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**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Calculation method of uncertainty in flow measurement of
power plant**

火电厂流量测量不确定度计算方法

(English Translation)

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Table of Contents

Foreword
1 Scope
2 Normative references
3 Terms and definitions
4 Parameter symbols
5 General principles of uncertainty evaluation
6 Calculation method of uncertainty in independent measurement
7 Linear fitting and uncertainty calculation method
8 Non-linear fitting and uncertainty calculation method
Appendix A (Normative Appendix) Calculation of Standard Deviation of General Function
Appendix B (Informative appendix) Calculation example of open channel calibration
Appendix C (informative appendix) Uncertainty calculation examples of closed pipeline flow calibration
Appendix D (Normative Appendix) Regression Method
Appendix E (Informative Appendix) Orthogonal Polynomial Curve Fitting

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009 "Guidelines for Standardization Work Part 1: Standard Structure and Compilation".

Please note that certain contents of this document may involve patents. The issuing agency of this document is not responsible for identifying these patents.

This standard was proposed by the China Electricity Council.

This standard is under the jurisdiction of the Power Plant Steam Turbine Standardization Technical Committee.

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1 Scope

This standard specifies the uncertainty calculation method for the linear and non-linear relationship of thermal power plant flow measurement during calibration and use.

This standard applies to flow measurement of various closed pipelines or open channels.

2 Normative references

The following documents are indispensable for the application of this standard. For dated reference documents, only the dated version applies to this standard.

For undated reference documents, the latest version (including all amendments) is applicable to this standard.

GB/T 27759-2011 fluid flow measurement uncertainty evaluation procedure ISO 772 Hydraulic Measurement-Vocabulary and Symbols ISO -TR-7066-1 Estimation of Uncertainty in the Calibration and Use of Flow Measuring Devices

--Part 1: Linear calibration relationship ISO -TR-7066-2 Uncertainty Estimation of Calibration and Use Method of Flow Measuring Device--Part 2: Nonlinear Calibration Relation

3 Terms and definitions

Calibration graph

Certain response parameters and flow functions of the flowmeter are points drawn from the coordinates.

Confidence limits

The (confidence) upper and lower limits of the observed or calculated value, the estimated interval of the overall parameter constructed by the sample statistics.

Correlation coefficient an index indicating the degree of linear relationship between two variables.

Variance

Characterize the data distribution, measure the degree of deviation between the variable value and the expected value, defined as 3.5 Covariance the expectation of the overall error between two variables is defined as 3.6 Error of measurement the difference between the measured value and the true value, including systematic and random errors.

Random error

The difference between the measurement result and the average result of a large number of repeated measurements for the same measurement.

Systematic error

Under repeatability conditions, the difference between the average value and the true value of the measured result from an unlimited number of measurements on the same measured.

Spurious error

The error under the specified conditions.

3.10

Residual

Refers to the difference between the actual observed value and the estimated value.

3.11

Sample (experimental) standard deviation the dispersion measure of the average value of the same measured n times, defined as 3.12 Uncertainty A parameter associated with the measurement result, used to characterize the dispersion of the measured value that is reasonably assigned.

3.13

Individual measurement Only need to measure a single variable measurement process.

3.14

Unbiased fitting

The fitting curve can truly reflect the distribution trend of the data and is used to evaluate the excellent characteristics of the degree of fitting.

4.1 Parameter symbol definition

The symbols and measurement value units in this standard shall meet the requirements of Table 1.

4.2 Definition of upper and subscripts of parameter symbols

The definition of superscript and subscript of parameter symbols in this standard shall meet the requirements of Table 2.

6.1 Calculation of random uncertainty

6.1.1

List the source of uncertainty for each variable and make a table. The table should include all the errors in the measurement and list the random Error term and system error term.

6.1.2

For variable values determined by direct measurement, formula (2) or formula (3) can be used to calculate the standard deviation.

6.1.3

Substituting the standard deviation calculation result into equation (4), the random uncertainty of a specific t value of the measured x can be obtained.

6.1.4

In order to improve the accuracy of the assessment, sufficient data points must be taken.

6.1.5

When the variable is the sum or difference of multiple independent measurement results, calculate the overall standard deviation according to the following formula.

6.1.6

For more complex functions, such as the product or quotient between the dependent variable and the independent variable, the standard deviation should be calculated in accordance with Appendix A Calculate, and then substitute equation (4) to calculate the corresponding uncertainty.

6.2 Calculation of system uncertainty

6.2.1

The indeterminate component of the system error should be evaluated based on the past valid calibration data and historical records.

6.2.2

When the variable is the sum of multiple independent measurement results, and the sign of each component is uncertain, the system error is calculated by the following formula.

6.2.3

For more complex functional relations, the system error limit shall be applied to the method given in Appendix A, replacing the variance term in the formula with $2, eS$ i.

6.2.4

When the sources of all uncertainties are determined, and each variable is combined with random uncertainty and system uncertainty, complete the evaluation process.

6.2.5

Refer to Appendix B and Appendix C for calculation examples of uncertainty evaluation of flow measurement in open channels and closed pipelines.

7 Linear fitting and uncertainty calculation method

7.1

The linear judgment of the calibration chart in order to determine whether the fitted value and the measured value can fit unbiasedly, the measurement result and the residual error of the fitted straight line should be observed, and the following method should be used to obtain Get an approximate straight line.