IEEE Recommended Practice for Seismic Design of Substations

IEEE Power Engineering Society

Sponsored by the
Substations Committee

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Abstract: Seismic design recommendations for substations, including qualification of each equipment type, are discussed. Design recommendations consist of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation.
Keywords: anchorage, conductor, electrical equipment, damping, dynamic analysis, loads, projected performance, required response spectrum, seismic qualification, shake table, sine beat, static coefficient analysis, support structure, suspended equipment, time history

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Introduction

This introduction is not part of IEEE Std 693-2005, IEEE Recommended Practice for Seismic Design of Substations.

This revision of IEEE Std 693-1997 was developed as a recommended practice for the seismic design of substations. This recommended practice emphasizes the qualification of electrical equipment. Nuclear Class 1E equipment is not covered by this recommended practice, but it is covered by IEEE Std 344™.

This recommended practice is intended to establish standard methods of providing and validating the seismic withstand capability of electrical substation equipment. It provides detailed test and analysis methods for each type of major equipment or component found in electrical substations.

This recommended practice is intended to assist the substation user or operator in providing substation equipment that will have a high probability of withstanding seismic events to predefined ground acceleration levels. It establishes standard methods of verifying seismic withstand capability which gives the substation designer the ability to select equipment from various manufacturers, knowing that the seismic withstand rating of each manufacturer's equipment is an equivalent measure.

This recommended practice is also intended to guide the manufacturers of power equipment in the seismic design and in demonstrating and documenting the seismic withstand capability of their product in a form that can be universally accepted.

Although most damaging seismic activity occurs in limited areas, many additional areas could experience an earthquake with forces capable of causing great damage. This recommended practice should be used in all areas that may experience earthquakes.

It is the hope of those who worked on the development of this recommended practice that these standard methods of verifying seismic withstand capability will lead to better earthquake performance and to lower qualification costs.

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Errata, if any, for this and all other recommended practices can be accessed at the following URL: http://standards.ieee.org/reading/ieee/updates/errata/index.html. Users are encouraged to check this URL for errata periodically.

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Contents

IEEE Recommended Practice for Seismic Design of Substations

1. Overview

1.1 General

This recommended practice provides minimum requirements for the seismic design of substations, excluding Class 1E equipment for nuclear power generation stations. Seismic qualification of electrical equipment and its support is emphasized.

1.2 Scope

The recommended practice contains recommendations for the seismic design of substation buildings, structures, and equipment.

1.3 Purpose

This recommended practice is for new substations and planned additions or improvements to existing substations. It is not intended that existing substations must be retrofitted to these recommended practices.

For instruction on how to include this recommended practice in specifications, refer to 5.2.

IEEE Std 693 is designed as an integrated set of requirements for the seismic qualification of electrical power equipment. Users should use IEEE Std 693 as a whole. Do not modify or remove any requirement, except as allowed herein.

If any part of this recommended practice is removed, not met, or reduced, then neither the user nor the manufacturer may claim the equipment is in compliance with IEEE Std 693 and should not attach the seismic identification plate to the equipment. The user is strongly urged not to modify any of the requirements herein, including increasing or adding to the requirements.

The most important goal of this recommended practice is to provide a single standard set of design recommendations for seismic qualification of each equipment type. Design recommendations consist of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation. The intent of a uniform and consistent seismic qualification procedure is to reduce the cost for qualification of substation equipment, because the