

**STATE OF VERMONT
PUBLIC UTILITY COMMISSION**

Investigation pursuant to 30 V.S.A. §§ 30 and)
209 regarding the alleged failure of Vermont)
Gas Systems, Inc. to comply with the certificate) Case No. 17-3550-INV
of public good in Docket 7970 by burying the)
pipeline at less than required depth in New)
Haven, Vermont)

Notice of Probable Violations of Vermont Gas)
Systems, Inc. for certain aspects of the) Case No. 18-0395-PET
construction of the Addison natural gas pipeline)

**PREFILED DIRECT TESTIMONY
OF KEVIN BODENHAMER
ON BEHALF OF
VERMONT ELECTRIC POWER COMPANY, INC.
AND VERMONT TRANSCO LLC**

July 23, 2021

Summary of Testimony

In response to the Commission’s order of April 30, 2021, Mr. Bodenhamer of TRC was retained by VELCO to perform a technical review of relevant information concerning whether the HS-20+15% loading standard has been met, considering among other things the May 25, 2016 engineering study prepared for VGS by Mott MacDonald (“MM”) and (the “2016 MM Study”). In addition, VELCO asked TRC to consider three assumptions in the 2016 MM Study: (1) the diameter of the pipeline (12 inches versus 15 inches); (2) the method of burial (trenching versus horizontal directional drilling); and (3) the density of the soil surrounding the pipeline. Mr. Bodenhamer’s testimony addresses those issues.

1 **Q1. Please state your name and occupation.**

2 A1. My name is Kevin Charles Bodenhamer. I am employed by TRC Pipeline Services, LLC
3 (“TRC”) as Vice President and Chief Engineer. I am also a Registered Professional
4 Engineer in all 50 states and the District of Columbia.

5 **Q2. Please describe your educational and business background.**

6 A2. I have a Bachelor of Science degree in Civil Engineering from Missouri University of Science
7 and Technology (formerly University of Missouri – Rolla). I have over 40 years of
8 experience in the construction, engineering, design, operation, maintenance, and regulatory
9 compliance of natural gas and hazardous liquids pipelines and related facilities. Throughout
10 my career I have been involved in all phases of a pipeline’s “life cycle” including, but not
11 limited to, initial feasibility, routing, co-location assessments, engineering, detailed design,
12 permitting, construction, testing, commissioning, operations, maintenance, regulatory
13 compliance, conversion of service, decommissioning, abandonment, and removal. My
14 resume is provided as *Exhibit VELCO-KB-1*.

15 **Q3. Have you previously testified before the Public Utility Commission or other**
16 **regulatory bodies?**

17 A3. No, I have not testified before the Vermont Public Utility Commission, but I have testified
18 before similar state agencies such as the Oklahoma Corporation Commission and the Texas
19 Railroad Commission. I have also testified before federal agencies such as the Pipeline and
20 Hazardous Materials Safety Administration (PHMSA) and the National Transportation
21 Safety Board (NTSB).

22 **Q4. What is the purpose of your testimony?**

23 A4. In the Commission's Order of April 30, 2021 in this proceeding, it stated the following:

24 A key finding in the Liability Order is that the burial depth that Vermont Gas
25 achieved in the VELCO right-of-way in New Haven has the potential to limit
26 VELCO's future use of its right-of-way for additional transmission lines. VELCO
27 only recently sought party status in this case and therefore did not participate in the
28 evidentiary hearing. However, in its recent filing VELCO has now opined that the
29 hearing officer's proposed findings on the burial-depth issue, and thus whether the
30 applicable loading standard has been met, are incorrect. We believe that there would
31 be value in hearing testimony from VELCO in this proceeding on why it believes the
32 loading standard has been met.

33
34 We believe it will be judicially efficient for VELCO to provide testimony as to
35 whether the pipeline as buried in the swamp would, or would not, limit its future use
36 of its right-of-way for additional transmission lines. If VELCO relies on the
37 previously filed study to support its conclusions, then it must account for the flawed
38 assumptions in the study identified by the hearing officer.

39
40 In response to the Commission's order, VELCO retained TRC to perform a technical
41 review of relevant information concerning whether the loading standard has been met,
42 considering, among other things, the May 25, 2016 engineering study prepared for VGS by
43 Mott MacDonald ("MM") (the "2016 MM Study"). In addition, VELCO asked TRC to
44 consider three assumptions in the 2016 MM Study that the Commission focused on in its
45 order: (1) the diameter of the pipeline (12 inches versus 15 inches); (2) the method of burial
46 (trenching versus horizontal directional drilling); and (3) the density of the soil surrounding
47 the pipeline. My testimony addresses the above issues.

