

NORSOK STANDARD

COMMON REQUIREMENTS
ELECTRICAL SYSTEMS

E-CR-001
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Please note that whilst every effort has been made to ensure the accuracy of the NORSOK standards neither OLF nor TBL or any of their members will assume liability for any use thereof.

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1 FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (The Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardization process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

2 SCOPE

This 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 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.

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

3 NORMATIVE REFERENCES

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on E-CR-001 Electrical systems are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below.

IEC 34-5: 1991	Rotating electrical machines, Part 5: Classification of degree of protection provided by enclosures of rotating electrical machines (IP code).
IEC 76-1: 1993	Power transformers, Part 1: General.
IEC 146-4: 1986	Semiconductor convertors, Part 4: Method of specifying the performance and test requirements of uninterruptible power systems.
IEC 298: 1990	AC metal-enclosed switchgear and controlgear for rated voltages above 1kV and up to and including 52kV.

IEC 439-1: 1992	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies
IEC 947-4-1: 1990	Low voltage switchgear and control gear, Part 4: Contactors and motor-starters. Section one - Electromechanical contactors and motor-starters.
EN50091-1: 1993	Uninterruptible power systems (UPS), Part 1: General and safety requirements.
NEK 606	“Norsk Elektroteknisk Komite, Kabler for offshore installasjoner Halogenfrie, eller borevæskebestandige.”
E-CR-002	NORSOK standard, Adjustable speed ac motor drives.
I-CR-002	NORSOK standard, Safety and automation systems (SAS).
S-DP-001	NORSOK standard, Technical safety.
S-DP-002	NORSOK standard, Working environment.

4 DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

Normative references	Shall mean normative in the application of NORSOK standards.
Informative references	Shall mean informative in the application of NORSOK standards.
Shall	Shall is an absolute requirement which shall be followed strictly in order to conform with the standard.
Should	Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable.
May	May indicates a course of action that is permissible within the limits of the standard (a permission).
Can	Can requirements are conditional and indicates a possibility open to the user of the standard.

4.2 Abbreviations

CENELEC	European Committee for Electrotechnical Standardization.
EPS	Emergency Power Supply.
ESD	Emergency Shut Down.
HVAC	Heating, Ventilation and Air Conditioning.
ISO	International Organization for Standardization.
MCC	Motor Control Center.
PABX	Private Automatic Branch Exchanger Panel (telephone panel).
PCS	Process Control System.
PDCS	Power Distribution Control System.
PE	“Produkt- og Elektrisitetstilsynet” former “ET, Elektrisitetstilsynet”.
PLC	Programmable Logic Controller.
RTD	Resistor Temperature Detector.
SAS	Safety and Automation Systems.
UPS	Uninterruptible Power Supply.
VDU	Visual Display Unit.

5 DESIGN CRITERIA

5.1 General

Necessary redundancy to obtain the required availability shall be provided to maintain the power supply during normal maintenance operations and service interruption of critical power distribution equipment.

Equipment with identical functions should be directly interchangeable.

5.2 Studies and calculations

5.2.1 *Electrical load study*

An electrical load list 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 - 1.4
- Pre-engineering : 1.25
- Detail engineering : 1.10

Note: If the electrical load data at different stages are well defined, lower factors may be used.

5.2.2 *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 5.2.1.

The following data shall 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.

5.2.3 *Short circuit calculations*

Short circuit calculation shall be carried out for the following fault conditions, with maximum and minimum fault contribution.

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

The maximum symmetrical r.m.s. value of the sub transient fault current shall 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

5.2.4 *Power system dynamic calculations*

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

The simulations shall include:

- Direct on line starting of the largest motors.
- Short-circuited feeders with clearance of the fault after set time delay of the protective relays or blowing 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 within acceptable limits.

5.2.5 *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."

5.2.6 Calculation of harmonic currents and voltages

The content of harmonics in the power system shall be examined when large converters are connected.

The magnitude of the harmonics and the total voltage distortion shall be computed for all main busbars.

On high voltage busbars the total harmonic distortion should not exceed 8% and no single harmonic should exceed 5%.

On low voltage busbars the total harmonic distortion should not exceed 10% and no single harmonic should exceed 7%.

The detailed harmonic voltage acceptance limits shall be as defined in E-CR-002, clause 5.4.2, table 1.

Note: It may be necessary to feed sensitive equipment from an UPS system.

5.2.7 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.
- Short circuit withstand, mechanical and thermal.

Electrical cables shall comply with NEK 606.

6 SYSTEM REQUIREMENTS

6.1 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.
6.6kV, 3-phase	Generation and distribution voltage. Should be used when total installed generator capacity is between 4-20MW. Should be used for motors from 300kW and above.