

Electrical systems

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Contents

FOREWORD	2
INTRODUCTION	2
Contents	1
Foreword	2
Introduction	2
1 Scope	3
2 Normative references	3
3 Abbreviated terms and symbols	4
3.1 Abbreviated terms	4
4 Design criteria	4
4.1 General	4
4.2 Studies and calculations	4
5 System requirements	8
5.1 System voltage and frequency	8
5.2 Power supply	8
5.3 Power distribution system	10
5.4 Earthing	11
5.5 Lighting system	12
5.6 Power outlets	13
5.7 Temporary work station	13
5.8 Electrical heat tracing	13
5.9 Navigational aid system	14
5.10 Thermographic inspection	14
5.11 Separate electrical rooms	14
5.12 Location of major electrical equipment	14
5.13 Ignition source control	14
6 Equipment requirements	14
6.1 General	14
6.2 High voltage switchboard	15
6.3 Low voltage switchboard	15
6.4 Uninterruptible power system (UPS)	16
6.5 Electrical indicating instruments	16
6.6 Motors	17
6.7 Generators	18
6.8 Power transformers	19
6.9 Distribution panels	19
7 Relays and protection	19
7.1 General	19
7.2 Main generator protection	20
7.3 Emergency generator protection	20
7.4 Electric motor and power transformer protection	21
7.5 11kV / 6.6kV busbar relays	21
7.6 Other circuits	21
Annex A (Normative) Equipment data sheets	23
Bibliography	24

Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for existing and future petroleum industry developments.

The NORSOK standards are prepared to complement available international standards and 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 Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

These 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 preparation and publication of the NORSOK standards is supported by OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Manufacturing Industries). NORSOK standards are administered and issued by NTS (Norwegian Technology Centre).

Annex A is normative.

Introduction

This issue of NORSOK standard E-001 replaces E-001 Rev. 3, December 1997.

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

1 Scope

This NORSOK standard contains provisions for electrical installations at all voltages and is intended to enable 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.

2 Normative references

The following standards include provisions which, through reference in this text, constitute provisions of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed.

IEC 60073,	<i>Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators</i>
IEC 60076-1,	<i>Power transformers, Part 1: General</i>
IEC 62040-3 (1999-03),	<i>Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements</i>
IEC 60298,	<i>A.C. metal-enclosed switchgear and controlgear for rated voltages above 1kV and up to and including 52kV. (1990-12)</i>
IEC 60439-1,	<i>Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies</i>
IEC 60726,	<i>Dry - type power transformers</i>
IEC 60947-4-1,	<i>Low voltage switchgear and control gear, Part 4: Contactors and motor-starters. Section one - Electromechanical contactors and motor-starters</i>
IEC 61892-3,	<i>Mobile and fixed offshore units-Electrical installations, Part 3: Equipment</i>
IEC 61892-7,	<i>Mobile and fixed offshore units-Electrical installations, Part 7: Hazardous areas</i>
IEC 60034	<i>Rotating electrical machines.</i>
IEFA,	<i>Guidelines for the documentation of selectivity (discrimination) in a.c. systems.</i>
IEFA,	<i>Veiledning for varmekabelanlegg i industri og offshore</i>
	<i>Trace heating guidelines in industri and offshore</i>
EN 1838,	<i>Lighting application - Emergency lighting (NSEN 1838, Norwegian edition)</i>
EN 50091-1,	<i>Uninterruptable power systems (UPS), Part 1: General and safety requirements</i>
EN 50091-2,	<i>Uninterruptable power systems (UPS), Part 2: EMC requirement</i>
PrEN50272-2,	<i>Final draft November 1999</i>
	<i>Safety requirements for secondary batteries and battery installations, Part 2: Stationary batteries</i>
NEK 606,	<i>Cables for offshore installations Halogen-free, or mud resistant</i>
89/336/EEC,	<i>EU directive for EMC</i>
NORSOK E-002,	<i>Adjustable speed a.c. motor drives</i>
NORSOK I-002,	<i>Safety and automation systems (SAS)</i>

