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Wind energy generation systems - Electrical simulation model validation

风能发电系统 电气仿真模型验证

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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 for Standardization Documents" drafting: This document is equivalent to IEC 61400-27-2:2020 "Wind Power Generation System Part 27-2: Model Verification of Electrical Simulation Models": The following minimal editorial changes have been made to this document:

--- In order to coordinate with existing standards, change the name of the standard to "Verification of Electrical Simulation Model of Wind Power Generation System": Please note that some contents of this document may refer to patents: The issuing agency of this document assumes no responsibility for identifying patents: This document is proposed by China Machinery Industry Federation: This document is under the jurisdiction of the National Wind Power Standardization Technical Committee (SAC/TC50): This document was drafted by: China Electric Power Research Institute Co:, Ltd:, Northwest Branch of State Grid Corporation of China, State Grid Jilin Electric Power Co:, Ltd: Co:, Ltd:, Xinjiang Goldwind Technology Co:, Ltd:, State Grid Inner Mongolia Eastern Power Co:, Ltd:, Shanghai Electric Wind Power Group Co:, Ltd:, State Grid Sichuan Electric Power Company, Siemens Gamesa Renewable Energy Technology (China) Co:, Ltd:, Guodian United Power Technology Co:, Ltd:, China Quality Certification Center, Longyuan Power Group Co:, Ltd:, State Grid Liaoning Electric Power Research Institute, State Grid Northeast Branch of the company, State Grid Shaanxi Electric Power Co:, Ltd:, State Grid Shanxi Electric Power Company, State Grid Shandong Electric Power Research Institute, Zhejiang Yunda Wind Power Co:, Ltd:, Sungrow Power Supply Co:, Ltd:, Envision Energy Co:, Ltd:, Beijing Huizhi Tianhua New Energy Technology Co:, Ltd: Co:, Ltd:, State Power Investment Group Co:, Ltd:, Shenzhen Hopewind Electric Co:, Ltd:, Zhejiang University, CRRC Zhuzhou Electric Locomotive Research Co:, Ltd:, State Grid Zhejiang Electric Power

Co:, Ltd: Electric Power Research Institute, Mingyang Smart Energy Group Co:, Ltd:, Sany Heavy Energy Co:, Ltd: Ltd: The main drafters of this document: Qin Shiyao, He Jing, Li Shaolin, Cheng Lin, Sun Yong, Yang Zhiqian, Su Peng, Zhu Zhiquan, Ye Xi, Li Yue, Du Wen, Kang Wei, Liu Junqi, Li Baoju, Li Shenghui, Li Dan, Li Li, Yang Chaoying, Cheng Yan, Faradir, Zhang Xiaoqi, Xiang Song, Liang Xinxin, Fang Xinyu, Chen Danghui, Zhang Chong, Wang Sufei, Wu Lijian, Zang Xiaodi, Ma Junchao, Li Chunyan, Tang Jianfang, Fu Yongtao, Tang Binwei, Yang Ningning, Liang Jianing, Fan Yi, Zhang Jin, Guo Jiangtao, Yuan Xu:

This document specifies a model validation procedure for wind turbines and wind farms: With the increasing penetration of wind power in the power system, transmission system operators (TSOs) and distribution system operators (DSOs) require the use of wind power system dynamic models for power system stability analysis: This document specifies a dynamic model verification procedure that can be used for power system stability analysis: Institute of Electrical and Electronics Engineers and the International Grid Organization (IEEE/CIGRE) Stability Terms and Definitions 1) The joint working group classified power system stability, as shown in Figure 1 shown: 1) Numbers in square brackets cite references: 2) The scope of this document is to provide verification of model simulation accuracy and methods for eliminating uncertainties: 3) Chapter 7 specifies a large number of model validation methods: The focus of model validation depends on the type of grid and the content of the stability analysis: Appendix D Description This limits the accuracy of the model simulation: 4) In the preparation stage: Figure

