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**Excitation System for Synchronous Electrical Machines -
Technical Requirements of Excitation System for Large and
Medium Synchronous Generators**

同步电机励磁系统 大、中型同步发电机励磁系统技术要求

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Excitation System for Synchronous Electrical Machines - Technical Requirements of Excitation System for Large and Medium Synchronous Generators

1 Scope

1.1 This Part specifies the technical requirements, test items, marking and packing of the excitation systems for synchronous electrical machines and phase modifiers and it applies to the excitation systems for those 10MW and above hydraulic generators, 50MW and above turbine-type synchronous electrical machines and phase modifiers that are connected with power system. The excitation systems for generator motors also may be used by making reference thereof.

1.2 This Part only applies to the excitation systems of the following types:

1.2.1 Excitation system with AC exciter

- a) AC exciter with stationary rectifier;
- b) AC exciter with rotating rectifier (brushless excitation system).

1.2.2 Static excitation system

- a) Potential source static excitation system;
- b) Compound source static excitation system.

2 Normative References

The following normative documents contain provisions which, through reference in this Part, constitute provisions of this Part. For dated reference, subsequent amendments to (excluding correction to), or revisions of, any of these publications do not apply. However, the parties whose enter into agreement according to these specifications are encouraged to research whether the latest editions of these references are applied or not. For undated references, the latest editions of the normative documents are applicable to this Part.

GB 755 "Rotating Electrical Machines-Rating and Performance" (GB 755-2000, idt IEC 60034-1:1996)

GB 1094 (all parts) "Power Transformers" (GB 1094.1-1996, eqv IEC 60076-1:1993; GB 1094.2-1996, eqv IEC 60072-2:1993; GB 1094.3-2003, IEC 60076-3: 2000,

4 Operating Conditions

4.1 Ambient temperature

The maximum ambient temperature shall not exceed +40°C and the mean temperature within 24h shall not exceed +35°C or less than -5°C. The temperature variation ratio of working environment shall not be larger than 5°C/h. (rectifiers adopt the water cooling type, and its minimum temperature is +5°C).

4.2 Relative ambient air humidity

The maximum mean average relative humidity of the most humid month at the operating site shall not exceed 90%, and the mean monthly minimum temperature of this month shall not be larger than 25°C.

4.3 Gaseous contamination

No conductive or explosive dust, corroding metal or gas or steam destroying the insulation exit at the operating site.

4.4 Oscillation

Oscillation condition allowed at the operating site: when the oscillation frequency scope is 10Hz~150Hz, the oscillating acceleration shall not be larger than 5m/s².

4.5 Altitude

The absolute altitude at the operating and application site shall not exceed 1000m.

When the altitude is larger than 1000m, the influence of the altitude increase on excitation system shall be taken into account.

4.6 Station service condition

The voltage deviation of the DC and AC supplies for the power plant service shall not exceed +10%~-15% of the rated value, the frequency deviation of AC supply shall not exceed +4%~-6%.

4.7 Installation inclination

For the equipment installed vertically, the installation inclination shall not greater than 5%.

5 Basic Performance

5.1 The excitation system shall meet the relevant requirements of GB 755.

5.2 When the excitation voltage and current of synchronous electrical machine are not greater than 1.1 times of the rated values, the excitation system shall ensure that it may continuously operated.

5.3 The excitation ceiling voltage ratio shall be determined according to the network condition and the status of the generator in the network:

- a) Generally is 1.8 times for the 100MW and above turbine generators;
- b) Generally is 2 times for the 50MW and above hydraulic generators;
- c) Generally is 1.6 times for other types.

For the potential source static excitation system with its excitation source provided from the generator terminals, its excitation ceiling voltage ratio shall be calculated according to 80% of the generator rated voltage.

5.4 The excitation system ceiling current shall not exceed 2 times of the rated excitation current, and the permissible duration shall not be less than 10s.