NORSOK S-001,	<i>Technical safety</i>
NORSOK S-002,	<i>Working environment</i>
NORSOK Z-010,	<i>Electrical, instrumentation and telecom installation</i>
NORSOK Z-015	<i>Temporary equipment</i>

3 Abbreviated terms and symbols

3.1 Abbreviated terms

A.C.	alternating current
AN	naturally air cooled
AVR	automatic voltage regulator
CCR	central control room
CENELEC	European Committee for Electrotechnical Standardization
D.C.	direct current
DOL	direct on line
EMC	Electromagnetic Compatibility
EPS	emergency power supply
ESD	emergency shut down
FCR	field current regulator
HVAC	heating, ventilation and air conditioning
IEC	International Electrotechnical Commission
IFEA	Industriens Forening for Elektroteknikk og Automatisering
I/O	Input/output
IP	International Protection
ISO	International Organization for Standardization
LED	light emitting diode
LSS	load shedding system
LV	Low voltage
MCC	motor control center
NEK	Norsk Elektroteknisk Komite
NPD	Norwegian Petroleum Directorate
PABX	Private Automatic Branch Exchanger Panel (telephone panel)
PCS	process control system
PDCS	power distribution control system
PE	Produkt- og Elektrisitetsstilsynet
PLC	programmable logic controller
RTD	resistor temperature detector
SAS	safety and automation systems
TEFC	totally enclosed fan cooled
THD	total harmonic voltage distortion
UPS	uninterruptible power system
VDU	visual display unit

4 Design criteria

4.1 General

The electrical system shall fulfill the requirement of the EU directive 89/336/EEC (EMC).

4.2 Studies and calculations

4.2.1 Electrical load study

Electrical load lists shall be prepared to establish the electrical power requirements throughout the installation. Load estimates shall be carried out for all operational states, e.g.:

- Drilling.
- Maximum power consumption for all systems.

- Life support.
- Emergency.
- Minimum load for full production with low priority loads disconnected.

An electrical load profile shall be prepared for normal operations over the entire lifetime of the installation.

Separate load studies shall be carried out to establish the temporary load requirements during pre production phases, e.g.:

- Onshore commissioning and testing.
- Float out.
- Deck mating.
- Inshore hookup and commissioning.
- Tow out.
- Offshore hookup and commissioning.

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.

4.2.2 Load flow calculations

Steady state load flow calculations shall be carried out for the operational states giving maximum peak load and minimum load based on 4.2.1.

The following data should be computed:

- Magnitude and phase angle of the busbar voltages.
- Active and reactive power production and load at the busbars.
- Active and reactive power flow in cables and transformers.
- Power losses.
- Recommended setting of the transformers tapplings.
- Voltage rise in long runs of high voltage cables.

4.2.3 Short circuit calculations

Short circuit calculation shall be carried out for the following fault conditions, with maximum and minimum short circuit currents:

- 3-phase symmetrical fault.
- Single-phase to earth fault.
- Phase to phase fault.
- Phase to phase to earth fault.

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

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

4.2.4 Power system dynamic calculations

A stability analysis of the electrical power system shall be carried out and shall comprise simulations of the system transient behaviour following disturbances during relevant operational modes of the installation.

The simulations shall include:

- Direct on line starting of large motors.
- Short-circuited feeders with clearance of the fault after set time delay of the protective relays or clearing time of the fuses.
- Generator short circuit with clearance of the fault and generator trip after the set time delay of the protective relays. Based on the analysis, load shedding shall be applied when required.
- Generator trip. Based on analysis, load shedding shall be applied when required.

The analysis shall be carried out for the worst case conditions with respect to system stability, which shall be determined separately by each project.

The analysis shall prove that the system will restabilize following the specified disturbances, and that the transient voltage and frequency variations, motor slip, reacceleration and start up times are acceptable.

4.2.5 Protective relay coordination and discrimination study

A relay coordination study shall be carried out to determine the setting of the protective relays and direct acting circuit breakers.

Series connected overcurrent relays, direct acting circuit breakers and fuses shall be coordinated to achieve correct discrimination during fault conditions. Correct discrimination shall be maintained for the minimum and 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 IFEA "Guidelines for the documentation of selectivity (discrimination) in a.c. systems."

