Pipeline System Pressure Test

STEP Engineered Pipeline Services

A Canadian energy transportation company relied on STEP Energy Services for technical and infield execution of its recertification pressure test during a time-sensitive outage. STEP was chosen for this important pressure test because of safe work practices, personnel experience in pipeline pressure testing, engineering simulation and planning techniques, and STEP's state of the art in-field, real-time data collection and broadcast system.

Discussion

Pressure testing is a method used to perform strength and leak tests of a pipeline. Pressure testing of pipelines presents unique safety, operating, environmental and community liaison challenges. This method requires thorough analysis and planning as outlined in CSA Z662-19 and AER Directive 77. The test involves taking the pipeline out of service, filling it with a test medium, raising the internal pressure of the pipe to a designated pressure or stress level and holding the pipe at, or above, the designated pressure for a prescribed period of time.

Hydrostatic pressure testing has long been used to commission new pipeline systems or to re-certify the operating pressure of existing pipelines. During installation, pipeline companies perform a hydrostatic pressure test to identify flaws in manufacturing of the materials, injurious damages incurred during transporting the materials, and defects caused during facility construction. Re-certification pressure tests of existing pipeline systems are undertaken by the operator to prove the safety of their system so as to operate at a higher pressure than the regulated pressure of the system, or prior to a change of product being transported by said pipeline.

A successful pressure test establishes a safety margin for pipeline operation and the maximum allowable operating pressure.

Commonly, hydrostatic pressure testing of pipelines is referred to as hydrotesting; the use of water in pressuring and proving the integrity of pipeline systems is well studied and documented. In certain circumstances, water may not be the test medium and alternate test mediums (i.e. water-methanol, nitrogen gas, LVP crude oil) are applied after first exhausting the use of water. Note:

> CSA Z662 Clause 8.7.2.1 Except allowed by Clauses 8.7.2.2 and 8.7.2.3, water shall be used as the pressure test medium.
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> Clause 8.7.2.2 Where climate, line capacity, service fluid contamination, or other circumstances make the use of a liquid other than water preferable, LVP liquids, water containing a freezing point depressant, or another appropriate liquid test medium may be used. Where such alternative liquids are used, contingency plans shall be developed to protect the environment in the event of leakage during testing
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> Clause 8.7.2.3 Air or another non-flammable, nontoxic gas may be used as the pressure-test medium, provided that the
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> > a) piping materials have notch toughness properties that are as specified in Clause 5.2, based upon the hoop stress developed by the gaseous-medium pressure test rather than upon the design operating stress;

b) pipe is not used pipe and has a longitudinal joint factor of 1.00; and

c) at the time of such pressure testing, one or more of the following conditions exist:

i) The ambient temperature is 0 °C or lower or is expected to fall to such a temperature before the pressure test can be completed.

ii) A liquid of appropriate quality is not available in sufficient quantity.

iii) The piping is such that removal of a liquid pressure-test medium would not be practical.

iv) The elevation profile of the piping is such that an excessive number of test sections would be required for liquid-medium pressure testing.

v) The strength test pressure will not produce a hoop stress in excess of 80% of the specified minimum yield strength of the pipe.

A carefully thought-out pressure test plan contains a number of important topics to ensure safe and efficient use of time and resource. Topics of importance include:

- Site specific details and survey (test locations)
- Test plan data (engineering plan)
- Roles and responsibilities (operator and contractors)
- Spill response (environmental plan)
- Equipment required
- Instrumentation and certifications (pressure, temperature, data collection, contingency systems)
- Safety zones (high pressure operations)
- Pre-fill, fill, test and depressuring sequences (operations plan)
- Locating leaks and failures
- Test documentation and determination

STEP Energy Services – Leadership in Pipeline Pressure Testing

With a time sensitive outage, a pipeline system required recertification of a pressure test to ensure its continuing operation as throughput demands on the system increased. STEP collaborated with the operator to review critical details of the as-built system and design a pressure test program for the pipeline system which was undertaken in sub-zero (°C) temperatures. The pipeline operator sought best-in-class field execution to meet their pressure test schedule and trusted STEP based on the company's unwavering focus on safety, operation preparedness and contingency foresight, engineering techniques, and instrumentation art.

Being an industry leader in pumping services, STEP worked with the operator to determine the best test medium to perform the pressure test and, in collaboration with peer review engineering, designed the pressure test program based on fit-for-purpose fluid.

STEP conducted a thorough analysis of the pipeline test segments and recognized the opportunity to conserve resources by utilizing bespoke design instrumentation packages at multiple points along the test segment. The accurate measurement of pressure, temperature and corrected volume is paramount to a successful pressure test and report acceptance by governing authorities. STEP employed its real-time data system which contains a redundant systems of pressure, deadweight measurement, and temperature in multiple locations along the test segment; what makes the STEP system unique is the ability to broadcast all data collected along the test segment in real-time and share this with the pipeline operator and peer engineering in live format. By providing accurate real-time and live measurement, it was immediately apparent that the pipeline system passed the prescribed test. Reporting of results was instantaneous which allowed the pipeline operator to present findings to governing authorities without delay.

After the pressure test was complete, STEP assisted the operator in the de-pressuring of their system in a controlled manner designed to prevent “hammer” effect.

The efficiency of STEP’s pressure test services is proven by safety performance, engineering simulation, in-field preparedness and execution contingency, reduced headcount in field through use of remote instrumentation measurement, on-site data management and reporting.

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STEP Energy Services – The Importance of a Well-Designed Pressure Test Program

Pressure testing a pipeline system is an operation that requires attention to detail and early engagement with a trusted service provider. A key consideration in the success of a pressure test plan is to ensure the accurate measurement and analysis of the pressure and temperature relationship. To ensure accuracy, STEP employs the latest technology instrumentation which is calibrated and certified before every mobilization. The use of real time data collection and live streaming of data allows for multiple layers of technical oversight to ensure program simulation and real results make sense and valuable time is not lost in interpretation or reporting. STEP's fit for purpose and latest generation pumping equipment provides assurance of productive time on the job and the professionals who operate that equipment want to share in our client success.