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Replacing GB/T 20834-2014

Technical requirements for motor-generator

发电电动机技术要求

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4 Site operating conditions

Unless otherwise specified, the motor-generator shall be capable of continuous operation at its rating under the following ambient conditions: altitude not exceeding 1 000 m; cooling air temperature not exceeding 40 °C; inlet water temperature of the air coolers and oil coolers not higher than 30 °C and not lower than 5 °C; relative humidity not exceeding 85 %.

The machine shall also meet the seismic acceleration requirements of the site. The purchaser shall provide the required horizontal and vertical acceleration values on the basis of the geographical conditions of the site.

For operating environments differing from the above, the site operating conditions are to be agreed between supplier and purchaser.

5 Ratings and parameters

5.1 The rated capacity in generating operation is the apparent power delivered at rated frequency, rated voltage and rated power factor, expressed in MVA. The rated power in motoring operation is the mechanical power delivered at the shaft at rated frequency, rated voltage and rated power factor, expressed in MW. The capacity and power of the motor-generator shall match the turbine-mode output power and the maximum pump-mode input power of the pump-turbine.

5.2 The rated voltage of the motor-generator should be selected from the following voltage levels, in kV: 6.3, 10.5, 13.8, 15.75, 18, 20 and 22.

5.3 In generating operation the rated power factor should be not lower than 0.875 (overexcited) for a rated capacity not greater than 150 MVA, not lower than 0.9 (overexcited) for a rated capacity greater than 150 MVA and not greater than 350 MVA, and not lower than 0.925 (overexcited) for a rated capacity greater than 350 MVA. In motoring operation the rated power factor should be not lower than 0.975 (overexcited).

5.4 The rated rotational speed is selected in accordance with GB/T 7894.

5.5 The range of steady-state voltage and frequency variation is divided into two zones, A and B, shown in Figure 1; the extent of zone A may be adjusted by technical agreement between supplier and purchaser. Other requirements for voltage and frequency variation during operation follow GB/T 7894. The motor-generator shall meet the requirement for a frequency variation from 0 Hz to 52.5 Hz when starting in motoring operation.

5.6 The weighted average efficiency is calculated by the formula given in GB/T 7894-2023, the purchaser supplying the weighting coefficients for generating and motoring operation according to how the unit is operated in the system. Losses and efficiency should be determined by the calorimetric method in accordance with GB/T 25442 and GB/T 5321. The losses to be included are: copper losses of the stator winding; copper losses of the field winding; core losses; windage losses; guide bearing losses; thrust bearing losses, counting only the share attributed to the rotating parts of the motor-generator; stray losses; excitation system losses, such as those of the excitation transformer, rectifier and voltage regulator; brush electrical and friction losses; and other losses, such as those associated with the external circulating oil pump of the thrust bearing and with added cooling fans.

5.7 Base values for electrical parameters such as synchronous reactance, transient reactance, subtransient reactance, short-circuit ratio and the time constants shall refer to generating operation, and the parameters and time constants shall satisfy GB/T 7894.

5.8 With the stator winding on open circuit, at no-load rated voltage and rated speed, the total harmonic distortion of the line voltage waveform shall not exceed 3 %.

6 Temperature

6.1 Under the ambient conditions of Clause 4 and at the rated duty, the machine shall be capable of long-term continuous operation and the temperature rise of the stator winding, field winding, stator core and other parts shall not exceed the limits of Table 1. Table 1 gives limits in kelvin for three measuring methods, the infrared method, the resistance method and the embedded temperature detector method: 100 by the embedded detector method for the stator winding, 95 by the embedded detector method for the stator core, 100 by the resistance method for the field winding, and 75 by the infrared method for the slip rings. For parts not in contact with windings, the temperature rise shall not damage the insulation of

the part itself or of any adjacent part. A note to the table states that the limits already take into account the effect of frequent starting of the motor-generator.

6.1.2 The stator and rotor insulation shall use insulating materials of thermal class 155 (F).

6.1.3 Where the rotor insulation uses materials of thermal class 180 (H), the temperature rise of the field winding measured by the resistance method shall not exceed 125 K.

6.2 The measurement of the temperature rise of the stator winding and stator core shall meet the requirements of GB/T 7894.

6.3 Where the rated operating conditions of the machine depart from those of Clause 4, the temperature rise limits shall be corrected in accordance with GB/T 755.

6.4 In normal operation the maximum bearing temperature measured by the embedded temperature detector method shall not exceed 80 °C for babbitt-lined thrust bearing pads and 75 °C for babbitt-lined guide bearing pads. The embedment depth of the temperature sensors should be 20 mm to 30 mm from the friction surface.

7 Operating characteristics and electrical connection

7.1 The capability of the motor-generator to withstand unbalanced current and overcurrent shall satisfy GB/T 7894. The machine shall withstand the short-time overload and rapid speed rise caused by load rejection of other units on the same waterway, the short-time overload not exceeding 150 % of rated load. In motoring operation the machine shall withstand 150 % overtorque for 15 s without losing synchronism.

7.2 When starting in motoring operation the machine shall meet the requirements for starting by static frequency converter (SFC) and for back-to-back synchronous starting.

7.3 Synchronising to the network, earthing, the neutral point lead, phase sequence and the stator winding shall comply with GB/T 7894.

8 Insulation system

8.1 The dielectric dissipation factor of the stator bars or coils at ambient condition and its increment shall comply with Table 2. The table sets a limit of not more than 1 % for tan delta measured at 0.2 times the rated line voltage, and a limit of not more than 0.5 % for the increment between 0.2 and 0.6 times the rated line voltage, the increment being the difference between the value at 0.6 times and the value at 0.2 times the rated line voltage. Notes to the table state that the rated line voltage is expressed in kV and that testing is carried out on 100 % of the items.

8.2 Where the design of the winding is such that the upper-layer winding cannot be tested in groups by voltage withstand test after being placed in the slots and wedged, that stage of the voltage withstand test may be omitted.