48 **Q5. What is TRC's role as a consultant to VELCO with respect to this Commission**
49 **proceeding concerning VGS's pipeline in the VELCO ROW near New Haven,**
50 **Vermont?**

51 A5. I have been retained by VELCO to review the installed depth of cover and allowable
52 vehicular loading for the VGS pipeline near New Haven, Vermont, as it pertains to the
53 Commission's Order of April 30, 2021.

54 **Q6. What work have you performed and what engineering, technical, and other materials**
55 **have you considered in preparation of your testimony?**

56 A6. I have reviewed the following information:

- 57 • Technical Memorandum between VELCO and VGS, dated October 1, 2012
- 58 • Memorandum of Agreement between VELCO and VGS, dated June 13, 2013
- 59 • VELCO/VGS Construction, Operations, and Maintenance Agreement, dated July 24,
60 2015
- 61 • Mott MacDonald report to VGS concerning pipe stress calculations, dated May 25, 2016
- 62 • CHA Consulting, Inc.'s report to VGS concerning pipe loadings, dated November 7,
63 2014
- 64 • RCP report to the Vermont Public Utility Commission, dated December 11, 2019
- 65 • Mott MacDonald report to VGS concerning pipe loading, dated June 15, 2021
- 66 • Reviewed the route of the installed pipeline via Google Earth Pro.

67 **Q7. Paragraph 5 of the MOU that you cite above states, “VGS will design the Project in**
68 **VELCO’s ROW and access roads into VELCO’s ROW to meet an HS-20+15%**
69 **standard which VGS plans to meet by using Class 3 pipe interred at a depth of 4**
70 **feet.” In the Commission’s Order of April 30, 2021, it found that “the burial depth in**
71 **the VELCO right-of way in the Clay Plains swamp in New Haven was less than four**
72 **feet, and in some places less than three feet.” Please explain your understanding of**
73 **the loading standard and whether it has been met in the VELCO ROW, including in**
74 **the Clay Plains swamp.**

75 A7. The detailed design of pipelines takes into account many factors, one of which is external
76 loads. The most common external load for a pipeline is from vehicles or equipment passing
77 over the top of a pipeline while it is in service. This can come from cars or trucks passing
78 over the pipeline at a highway crossing or from off-road equipment traveling along the right-
79 of-way. The American Association of State Highway and Transportation Officials
80 (AASHTO) is a standards-setting body which publishes specifications, test protocols, and
81 guidelines that are used in highway design and construction throughout the United States.
82 These specifications are utilized by pipeline engineers to determine external loads to the
83 pipeline from vehicles or equipment to ensure that such loads can be safely tolerated by the
84 pipeline. HS-20 is an AASHTO designation representing a fully loaded tractor trailer with a
85 gross weight of 80,000 pounds, which is the maximum weight allowed in Vermont. The
86 +15% indicates that the weight is increased by 15% for a margin of safety. The HS-20
87 +15% load classification is a very common and conservative approach to calculate external
88 loads.

89 To actually translate the AASHTO load into design of the pipeline, engineers utilize
90 American Petroleum Institute's Recommended Practice 1102, Steel Pipelines Crossing
91 Railroads and Highways (API RP 1102). API RP 1102 is the formula used by pipeline
92 engineers and referenced by PHMSA for the design of natural gas pipelines. The Vermont
93 Public Utility Commission defaults to PHMSA regulations for intrastate gas transmission
94 pipelines.

95 Review of the calculations and documentation for this pipeline indicate that the pipe
96 has been designed and installed to safely accept the HS-20+15% loading at all locations and
97 at 2' to 4' of ground cover above the pipe. These calculations were performed by Mott
98 MacDonald, then reviewed by Brendan Kearns of CHA Consulting, Williams Byrd of RCP
99 Inc, and now TRC. All of the consulting engineers concur that the pipeline as installed has
100 sufficient cover and strength to support HS-20+15% loading.

101 **Q8. Please explain how the API RP 1102 calculations are performed, including the use of**
102 **inputs and variables, as well as the use of the output for purposes of designing a**
103 **pipeline that meets the HS-20+15% loading standard**

104 A8. API RP 1102 calculations are performed utilizing the formulas provided in the
105 recommended practice. These formulas were developed in the 1950s and can be done by
106 hand, but decades ago they were placed into computer programs or software applications for
107 efficiency and accuracy. An engineer will then input all of the variables concerning the pipe
108 (diameter, wall thickness, grade, etc.), construction (burial depth, soil type, casing, etc.),
109 operating conditions (pressure, temperature, etc.), and surface load (type of crossing,
110 maximum surface load, etc.). The output of the calculations is the maximum stress applied
111 to the pipe under the input conditions and then a comparison to the maximum allowable for

112 the pipe with a pass/fail determination. Pass indicates that the stress to be applied to the
113 pipe by the surface load is within allowable limits and fail indicates that the stress to be
114 applied by the surface load exceeds the allowable limits. All of the various cases that were
115 run for this pipeline passed.

