

Electrical systems

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Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Annex A is normative.

Introduction

This NORSOK standard is based on equipment and practices which are in current use, but it is not intended in any way to impede development of new or improved techniques.

Each clause in this NORSOK standard refers to the equivalent clause in the IEC 61892, Edition 1, series of standards.

1 Scope

This NORSOK standard 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.

This NORSOK standard does not apply for the electrical installations in rooms used for medical purposes or in tankers.

This NORSOK standard applies to all electrical installations. The installation may be permanent, temporary, transportable or hand-held, to AC installations up to and including 35 000 V and DC installations up to and including 1 500 V.

NOTE 1 This NORSOK standard is applicable for the voltages stated above, even if a different voltage limit may be given in some of the parts in the IEC 61892 series of standards. It is expected that the voltage levels in the IEC 61892 series of standards will be corrected as part of the maintenance cycle of this IEC standard.

NOTE 2 Where this NORSOK standard does not give guidelines for systems, equipment and installation for higher voltage level than 11 kV, reference is made to relevant IEC standards.

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet the requirements of the referenced standards.

2.1 Normative references

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
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 convertors – 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 (<i>work in progress</i>)
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
NEK 400	Electrical installations
NEK 606	Cables for offshore installations Halogen-free, or mud resistant
NEK EN 50272-2	Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries
NORSOK I-002	Safety and automation systems (SAS)
NORSOK M-501	Surface preparation and protective coating
NORSOK S-001	Technical safety
NORSOK S-002	Working environment
NORSOK T-001	Telecommunication systems
NORSOK T-100	Telecom subsystems
NORSOK U-001	Subsea Production Systems
NORSOK U-102	Remotely operated vehicle (ROV) services
NORSOK Z-001	Documentation for Operation (DFO)
NORSOK Z-007	Mechanical Completion and Commissioning
NORSOK Z-015	Temporary equipment
NORSOK Z-DP-002	Coding system
Directive 98/37/EC	Machinery Directive
	NOTE Implemented in Norway by "Forskrift om maskiner"
IMO 1989 MODU Code	Code for construction and equipment of mobile offshore units with later amendments.
PSA Regulations	Frame Regulations
PSA Regulations	Facilities Regulations
DBE-9039	Retningslinjer for jording i maritime anlegg (Guidelines for earthing in maritime installations)
FSE	Forskrift for sikkerhet ved arbeid i og drift av elektriske anlegg

Trace Heating guidelines in Industry and Offshore (IFEA)
 Guidelines for the documentation of selectivity (discrimination) in AC systems (IFEA)

2.2 Informative references

IEC 60092-504 Electrical installation in ships – Part 504: Special features - Control and instrumentation

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

shall

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.2

should

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

3.1.3

may

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.4

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.2 Abbreviations

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
BSL	Bestemmelser for sivil luftfart
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, $U \geq 1\text{kV}$
IE	Instrument earth
IEC	International Electrotechnical Commission
IFEA	Industriens Forening for Elektroteknikk og Automatisering
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, $U < 1\text{kV}$
MCC	motor control centre

MCT	multi cable transit
NEK	Norsk Elektroteknisk Komité
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
PSA	Petroleum Safety Authority Norway
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

4 General requirements and conditions (see IEC 61892-1)

4.1 General (see IEC 61892-1, 4.1)

4.2 Acceptance of substitutes or alternatives (see IEC 61892-1, 4.4)

If equipment, construction or arrangement not specified in this NORSOK standard is used, compliance with relevant PSA Regulations is to be documented, see Frame Regulations, § 8.

Reference to PSA Regulations, Frame Regulations, § 18, for use of standard and guidelines.

NOTE The use of this NORSOK standard will normally ensure compliance with the PSA Regulations.

4.3 Environmental conditions (see IEC 61892-1, 4.7)

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

4.4 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 according to NORSOK M-501.

Electrical/electronic equipment in panels shall be protected against hydraulic leakage.

4.5 Power supply system characteristics (see IEC 61892-1, 4.9)

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.

4.6 Clearance and creepage distances (see IEC 61892-1, 4.12)

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

4.7 Insulation (see IEC 61892-1, 4.13)

Insulating materials shall be flame retardant.

4.8 Maintenance and inspection (see IEC 61892-1, 4.14)

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

4.9 Cable entries (see IEC 61892-1, 4.15)

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

4.10 Location of electrical equipment in units (see IEC 61892-1, 4.17)

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.

Battery rooms shall comply with NEK EN 50272-2.

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.

4.11 Spaces and compartments (see IEC 61892-1, 4.18)

Spaces in which engine driven generating sets are located shall comply with the requirements of the PSA Regulations.

NOTE Regarding separation of main and emergency power and fire divisions for rooms containing electrical equipment, reference is made to the PSA Regulations, Facilities Regulations, sections 29 and 37.

4.12 Spare requirements for future modifications

The requirements are related to spare at the time of plant start-up.
For switchboards, see 6.4.

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.

4.13 Mechanical protection (see IEC 61892-1, 4.19)

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

4.14 Protection from heat, water, steam and oil (see IEC 61892-1, 4.20)

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 minimised.

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

5 System design (see IEC 61892-2)

5.1 Sources of electrical power (see IEC 61892-2, Clause 4)

5.1.1 General (see IEC 61892-2, 4.1)

See IEC 61892-2, 4.1.4

For further detailed requirements concerning voltage drop at various parts of the electrical system, see additional requirements in 5.6.6.

5.1.2 Main source of electrical power (see IEC 61892-2, 4.2)

See IEC 61892-2, 4.2.1

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.

See IEC 61892-2, 4.2.2

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. See additional requirement in 5.1.3 (addition to IEC 61892-2, 4.6.3).

5.1.3 Emergency source of power (see IEC 61892-2, 4.3)

See IEC 61892-2, 4.3.1

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 capable of supplying the consumers with emergency power for at least 18 h.

See IEC 61892-2, 4.3.2

See additional requirements in 5.1.6, 5.1.7 and 5.1.8 (addition to IEC 61892-2, 4.7, 4.8 and 4.9). 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.

See IEC 61892-2, 4.3.3

Services required for the transitional source of electrical power are missing in IEC 61892-2, 4.3.5. See additional requirement to IEC 61892-2, 4.3.4.

See IEC 61892-2, 4.3.4

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.

UPS power shall be provided for the following services:

- safety systems (emergency consumers);
- control systems required for operation and monitoring of safety auxiliary systems;
- vital telecommunication systems;
- control systems required for restarting of the drilling and production systems;
- control equipment liable to fail or malfunction upon occurrence of normally expected voltage transients, e.g. on starting of large induction motors;
- obstruction lights;
- circuit breaker control voltage.

Reference is also made to NORSOK S-001, EN ISO 13702, Annex C.1, and IMO 1989 MODU Code, section 5.3.10.

Each UPS should be provided with facilities for battery capacity test including logging of test values. Inverter feeding battery energy back to the grid is preferred.

Analysis shall be carried out to demonstrate the availability and reliability of the UPS.

The UPS system shall at least consist of two independent and redundant units to provide two independent power sources to critical consumers such as critical control systems and control voltages. Such consumers shall have two redundant power supplies.

Redundant UPS shall not contain common mode failure elements. This means that redundant units shall be located in separate rooms.

Each UPS main distribution board section shall be equipped with earth fault detection and common alarm. The earthfault detection system shall as a minimum be of a type that enables manual fault finding of each outgoing circuit. Space shall be provided for fault finding of the outgoing circuits with a portable apparatus.

Selection and coordination of protection devices shall ensure selectivity in all modes of operations.

Emergency batteries shall have a capacity to supply emergency power for a minimum period of 30 min, see ISO 13702, Table C.1.

Note ISO 13702, Table C.1, is not applicable for emergency escape lights, see. 5.8.2.

See IEC 61892-2, 4.3.5

The emergency generator(s) shall be arranged for parallel operation with the main power grid for regular testing and maintenance of the set(s). The systems shall be designed for the short circuit current that can occur during such operation.

The emergency switchboard shall be designed for disconnecting of power supply for a short period, without affecting production or essential function, to be able to test automatic starting arrangement of emergency generator.

See IEC 61892-2, 4.3.6

When essential source of power is available, essential source of power shall be used for supply of the main generator starting arrangement.

The requirement for starting arrangement of essential generator is the same as for emergency generator described in 5.1.8 (addition to IEC 61892-2, 4.9), except those concerning locations.

Other detailed design requirement for essential power system will be the same as for the main power system.

See IEC 61892-2, 4.3.7

See the requirements to the transitional source of power mentioned in 5.2.3 (addition to IEC 61892-2, 4.3.4).

5.1.4 Additional requirements for periodically unattended machinery spaces (see IEC 61892-2, 4.4)

See IEC 61892-2, 4.4.1

All production platforms shall be designed for normally unattended machinery spaces.

See IEC 61892-2, 4.4.2

If one main generator can supply the total maximum load at the plant, arrangement like load shedding is not required for the main power system. Otherwise for floating offshore units depending on thrusters, propulsion and steering, arrangement like load shedding is required, to prevent overloading the generator.

See IEC 61892-2, 4.4.3

Automatic starting and connection to the main switchboard of a stand-by generating set is only required for offshore units depending on thrusters, propulsion and steering. Stand-by generator set can be essential generator(s) as described in 5.1.2 (addition to IEC 61892-2, 4.2.2).

See IEC 61892-2, 4.4.4

The requirement for automatic re-starting only applies to consumers where prolonged disconnection will cause serious damage, reduced safeguarding, or extended shutdown.

See IEC 61892-2, 4.4.5

This requirement applies to essential generators as mentioned in 5.1.2 (addition to IEC 61892-2, 4.2.2).

See IEC 61892-2, 4.4.6

Arrangement shall be provided to prevent automatic closing of any generator circuit breaker under detected short circuit conditions. This can be implemented by "lock out" and /or "close inhibit" functions in circuit breaker's control.

See IEC 61892-2, 4.4.7

Based on analysis, load shedding shall be applied when required. Where implemented, the load shedding system shall be an independent software module within the PDCS. Care shall be taken to ensure that the response time is sufficient to enable the load shedding system to perform its function and maintain a stable electrical system.

Input to load shedding system for initiating load shedding should be

- generator circuit breaker status,
- power frequency,
- turbine combustion temperature and/or generator power output,
- overload of other power sources (supply from shore and other units).

5.1.5 Arrangement and location (see IEC 61892-2, 4.6)

All testing, operations, starting, transfer of power and stopping of main generators, shall be possible to be performed by one operator at one location (main generator control station).

All testing, manual operation, starting, transfer of power and stopping of emergency generator, and testing shall be possible to be performed by one operator at one location (emergency generator control panel).

The emergency switchboard and the emergency source of power (emergency generator) can be located in separated rooms close to each other.

Emergency sub switchboards should not be located in the same room as main power switchboards.

Emergency main distribution board for lighting and small power shall be located in an emergency switchboard room or similar. There is no such restriction concerning sub emergency distribution panels.

5.1.6 Output (see IEC 61892-2, 4.7)**See IEC 61892-2, 4.7.1**

The emergency power supply system shall serve emergency power consumers as defined by PSA. Reference is made to

- NORSOK S-001, 9.6,
- EN ISO 13702, Clause 9,
- EN ISO 13702, Annex C.1,
- IMO 1989 MODU Code, section 5.3 and 5.4.

See IEC 61892-2, 4.7.2

For further requirements to signalling light/sound signals, see Facilities Regulations, § 72. Control cabinets, charger and battery for this system shall not be located in naturally ventilated area. Preferable it shall be located inside electrical equipment room or similar. The integrated power supplies shall be galvanically isolated from the mains.

5.1.7 Additional requirement for electrical emergency power system (see IEC 61892-2, 4.8)**See IEC 61892-2, 4.8.1**

The prime mover for emergency generators can be stopped automatically in the event of

- a) gas detection in ventilation air inlet,
- b) over speeding,
- c) loss of lubricating oil pressure.

NOTE Item a) and c) do not apply to emergency generator(s) supplying fire pump(s).

In test or manual mode, the prime mover for the emergency generator shall be equipped with automatic stop functions as a normal stand-by generator.

In cases where fire pumps are fed from the emergency power system, the driver of the emergency generator is regarded as prime mover for the fire pumps and thus will have to fulfil the requirements for firewater pumps prime mover.

See IEC 61892-2, 4.8.2

Instead of alarm in case of discharging battery, alarm in case of charger fault can be used.

5.1.8 Starting arrangement for emergency generators (see IEC 61892-2, 4.9)

See IEC 61892-2, 4.9.1

The generator(s) shall start automatically and operate directly on the emergency bus bar in case of failure of main system. The normal starting time until the emergency switchboard is energized shall not exceed 45 s.

The emergency generator prime-mover shall have temperature controlled jacket water heating.

Arrangements for black start shall be provided.

See IEC 61892-2, 4.9.2

An emergency generator shall be provided with two independent starting systems. Each arrangement shall have storage energy capability of at least three consecutive starts. One of these systems can be a manually operated starting system.

See IEC 61892-2, 4.9.8

Emergency generator shall be equipped with automatic start arrangement, i.e. only a manual start arrangement is not allowed.

5.2 System earthing (see IEC 61892-2, Clause 5)

5.2.1 General requirements (see IEC 61892-2, 5.2)

See IEC 61892-2, 5.2.1

The low insulation alarm on IT system shall be continuously monitored at a manned control station, see IEC 61892-2, 7.2.1.

See IEC 61892-2, 5.2.3

An alternative on HV-systems to perform system earthing by connecting the power sources neutral to ground, is use of dedicated neutral transformers. Each section of the voltage system possible to be powered alone, shall than be equipped with such neutral transformer.

This should be considered where a significant number of power sources could be connected to the same system voltage, see 5.5.2 (addition to IEC 61892-2, 5.4.1) and 5.2.3 (addition to IEC 61892-2, 5.5.1).

See IEC 61892-2, 5.2.4

For emergency power systems potential risk of operating system with earth fault in emergency situations (e.g. huge gas leakage) should be considered when deciding system earthing.

For emergency systems the following is recommended:

- switchboard where source of emergency power is connected shall be isolated in emergency/automatic mode and high resistance earthed in test/manual mode;
- emergency distribution system 400/230 V shall be directly earthed;
- UPS system shall be isolated. For further information, see Table 2.

See IEC 61892-2, 5.2.5

UPS voltage system dedicated for a special purpose can be solidly earthed. Necessity of continuous operation of consumers versus potential risk of operating system with earth fault in emergency situations (e.g. huge gas leakage) should be considered when deciding system earthing.

5.2.2 Neutral earthing for system up to and including 1000 V (see IEC 61892-2, 5.4)

See IEC 61892-2, 5.4.1

The system earthing methods for the different low voltage levels are shown in Table 2.

The neutral shall be earthed through a resistance with numerical value equal to or somewhat less than 1/3 of the capacitive reactance between phase and earth.

The resistive current shall for all voltage levels be limited to the maximum values given in Table 3.

Table 2 - System earthing methods

System voltage	Power source	Transformer
690 V	Generator neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 100A per generator. ^b	Transformer neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 100 A per transformer.
400/230 V Direct earthed power systems		Transformer neutrals shall be solidly earthed.
230 V IT (UPS)	Isolated ^c	Isolated
DC	Both poles isolated. ^a	
^a DC voltages for telecommunication system may have one pole earthed.		
^b Emergency generator neutral(s) shall be isolated.		
^c UPS dedicated for a special purpose, can be solidly earthed.		

5.2.3 Neutral earthing for system above 1000 V (see IEC 61892-2, 5.5)

See IEC 61892-2, 5.5.1

The system earthing methods for the different voltage levels are shown in Table 3. For high voltage levels, the system earthing shall be performed as "High resistance earthed neutral".

The neutral shall be earthed through a resistance with numerical value equal to or somewhat less than 1/3 of the capacitive reactance between phase and earth.

The resistive current shall for all voltage levels be limited to the maximum values given in Table 3.

Table 3 – System earthing methods

System voltage	Power source	Transformer
11 kV	Generator neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20 A per generator.	Transformer neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20 A per transformer.
6,6 kV	Generator neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20 A per generator.	Transformer neutral shall be high resistance earthed. Maximum earth fault shall be limited to 20 A per transformer.

5.2.4 Earthing resistors, connection to hull/structure (see IEC 61892-2, 5.7)

See IEC 61892-2, 5.7.2

Each power source shall have separate earthing boss for neutral earthing. Common earthing boss for system earthing and protective earthing can be used for the same unit. Connection on earthing side of resistors is not required.

5.3 Distribution systems (see IEC 61892-2, Clause 6)

5.3.1 Direct current (DC) distribution systems (see IEC 61892-2, 6.1)

The following voltage levels shall be used:

— UPS 48 V DC (shall only be used as distribution voltage for telecommunication systems);

— UPS 60 V DC (shall only be used as distribution voltage for telecommunication systems).

See IEC 61892-2, 6.1.1

Refer to Table 2 for details concerning DC systems. The structure or hull shall not be used as current conductor for any power consumer.

Local isolated system (e.g. separate control voltage in a cabinet) does not require insulation monitoring devices, provided the circulation current does not exceed 30 mA under the most unfavourable conditions.

See IEC 61892-2, 6.1.1.1

In TN system (+ or - earthed) combined neutral and PE shall not be used. Exceptions are given for limited and locally earthed systems, e.g. engine starting systems.

5.3.2 Alternating current (AC) distribution systems (see IEC 61892-2, 6.2)

The following voltage levels and frequency shall be used:

11 kV, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity exceeds 20 MW. Should be used for motors from 400 kW and above for DOL starting.
6,6 kV, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity is between 4 MW to 20 MW. Should be used for motors from 400 kW and above for DOL starting.
3.3 kV, 3 phase	Distribution voltage. Can be considered as a second high voltage distribution level.
690 V, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity is below 4 MW. Should be used for DOL starting of motors, below 400 kW and as primary voltage for converters for drilling motors.
400/230 V	TN-S system shall be used as distribution voltage for lighting and small power, and for single phase heaters below 3 kW, including heat tracing. For living quarter, kitchen and laundry 400 V 3-phase may be used as supply voltage to consumers. The system shall be symmetrically loaded.
UPS 230 V	IT system shall be used as distribution voltages for instrumentation, control, telecommunication and safety systems. UPS dedicated for a special purpose can be solidly earthed.
230 V IT	May be used for emergency power supply system. Normally emergency power for lighting and small power shall be TN-S.
Frequency	50 Hz.

See IEC 61892-2, 6.2.1

Low voltage primary AC distribution systems shall be of type TN-S as described in IEC 61892-2, 6.2.2.1, Figure 6. Exceptions for UPS systems which normally shall be IT.

5.4 Distribution system requirements (see IEC 61892-2, Clause 7)

5.4.1 Balance of loads (see IEC 61892-2, 7.3)

See IEC 61892-2, 7.3.1

For AC three- or four-wire systems, the current-consuming units shall be grouped in the final circuits so that the load on each phase, under normal conditions, will be balanced as far as possible at the individual distribution and section boards as well as the main switchboard.

5.4.2 Final circuits (see IEC 61892-2, 7.4)

See IEC 61892-2, 7.4.1

Final circuits rated above 16 A shall normally not supply more than one appliance. Exceptions can be given for floodlights (up to 20 A) and socket outlet.

See IEC 61892-2, 7.4.2

Final circuits for lighting shall not supply other appliances. Exceptions can be given for consumers in a limited package or container.

