Predicting the Power Cost of Reciprocating Compressor Manifolds (Phase 2) – GMRC 2014 Research Project

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A method to accurately predict power loss is needed by the industry, particularly power loss when there is pulsation flow. This project was identified as a significant technology gap by the GMRC High Speed Specification Committee.

Reciprocating compressors generate pulsations in the suction and discharge systems. Much design work goes into minimizing the likelihood of fatigue failures from vibration caused by pulsations. Minimizing pulsations generally causes extra power consumption (losses). Predicting horsepower consumption for pulsating flows is technically challenging:

- There are complicated flow patterns and complex arrangements encountered in the pulsation control devices.
- Limited industry data is available to accurately calculate (and verify) these losses.
- Fundamental testing to better understand the associated power losses has never been attempted.

The deliverables from the project include:

- An analytical methodology that will enable Owners, OEMs, and Packagers to quantify power loss due to pulsating flow.
- Real test data:
    - to accurately quantify compressor pulsation device power loss
    - to validate the developed predictive tools

This project will benefit owners of compressor stations. Accurate identification, analysis, and interpretation of pressure and horsepower losses in compressor manifold systems can result in better trade-off decisions between efficiency and vibration; it can avoid undersizing, or needlessly oversizing (because of uncertainty in current design approaches), the compressor driver.

Results will benefit engineering companies and analysis companies who conduct pulsation and mechanical studies

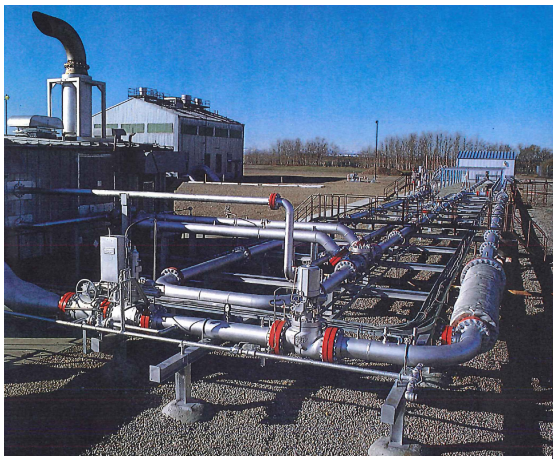
The research contractor and team include Beta Machinery Analysis, NOVA Research and Technology Centre (NRTC), TransCanada Pipelines, Peerless Manufacturing and a number of Project Steering Committee (PSC) Members.

Phase 1 (2013) the project team developed an approach to quantify the power loss in compressor manifold and piping system. Based on comparing field data from a Kinder Morgan site to the predicted values, the proposed method shows considerable promise (refer to GMC 2013, for results and presentation).

Phase 2 (2014) the focus of the work involved developing a test plan, fabricating a customized pulsation bottle and orifice plates, and onsite testing at the TCPL test loop. Various bottle and orifice configurations were tested to collect data at different frequencies and flow rates.

Peerless Manufacturing provided a generous contribution to the project by donating the custom designed bottle used in the testing program. The unique design allows the team to open up the vessel to change choke tubes and end treatments.

TransCanada Pipelines (TCPL) agreed to make available its well established Didsbury Gas Dynamic Test Facility for this project. One key feature of this facility is that is uses pipeline gas at typical pipeline conditions. TCPL's facility is easily configurable to allow for testing of pressure losses due to steady flow as well as the effects of oscillating flow. Installation of the equipment and testing took place during June and July, 2014. The following pictures show the testing program.



TCPL Dynamic Test Facility (Didsbury, AB)

Pulsation generator, above left and pulsation bottle, lower right

Customized Pulsation Bottle (donated by Peerless Manufacturing)

Pressure and Vibration Data acquisition system, including orifice testing

Upon completion of Phase 2 (end of 2014), the project will include:

- Completion of approved test program at TCPL Test Facility
- Comparison of test results to proposed power loss methodology
- Presentation of test results for orifice plate and choke tube losses at different flows and frequencies
- Additional testing at an actual compressor site to verify the methodology is accurate
- Recommended approach for pulsation modeling

For more information, contact info@BetaMachinery.com or see our website, BetaMachinery.com.