



NATIONAL PETROCHEMICAL COMPANY STANDARDS

MATERIAL STANDARD FOR SYNCHRONOUS GENERATORS

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1 SCOPE

- 1.1 This standard covers the minimum requirements for design, manufacture, assembly, testing, and preparation for shipment of a synchronous generator for safe and continuous operation in the petrochemical complexes.
- 1.2 This standard supplemented by the data sheets on which the operating conditions and special requirements are listed in detail.
- 1.3 The synchronous generator and its auxiliaries shall be capable of continuous operation for a minimum of 3 years without any maintenances shutdown.
- 1.4 In case of conflict between documents listed below, the ones appearing first in sequence of this listing will precede over the following ones.
- a) Purchase order
 - b) Data sheets
 - c) This material standard
 - d) Other standard and specifications referred to in the above documents
 - e) Vendor drawings
- 1.5 Compliance by manufacturer with the provisions of this standard does not relieve him of the responsibility of furnishing unit of proper design, mechanically suited to meet operating guarantees at the specified operating conditions.
- 1.6 Such deviations from this standard which manufacturer may consider advisable shall be submitted in writing to purchaser for approval.
- 1.7 Exceptions other than those included in the above mentioned documents shall not be considered.
- 1.8 All documentation shall be issued, using SI metric system of measurement, according to NPCS-ES-GN-03.
- 1.9 The English language shall be used for all correspondence documents, catalogues, drawings and nameplates.
- 1.10 In this standard purchaser- means National Petrochemical Company of Iran, "NPC".

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2 STANDARDS AND CODES

- 2.1 The synchronous generator shall be designed, constructed and tested in accordance with applicable portions of the latest below listed standards and codes.
- 2.1.1 - IEC International Electrotechnical Commission.
IEC 34 Rotating Electrical Machines.
- 2.1.2 - ANSI American National Standards Institute.
ANSI C50.26 Test Procedures for Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Stator Coils.
ANSI C50.13-89 Rotating Electrical Machinery- Cylindrical-Rotor Synchronous Generators.
ANSI C50.14-77 Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Motors and Synchronous Machines in General.
- 2.1.3 - API American Petroleum Institute
API 614-84 Lubrication, Shaft-Sealing and Control Oil Systems for Special Purpose Application.
API 670-86 Noncontacting Vibration and Axial Position Monitoring Systems.
- 2.1.4 - IEEE Institute of Electrical and Electronics Engineers
IEEE 4-78 High-Voltage Testing Techniques.
IEEE 43-74 Testing Insulating Resistance of Rotating Machinery.
IEEE 115-83 Test Procedures for Synchronous Machine.

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- 2.1.5 - NEMA National Electric
 Manufacturer's Association
- NEMA MG 1-87 Motors and Generators.
- 2.1.6 - NFPA National Fire Protection
 Association
- NFPA 70-90 National Electrical Code.
- 2.2 The equipment as a whole may conform with the national standards of the country of manufacturer provided these standards are based on the above mentioned standards and codes. Vendor shall state in the quotation the standards to which the equipment conforms. If these are the national standards, then vendor shall state in the quotation, the deviations from the above mentioned standards and codes.
- 2.3 The testing and certification by following authorities are acceptable where relevant, other authorities may be considered subject to client approval.
- a) European organization for testing and certification under CENELEC Administration (EOTC).
- b) Underwriters laboratories.
- c) Electrical equipment certification services (EECS).
- 3 TECHNICAL REQUIREMENTS
- 3.1 GENERAL
- 3.1.1 The synchronous generator shall be designed in accordance with the applicable codes and standards. The generator shall be for indoor installation, capable of continuous-duty service at rated KVA, frequency, and power factor at any voltage between 5% above or below **rated voltage**. The generator shall be capable of providing continuously reliable power.
- 3.1.2 The generator shall be three phase, 50 Hz, wye-connected, with a 0.80 power factor and short-circuit ratio of not less than 0.58.



- 3.1.3 The generator voltage shall be as will be specified in the generator data sheet.
- 3.1.4 The generator shall be supplied with space heater. Generator space heater voltage shall be as indicated on the data sheet. The heater sheath maximum temperature shall not exceed 180°C at any value at or below maximum rated ambient temperature of 40°C and 120 percent of ra-ted voltage. Space heater leads shall be terminated in a separate terminal box from all other connections.
- 3.1.5 The generator shall be capable of withstanding 20% overspeed without mechanical damage. Generator rotation shall be dictated by the driver rotation. Phase sequence shall be 1,2,3, with counterclockwise phase rotation when looking at the coupling shaft end.
- 3.1.6 Current transformers used for the generator differential protection shall be accurate to within 1.5% up to twice the normal current ratings. The seller shall be responsible for the coordination of the current transformer characteristics with the manufacturer of the switchgear for proper differential protection.
- 3.1.7 Current transformers shall be rated to withstand the thermal and magnetic stresses resulting from short circuit currents. Current transformers shall be of an accuracy class making them suitable for meters and protective relaying. The minimum CT accuracy shall be C200. Secondary circuit for current transformers shall be prewired, terminated using short-circuiting terminal boards and equipped with a secondary open circuit protector.
- 3.1.8 The voltage wave form of each generator shall be near sine wave perfection. The harmonic content shall not be greater than 3% for any single harmonic and 5% for all harmonics. The deviation factor shall not exceed 6%.
- 3.1.9 Maximum phase-to-phase voltage deviation shall not exceed 1% of rated voltage, with 5% unbalanced phase current present.
- 3.1.10 The generator neutral shall be neutral resistance grounded with isolator switch as will be shown on the single-line diagrams.

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3.2 GENERATOR SIZING CRITERIA

- 3.2.1 For steam turbine application, the generator nameplated power output rating at class B insulation temperature, rise shall be sized to exceed the maximum steam turbine output for all steam inlet and outlet conditions. The generator size shall be 10% higher than the expected operating condition.
- 3.2.2 The generator shall be able to carry an overload equal to 1.5 times of rated current for at least 30 seconds according to IEC 34.1 paragraph 18.1.
- 3.2.3 The generator shall be capable of withstanding, without mechanical injury, for 3 seconds a three phase short circuit at its terminals when operating at the highest capability KVA, rated power factor and at 5% overvoltage. The generator shall also be capable of withstanding without injury, any other short circuit at its terminals for maximum 30 seconds such that

$$I^2 \cdot t < 30$$

Where:

I = Negative sequence current in per unit.

t = Time in second < 30 second.

The criteria for no injury to stator windings is that the windings shall satisfactorily withstand a normal maintenance high-potential test and there is no visible abnormal deformation or damage to the winding coils and connections.

3.3 ENCLOSURE

- 3.3.1 The generator shall be designed and provided with protection against chemicals, corrosion, high humidity conditions and fungus.
- 3.3.2 The generator enclosure shall be the totally enclosed water-air-cooled type (TEWAC). A minimum of two 100% rated water coolers shall be furnished to provide air cooling with in-plant cooling water supplied at 33°C and 4.1 barg.
- 3.3.3 The water cooler design shall be based on a maximum water temperature increase across the coolers of 10°C and maximum pressure drop of 0.7 bar. The design cooling water flow velocity shall be 2.0 m/s (min.) to 3.0 m/s (max.). The water cooler shall be designed to withstand a maximum pressure of 8.6 barg.

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