5.4.3 Control circuits (see IEC 61892-2, 7.5)

See IEC 61892-2, 7.5.1

Essential and critical control circuits shall be supplied from UPSs of 230 V AC. This also includes circuit breakers in switchboards.

See IEC 61892-2, 7.5.5

Critical consumers shall have two independent control voltage supplies, one duty and one stand-by, with automatic changeover. Each supply shall be monitored with alarm for loss of availability.

Where the control circuits require a DC voltage, two independent rectifiers (2 x 100 %) with separate supplies shall supply the circuits in parallel. Each rectifier shall be equipped with fault alarm.

The mentioned alarms shall be monitored in a manned control centre.

5.4.4 Socket outlets (see IEC 61892-2, 7.6)

Ex socket outlets should be standardized for the whole unit.

A power socket outlet system shall be designed such that any working area can be reached with a 40 m flexible cable without passing through doors or different decks. The sockets shall be rated 63 A, 400/230 V, 3 phases + neutral. Ex-certified equipment should be used in naturally ventilated areas.

Small power socket outlets shall be 230 V, 2 pole rated 16 A. Circuits dedicated for socket outlets shall have no other consumers connected. A small power socket outlet system shall be designed such that any area can be reached with a 25 m flexible cord without passing through doors.

In control rooms, local equipment rooms and offices approximately 20 % of the convenience outlets shall be fed from the local emergency sub distribution board limited to essential equipment that has to be available during a shutdown situation, see NORSOK S-001 for ignition source control.

Ex-certified equipment shall be used in naturally ventilated areas.

5.4.5 Temporary workstations

Socket outlets or junction boxes for connection of 125 A, 400/230 V, 3 phase + neutral, temporary workstation for turnarounds and major modification work, should be located close to container lay down areas. Reference is made to NORSOK Z-015, 4.5.

Ex-certified equipment should be used in naturally ventilated areas.

5.5 Diversity (demand) factors (see IEC 61892-2, Clause 8)

See IEC 61892-2, 8.5

If the needed shaft power of the mechanical load is unknown the motor power rating shall be used.

5.6 System study and calculations (see IEC 61892-2, Clause 9)

5.6.1 Electrical load study (see IEC 61892-2, 9.2)

An allowance and contingency multiplication factor shall be applied to the estimated load to select the rating of generators and transformers.

The following factors should be used:

- feasibility study: 1,5
- conceptual study: 1,35 to 1,4
- pre-engineering: 1,25
- detail engineering: 1,10

NOTE If the electrical load data are well defined in the early phases, lower factors may be used.

5.6.2 Short circuit calculations (see IEC 61892-2, 9.4)

The fault condition "Phase to phase to earth fault" shall be included in addition to those described in IEC 61892-2, 9.4.1.

The maximum symmetrical root mean square (rms) value of the sub transient fault current should not exceed the following values:

- 11 / 6,6/3,3 kV: 40 kA rms;
- 690 V: 50 kA rms;
- 400/230 V: 30 kA rms - Main distribution board;
- 400/230 V: 10 kA rms - Sub distribution board.

5.6.3 Protection and discrimination study (see IEC 61892-2, 9.5)

Series connected over-current relays, direct acting circuit breakers and fuses shall be coordinated to achieve correct discrimination during fault conditions (discrimination for a feeder and the downstream incomer is not required). Correct discrimination shall be maintained for all currents up to maximum prospective fault currents, while the thermal effect of the fault current shall not exceed the thermal withstand capability of any circuit component.

The relay coordination study shall be carried out according to the requirements of the "Guidelines for the documentation of selectivity (discrimination) in AC systems (IFEA)". The establishing relay setting tables and logarithms current versus time curves shall be a part of the study report.

5.6.4 Power system dynamic calculations (see IEC 61892-2, 9.6)

All feeders, motor starters etc. shall be designed for restart after all relevant disturbance or fault conditions which are cleared within 0,5 s. Such disturbances shall not imply any trip of the process or drilling activities.

5.6.5 Calculations of harmonic voltages (see IEC 61892-2, 9.7)

The detailed harmonic voltage acceptance limits are specified in 4.5.

5.6.6 Cable selection and sizing criteria

An electrical cable sizing study shall be performed in order to establish cable-sizing criteria. The following general criteria shall be incorporated:

- nominal current;
- voltage drop, stationary and transient, according to IEC 61892-2, clause 4.1.4. Except that 10 % is accepted for lighting at last fixture;
- short circuit withstands capability, mechanical and thermal;
- short circuit (phase to phase) at the end of the power cable supplying small power and lighting shall cause instantaneous trip of the protective device.

Type of cable to be used for which purpose and area shall be described, i.e. mud/oil resistant, fire resistant etc.

Electrical cables shall comply with NEK 606.

Total voltage drop at motor terminals during start shall be maximum 20 % (typical power factor 0,2).

5.6.7 Switching/equipment insulation study

Surge arrestors or other protection devices shall be used where switching voltage escalation may exceed the insulation level. A switching/equipment insulation study should be performed in order to specify the correct equipment insulation levels and if additional protections are required. The study shall identify where the

protection equipment shall be located, if any. Insulation levels and the requirements for surge arrestors or other protection device shall be given in the applicable equipment data sheet.

5.6.8 Electromagnetic compatibility (EMC) (see IEC 61892-2, 12.9)

Vendors/suppliers instruction with regards to EMC shall be followed.

General EMC planning shall be in accordance with IEC 60533, Annex B.

5.7 Protection (see IEC 61892-2, Clause 10)

5.7.1 General (see IEC 61892-2, 10.1)

Solid state, microprocessor based multifunction protective relays with programmable release characteristics should be employed for protection of the electrical power generation and distribution system and electric motors.

Relays with data communication features should be employed in large, centrally controlled systems.

5.7.2 Generator protection (see IEC 61892-2, 10.4.2)

Main generator protection shall be according to Table 5.

Table 5 - Generator protection

Protective function	Trip generator breaker	Generator de-excitation	PDCS and generator control alarms
Differential protection ^b	X	X	X
Overcurrent	X		X
Shortcircuit	X	X	X
Earth fault	X	X	X
AVR fault	X	X	X
Stator RTD, temp. high			X
Stator RTD, temp. high/high ^c	X		X
Rotor earth fault ^b	X	X	X
Directional earth fault ^a	X	X	X
Overvoltage ^d	X	X	X
Undervoltage ^d	X		X
Reverse active power ^a	X		X
Reverse reactive power ^a	X		X
Negative phase sequence ^d	X		X
^a For generators in parallel operation only. ^b For generators above 4 MVA. ^c Overload protection ^d High voltage generator only			

Emergency generator protection shall be according to Table 6.

Table 6 - Emergency generator protection

Protective function	Emergency mode		Test mode	
	Trip generator breaker	PDCS and generator control alarms	Trip generator breaker	PDCS and generator control alarms
Short circuit ^b	X	X	X	X
Over-current		X	X	X
Earth fault		X	X	X
Stator RTD, temp. high		X		X
Stator RTD, temp. high/high		X	X	X
Reverse active power ^b	X	X	X	X
^a For generators in parallel operation only.				
^b Short circuit shall de-excitation the generator				

See IEC 61892-2, 10.4.2.2

All generators shall be protected against short circuit and earth faults on the generator side of the circuit breaker.

See IEC 61892-2, 10.5.1

Interlocking with no voltage relays is the preferred solution to avoid that a none operating generator is connected to an energised switchboard.

5.7.3 Transformer protection (see IEC 61892-2, 10.4.4)

Electric motor and power transformer protection shall be according to Table 7.

Table 7 - Transformer protection

Protective function to disconnect supply	Small power and lighting transformer	Power transformer	PDCS alarms
Overload	X	X	X ^e
Shortcircuit	X	X ^c	X ^e
Earth fault	X	X ^b	X ^e
Differential protection		X ^d	X
RTD, temp. high		X ^a	X
RTD, temp. high/high		X	X
^a Alarm only. ^b Earth fault protection shall be provided - for protection of the primary winding against internal faults, - for protection of the switchboard connected to the secondary winding, and internal faults when the neutral point is earthed across a neutral resistor. ^c Shall protect the primary and secondary windings, and the bus bar of the switchboard connected to the secondary winding. ^d Transformer differential protection shall be used for • liquid immersed high voltage transformers, • all high voltage transformers in living quarter, • all transformers above 11 kV (13,8 kV). ^e Overload, short circuit and earth fault can be a common alarm for small power transformer.			

5.7.4 Motor protection (see IEC 61892-2, 10.4.6)

Motor protection shall be according to Table 8.

Table 8 - Motor protection

Protective function to disconnect supply	Low voltage motor	High voltage motor	PDCS alarms
Overload	X ^d	X ^d	X
Shortcircuit	X	X	X
Earth fault	X	X	X
RTD, temp. high		X ^a	X
RTD, temp. high/high		X ^b	X
Stalled rotor	X ^c	X	X
No. of start attempts/thermal state		X	X
Negative sequence		X	X
^a Alarm only. ^b Should the RTD detect overtemperature in motors driving firewater pumps, an alarm only shall be annunciated while the operation shall be continued in emergency mode. ^c Stalled rotor protection shall be provided for submerged pump motors and other critical motors when specified in the datasheet. ^d Fuses are not allowed as overload protection.			

5.7.5 11 kV/6,6kV bus bar relays (see IEC 61892-2, 10.5.2)

The following relays shall be installed in each bus bar section of 11 kV/6,6 kV switchboard:

- under voltage relay;
A stationary under voltage situation shall initiate tripping of the connected motors.
- frequency relay;
Input to load shedding system.
- arc detection relay.

An arc detection system shall be installed either alone or in combination with a current relay. Detection shall sectionalize the bus bar and trip incomer(s). This does not apply for single-phase air or gas (SF₆ =sulphur hexachlorid) insulated switchboards.

5.7.6 Other circuits (see IEC 61892-2, 10.4.5 and 10.4.7)**Table 9 – Protection of other circuits**

Protective function to disconnect supply	690 V sub-distribution board feeders	Feeders to 400/230 V sub distribution boards	Lighting and small power circuit	Trace heating circuits
Overcurrent	X ^{a d}	X ^{b d}	X ^c	X ^c
Short-circuit	X ^{a d}	X ^{b d}	X ^c	X ^c
Earth fault	X	X	X	X
^a Over-current and short-circuit included in circuit breaker relay. ^b Over-current and short-circuit included in moulded case circuit breaker. ^c Over-current and short-circuit included in miniature circuit breaker. ^d Outgoing feeders below 400 A may be provided with load breaker and fuses.				

690 V sub distribution feeder shall have a common alarm to PDCS per feeder.

Each 230 V main or sub distribution boards shall at least have common alarm to PDCS for each board indicating tripped circuits. Common alarm for emergency lightings shall be separated as described in IEC 61892-2, 11.4. Heat tracing circuits should also have separate common alarms to PDCS.

5.8 Lighting (see IEC 61892,2, Clause 11)

5.8.1 General

The following clauses govern the design and functional requirements of the general lighting system.

Other lighting systems (e.g. navigation aids, helideck lighting, marking systems and aviation obstruction lighting) shall be designed according to the requirements of statutory regulations.

Lighting calculations shall be performed, and a maintenance factor shall be applied, reflecting the environmental conditions and maintenance intervals. The normal illumination levels shall be according to NORSOK S-002.

It should be noted that lighting equipment with electronic starter may cause interference with radio communication. A study shall be performed to investigate the extent of the problem and propose solutions.

Local sub distribution boards shall be provided for power distribution to the lighting system within each functional area.

5.8.2 General lighting (see IEC 61892-2, 11.2)

The general lighting shall be fed from the main distribution system and shall cover approximately 70 % of the lighting requirement.

The general lighting system shall be designed with fluorescent luminaries. The fluorescent tubes shall be of the two pins, slim long life type.

Floodlights, with high pressure sodium lamp, shall be used for general lighting of open deck areas, inside big open modules where an acceptable mounting height is achievable, on cranes, flare booms, sea surface below boat and raft stations.

Floodlights and control gear for flood lights shall be mounted in locations where they can be easily maintained and mounted in groups for a particular area.

Incandescent luminaries shall not be used. For comfort lighting within the living quarter and office areas, low energy lighting sources like compact/mini tubes should be used.

It shall be possible to vary the lighting level within control rooms and common recreation areas.

5.8.3 Emergency lighting (see IEC 61892-2, 11.3)

Emergency standby lighting shall cover approximately 30 % of the platform lighting requirements. In normal operation the emergency stand by lighting shall form part of the normal lighting system.

Emergency escape lighting shall be supplied from a battery source, and sited according to EN 1838. Other emergency luminaries (e.g. floodlights) shall be supplied from a UPS system with a battery back up for 30 min. The illumination levels shall fulfill the requirements in EN 1838.

Emergency luminaries shall be of the instant start type.

For emergency light fittings with integral batteries, the batteries shall be located such that they are not subject to excessive heating from the light fitting. It should be possible to replace the batteries without dismantling the light fitting.

Electrically powered lighting or photo luminescent indicators (low level lighting) shall be placed at points of the escape to readily identify all escape routes when the normal emergency lights are less efficient due to smoke. The type to be used depends upon the type of area. These luminaries shall meet zone 1 requirements.

Emergency distribution boards shall be Ex-certificated except those located in the emergency switchboard room.

In case of supply to escape lighting from the UPS (centralized battery bank) UPS distribution boards supplying the escape lighting shall be Ex-certificated except those located in the UPS rooms.

5.9 Control and instrumentation (see IEC 61892-2, Clause 12)

Power distribution control system (PDCS) (see IEC 61892-2, 12.13)

A PDCS shall be established and include as a minimum the following functions:

- VDU mimic of the electrical network with circuit breaker and isolator status;
- control of all main breakers in the electrical network;
- status and alarm monitoring of all main breakers;
- alarm from all relevant sub distribution boards and UPSs;
- event recording of all alarms and status changes.

In addition the following functions may be included as required:

- load shedding system;
- power management system;
- change over using "make-before-break" between incomer and bus tie breakers;
- power reading of main generators, high voltage motors, feeders, and other analogue values according to Table 16;
- trend recording.

Motor starter/consumer feeder interface should be directly to SAS/PCS.

The PDCS shall be an independent functional unit with interface to the PCS, preferable as a part of the SAS hardware or as an independent unit with data communication to the PCS.

Alarm and control signals shall be collected from each switchboard to the PDCS by use of local control units, distributed I/O units or intelligent units with communication.

Data communication with standard protocols and electrical interface should be used. Selection of communication protocol shall be coordinated with selected SAS system to ensure compatibility.

The event recording function shall enable printing of all events sequentially with the proper identification, time and date tagging. The time resolution for the main distribution system shall be maximum 20 ms while I/O units for motors and sub-systems shall be maximum 1s. Time tagging shall preferably take place on the lowest level (I/O unit). All time tagging shall be time synchronised with the SAS or corresponding time reference.

The total response time from operation of main breaker from VDU to reached status change, shall not exceed 3 s, see NORSOK I-002, Annex 2.

Where implemented, the load shedding system shall be an independent software module within the PDCS. Care shall be taken to ensure that the response time is sufficient to enable the load shedding system to perform its function and maintain a stable electrical system.

5.10 Degrees of protection by enclosures (see IEC 61892-2, Clause 13)

See IEC 61892-2, 13.1

Minimum degree of protection provided by enclosure shall be as follows:

- for outdoor, in naturally ventilated areas and wash down areas: IP 56 (see NOTE)
- dry indoor areas: IP 20
- other areas: IP 44

Above represents minimum requirements. It should be noted that regulations may contain more stringent requirements and shall be consulted.

NOTE IP 56 is required where equipment is placed in open deck exposed to water from heavy seas or in areas exposed to water projected jets or deluge, elsewhere IP 55 is required.

6 Equipment (see IEC 61892-3)

6.1 General

Locations of major equipment shall be according to 4.11. For equipment datasheets, see Annex A.

The terminals and the earthed frame of high voltage equipment shall be provided with contact bolts for application of mobile earthing apparatus. Earthing terminal shall be mounted outside the enclosure.

In equipment which can be accessible during normal operation (open front door), all components with potentials above 50 V shall have a degree of protection of IP 20.

6.2 Generators and motors (see IEC 61892-3, Clause 4)

6.2.1 Motors (see IEC 61892-3, 4.1)

6.2.1.1 General (see IEC 61892-3, 4.1)

AC motors should be of the squirrel cage, direct on-line start type. Where variable speed/torque regulation is required, converter fed AC motors shall be used.

The insulation shall minimum be class F, temperature shall be limited to class B.

All Exe motors shall be star connected.

High voltage motors shall have preformed and vacuum impregnated windings and shall be star connected.

6.2.1.2 Motor rating, Ex-protection and enclosure

Motor rating and protection shall be according to Table 10.

Table 10 - Motor rating and degree of protection (IP)

Motor type	Nominal voltage	Rated output	Ex protection ^d	Insulation class	Enclosure
LV	400 V AC ^c	< 150 kW	e, n, d/e ^a	F	IP55 ^b
LV	690 V AC	< 400 kW	e, n, d/e ^a	F	IP55 ^b
HV	3,3 kV	> 200 kW	n, p/e, d/e ^a , e ^e	F	IP55 ^b
HV	6,6 kV	> 300 kW	p/e, d/e ^a , e ^e	F	IP55 ^b
HV	11 kV AC	> 400 kW	p/e, d/e ^a	F	IP55 ^b

^a Ex d motors shall only be used with Ex e termination. Ex de is preferable for LV ASDS, heavy start and intermittent motors, see IEC 60079-14.
^b IP56 shall be used on open deck and where equipment may be exposed to powerful water jets and deluge.
^c For special applications only.
^d Non-ex type motors may be used in non-hazardous mechanically ventilated areas.
^e HV Exe motors shall not be used in zone 1 areas.

Motors in zone 1 or 2 from 11 kV and above shall be Ex p or Ex d with Ex e termination.

Totally enclosed fan cooled (TEFC) motors may be used on open deck provided embedded temperature detectors for trip upon blocking or destroying of fan blades protect the motor.

6.2.1.3 Local control stations

Control stations shall be standardized according to IEC 60073 with respect to symbols, colours and lettering on pushbuttons, indication lights, and selector switches, etc. throughout the unit.

Local stop, stay put pushbutton, shall be installed adjacent to each motor shall be hard wired connected directly to the motor starter.

Requirement for emergency stop, see Directive 98/37/EC. Where emergency stop is required, the local stop is not required.

6.2.1.4 Testing

Tests shall be performed according to IEC 60034-4.

All HV motors shall be routine tested according to Table 11. These routine tests shall be considered to be the minimum test requirements for HV motors and shall, if not otherwise agreed, be performed by the motor supplier. If other tests are required, additional tests shall be specified in the motor data sheet.

For HV synchronous motors the minimum test requirements, see AC Generator test table 12.

Table 11 – HV motor test requirements

Item no	Test requirements
1	Measurement of ohmic resistance of stator winding referred to 20 °C.
2	Insulation resistance test of stator winding (Megger test).
3	No-load test (measurement of no-load characteristic and the no-load losses at rated voltage and rated frequency).
4	Short circuit test (measurement of short circuit characteristic and load losses at rated current and rated frequency. Short circuit point).
5	Check of phase sequence and terminal markings, see IEC 60034-8.
6	Withstand voltage test, see IEC 60034-1.
7	Vibration measurement, see IEC 60034-14.
8	Functional check of accessories, e.g. temperature detectors in windings and bearings, vibration monitoring, heaters.
9	Noise level test at no-load, see IEC 60034-9. If more than one identical motor are ordered, noise level test shall be subjected to one motor only.
10	Heat run test. If more than one identical motor are ordered, the heat run test shall be subjected to one motor only.

