# 18
# Miscellaneous Subjects

## 18.1 LIGHTING SYSTEMS

Normal lighting should provide approximately 75% of the total illumination an area of a plant that is densely filled with processing equipment and buildings. Sparsely filled areas such as road ways and perimeter fences can be fully illuminated with normal lighting, unless emergency escape routes exist in these areas.

Emergency lighting should therefore provide between 25% and 30% of the illumination in processing areas. These criteria generally apply to both outdoor and indoor locations, and to onshore and offshore installations. Emergency lighting should be supplied by power from emergency diesel generators, except for lighting that illuminates escape routes. Escape route lighting requires a source of battery power that should last for at least one hour from a loss of all other power sources. The battery may be integral with the lighting fitting or a common battery and local distribution panel for a room or group of rooms, access ways, corridors and the like. The lighting level for escape lighting does not need to be high, a typical value is 20 lux for indoor areas is adequate. Individual oil companies have their own recommendations on these subjects.

Offshore and marine installations are by nature very compact and therefore some additional requirements are generally required, especially with regard to escape routes. Escape lighting should be provided for exit doorways, sleeping cabins in the living quarters, stairways, walkways, corridors, lounges, recreation rooms, dining rooms and gallies. It is essential to illuminate embarkation stairways, helideck, helideck offices, survival craft stations, waiting room, and areas that are associated with personnel having to leave the facility in an organised manner. If in doubt provide more than is a minimum requirement.

Emergency lighting has some separate requirements to escape lighting. For example the personnel operating the plant need to be able to see and operate control panels, visual display units, start-up emergency generators and systems, carry out switching operations, test for hazardous gas, test certain equipment and generally manage an emergency situation. They require a minimum amount of emergency lighting. Consequently the following areas and functions need to be properly illuminated.

- Plant main control room and radio room.
- Emergency generator room or module.
- Main switchroom.
- Main generator room or module.

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- All areas in the living quarters.
- All workshops, stores, cranes and utility areas.
- Offshore installation manager (OIM) offices.
- Obstructed areas within the plant.
- Vent stacks and flare booms.
- Perimeter areas.

During an emergency the personnel should be able to access portable lamps and torches. These should be located adjacent to exit doors, in operational rooms, plant rooms, emergency accommodation areas, OIM's offices, central control room and muster areas. They should be provided with charger units and be suitable for zone 1 hazardous areas, and be capable of operating for at least five hours.

Where possible the control of lighting fittings should be from a non-hazardous area, i.e. one adjacent to the hazardous area, using double pole switches. The supply neutral should be switchable. In rare situations this may not be practical in which case a switchboard or distribution board suitable for the hazardous area and the environmental conditions will need to be installed e.g. Zone 1, IP55 or 56, with a suitable gas group and temperature class, see Chapter 10.

It is often a good practical consideration to use only lighting fittings in a plant that are suitable for Zone 1 areas that are also exposed to wet weather conditions e.g. IP66 enclosures of at least Ex (e) hazardous area types, unless of course they are installed indoors in areas where water sprays are not needed. Indoor process areas such as gas compressor modules require water-based fire-fighting deluge systems. Such locations require waterproof electrical fittings of all types, e.g. lighting, junction boxes, local control stations, local control panel. Locations such as control rooms, computer rooms, electronic equipment rooms, accommodation areas and offices do not require such hazardous area fittings, and good quality domestic or light industrial fittings are usually suitable and aesthetically acceptable.

Some areas are suitable for floodlighting and high-pressure sodium fittings can be used.

The incoming three-phase supply to the lighting distribution panels should be provided with four pole switches or circuit breakers, to ensure that the neutral is opened when the panel is de-energised for maintaining sub-circuits in hazardous areas. The sub-circuit loading should be arranged to give a balanced load on the incoming supply. Each sub-circuit will be a single-phase consumer, for which the single-phase two-wire supply can be taken between one phase and neutral of a four-wire system, or a single-phase two-winding step down transformer can be used. The use of a small transformer will ensure that the voltage required for the light fittings is well matched. Occasionally a 440 V three-phase supply is used throughout a plant, for which the line-to-neutral voltage is 254 V. A single- phase nominal voltage of 254 V is out of range for the products of some manufacturers of lighting fittings. A choice of 415 V/240 V, 400 V/230 V or 380 V/220 V would enable a wider choice of standard equipment to be used.

Fluorescent lamps should be chosen and located carefully where they illuminate rotating shafts, so as to avoid a stroboscopic effect that shows the shaft to appear stationary even though it is in fact rotating at a high speed.

Lighting schemes within modules and compact plant areas should be divided into at least two groups so that a supply failure does not put the whole area into darkness. This consideration applies to both normal and emergency schemes.

