KLM Technology Group
#03-12 Block Aronia,
Jalan Sri Perkasa 2
Taman Tampoi Utama
81200 Johor Bahru
Malaysia

OFF SHORE ELECTRICAL SYSTEMS

(PROJECT STANDARDS AND SPECIFICATIONS)

TABLE OF CONTENT

SCOPE

This Project Standard and Specification contains provisions for electrical installations at all voltages to provide safety in the design of electrical systems, selection, and use of electrical equipment for generation, storage, distribution and utilization of electrical energy for all purposes in offshore units which are being used for the purpose of exploration or exploitation of petroleum resources.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. EN Standards

EN 1838	Lighting application – Emergency lighting
EN 13463-1	Non-electrical equipment for potentially explosive atmospheres. Basic method and requirements
EN ISO 13702	Petroleum and natural gas industries - Control and mitigation of fires and explosions on offshore production installations - Requirements and guidelines

2. IEC (International Electro Technical Commission)

IEC 62040-1-1	Uninterruptible power systems (UPS) - Part 1-1: General and safety requirements for UPS used in operator access areas
IEC 62040-1-2	Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations
IEC 60034-1	Rotating electrical machines - Part 1: Rating and performance
IEC 60034-4	Rotating electrical machines - Part 4: Methods for determining synchronous machine quantities from tests
IEC 60034-4-am1	Amendment 1 - Rotating electrical machines - Part 4: Methods for determining synchronous machine quantities from tests
IEC 60034-8	Rotating electrical machines - Part 8: Terminal markings and direction of rotation

IEC 60034-8 Corr.1	Corrigendum 1 - Rotating electrical machines - Part 8: Terminal markings and direction of rotation
IEC 60034-9	Rotating electrical machines - Part 9: Noise limits
IEC 60034-9-am1	Amendment 1 - Rotating electrical machines - Part 9: Noise limits
IEC 60034-14	Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity
IEC 60034-14-am1	Amendment 1 - Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity
IEC 60073	Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators
IEC 60076 (all parts)	Power transformers
IEC 60076-1	Power transformers – Part 1: General
IEC 60076-11	Power transformers – Part 11: Dry-type transformers
IEC 60079-0	Electrical apparatus for explosive gas atmospheres - Part 0: General requirements
IEC 60079-14	Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines)
IEC 60079-15	Electrical apparatus for explosive gas atmospheres - Part 15: Construction, test and marking of type of protection "n" electrical apparatus
IEC 60146-1-1	Semiconductor converters - General requirements and line commutated convertors – Part 1-1: Specifications of basic requirements
IEC 60146-1-3	Semiconductor converters – General requirements and line commutated converters – Part 1-3: Transformers and reactors.
IEC 60439-1	Low-voltage switchgear and control gear assemblies - Part 1: Type-tested and partially type-tested assemblies
IEC 60502-2	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um=1.2 kV) up to 30 kV (Um=36 kV) – Part 2: Cables for rated voltages from 6 kV (Um=7.2 kV) up to 30 kV (Um=36 kV)
IEC 60533	Electrical and electronic installation in ships – Electromagnetic compatibility

IEC 60947-4-1	Low voltage switchgear and control gear - Part 4-1: Contactors and motor-starters Section one - Electromechanical contactors and motor-starters
IEC 61000-2-4	Electromagnetic compatibility (EMC) - Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances
IEC 61800-3	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
IEC 61800-4	Adjustable speed electrical power drive systems - Part 4: General requirements - Rating specifications for a.c. power drive systems above 1 000 V a.c. and not exceeding 35 kV
IEC 61893 (all parts)	Mobile and fixed offshore units
IEC 61892-1, 2001-12	Mobile and fixed offshore units - Electrical installations - Part 1: General requirements and conditions
IEC 61892-2, 2005-03	Mobile and fixed offshore units - Electrical installations - Part 2: System design
IEC 61892-3, 1992-02	Mobile and fixed offshore units - Electrical installations - Part 3: Equipment
IEC 61892-4	Mobile and fixed offshore units - Electrical installations - Part 4: Cables (*work in progress*)
IEC 61892-5, 2000-08	Mobile and fixed offshore units - Electrical installations - Part 5: Mobile units
IEC 61892-6, 1992-02	Mobile and fixed offshore units - Electrical installations - Part 6: Installation
IEC 61892-7, 1997-05	Mobile and fixed offshore units - Electrical installations - Part 7: Hazardous areas
IEC 62040-3	Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements
IEC 62271-200	High-voltage switchgear and control gear – Part 200: A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
IEC 60092-504	Electrical installation in ships – Part 504: Special features - Control and instrumentation