4.2.6 Calculation of harmonic currents and voltages

A harmonic study shall be carried out when adjustable speed drive(s) is a part of the electrical network, ref. NORSOK E-002. The magnitude of the harmonics and the total voltage distortion shall be computed for all main busbars.

On high voltage busbars ($U_n > 1000V$), the voltage THD should not exceed 8% and no single harmonic should exceed 5%, corresponding to IEC 61000-2-4, class 2.

On low voltage busbars ($U_n < 1000V$) the voltage THD should not exceed 10%, and no single harmonic should exceed 8% corresponding to IEC 61000-2-4, class 3.

The detailed harmonic voltage acceptance limits shall correspond to IEC 61000-2-4, class 2 for high voltage, and class 3 for low voltage.

NOTE: It may be necessary to feed equipment sensitive to harmonics from UPS.

4.2.7 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 Table 1.
- Short circuit withstands capability, mechanical and thermal.

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

Electrical cables shall comply with NEK 606.

The voltage drop in cables should not exceed the following values, measured from the last distribution board with regulating facilities, i.e. supplied by a transformer with tapings or a generator.

Table 1 – Voltage drop in cables

System voltage	Circuit type	Stationary voltage drop	Typical power factor
400/230V	Feeder	2%	0,9
	Branch	4%	
	Total	6%	
	Lighting, at last fixture	10%	
11/6,6/0,69kV	Feeder	2%	0,8
	Branch	4%	
	Motor feeder	4%	
	Total	6%	
Total voltage drop at motor terminals during start shall be maximum 20 %. (Typical power factor 0,2)			

5 System requirements

5.1 System voltage and frequency

The following voltage levels and frequency shall be used:

11kV, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity exceeds 20MW. Should be used for motors from 400kW and above for DOL starting.
6,6kV, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity is between 4 to 20MW. Should be used for motors from 400 kW and above for DOL starting.
690V, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity is below 4MW. Should be used for DOL starting of motors, below 400kW and as primary voltage for converters for drilling motors.
400/230V 3-phase + N	TN-C-S / TN-S system shall be used as distribution voltage for lighting and small power, and for heaters below 3kW, including heat tracing. For living quarter, kitchen and laundry 400V 3-phase may be used as supply voltage to consumers. The system shall be symmetrically loaded.
UPS 230V	IT system shall be used as distribution voltages for instrumentation, control, telecommunication and safety systems.
230V IT	May be used for emergency power supply system.
UPS 48V D.C.	Shall only be used as distribution voltage for telecommunication systems.
Frequency	50Hz.

Only one high voltage level should be employed.

5.2 Power supply

To obtain the required availability, redundancy of the power distribution system shall be provided to maintain the power supply during normal maintenance operations or service interruption.

5.2.1 Main power supply

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. A changeover system shall be provided.

5.2.2 Emergency power supply

The emergency power supply system shall serve emergency power consumers as defined by NPD. Reference is also made to NORSOK standard S-001.

The emergency power supply systems shall comprise a combination of UPS, and if necessary a diesel fueled engine driven generator.

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 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.

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

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 fulfill the requirements for firewater pumps prime mover.

5.2.3 Uninterruptible power system (UPS)

UPSs shall be provided for emergency services and non-emergency services requiring continuous a.c. or d.c. power supply in case of main power failure blackout or electrical disturbances. Equipment sensitive to electrical disturbances such as 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 standard S-001.

Each UPS should be provided with facilities for battery capacity test including logging of test values.

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

Multiple UPS shall not contain common mode failure elements.

Redundant UPS supply shall be fed from fully independent UPS units without any common mode failure elements.

Each 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.

5.2.4 Drilling backup power supply

The backup power supply for drilling shall secure well and equipment in case of main power failure. The back-up power supply should be part of the permanent power supply system. For removable drilling facilities the backup power supply should be part of the drilling package.

5.2.5 Subsea power supply

The platform power system shall provide electrical power to the topside part of the subsea production control system, which in turn shall generate the necessary hydraulic and electrical power and control signals to the subsea installation.