When designing a lighting circuit it is customary practice to size the cables so that the farthest lamp from the supply receives no less than 95% of its nominal voltage. In addition it is assumed that all the lighting fittings are energised when this design calculation is made.

### 18.1.1 Types of Lighting Fittings

As a general guide to the appropriate types of fittings that can be used, the following are suitable:

- Industrial weatherproof fluorescent usually double 40 watt tubes for non-hazardous general areas.
- Ex (e) certified and weatherproof fluorescent, also double 40 watt tubes, for hazardous areas.
- Ex (e) or Ex (d) certified and weatherproof floodlights of the SON-T type, for areas such as well-head, platform legs and sea surface lighting.
- Ex (e) or Ex (d) certified and weatherproof bulkhead fittings with a single 60 watt incandescent lamp.
- Ex (n) certified and weatherproof fluorescent with single or double tubes for Zone 2 and non-hazardous areas, and areas where corrosion and determination will be minimal.

Note that low-pressure sodium lamps are not generally permitted in hazardous areas because they are considered to be a risk with regard to igniting hazardous gases. Fittings made from aluminium and its alloys should be avoided because the oxide that invariably forms after a time is considered as a potential source of sparks caused by mechanical impact.

### 18.1.2 Levels of Illumination

The levels of illumination needed at different locations and within rooms are given as a general guide in Table 18.1.

**Table 18.1.** Illumination levels of onshore and offshore plants

| Location and equipment | Illumination level in lux, see Note 1 |
|---|---|
| Laboratory | 500 |
| Computer room | 500 |
| Radio room | 500 |
| Gymnasium | 500 |
| Medical treatment room | 500 |
| Pharmacy | 500 |
| Helicopter reception offices | 500 |
| Helicopter operations office | 500 |
| Administration offices | 400 to 500 |
| Drawing office | 400 |
| Library and reading room | 400 |
| Kitchen and galley | 300 to 500 |
| Manned process modules | 300 |
| Central control room | 300 Note 2 |

(*continued overleaf*)

**Table 18.1.** (*continued*)

| Location and equipment | Illumination level in lux, see Note 1 |
|---|---|
| Local control room | 300 |
| Laundry | 300 |
| Medical consulting room | 300 |
| Lecture room or theatre | 300 |
| Medical consulting room | 300 |
| Drillers console | 300 |
| Workshop | 300 |
| Print and reprographic room | 300 |
| Major rotating equipment areas and module | 200 |
| Major switchroom | 200 |
| Rear of control panels | 200 |
| Battery and UPS room | 200 |
| HVAC | 200 |
| Bulk storage room | 200 |
| Well-head area | 150 |
| Drill floor | 150 |
| Radio equipment room | 150 |
| Electronic equipment | 150 |
| Local equipment room | 150 |
| Food store | 150 |
| Dining and mess area | 150 |
| General recreation room | 150 |
| Projector presentation room | 150 |
| General storage room | 150 |
| Rest room | 150 |
| Visitors room | 150 |
| Wash room and showers | 150 |
| Toilets | 150 |
| General process areas | 100 |
| Mud pump area | 100 |
| Shale shaker area | 100 |
| Drilling sack store | 100 |
| Medical storage room | 100 |
| Locker rooms | 100 |
| Minor materials storage room | 100 |
| Corridors, stairs and ladders | 100 |
| Gauge glasses | 100 |
| Cinema | 100 |
| Elevators | 100 |
| Roof areas | 100 |
| Drilling derrick access points | 50 |
| Seawater level and below platform | 50 |
| Accommodation cabins | 50 |
| Outdoor walkways and access ways | 50 |
| Lifeboat and muster stations | 50 |

**Table 18.1.** (*continued*)

| Location and equipment | Illumination level in lux, see Note 1 |
|---|---|
| Material storage and handling yards | 50 |
| Road tanker loading areas | 25 |
| Drill pipe laydown area | 10 |
| General car parking area | 1 to 5 |

Note 1: Some oil companies specify the level of illumination to be floor level, whilst others prefer it at a working desk height, e.g. 0.7 to 0.85 m.
Note 2: The lighting level in the central control room can be arranged to be wholly or partly adjustable so as to minimise glare and eyestrain whilst operating visual display units (VDU) or man–machine interfaces (MMI).

Helideck lighting is a specialised subject that is covered by national and international regulations.

It is recommended to supply the helideck landing circle light fittings from a DC service e.g. 110 VDC uninterruptible supply, that should have a 110 VAC back-up supply so that the DC system can be maintained without switching off the circle lighting.

A comprehensive source of general information on lighting is Reference 1. It also describes in detail how to calculate lighting levels.

## 18.2 NAVIGATION AIDS

This sub-section mainly applies to offshore and marine installations, and is given as general guidance. For more detail appropriate references should be sought and carefully studied, and their latest revisions verified.

