

IEEE Recommended Practice for Functional and Performance Characteristics of Control Systems for Steam Turbine-Generator Units

Sponsor

Energy Development and Power Generation Committee
of the
IEEE Power Engineering Society

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Abstract: Minimum functional and performance characteristics related to speed/load-control systems for steam turbine-generator units that may be interconnected on a power system are recommended. The recommendations apply to the following types of steam turbines, rated at 500 kW and larger, intended to drive electric generators at constant speed without initial steam-pressure control, exhaust steam pressure control, or either: (1) condensing or noncondensing turbines without initial steam-pressure control, exhaust steam-pressure control, or either, including turbines used with reheat, regenerative feedwater heaters, or both; (2) condensing or noncondensing turbines with initial and/or exhaust steam-pressure control, including turbines used with reheat, regenerative feedwater heaters, or both; (3) automatic extraction and/or induction and mixed-pressure turbines. Emergency governors, other overspeed control devices, and, in general, devices that are not responsive to speed are not covered.

Keywords: Automatic extraction turbines, automatic induction turbines, condensing turbines, mixed-pressure turbines, noncondensing turbines

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Foreword

(This foreword is not a part of IEEE Std 122-1991, IEEE Recommended Practice for Functional and Performance Characteristics of Control Systems for Steam Turbine-Generator Units.)

The formation of a joint AIEE/ASME committee to prepare a recommended practice covering the speed-governing of prime movers intended to drive electric generators that may, if desired, be included in prime-mover purchase specifications was approved by the AIEE Board of Directors on January 30, 1941, and by the ASME Council on June 15, 1941. The members of this joint committee were appointed jointly by the chair of the AIEE Power Generation Committee and by the ASME Standing Committee on Performance Test Codes under sponsorship of the ASME Division.

The work of the joint committee resulted in the issuance of AIEE No. 600, Recommended Specification for Speed-Governing of Steam Turbines Intended to Drive Electric Generators Rated 500 kW and Larger, in May, 1949.

The joint committee was reorganized in 1955, at which time it updated AIEE No. 600.

The joint committee was again reorganized in January 1980, and was instructed to prepare a revision of the recommended specification under the designation of IEEE Std 122. This revision was expanded to cover speed and load controls, and the term “governor” was replaced by the term “control systems.”

The joint committee was reformed in 1987 to update the recommended practice. This revision, like the original, is limited in its scope to steam turbine generators rated at 500 KW and larger, designed to operate on a utility type system. The term “control systems” now includes torsional effects, transient response, and influences outside the control system (see Appendix) that should be considered by the purchaser. Users of this text should pay particular attention to the parts of Section 4. that indicate the need to specify or agree upon limits with the manufacturer. Such specification or agreements should be made before the manufacturer bids on the proposal.

This recommended practice does not cover emergency governors, other overspeed control devices, or, in general, devices that are not responsive to speed. Exceptions to the latter were made for turbines designed to operate with controlling steam pressures, as in the case of turbines with initial or exhaust steam pressure control, automatic-extraction and mixed-pressure turbines, or a combination of these, since the performance of the speed-governing system is affected by the performance of the steam pressure-regulating system.

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IEEE Recommended Practice for Functional and Performance Characteristics of Control Systems for Steam Turbine-Generator Units

1. Purpose and Scope

1.1 Purpose

The purpose of this recommended practice is to recommend functional and performance characteristics related to speed/load-control systems for steam turbine-generator units that may be interconnected on a power system, such that this recommended practice may be included in prime-mover purchase specifications.

1.2 Scope

These recommendations apply to the following types of steam turbines, rated at 500 kW and larger, intended to drive electric generators at constant speed:

- 1) Condensing or noncondensing turbines without initial steam-pressure control, exhaust steam, pressure control, or either, including turbines used with reheat, regenerative feedwater heaters, or both. (See Figs 1 and 2).
- 2) Condensing or noncondensing turbines with initial steam-pressure control, exhaust steam-pressure control, or both, including turbines used with reheat, regenerative feedwater heaters, or both. [See Figs 3, 7, 8(a), and 8(b)].
- 3) Automatic extraction, induction, or both, and mixed-pressure turbines. [See Figs 4, 5, and 8(c)].

2. References

This recommended practice should be used in conjunction with the following publications.

- [1] ANSI C50.10-1990, American National Standard General Requirements for Synchronous Machines.¹
- [2] ASME PTC 20.1-1977 (Reaf 1982), Speed and Load Governing Systems for Steam Turbine-Generator Units.²
- [3] ASME PTC 20.2-1965 (Reaf 1986), Overspeed Trip Systems for Steam Turbine-Generator Units.
- [4] ASME PTC 20.3-1970 (Reaf 1980), Pressure-Control Systems Used on Steam Turbine-Generator Units.
- [5] IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronics Terms.³
- [6] NEMA SM 23-1985, Steam Turbines for Mechanical Drive Service.⁴
- [7] NEMA SM 24-1985, Land Based Steam Turbine Generator Sets, 0 to 33 000 kW.

