SLOVENSKI STANDARD
oSIST prEN 60034-3:2018

01-september-2018

Električni rotacijski stroji - 3. del: Posebne zahteve za sinhronske generatorje, ki jih poganjajo parne ali plinske turbine, in za sinhronske kompenzatorje (IEC 60034-3:2007)

Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators

Ta slovenski standard je istoveten z: **prEN 60034-3:2018**

ICS:

27.040	Plinske in parne turbine. Parni stroji	Gas and steam turbines. Steam engines
29.160.20	Generatorji	Generators

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COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60034-3 ED7**	
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IEC TC 2 : ROTATING MACHINERY	
SECRETARIAT: United Kingdom	SECRETARY: Mr Charles Whitlock
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators

PROPOSED STABILITY DATE: 2021

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ROTATING ELECTRICAL MACHINES

Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators

FOREWORD

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International Standard IEC 60034-3 has been prepared by IEC Technical Committee 2: Rotating machinery.

This seventh edition cancels and replaces the sixth edition published in 2007. This edition constitutes a technical revision. The significant technical changes with respect to the previous edition are as follows:

- Scope extended to synchronous compensators
- Rotor overcurrent requirements added
- Impact of stator harmonics on rotor unbalanced load capability introduced
- Synchronisation requirements added
- Adjustments of temperatures or temperature rise revised for gas turbine applications
- Requirements for auxiliaries updated

55 The text of this standard is based on the following documents:

FDIS	Report on voting
2/XXXX/FDIS	2XXXX/RVD

56
57 Full information on the voting for the approval of this standard can be found in the report on
58 voting indicated in the above table.

59 This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

60 A list of all parts of IEC 60034 series, published under the general title *Rotating electrical machines,*
61 can be found on the IEC website.

62 The committee has decided that the contents of this publication will remain unchanged until
63 the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in
64 the data related to the specific publication. At this date, the publication will be

65 • reconfirmed,
66 • withdrawn,
67 • replaced by a revised edition, or
68 • amended.

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ROTATING ELECTRICAL MACHINES

Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators

1 Scope

This part of IEC 60034 applies to large three-phase synchronous generators, having rated outputs of 10 MVA and above driven by steam turbines or combustion gas turbines. Also included are synchronous MVAr compensators of the same output range connected to a grid for the purpose of exchanging reactive power.

This standard supplements basic requirements for rotating machines given in IEC 60034-1.

Common requirements are prescribed together with specific requirements for air, hydrogen or liquid cooled synchronous generators or compensators.

This part of IEC 60034 also gives the precautions to be taken when using hydrogen cooled generators including:

– rotating exciters driven by synchronous generators;

– auxiliary equipment needed for operating the generators;

– parts of the building where hydrogen might accumulate.

NOTE 1 These requirements also apply to a synchronous generator driven by both a steam turbine and a combustion gas turbine as part of a single shaft combined cycle unit.

NOTE 2 These requirements do not apply to synchronous generators driven by water (hydraulic) turbines or wind turbines.

NOTE 3 The precautions to be taken when using hydrogen are valid for all cases where hydrogen is used as a coolant.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 60034-18, *Rotating electrical machines - Part 18-1: Functional evaluation of insulation systems - General guidelines*. Depending on the insulation system used and the winding design, additional parts of IEC 60034-18 are applicable.

IEC 60045-1, *Steam turbines – Part 1: Specifications*

IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

IEC 60085, *Electrical insulation - Thermal evaluation and designation*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60034-1 together with the following additions apply.

3.1 Grid

In this standard 'grid' is used for a public electrical network or a local (e.g. industrial) network, which is connected to the generator or compensator either directly or through a transformer.

3.2 Synchronous Generator

Generators covered by this standard are large synchronous machines driven by steam or gas turbines. They convert mechanical energy into electrical energy and supply it to an electrical grid. Generators can also provide reactive power to the grid. The driving unit itself or additional equipment is used to start up the generating unit.

3.3 Synchronous Compensator

A synchronous compensator is a large synchronous machine electrically coupled to the grid but not exchanging mechanical energy through the shaft during steady state operation. Reactive power is supplied to the grid or imported to the compensator by means of adjusting the field current. The losses are covered by the grid. A compensator needs a start-up device, which accelerates the unit to operating speed.

3.4 Mechanical start

Change in speed from zero or turning gear speed to rated speed.

3.5 Turning gear operation

Rotation at low speed to avoid undesirable bending of turbine- and/or generator/compensator-rotors due to uneven circumferential temperature distribution.

4 General

4.1 General rules

Turbine driven synchronous generators and synchronous compensators shall fulfil the basic requirements for rotating machines specified in IEC 60034-1 unless otherwise specified in this standard.

Wherever there is reference to an agreement in this standard, it shall be understood as an agreement between manufacturer and purchaser.

4.2 Rated conditions

4.2.1 Generators

The rated conditions of a generator are given by the rated values of

– the apparent power;
– frequency;
– voltage;
– power factor;
– primary coolant temperature (40°C unless otherwise agreed upon);
– field current and field voltage (see also NOTE below);

and where applicable

– site altitude;
– hydrogen pressure with indication whether the figure is to be interpreted as absolute or gauge pressure;
– range of hydrogen purity, see IEC 60034-1.

4.2.2 Compensators

The rated conditions of a compensator are basically the same as those of a generator but with different definitions of apparent power and power factor.

– The rated apparent power consists mainly of the maximum reactive output at rated voltage when the machine is overexcited, and of a small amount of active power delivered to the compensator.

- The rated power factor is close to zero, reflecting mainly the maximum reactive power and the losses compensated by the grid.