Navigation aids consist of the following equipment:

- Flashing marker lights.
- Fog horns.
- Platform nameplates.
- Aircraft hazard lights.
- Helideck landing facilities.
- Radio communications and beacons.
- Radar.
- Echo-sounding and sonar.

### 18.2.1 Flashing Marker Lights

A typical requirement is that recommended by the British Department of Trade document 'Standard Making Schedule for Offshore Installations',

1. White and red lights flashing the Morse letters ‘U’ every 15 seconds as follows:

| | | |
|---|---|---|
| Eclipse | 1.00 | s |
| Flash | 1.00 | s |
| Eclipse | 1.00 | s |
| Flash | 3.00 | s |
| Eclipse | 8.00 | s |
| Total Period | 15.00 | s |

2. Fog signals sounding the ‘U’ every 30 seconds as follows:

| | | |
|---|---|---|
| Blast | 0.75 | s |
| Silent | 1.00 | s |
| Blast | 0.75 | s |
| Silent | 1.00 | s |
| Blast | 2.50 | s |
| Silent | 24.00 | s |
| Total Period | 30.00 | s |

3. Illuminated identification panels.
4. Navigation buoys.

## 18.2.2 White and Red Flashing Lights

The ‘normal’ range and ‘apparent intensity’ of these flashing lights should be in accordance with the local requirements, e.g. for UK waters, IALA publication ‘Recommendations for the Notation of Luminous Intensity and Range of Lights’. Appendix II (16th November 1996) and BS 942 (1949) clauses 10 and 11 respectively.

### *18.2.2.1 Main lights*

The main white lights should have a ‘nominal’ range of 15 miles and be visible in every direction of approach, there should normally be a minimum of two and a maximum of four main white lights.

### *18.2.2.2 Subsidiary lights*

Subsidiary red lights of 3 miles ‘nominal’ range should be positioned to mark the horizontal extremities of the structure, in positions not occupied by white lights, to indicate any irregular projections of the complex.

### *18.2.2.3 Secondary lights*

Secondary white lights of 10 miles ‘nominal’ range and visible in every direction of approach should automatically come into operation in the event of failure of the 15 mile main white lights; these are normally mounted in similar location to the main white lights.

#### *18.2.2.4 Operation and control of lighting systems*

Navigation lighting systems can be fitted with a device to automatically switch on 15 minutes before sunset until sunrise or whenever the visibility is less than 2 sea miles. There can also be a manual override device to enable the navigation aids to be switched on during unusual conditions or for maintenance and testing etc.

Failure of any of the navigation lights can be indicated in the central control room and in the radio room.

In the event of failure of the main white lights control equipment, control should automatically be transferred to the secondary system, which would cause the secondary and the main lights to flash in synchronism, and generate an alarm in the central control room and the radio room.

All subsidiary lights should operate in synchronism.

The secondary and subsidiary lights can be equipped with an automatic lamp changer or multiple filament bulb. This provides a minimum of one standby lamp or filament which will be automatically activated in the event of a filament failure. Filament failure should produce an alarm in the central control room and the radio room until a defective bulb is replaced.

On long narrow structures or structures linked by bridges where lights may otherwise be several hundred metres apart, intermediary 3 mile red lights should be mounted in positions to deter vessel from colliding with the central sections of the structure of bridges.

The secondary and subsidiary lights should be capable of operating for 96 hours from a battery power source which is independent of the main supply. The equipment would normally operate on the main AC supply, with automatic switching to an alternative AC supply in the event of main supply failure, and automatic switching to battery supplies when no AC supply is available.

### 18.2.3 Navigation Buoys

Navigation marker buoys can be wave or solar powered or alternatively fitted with batteries. They would be retained in a position to facilitate quick manual launching, and provision should be made for ready inspection and maintenance of batteries.

### 18.2.4 Identification Panels

The structure identification panels usually consist of black letter and figures one metre high on a yellow background with illumination or be on a retro-reflective background.

### 18.2.5 Aircraft Hazard Lighting

Hazard lighting should be provided on all projections from the structure which could present a danger to helicopters approaching the platform. Positions where it would be impractical to fit red lights due to the possibility of damage or difficulty of maintenance caused by high temperature, such as flare towers and exhaust stacks, would be flood lit from convenient locations.

In the event of main supply failure the hazard lighting would be supplied from an emergency generator or battery supply.

No form of lighting on the structure should be capable of creating a hazard to helicopters by night-blinding the pilot due to dazzle or glare.

### 18.2.6 Helicopter Landing Facilities

Helideck markings and illumination should be in accordance with appropriate standards, e.g. BSIDD55/1978 and GODAC Part II, Section 5.3.6.

A high frequency radio beacon with a minimum range of 30 miles can be provided for the guidance of approaching helicopters, and VHF/AM radio would be provided for communication with pilots to comply with the appropriate standards, for the location.

