PG&E Line 191-1 Pipe Span Investigation for Buckeye Ranch Trail and Girl Scout Camp Spans in Briones Regional Park

Comments on Subject Report produced by Exponent, Inc (October 16, 2019) Submitted to Pacific Gas and Electric, attn.: Bennie Barnes Chief Engineer

The following comments and observations are based on a review of the subject report which was provided to the Lafayette Gas Safety Task Force (GSTF) by the California Public Utilities Commission. The GSTF mission is to promote increased safety of gas pipeline operations in the city of Lafayette and to work cooperatively with the CPUC and PG&E in addressing that objective.

*These comments are based solely on the Exponent report, which incorporates limited site investigations of the two exposed pipeline segments and information provided by PG&E. Nothing in these comments suggests any conclusion to the safety (or lack thereof) of the remaining sections of Line191-1 in Briones or the City of Lafayette. We would expect PG&E to incorporate the information and analysis of the Exponent report along with these comments into a full safety analysis of the entire L-191-1.*

1. **General Comments:** The Exponent Report (Report) is a comprehensive and well-done professional analysis of the subject pipeline segments, covering hydrological, topographic, geologic, soil, seismic and fire threats. Stress analysis of the pipe was performed to ascertain pipeline responses to these threats, including the impact of adjacent large trees falling on the exposed line. Please note that Exponent’s knowledge of the as-built condition of the pipeline is limited to what was exposed during their very limited investigation. Also, several risk factors were not addressed. And an important assumption related to the fire risk needs to be reviewed.

2. **Weld Adequacy:** The report made no mention of the current condition of the welds which link individual pipe segments via circumferential welds, nor their locations. What type of welds are used on this line? What was the quality of field welding in 1952? (the defective welds on the San Bruno pipeline were made in1956). Has PG&E ever performed non destructive tests on 70 year old welds on any of their pipelines? Or destructive tests on pipeline segments that have been replaced?

The Report suggests that the curve in the Buckeye line was created by field bending, or through a use of miter cuts and welds. This raises issues related to how well the curved sections of pipe mate up with the straight sections of pipe. In order to have flush connections before welding, the ends of the curved portions may have been miter cut to assure a flush surface. What is the precision of field cutting 11” steel pipes as compared to factory machining? How much additional weld material would be
applied if the weld surfaces were not perfectly flush with each other? Removing the entire coal tar coating and visually examining the pipe for all welded joints along with non destructive testing of the welds will be required to fully establish weld adequacy. Welding quality in engineered structures is a current focus in mid and high -rise steel frame buildings in San Francisco constructed in the 1960’s and 1970’s. The concern is the adequacy of welds in the moment resisting frames during earthquake shaking.

As of now, the report implicitly assumes that these welds are at least as strong and possess the same factors of safety computed for the steel pipe. This is a major unknown risk factor which should be addressed by radiographic tests to assess the potential of weld cracking, inclusions, or other weld defects. The exposed line gives PG&E a unique opportunity to test older welds on old lines. The findings would give insight to the quality of other welds on the 191-1 line running through downtown Lafayette as well as other similar vintage lines in the gas system.

A failure in a weld in an underground pipe segment could result in a gas leak, along with other leak sources such as corrosion, geotechnical, dig in’s, etc. If this pipe was located in a CPUC tier 2 or Tier 3 CPUC vegetation zone, gas release could ignite and cause a catastrophic wildfire. {note to CPUC- consideration should be given to redefining HCA’s to include the fuel load and human exposure in Tier 2 or Tier 3 zones}

3. Fire Temperature Assumption: The report uses an assumed pipe temperature of 600 degrees F for thermal calculations. This appears to be lower than one would expect for the extreme firestorm events occurring in California. Paper burns at 451 degrees F and wood burns at around 1000 degrees F when internal gases are released during combustion. The firestorms are another level of severity based on supercharged airflow (i.e winds) combined with low humidity and dry vegetation. Estimates range from 1200- 1500 degrees F. Aluminum melts at 1,250 degrees F. Anecdotal reports of melted aluminum auto parts have been observed in recent fire events. So it is recommended that Exponent review their temperature assumptions and revise their analysis. It is also suggested that since there is substantial uncertainty in wildfire temperature assumptions, Exponent should consider using a probability distribution of firestorm temperatures, and selecting temperatures in the right side tail of the distribution. The USGS treats earthquake ground motion in a probabilistic manner because of the large variability in estimating ground motions at a specific site so this would be consistent with their assessment of hazards.
4. **Coal Tar Coating Flammability**: The report mentions that the asphalt based coating was not tested to determine if the coating could combust, resulting in an increase in the temperature of the pipe. The simple match test performed suggests this needs to be assessed. If a match flame can cause melting of the coating, what would 1000 degree plus temperatures do to the coating?

5. **Pipeline Gas Overpressure**: Very high temperatures at the exposed pipeline segment would result in a rapid increase in the internal pressure of the pipeline. No assessment of the consequences to the structural integrity of the line, nor downstream distribution line consequences to a sudden large increase in gas pressure were addressed. Could these overpressures result in failed welds at the exposed segment, which is what caused the San Bruno gas leak and subsequent explosion?

6. **Conclusion**: Weld failure and/or extremely high fire temperature can result in catastrophic events including loss of life, property, wildlife, soil erosion and water quality. The Report’s low cost recommendation to cut down selected trees will not fully address these catastrophic events. The current stress analysis is insufficient to ascertain the safety of the Buckeye Trail Segment. PG&E should conduct a stress analysis (finite element) on the welded joints in the Buckeye Ranch Trail segment as soon as possible with both fire and earthquake loads applied. Unless PG&E can prove that the pipeline welds are fully satisfactory and that the exposed line can withstand temperatures up to 1,500 degrees F, the Buckeye segment and all other exposed pipeline segments in Lafayette should be placed underground.

Respectfully submitted by Dennis E. Kuzak(*) for the Lafayette GSTF

* Resume summary: Education BS Civil Engineering Purdue, SM in Civil Engineering MIT specializing in structural engineering, MBA from Stanford University School of Business specializing in finance. Registered Civil Engineer in California (retired not active). Technical career in structural design of steel and concrete buildings, industrial and oil refining facilities and nuclear power plants, including earthquake analysis. Last 20 years of career in catastrophic risk assessment including earthquakes, floods, hurricanes, ice storms, hail storms, tsunamis, etc. Provided risk analysis for establishment of the California Earthquake Authority at inception. Other clients included the World Bank, International Atomic Energy Agency, Turkey Catastrophic Earthquake Insurance Pool, Swiss Re, Munich Re, State Farm Insurance, Exxon, Enbridge pipeline, Houston Lighting and Power, Florida Power and Light, Goldman Sachs, Citibank, Fannie Mae, Walmart, Tokyo Disneyland, Japan Railway East.