SYMBOLS AND ABBREVIATIONS

SYMBOL/ABBREVIATION	DESCRIPTION
AC	alternating current
AF	forced air cooled
AN	naturally air cooled
APS	abandon platform shutdown
ASDS	adjustable speed drive system
ATEX	ATmosphere EXplosible
AVR	automatic voltage regulator
BDM	basic drive module
CENELEC	European Committee for Electrotechnical Standardization
DC	direct current
DOL	direct on line
EMC	electromagnetic compatibility
ESD	emergency shut down
Ex	explosion proof
FCR	field current regulator
HV	high voltage, U ≥1kV
IE	Instrument earth
IEC	International Electrotechnical Commision
I/O	input/output
IP	degree of protection of enclosures
IS	intrinsically safe
ISO	International Organization for Standardization
IT	isolated power system
LCI	load commutated inverter
LV	low voltage, U<1kV
MCC	motor control centre
MCT	multi cable transit
PCS	process control system
PCC	point of common connection
PE	protective earth
PDCS	power distribution control system
PDS	power drive system
PLC	programmable logic controller
PSD	process shut down
RTD	resistor temperature detector
SAS	safety and automation systems
TN-S	directly earthed, a separate protective conductor is used

UPS	uninterruptible power system
VDU	visual display unit

GENERAL REQUIREMENTS AND CONDITIONS

Environmental Conditions

Unless otherwise specified for the relevant project, the following ambient temperatures shall be used as a basis:

- Ambient outdoor air temperature: minimum -5 °C, maximum 25 °C
- Sea water temperature: minimum 5 °C, maximum 15 °C

Materials

All equipment and materials should have low halogen content.
Equipment enclosures located outdoor, in naturally ventilated areas and wash down areas, shall be made of proven sea water resistant material or protected by a coating system.
Electrical/electronic equipment in panels shall be protected against hydraulic leakage.

Power Supply System Characteristics

For harmonic distortion (voltage waveform) (see IEC 61892-1, 4.9.2.2) the detailed harmonic voltage acceptance limits shall correspond to IEC 61000-2-4, Table 2 class 2, for any voltage. In addition the fifth harmonic shall not exceed 5 % for the high voltage system.

Clearance and Creepage Distances

Table 1 is not applicable for type approved equipment. The following minimum creepage distances shall be met for not approved equipment, and if any site modifications to type approved equipment shall be made.

Table 1 – Creepage distances

Rated insulation voltage of equipment or working voltage V	Creepage distances, IEC 60439-1, Pollution degree 3, Material Group IIIa mm
< 63	2
64 to 250	4
251 to 400	6,3
401 to 500	8
501 to 630	10
631 to 800	12,5
801 to 1000	16
1001 to 3200	50
3201 to 6300	100
< 10 000 (IEC)	160

Insulation

Insulating materials shall be flame retardant.

Maintenance and Inspection

Electrical equipment shall be designed to allow for thermo graphic on load inspection or use of thermostrips, where possible.

Cable Entries

Cable entries which require EMC protection are a result from the engineering and should be specified in datasheet or similar.

Location of Electrical Equipment In Units

Major electrical equipment is normally all electrical MCC and distribution boards/panels, all 3 phase motor starters and feeders including contactors and breakers, all 3 phase transformers, battery chargers, and frequency converters.

In order to avoid installation of major electrical equipment in hazardous areas or in exposed environments, all major electrical equipment shall be installed inside equipment rooms with a controlled atmosphere. In addition control panels containing PLC, etc. should be avoided in hazardous areas or in exposed environments.

Location of high voltage equipment shall comply with FSE.

The room shall withstand the highest blast pressure caused by short circuit without any damage.