116 **Q9. In your opinion, is a minimum depth of 4 feet necessary to reach the HS-20+15%**
117 **standard in this section of the VELCO ROW? Why or why not?**

118 A9. A depth of soil cover of 4' is not necessary for the pipe to support a HS-20+15% loading, as
119 confirmed in the above-referenced documents utilizing API RP 1102 calculations for this
120 pipeline as installed. As discussed previously, a soil cover anywhere in the range of 2' to 4' is
121 sufficient for this pipeline as installed. In addition, the depth of cover required for this
122 pipeline by PHMSA and Vermont Public Utility Commission regulations is 36 inches.

123 **Q10. The 2016 MM Study concluded that a three-foot burial depth was sufficient to meet**
124 **the loading standard. In the 2021 MM Memo that you mention above, MM**
125 **concludes that as little as a two-foot burial depth meets the loading standard. Please**
126 **explain: (i) your understanding of these studies; (ii) whether they were conducted**
127 **according to appropriate industry standards and techniques; and, (iii) whether their**
128 **conclusions were accurate.**

129 A10. The MM studies and calculations were all performed utilizing standard industry and
130 regulatory API RP 1102 calculations. In all cases the pipe as installed has sufficient strength
131 to safely operate within the design conditions with as little as 2' of cover. The API RP 1102
132 calculations are the industry and regulatory standard for the design and safe operation of
133 pipelines under normal vehicle loadings. Based upon my review of the above-referenced

134 documents, Mott McDonald performed all calculations correctly using the as-installed soil
135 conditions and depth of cover.

136 **Q11. The Commission requested that VELCO address three assumptions that were**
137 **utilized in the 2016 MM Study. First, the Commission stated that the 2016 MM Study**
138 **included a diameter of the ANGP (12.75 inches) which did not consider the cement**
139 **coating of the pipeline which increased the total diameter to approximately 15**
140 **inches. In your opinion, does the fact that MM did not account for the cement**
141 **coating on the pipe's overall diameter for purposes of its loading analysis affect the**
142 **accuracy of MM's conclusion that the ANGP met the HS-20+15% loading standard?**
143 **Please explain.**

144 A11. No. MM's assumption to not include the cement coating in the diameter did not affect the
145 accuracy of its conclusion. The purpose of concrete coating is to add weight to the pipe to
146 counteract the buoyancy effect of the pipe to maintain the proper burial depth during
147 construction or normal operation. The concrete coating does not add any strength to the
148 steel pipe and thus is not considered in any pipe loading calculation. The API RP 1102
149 calculations do not take concrete coatings into account and rely solely on the diameter and
150 strength of the steel pipe. Based upon my review of the above-referenced documents, Mott
151 McDonald correctly performed the calculations by not considering the concrete coating.

152

153 **Q12. The second assumption in the 2016 MM Study that was called out by the**
154 **Commission was the method of installation – open trench vs. horizontal direction**
155 **drill. In your opinion, did MM’s assumption concerning the installation method for**
156 **purposes of its loading analysis affect the accuracy of MM’s conclusion that the**
157 **ANGP met the HS-20+15% loading standard? Please explain.**

158 A12. No. The method of installation did not affect the accuracy of MM’s conclusion. Open
159 trench construction is a common method of pipe installation in marsh or wetland locations.
160 For marsh or swamp locations, concrete coating is used for buoyancy control, to ensure that
161 the pipeline remains at the proper burial depth. The API RP 1102 calculations are not based
162 upon the method of installation, but are based upon the physical conditions present after
163 installation. Depth of cover and type of soil are two of the post construction conditions
164 considered by API RP 1102. Based upon my review of the above-referenced documents,
165 Mott McDonald correctly applied the API RP 1102 calculations for this pipeline.

166 **Q13. The third assumption in the 2016 MM Study that was called out by the Commission**
167 **was that the density of the soil surrounding the pipeline was a mix of “swamp water**
168 **and mud,” rather than compacted soil. In your opinion, did MM’s soil density**
169 **assumption affect the accuracy of MM’s conclusion that the ANGP met the HS-**
170 **20+15% loading standard? Please explain.**

171 A13. No. The soil density during construction did not affect the accuracy of MM’s conclusion.
172 The API RP 1102 calculations take into account the type of soil above the pipe after
173 construction when any surface load might occur. Soil conditions in wetland areas may vary
174 throughout the year but the type of soil remains unchanged. The pipeline as installed has
175 sufficient strength to support HS-20+15% loading in this area based upon the type of soil.

176 Upon my review of the above-referenced documents, Mott McDonald correctly applied all
177 of the required variables, including soil type and soil conditions in the calculations.

178 **Q14. Does that conclude your testimony at this time?**

179 A14. Yes, it does.