Nuclear Power Plant Seismic-Resistant Distribution Box

Overview

This study establishes a three-dimensional isolated nuclear power plant containment structure based on the principle of similarity ratio, and compares and analyzes the acceleration, base...

Key Takeaways

Seismic-resistant distribution boxes in nuclear power plants are specially engineered enclosures designed to maintain electrical functionality and safety during earthquakes, complying with rigorous seismic and anti-vibration standards. Design and StandardsSeismic-resistant distribution boxes are built to withstand both operating basis earthquakes (OBE) and safe shutdown earthquakes (SSE), ensuring that critical electrical systems remain operational during seismic events. These enclosures are designed according to international standards such as IEEE 344 and IEC 60980, which define seismic qualification procedures for safety-related electrical equipment in nuclear facilities.

The design process includes type testing, analysis, and operational experience verification to confirm that the equipment can endure extreme environmental conditions, including vibration, temperature, humidity, and radiation.

Construction Features

Manufacturers like Delvalle Box provide enclosures that comply with seismic and anti-vibration regulations, offering custom solutions for nuclear and thermal power stations. Key features include: Robust structural frames to resist seismic forces. Anti-vibration mounts or isolation systems to reduce transmitted motion.

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Environmental protection against temperature, humidity, and dust. Modular design for easy installation and maintenance.

Seismic Isolation and Performance

Advanced seismic-resistant distribution boxes may incorporate seismic isolators or rubber bearings to reduce horizontal and vertical seismic responses. These isolation systems prolong the natural vibration period of the structure, absorb energy, and reduce stress on the enclosure, enhancing the overall seismic performance of the nuclear plant's electrical systems. Studies show that such isolation can significantly reduce acceleration and shear forces on equipment, improving redundancy and reliability.

Testing and QualificationSeismic-resistant distribution boxes undergo rigorous qualification procedures, including: Tri-axial time-history seismic tests simulating real earthquake conditions. Climatic and environmental tests for temperature, humidity, and condensation effects. Functional verification to ensure continued operation of protection and control circuits during seismic events.

These tests ensure that the distribution boxes can reliably perform their safety functions, such as reactor shutdown and critical system control, even under extreme seismic conditions. ConclusionSeismic-resistant distribution boxes are a critical component of nuclear power plant safety. They combine robust mechanical design, seismic isolation, and rigorous testing to ensure that electrical systems remain operational during earthquakes, supporting the safe shutdown and continued operation of the plant.

Article Content

Effect of nonlinear structural response on seismic fragility and risk ...

Using the emergency power supply and distribution system in a NPP as an example, this study investigated the effect of nonlinear structural response on the seismic fragilities of various

Seismic Isolation Performance of Nuclear Power Plant

This study establishes a three-dimensional isolated nuclear power plant containment structure based on the principle of similarity ratio, and compares and analyzes the acceleration, base...

Seismic Design for Nuclear Installations | IAEA

Seismic Design for Nuclear Installations. This Safety Guide provides recommendations on how to meet the applicable safety requirements in relation to the design aspects of new nuclear

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Risk-Informed, Performance-Based Design of a Seismic Isolation

A methodology to achieve a user-specified performance target for a seismic base-isolation system for a nuclear power plant (NPP) is presented and demonstrated. The isolation

Nonlinear seismic assessment for nuclear power plants with structural ...

Improving the seismic resilience of nuclear power plants (NPP) to withstand super-strong earthquakes is critical for ensuring nuclear safety. Seismic isolation can effectively enhance the

ISO 4917-4:2024 (en), Design of nuclear power plants against seismic ...

This document applies to nuclear power plants with water cooled reactors. For other nuclear facilities check the applicability of the document in advance, before it might be applied correspondingly.

IAEA-TECDOC-1905 IAEA TECDOC SERIES

The expected benefits of applying seismic isolation technologies for a nuclear power plant (NPP) or a nuclear facility are the following: sponse of isolated SSCs is reduced. This reduction can be

Enclosures for nuclear and thermal power plants | Delvalle Box

We make enclosures which comply with seismic and anti-vibration regulations, specially for installation in nuclear and thermal power stations. We provide custom made global solutions for the fitting and

An Overview of Seismic Design Parameters for Design of Nuclear

The paper provides an overview of regulatory documents, guidelines, standards, and codes related to seismic design for Nuclear Power Plants (NPPs), focusing on IAEA, WENRA, EUR, US NRC, and

Seismic soil-structure interaction in nuclear power plants: An ...

Soil-structure interaction is crucial for seismic design and analysis of critical structures like nuclear power plants (NPPs).

Seismic Response Analysis of Buried Nuclear Power

In this paper, a refined 3D direct finite element model including nuclear power plant structures and soil is developed. The wave input method,

Effect of nonlinear structural response on seismic fragility and risk ...

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Seismic probabilistic risk/safety assessment (SPRA/SPSA) on nuclear power plant (NPP) has a development history starting in the 1970s . Ang and Newmark evaluated the seismic

Seismic Design Criteria for Structures, Systems, and Components in ...

Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities This document uses both the International System of Units (SI) and customary units.

Application of innovative multi-directional laminar shear box to ...

Abstract An innovative multi-directional laminar shear box (MDLSB) suitable for 3D shaking tests is developed and is employed to investigate the seismic response of a nuclear power

IAEASAFETY STANDARDSSERIES

presenting a conventional risk); — National and international nuclear design standards that do not include seismic design standards; — National non-nuclear and non-seismic design standards.

Seismic evaluation of different types of electrical cabinets in nuclear ...

In nuclear power plants, electrical cabinets are used in larger quantities than any other non-structural component and they possess different dynamic properties. However, certain cabinets are prone to

Seismic Isolation Performance of Nuclear Power Plant Containment

Therefore, setting epoxy plate thick layer rubber isolation bearings in the isolation layer can effectively enhance the seismic performance of the structure, thereby improving the redundancy

Seismic response of nuclear power plants on different foundations ...

Abstract This study evaluates the seismic response characteristics of nuclear power plants supported by piled raft foundations constructed in non-rock sites and the influence of structural

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