1 The classification of power system stability by the IEEE/CIGRE Stability Terms and Definitions Joint Working Group Based on the above classification, the model is suitable for the study of large-disturbance short-term stability of wind power generation, such as short-term voltage stability, short-term frequency stability, etc: and the short-term transient power angle stabilization in Figure 1: Therefore, the model is suitable for dynamic simulation of power system events, such as short circuit (low voltage breakdown more), offline or load shedding, and system disconnection: The verification procedure specified in this document can be used to evaluate the accuracy of the fundamental frequency response of wind turbine and wind farm models, including verification documents Generic positive sequence model specified in IEC 61400-27-1, verification of positive and negative sequence responses to detailed models established by wind turbine developers should feature: The model validator has the following limitations:

---The model verification procedure does not specify the requirements for model accuracy, but only specifies the method for measuring model accuracy 2), 3);

---The model verification procedure does not specify the test and measurement procedures, and the relevant regulations can be based on IEC 61400-21-1 and IEC 61400-21-24);

---The model verification procedure is not used to judge the rationality of grid codes, power quality requirements or national regulations;

---The model verification program does not involve steady-state capability verification, such as reactive power, but only focuses on verifying the dynamic characteristics of the model;

--- Model validation procedure is not suitable for long-term stability analysis;

--- Model validation procedures are not suitable for studying subsynchronous interactions;

---The model verification procedure is not suitable for studying fluctuations caused by changes in wind speed in time and space;

--- The model verification procedure is not suitable for the study of harmonics, flicker or other electromagnetic compatibility (EMC) disturbances in the IEC 61000 series documents question;

---The model verification program is not suitable for the calculation of eigenvalues for small signal stability analysis;

--- The model verification procedure does not involve short-circuit calculation characteristics;

1 Scope

GB/T 42599-2023 specifies the validation of the electrical simulation models of wind turbines and wind farms. Grid operators plan and study the system on models, and for a network with as much wind as China's the results are only as good as the wind turbine models fed into them: a model that does not reproduce what the machine actually does during a voltage dip will predict a stable system where the real one collapses. Validation means comparing the model against measurements from the machine under defined disturbances. The standard sets the model validation procedure requirements for the turbine and for the wind farm, and the general methods of validation, covering the test results, the simulation and the comparison and acceptance criteria between them, with an annex giving the simulation model and validation information and a result template. It took effect on 23 May 2023.

This document specifies the verification procedure for electrical simulation models of wind turbines and wind farms for power system and grid stability analysis: The test data for model verification is obtained according to the IEC 61400-21 series of documents: This document applies to the general model and other fundamental frequency wind turbine and wind farm models: The wind turbine model verification project includes fault ride-through capability and control characteristic simulation verification: Fault ride-through capability including wind power generation The unit model responds to voltage drop and voltage rise under balance and unbalance: Control features include active power control, frequency control, inertial Quantity control and reactive power control: The test data used for the verification of the wind turbine model is based on the test procedures specified in IEC 61400-21-1: The certificate is at the output end of the wind turbine: Since IEC 61400-21-2,

which specifies the content and methods of wind farm testing, is still in the preparation stage, this document does not specify wind power in detail: The reference point for wind farm model verification is the wind farm access point (hereinafter referred to as "grid connection point"):

Note: The wind farm access point is also called the grid connection point of the wind farm: The model verification procedure specified in this document is based on the comparison of test data and simulation data, and the verification results do not depend on the selection of simulation software:

2 Normative references

The contents of the following documents constitute the essential provisions of this document through normative references in the text: Among them, dated references For documents, only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to this document:

GB/T 2900:53-2001 Electrotechnical Terminology Wind Turbine Generating Sets (

IEC 60050-415:1999, IDT): IEC 61400-21-

1 Wind power generation systems Part 21-1: Measurement and evaluation methods for electrical characteristics of wind turbines (Winden- turbines) IEC 61400-27-

1 Wind energy generation system Part 27-1: General model of electrical simulation model (Windenergy

GB/T 36237-2023 General electrical simulation model of wind power generation system (

IEC 61400-27-1:2020, IDT):

3 Terms, Definitions, Abbreviations and Subscripts 3: