8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

EVALUATING THE EFFECT OF CONNECTION PLATE THICKNESS AND STIFFNESS ON SEISMIC RESPONSE OF HIGH VOLTAGE CURRENT TRANSFORMERS

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Keywords: Lifelines, Power network equipment, High voltage substations, Seismic vulnerability, Current transformer

Lifelines play a vital role in the life of industrial and developed communities, and any failures in their proper function disrupts the activities and leads to great business interruption losses. Among different groups of lifelines, the power industry is more important due to its widespread use. One of the key elements in the process of transmission and distribution of electric power in the networks are the Substations. The study of recent earthquakes indicates that the vulnerability of equipment inside the substations are really noticeable (Figure 1). One of the main problems in this area is the lack of seismic design provisions for these elements and poor design assumptions.

Figure 1. Failure of porcelain insulators in high voltage substations (Khalvati, 2008).

This study has investigated the effect of thickness and flexural rigidity of the plate, connecting the equipment to the top of the supporting structure. The equipment evaluated in this paper is a 230 KV current transformer (Figure 2), which has been selected as an important and key element in the electric power substation, and its seismic behavior has been studied more carefully. For this purpose, the information of the equipment including dimensions, weight and the stiffness of different parts of the equipment have been investigated, in order to prepare an analytical model and begin the seismic analyses by the means of ABAQUS FEA software.

The current transformer is modeled using nine different elements. Insulators are made of porcelain, but the other parts are made of steel and cast iron. Solid, Shell and Wire methods have been used to model the elements (Figures 3 and 4).


Figure 2. Current transformer

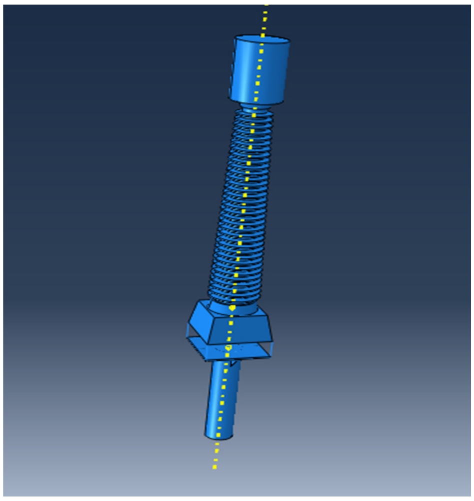
Figure 3. Main core of transformer (Khalvati, 2008).

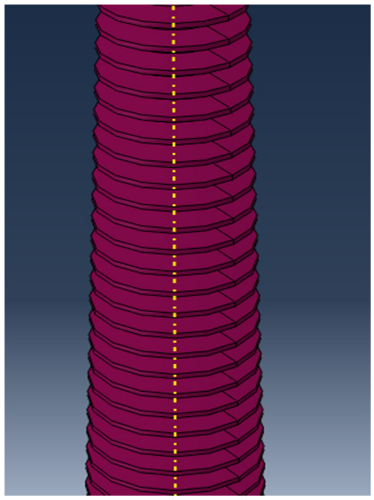
Figure 4. The insulator.

Meshing are structured according to the partitioning of each element, and in some parts, especially those made using the revolve technique, the sweep mesh is used. The size of the mesh was selected by performing a sensitivity analysis.

The type of analysis used in this study is linear dynamic time history analysis. The inputs are five different earthquake time histories, and the acceleration and displacement at the top of the equipment, and the maximum stress in the insulator are derived as the outputs.

The study results show that decreasing the thickness of the connecting plate, the maximum acceleration and maximum displacement at the head of the equipment have been significantly changed. The tension inside the insulator has also been changed.

By evaluating the results obtained from each input for different thicknesses, the appropriate thickness for the connecting plate can be selected, so that the equipment damage could be controlled properly.

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