EXECUTIVE SUMMARY: Advanced Pipeline Design

The material presented in this report is an investigation of conventional natural gas pipeline optimization. First, a comprehensive study on various natural gas hydraulic equations was conducted. The results of this study proved that current hydraulic equations produce large amounts of error when modeling a pipeline. This error is unacceptable due to the high costs associated with this hot commodity. Furthermore, the conventional economical analysis using J-curves has been proven to be extremely time consuming if accurate results are desired. Thus, the implementation of a new methodology of optimization in natural gas pipelines is extremely necessary. This report expands upon a state-of-the-art discrete mathematical optimizer and applies the tool to a ramified natural gas pipeline case study.

The results of the natural gas pipeline case study introduced some interesting concepts to the process of designing an optimal pipeline. Implementing mathematical programming optimization saved the designer a significant amount of money and valuable time. It also eliminated the need to make several risky assumptions that are required to make conventional optimization processes plausible. Furthermore, the model was able to account for increases/decreases in demand, variations in demand (i.e. summer to winter), and the time value of money throughout the project's lifespan. Also, the mathematically programmed model was able to provide more economic statistics to the designer. This is important because it supplies the user more insight into seeing if the project is economically favorable to execute.

In light of the results of this report, the following recommendations have been made. The future work on this model will consist of adding uncertainty to the model. Since the model uses large amounts of forecasted information, it is important to add uncertainty to the model to make the results compare more to a real system's behavior. Furthermore, many more cost function can be added and updated to the model making it a more robust tool. Another expansion will be adding bursting pressure calculations to the model in order to determine the appropriate pipe thickness that will be used in the network. Finally, a combination of the linear and non-linear models will be performed, and in order to streamline the optimization process thus making the program more user friendly. Even though the program is not complete, the results of this report have proven the potential value of this tool, and therefore continued research is absolutely essential. Once these additions are made, this model will be a very powerful tool.