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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 13625-2018

Replacing GB/T 13625-1992

Seismic qualification of safety class electrical equipment for nuclear power plants

核电厂安全级电气设备抗震鉴定

Issued on: May 14, 2018 **Implemented on: December 1, 2018**

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Table of Contents

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009. This standard replaces GB/T 13625-1992 "Non-seismic appraisal of electrical equipment for safety systems of nuclear power plants", and GB/T 13625-1992 The main technical changes are as follows:

--- Added damping related content (see Chapter 6 and Appendix A);

--- Revised the requirements of the TRS low frequency band so that the low frequency displacement of the test device will not be too large (see 8.6.3.2);

--- Increased the relevant content of the power spectral density envelope (see 8.6.3.2.1);

--- Increased seismic identification methods combined with analysis and testing (see Chapter 9);

--- Added guidelines for seismic identification through reference equipment seismic data (see Appendix G). This standard was proposed by China National Nuclear Corporation. This standard is under the jurisdiction of the National Nuclear Instrumentation Standardization Technical Committee (SAC/TC30). This standard was drafted. Shanghai Nuclear Engineering Research and Design Institute. The main drafters of this standard. Ma Yuanrui, Liu Gang, Xie Yongcheng, Yang Ren'an, Bi Daowei. The previous versions of the standards replaced by this standard are.

---GB/T 13625-1992. Seismic identification of safety grade electrical equipment in nuclear power plants

1 Scope

GB/T 13625-2018 is the Chinese national standard on seismic qualification of safety class electrical equipment for nuclear power plants, in the field of energy and heat transfer engineering. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 14 May 2018 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 December 2018. Classification: ICS 27.120.10, CCS F65. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This standard specifies the resistance to verify that safety-grade electrical equipment can perform its safety functions during and/or after an earthquake. Implementation methods for seismic identification and their documentation requirements. This standard applies to seismic identification of safety grade electrical equipment in nuclear power plants, including the adverse effects of failure on the performance of safety systems. Any interface component or device.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only dated versions apply to this article. Pieces. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 12727 Nuclear power plant safety grade electrical equipment identification

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Broadband response spectrum broadbandresponsespectrum A reaction spectrum that produces an amplification reaction motion over a wide frequency range is described.

3.2 Coherence function Characterize the relationship between the two time periods in the frequency domain. The coherence function gives the statistical correlation between the two motions as a function of frequency. The values range from 0 to 1.0, with a completely uncorrelated motion of 0 and a fully correlated motion of 1.0.

3.3 Correlation coefficient function correlationcoefficientfunction Characterize the relationship between two time periods in the time domain. The correlation coefficient function gives the statistical correlation between the two motions, which is a time delay. A function that is late as an argument. The values range from 0 to 1.0, with a completely uncorrelated motion of 0 and a fully correlated motion of 1.0.

3.4 Key seismic characteristics criticalseismiccharacteristics The ability to ensure that the equipment performs the required design, material and performance characteristics under seismic loading.

3.5 Cutoff frequency cutofffrequency The frequency at which the zero-cycle acceleration asymptote begins at the response spectrum. The frequency of a single-degree-of-freedom oscillator will no longer be amplified after exceeding this frequency. Into motion, this is the upper frequency limit of the waveform being analyzed.

3.6 Damping damping An energy dissipation mechanism that reduces the amount of amplification and broadens the vibration response in the resonance region. Damping is usually in percent of critical damping Said. Critical damping is defined as the minimum viscous damping value of a single-degree-of-freedom system that does not oscillate back to its original position after the initial disturbance.

3.7 Earthquake experience spectrum earthquakeexperiencespectrum; EES A response spectrum characterizing the seismic resistance of the reference device is determined based on seismic empirical data.

3.8 Flexible equipment flexibleequipment Equipment, structures, and components with a minimum resonant frequency that is less than the cutoff frequency of the reaction spectrum.

3.9 Range rule inclusion rules Determining the reference device group based on empirical data that has proven to be an acceptable range of physical characteristics, dynamic characteristics, and functionality of the seismic equipment rule.

3.10 Independent item independentitems Have different physical properties or withstand different seismic motion characteristics [eg different earthquakes, different sites, different structures, Or parts and equipment in different directions and/or positions of the same structure.

3.11 Narrowband response spectrum narrowbandresponsespectrum Describe a response spectrum that produces an amplification reaction in a finite (narrowband) frequency range.

3.12 Natural frequency When an object is deformed in a specific direction and then released, the object vibrates due to its own physical properties (mass and stiffness) Frequency of.

3.13 Running a baseline earthquake operatingbasisearthquake; OBE Combining regional and local geological and seismic conditions and the specific characteristics of local stratigraphic materials, it can be reasonable during the normal operating life of the power plant. An earthquake that is expected to occur at the site.

4 Introduction to seismic environment and equipment response

4.1 Earthquake environment The three-dimensional random ground motion generated by an earthquake can be characterized by simultaneous and statistically independent horizontal and vertical components. Although the whole An earthquake event may last for a long time, but its strong earthquake duration may be only 10s~15s. Ground motion is typical of wideband Machine motion may cause damage in the frequency range from

1 Hz to the response spectrum cutoff frequency.

4.2 Based equipment For equipment installed on a foundation, the vibration characteristics of ground motion (horizontal and vertical) may be amplified or attenuated. For any given Ground motion, amplification or attenuation depends on the natural frequency and damping dissipation mechanism of the system (soil, foundation and equipment). Most of the ground sports The broadband response spectrum is described to show that multi-frequency excitation plays a leading role.

4.3 Structural equipment Ground motion (horizontal and vertical) can produce amplified or attenuated narrowband motion in the structure due to the filtering of the associated structure. Structurally The dynamic response acceleration of the device will be further amplified or attenuated, up to several times or a fraction of the maximum ground acceleration. Depends on the damping and natural frequency of the device. A narrow-band response spectrum is usually used to describe the floor motion of the structure, indicating the components of the equipment Single frequency excitation plays a leading role. Similar filtering effects in the motion of the structure can also occur in flexible piping systems. For not supporting The final movement of the assembled components may be a single frequency dominated by the resonant frequency of the tube system (or its vicinity). This resonance condition will be installed in the pipeline The upper part produces the most demanding seismic loads.

4.4 Simulated earthquake

4.4.1 Overview The purpose of seismic simulation is to replicate the assumed seismic environment in a viable manner. Modulus used to identify equipment using analytical or experimental methods The quasi-seismic motion can be given in any of the following forms.

a) response spectrum;

c) Power spectral density (PSD). Simulated seismic motion can be generated for substructures of foundations, structures, or installation equipment. These simulated earthquake movements are usually done by users or Its principal is specified in the equipment specification. Due to the directionality of seismic motion and the directionality of output motion after filtering of structures and equipment structures, the directional