6.2.2 AC generators (see IEC 61892-3, 4.3.3)

6.2.2.1 General

The generator shall be designed for operation in parallel with units of equal and unequal ratings.

The stator winding shall be star connected and star point and main terminals brought out to terminal boxes on the outside of the generator hood.

The generator should preferably be delivered with a neutral resistor as an integral part of the generator. If the neutral resistor by practical reasons not can be attached to the generator, it will still be the generator supplier's responsibility to supply the neutral resistor. The resistor shall be rated in accordance with the data sheet.

The generator bearing shall be protected against circulated current.

Minimum two temperature resistance sensors shall be embedded in each phase of the stator winding. The exciter shall be of the brush less type and directly connected to the main rotor winding. The exciter and rectifier assembly shall be rated minimum 10 % above the nominal value required when the generator is running at rated load and power factor.

For HV generators facilities shall be provided for continuous monitoring of exciter and field winding insulation resistance, facilities shall also be provided for monitoring of the rectifier diodes. Alarms shall be given for failed shorted diodes.

The electronic AVR shall have adequate protection against voltage surges, shall be free of voltage drifting, be insensitive to temperature changes, vibration and shall maintain regulation accuracy for frequency variations of $\pm 10\%$ of rated value.

The voltage regulation system shall consist of minimum one AVR system and one FCR for test and standby purpose. AVR and FCR can be combined as one unit.

Each bearing shall be provided with temperature detectors (one spare) for alarm and shutdown purposes.

The lubrication oil system shall operate during spin-down of the generator in a black out situation, preferably by gravity fed lube oil supply.

6.2.2.2 Testing

Tests shall be performed according to IEC 60034-4.

All generators shall be routine tested according to Table 12. These routine tests shall be considered to be the minimum test requirements for generators and shall, if not otherwise agreed, be performed by the generator supplier. If other tests are required, additional tests shall be specified in the generator data sheet.

Table 12 – AC generator test requirements

Item no	Test requirements
1	Measurement of ohmic resistance of stator winding referred to 20 °C.
2	Measurement of ohmic resistance of rotor winding referred to 20 °C.
3	Insulation resistance test of stator winding (Megger test).
4	Insulation resistance test of rotor winding (Megger test).
5	Measurement of no-load characteristics and determination of core- and friction-losses.
6	Short-circuit characteristic test and determination of short-circuit losses.
7	Check of phase sequence and terminal markings, see IEC 60034-8.
8	Withstand voltage test of stator winding (dielectric test according to IEC 60034-1).
9	Withstand voltage test of rotor winding (dielectric test according to IEC 60034-1).
10	Vibration measurement, see IEC 60034-14.
11	Functional check of accessories such as temperature detectors in windings and bearings, vibration monitoring, heaters, excitation equipment.
12	Noise level test at no-load, see IEC 60034-9.
13	Over speed test shall be done for HV main generators.
14	Heat run test. If more than one identical generator is ordered, the heat run test shall be subjected to one generator only.

6.3 Transformers for power and lighting (see IEC 61892-3, Clause 5)

6.3.1 General (see IEC 61892-3, 5.1)

Transformers shall comply with IEC 60076 (all parts).

The following requirements are not applicable for 3-phase transformers with a nominal rating below 5 kVA and single phase transformers below 1 kVA.

High voltage power transformers of rated nominal power up to and including 2 500 kVA (AN) shall be prepared for forced cooling rated 140 % (AF). For high voltage power transformers with rated nominal power above 2 500 kVA (AN) the AF rating shall be minimum 125 %, if not otherwise stated in the power transformer data sheet. Increased AF rating will have significant impact on the sound level.

HV transformers shall be equipped with hinged panels.

All HV transformers shall have a rated lightning impulse insulation level according to List 2 if not other lower requirement (List 1) is stated in the power transformer data sheet. List 1 and 2 are defined in IEC60076-11.

Insulation class shall be minimum F. High voltage power transformers should be of the cast resin dry type. Low voltage (LV/LV) transformers may be dry types without cast resin insulation.

Transformers located indoors shall be designed for yearly average environmental temperature of 25 °C.

Neutral resistor should be an integrated part of the transformer, including current transformer. The current transformer shall not be affected by inrush current (EMC).

6.3.2 Tests (see IEC 61892-3, 5.8)

Tests shall be performed according to IEC 60076-1. For dry type transformers tests shall be performed according to IEC 60076-11.

All transformers shall for each project be subjected to the tests in Table 13.

These tests shall be considered to be the minimum test requirements for transformers and shall, if not otherwise agreed, be performed by the transformer supplier. If other tests are required, additional tests shall be specified in the power transformer data sheet.

Table 13 – Transformer test requirements

Item no	Test requirements
1	Measurement of winding resistance.
2	Measurement of voltage ratio and check of phase displacement.
3	Measurement of short circuit impedance and load loss.
4	Measurement of no-load loss and current.
5	Separate-source voltage withstand test.
6	Induced over voltage withstand test.
7	Test on on-load tap-changers, if applicable.
8	Functional check of accessories such as temperature detectors, cooling fans, etc.
9	Measurement of sound level. The sound level shall be tested with transformer enclosure mounted. Measurements shall be made with and without cooling fans in operation. If more than one identical transformer is ordered, the sound level test shall be subjected to one transformer only. This test is not applicable for transformers with nominal rating below 100 kVA (AN). All transformers with forced cooling shall be subjected for this test.
10	Temperature-rise test (heat run test). If more than one identical transformer is ordered, the test shall be subjected to one transformer only.

6.4 Switchgear and control gear assemblies (see IEC 61892-3, Clause 6)

6.4.1 Low voltage switchboard (see IEC61892-3, 6.3 to 6.8)

6.4.1.1 General

Spare space of approximately 20 % at the time of delivery to operation should be provided, alternatively spare space shall be provided in room for switchboard extension.

Status for main circuit breakers shall be shown on the breaker front (i.e. on, off, trip).

Starters shall be designed for direct on-line starting of type AC3 according to IEC 60947-4-1.

The control voltage for motor starters/contactors feeders should be supplied from a common control voltage transformer for each motor starter/contactor feeder cubicle or each bus bar section. Protection shall be provided individually for each motor starter/contactor feeder circuit.

Trip circuits of emergency generator breakers shall be equipped with shunt trip coil and under voltage coil. The under voltage coil shall be supplied from the emergency generator.

For circuit breakers the control voltage shall be supplied from UPS at 230 V AC, see 5.1.3.. Socket outlet should be provided inside the switchboard fed from the UPS circuit.

The starters shall have a test possibility when disconnected from the main circuit.

Starters should be grouped into motor control centres located in switchboard rooms; free standing motor starters in outdoor location are not acceptable. Combined switchboards including switchgear and MCC are acceptable.

Pad locking facilities shall be provided for all incoming and outgoing circuits. This shall apply for all voltage levels including 230 V.

Internal segregation shall for 690 V switchgears be according to IEC 60439-1, form 4b.

Internal segregation shall for 690 V MCC be according to IEC 60439-1, form 3b.

Air circuit breakers and motor starters shall be of the withdraw-able type.

6.4.1.2 Motor control center (MCC) modules

When intelligent programmable feeders and motor starters with protection control devices are used, these should have communication possibilities to supervisory systems and data transferred to SAS/maintenance system.

6.4.1.3 Test specifications (see IEC 61892-3, 6.8)

Routine tests shall be performed according to IEC 60439-1.

Arc-testing shall be part of the type test.

All low voltage switchboards shall for each project be subjected to the tests in Table 14. These tests shall be considered to be the minimum test requirements for low voltage switchboards and shall, if not otherwise agreed, be performed by the switchboard supplier. If other tests are required, additional tests shall be specified in the low voltage switchboard data sheet.

Table 14 – Low voltage switchboard test requirements

Item no	Test requirements
1	Visual Inspection and check of wiring and dimensions according to project drawings.
2	Dielectric test on main circuit. HV test at 50 Hz for 1 min followed by insulation (Megger) test.
3	Insulation test (Megger test) on the control and auxiliary circuits.
4	Functional test of all moving parts and mechanical interlocks.
5	Functional operation test of all electrical control and auxiliary circuits according to project schematic and wiring diagrams.
6	Functional operation test of protection relay settings by either secondary or primary current injection. A minimum spot check of 10 % of all protection relays shall be made. If any fault is found by the 10 % spot check then all relays shall be tested.

6.4.2 High voltage switchboard (see IEC 61892-3, 6.1)

6.4.2.1 General

The switchboard and cubicles shall be metal enclosed according to IEC 62271-200. Separate low voltage compartments shall be located in the front of the switchboard.

The switchboard shall be of either air or SF6 insulated type.

All circuit breakers and contactors shall be of either vacuum or SF6 type.

The circuit breakers and contactors shall be equipped with facilities for testing when disconnected from the mains. The control voltage shall be supplied from UPS of 230 V AC, see 5.1.3. Socket outlet should be provided inside the switchboard fed from the UPS circuit.

Trip circuits of generator breakers shall be equipped with shunt trip coil and under voltage coil or double shunt trips.

For air insulated switchgears the high voltage compartments should be provided with pressure relief.

The switchgear room shall allow for extension of the switchgear in at least one end.

All circuit breakers and contactors shall be withdraw-able for air insulated switchboards. Circuit breakers, contactors, and earthing switches shall be provided with padlocking facilities.

Mechanical interlock between circuit breaker, contactor, and earthing switch in the same cubicle shall be provided. Where mechanical interlock is not possible (i.e. closing of earth switch on live main bus bar), other interlock system shall be provided.

6.4.2.2 Test specifications (see IEC 61892-3, 6.8)

All high voltage switchboards shall for each project be subjected to the tests in Table 15. These tests shall be considered to be the minimum test requirements for high voltage switchboards and shall, if not otherwise agreed, be performed by the switchboard supplier. If other tests are required, additional tests shall be specified in the high voltage switchboard data sheet.

Routine tests shall be performed according to IEC 62271-200. High voltage switchboards shall be type tested according to IEC 62271-200, annex A, for arcing due to internal faults. The duration of the arc shall be 1s.

Table 15 – High voltage switchboard test requirements

Item no	Test requirements
1	Visual Inspection and check of wiring and dimensions according to project drawings.
2	Dielectric test on main circuit. HV test at 50 Hz for 1 min followed by insulation (Megger) test.
3	Dielectric test (Megger test) on the control and auxiliary circuits.
4	Measurement of the resistance of the main circuit.
5	Functional test of all moving parts and mechanical interlocks.
6	Functional operation test of all electrical control and auxiliary circuits according to project schematic and wiring diagrams.
7	Functional operation test of all protection relay settings by either secondary or primary current injection.
8	IEC routine test of all high voltage circuit breakers and contactors. The circuit breaker/contactors routine test reports shall document the proper function of all circuit breakers and contactors included in the actual switchboard. The circuit breaker/contactors routine test reports shall be presented during the testing of the complete switchboard.
9	Tightness test (for gas insulated switchboards only).

6.5 Electrical indicating instruments

6.5.1 General

Panel instruments should be of class 1.5.

Current transformers for measuring purposes shall have 5 A or 1 A secondary current.

Voltage transformers shall have 110 V secondary voltage. Shunts used on DC current metering shall be 60 mV.

Where synchronizing can take place, the following instruments shall be provided for manual synchronizing:

- synchroscope;
- double voltmeter;
- double frequency meter;
- check synchronizing relay.

6.5.2 Requirement

Electrical indicating instruments shall be according to Table 16.

Table 16 – Electrical indicating instruments

	Generators		Motor feeders	Transformer feeders/outgoing circuit breaker feeders	Incomers	DC systems	Bus bar metering
Indicating instruments	Incomers	Control panel					
Voltmeter + selector switch	X	X			X		X ^b
1 voltmeter						X	
Ammeter + selector switch ^a	X	X		X	X		
1 ammeter						X	
Wattmeter		X ^b	X ^c	X ^c			
VAr meter		X					
Frequency meter		X					
Synchroscope		X					
Ammeter for field current AVR		X					
Temperature measurement		X	X HV motors only	X HV transformers only			
Hours run meter		X	X ^b				
kWh meter		X					
^a Ammeters per phase may be used. ^b The values shall be registered in the SAS or PDCS, if available. ^c Optional, may be implemented in the PDCS or local.							

6.6 Semiconductor converters (see IEC 61892-3, Clause 7)

6.6.1 Adjustable speed AC motor drives (see IEC 61892-3, Clause 7)

General

These additional requirements are valid for adjustable speed AC motor drives with a motor nominal power larger than 100 kW.

Generally the PDS shall be designed, manufactured and tested by the same supplier.

The different parts of the PDS might be installed in locations separated from each other. The supplier shall specify the maximum acceptable cable lengths between the different parts.

Selection of cables, earthing of equipment, and other installation requirements shall be subjected to BDM supplier's installation manuals.

6.6.2 Supply voltage and EMC requirements

General

The PDS shall fulfil the requirements of IEC 61800-3.

Transients

The PDS shall be able to operate with voltage and frequency transients that occur in maritime installations. Reference is made to transient limits as given in IEC 61892-1.

Harmonic distortion

Generally a harmonic distortion analysis is required when installing a PDS. On the PCC (point of coupling, normally primary side of the converter transformer) the total harmonic voltage distortion should not exceed limits as given in 4.5 and 5.6.5.

The harmonic distortion analysis at the PCC should normally be done by the PDS supplier. This analysis should focus on the worst case scenario. It shall be based on the minimum short circuit power at the PCC when the PDS is in operation, and the maximum required motor shaft power. This information should normally be given by the purchaser.

6.6.3 Critical speeds and pulsating torque

Critical speeds

A dynamic lateral and torsional analysis of the complete string (i.e. motor, gear, and driven unit) shall be made for drives when specified in the ASDS data sheet. This analysis shall be the responsibility of the supplier of the driven unit (i.e. pump, compressor, thrusters, etc). However, the required motor information for this analysis shall be made available by the PDS supplier. The foundation which often is softer in offshore applications compared to onshore should be focused.

The PDS/BDM supplier shall advise the critical speeds in his bid and if any inside the operating range he shall document how to avoid these critical speeds.

Pulsating torque

For drives equal and larger than 2 MW nominal motor rating the PDS/BDM supplier shall give information about any pulsating torque in the low speed range as well as in the operating speed range. For LCI drives, the inter-harmonic frequencies supplied to the grid shall also be given.

6.6.4 Equipment requirements

General

After the commissioning period, the drive should have the capability to run continuously for a period of at least 24 months, under the specified site conditions without any scheduled shutdown. No component of the drive system should require any routine or preventive maintenance that needs a shutdown of the system over any consecutive 24 months period following initial operation.

If the PDS shall be used for special duties (e.g. intermittent duty, short time overload, etc.) the special duty class shall be given in the ASDS Data Sheets. If no duty class information is given then Duty Class 1 (continuous full load) shall be applied. Duty class definitions are given in IEC 60146-1-1.

The equipments shall be able to operate under the movements (roll and pitch) and vibrations that are normal in a floating vessel. If not other requirements are given in the data sheets, the equipment shall meet the ambient requirements as given in IEC 61892-1.

Motor

The insulation shall be class F. The temperature rise at specified load in the entire speed range should be limited to class B. Higher insulation classes may be agreed upon.

The supplier is free to choose motor voltage, frequency and pole pairs unless otherwise stated in the data sheet. The required speed range is stated in the data sheet.

Unless otherwise stated in the data sheet the motor neutral shall be isolated.

Motor bearings shall be protected against currents generated by the BDM.

The motor shall be designed for operation with the applicable BDM and take into account all additional losses, the actual load and relevant voltage spikes.

All HV motors shall be dynamically balanced according to the limits in IEC 60034-14, Vibration Grade B.

For LCI drives with HV synchronous motors, the motor windings shall consist of two three-phase systems with 30° electrical phase shift in order to minimise torque pulsations. The windings shall be star connected and isolated. The exciter shall be of the brushless type. The rotor winding and the diodes shall withstand any symmetrical or asymmetrical fault occurring in the stator windings.

Basic drive modul (BDM)

The BDM shall include an alphanumeric panel display showing drive parameters and operating status and a fault detection/protection list (alarms). The BDM fault diagnostic shall have a memory function to retain information about the cause of tripping. This information should be retained for at least 72 h even if the entire system is de-energised.

The BDM shall provide proper protection for the PDS against overload, over-voltage, under-voltage and short circuit, asymmetric currents as well as inability to start and over-speed.

If a by-pass switch is required, this shall be stated in the ASDS converter data sheet. If required, the by-pass shall be manually operated and provided with mechanical interlocks to prevent paralleling of the PDS and the by-pass power supply.

Serial link for communication to platform control system (e.g. SAS, PCS, etc.) shall be included unless other requirement is given in the data sheet. A separate hard wired 24 V DC interface for external emergency shut down (PSD/ESD) shall in addition be provided.

The control system shall be able to control the drive by speed ramp, torque or power. The normal control mode is indicated on the data sheet.

If the reference signal is lost the drive shall either decelerate to minimum speed/torque/power or down to standstill as stated in the data sheet.

As a minimum the following potential-free output signals shall be provided and wired to terminals:

- Ready to start
- Running
- Stop - when stopped by process system or PDS protection devices
- Stop - when stopped by emergency push-button

During normal operation after decelerating the motor to standstill, it shall be possible to de-energise the motor by blocking gate/base signals to the power semiconductors, leaving line transformer and converter input circuit energised.

When automatic restart is specified in the data sheet this shall also be possible with a rotating motor. This is called "flying restart".

Measures shall be taken that HV cubicles/compartments can be completely de-energised, isolated and earthed.

If special tools and/or software are required for operation or maintenance it shall be supplied by the BDM supplier.

Earth fault shall give alarm and controlled run-down.

Du/dt filter may be required when voltage source converter technology is used, i.e. insulated gate bipolar transistor technology or integrated gate commutated thyristor technology. It is within the responsibility of the PDS supplier to include and design a du/dt filter, out-put reactor, select the correct motor winding insulation, and, if specified, to have the PDS system Ex certified.

Feeding section

Converter transformers (if any) shall normally be of the dry cast resin type. These transformers shall meet the requirements in IEC 60146-1-3 and IEC 60076-11.

If no converter transformer is to be used the BDM supplier shall evaluate whether an input reactor is necessary or advisable in order to fulfil proper BDM function and acceptable level of supply current distortion. If required, this reactor shall be part of the BDM supplier's scope of supply.

The selection of the converter transformer/reactor reactance shall be the responsibility of the PDS supplier. It shall be ensured a reactance adequate for proper function and short circuit protection of the BDM. The short circuit level on the primary side of the converter transformer/reactor shall be informed by the purchaser.

Converter transformers shall be equipped with temperature sensors in secondary windings and all legs of iron core.

Earthing screen between primary windings and secondary windings shall be installed for all converter transformers.

Low voltage/low voltage transformer windings are accepted as dry type without cast resin insulation. The transformer shall meet the requirements in IEC 60076-11 and IEC 60146-1-3.

6.6.5 Testing

Transformer test

ASDS transformers shall be subjected to the same tests requirements as distribution transformers, see 6.3.2. If additional tests are required, these tests shall be specified in the power transformer for ASDS data sheet.

