

- lamp type,
- lamp burning hours,
- number of switching.

For information, the re-lamping interval approach is the following (in per unit versus incandescent lamp):

- Incandescent lamp: 1 p.u,
- Fluorescent lamp: 9 p.u,
- Metal halide lamp: 6 p.u,
- Mercury lamp: 9 p.u,
- High pressure sodium lamp: 15 p.u.

According to R_a requirements and re-lamping interval approach, the required COMPANY lighting lamp types are :

- for "D" work plane locations : high pressure sodium and fluorescent lamps;
- for "N" work plane locations:
 - except living quarters: fluorescent lamps;
 - living quarters: tungsten, metal halide and fluorescent lamps.
- Incandescent lamps shall be limited to portable lighting.

5.2 Maintenance factor

The Maintenance Factor shall be 0,7.

Higher Maintenance Factor may be considered if justified by calculation note, subject to COMPANY approval.

6. Luminaire and lamp requirements

6.1 Luminaire data sheet

Each luminaire shall be specified as follows:

- Protection mode according to environmental condition ([GS ELE 079](#));
- Lamp type;
- Number of lamps;
- Luminous intensity distribution: Symmetrical or Asymmetrical;
- Luminous flux distribution: Wide Angle or Narrow Angle;
- Power supply system:
 - Lamp control gears,
 - Electrical apparatus isolation: class I, class II or class III ([IEC60598-1](#));
- Supporting and fixing system:
 - Fixing systems : adjustable, portable, pendant, rise and fall pendant or recessed,
 - Height of supporting and fixing system,
 - Supporting systems: in/on un-flammable or flammable supporting surface;
- Maintenance factor: LMF and RSMF;
- Type test certificates.

Isolation Class II (or III) luminaires shall be provided in bathrooms.

6.2 Lamp data sheet

Each lamp shall be specified as follows:

- Luminaire;
- Radiant power or radiant flux (in W);

- Correlated colour temperature (T_{CP});
- Lamp burning hours;
- Maintenance factor: LLMF and LSF;
- Type test certificates.

The required T_{CP} of lamps for the living quarters and control rooms shall be above 5300 K.

6.3 Lamp control gear data sheet

Each lamp control gear shall be specified as follows:

- Lamp;
- Number of lamps;
- External power supply in charge to feed the luminaire:
 - the Voltage rated: High Voltage (HV), Low Voltage (LV) or Safety Extra Low Voltage (SELV),
 - the Current rated: Direct Current or Alternative Current;
- Lighting system: self contained or without;
- Their location: built-in , independent or integral;
- Type test certificates.

7. Minimum CONTRACTOR document requirements

As a minimum CONTRACTOR shall supply the following documents:

- Project Particular Lighting Specification which shall amend the present document,
- Project lighting general layout,
- Detailed lighting & emergency lighting arrangement drawings per work plane location (listed in Chapter 4),
- Project lighting maintenance schedule,
- Project lighting work plane location calculation notes,
- Project lighting material take-off document,
- Type test certificates,
- Project measurement lighting reports per work plane location (listed in Chapter 4).