Equipment, which is required for shutting down the subsea installation in a controlled manner, shall be powered from the UPS.

Where the subsea control system requires dual redundancy this requirement shall also apply to the UPS.

5.3 Power distribution system

5.3.1 Main power distribution system

The electrical power distribution system should be provided with duplicate incomers and a bus-section circuit breaker for all major switchboards. The bus-section circuit breaker shall be normally open, the incoming circuit breakers normally closed. Duplicate equipment shall be supplied from different busbar sections.

For switchboards fed directly from generators, the bustie breaker shall be normally closed.

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

5.3.2 Emergency distribution system

In normal operation the emergency switchboard shall be fed from the main power system. After loss of main power the switchboard shall be fed from the emergency generator(s).

The busbar sectionalizing arrangement shall be adapted to the emergency generator configuration.

Electrical equipment classified as emergency equipment shall be connected to the emergency switchboard. Equipment requiring continuous operation according to statutory regulations shall be connected to UPSs, fed from the emergency switchboard. Self-contained emergency equipment with battery units shall be fed from the emergency switchboard.

5.3.3 Power distribution control system (PDCS)

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 bustie breakers.
- Power reading of main generators, high voltage motors, feeders, and other analogue values according to Table 3. Clause 6.5.2.
- Trend recording.
- Motor starter interface if not directly to the PCS.

The PDCS shall be an independent functional unit with interface to the PCS, either 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.

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 3s, see NORSOK standard I-002, Annex 2.

Where implemented, the load shedding system shall be an independent software module within the PDCS. Care must 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.

5.4 Earthing

5.4.1 General

Earthing systems shall comply with PE "Retningslinjer for jording i maritime anlegg".

Exception: Field equipment shall be earthed through the supply cable.

5.4.2 System earthing

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

Table 2 – System earthing methods

Voltage	Power source	Transformer
11kV	Generator neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20A per generator.	Transformer neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20A per transformer.
6,6kV	Generator neutral shall be high resistance earthed. Maximum earth fault current shall be limited to 20A per generator ^b	Transformer neutral shall be high resistance earthed. Maximum earth fault shall be limited to 20A per transformer.
690V	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 100A per transformer.
400/230V TN systems		Transformer neutrals shall be solidly earthed.
230V IT UPS, Emergency	Isolated	Isolated
D.C.	Both poles isolated. ^a	
^a D.C. voltages for telecommunication system may have one pole earthed. ^b Emergency generator neutral(s) shall be isolated.		

5.4.3 Lightning protection

No additional installations 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.

5.5 Lighting system

5.5.1 General

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

Other lighting systems such as 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.

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.

5.5.2 Lighting equipment

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.

Battery operated handlamps with battery chargers shall be provided. The handlamps shall be certified for use in zone 1.

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 photoluminescent 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. What type to be used depends upon the type of area. These luminaries shall meet zone 1 requirements.

For emergency distribution boards, Ex-certification shall be evaluated in each case depending on the location.

Illuminated level gauges should be of the LED type with long lifetime.

5.5.3 Lighting system design

The lighting system should consist of four categories of lighting:

- Normal lighting:
Covering approximately 70% of the lighting requirements. The normal lighting shall be fed from the main distribution system.
- Emergency standby lighting:
Covering 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:
A part of the emergency luminaries, 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.
- Portable emergency lighting:
The battery charger for battery operated handlamps shall be fed from the emergency distribution system.

Local subdistribution boards shall be provided for power distribution to the lighting system within each functional area. The distribution boards shall to the extent possible be located in non-hazardous dry areas.

Distribution boards for emergency lighting shall be equipped for common remote alarming of tripped circuit.

5.5.4 Normal lighting illuminance levels

The illumination levels shall comply with the NORSOK standard S-002.

5.5.5 Emergency lighting illuminance levels

The illumination levels shall comply with the relevant parts of EN 1838.

5.6 Power outlets

5.6.1 Small power outlets

A small power convenience 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 subdistribution board limited to essential equipment which has to be available during a shutdown situation.