Motor test

ASDS motors shall be subjected to the same tests requirements as other motors, see 6.2.1.4. If additional tests are required, these tests shall be specified in the motor for ASDS data sheet.

Frequency converter (BDM) test

BDM shall for each project be subjected to the standard tests given in Table 17. These tests shall be considered to be the minimum test requirements for BDM and shall, if not otherwise agreed, be performed by the BDM supplier. If additional tests are required, these tests shall be specified in the converter for ASDS data sheet.

Tests shall be performed according to IEC 60146-1-1.

Table 17 – Basic drive module (BDM) test requirements

Item no	Standard test
1	Visual inspection and check of wiring and dimensions according to project drawings.
2	Insulation test.
3	Light load and functional test.
4	Over-current capability.
5	Checking of auxiliary devices.
6	Checking the properties of the control equipment.
7	Checking the protective devices.
8	Audible noise test. Measurements shall be made with and without cooling fans in operation. If more than one identical BDM is ordered, the sound level test shall be subjected to one BDM only. All BDM ratings with forced cooling shall be subjected for this test. However, this test is not applicable if the audible noise level can be documented by type test measurements on identical BDM.

Power drive system (PDS) test

A functional system test of the PDS shall be performed when specified in the ASDS Data sheet.

A PDS system test shall then be carried out for verification of all components that are part of the PDS scope of supply are functioning in accordance to specifications.

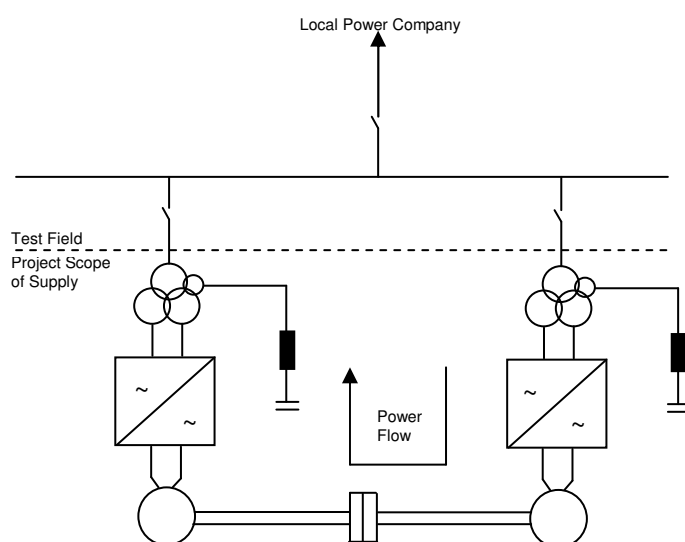


Figure 1 - Example for PDS system test

The PDS supplier is responsible for such test and shall in the bid attach a single line diagram showing how the PSD supplier intends to carry out this test. PDS supplier shall attach a PDS system test plan in the bid.

The measurements carried out during the PDS system test are for determination and proof of particular PDS operational data, especially of the guaranteed values. As a minimum, the PDS system test should contain topics as listed in Table 18.

Tests shall be performed according to IEC 61800-4.

Table 18 – Power drive system (PDS) test requirements

Item no	Standard test
1	Visual inspection and check of wiring and dimensions according to project drawings.
2	Insulation test.
3	Functional test including all auxiliaries and test of remote signals.
4	Checking co-ordination of protective devices.
5	Load characteristic test.
6	Efficiency
7	Power factor.
8	Line-side current distortion content.
9	Motor vibration.
10	Torque pulsation.
11	Dynamic performance test.
12	Audible noise.
13	Shaft current/bearing insulation.
14	Over-current capability.

String test

For drives, where string tests including driven equipment (e.g. compressor, pump, thrusters, etc) have been specified, the string test will normally replace the PDS system test. However, the PDS system properties should also be proven during a string test. String test plan has to be discussed and agreed upon for each project.

6.7 Secondary cells and batteries (UPS) (see IEC 61892-3, Clause 7 and Clause 8)

6.7.1 General

The UPS unit shall meet the requirement in IEC 62040-1-1 and IEC 62040-1-2.

The UPS unit shall have internal fault supervision facilities to verify operational properties for the system. The fault supervision shall include battery discharge test without closing down the supply to the consumers. The UPS shall have a separate battery discharge alarm.

To obtain isolation from all power sources at ESD, all battery breakers shall have a remote trip function, see NORSOK S-001, Figure 9.1. Means shall be provided to enable closure of the battery breaker after a trip without utilising external auxiliary voltage or temporary links.

UPS batteries should be located in separate battery rooms if the battery capacity exceed 20 kWh (battery $AH \cdot U_N$).

Valve regulated batteries can be located in the same room as the UPS including distribution.

Ventilation shall comply with NEK EN 50272-2.

All UPS shall be equipped with a manual by-pass circuit for maintenance purpose and a static switch for automatic and uninterrupted transfer of load from the inverter to the by-pass supply. Retransfer of the load from the manual bypass switch to the inverter shall be manually operated.

The UPS unit should include interlocks to prevent black-outs caused by operational mistakes, i.e. safe operational command software.

The UPS unit should have a mimic diagram on front showing operational modes and voltage/amps/frequency.

6.7.2 Testing

UPS and batteries shall for each project be subjected to the standard test listed in Table 19. These tests shall be considered to be the minimum test requirements for UPS and batteries and shall, if not otherwise agreed, be performed by the UPS supplier. If other tests are required, additional tests shall be specified in the uninterruptible power system data sheet.

Tests shall be performed according to IEC 62040-3.

Table 19 – Uninterruptible power system (UPS) and batteries test requirements

Item no	Standard test
1	Visual inspection and check of wiring and dimensions according to project drawings.
2	Insulation test.
3	A complete functional test. This test shall also include test of supervisory and remote signalling circuits.
4	Full load test.
5	Short circuit test.
6	Short circuit protection device test. Test shall be performed to document the selectivity in the UPS distribution. Identical type of largest fuse and/or circuit breaker as installed in the UPS distribution board shall be included in the test. Test shall be done with and without by-pass available.
7	Earth fault test.
8	Transfer test. Measurement of UPS output voltage quality. The test shall document proper function of the UPS voltage regulation during switching between all different modes of operation.
9	Battery discharge test function shall be demonstrated.
10	Restart test. Black-start of UPS shall be demonstrated.
11	Audible noise test. Measurements shall be made with and without cooling fans in operation. If more than one identical UPS is ordered, the sound level test shall be subjected to one UPS only. All UPS ratings with forced cooling shall be subjected for this test. However, this test is not applicable for UPS with nominal rating below 100 kVA (AN), or if the audible noise level can be documented by type test measurements on identical UPS.

6.8 Luminares (see IEC 61892-3, Clause 9)

Floodlights shall be provided with an extra safeguarding against falling down if the screwed connections loosen.

6.9 Heating and cooking appliances (see IEC 61892-3, Clause 10)

6.10 Trace and surface heating (see IEC 61892-3, Clause 11)

6.10.1 General

Heat tracing shall be applied for frost protection, condensation prevention and process temperature maintenance.

Design, material and installation should be according to "Trace Heating guidelines in Industry and Offshore (IFEA)".

6.10.2 Design

The heat tracing cables should be of the self-limiting type.

Use of temperature control devices like RTD, thermostats etc. should be limited. For specific applications, however, where the self-limiting characteristic of the heating cable is unsuitable regarding response or temperature limitations, temperature control device control shall be used. Temperature control devices shall be installed if excessive temperature will cause corrosion on pipes and tubing or at any process limitations.

6.10.3 Power supply

One heat tracing circuit should only supply one process system. However, when a drain/flare line is connected to a process line, the heat tracing cables can be on the same heat tracing circuit.

Each of the circuits shall be equipped with an automatic trip, 30 mA earth fault relay. Trip indication shall be provided for each circuit. Common alarm shall be given to a central alarm system for each sub distribution board.

Sub distribution boards shall be provided for local power distribution to the heat tracing system in each functional area. The distribution boards should not be located in hazardous areas or in exposed environments.

6.11 Communication (see IEC 61892-3, Clause 12)

See IEC 61892-3, 12.1

For telecom systems reference is made to NORSOK T-001 and NORSOK T-100.

6.12 Underwater systems and appliances (see IEC 61892-3, Clause 13)

See IEC 61892-3, 13.1

For remote operated vehicle (ROV) equipment reference is made to NORSOK U-001 and NORSOK U-102.

6.13 Control and instrumentation (see IEC 61892-3, Clause 14)

6.13.1 General (see IEC 61892-3, 14.1)

For SASs reference is made to NORSOK I-002.

General requirements and environmental and supply conditions should also be valid for SAS.

6.13.2 Environmental and supply conditions and testing (see IEC 61892-3, 14.3)

6.13.2.1 General (see IEC 61892-3, 14.3.1)

For switchboard assemblies housing control and instrumentation equipment the test requirements for the switchboard assembly shall be the basic test requirements. Control and instrumentation components shall be regarded as pre tested components.

6.13.2.2 Mechanical conditions (see IEC 61892-3, 14.3.4.1)

Vibrations should be based on requirements in Table 1 in IEC 60092-504.

6.13.2.3 Testing (see IEC 61892-3, 14.3.7)

Vibrations test 9 should be based on requirements in Table 1 in IEC 60092-504.

Test 4a and test 4b should be based on requirements in Table 1 in IEC 60092-504.

6.13.3 Computer based systems (see IEC 61892-3, 14.16)

For computer based safety systems the requirements in the ATEX directive shall be followed. In general requirements in NORSOK I-002 shall be followed for SAS.

6.14 Accessories (see IEC 61892-3, Clause 15)

Reference to 5.4.4 and 5.4.5.

7 Cables (see IEC 61892-4)

Cables shall comply with NEK 606, see 9.2 in this NORSOK standard.

8 Mobile units (see IEC 61892-5)

Limits of inclination of the unit (see IEC 61892-5, Clause 5)

All machines and apparatus, for fixed floating units, shall operate satisfactory under all conditions with the unit upright and when inclined up to 17° plus 5° dynamic.

Machines and apparatus for emergency and life support systems shall operate satisfactory under all conditions with the unit upright and when inclined up to 25°.

9 Installation (see IEC 61892-6)

For typical installation drawings, see Annex B.

9.1 Equipment earthing and bonding (see IEC 61892-6, Clause 4)

9.1.1 General (see IEC 61892-6, 4.1)

Earthing shall comply with DBE-9039 with exception of field equipment which shall be earthed through supply cable.

Only corrosion resistant components shall be used as earthing parts.
Unless other is accepted, only one core is accepted on each terminal point.

Earth bars shall be located in front of equipment and junction boxes to allow easy access for usage, inspection and maintenance. All earthing bars and terminals shall be visible and possible to be checked also after termination of cables.

If aluminium is used for any part of the main structure, attention shall be given to ensure that continuity in the structural earth is maintained at aluminium/steel interface points.

The main earth reference points shall be earth bosses welded to the structure as close as possible to the cabinet/equipment. Alternatively, earth bars mounted on earth bosses welded to structure may be used.

There shall be a separate main earth reference point for PE and IE.

For PDS/PCS/SAS applications separate high frequency bonding shall be installed based on recommendation from PDS/PCS/SAS supplier.

The distance between the PE and IE reference points shall be minimum 1 000 mm.

Final circuits for lighting and small power inside living quarter shall be according to relevant parts of NEK 400.

9.1.2 Earthing of exposed conductive parts (see IEC 61892-6, 4.2)

Field equipment shall be connected to the PE system through the cable. The braid armour should be the earth conductor and it shall be electrically continuous from the field to the central equipment PE bar.

For power cables where the braid armour does not have sufficient cross section, the equipment shall be earthed through a separate earthing conductor in the cable.

Equipment supplied by single core cables shall be connected to PE by a separate earth cable. The separate earth cable shall run alongside the power cables to form a "cable system" and be terminated to the field equipment earth terminal as well as feeding end earth bar/terminal.

The copper braid of the single core cables shall be earthed at one end, isolated in the other end. Where hazardous areas are involved, the copper braid shall be earthed in the hazardous area.

Ex d electrical equipment with direct entry, shall be connected to the PE system by a separate earth conductor in the cable, see 10.3.2.

The PE earth cables or braids armour of cables, connected to a switchgear, cabinet, equipment etc., shall be connected to a PE earth bar as close as possible to the cable entry of the switchgear, cabinet, equipment, etc.

9.1.3 Equipotential bonding (see IEC 61892-6, 4.3)

Exposed conductive parts located in hazardous and mechanical ventilated areas shall be bonded to the main structure.

Enclosures of high voltage equipment located in hazardous areas shall be connected to PE and bonded to the main structure.

9.1.4 Instrumentation earth

The IE shall be the earth reference for non-intrinsically safe, intrinsically safe instrumentation and telecommunication 0 V references etc.

The IE screen shall be left floating in the field end. It shall be electrically continuous from the field equipment and be connected to IE bar in the central cabinet.

The screen shall be connected to one IE bar only for signal cables between two control cabinets.

9.1.5 Earth bar and earth boss

Earth bars shall be fabricated from copper and provided to suit number and size of connections.

PE bars shall be connected to the nearest convenient main structure point through an insulated earth conductor or through the supply/feeder cable.

IE bars shall be isolated from the enclosure and connected to the nearest convenient main structure point through an insulated earth conductor.

Where earth bosses are used, each earth boss shall only have one connection. After connection, the whole assembly shall be sealed in accordance with NORSOK M-501. Bonding bosses in outdoor and exposed areas to be coated to prevent corrosion.

9.2 Cables and wiring (see IEC 61892-6, Clause 5)

9.2.1 General (see IEC 61892-6, 5.1)

All installed cables shall be according to NEK 606.

Fire resistant cables shall be selected according to Authority requirements. All other cables used shall be flame retardant, see Facilities Regulations, § 11.

Mud resistant cables shall be used where cables are routed through areas exposed to mud/oil.

Multicore cables with collective screen shall be standard, individual screens shall only be used when required.

The following systems shall have separate multicore cables:

- general instrumentation;
- fire and gas;
- ESD;
- telecommunication.

Cables without armour may be used in the accommodation part of the living quarter, offices and control rooms.

Internal wires for all electrical panels shall be halogen free and flame retardant .

For equipment supplied with flying leads, suppliers standard cables are accepted. It shall be as short as possible and with mechanical protection.

9.2.2 Cable segregation

The cable network shall be separated into the following systems:

- System 1 High voltage systems (above 1000 V);
- System 2 Low voltage power supply and control cables for electrical systems (1000 V and below);
- System 3 Instrumentation and telecommunication systems.

Cable ladders installed horizontally shall have sufficient space to facilitate cable pulling and cleating/strapping. It shall be minimum 300 mm free space between top of one ladder edge to bottom of next ladder edge, and from top ladder edge to roof.

Instrumentation and telecommunication cables may be routed on system 2 cable support systems when minimum 300 mm distance between the individual systems are kept.

System 2 and system 3 cables can be installed on same field tray from branch to single equipment when this is not in conflict with the type of signals in the cable.

Crossing at right angles is acceptable without further segregation.

Considerations shall be taken during installations of cables entering and leaving field type of equipment like smaller packages, minor modules, crane pedestals etc. related to segregations as listed above.

Non-IS and IS instrument cables should be routed on the same cable ladders/trays. If routed on same ladder/tray, the IS and non-IS cables, which contain both armour and screen can be tied together in same bundle.

9.2.3 Cable routing

All cables should be routed on cable ladders and trays.

Trunking or conduits may be used for special mechanical protection of single field routed cables for shorter distances (approximately 5 m). Where conduits are used, they shall be installed with open ends.

A computer based cable routing system reflecting the layout of the main cable support system (i.e. cable ladders with width 300 mm and above) represented by ladder segment references, transit numbers etc. and necessary describing information related to the individual cable including its route, shall be used in the design.

Field cables may utilize the main cable support system provided the route of the individual cable is being registered in the routing system and the filling and loading of the main cable support system is acceptable.

The cable ladders should not be filled so the height of the cable ladder side rail is exceeded.

Redundant cable systems shall be routed separately as shown on Figure 2, room N1.

Field routing inside rooms in safe locations may be on same cable rack/ladder if this is not in conflict with the redundant coverage of the area as shown on Figure 2, room N2.

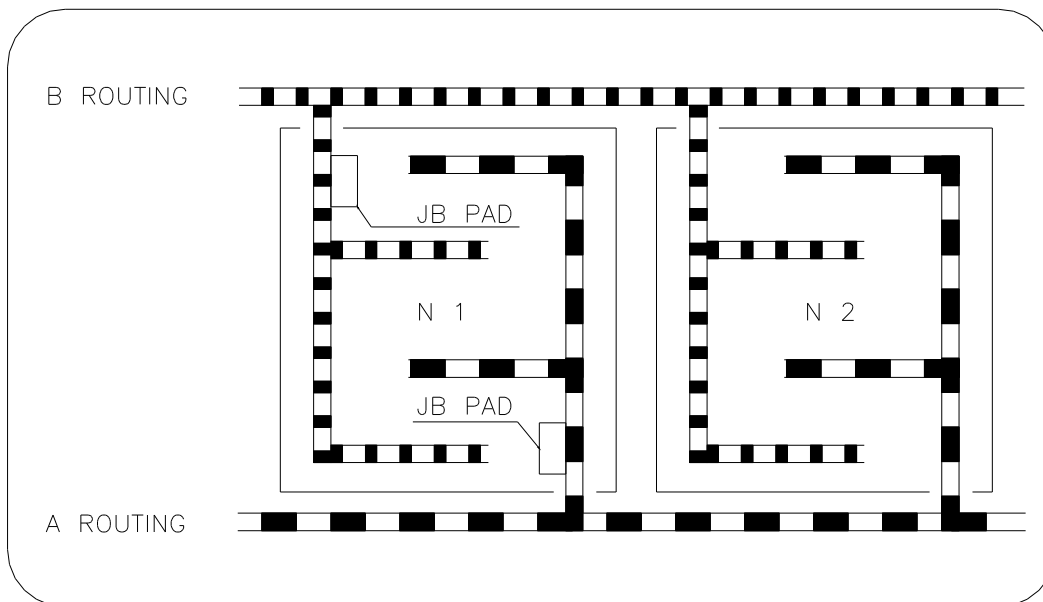


Figure 2 - Redundant cable routing

9.2.4 Cable installation

Access for maintenance and an orderly layout shall be ensured when cabling below raised floor is performed.

Once a cable has been cut, a protective cap/sealing shall be applied on the end, when being exposed to humid atmosphere.

All cable entries to equipment located outdoors and in wash down areas should be from below. Top entry is not allowed and side entry shall be provided with drip nose.

Sufficient cable spare length shall be provided for equipment that needs future adjustments (e.g. floodlights, loudspeakers, etc.) or where equipment has to be dismantled for maintenance and calibration without disconnecting the cable.

Single core cables for 3-phase AC shall run in trefoil formation. The braided armour shall be earthed in one end. For equipment installed in hazardous areas, the braid shall be earthed at the hazardous end. When using single core cables, additional cables for earthing have to be installed.

Single core cables shall not be installed separately through openings surrounded by magnetic materials. Non-magnetic stainless steel separation walls and stay plates shall be used in multi cable transits utilised for single core cables.

The minimum permissible bending radius specified by supplier shall be adhered to.

9.2.5 Cable cleating and strapping

Stainless steel AISI 316 straps shall be used for all runs outside and in non ventilated areas. When cut, no sharp ends shall be left in cutting end.

