SpringerBriefs in Energy

Xianghao Zheng · Yuning Zhang · Yuning Zhang ·
Jinwei Li

Flow-Induced Instabilities of Reversible Pump Turbines

Springer

SpringerBriefs in Energy

SpringerBriefs in Energy presents concise summaries of cutting-edge research and practical applications in all aspects of Energy. Featuring compact volumes of 50 to 125 pages, the series covers a range of content from professional to academic. Typical topics might include:

- A snapshot of a hot or emerging topic
- A contextual literature review
- A timely report of state-of-the art analytical techniques
- An in-depth case study
- A presentation of core concepts that students must understand in order to make independent contributions.

Briefs allow authors to present their ideas and readers to absorb them with minimal time investment.

Briefs will be published as part of Springer's eBook collection, with millions of users worldwide. In addition, Briefs will be available for individual print and electronic purchase. Briefs are characterized by fast, global electronic dissemination, standard publishing contracts, easy-to-use manuscript preparation and formatting guidelines, and expedited production schedules. We aim for publication 8–12 weeks after acceptance.

Both solicited and unsolicited manuscripts are considered for publication in this series. Briefs can also arise from the scale up of a planned chapter. Instead of simply contributing to an edited volume, the author gets an authored book with the space necessary to provide more data, fundamentals and background on the subject, methodology, future outlook, etc.

SpringerBriefs in Energy contains a distinct subseries focusing on Energy Analysis and edited by Charles Hall, State University of New York. Books for this subseries will emphasize quantitative accounting of energy use and availability, including the potential and limitations of new technologies in terms of energy returned on energy invested.

Xianghao Zheng · Yuning Zhang · Yuning Zhang ·
Jinwei Li

Flow-Induced Instabilities of Reversible Pump Turbines

Springer

Xianghao Zheng
Key Laboratory of Power Station Energy Transfer Conversion and System (Ministry of Education), School of Energy, Power and Mechanical Engineering
North China Electric Power University
Beijing, China

Yuning Zhang
Key Laboratory of Power Station Energy Transfer Conversion and System (Ministry of Education), School of Energy, Power and Mechanical Engineering
North China Electric Power University
Beijing, China

Yuning Zhang
Beijing Key Laboratory of Process Fluid Filtration and Separation, College of Mechanical and Transportation Engineering
China University of Petroleum-Beijing
Beijing, China

Jinwei Li
China Institute of Water Resources and Hydropower Research
Beijing, China

This work was supported by the National Natural Science Foundation of China (Project Nos.: U1965106, 51976056 and 52076215).

ISSN 2191-5520 ISSN 2191-5539 (electronic)
SpringerBriefs in Energy
ISBN 978-3-031-18056-9 ISBN 978-3-031-18057-6 (eBook)
https://doi.org/10.1007/978-3-031-18057-6

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This book provides a comprehensive introduction of the flow-induced instabilities (e.g., the pressure fluctuations and the vibrations) of the prototype reversible pump turbines (RPTs) in the pumped hydro energy storage power stations (PHSEPSs) in China based on our long-term on-site experiments. In September 2021, the National Energy Administration of China released the medium- to long-term development plan for the PHSEPSs (2021–2035), in order to help achieve China's "dual carbon" target. In the modern grid, the operational conditions of the RPT need to be switched frequently to meet the requirements of peak shaving and valley filling. During the daily operation, the RPTs are significantly affected by the flow-induced instabilities. However, these instabilities have not been fully revealed and grasped, and need urgent attentions now. Therefore, in this book, the pressure fluctuation, the vibration, and the shaft displacement signals of several RPTs in China under different operational conditions will be analyzed in detail to reveal the generation mechanisms and the propagation characteristics of typical unstable flows. The advanced signal analysis methods will be employed to obtain the time-frequency information accurately and further find out the internal correlations between different types of signals. The advanced artificial intelligence algorithms will be adopted to recognize and diagnose different flow-induced vibration faults. This book will show some fundamentals of the RPTs, the suitable signal analysis methods, and the artificial intelligence algorithms, which may be useful for engineers and researchers in this field to carry out similar researches and improve the safe operational levels of the RPTs. In addition, the analysis results of the measured signals from the on-site experiments could be employed for calibrations of numerical simulations and comparisons of model tests.

Beijing, China
June 2022

Xianghao Zheng
Yuning Zhang
Yuning Zhang
Jinwei Li

Acknowledgements This book was financially supported by the National Natural Science Foundation of China (Project Nos.: U1965106, 51976056, and 52076215).

Contents