Convenience socket outlets shall be rated 16A. Circuits dedicated for socket outlets shall have no other consumers connected.

Ex certified equipment shall be used in naturally ventilated areas.

5.6.2 Power outlets

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 63A, 400/230V, 3 phases + neutral. Ex certified equipment should be used in naturally ventilated areas.

5.7 Temporary work station

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

Ex certified equipment should be used in naturally ventilated areas.

5.8 Electrical heat tracing

5.8.1 General

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

Design, material and installation should be according to the guidelines issued by IFEA "Veiledning for varmekabelanlegg i industri og offshore".

5.8.2 Design

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

Temperature control devices like RTD, thermostats etc. should not be used. 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.

5.8.3 Power supply

One heat tracing circuit should only supply one process system.

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

Subdistribution 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.

5.9 Navigational aid system

All power supply and control equipment for fog horn and navigational lights shall be located indoors, at a location suitable for maintenance activities.

The integrated power supplies shall be galvanically isolated from the mains.

5.10 Thermographic inspection

Possibilities for thermographic on load inspection or use of thermostrips for equipment like power transformer, UPS, switchgear and motor control center, should be arranged where possible.

5.11 Separate electrical rooms

Separate electrical equipment rooms shall be used when required by statutory regulations. 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. For battery room reference is made to prEN 50272-2.

5.12 Location of major electrical equipment

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.

5.13 Ignition source control

Equipment left live in an ESD situation shall be explosion protected and suitable for installation in zone 1 area. Excepted is emergency equipment in living quarter and other areas subject to special considerations. Reference is made to NORSOK standard S-001.

Depending on the location, small power outlets, power outlets and temporary workstations shall be automatically isolated upon detection of gas.

6 Equipment requirements

6.1 General

Equipment shall meet the requirements in IEC 61892-3 and IEC 61892-7. For Ex requirements reference is made to NORSOK standard Z-010, 4.1.

Equipment with identical functions should be directly interchangeable.

High voltage equipment shall be equipped for earthing by a portable apparatus. The terminals and the earthed frame shall be provided with earth lug or ball suitable for connection of standardised portable mobile earthing apparatus. A standard type of earthing apparatus shall be selected for all equipment.

For air insulated switchgears isolation of circuits shall be by use of withdrawable breakers and starters.

Circuit breakers shall be equipped with mechanically acting push buttons for local testing and emergency operations, and be provided with "service" and "test" positions.

Safety thermostats in heaters shall be wired directly into the control circuit of the feeding circuit.

Earth bars shall normally be located in front of the cable entries to allow easy access for inspection and maintenance.

Space shall be provided for entry, strapping and termination of all cables as specified in the data sheet plus 10% spare.

6.2 High voltage switchboard

6.2.1 General

The switchboard and cubicles shall be metal enclosed according to IEC 60298-3.102. In addition the cubicles shall be of type metal clad according to IEC 60298-3.102.1. 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 circuitbreakers and contactors shall be of either vacuum or SF6 type.

The circuit breakers and contactors shall have test possibilities when disconnected from the mains. The control voltage shall be supplied from an UPSs of 230V a.c.

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

Surge arrestors or other protection devices shall be used in connection with vacuum contactors/circuitbreakers where switching voltage escalation may exceed the insulation level.

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

All circuitbreakers and contactors shall be withdrawable for air insulated switchboards. Circuitbreakers, contactors, and earthing switches shall be provided with padlocking facilities.

Mechanical interlock between circuitbreaker, 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 busbar), other interlock system shall be provided.

6.2.2 Testing

Routine tests shall be performed according to IEC 60298, Section 7. High voltage switchboards shall be type tested according to IEC 60298 for arcing due to internal faults. The duration of the arc shall be 1s.

6.3 Low voltage switchboard

6.3.1 General

Spare space of approximately 10% at the time of delivery of the equipment should be provided. Spare panels and compartments shall facilitate future installation without shutting down the switchboard.