3. Definitions and Descriptions of Terms

All definitions, except as specifically covered in this section, are defined in IEEE Std 100-1988 [5].⁵

3.1 Types of Steam Turbines

3.1.1 Straight Condensing Turbine: All the steam enters the turbine at one pressure and leaves the turbine exhaust at a pressure below atmospheric pressure. (See Fig 1).

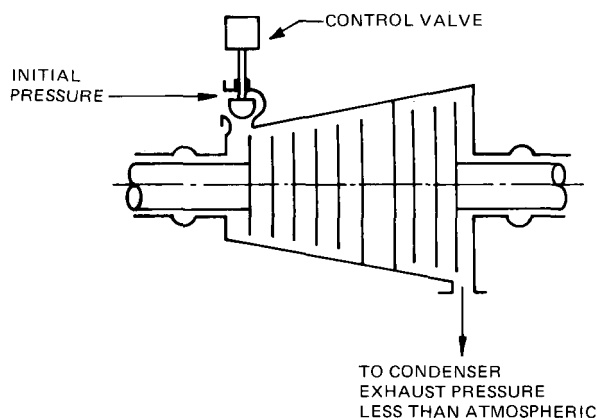


Figure 1—Straight Condensing Turbine

3.1.2 Straight Noncondensing Turbine: All the steam enters the turbine at one pressure and leaves the turbine exhaust at a pressure equal to or greater than atmospheric pressure. (See Fig 2).

¹ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

²ASME publications are available from the American Society of Mechanical Engineers, 22 Law Drive, Fairfield, NJ 07007, USA.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

⁴NEMA publications are available from the National Electrical Manufacturers Association, 2101 L Street NW, Washington, DC 20037, USA.

⁵The numbers in brackets correspond to the references in Section 2.

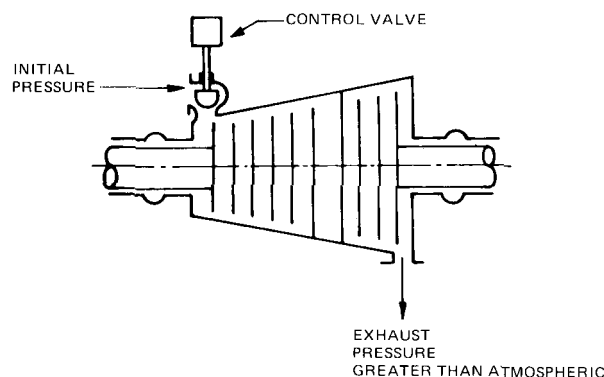


Figure 2—Straight Noncondensing Turbine

3.1.3 Nonautomatic Extraction Turbine — Condensing or Noncondensing: Steam is extracted from one or more stages without means for controlling the pressures of the extracted steam. (See Fig 3).

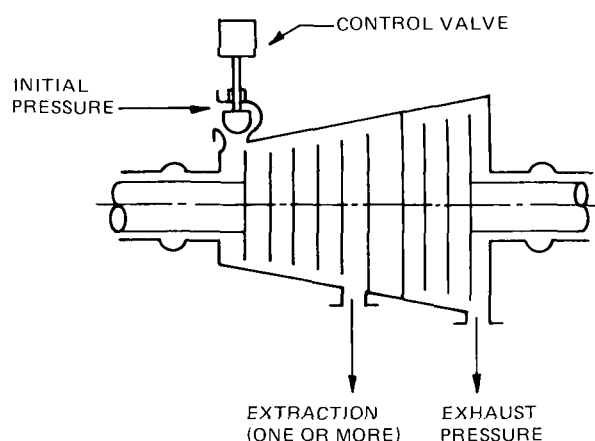


Figure 3—Nonautomatic Extraction Turbine — Condensing or Noncondensing

3.1.4 Automatic Extraction Turbine — Condensing or Noncondensing: Steam is extracted from one or more stages with means for controlling the pressure(s) of the extracted steam. (See Fig 4).

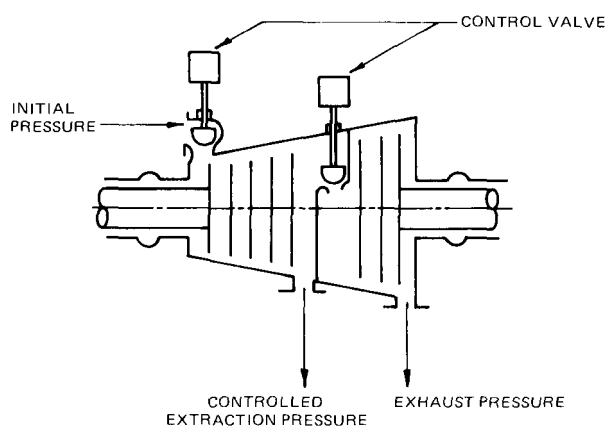


Figure 4—Automatic Extraction Turbine — Condensing or Noncondensing