Technology Innovation Project

Project Brief

TIP 316: Combined Horizontal-Vertical Seismic Isolation System for High-Voltage Power Transformer

Context

Seismic isolation systems developed and implemented for power transformers, so far, only provide protection against the horizontal components of earthquake motion. The vertical ground motion is transmitted unchanged through or even magnified by the isolation system.

Furthermore, the vertical ground motion may affect and cause reduction of the effectiveness of the isolation system in the horizontal direction. The isolation system is still very effective as the accelerations are much less than the IEEE design spectrum and much less than the case of the non-isolated transformer bushing.

Description

This project conducts research to develop and demonstrate the effectiveness of a practical 3-dimensional seismic isolation system for use in light weight electrical equipment (weight of the order of or less than 1000kip). A plan is as follows:

Study Options, Development of Concepts, Selection of Viable Systems
The mechanics of the elements of three alternate systems will be studied so that the best (or optimum) configurations are achieved and then studied for their seismic isolation effectiveness of the example equipment. The study will demonstrate the benefits and drawbacks of each option.

Design, Build and Test on the Shake Table a 3D Seismic Isolation System with a Model of an Electrical Equipment
Analytical models of the tested system will be developed in commercially available software and used to compare results to the experimental results, thus validating the models.

Why It Matters

To advance base isolation technology for the protection of high-voltage transformers additional research is necessary, particularly in locations were the vertical acceleration component is significant and important in the implementation of transformer base isolation.

Goals and Objectives

Project objectives are to develop a combined horizontal and vertical acceleration isolation system that:

- Separate the vertical and horizontal isolation mechanisms so that a much lower horizontal frequency is achieved to provide protection from the most damaging horizontal components of earthquake motion.
- Achieve a combination of sufficiently low vertical frequency and high linear viscous damping to result in reduction of the vertical acceleration response (here the mechanism for reduction of vertical acceleration is envisioned to be more due to viscous damping rather than due to the low frequency).
- Ensure sufficient rigidity for service loads.
- Ensure that rocking response is minimized or eliminated in order to prevent additional acceleration response due to rotation.

Deliverables

Deliverables for each phase of work will include:

- Phase 1, Report of mitigation options
- Phase 2, Report on analysis and preliminary testing of selected options
- Phase 3, Report on the final mitigation options

A project close-out meeting will be held at University at Buffalo, NY. Key findings from the project and final deliverables will be presented.

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Project Start Date: October 1, 2014

Project End Date: September 30, 2017

Reports & References

Links

Participating Organizations

Funding

Total Project Cost:	$812,000
BPA FY2016 Budget:	$330,000

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