Status for main circuit breakers shall be shown on the breaker front (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 should be supplied from a common control voltage transformer for each motor starter cubicle or each busbar section. A separate control voltage busbar should be provided. Protection shall be provided individually for each motor starter circuit.

The control voltage shall be supplied from an UPSs at 230V a.c. for air circuit breakers and other critical consumers other than motor starters, see 5.2.3.

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

Starters should be grouped into motor control centers located in switchboard rooms. Pad locking facilities shall be provided for all incoming and outgoing circuits. This shall apply for all voltage levels including 230V.

6.3.2 Motor control center (MCC) modules

Intelligent programmable feeders and motorstarters with protection control devices should have serial link communication possibilities to supervisory systems and data transferred to maintenance system.

6.3.3 Testing

Routine tests shall be performed according to IEC 60439-1.
Arc-testing shall be part of the type test.

6.4 Uninterruptible power system (UPS)

6.4.1 General

The UPS unit shall meet the requirement in EN 50091-1 and EN 50091-2.

The UPS unit shall have internal test facilities to verify all operational features for the system including 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. Reference is made to NORSOK standard 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.

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 have a mimic diagram on front showing operational modes and voltage/amps/frequency.

Air circulation gaps around the battery cells shall be provided according to the manufacturer recommendation.

6.4.2 Testing

Routine tests shall be performed according to IEC 60146-4, clause 7.

6.5 Electrical indicating instruments

6.5.1 General

Panel instruments should be of class 1.5.

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

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

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

- Synchronoscope.
- Double voltmeter.
- Double frequency meter.
- Check synchronizing relay

6.5.2 Requirements

Electrical indicating instruments shall be according to Table 3.

Table 3 – Electrical indicating instruments

	Generators		Motor feeders	Transformer feeders/ outgoing circuit breakers	Incomers	D.C. systems	Busbar 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 Motors

6.6.1 General

A.C. motors should be of the squirrel cage, direct on-line start type. Where variable speed/torque regulation is required, converter fed a.c. motors shall be used. d.c. motors may be used for certain applications.

The terminals and the earthed frame of high voltage motors shall be provided with contact bolts for application of mobile earthing apparatus.

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

6.6.2 Motor rating, Ex protection and enclosure

Motor rating and protection shall be according to Table 4.

Table 4 - Motor rating and degree of protection (IP)

Motor type	Nominal voltage	Rated output	Ex protection ^d	Insulation class	Enclosure
LV	400V a.c. ^c	< 200kW	e, n, d/e ^a	F	IP55 ^b
LV	690V a.c.	< 400kW	e, n, d/e ^a	F	IP55 ^b
HV	6.6kV a.c. 11kV a.c.	> 300kW > 400kW	p, d/e ^a	F	IP55 ^b
^a Exd motors shall only be used where necessary and with Ex e termination. ^b IP56 shall be used on open deck and where equipment may be exposed to powerful water jets. ^c For special applications only. ^d Non-ex type motors may be used in non-hazardous mechanically ventilated areas.					

Motors in zone 1 or 2 from 6 kV and above shall be Ex p or Ex d with Ex e termination.

TEFC motors may be used on open deck provided embedded temperature detectors for trip upon blocking of fan blades protect the motor.

6.6.3 Local control stations

Local emergency stop, stay put pushbutton, adjacent to the motor shall be connected directly to the motor starter circuit.

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

6.6.4 Testing

Tests shall be performed according to IEC 60034.

6.7 Generators

6.7.1 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 be delivered with a neutral resistor as an integral part of the generator. The resistor shall be rated in accordance with the data sheet.

Minimum two temperature resistance sensors shall be embedded in each phase of the stator winding.

The rotor shall be dynamically balanced according to relevant international standards and be able to withstand an overspeed of 120% of the nominal speed for two minutes.

The exciter shall be of the brush less type and directly connected to the main shaft. 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.

Facilities shall be provided for continuous monitoring of exciter and field winding insulation resistance. Facilities shall be provided for monitoring of the rectifier diodes. Alarms shall be given for failed open as well as 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 +/-10% of rated value.

The AVR system shall consist of dual independent channels:

- either a double AVR system;
- or with one AVR channel and one manual FCR channel.

