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Design application guide of turbo generators under abnormal operation

透平型发电机非正常运行工况设计和应用导则

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Foreword

This Standard was formulated for the first time.

This Standard supplements to GB/T 7064 *Specific requirements for cylindrical rotor synchronous machines*.

During the formulating, this Standard mainly referred to *Draft of Guide on Synchronous Generator Abnormal Operation* submitted by CIGRE11.03 working group in 1980; absorbed the content of turbine generator absorb reactive power, asynchronous short operation, out-of-step operation, examination and overvoltage limit after large system disturbance; and added requirements for special operating conditions such as overcurrent limit, unbalanced load, frequency's abnormal operation, out-of-phase synchronization, single-phase reclosing; as well as start-stop times of generator.

This Standard was proposed by China Machinery Industry Federation.

This Standard shall be under the jurisdiction of Technical Sub-committee on Generator of National Technical Committee on Rotary Motor of Standardization Administration of China.

Drafting organizations of this Standard: Harbin Institute of Electronics, North China Electric Power Research Institute, Hubei Electric Power Research Institute, Beijing Turbine Generator Co., Ltd., Guangdong Electric Power Test & Research Institute, and Shanghai Turbine Generator Co., Ltd..

Main drafters of this Standard: Sun Yutian, Bai Yamin, Tong Xusong, Ruan Ling, Zhuge Wenbing, Yang Chuming, and Liang Xubiao.

This Standard shall be interpreted by Technical Sub-committee on Generator of National Technical Committee on Rotary Motor of Standardization Administration of China.

Design application guide of turbo generators under abnormal operation

1 Scope

This Standard specifies the operating range and degree of turbo generators under various abnormal operating conditions.

This Standard is applicable to turbo synchronous generators of which the capacity range is greater than 100 MW.

This Standard can be used as the basis by user and manufacturer when signing technical agreement. Special requirements for specific products shall be agreed by both supplier and buyer.

2 Normative references

The following standards contain the provisions which, through reference in this Standard, constitute the provisions of this Standard. For dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, the parties who enter into agreement based on this Standard are encouraged to investigate whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB 755-2000 *Rotating electrical machines - Rating and performance (idt IEC 60034-1: 1996)*

GB/T 7064-2002 *Requirements for turbine type synchronous machine (IEC 60034-3: 1988, NEQ)*

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 asynchronous operation

Asynchronous operation state caused by excitation-loss.

3.2 out-of-step operation

47.0 < F ≤ 46.5	> 2	> 5

4.8 Water-break operation

The allowable water-break operation duration time of water cooled motor is 30 s. If the backup pump cannot restore the water supply within the aforementioned time, it must be power-trip.

4.9 Out-of-phase synchronization

It shall ensure that the power generator can withstand 180° out-of-phase synchronization for 5 times or 120° out-of-phase synchronization for 2 times during its life time.

4.10 Single-phase reclosing-switch

The power generator shall have the capability of withstanding single-phase high-voltage line reclosing-switch, which shall not affect its reliability.

4.11 Start and stop times of generator set

Two-shift peak-adjustment set is allowed to start and stop for 10000 times during its life time.

Non two-shift set shall withstand start and stop for 3000 times during its life time.

4.12 Examination on turbo generator after large system disturbance

The turbo synchronous generator shall withstand sudden short circuit of stator winding outlet end under rated voltage, rated active power and rated power factor.

Generator shutdown inspection shall be conducted for direct cooling or indirect cooling turbo generator after withstanding large system disturbance. The abnormal operation working conditions requiring post inspection are as follows:

- Generator outlet; in some cases, it also includes three-phase or two-phase sudden short circuit of high-pressure side of step-up transformer of electrical transformer unit;

- Sudden short circuit of generator transformer unit and system networking when they are operating near generator transformer proximal end;

- Generators and network operation failure, e.g., out-of-phase synchronization reclosing-switch;

- Asynchronous operation that exceeds the allowable limit (especially high rotating-difference rate) and out-of-step operation;
- High negative sequence current operation is not allowed;
- Abnormal rise in rotational speed caused by turbine.

After serious abnormal operation, visual inspection and some tests shall be conducted based on specific abnormal operating conditions. For example, inspections on heating of rotor surface, stator end windings and structural parts, coupling screws and voltage resistance test and dye penetration test, etc.

4.13 Matters not specified in this Standard shall comply with the provisions of GB/T 7064.

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