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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Guidelines to specification of hydraulic turbine governing systems

Lignes directrices pour la spécification des systèmes de régulation des turbines hydrauliques

IEC 61362:2024-09(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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GUIDELINES TO SPECIFICATION OF HYDRAULIC TURBINE GOVERNING SYSTEMS

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IEC 61362 has been prepared by IEC technical committee 4: Hydraulic turbines. It is an International Standard.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) adoption of parts of IEC 60308:2005 which deal with specification matters;
b) introduction of several new technical topics;
c) overall editorial revision.

The text of this document is based on the following documents:

Draft	Report on voting
4/500/FDIS	4/509/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
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INTRODUCTION

While a standard for the testing of hydraulic turbine governing systems had been existing for a very long time (IEC 60308 published in 1970)[1], guidelines for the specification of hydraulic turbine governing systems were missing until 1998. The need for such guidelines became more and more urgent with the fast development and the new possibilities especially of the digital components of the governor.

While the first edition was written more or less as a supplement to the already existing guide for testing, the objective of the second edition was to be the leading guide with respect to turbine governing systems.

The second edition of this document took into account the experience with the guide until 2012 as well as the progress in the state of the art of the underlying technologies.

This third edition was developed together with the third edition of the standard for the testing of hydraulic turbine governing systems (IEC 60308) in order to harmonize their contents and their publishing dates.

Furthermore, the standards are kept open for state of the art by introducing new topics and harmonizing the structure as well as the terms and definitions for both standards.

[1] IEC 60308:1970, *International code for testing of speed governing systems for hydraulic turbines*. This publication was withdrawn and replaced with IEC 60308:2005.

GUIDELINES TO SPECIFICATION OF HYDRAULIC TURBINE GOVERNING SYSTEMS

1 Scope

This document includes relevant technical data used to describe hydraulic turbine governing systems and to define their performance. It is aimed at unifying and thus facilitating the selection of relevant parameters in bidding specifications and technical bids. It serves also as a basis for setting up technical guarantees.

The scope of this document is restricted to the turbine governing level. Additionally some remarks about the control loops of the plant level and about interactions with the electrical grid in case of primary and secondary frequency control (see also Annex B and Annex C) are made for better understanding without making a claim to be complete.

Important topics covered by the guidelines are:

– speed, power, water level, opening and flow (discharge) control for reaction and impulse-type turbines including double regulated machines;

– means of providing actuating energy;

– safety devices for emergency shutdown, etc.

To facilitate the setting up of specifications, these guidelines also include data sheets, which are filled out by the customer and the supplier in the various stages of the project and the contract.

Acceptance tests and specific test procedures are outside the scope of this document; those topics are covered by IEC 60308.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60308, *Hydraulic turbines – Testing of control systems*

IEC 61131-2, *Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 General terms and definitions

3.1.1
turbine governing system
technical equipment governing the opening (guide vane, runner blade, needle, deflector position) of hydraulic turbines

Note 1 to entry: At the present state of the art, the turbine governing system consists of an oil hydraulic and an electronic part, the "oil hydraulic governor" and the "electronic governor" and an interface between both, the electro/hydraulic converter.

3.1.2
controlled system
system controlled by the actuators of the governing system consisting of the hydraulic turbine, its water supply and discharge passages, the generator with voltage regulator and the electric power grid to which it is connected

3.2 Terms and definitions related to control levels, control modes and operational modes

3.2.1
control levels

3.2.1.1
turbine governing level
control functions directly related to the governing system of a single turbine

Note 1 to entry: The following control modes are related to the turbine governing level:

– speed control;
– power output control;
– water level control;
– opening control;
– flow control (the term flow used in this document has the same meaning as the term discharge).

3.2.1.2
unit control level
control functions directly related to the overall control of a single unit (turbine, generator, unit auxiliaries) including turbine governing, voltage regulation, start-stop-sequencing etc.

3.2.1.3
plant control level
control functions related to the overall control of a whole plant including the control of several units

Note 1 to entry: In automatic unit and plant control operation, the turbine governing system gets its modes and set-points from the unit and plant control level.

3.2.1.4
grid control level
control functions related to the overall control of the grid as a whole

Note 1 to entry: If applicable the turbine governing system participates either by primary or by secondary frequency control, or both (see Annex B).

3.2.2
control modes at the turbine governing level

3.2.2.1
speed control
mode of the governing system dealing with the control of the speed of the turbine

3.2.2.2
power output control
mode of the governing system dealing with the control of the power output of the generator

3.2.2.3
water level control
mode of the governing system dealing with the control of the water level of the headwater reservoir

3.2.2.4
opening control
mode of the governing system dealing with the control of the position of the main actuator(s) of the turbine

3.2.2.5
flow control
mode of the governing system dealing with the control of the flow through the turbine

3.2.3
main operation modes

3.2.3.1
no-load operation
mode of the governing system when the unit is not connected to a grid

3.2.3.2
island operation
operation of a generating unit that is interconnected with a relatively small number of other generating units

Note 1 to entry: Such a small number can occur after inadvertent tripping of circuit breakers that interconnect the island with a large interconnected power system.

3.2.3.3
isolated operation
specific case of islanded operation consisting of a single generating unit

3.2.3.4
grid operation
mode of the governing system when the unit is connected to a stable grid

3.3 Terms and definitions from control theory

3.3.1
differential equation
equation describing the dynamic system behaviour in the time-domain, as shown in Annex A

3.3.2
transient response
system response (output) to a step change of the input

3.3.3
frequency response
for a linear time-variant system with a sinusoidal input variable in steady-state the ratio of the phasor of the output variable to the phasor of the corresponding input variable, represented as a function of the angular frequency ω

Note 1 to entry: The frequency response coincides with the transfer function taken on the imaginary axis of the complex plane.