For a double AVR system, one channel shall be main while the other shall be in stand-by. It shall be possible to manually choose which channel shall be in main.

For a system with one AVR and one FCR, the AVR shall be main and the FCR shall be stand-by.

For both systems, a follow-up regulation shall be provided. This shall ensure voltage stability upon transfer between the main and stand-by channel.

Automatic transfer from main to stand-by channel shall take place for faults influencing the regulation. For the AVR/FCR system such automatic changeover shall only take place when two or more generators are running in parallel.

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.

6.7.2 Testing

Tests shall be performed according to IEC 60034.

6.8 Power transformers

6.8.1 General

High voltage power transformers shall be prepared for forced cooling rated 140% of rated load. The transformer should be of the cast resin dry type.

Low voltage (LV/LV) transformers may be dry types without cast resin insulation.

Insulation class shall be F.

Reference is made to IEC 60726.

Neutral resistor may be an integrated part of the transformer, including current transformer.

6.8.2 Testing

Tests shall be performed according to IEC 60076-1.

6.9 Distribution panels

Explosion protected distribution panels shall be constructed such that the position of circuit breakers are visible without opening the enclosure.

7 Relays and protection

7.1 General

Solid state, microprocessorbased 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.

7.2 Main generator protection

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
Overload	X		X
Shortcircuit	X	X	X
Earth fault	X	X	X
AVR fault	X	X	X
Stator RTD, temp. high			X
Stator RTD, temp. hi/hi	X		X
Rotor earth fault	X	X	X
Directional earth fault ^a	X	X	X
Overvoltage	X	X	X
Undervoltage	X		X
Reverse active power ^a	X		X
Reverse reactive power ^a	X		X
Negative phase sequence	X		X
^a For generators in parallel operation only.			
^b For generators above 4 MVA.			

7.3 Emergency generator protection

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	X	X	X	X
Overcurrent		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 ^a	X	X	X	X
^a For generators in parallel operation only.				

7.4 Electric motor and power transformer protection

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

Table 7 - Motor and power transformer protection

Protective function to disconnect supply	Low voltage motor	High voltage motor	Power transformer	PDCS alarms
Overload	X	X	X	X
Shortcircuit	X	X	X ^e	X
Earth fault	X	X	X ^d	X
Differential protection			X ^f	X ^f
RTD, temp. high		X ^a	X ^a	X
RTD, temp. high-high		X ^b	X	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 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.
^e Shall protect the primary and secondary windings, and the busbar of the switchboard connected to the secondary winding.
^f Differential protection not required for dry type transformers.

7.5 11kV / 6.6kV busbar relays

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

- Undervoltage relay.
A stationary undervoltage 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 sectionalise the busbar and trip incomer(s). This does not apply for single-phase air or gas (SF₆ = Sulphur Hexachlorid) insulated switchboards.

7.6 Other circuits

Other circuits shall be equipped as follows:

- Lighting and small power transformers:
 - Circuit breakers with primary overcurrent/shortcircuit relay, moulded case circuit breaker or fuse.
 - Earth fault protection.
- 690V Sub-distribution feeders:
 - Circuit breakers with overcurrent/short circuit relay.
 - Earth fault protection.
- Feeders to 230V sub-distribution boards:
 - Moulded case circuit breakers with overcurrent/shortcircuit relay.
 - Earth fault protection.

- Lighting and small power circuits:
 - Miniature circuit breakers.
 - Earth fault protection.
- Trace heating circuits:
 - Miniature circuit breakers.
 - Earth fault protection.

Outgoing feeders below 400A may be provided with load breaker and fuses.

