**FINAL PROJECT**

# ANALYSIS OF FLOW PATTERN AND TOTAL STRESS OF THE DIFFERENT EXPANSION LOOP GEOMETRIES ON THE PIPELINE

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## ABSTRACT

The distribution of petroleum liquids, which typically have relatively high temperatures, necessitates a reliable piping system to ensure the proper transfer of extracted oil and gas. Pipelines that transport hot fluids over long distances are susceptible to failure and deformation (buckling) due to the thermal stresses exerted on them. To mitigate thermal displacement—one of the main causes of thermal stress—expansion loops are employed. These loops enhance the flexibility of pipelines but simultaneously alter the piping layout, resulting in changes in flow velocity.

This research investigates the flow pattern phenomena associated with three variations of expansion loop geometry—Half Circle Loop (HCL), Half Circle and Straight-Line Loop (HCLSL), and U-Shape Loop—using ANSYS Fluent. Additionally, the study analyzes the stress distribution across different expansion loop types (U-shape, HCL, and HCLSL), as well as symmetrical and asymmetrical loop configurations, through ANSYS Static Structural analysis.

The findings indicate that the U-shaped symmetrical expansion loop provides the most suitable geometry and positioning for minimizing stress. In both the 1/3 inlet and 1/3 outlet configurations, stress and deformation were concentrated at one edge of the loop, exhibiting the highest values. The parameters evaluated in this research include turbulence kinetic energy, fluid velocity, and von Mises stress.



Key words: expansion loop, von misses stress, fluid flow, oil and gas, flexibility.