Seismic Qualification of an Exhaust Gas Silencer in a Nuclear Power Plant Using Finite Element Analysis

Karki Anisha
Jeju National University, South Korea

Abstract:

This study presents the structural and seismic qualification of an Exhaust Gas Silencer (EGS) integrated into the Emergency Diesel Generator (EDG) system of a nuclear power plant. The EGS is critical for maintaining uninterrupted exhaust flow and suppressing noise during emergency scenarios, making its seismic reliability essential. A comprehensive Finite Element Analysis (FEA) was conducted using ANSYS 12.1, adhering to KEPIC MN Class 3 and ASME Section III guidelines, to evaluate its performance under normal, upset (SSE), and faulted (SSE) seismic loading conditions.

Modal analysis revealed a minimum natural frequency of 69.13 Hz—exceeding the 33 Hz threshold—thereby validating the use of equivalent static seismic analysis. Stress evaluations at key structural regions, such as saddle supports, reinforced zones, and shell-to-head intersections, confirmed that the maximum combined stress of 240.62 MPa remains within the allowable design limit of 243.12 MPa.

These results confirm the EGS's compliance with nuclear seismic codes, ensuring safe operation during seismic events. The study contributes a replicable, code-compliant methodology for qualifying auxiliary systems in nuclear facilities, especially in seismic-prone regions. Through this research, I aim to contribute to the safe and effective design of auxiliary components in nuclear power facilities.

Keywords:

Exhaust Gas Silencer, Finite Element Analysis, Seismic Qualification, Nuclear Power Plant, Structural Integrity, ANSYS.