Ultra violet resistant plastic straps may be used for horizontal runs indoor.

Stainless steel AISI 316 straps shall be used for vertical runs and for horizontal runs in the vertical plane both indoor and outdoor. For strapping of fibre-optical and coaxial cables, supplier guidelines shall be adhered to.

The distance between cable straps shall not exceed

- 900 mm for horizontal runs,
- 300 mm for vertical runs and for horizontal runs in the vertical plane,
- ten times the cable outer diameter from cable entry to the first strap.

Trefoil cable cleats for single core power cables shall be approved for the potential short circuit stress. The cleats shall outdoors, in naturally ventilated areas and wash down areas, be made of stainless steel AISI 316.

The distance between trefoil cleats for single core cables shall be as specified by the cable manufacturer based on the calculated short circuit level.

Cable splicing should be avoided.

Any splicing should be agreed with the company for the installation in question.

9.2.6 Temporary cables

Temporary cables routed on permanent cable support systems shall be installed such that they will not obstruct permanent installations and are easy to remove.

Temporary cables should not be pulled through multi cable transits intended for permanent cables.

9.2.7 Cable gland selection

Cable glands/blanking and drain plugs shall be selected as given in Table 20.

Table 20 – Gland selection

Plastic enclosures (relevant for field cables).	Plastic for size below M32.
Plastic enclosures, reinforced with a metal gland plate for support of large supply- and multi core cables.	Brass
Metal enclosures (except aluminium).	Brass/stainless steel (AISI 316).
Aluminium enclosures.	Stainless steel/nickel plated brass.

The certifications of the cable glands, blanking and drain plugs shall comply with the certification of the equipment in which the glands and plugs are connected.

Ex d gland only to be used on Ex d direct entry equipment. The gland shall be suitable for braided cable, where the braid is terminated inside the gland. All other glands shall be of the through type.

Shrouds and similar shall not be used on cable glands.

9.2.8 Cable termination

Cables with braid armour shall have outer heat shrink sleeve, which is fitted over the complete cable make-off.

Instrument and telecommunication cables with both braid armour and screen shall have inner and outer heat shrink sleeves as follows:

- the inner sleeve shall be drawn over the inner bedding, i.e. passed under the braiding providing insulation between braiding and screen;
- the outer sleeve shall be fitted over the complete cable make-off;
- the inner sleeve may be excluded at termination's providing a minimum of 50 mm inner bedding.

Where the screen shall be left disconnected (e.g. applicable for field instrument) it shall be sealed and isolated with an isolating cap, which allows for insulation testing without any disconnecting.

To minimize the extent of hot work sleeves of type self vulcanizing-tape may be used on units in operation.

High voltage cables should be fitted with compression lugs, unless other termination type is specified.

All cable conductors shall be terminated by use of compression lugs or ferrules dependent upon the type of termination, unless the terminal is of a type designed to be used without ferrules. The compression ferrule should be the type where the conductor strands are inserted through the whole ferrule and reach the bottom of the terminal.

Support for cleating of cables when entering panels should be provided.

In switchboards and distribution boards, adequate space shall be provided for the use of a clip-on ampere meter without causing undue stress on the cable conductors or connections.

The braid armour and the screen shall be separated from each other as well as from the conductors, twisted and fitted as required. This shall be done without any reduction of the cross sectional area.

Only one conductor is allowed in each terminal of a terminal block/row for external connections. This is not related to terminals approved for two conductors for internal components, e.g. relays, contactors. Two conductors may in certain cases be used in one approved type ferrule connected to one terminal.

9.2.9 Spare conductors

Spare conductors in instrument and telecom cables shall be terminated and left floating at the field end.

In cabinets all spare conductors shall be marked with terminal number and connected to terminals linked together by solid terminal links, which shall be connected to the relevant earth bar.

Spare cores in instrument and telecom cables shall be connected to IE earth in supply end only.

If there are no spare terminals left in the cabinet, all spare conductors shall be covered with yellow/green sleeves and marked with relevant cable number and connected directly to the relevant earth bar.

9.2.10 Support system (cable ladders and trays)

Maximum distance between the supports for cable ladders and trays shall be as specified by supplier. Typical support distance is every 3 m.

Cable ladders installed horizontally shall have sufficient space to facilitate cable pulling and fixing (minimum 300 mm free space on top of ladder).

All surfaces shall be cleaned prior to bolting together.

Cable support systems shall be located to leave sufficient space for surface protection of adjacent structure.

In offices and living quarters where multidiscipline socket outlets are grouped together, multipurpose cable channels designed for recessed installed outlets should be used.

Kick plate shall be fitted around penetrations in floor where cables/tubing are exposed to mechanical damages.

Protection shield (minimum 500 mm above the floor) shall be installed where cables can be exposed to physical damages.

Cable ladder systems shall be protected from danger of dropped object due to crane handling or similar.

Equipment brackets and supports should not be installed on removable deck, grating, panels, handrails, pipes or other removable equipment.

9.3 Generators and motors (see IEC 61892-6, Clause 6)

See IEC 61892-6, 6.1

9.4 Transformers (see IEC 61892-6, Clause 7)

9.4.1 General (see IEC 61892-6, 7.1)

9.4.2 Installation and location (see IEC 61892-6, 7.2.1)

Oil filled transformers can be located in naturally ventilated areas.

9.5 Switchgear and control gear assemblies (see IEC 61892-6, Clause 8)

9.5.1 General (see IEC 61892-6, 8.1)

9.5.2 Space at the rear and passageways (see IEC 61892-6, 8.5)

If need for maintenance at the rear of low voltage switchboard and control panels minimum space shall be not less than 0,6 m.

If need for maintenance at the rear of high voltage switchboard minimum space shall be not less than 0,8 m.

9.6 Secondary cells and batteries (see IEC 61892-6, Clause 10)

Access (see IEC 61892-3, 10.3.1)

See IEC 61892-6, 10.7.

Single core cables where the braiding is floating and terminated in cabinets and terminated under crimps shrink at the battery.

9.7 Luminaires (see IEC 61892-6, Clause 11)

9.7.1 General (see IEC 61892-6, 11.1)

Cables shall be looped between lighting fixtures, independent of the sequence numbers used for fixture identification. The use of junction boxes should be avoided.

If junction boxes have to be used, they shall be installed easily accessible.

Light fixture to be installed according to maintenance/handling/safety requirements.

Light fixture to be installed minimum 2 100 mm over escape route.

Floodlights shall be installed on solid and adjustable brackets which ensure stability in all directions.

Floodlights shall be provided with an extra safeguarding against falling down if the screwed connections loosen

9.7.2 Emergency lighting (see IEC 61892-6, 11.4)

Emergency lighting shall be marked with red labelled.

9.7.3 Lighting installation for navigational aid and platform identification sign

9.8 Trace and surface heating (see IEC 61892-6, Clause 13)

9.8.1 General (see IEC 61892-6, 13.1)

The installation shall comply with "Trace Heating guidelines in Industry and Offshore (IFEA)". Supplier installation requirements shall be adhered to.

9.8.2 Trace heating cables (see IEC 61892-6, 13.2)

Heat tracing cables shall be 100 % covered with insulation material. Exceptions may be in instrument enclosures. Inside Ex certified cabinets only separate ATEX approved space heaters shall be installed.

The heat tracing cable should be protected against damage by applying an aluminium tape/foil on top of the cable when cellular glass is used as insulation material.

9.9 Lightning protection (see IEC 61892-6, Clause 16)

No additional installation will be required for the lightning protection, provided the unit consist of bolted and welded steelwork that will provide a continuous current path from the highest point of the unit to the main earth.

9.10 Test of completed installation (see IEC 61892-6, Clause 17)

Reference is made to NORSOK Z-007.

Testing of high voltage cables shall be carried out in accordance with IEC 60502-2, 20.2. The DC test should not be used. The 24 h AC tests is preferable.

9.11 Documentation (see IEC 61892-6, Clause 18)

In addition, see NORSOK Z-001.

9.12 Marking and labelling**9.12.1 General**

All marking shall be in accordance with NORSOK Z-DP-002.

All electrical consumers shall have an easy readable sign giving reference to supply MCC identification or panel and circuit for safe isolation of electrical power. If more than one supply gives electrical power to the same equipment, a warning label shall be mounted for information of those. If the tag number contains information about the supplying circuit no additional sign is required.

9.12.2 Cable ladders

Cable ladder segments and MCTs shall be marked with system and segment number.

High voltage cable ladders, shall be marked with warning labels in accordance with the national regulations.

9.12.3 Equipment

Internal in serial produced equipment with power electronics (i.e. like UPS, ASDS) supplier's standard for internal wiring and marking shall be accepted.

All labels shall be fabricated and installed in accordance with the following requirements:

- labels shall be readable from deck or access platform. Label text to be sized accordingly;
- labels should not be mounted on removable parts;
- labels should be fixed by AISI 316 screws, rivets or suitable glue (only in dry areas);
- separate label brackets, if used, shall be made of AISI 316;
- labels shall be of engraved traffolyte, marked as follows:
 - black letters on white background, letter size 10 mm to 20 mm;
 - electrical, instrumentation and telecommunication systems with service description in Norwegian;
- white letters on red background, letter size 10 mm to 20 mm.
 - instrument ESD systems, fire and gas systems and warning labels with service description in Norwegian and English language.

In panels fuses shall be clearly marked. A fuse list shall be provided inside of panel.

All emergency lighting fixtures with integral batteries shall in addition to normal labelling be marked to identify that integral batteries are present and to identify which light source is battery backed.

Warning labels shall be in accordance with national regulations.

9.12.4 Cables

Each cable shall be marked with indelible and non-corrosive cable markers indicating the cable number. The cable markers shall be clearly visible after cleating and strapping. Outdoors, in exposed- and wash down areas the cable markers shall be of stainless steel.

Each cable shall have a cable marker located

- at both side of multi cable transits,
- at both ends,
- outside cabinets with gland/MCT entries,

— inside cabinets with open entries.

Heat tracing cables shall be marked

- on the cable loop inside the junction box,
- with warning labels indicating the legend "Heat Tracing Cable". The warning labels shall be fitted to the thermal insulation covers as required, at maximum distance 5 m,
- warning labels indicating "Heat tracing splice" and "Heat tracing end seal" which shall be fitted to the thermal insulation covers above splices and end seals.

9.12.5 Identification of bus bars, conductors and wires

Individual conductors and wires shall be identified with easily readable markers carrying a number identical to the terminal. This is also applicable to the single conductors for cross wiring between the terminal blocks in panels.

Cable core identification shall be according to one of the alternatives listed in NEK 606. The CENELEC alternatives in NEK 606 is the preferred solutions.

Bus bars, conductors and earth wires shall be coded as follows:

AC systems:

	Bus bar:	Cable:
Phase 1	L1	Black
Phase 2	L2	Grey
Phase 3	L3	Brown
Neutral	N	Blue
Protective earth	PE	Yellow/Green
Protective earth/neutral	PEN	Yellow/Green + Blue

If one of the cores is black and the other one is not blue in cable used for single phase power supply, black core shall always be used for the phase and the other one for the neutral. Addition marking of the neutral core is not required.

DC systems:

Positive pole	(+)	Brown
Negative pole	(-)	Blue (White)

9.12.6 Colour coding of earth conductors, earth bars and cable screen

9.12.6.1 Protective earth (PE)

Earth conductors shall be coloured yellow/green.

The braid armour shall be covered with sleeves, coloured yellow/green.

PE bars shall be marked yellow/green.

9.12.6.2 Bonding

Static earth conductors shall be coloured yellow/green.

9.13 Bulk materials

9.13.1 Junction boxes

Junction boxes should be made of glass fibre reinforced plastic with polyester resin. In outdoor areas exposed to changing environmental conditions stainless steel AISI 316 may be used.

When junction boxes are installed in exposed areas, drain plugs shall be installed. Anti condensation heating should be provided in boxes containing active components.

Junction boxes shall be designed with sufficient space for the expected number of cables and cable make-offs.

9.13.2 Control stations

Control stations shall be located approximately 1 500 mm above deck level measured to centre of control station, and located adjacent to the equipment which it controls without obstructing removal of the equipment.

Location shall also be where it is practical for operation, i.e. close to gangways etc.

Anti condensation heating should be provided in control stations containing active components.

9.13.3 Sockets outlets

Special considerations should be made to the use, when finalizing the location of socket outlets in offices and similar areas like control rooms, laboratories, and workshops. As a guideline the location should be approximately 300 mm above fixed floor level or in cable channels/ducts above desk height. In other areas, outdoor, process etc., the socket outlets shall be located approximately 1 500 mm above deck level measured to centre of socket outlet.

9.13.4 Cable support systems

Cable support systems located outdoors, in natural ventilated areas and wash down areas shall be made of stainless steel AISI 316 L. For indoor ventilated areas cable support systems made of galvanized carbon steel may be used. Cable supports shall be of same material as the cable rack/tray.

Aluminium cable support system may be used in special selected areas.

Cable protection shields shall be made in the same material as the cable support system in the area.

9.13.5 Equipment brackets and supports

Equipment brackets and supports should be fabricated from carbon steel hot-dip galvanised in accordance with NORSOK M-501 or from stainless steel AISI 316L.

Equipment brackets shall be fabricated from the same material as the cable support system in the area.

Junction box stands shall be fabricated from the same material as the cable support system in the area.

9.13.6 Multi cable transits (MCT)

According to cable configuration, the material shall be selected to avoid eddy current.

9.13.7 Earth bosses

Earth bosses shall be made of stainless steel AISI 316 L.

9.13.8 Fixing materials

Screws, bolts, nuts and washers shall be made of stainless steel AISI 316. Star washers shall not be used.

On cable racks/trays etc. nuts with integrated washer or manufacturer standard to be used.

9.13.9 Precautions against galvanic corrosion

Precautions against galvanic corrosion shall be taken whenever contact between dissimilar metals is present.

10 Hazardous areas (see IEC 61892-7)

10.1 Electrical systems (see IEC 61892-7, Clause 4 and Clause 5)

Design of electrical systems in hazardous areas shall be according to Clause 4 and Clause 5.

10.1.1 Static electricity (see IEC 61892-7, 5.7.4)

The requirements in EN 13463-1 shall be fulfilled regarding electrostatic charging.

10.2 Electrical equipment (see IEC 61892-7, Clause 6)

10.2.1 General

Requirements for equipment are stated in IEC 61892-7, Clause 6.

All Ex equipment shall have the ex labelling located so they are readable also when installed on site. Labels shall be designed and fastened to withstand environmental stresses (included high pressure cleaning with salt water) for the certified equipments expected lifetime.

10.2.2 Ex requirements

Ex-certified equipment should be selected in accordance with the following:

- Ex i and Ex e should be used;
- Ex n may be used in zone 2;
- Ex d and Ex p should be avoided. For motors, see Table 10;
However, if Ex d equipment is used, it should be provided with an Ex e indirect entry. Compression type Ex d gland may be accepted if the equipments ATEX certificate cover gland and installed cable type, actual gas group and Ex d compartment volume (normally under 2 litre). Reference is made to figure 1 in IEC 60079-14. Ex d compression glands shall be of the type where the braid is terminated in the gland and compression takes place on inner cable sheath.
- Equipment, which shall remain energised after an APS/ESD situation, should follow the requirements specified in NORSOK S-001.

10.2.3 Electrical apparatus with type 'n' protection

Ex n equipment shall be marked according to IEC 60079-0 and IEC 60079-15 and have a test certificate from a test institution recognized at national level.

10.3 Installation (see IEC 61892-7, Clause 7)

In hazardous areas conduit systems (see IEC 61892-7, 7.5.1) with drawn-in insulated conductors are not permitted.

NOTE The requirement means that "American conduit systems" among others is not permitted in hazardous areas. However, use of conduits as mechanical protection for cables is permitted.

For package equipment it may also be accepted to use vendor standardized conduit system if alternative cable installation is not recommended.

However, such installation shall end in a termination box designed to connect conduit system to a cable system. The total installation shall be certified and fulfil requirements according to IEC 61892 (all parts).

10.4 Documentation (see IEC 61892-7, Clause 10)

10.4.1 Apparatus (see IEC 61892-7, 10.3)

The following additional documentation shall be delivered together with non standard Ex equipment:

- Ex-certificate issued by certified body;
- individual test certificate showing delivered variation;
- drawings and list of apparatus when relevant showing all components covered by the actual certification;
- any special conditions regarding installation, operation and maintenance of the equipment.

10.4.2 Installation (see IEC 61892-7, 10.4)

All IS loops shall be calculated individually and documented to be according to requirements.

Annex A

(Normative)

Data sheets

EDS-001	UNINTERRUPTIBLE POWER SYSTEM	Rev. 4, July 2001
EDS-002	AC GENERATOR	Rev. 4, July 2001
EDS-003	HIGH VOLTAGE SWITCHBOARD (>1kV)	Rev. 4, July 2001
EDS-004	INDUCTION MOTOR	Rev. 4, July 2001
EDS-005	LOW VOLTAGE SWITCHBOARD	Rev. 4, July 2001
EDS-006	CONVERTER FOR ASDS	Rev. 3, Mar. 2001
EDS-007	POWER TRANSFORMER	Rev. 4, July 2001
EDS-008	MOTOR FOR ASDS	Rev. 3, Mar. 2001
EDS-009	POWER TRANSFORMER FOR ASDS	Rev. 3, Mar. 2001
EDS-010	CAPACITOR	Rev. 4, July 2001
EDS-011	REACTOR	Rev. 4, July 2001
EDS-012	RESISTOR	Rev. 4, July 2001

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Project Requirements		
2.01	Tag No.	:
2.02	Unit	:
2.03	Service	:
2.04	Supplier	:
2.05	Manufacturer	:
2.06	Type	:
2.07	Location / Module	:
2.08	Job. No.	:
2.09	Inquiry No.	:
2.10	Quote No.	:
2.11	P.O. No	:
Input Short Circuit Levels		
2.12	Peak Withstand Current	:
	for Main/Bypass	kA :
2.13	Symmetric Breaking Current	:
	for Main/Bypass (rms)	kA :
Output Power		
2.14	Rated Load and Power Factor	kVA/cos Phi :
2.15	Battery Back-up Time	min. :
Rectifier/Inverter System		
2.16	String System	Single/Dual/Trippl :
2.17	Bypass	Manual/Static/Both :
2.18	Recharge time, end discharge to 90% capacity	h :
2.19	Output Voltage Tolerances	% :
2.20	Output Frequency Tolerances	% :
Batteries		
2.21	Type of Technology	NiCd/Lead Acid :
2.22	Electrolyte Level visible	Yes/No : Yes Only vented cells
2.23	Type of battery	Open/VR :
2.24	Design Temperature	°C :
Battery Circuit Breaker Cabinet		
2.25	Hazardous area classification	Haz/Non-Haz :
2.26	Insulation monitoring required	Y/N :
Distribution Board		
2.27	Degree of protection	IP : 2X
2.28	Main Feeder ; Type (CB/LB) x Phase x Amp. (A)	:
2.29	Breakers Breaking Capacity	A :
2.30	Breakers Peak Withstand Capability	A :
2.31	Outgoing Feeders; Number x Phase x Amp. (A)	:
2.32	Outgoing Feeders; Number x Phase x Amp. (A)	:
2.33	Outgoing Feeders; Number x Phase x Amp. (A)	:
2.34	Outgoing Feeders; Number x Phase x Amp. (A)	:
Earth Fault Monitoring		
2.35	Battery; Individual/Common/Not Required	:
2.36	Distr. Board; Individual/Common/Not Required	:
Notes		