5.5 The excitation system nominal response is specified as follows:

- a) The excitation system nominal response of the 50MW and above hydraulic generators and 100MW and above turbine generators shall not be less than 2 times of the rated excitation voltage per second;
- b) Excitation system nominal response of other types shall not be less than 1 times of the rated excitation voltage per second.

5.6 The automatic voltage regulation function of excitation system shall be able to guarantee its steady and smooth regulation within 70%~110% of the rated no-load voltage of generator.

5.7 The manual excitation regulation function of excitation system shall be able to guarantee smoothly regulating the excitation current of synchronous electrical machine within a scope from 20% of its no-load excitation current to 110% of its rated excitation current.

5.8 When the synchronous electrical machine operates at no load, the changing speed of the machine voltage caused by the variations in the given values of automatic voltage regulator and manual controller shall be within 0.3%~1% of the rated voltage of the machine.

5.9 The excitation system shall guarantee the setting range of the reactive current compensative ratio (idle current compensation) of synchronous generator being no less than $\pm 15\%$.

5.10 The excitation system shall guarantee the static potential difference rate of the

5.18 The excitation system shall be with excitation suppression function and be able to de-excite reliably under normal operating conditions or under the following abnormal conditions:

- a) The excitation current of the generator that operates in systems shall not exceed the rated value, and the stator circuit shall be of short circuit externally or internally.
- b) Generator no-load abnormal forcing (the relay protection acts).

5.19 The redundancy of the power rectifiers in excitation system may be set according to that the rest branch circuits still can meet all the operation condition requirements of generator after one among the parallel branches of all the power rectifiers is out of service, and the current equalization coefficient of the power rectifiers shall not be less than 0.85.

5.20 The following factors shall be taken into account when selecting the excitation transformers:

- a) The transformer capacity shall be selected according GB/T 18494.1 with consideration of the influence when the characteristic and non-characteristic harmonic loss produced by rectifier make the transformer generate additional exothermic heat;
- b) Shielding layers shall be set between the original and auxiliary side winding of excitation transformer and shall be grounded reliably;
- c) When adopting dry-type transformers, the protection grade of the transformer cabinet should not be above IP21.

5.21 The static excitation system shall be able to field flash reliably, the field flashing source may adopt DC or AC rectifier sources.

5.22 The excitation system shall be set with necessary signals and protection in order to monitor the operation condition fault protection of excitation system.

5.23 Requirements for the insulation and voltage withstand test capability of excitation system and its elements;

- a) The generator field winding is, directly or through rectifiers, connected to the electrical component (for AC exciter, see JB/T 7784), when its rated excitation voltage is equal to or less than 500V, the voltage value for the exit-factory test of generators shall be 10 times of the rated excitation voltage and shall not be less than 1500V at least. When the rated excitation voltage is larger than 500V, the voltage for the exit-factory test shall be 2 times of the rated excitation voltage added by 4000V.
- b) The voltage for field commissioning test shall be the exit-factory test voltage,

- a) Name of receiving unit;
- b) Address of receiving unit;
- c) Product name;
- d) Factory number;
- e) Manufacturer name;
- f) Manufacturer's address;
- g) Marks of the positions requiring rain protection, shock resistance and crash resistance;
- h) Net mass and gross mass of product (kg);
- i) Position of lifting rope.

7.2 Packaging

7.2.1 The product package must guarantee that the products are free from mechanical damages during the storage and transportation process, and also have the ability of rain protection, dust prevention and moisture protection. The product package period is 1 year since the exit-factory shipment date.

7.2.2 The accompanying technical documents are:

- a) List of accompanying documents;
- b) Quality certificate;
- c) Product specification (including parameter list of the major equipment of excitation system, the excitation system models and recommended parameters, the application, principle and maintenance of excitation system, etc.);
- d) Product assembly drawing (including installation drawing);
- e) Product wiring diagram;
- f) Electrical schematic diagram;
- g) Detailed delivery list;
- h) Product exit-factory test records.

7.3 Transportation and storage

7.3.1 During the transportation process, the products shall not be vibrated or impacted fiercely or be turned over. Some components with special requirement on

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