Chapter 15

Financial Risk Analysis for Crude Oil Buried Pipeline System

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ABSTRACT

Buried pipelines are the most lucrative deal in today’s transportation for transmission of vital fluids and liquids. However, with the advent of disasters, the continuous flow through these indispensable systems gets hampered. The purpose of this chapter is twofold: one is to develop a simulation approach to capturing the effect of risk/disaster due to unforeseen events on buried pipeline, and the second is to gauge financial losses due to such uncertain events. A simulation model considering hoop, longitudinal, and radial stresses on continuous flow carrying buried pipeline subjected to uncertain and risky events is developed in CAESAR II engineering software. The authors performed statistical analysis to carry node-based analysis to describe the repair cost associated with the individual node or throughout the whole pipeline system under study. Although with a limitation in terms of model accuracy and reliability as the actual scenario could differ from the simulated model, the study outlines financial gain over total repair cost using simulation modeling approach in face of disruptions.

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INTRODUCTION

Keeping in concern the economic, safety, speed and pollution aspects, every year crude oil and gas are transported in heavy quantities to different demand points. The activity of transportation involves the transfer via trucks, barge, and rail, and pipeline, sea/river ways transport as a ship, underwater pipeline transport and under-earth transport. Moreover, for long distance transports, pipelines are the best suitable and cheap option. Such transport is safe (less prone to accidents), fast, and continuous and significant in terms of volume transportation. Such system not only carries petroleum products, crude oil, and natural gas but other essential liquids but also it is more eco-friendly and leaves a low carbon footprint.

However, the pipelines are affected by the different geological conditions, under various regions and under different seismicity. Thus, it is acknowledged as reliable, economic and efficient means for the transportation of water and other commercial fluids such as oil and gas (Shah, 2016). Many times booster pumps are used to facilitate the flow in the piping system by maintaining the integrity and need of the nation’s (Riegel et al, 2007; Mehrishi, 2017). To ensure the maximum degree of safety, it is important to design the pipeline to ensure a uniform approach to the problem (Kumar, 2016). Majorly, any pipeline system is subjected to the static and dynamic forces; however, the system is required to have the flexible and expansion capabilities for sustainable flow of crude oil. Because as these forces increases, there excessive bending, unusual loads at joints, or undesirable forces or moments at points puts pressure on the points of connection of the systems (Kumar, 2016). Majorly two types of the loading are affected by the pipeline system and are classified as primary loads and secondary loads. Also when the failure is sudden, it attributes to primary and loadings primary loadings. Every piping system goes through the life cycle where in it has to face different potential loads. Therefore, ignoring any such loads poses challenges to the designers such as excessive erection, hydro-testing issues, and automatic shut-up and down, abnormal operation, and heavy maintenance etc. to the piping system. At times, due to dominos effect the pipeline might break down. The Present work intended to study stress analysis of the buried Pipeline (at construction stage) with a practical solution and to reduce stress and to increase the life of pipeline with an appropriate design for the pipelines so that they can withstand these stresses (Green et al, 2015; Anderson, 1994; Azevedo, 2007). The piping system consists of pipe, fixtures such as nuts and bolts, valves, and joints to handle the flow due to other portions of the piping components. Apart from these, other items are also required such as components which help to reduce excessive pressure and stress. Thus, pipe is just an element or a part of piping. Thus, pipes should be tightly fit to the valves and other joints properly in order to hang and support to the other mechanical equipments (Shah, 2016; Riegel, 2007).

Pipeline Network in India

Presently, the pipelines exist across India spreads over 15000 km. The authority which looks over the working and design of the network in India is GAIL ltd (India) (Kumar, 2016). Currently, Bokaro-Ranchi-Talcher-Paradip-Angul pipeline is implementation. Also, a project named Coal Bed Methane (CBM) of 312 km is in process to connect to the existing Hazira-Vijyapur-Jagdishpur pipeline at Phulpur, Uttar Pradesh. Apart from these big projects, small projects such as Phulpur (UP) to Dobhi (Bihar) of 414 km, are taken under by the respective oil and gas corporations (Kumar, 2016).