Doors to high voltage rooms shall open out from the room. Hinged doors shall be provided with “panic opening device” which can be opened without using the hands.

Oil filled transformers can be located in naturally ventilated areas.

Location of electrical equipment shall be selected to avoid interference with escape routings, walkways, other equipment, pipes etc. and obstruction against activities related to transport and lifting operations.

Field equipment such as public address flashing lights, loudspeakers, junction boxes, splitters and tap-off, may be located on the support for cable ladders and trays or on the side rail of the cable ladders.

When field equipment is mounted on handrails, the hands rails shall have sufficient strength for the extra load.

Field equipment may be mounted underneath cable ladders or as integrated part of handrail support arrangement.

Equipment shall not be mounted on blast walls/explosion relieves. Equipment can, however, be installed on the support frames for the blast walls if the integrity of the blast wall is not interfered.

Equipment located in areas which do not allow for maintenance accessibility as required, should as shown on typical drawing be installed such that the equipment can be rotated, raised or lowered into areas where maintenance can take place without the need for scaffolding.

Spare Requirements for Future Modifications

The requirements are related to spare at the time of plant start-up.
The installation should be prepared for:

- relevant area interface cabinets, junction boxes, cabling etc. to meet a 10 % increase,
- main cable ladders and transits to meet a 10 % increase.

Mechanical Protection

Special attention to protection of electrical equipment against mechanical damage shall be given in storage, loading and other exposed areas.

Protection From Heat, Water, Steam and Oil

Full scale testing of deluge system may take place. Selection and installation of equipment should be such that adverse effects to the equipment due to testing is minimized.

Equipment located in areas where deluge testing will take place shall have degree of protection at least IP 56.

SYSTEM DESIGN

Sources of Electrical Power

1. General

   For further detailed requirements concerning voltage drop at various parts of the electrical system, see additional requirements below.

2. Main source of electrical power

   The main power supply shall serve all electrical functions during normal operation.

   The main power supply may be arranged locally, with subsea cables from another offshore unit, from shore or with a combination of the alternatives.

   When local power generation is provided, the generators shall be grouped in a central power plant. The unit rating and number of generating sets shall be adapted to the load profile of the systems served over the entire lifetime of the unit.

   The main power generator auxiliary consumers shall be supplied from both the main and the emergency system. If an essential source of power is available, these consumers shall be supplied from the main and the essential system. A make before break system shall be provided.

   The configuration of the main power distribution system shall depend on the regularity requirements of the production process.

IEC 61892-2 requires at least two main generators. If one main generator can supply the total maximum load at the plant, and the regularity requirements do not require “2 x 100 %”, the second generator can be an essential generator.

The regulations do not allow connecting other consumers than emergency consumers to the emergency switchboard. Therefore an essential power system with essential generator(s) should be evaluated. Criteria for essential power system should be sufficient power for utilities necessary for accommodation (normal conditions of habitability), and power for turnaround periods.

3. Emergency source of power

   The emergency power supply systems shall comprise a combination of UPS, and, if necessary, a diesel engine driven generator. Alternatively to diesel engine driven generator, power cable from another independent plant may be considered.

   The emergency power supply system shall be independent of the main supply systems. Main and emergency distribution equipment shall be located in separate rooms. Sub distribution boards may be located in the same room as main supply systems.

   If the emergency power is supplied from a diesel driven emergency generator it shall be a capable of supplying the consumers with emergency power for at least 18 h.

   Efforts should be done to avoid dependence of seawater for cooling of the emergency generator prime-mover, hence air cooled prime mover should be used.

   The requirements to the transitional source of power mentioned in IEC 61892-2, 4.3.4, and the uninterruptible power supply system mentioned in IEC 61892-2, 4.3.7, shall be fulfilled by the plants UPS system. This means that the charging shall be supplied from the emergency switchboard. By pass supply shall be from essentials or normal power system.

   UPSs shall be provided for emergency services and non-emergency services requiring continuous AC or DC power supply in case of main power failure blackout or electrical disturbances. Equipment sensitive to electrical disturbances (e.g. voltage transients and harmonic distortion should be supplied from UPSs.