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Xianghao Zheng · Yuning Zhang · Yuning Zhang ·
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Flow-Induced Instabilities of Reversible Pump Turbines

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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.

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