IEEE PES Transformers Committee
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Pragmatic Approach to Seismic Protection of High Voltage Transformer Bushings

— Technical Presentation —
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1. Abstract

Power transformers are critical to any grid, and large (high voltage) power transformers are known to be susceptible to seismic failure. Historically, earthquakes have damaged large power transformers through internal electrical failures, bushing failures, anchorage failures (inadequate anchoring), oil conservator tank failures, and fires from oil leaks, all of which require replacing the transformer or major, time-consuming repairs. All these failure modes are generally a function of the system's structural dynamics. With a forthcoming amendment to IEEE 693 which requires consideration of these dynamics, understanding how to mitigate problematic power transformer dynamics is more critical than ever. This amendment pays particular attention to large (>138kV) bushings and surge arresters, as these components have been frequent failure points during recent earthquakes.

Come and learn about ways to identify and mitigate problematic transformer structural dynamics to improve seismic bushing performance.

2. Learning Objectives

This tutorial provides opportunities to learn about the following:

- Review the dynamic behavior of transformer bushing systems under seismic loads
- Understand critical load path elements, and how their stiffness can impact the seismic bushing stress
- Discuss various solutions to reduce seismic bushing demands/amplification

3. Learning Outcomes

By attending this tutorial, attendees will gain an understanding of the following:

- Basic understanding of designs that are at risk of seismic amplification
- State of the art methods for mitigating seismic amplification
    a. Structural design considerations
    b. Seismic isolation

4. Presenters' Biographies

Jon Bender (PES member) received his master's degree in civil/structural engineering from Boise State University. He is the principal research investigator at WEGAI Research, LLC, and serves on the IEEE 693 working group. Jon has extensive experience with seismic analysis and testing of substation equipment and has authored several peer-reviewed publications on transformer bushing seismic amplification.

Dr. Bjorn Vaagensmith (IEEE member) currently works as an electrical engineering researcher at Idaho National Laboratory, where he leads projects centered around power transformers, power systems data acquisition solutions, grid hardening and resilience, and large-scale power studies. He received his BS Degree in Engineering with an emphasis in Electrical Engineering from Dordt College, Iowa and his MS and PhD degrees in Electrical Engineering with an emphasis on Electronic Materials and Devices from South Dakota State University.