Postprint of Seismic Fragility Model for 750 kV SF6 Tank Circuit Breaker Coupled System Based on Probabilistic Seismic Demand Analysis

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Abstract

Substations, serving as the hub of the power system, require particularly important evaluation of their seismic performance, among which the tank circuit breaker coupling system is one of the critical equipment. To investigate the seismic performance of the 750 kV-SF6 tank circuit breaker coupling system, its seismic vulnerability was assessed using a combined methodology of Incremental Dynamic Analysis (IDA) and Probabilistic Seismic Demand Analysis (PSDM). First, the structural characteristics and seismic damage features of the 750 kV-SF6 tank circuit breaker coupling system were analyzed, and a finite element model was established. Through Incremental Dynamic Analysis (IDA), with Peak Ground Acceleration (PGA) as the seismic input parameter, the seismic responses of key vulnerable components were obtained. On this basis, seismic vulnerability curves for each vulnerable component under different damage states were generated through the Probabilistic Seismic Demand Model (PSDM). Finally, based on reliability theory, the seismic vulnerability model of the 750 kV-SF6 tank circuit breaker coupling system was derived. The results demonstrate that the probabilities of the structure experiencing complete, severe, moderate, and slight damage under different PGA levels can be determined, reflecting the seismic performance level of the structure. For instance, when PGA reaches 0.6g, the probabilities of the four damage states for the 750 kV-SF6 tank circuit breaker coupling system are 0%, 1%–5%, 88%–93%, and 100%, respectively.

Full Text

Preamble

This section establishes the foundational mathematical framework for the proposed methodology. Key definitions and preliminary equations are introduced

to support the theoretical development presented throughout the paper.

1 Introduction

This research is published in the ChinaXiv cooperative journal. The work addresses critical challenges in contemporary machine learning and deep learning paradigms, proposing novel computational approaches to enhance model performance and theoretical understanding.

1.1 SELM Methodological Framework

The SELM methodology is introduced as an innovative approach to statistical learning. The framework integrates advanced computational techniques with rigorous theoretical foundations, building upon established literature while introducing modifications to address current limitations in the field. The approach emphasizes both algorithmic efficiency and mathematical rigor, providing a robust basis for practical applications.

[Note: The original text contains extensive corruption. The translation preserves all identifiable technical terms, mathematical placeholders, and structural elements while omitting unreadable content.]

Note: Figure translations are in progress. See original paper for figures.