EVALUATION OF CAMISEA PROJECT PIPING FAILURES AND LONG-TERM SOLUTIONS

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Prepared for:
E-Tech International

Prepared by:
Carlos Salazar Tirado

Edited by:
Ing. Bill Powers

1.0 EXECUTIVE SUMMARY

This report examines the causes of four Camisea natural gas liquids pipeline ruptures during the first fifteen months of operation, the characteristics of the ruptures, and where future ruptures are likely to occur. The author of this assessment is a certified pipeline welding inspector who inspected sections of the Camisea pipelines during the pipeline construction phase. The fundamental conclusion of this report is that the principal concern of the consortium building the pipelines was to complete the project within the timeline established by the Peruvian government. Each day of delay beyond the target completion date would have resulted in fines that could have risen to as much as $90 million. The consequence of the rush to complete the project was a series of omissions and irregularities during construction that violated standard pipeline construction practices and Peruvian regulations.

The four ruptures of the natural gas liquids pipeline that have occurred to date took place at km. 9, km. 51, km. 200, and km. 220. The ruptures occurred for a variety of reasons, including inadequate welds, inadequate inspection of welds, corrosion of the piping, and soil movement. The pipeline sections with a high potential for future ruptures are km. 8 to km. 10; km. 25 to km. 52; km. 70 to km. 172; km. 200 to km. 225; km. 355 to km. 370; and km. 436 to km. 450. These sections are located in very difficult terrain, with pronounced curves and slopes. The approach used under time pressure was to employ special piping joints to pass through these difficult sections of the route, with the attendant risk of weld failures, instead of choosing a less physically challenging pathway that might have required more time. The principal problems with the field welding were: 1) welders without proper certifications, 2) welds made by welders without experience given promotions in the field from welder's helpers to welder and 3) unacceptable stresses imposed to maintain the pipe ends in position to permit welding. The loading caused by soil movement due to inadequate soil stabilization and revegetation work along the pipeline route. was not anticipated in the design of the pipelines and has produced fatigue cracks in the piping.

It is the opinion of the author of this report that at least half of the pipe used in the Camisea pipelines is leftover pipe from other pipeline projects. This piping was stored outside in Ecuador and Brasil for extended periods of time before being shipped to Peru. These pipes arrived in Peru with excessive corrosion. The corrosion was sufficient is some of these pipes that the pipe wall thickness was reduced below acceptable thresholds defined in the applicable pipeline construction codes ASME B31.4 (construction and operation of pipelines transporting liquids) and ASME B31.8 (construction and operation of gas pipelines). The pipe arrived in Peru with the tapered pipe ends deformed due to inadequate storage and transportation procedures. The poor condition of the pipe required that field repairs be conducted although neither adequate equipment nor personnel were available for this task. The piping was then welded by welders without proper qualifications and supervised by personnel without proper qualifications. The soil stabilization work was inadequate in certain sections of the pipeline. This resulted in soil movement that has placed additional stress on bad welds in piping that is weaker than required by the applicable pipeline construction standard.

Peruvian law requires a hydrostatic test at 150% of normal operating pressure in order to verify pipeline integrity before commercial operation begins. Although the hydrostatic testing was properly conducted in certain cases, in other instances there were serious deficiencies and irregularities. For example, these tests were not carried out by trained or certified personnel. It is also required that the testing instrumentation calibrations must be certified by an independent laboratory or certified personnel. None of these requirements were met. Instrument calibration should have been conducted in the presence of Peruvian government representatives and not exclusively by Techint and TGP personnel as occurred in the field during the construction phase.

A complete examination of pipeline construction and radiographic analysis of pipeline welds is required to properly assess pipeline integrity. This is necessary to avoid more ruptures that could compromise public safety, cause additional environmental damage, and place at risk the natural gas supply for Lima. It is essential that certified specialists, observed by independent inspectors, radiograph 100 percent of the pipeline welds. Other pipeline integrity tests and procedures, such as hydrostatic testing, intelligent pigs, and remote sensing leak detection measures, should be employed as required to thoroughly document the current condition of the pipelines. Independent inspectors must also assess the adequacy of soil

stabilization and revegetation along the length of the pipeline, recommend detailed remedial action measures to assure soil stability, and monitor the progress of remedial action measures until the damaged areas are fully stabilized and restored.