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Vendor Data		
UPS Unit		
3.01	Dimensions (L x W x H)	mm :
3.02	Overall Weight	kg :
3.03	Degree of Protection	IP :
3.04	Minimum Clearance Required:	
	In Front/Behind/Above	mm :
3.05	Service Access	Front/Back :
3.06	Lifting lugs	Yes/No :
3.07	Max Heat Loss to Environment	kW :
3.08	Method of Ventilation	Natural/Forced :
3.09	Sound Pressure Level Lp	dBA :
3.10	Narrow Band Component, if any	Hz :
3.11	Recommended supply breaker sizes	A :
Rectifier		
3.12	Manufacturer	:
3.13	Type	:
3.14	Rated Input	kVA :
3.15	Rated Power Factor	cos Phi :
3.16	Rated Input Voltage/Variation	V/±% :
3.17	Peak Withstand Current (Breaker)	kA :
3.18	Symmetric Breaking Current (Breaker)	kA :
3.19	Rated Output Voltage/Variation	V/±% :
3.20	Rated Output Current	A :
3.21	Efficiency at Full Load	% :
3.22	Boost Charging Voltage	V :
3.23	Boost Charging Current	A :
Inverter		
3.24	Manufacturer	:
3.25	Type	:
3.26	Rated Input Voltage/Variation	V/±% :
3.27	Rated Output	kVA :
3.28	Rated Power Factor	cos Phi :
3.29	Rated Output Voltage/Variation	V/±% :
3.30	Rated Output Current	A :
3.31	Rated Output Frequency/Variation	Hz/±% :
3.32	Number of Phases	:
(continued)		
Notes		

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Vendor Data		
Inverter (continued)		
3.33	Max. Transient Output Voltage Variation:	
	- 0% - 100% Load	Volt. %/ms : _____
	- 100% - 0% Load	Volt. %/ms : _____
3.34	Efficiency at Full Load	% : _____
3.35	Min Output Short Circuit Level	Amp for msec. : _____
3.36	Total Harmonic Voltage Content, Linear Load	% : _____
3.37	Max. Load Crest Factor	: _____
Bypass Circuit		
3.38	Peak Withstand Current (Breaker)	kA : _____
3.39	Symmetric Breaking Current (Breaker)	kA : _____
3.40	Transformer Manufacturer	: _____
3.41	Model	: _____
3.42	Rating	kVA : _____
3.43	Short Circuit Impedance	% : _____
Distribution Board		
3.44	Manufacturer	: _____
3.45	Model	: _____
3.46	Main Bus-bar Current Rating	A : _____
3.47	Earth Bus-bar Size	mm ² : _____
3.48	Peak Withstand Current	kA : _____
3.49	Symmetric Breaking Current (rms)	kA : _____
3.50	Main Switch Rating	A : _____
3.51	Dimensions (L x W x H)	mm : _____
3.52	Weight	kg : _____
3.53	Lifting Lugs	Yes/No : _____
3.54	Max MCB/Fuse Rating	A : _____
Not Integrated Battery Circuit Breaker in UPS		
3.55	Manufacturer	: _____
3.56	Type	: _____
3.57	Rated Voltage	V : _____
3.57	Rated Current	A : _____
3.58	Rated DC Breaking Capacity	IP : _____
3.58	Operation	Manual/Motor/Solenoid : _____
3.59	Tripping Release	Undervoltag/Shunt : _____
3.59	Degree of Protection	IP : _____
3.60	Ex. Protection	EEx : _____
3.61	Circuit Breaker Size	A : _____
3.62	Earth Fault Protection Type	: _____
3.63	Dimentions (L x W x H)	mm : _____
3.64	Weight	kg : _____
Notes		

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Vendor Data		
Batteries		
3.65	Manufacturer	:
3.66	Type	:
3.67	Amperehour Capacity at 20°C (Design Temperature)	:
3.68	Amperehour Capacity + relevant aging (Pb)	Ah/10h :
3.69	Amperehour Capacity + relevant aging (NiCd)	Ah/5h :
3.70	Battery Power at Rated Load Discharge + 20% Spare	kW :
3.71	Battery Float/Boost/End Discharge	V :
3.72	Time to Recharge after a Rated Load Discharge	Hours :
3.73	Battery Cell Interconnection	Type / Square Area :
3.74	Nominal Cell Voltage	V :
3.75	Number of Cells in Series	:
3.76	Number of Strings in Parallel	:
3.77	Cell End Voltage After Discharge	V :
3.78	Cell Float Charge Voltage	V :
3.79	Cell Boost Charge Voltage	V :
3.80	Boost Charging Current	A :
3.81	Permissible Current Ripple	A :
3.82	Battery Termination Short Circuit Current	A for ms :
3.83	Weight pr. Cell/Monoblock	Dry/Filled; kg :
3.84	Weight pr. Battery Bank incl. Rack	Dry/Filled; kg :
3.85	Overall Dimensions pr. Battery Bank	(LxWxH); mm :
3.86	No. of Battery Banks	:
3.87	Hydrogen Emission On Boost per Battery Bank ref. EN50272-2	ltr/h :
3.88	Max. Heat Loss pr Battery Bank	kW :
3.89	Battery Terminal Box	Included/Not Included :
3.90	Max. storage time without maintenance charging at given temperature	:
Battery Rack		
3.91	Material Type	:
3.92	Manufacturer	:
3.93	Loaded Rack Tilt Withstand in any Direction	degrees :
3.94	Loaded Rack Acceleration Withstand Vertical/Horizontal	ms ² /ms ² :
3.95	Number of Rack Sections	:
3.96	Number of Tiers/Rows	:
3.97	Stepped/Levelled Tier Design	:
3.98	Acid Trays	Included/Not Included :
3.99	Welded / Bolted Construction	:
Notes		

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Project Requirements			
2.01	Tag No.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Type	:	
2.07	Location / Modul	:	
2.08	Job. No.	:	
2.09	Inquiry No.	:	
2.10	Quote No.	:	
2.11	P.O. No	:	
Generator			
2.12	Required Power	kVA :	
2.13	Rated Voltage	kV :	
2.14	Power Factor	cos Phi :	
2.15	Location	Indoor/Outdoor :	
2.16	Direct Axis Subtransient Reactance, xd"	Unsat/Sat% :	
2.17	Direct Axis Transient Reactance, xd'	Unsat/Sat% :	
2.18	Direction of Rotation Facing Shaft End	CW/CCW :	
2.19	Max. Allowable Cont. of Harmonics (THD)	% :	
2.20	Vibration Detectors	Type :	
Cooling			
2.21	Cooling Method	IC :	
2.22	Cooling Medium	:	
2.23	Cooling Water Supply Temp.	Max/Min °C :	
2.24	Cooling Water Supply Pressure	Max/Min bar g :	
Cables and Terminals			
2.25	Main Terminal Boxes Degree of Protection	IP :	
2.26	Main Terminal Boxes Material	:	
2.27	Number of Power Cables	:	
2.28	Power Cable Size	n x mm ² :	
2.29	Power Cable Outer Diameter	mm :	
2.30	Cable Entry Type	Gland/MCT/Other :	
2.31	Aux. Terminal Boxes Degree of Protection	IP :	
2.32	Aux. Boxes Material	:	
2.33	Other Cables (specify)	:	
Notes			

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Vendor Data		
Generator		
3.01	Manufacturer	:
3.02	Type	:
3.03	Degree of Protection	IP :
3.04	Frame Size (IEC)	:
3.05	Rotor Type	Salient Poles/Cylindrical :
3.06	Synchronous speed	rpm :
3.07	Direction of Rotation Facing <i>Shaft End</i>	CW/CCW :
3.08	Overall Dimension (LxWxH)	mm :
3.09	Dimentional Drawing No.	:
3.10	Weight of Overall Machine	kg :
3.11	Weight of Rotor	kg :
3.12	Weight of Exciter	kg :
3.13	Weight of Heater Exchanger, Dry	kg :
3.14	Weight of Coolant	kg :
3.15	Prime Mover-Moment of Inertia $J=GD^2 /4$	kg m ² :
3.16	Generator-Moment of Inertia $J=GD^2 /4$	kg m ² :
3.17	Rated Voltage	kV :
3.18	Rated Frequency	Hz :
3.19	Rated Power Output, S _n	kVA :
3.20	Rated Power Factor	cos Phi :
3.21	Duty Type	:
3.22	Rated Current	A :
3.23	Max. Allowable Neg. Phase Seq. Current	% :
3.24	Max. Allowable Cont. of Harmonics (THD)	% :
3.25	Efficiency at 1/1 and 3/4 load	% :
3.26	Field Current No Load	A :
3.27	Field Current <i>Rated</i> Load	A :
3.28	Insulation Class	Stator/Rotor :
3.29	Temp. Rise Class	Stator/Rotor :
3.30	Overload Capability	% for hours :
3.31	Overload Capability	% for seconds :
3.32	Sustained Short-Circuit	% for seconds :
3.33	Short Circuit Ratio	:
3.34	Dir. Axis Subtrans. Reactance x _d " Unsat	%/± :
3.35	Dir. Axis Subtrans. Reactance x _d " Sat	%/± :
3.36	Quadrat Axis Subtransient Reactance x _q "	%/± :
3.37	Dir. Axis Transient Reactance x _d ' Unsat	%/± :
3.38	Dir. Axis Transient Reactance x _d ' Sat	%/± :
3.39	Quadrat Axis Transient Reactance x _q '	%/± :
3.40	Dir. Axis Synchr. Reactance x _d Unsat	%/± :
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Vendor Switchboard Data			
3.01	Manufacturer	:	
3.02	Type	:	
Switchboard Construction			
3.03	Fixing Accessories	:	
3.04	Lifting Eye Bolts	Yes/No :	
3.05	Handling Truck Required	Yes/No :	
3.06	Minimum Clearance Required :		
	In Front of Switchboard	mm :	
	At Back of Switchboard	mm :	
	At Side of Switchboard	mm :	
	Above Switchboard	mm :	
3.07	Dimensions L x W x H	mm :	
3.08	Total Weight of Switchboard	kg :	
3.09	Degree of Protection	IP :	
3.10	No. of Cubicles	:	
3.11	Service access	Front/Back :	
3.12	Arrangement ; Single front/Back-to-back/L-shape	:	
3.13	Type of Switchgear	SF6/Air/Other :	
Bus Bars			
	Main Bus Bar :		
3.14	Type	Single/Double :	
3.15	Rating at 40 °C	A :	
3.16	Cross Section	mm ² :	
3.17	Completely Insulated	Yes/No :	
	Earth Bus Bar :		
3.18	Rating	A :	
3.19	Cross Section	mm ² :	
Arc Test			
3.20	Duration of Arc	sec. :	
3.21	Max. Current	kA :	
3.22	Name of Testing Authority	:	
Bus Duct			
3.23	Bus Duct Section A/B	Yes/No :	
3.24	Bus Duct Interface	Top/Bottom/Other :	
Notes			

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Project Requirements		
2.01	Tag No.	:
2.02	Unit	:
2.03	Service	:
2.04	Supplier	:
2.05	Manufacturer	:
2.06	Type	:
2.07	Location / Modul	:
2.08	Job. No.	:
2.09	Inquiry No.	:
2.10	Quote No.	:
2.11	P.O. No	:
Electrical		
2.12	Rated Voltage	V :
2.13	Rated Output	kW :
2.14	Max. Permissible Starting Current	xIn :
2.15	Start Up Time Min/Max.	sec. :
2.16	No. of Starts per hour	:
Construction		
2.17	Ex Classification	:
2.18	Degree of protection	IP :
2.19	Insulation Class Stator	F :
2.20	Temperature rise	B/F :
2.21	Instrument Air for Exp System	bar g :
2.22	Bearing Vibration, Instrument Make/Type	:
2.23	Sound Pressure Level	Lp dBA : ≤80
2.24	Cooling Method	IC :
2.25	Cooling Water Supply Temp. (max. / min.)	°C :
2.26	Cooling Water Supply Pressure (max. / min.)	bar g :
2.27	Heat Exchanger Material	:
2.28	Painting Specification	Norsok/Other :
2.29	Space Heater	Yes/No :
2.30	Winding temperature detection	Yes/No :
2.31	Motor Housing Material	:
Environmental Conditions		
2.32	Hazardous Area Classifications	:
2.33	Location	Indoor/Outdoor :
Notes		

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Motor Vendor Data		
4.01	Manufacturer	:
4.02	Type	:
4.03	Serial No.	:
4.04	Degree of Protection	IP :
4.05	Rated Shaft Power	kW :
4.06	Rated Voltage	V :
4.07	Rated Frequency	Hz :
4.08	Winding Connection	Star/Delta :
4.09	Asynchronous Speed	rpm :
4.10	Temperature Rise	K :
4.11	Rated Current, In	A :
4.12	Start Current at 1.0 U _n	% x In (p.u.) :
4.13	Start Current at 0.8 U _n	% x In (p.u.) :
4.14	Start Time at 1.0 U _n with driven equipment	s :
4.15	Start Time at 0.8 U _n with driven equipment	s :
4.16	Allowable Locked Rotor Time, Cold	s :
4.17	Allowable Locked Rotor Time, Hot	s :
4.18	Efficiency at 1/1 load	% :
4.19	Efficiency at 3/4 load	% :
4.20	Speed/Torque Curve Ref. No.(Frame ≤ 315)	:
4.21	Power Factor at 1/1 load	cos Phi :
4.22	Power Factor at 3/4 load	cos Phi :
4.23	Starting Power Factor	cos Phi :
4.24	Allowable Starting Voltage	%U _n :
4.25	No. of Allowable Consecutive Starts, Cold	:
4.26	No. of Allowable Consecutive Starts, Hot	:
4.27	t _c time constant at 1.0 U _n	s :
4.28	t _c time constant at 0,8U _n	s :
Construction		
4.29	Insulation Class	Stator/Rotor :
4.30	Mounting Arrangement (acc. to IEC 60034.7)	IM :
4.31	Cooling Method	IC :
4.32	Cooling Water Flow Rate	m ³ /hr :
(continued)		
Notes		

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Project requirements		
2.01	Tag no.	:
2.02	Unit	:
2.03	Service	:
2.04	Supplier	:
2.05	Manufacturer	:
2.06	Type	:
2.07	Location / module	:
2.08	Job no.	:
2.09	Inquiry no.	:
2.10	Quote no.	:
2.11	P.O.No.	:
Electrical		
2.12	Rated system voltage	V :
2.13	Rated system frequency	Hz :
2.14	Max. short circuit power	MVA :
2.15	Min. short circuit power	MVA :
2.16	No. of pulses	6/12 :
2.17	Bypass	Yes/no :
Construction		
2.18	Cooling fan redundancy (n -1)	Yes/no :
2.19	Cooling method	AN/AF/water :
2.20	Cooling water supply	Fresh water/sea water :
2.21	Cooling water supply temperature	°C :
2.22	Cooling water supply pressure	MPa :
2.23	Power connection entry	Bottom/top/other :
2.24	Power connection type	Cables/busbar :
2.25	Auxiliary cables entry	Bottom/top/other :
2.26	Degree of protection	: LV IP 22 HV IP 32
Operation and control		
2.27	Control principle	Speed set/torque set :
2.28	Speed / torque set	4-20 mA/other :
2.29	Operating range f_{min} / f_{max}	Hz :
2.30	Serial link protocol type	:
2.31	Automatic restart	Yes/no :
2.32	Deceleration to	min. speed/standstill :
Notes		

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Functional Requirements

Electrical

1.01	Rated Power	kVA : 250, 315, 630, 1250, 1600, 2000, 2500
1.02	Primary Voltage	V : 11.0k, 6.6k, 690
1.03	Secondary System Voltage	V : 690, 400
1.04	Frequency	Hz : 50
1.05	No.of Phases	: 3
1.06	Vector Group	: Dyn 11
1.07	Tapping at Primary Side	± % : 2x2,5
1.08	Parallel Operations	: Yes
1.09	System Earthing (Secondary Voltage)	: 690V Neutral Resistor / 400V TN-S
1.10	Neutral Resistor Rating	: 100A
1.11	Winding Temp Sensors	: For power > 1250kVA

Environmental Conditions

1.12	Hazardous Area Classification	: <u>Non hazardous</u>
1.13	Ambient Temp.	°C : <u>Min. -5, max. +40</u>
1.14	Yearly Average Temp.	°C : <u>25</u>
1.15	Location	: <u>Indoor</u>
1.16	Humidity	% : <u>95</u>

Notes

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Project Requirements			
2.01	Tag No.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Model	:	
2.07	Location / Module	:	
2.08	Job. No.	:	
2.09	Inquiry No.	:	
2.10	Quote No.	:	
2.11	P.O. No	:	
Electrical			
2.12	Rated Power, Sn	AN/AF kVA	:
2.13	Rated Primary Voltage	V	:
2.14	Rated Secondary Voltage (No load)	V	:
2.15	Cooling Method	AN/AF	:
2.16	Short Circuit Impedance Uz	%	:
2.17	Short Circuit Level (RMS/Peak)	kA	:
2.18	Test Voltages acc. IEC 60076	kV/List 1/List 2	:
2.19	Degree of Protection	IP	:
2.20	Winding Insulation Class		Min. F
Primary Terminations			
2.21	Type of Termination	Busbar/Other	:
2.22	Busbar Dimensions H x W	mm	:
2.23	Number of Power Cables		:
2.24	Power Cable Size	n x mm ²	:
2.25	Power Cable Outer Diameter	mm	:
2.26	Entry	Top/Bottom	:
2.27	Entry Type	MCT/Gland/Other	:
2.28	Inspection/Earthing Openings	Hinged/Bolted	:
Secondary Terminations			
2.29	Type of Termination	Busbar/Cables/Other	:
2.30	Busbar Dimensions H x W	mm	:
2.31	Number of Power Cables		:
2.32	Power Cable Size	n x mm ²	:
2.33	Power Cable Outer Diameter	mm	:
2.34	Entry	Top/Bottom	:
2.34	Entry Type	MCT/Gland/Other	:
2.35	Inspection/Earthing Openings	Hinged/Bolted	:
Neutral Termination			
2.36	Cable Size	n x mm ²	:
2.37	Cable Outer Diameter	mm	:
2.38	Entry	Top/Bottom	:
2.39	Entry Type	MCT/Gland/Other	:
2.40	Inspection/Earthing Openings	Hinged/Bolted	:

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Project requirement		
2.01	Tag no.	:
2.02	Unit	:
2.03	Service	:
2.04	Supplier	:
2.05	Manufacturer	:
2.06	Type	:
2.07	Location / module	:
2.08	Job no.	:
2.09	Inquiry no.	:
2.10	Quote no.	:
2.11	P.O. no	:
Electrical		
2.12	Rated voltage	V :
2.13	Rated output	kW :
2.14	Start up time min/max.	s :
2.15	No. of starts per hour	:
Construction		
2.16	Ex classification	:
2.17	Degree of protection	IP :
2.18	Insulation class	Stator : F utilized to class B
2.19	Instrument air for exp system	MPa :
2.20	Bearing vibration, instrument make/type	:
2.21	Sound pressure level	Lp dBA : ≤80
2.22	Cooling method	:
2.23	Cooling water supply temperature (max /min)	°C :
2.24	Cooling water supply pressure (max /min)	MPa :
2.25	Heat exchanger material	:
2.26	Painting specification	NORSOK/other :
2.27	Space heater	Yes/no :
2.28	Winding temperature detection	Yes/no :
2.29	Motor housing material	:
Environmental conditions		
2.30	Hazardous area classifications	:
2.31	Location	Indoor/outdoor :
Notes		