For compensators, the range of reactive power shall be agreed upon.

NOTE During operation, the field current of a generator or compensator is adjusted depending on the demand of reactive power. Generator/compensator rated field current and field voltage are those values needed to operate the generator/compensator at rated conditions. Generator/compensator modelling studies may require base values for field current and field voltage other than rated.

4.3 Rated voltage

The rated voltage shall be agreed upon.

4.4 Power factor

The power factor of a generator shall be agreed upon. Standardised rated power factors at the generator terminals are 0,8, 0,85 and 0,9 overexcited.

NOTE 1 The lower the rated power factor the larger the generator will be.

NOTE 2 The rated power factor should reflect the demand on reactive power overexcited at rated active power output including some margin.

NOTE 3 It is recommended that the generator is capable of providing a power factor of 0,95 underexcited at rated active power output.

The power factor of a synchronous compensator deviates from zero only by an amount, which depends on the losses compensated by the grid.

4.5 Rated speed

Synchronous generators or compensators are typically connected to a grid with a fundamental operating frequency of 50Hz or 60Hz.

The rated speed is

$3\,000/p$ min^{-1} for 50 Hz generators or compensators;

$3\,600/p$ min^{-1} for 60 Hz generators or compensators;

where p is the number of pole pairs.

4.6 Ranges of voltage and frequency

Synchronous generators and compensators shall be capable of continuous rated output at the rated power factor over the ranges of ±5 % in voltage and ±2 % in frequency, as defined by the shaded area of Figure 1.

The temperature rise limits in Tables 8 and 9, or the temperature limits in Table 13 of IEC 60034-1:2017 shall apply at the rated voltage and frequency.

Potentially required operation outside the dashed borderline of Fig. 1 shall be the subject of an agreement.

NOTE 1 If the operating point deviates from the rated values of voltage and frequency, the temperature rise or total temperatures change and may progressively increase. Continuous operation at rated output at certain parts of the boundary of the shaded area may cause additional temperature rise of up to approximately 10 K. Generators or compensators will also carry output at rated power factor within the ranges of ±5 % in voltage and -5%...+3% in frequency, as defined by the outer boundary of Figure 1, but temperature rises will be further increased. As IEC 60034-1 applies to rated conditions, operation outside the shaded area should be limited in extent, duration and frequency of occurrence in order to minimize the reduction of lifetime due to thermal effects, The output should be reduced or other corrective measures taken as soon as practicable.

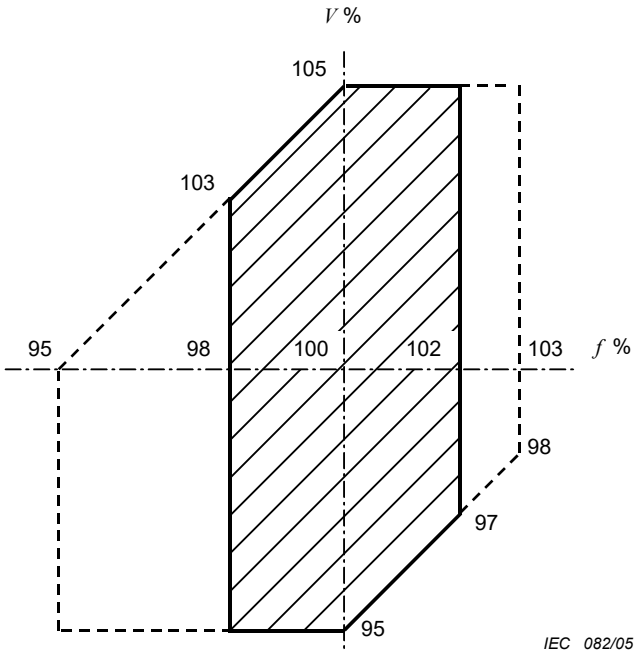

Figure 1 – Operation over ranges of voltage and frequency

NOTE 2 Overvoltage together with low frequency, or low voltage with over-frequency, are considered to be unlikely operating conditions. The former condition most likely increases the temperature rise of the field winding. Figure 1 shows operation in these quadrants restricted to conditions that will cause the generator or compensator and its transformer to be over- or under-fluxed by approximately 5%. Margins of excitation and of stability will be reduced under some of the operating conditions shown. With the operating frequency deviating from the rated frequency, effects outside the generator or compensator may become important and need to be considered. For example: The turbine manufacturer will specify permissible ranges of frequency and corresponding operating periods. Also, a certain range of permissible operating voltages and frequencies may apply to auxiliary equipment.

4.7 Direction of rotation

The direction of rotation shall be shown on the machine or on its rating plate, and the time-phase sequence of the stator voltage shall then be indicated by marking the terminals in the sequence in which their voltages reach maximum, for example, $U1$, $V1$, $W1$.

NOTE Terminal markings may not be consistent with IEC 60034-8.

For generators having one driven end, this shall be the reference end for the direction of rotation.

For generators driven on both ends, the end of the more powerful drive shall be the reference end. In case of comparable drive power on either end, the end opposite to the excitation terminals shall be the reference end for the direction of rotation.

The reference end of synchronous compensators shall be the end opposite to the excitation terminals

The sense of rotation (clockwise or counter-clockwise) shall be defined when facing the rotor from the reference side.

The phase sequence of the generator or compensator must coincide with the phase sequence of the grid to which the generator or compensator is to be connected.

4.8 Stator winding, output voltage

Unless otherwise agreed upon, the stator winding shall be arranged in star configuration. All phase ends shall be accessible from outside of the casing. The arrangement of the electrical terminals shall be agreed upon.

Output voltage is defined as the line to line voltage of the stator winding.