The structure would also be equipped with suitable devices for ascertaining the wind speed and direction, air temperature, barometric pressure, visibility and cloud cover.

### 18.2.7 Radar

Radar is not used on all offshore platforms. Its use is determined by the nature of the platform and the frequency and type of local sea traffic. When surveillance radar is installed precautions should be adopted to ensure the minimum of danger to personnel from high energy radiation and dangers associated with rotating aerial scanners, interference with electronic instruments and communication, and the elimination of ignition in hazardous atmosphere in accordance with the standards e.g. BS3192 and 4992.

All of the equipment and interconnecting cables should be located in a safe area. The transmitters and aerials should not be located near telecommunication equipment, electronic instruments and similar equipment which could suffer interference or damage due to high energy radio frequency radiation. The aerials must be positioned to prevent the creation of high energy radio frequency fields in hazardous areas where they could cause ignition.

The aerials should be installed in such a manner and location as to allow reasonable safe access for at least two people for servicing and maintenance, whilst preventing access to unauthorised personnel.

Emergency stop switches could be provided in a safe position, adjacent to the aerials, to switch off the scanners and transmitters.

### 18.2.8 Radio Direction-Finder

Platforms that are permanently manned would require equipment for obtained bearings on radio navigation beacons and survival craft transmitting on international distress frequencies. If the equipment is of a type approved by the British Department of Trade (or similar national standard) in accordance with SOLAS (1974) Regulation 12, then the SOLAS requirements could also be supplemented as follows:

- The equipment should be located in the radio room.
- The aerials and feeder cables should be located in a safe area as close as possible to the radio room.

- An emergency power supply should provide a minimum of 6 hours duration, and minimum of 3 hours of this supply should be from batteries. The batteries, charger and supply cables should be in a safe area as close as possible to the radio room.

### 18.2.9 Sonar Devices

If echo-sounding equipment is required then it should be of a type approved by the Department of Trade, or similar national authority appropriate to the location, in accordance with SOLAS (1974). The installation of sonar devices should be in accordance with appropriate standards, e.g. BS5345 Part I (1976), BS5490 (1977), Reference 2, and particular regard should be directed towards the dangers that high-powered underwater sonar transmissions may present during diving operations.

## 18.3 CATHODIC PROTECTION

Cathodic protection is the responsibility of the corrosion engineer or metallurgist. The subject is fundamentally reasonably simple to understand but can be extremely mathematical in its application.

Direct current is arranged to flow out from the impressed anodes into the surrounding electrolyte, which is the sea water for offshore structures or the damp ground for onshore structures. The current returns through the structure itself and then back to the negative terminal of the impressed current source. The direction of current as described prevents the loss of metal from the structure into the electrolyte. This is opposite in direction to the natural current present due to corrosion action.

The electrical engineer is not usually involved in the chemistry of the system, his work is mainly associated with sizing the AC and DC cables, accounting for the power requirements and ensuring that the equipment satisfies any hazardous area requirements that may exist.

Impressed current systems require low-voltage high-current DC power. The voltages are typically 12, 25 and 50 volts. The currents are typically 100 to 800 amperes from one unit. The power is supplied by transformer rectifier units in which the transformer coils and the power rectifier are usually immersed in insulating oil to improve heat removal. The AC supply is usually three phase at LV voltage, e.g. 380 to 440 volts, and the supply power factor is about 0.75 lagging.

The output voltage is adjustable between +33% and −25% to take care of local site variations. The correct setting is determined at site during commissioning. Adjustments are often made periodically as the site conditions vary or if the installation is modified.

The anodes are made of various materials and the choice is determined by the physical conditions, the electric field pattern, current densities, cost and anode corrosion. Anode current densities vary between 10 amperes per metre squared for silicon iron to more than 1000 amperes per metre squared for platinised and lead alloys.

The electrical engineer needs to size AC and DC cables and to choose them to suit the physical environment.

Reference 3 although rather dated gives an excellent treatment of the theory of practice of cathodic protection although the subject has no doubt been given a more up-to-date treatment by other authors. Another reference of a more practical nature is Reference 4.

## REFERENCES

1. *IES lighting handbook*. Edited by John E. Kaufman. Illumination Engineering Society, USA. Fifth edition. ISBN 0 879-95000-5 Library of Congress Card No. 77-186864. Composed and printed by Waverly Press Inc., Baltimore, USA.
2. *Regulations for the electrical and electronic equipment for ships, see Appendix C.*
3. J. H. Morgan, *Cathodic protection*. Leonard Hill (Books) Ltd, Eden Street, London, UK (1959).
4. *The PI handbook of cathodic protection*. P. I. Corrosion Engineers Ltd, Abesford, UK Printed by Abesford Press Ltd.