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Motor vendor data		
4.01	Manufacturer	:
4.02	Type	:
4.03	Serial no.	:
4.04	Degree of protection	IP :
4.05	Rated shaft power	kW :
4.06	Rated voltage	V :
4.07	No. of phases	3/6 :
4.08	Rated frequency	Hz :
4.09	Winding connection	Star/delta :
4.10	Full load speed	rpm :
4.11	Operating speed range	rpm :
4.12	Temperature rise	K :
4.13	Rated current in	A :
4.14	Start current at 1,0 U _n	% x I _n (p.u.) :
4.15	Start current at 0,8 U _n	% x I _n (p.u.) :
4.16	Start time at 1,0 U _n	s :
4.17	Start time at 0,8 U _n	s :
4.18	Allowable locked rotor time, cold	s :
4.19	Allowable locked rotor time, hot	s :
4.20	Efficiency at 1/1 load	% :
4.21	Efficiency at 3/4 load	% :
4.22	Efficiency acc. to load torque curve	Max.speed % :
4.23	Efficiency acc. to load torque curve	Rated speed % :
4.24	Efficiency acc. to load torque curve	Min.speed % :
4.25	Power factor at 1/1 load	cos π :
4.26	Power factor at 3/4 load	cos π :
	For Exe Motors:	
4.27	No. of allowable consecutive starts, cold	:
4.28	No. of allowable consecutive starts, hot	:
4.29	te-time constant at 1,0 U _n	s :
4.30	Speed/torque curve ref. no.(Frame ≥ 315)	:
Construction		
4.31	Insulation class	Stator/rotor :
4.32	Mounting arrangement (acc. to IEC 60034.7)	IM :
4.33	Cooling method	IC :
4.34	Cooling water flow rate	m ³ /h :
Notes		

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Motor vendor data		
Construction (continued)		
4.35	Cooling water design pressure	MPa : _____
4.36	Motor housing material	: _____
4.37	Terminal box material	: _____
4.38	Heat exchanger material	: _____
4.39	Cooling fan material	: _____
4.40	Frame size	: _____
4.41	Space heater voltage	V : _____
4.42	Space heater power	W : _____
4.43	Exp method	Pressurisation/purge : _____
4.44	Instrument air flow rate	m ³ /h : _____
4.45	Temperature detectors in bearing	Type/ no.of : _____
4.46	Temperature detectors in windings	Type/ no.of : _____
Mechanical		
4.47	Inertia J=GD ² /4	kg m ² : _____
4.48	Rated torque	Nm : _____
4.49	Locked rotor torque	% : _____
4.50	Breakdown torque	% : _____
4.51	Bearing drive end	Type/ no.of : _____
4.52	Bearing non drive end	Type/ no.of : _____
4.53	Oil quantity for bearings	l/min : _____
4.54	Make / type of vibration detectors	: _____
4.55	Lubrication system	: _____
4.56	Critical speed	rpm : _____
4.57	Sound pressure level, (Lp), acc. ISO 1680 or equal	Lp dB(A) : _____
4.58	Weight total	Ng : _____
4.59	Rotor weight for frame size ≥ 250	Ng : _____
4.60	Shaft	Standard/double end/extended : _____
Various		
4.61	Ex certificate issued by	: _____
4.62	Ex certificate number	: _____
4.63	Ex classification	: _____
4.64	Dimensional drawing no.	: _____
4.65	Main power cable entry sizes	: _____
4.66	Heating/cooling time constant (HV motors)	min : _____
Notes		

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Project requirements			
2.01	Tag no.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Model	:	
2.07	Location / module	:	
2.08	Job. no.	:	
2.09	Inquiry no.	:	
2.10	Quote no.	:	
2.11	P.O. no	:	
Electrical			
2.12	Rated power	AN/AF kVA	:
2.13	Rated primary voltage	V	:
2.14	Secondary voltage (no load)	V	:
2.15	Cooling method	AN/AF	:
2.16	Short circuit impedance Uz	%	:
2.17	Test voltages acc. IEC 60076	kV/List 1/List 2	:
2.18	Degree of protection	IP	: 23
2.19	Winding insulation class		: Min. F
Primary terminations			
2.20	Type of termination	Busbar/other	:
2.21	Busbar dimensions H x W	mm	:
2.22	Number of power cables		:
2.23	Power cable size	n x mm ²	:
2.24	Power cable outer diameter	mm	:
2.25	Entry	Top/bottom	:
2.26	Entry type	MCT/gland/other	:
2.27	Inspection/Earthing Openings	Hinged/Bolted	:
Secondary terminations			
2.28	Type of termination	Busbar/other	:
2.29	Busbar dimensions H x W	mm	:
2.30	Number of power cables		:
2.31	Power cable size	n x mm ²	:
2.32	Power cable outer diameter	mm	:
2.33	Entry	Top/bottom	:
2.34	Entry type	MCT/gland/other	:
2.35	Inspection/Earthing Openings	Hinged/Bolted	:
Neutral termination			
2.36	Cable size	n x mm ²	:
2.37	Cable outer diameter	mm	:
2.38	Entry	Top/bottom	:
2.39	Entry type	MCT/gland/other	:
2.40	Inspection/Earthing Openings	Hinged/Bolted	:

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Package no.:	Doc. no.:	Rev.
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Project Requirements			
2.01	Tag No.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Model	:	
2.07	Location / Module	:	
2.08	Job. No.	:	
2.09	Inquiry No.	:	
2.10	Quote No.	:	
2.11	P.O. No	:	
Electrical			
2.12	Rated Power	AN/AF	kVAr :
2.13	Nominal Voltage		V :
2.14	No/Size of Steps		μF :
2.15	Cooling Method	AN/AF	:
2.16	Build in Protection		:
2.17	Test Voltages acc. IEC	List 1/List 2	:
2.18	Current Limiting Reactor Size		:
2.19	Degree of Protection	IP	:
Primary Terminations			
2.20	Type of Termination	Busbar/Other	:
2.21	Busbar Dimensions H x W	mm	:
2.22	Number of Power Cables		:
2.23	Power Cable Size	n x mm ²	:
2.24	Power Cable Outer Diameter	mm	:
2.25	Entry	Top/Bottom	:
2.26	Entry Type	MCT/Gland/Other	:
2.27	Inspection/Earthing Openings	Hinged/Bolted	:
Secondary Terminations			
2.28	Type of Termination	Busbar/Other	:
2.29	Busbar Dimensions H x W	mm	:
2.30	Number of Power Cables		:
2.31	Power Cable Size	n x mm ²	:
2.32	Power Cable Outer Diameter	mm	:
2.33	Entry	Top/Bottom	:
2.34	Entry Type	MCT/Gland/Other	:
2.35	Inspection/Earthing Openings	Hinged/Bolted	:
Neutral Termination			
2.36	Cable Size	n x mm ²	:
2.37	Cable Outer Diameter	mm	:
2.38	Entry	Top/Bottom	:
2.39	Entry Type	MCT/Gland/Other	:
2.40	Inspection/Earthing Openings	Hinged/Bolted	:

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Project Requirements			
2.01	Tag No.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Model	:	
2.07	Location / Module	:	
2.08	Job. No.	:	
2.09	Inquiry No.	:	
2.10	Quote No.	:	
2.11	P.O. No	:	
Electrical			
2.12	Rated Current	AN/AF A :	
2.13	Nominal Voltage	V :	
2.14	No/Size of Steps	mH :	
2.15	Cooling Method	AN/AF :	
2.16	Test Voltages acc. IEC	List 1/List 2 :	
2.17	Short Circuit Level, RMS/Peak	kA :	
2.18	Degree of Protection	IP :	
2.19	Core Material	Iron/Air :	
Primary Terminations			
2.20	Type of Termination	Busbar/Other :	
2.21	Busbar Dimensions H x W	mm :	
2.22	Number of Power Cables	:	
2.23	Power Cable Size	n x mm ² :	
2.24	Power Cable Outer Diameter	mm :	
2.25	Entry	Top/Bottom :	
2.26	Entry Type	MCT/Gland/Other :	
2.27	Inspection/Earthing Openings	Hinged/Bolted :	
Secondary Terminations			
2.28	Type of Termination	Busbar/Other :	
2.29	Busbar Dimensions H x W	mm :	
2.30	Number of Power Cables	:	
2.31	Power Cable Size	n x mm ² :	
2.32	Power Cable Outer Diameter	mm :	
2.33	Entry	Top/Bottom :	
2.34	Entry Type	MCT/Gland/Other :	
2.35	Inspection/Earthing Openings	Hinged/Bolted :	
Neutral Termination			
2.36	Cable Size	n x mm ² :	
2.37	Cable Outer Diameter	mm :	
2.38	Entry	Top/Bottom :	
2.39	Entry Type	MCT/Gland/Other :	
2.40	Inspection/Earthing Openings	Hinged/Bolted :	

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Project Requirements			
2.01	Tag No.	:	
2.02	Unit	:	
2.03	Service	:	
2.04	Supplier	:	
2.05	Manufacturer	:	
2.06	Model	:	
2.07	Location / Module	:	
2.08	Job. No.	:	
2.09	Inquiry No.	:	
2.10	Quote No.	:	
2.11	P.O. No	:	
Electrical			
2.12	Rated Current	AN/AF A :	
2.13	Nominal Voltage	V :	
2.14	Tapping	Ohms :	
2.15	Rated Operation time	Duty Cycle :	
2.16	Cooling Method	AN/AF :	
2.17	Test Voltages acc. IEC	List 1/List 2 :	
2.18	Degree of Protection	IP :	
Primary Terminations			
2.19	Type of Termination	Busbar/Other :	
2.20	Busbar Dimensions H x W	mm :	
2.21	Number of Power Cables	:	
2.22	Power Cable Size	n x mm ² :	
2.23	Power Cable Outer Diameter	mm :	
2.24	Entry	Top/Bottom :	
2.25	Entry Type	MCT/Gland/Other :	
2.26	Inspection/Earthing Openings	Hinged/Bolted :	
Secondary Terminations			
2.27	Type of Termination	Busbar/Other :	
2.28	Busbar Dimensions H x W	mm :	
2.29	Number of Power Cables	:	
2.30	Power Cable Size	n x mm ² :	
2.31	Power Cable Outer Diameter	mm :	
2.32	Entry	Top/Bottom :	
2.33	Entry Type	MCT/Gland/Other :	
2.34	Inspection/Earthing Openings	Hinged/Bolted :	
Neutral Termination			
2.35	Cable Size	n x mm ² :	
2.36	Cable Outer Diameter	mm :	
2.37	Entry	Top/Bottom :	
2.38	Entry Type	MCT/Gland/Other :	
2.39	Inspection/Earthing Openings	Hinged/Bolted :	

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Annex B
(Informative)
Typical installation drawings

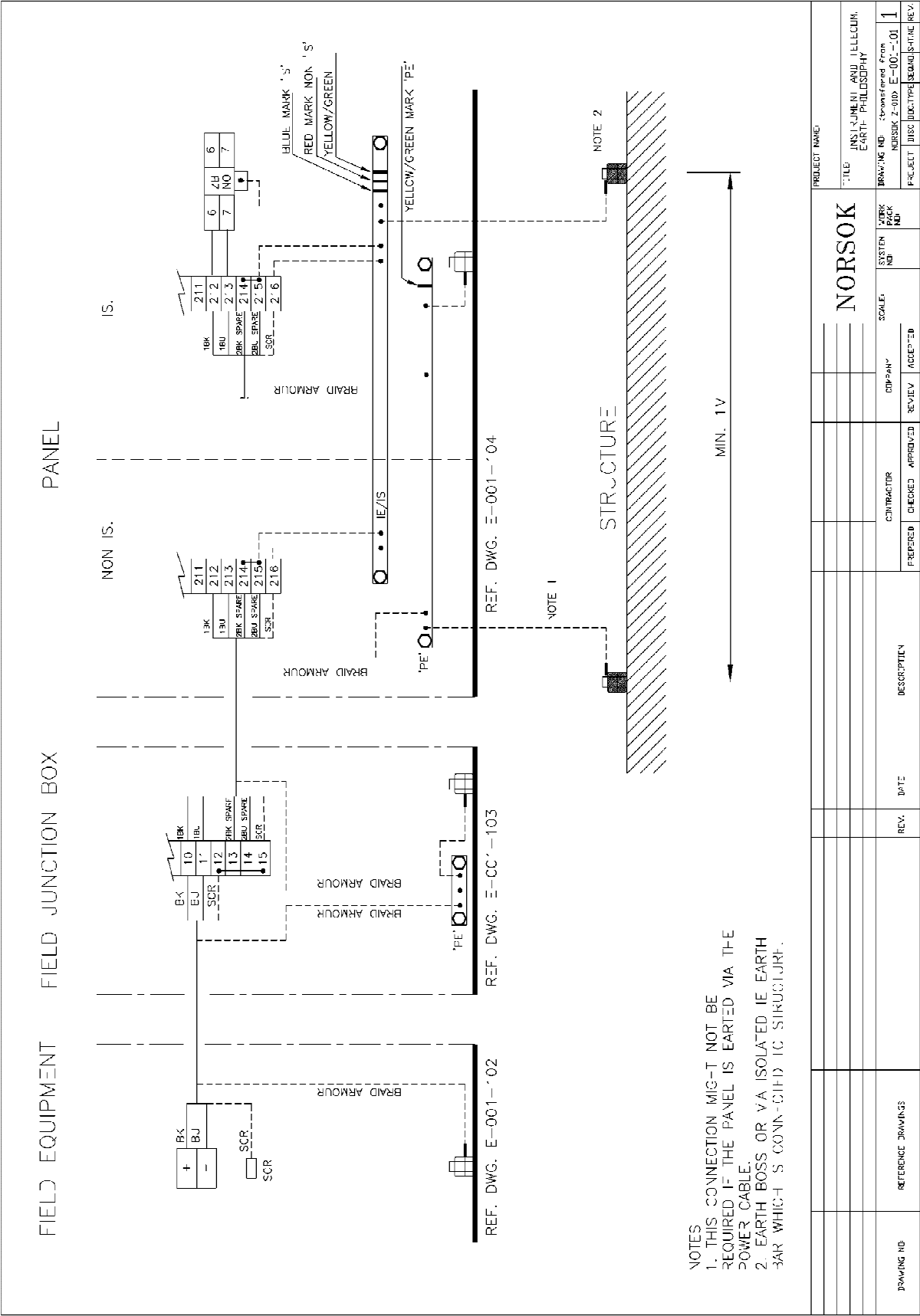


Figure B.1 – Instrument and telecom earth philosophy

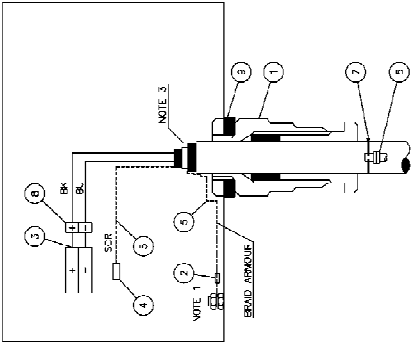
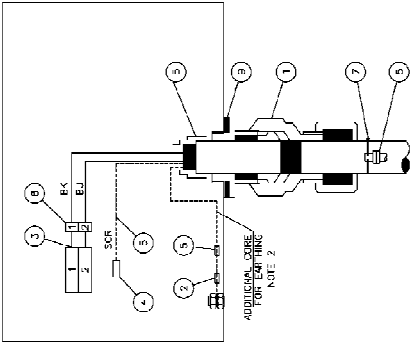
A		EQUIPMENT WITH THROUGH GLAND		B		EQUIPMENT FOR VOLTAGES ABOVE 30VAC, 50VDC WITH Exd ARMOUR CLAMPING GLAND TERMINATION OF INSTRUMENT CABLE		PRODUCT LIST	
						ITEM		DESCRIPTION	
1		GLAND		1		INSTRUMENTS FOR 50V DC OR 30V AC AND BELOW ARE DELIVERED WITHOUT ANY EARTH-BOSS OR LUG, THE BRAID ARMOUR SHALL BE SEALED BY USE OF AN ISOLATING CAP IN THE SAME WAY AS FOR THE SCREEN.			
2		CRIMP LUG		2		PROTECTIVE EARTH-WIRE SHALL BE YELLOW/GREEN OR THE CORE SHALL HAVE A YELLOW/GREEN HEAT-SHRINK SLEEVE.			
3		CRIMP PIN		3		TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.			
4		ISOLATING CAP/TERMINAL		4		EACH INDIVIDUAL SCREEN TO BE INSULATED WITH YELLOW/GREEN HEAT-SHRINK SLEEVE			
5		HEAT SHRINK		5					
6		CABLE NUMBER		6					
7		CABLE TIE		7					
8		TERMINAL NUMBER		8					
9		SEALING WASHER		9					
		NOTES:							
		1. IF INSTRUMENTS FOR 50V DC OR 30V AC AND BELOW ARE DELIVERED WITHOUT ANY EARTH-BOSS OR LUG, THE BRAID ARMOUR SHALL BE SEALED BY USE OF AN ISOLATING CAP IN THE SAME WAY AS FOR THE SCREEN.							
		2. PROTECTIVE EARTH-WIRE SHALL BE YELLOW/GREEN OR THE CORE SHALL HAVE A YELLOW/GREEN HEAT-SHRINK SLEEVE.							
		3. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							
		4. EACH INDIVIDUAL SCREEN TO BE INSULATED WITH YELLOW/GREEN HEAT-SHRINK SLEEVE							
		5. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							
		6. CABLE NUMBER							
		7. CABLE TIE							
		8. TERMINAL NUMBER							
		9. SEALING WASHER							
		NOTES:							
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		3. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							
		4. EACH INDIVIDUAL SCREEN TO BE INSULATED WITH YELLOW/GREEN HEAT-SHRINK SLEEVE							
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		9. SEALING WASHER							
		NOTES:							
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		2. PROTECTIVE EARTH-WIRE SHALL BE YELLOW/GREEN OR THE CORE SHALL HAVE A YELLOW/GREEN HEAT-SHRINK SLEEVE.							
		3. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							
		4. EACH INDIVIDUAL SCREEN TO BE INSULATED WITH YELLOW/GREEN HEAT-SHRINK SLEEVE							
		5. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							
		6. CABLE NUMBER							
		7. CABLE TIE							
		8. TERMINAL NUMBER							
		9. SEALING WASHER							
		NOTES:							
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		5. TYPICAL DETAIL, SHOWING THE HEAT-SHRINK ISOLATION BETWEEN BRAID ARMOUR AND SCREEN.							

