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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 14909-2021

Technical guidelines for exergy analysis in energy systems

能量系统 分析技术导则

Issued on: April 30, 2021 **Implemented on: November 1, 2021**

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Standardization Administration of China

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part

1.Structure and Drafting Rules of Standardization Documents" Drafting. This document replaces GB/T 14909-2005 "Energy System Analysis Technical Guidelines", compared with GB/T 14909-2005, except for editing In addition to the sexual changes, the main technical changes are as follows:

---Modified the scope of application of the standard (see Chapter 1, Chapter 1 of the.2005 edition).

--- Added "Normative Reference Documents" (see Chapter 2).

---Modified the definitions of "system", "environmental reference state", "loss" and "analysis" (see 3.1~3.5, 3.9,

2.1 in.2005 edition) ~2.5); The definitions of "standard and standard enthalpy", "energy grade" and "efficiency" have been added (see 3.6~3.8).

---Modified the atmospheric composition of the environmental reference state, and improved the elemental reference substance system (see 4.1, Table 1 and Table 2,.2005 edition Table 1 and Table 2).

---Modified and improved calculation method (see Chapter 4, Chapter 3 of the.2005 edition). In the evaluation indicators analyzed, added The new indicator "Energy Grade" (see 6.4).

---Modified and perfected the "Analytical Steps". Contents such as "energy balance calculation" and "energy grade calculation" have been added, and the "evaluation and analysis" have been refined. "Analysis" (see Chapter 7, Chapter 6 of the.2005 edition).

---Revised the calculation of Appendix A (normative) value and enthalpy value, balance and

loss. Added "substance value and enthalpy value" Calculation method, and calculation method of "value and enthalpy value under pressure lower than 100kPa"; supplemented the "basic process Balance, loss, efficiency and process quality" (see Appendix A, Appendix A of the.2005 edition).

---Revised Appendix B (informative) energy system analysis examples. Replaced with "Analysis of Four Building Heating Modes and Grade Analysis" "Boiler analysis" replaced "Analysis of the process of benzene hydrogenation to cyclohexane" with "Methanol synthesis and separation process analysis" (See Appendix B, Appendix B of the.2005 edition). Please note that some of the contents of this document may involve patents. The issuing agency of this document is not responsible for identifying patents. This document was proposed and managed by the National Standardization Technical Committee on Energy Foundation and Management (SAC/TC20). Drafting organizations of this document. Tsinghua University, Institute of Engineering Thermophysics, Chinese Academy of Sciences, North China Electric Power University, China National Institute of Standardization, North China Beijing University of Chemical Technology, China Petroleum and Chemical Industry Federation, China Electricity Council, China Urban Heating Association, Huadian Electric Power Research Institute Institute Co., Ltd., Beijing Thermal Group Co., Ltd., Tongfang Artificial Environment Co., Ltd., Tianjin Cement Industry Design and Research Institute Co., Ltd. Division, China Petroleum Planning Institute, Sinopec Engineering Construction Co., Ltd., Beijing Shougang International Engineering Technology Co., Ltd. The main drafters of this document. Zheng Danxing, Shi Lin, Zhang Na, Duan Liqiang, Liu Meng, Chen Xiaohui, Huang Weijia, Dai Xiaoye, Feng Lejun, Jiang Xizhuo, Zhou Junhua, Chang Yunling, Niu Xiaohua, Ruan Jiongming, Han Jingxiao, Gao Peifeng, Di Dongren, Wang Guanghe, Jian Jianghai, Wang Daijun. This document was first published in.1994, revised for the first time in.2005, and this is the second revision. Technical Guidelines for Energy System Analysis

1 Scope

China's national technical guidelines for exergy analysis of energy systems - the method that accounts not for how much energy a system uses but for how much of the useful work available in it is destroyed, and where. It specifies the principles, the methods and the procedures for carrying out an exergy analysis of an energy system. The distinction the method rests on is the one an ordinary energy balance cannot make. Energy is conserved, so an energy balance always closes and never tells you where the loss was - a boiler that turns fuel into steam at ninety per cent thermal efficiency looks excellent, and yet the combustion inside it has destroyed something like a third of the capacity of that fuel to do work, irreversibly, before the steam has gone anywhere. Exergy is the part of the energy that could in principle be converted into work given the surroundings, and unlike energy it is destroyed by every irreversible process: by combustion, by heat transfer across a temperature difference, by throttling, by mixing, by friction. An exergy analysis therefore

locates the real losses in a plant, and they are almost never where the energy balance suggests. That is why the method is used to decide where to invest in an existing plant and how to configure a new one - and it is the analytical basis for combined heat and power, for cascaded heat use and for the whole idea of matching the quality of a heat source to the quality of the demand. The standard sets the system boundary and the reference environment, without which no exergy figure means anything, the calculation of the exergy of the streams, the exergy balance and the destruction terms, the efficiency definitions, and the reporting. Issued on 30 April 2021 and in force since 1 November 2021. Amendment 1, GB/T 14909-2021/XG1-2023, forms part of the same document.

This document specifies the evaluation indicators for calculation, accountancy (balance) and analysis in energy system analysis, as well as the analysis step. This document applies to the analysis of unit equipment, processes, technological processes or systems that involve energy utilization or energy conversion; it also applies to comprehensive Energy system analysis that considers economic performance or ecological environmental impact, as well as energy supply plan planning, energy auditing and other energy management tasks.

2 Normative references

The content of the following documents constitutes an indispensable clause of this document through normative references in the text. Among them, dated quotations Only the version corresponding to that date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to This document.

GB/T 2587 General rules for energy balance of energy-consuming equipment

GB/T 3102.4 Thermal quantity and unit

GB/T 3484 General Principles of Enterprise Energy Balance

GB/T 17781 Basic Concepts of Technical Energy System

GB/T 35071 Energy System Optimization Guide

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 System An analysis object with a clear boundary determined according to the purpose of the research.

Note. In theoretical analysis, it is also called system, which can be divided into multiple subsystems according to certain research purposes and boundary division principles.

3.2 Environmental reference state An idealized outside world with limited conditions, which is selected from the categories of the earth, such as the atmosphere, the surface, and the

ocean, in a state of complete equilibrium. It is composed of a fixed reference material system (see 4.1), and has an environmental reference temperature of 298.15K (25°C) and an environmental reference of 100kPa State pressure (see 7.2) is the numerical benchmark for analysis and calculation.

3.3 exergy The system is reversible from any state (with a certain temperature, pressure and chemical composition) to a state of equilibrium with the reference state of the environment The work done to the outside world in the process.

3.4 Internalexergyloss Due to the irreversibility of the internal process of the system, the system's functional capacity is reduced.