Annex A

(Normative)

Equipment data sheets

EDS-001	UNINTERRUPTIBLE POWER SUPPLY (UPS)	Rev. 4, Mar. 2001
EDS-002	EG, a.c. GENERATOR	Rev. 4, Mar. 2001
EDS-003	EH, HIGH VOLTAGE SWITCHBOARD (>1kV)	Rev. 4, Mar. 2001
EDS-004	EM, INDUCTION MOTOR	Rev. 4, Mar. 2001
EDS-005	EN, LOW VOLTAGE SWITCHBOARD (<1kV)	Rev. 4, Mar. 2001
EDS-007	ET, POWER TRANSFORMER	Rev. 4, Mar. 2001
EDS-010	CAPACITOR DATA SHEET	Rev. 4, Mar. 2001
EDS-011	REACTOR DATA SHEET	Rev. 4, Mar. 2001
EDS-012	RESISTOR DATA SHEET	Rev. 4, Mar. 2001

NORSOK E-001	UNINTERRUPTIBLE POWER SYSTEM DATA SHEET	EDS-001
		Rev. 4, Mar. 2001
		Page 2 of 5

Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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/Triple :
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		

NORSOK E-001	UNINTERRUPTIBLE POWER SYSTEM DATA SHEET	EDS-001 Rev. 4, Mar. 2001 Page 4 of 5
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Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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	

NORSOK E-001	AC GENERATOR DATA SHEET	EDS-002
		Rev. 4, Mar. 2001
		Page 2 of 5

Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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			

NORSOK E-001	AC GENERATOR DATA SHEET	EDS-002
		Rev. 4, Mar. 2001
		Page 3 of 5

Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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 <i>Facing 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, Sn	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	%/± :
(continued)		
Notes		

NORSOK E-001	HIGH VOLTAGE SWITCHBOARD DATA SHEET	EDS-003
		Rev. 4, Mar. 2001 Page 3 of 5

Package no.:	Doc. no.:	Rev.
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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	mm² :
3.17	Completely Insulated	Yes/No :
	Earth Bus Bar :	
3.18	Rating	A :
3.19	Cross Section	mm² :
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		

NORSOK E-001	INDUCTION MOTOR DATA SHEET	EDS-004
		Rev. 4, Mar. 2001 Page 2 of 6

Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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		

NORSOK E-001	INDUCTION MOTOR DATA SHEET	EDS-004
		Rev. 4, Mar. 2001 Page 5 of 6

Package no.:	Doc. no.:	Rev.
--------------	-----------	------

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 _e time constant at 1.0 U _n	s :
4.28	t _e 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		

NORSOK E-001	LOW VOLTAGE SWITCHBOARD DATA SHEET	EDS-005
		Rev. 4, Mar. 2001

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	Type	:
2.07	Location / Module	:
2.08	Job. No.	:
2.09	Inquiry No.	:
2.10	Quote No.	:
2.11	P.O. No	:
Nominal Ratings		
2.12	Rated System Voltage	V :
2.13	Rated System Frequency	Hz :
2.14	Rated Current	A :
Short Circuit Ratings		
2.15	Short-Time Withstand Current (Therm.)	kA in 1sec. :
2.16	Asymm. Peak Withstand Current (Dyn.)	kA :
2.17	RMS Symmetric Breaking Current	kA :
Main Connection		
2.18	Entry	Bottom/Top/Other :
2.19	Type	Cables/Busbar :
Auxiliary Cables Connection		
2.20	Entry	Bottom/Top/Other :
Switchboard Construction		
2.21	Arrangement; Single Front/Back-to-Back/ L-Shape	:
2.22	Motor Heating	Internal/External :
2.23	Degree of Protection	IP :
Max Transport Sections		
2.24	Dimensions	L x W x H mm :
2.25	Weight	kg :
Space Heaters		
2.26	Heaters Required	Yes/No :
2.27	Power Rating	kW :
2.28	Voltage	V :
Notes		

NORSOK E-001	POWER TRANSFORMER DATA SHEET	EDS-007
		Rev. 4, Mar. 2001
		Page 2 of 3

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, 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	:

NORSOK E-001	CAPASITOR DATA SHEET	EDS-010
		Rev. 4, Mar. 2001
		Page 2 of 3

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	:

NORSOK E-001	REACTOR DATA SHEET	EDS-011
		Rev. 4, Mar. 2001
		Page 2 of 3

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 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 :	

NORSOK E-001	RESISTOR DATA SHEET	EDS-012
		Rev. 4, Mar. 2001
		Page 2 of 3

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 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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