Figure B.2 – Electrical, instrument and telecom equipment termination

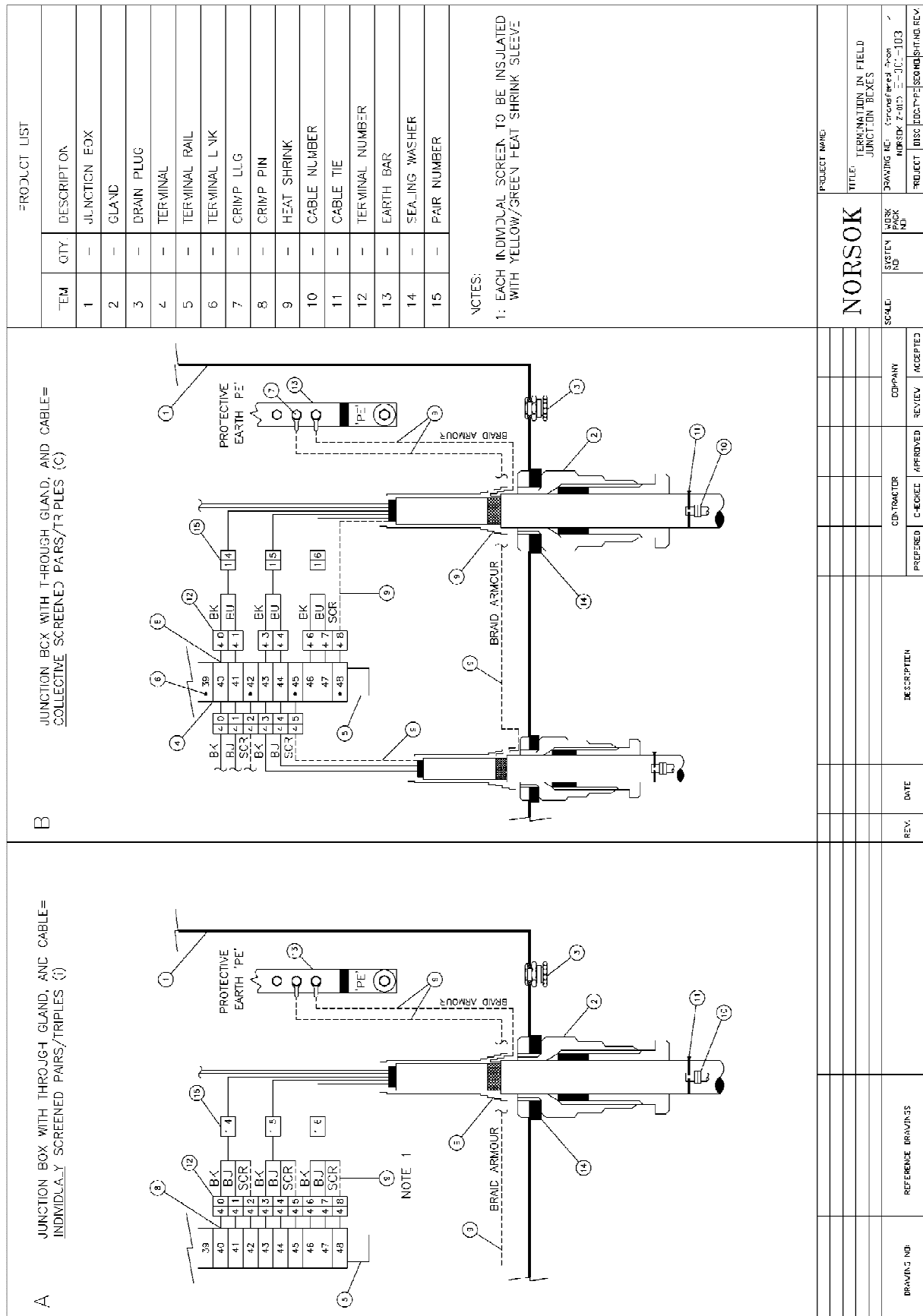
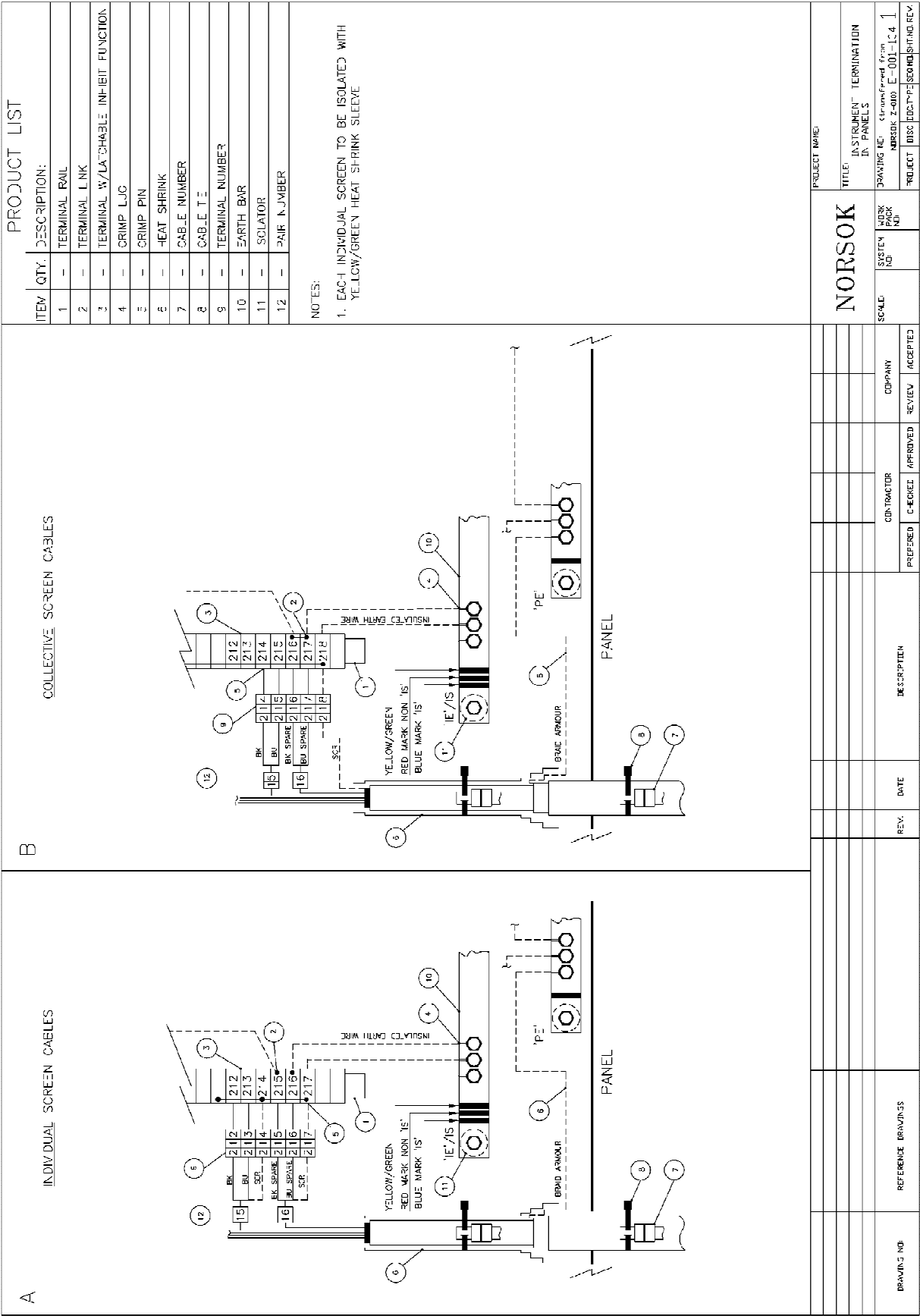


Figure B.3 – Termination in field junction boxes



PROJECT NAME:	NORSOK	
TITLE:	INSTRUMENT TERMINATION IN PANELS	
DRAWING NO.:	TRANSFORMED FROM	WORK PACK NO.
PROJECT ID:	NORSOK Z-000 E-001-1-4	REV
SCALE:	SYSTEM NO.	COMPANY
CHECKED:	APPROVED:	REVIEW:
DATE:	DESCRIPTION:	REFERENCE DRAWINGS:

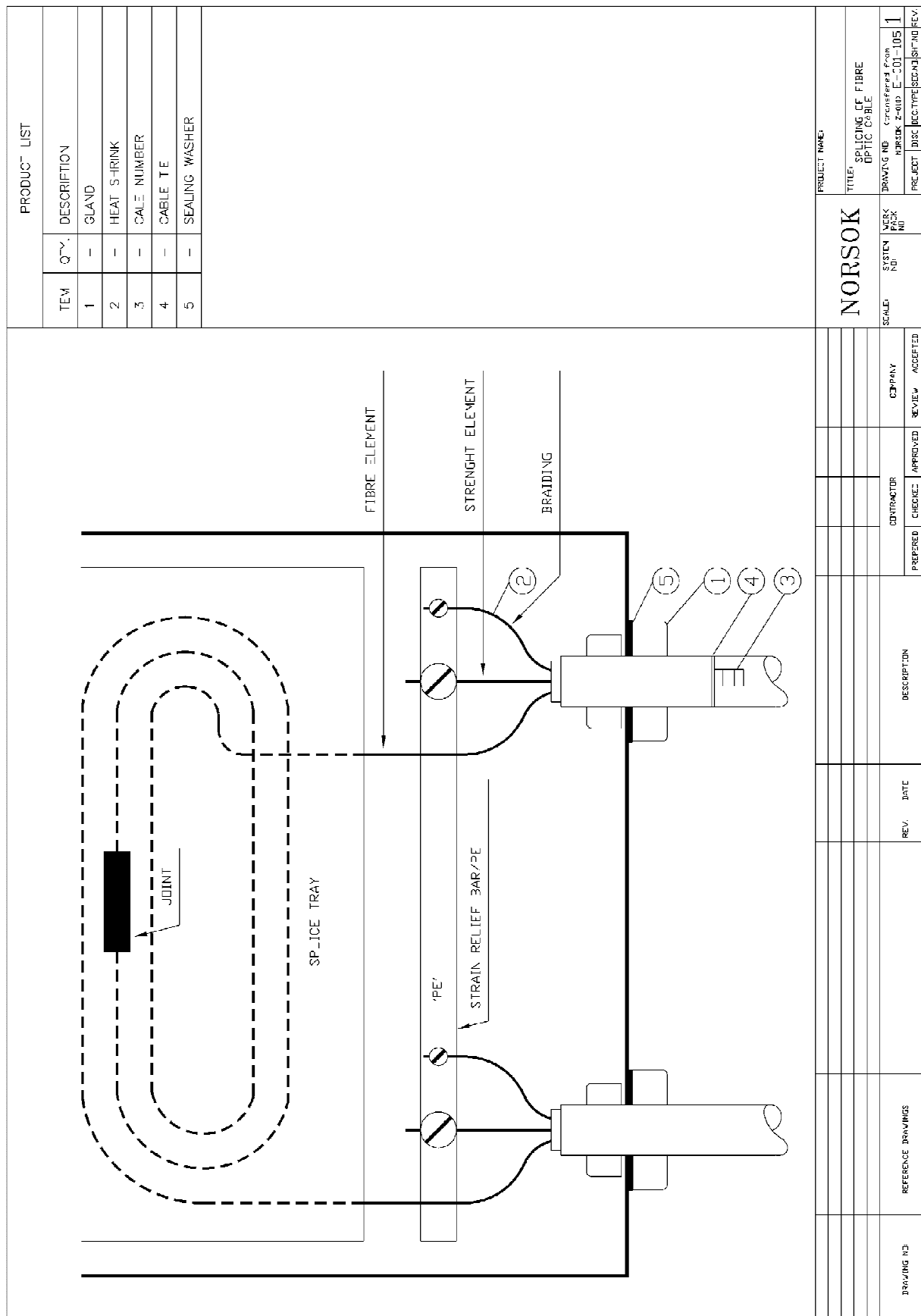


Figure B.5 – Splicing of fibre optic cable

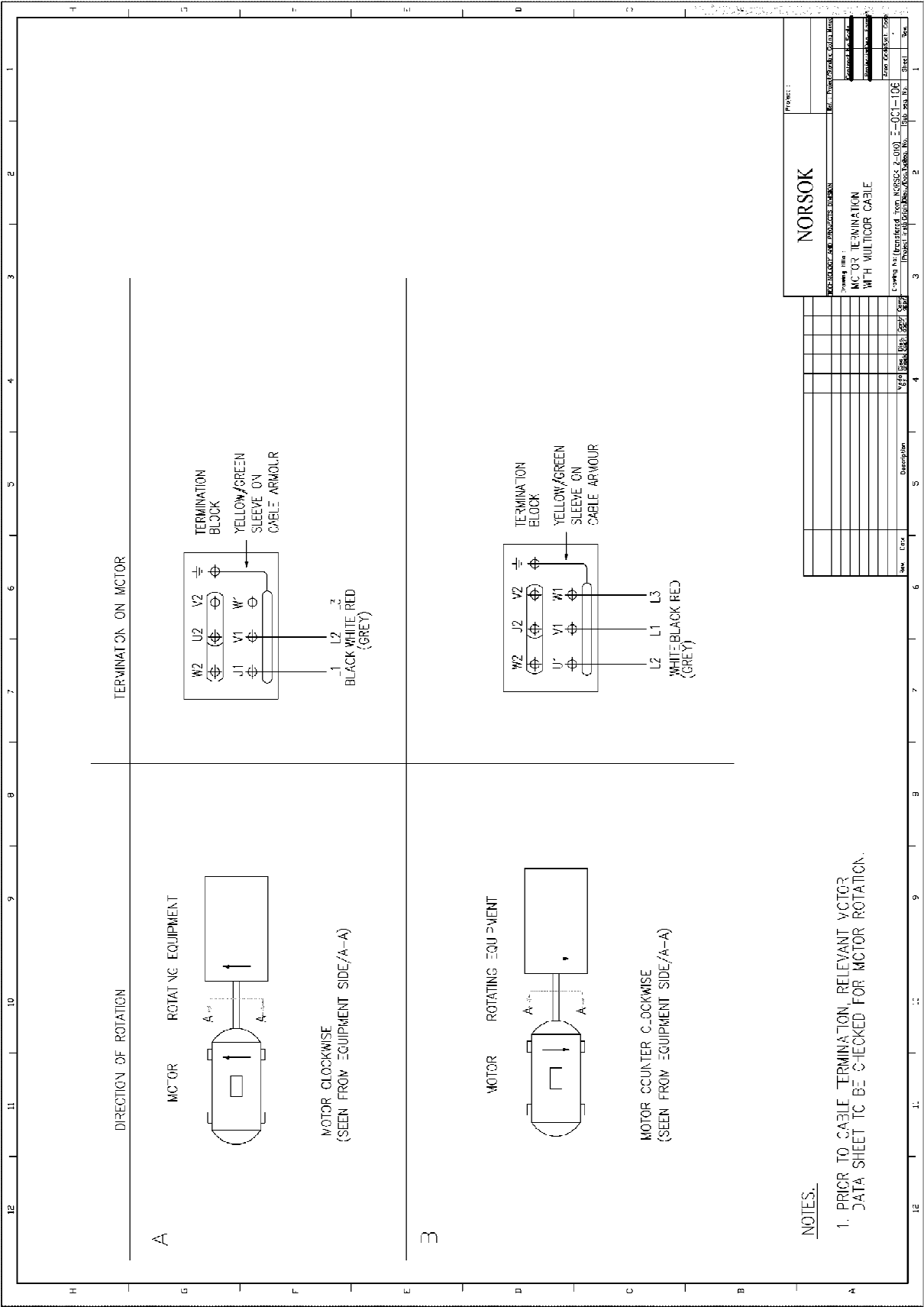
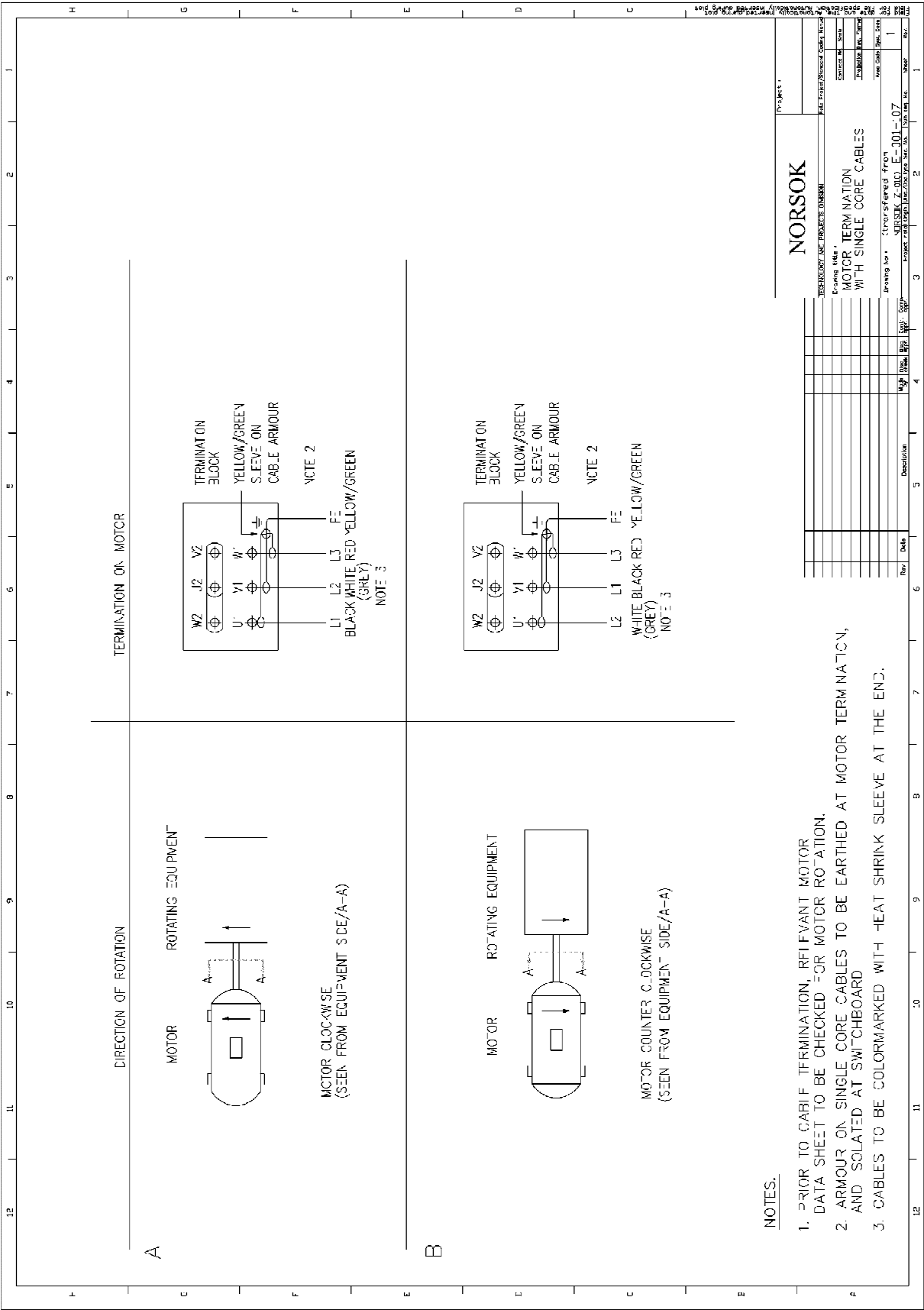


Figure B.6 – Motor termination with multicore cable



Bibliography

- [1] IEC 61136-1 Semiconductor power converter - Adjustable speed electric drive systems - General requirements Part 1: Rating specifications, particularly for d.c. motor drives.
- [2] IEC 61800-2 Adjustable speed electrical power drive systems, Part 2: General requirements Rating specifications for low voltage adjustable frequency AC power drive systems.
- [3] ISO 1680 Acoustics Test code for the measurement of airborne noise emitted by rotating electrical machines,
- [4] IEC 60364 Electrical low voltage installations

