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A Practical Guide to Help Identify the Causes and Mitigation of Oscillations Observed in High-Renewables Power Systems

Reston, Va. – The Energy Systems Integration Group (ESIG) has released a new report, *Diagnosis and Mitigation of Observed Oscillations in IBR-Dominant Power Systems: A Practical Guide*, providing guidance to engineering staff tasked with identifying causes of oscillatory behavior in power systems and identifying mitigations and countermeasures as needed.

While oscillations in power systems have always been of concern, the increasing use of inverter-based resources (IBRs), such as solar, wind, and batteries, has led to oscillations with a wider range of characteristics and root causes. These raise new issues and risks for power system operation and planning, as oscillations can lead to unwanted equipment disconnections, supply interruptions, equipment damage, and other violations of reliability criteria. This practical guide is a starting point for people who encounter oscillatory behavior, a sort of field guide or diagnostician's assistant.

"With the proliferation of inverter-based resources such as wind, solar, battery storage, and, increasingly, power electronic–interfaced loads, the risk of various types of oscillations on the grid is increasing," said Julia Matevosyan, chief engineer at ESIG. "When such oscillations happen, it can take many months and engineering staff hours to determine the source, the cause, and necessary mitigation. This guide provides an excellent taxonomy of various oscillation types and offers a systematic approach to oscillation analysis."

While there exists a great deal of practical knowledge among industry experts immersed in the minutiae of power system dynamics, this practical knowledge is under-documented. This guide aims to change that, drawing extensively from both the vast literature and the knowledge and experience of the diverse group of industry experts in the Energy Systems Integration Group Stability Task Force.

"We created this guide in response to rising concerns about oscillations and the expressed need for practical, concise help when they arise," said Nicholas Miller, task force lead and principal, HickoryLedge LLC. "It provides an essential complement to deeper, more detailed and scholarly published resources."

The guide is intended for engineering staff who have a degree of responsibility for maintaining system performance but who may not have extensive experience with integration of IBRs. Consulting the guide is the first step that follows "I see an oscillation. What is it? What do I do about it?" The guide helps the user find out which applies, what to do about it, and where to go for more help.

The guide begins with the technical background necessary as a foundation for forensics. Then it presents an overall diagnostic process including a high-level flow chart and supporting sections on measurements and analytical tools. A causality screening matrix distills the correlation between observed behaviors and possible causes into an extremely compact diagnostic aid. The diagnostician will emerge from the initial diagnostic assessment with a candidate causality, and then proceeds to more detailed diagnosis. The balance of the guide provides detailed guidance for assessment and countermeasures for specific oscillatory phenomena.

The industry is on a steep learning curve, with new tools and understanding constantly emerging. Most of the material in this guide will remain foundational even as new understanding and tools are developed, but users are invited to provide feedback specific to oscillation types, methods, and tools as well as more generally about the state of the field.

ESIG is a nonprofit organization that marshals the expertise of the electricity industry's technical community to support grid transformation and energy systems integration and operation. The report and executive summary can be downloaded at https://www.esig.energy/oscillations-guide/.

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