Appendix E

Minnesota Agricultural Protection Plan

AERIAL AND THERMAL DISPERSION ANALYSIS: OTTER TAIL TO WILKIN CARBON DIOXIDE PIPELINE PROJECT MN DOCKET NO.: PL-22-422

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PREPARED BY:

ALLIED SOLUTIONS

- Modeling pure CO_2 produces more conservative results.

5.2 Applicant's Aerial Dispersion Analysis

We vetted the applicant's aerial dispersion analysis of the proposed Otter Tail to Wilkin CO_2 pipeline. The applicant used the data in Tables 3 and 8 (Appendix A) to perform the toxic area impact analyses. Table 3 lists the analyses they conducted and the CO_2-specific LOCs they used. Table 8 in Appendix A lists the project-specific data they used.

Table 3. Applicant Project-Specific Analysis Information

Product	Analyses Performed	Toxic LOC (ppm)
CO_2	Toxic vapor cloud	15,000
		40,000
		80,000

NOTE: The applicant modeled their analysis in CANARY using a mixture of CO_2 and other components such as nitrogen (0.0047 molar fraction) and oxygen (0.002 molar fraction). This can interfere with CANARY's ability to accurately model the result due to software model constraints, per Quest Consultants.

6. Results

Since the environment where the pipeline would be located can vary greatly in terms of temperature and humidity (see Table 9 in Appendix B), we ran models for both the hottest part of the year and the coldest part of the year, along with the associated humidity levels, to determine worst-case toxic impact distance. Table 10 (Appendix B) shows the data we used for reasonable worst-case scenarios.

Based on our modeling of release impact distances using the highest and lowest reasonable temperatures and associated humidities (Table 10), we chose a reasonable worst-case temperature of -22.1 °F and a humidity level of 74.3%.

Table 4 shows the toxic impact distances for CO_2 at different concentrations.

There is a reasonable chance that the pipeline will need to be shut in during pipeline operations, which would leave CO_2 trapped in the pipeline for an undetermined amount of time. If the CO_2 stays above 1,200 psi, it stays in a supercritical state. If the CO_2 is allowed to depressurize below 1,200 psi, the operator runs the risk of CO_2 phasing to a mixture of gas and liquid—an operational condition to avoid.

Table 4. Toxic Impact Distances for CO2 at Different Concentrations

Pipeline	Pipeline Diameter (in)	Segment Length (mi)	Pressure (psi)	Max of Toxic Impact Distance at 40,000 ppm[1] (ft)	Max of Toxic Impact Distance at 30,000 ppm[2] (ft)	Max of Toxic Impact Distance at 15,000 ppm[3] (ft)
Otter Tail to Wilkins CO_2	4[4]	13.9	2,197.89	617.5	701.6	910.1

[1] 40,000 ppm is the immediately dangerous to life or health (IDLH) limit.

[2] 30,000 ppm is the National institute for Occupational Safety and Health (NIOSH) short-term exposure limit (STEL). The NIOSH STEL is the maximum time-weighted average concentration a person could be exposed to over a 15-minute period without injury.

[3] 15,000 ppm is half of the NIOSH STEL. We used it to compare with the applicant LOCs.

[4] A 4-inch nominal diameter pipeline has an outside diameter of 4.5 inches.

6.1 Evaluation of Applicant's Aerial Dispersion Analysis

Using applicant-provided data (see Table 8), Allied ran the CANARY model and verified the applicant-provided impact distances (see Table 5).

Table 5. Applicant Provided LOCs and Associated Impact Distances

Product	Analyses Performed	Toxic LOC (ppm)	Max of Toxic Impact Distance (ft)
CO_2	Toxic vapor cloud	15,000	896.0
		40,000	509.6

Also, the applicant used a software package called FLO-2D to model the aerial dispersion over terrain. However, from information supplied by the applicant, it appears that the FLO-2D analysis did not affect the impact distances produced using CANARY.

7. Discussion and Recommendations

Our analysis resulted in greater potential impact distances than the applicant-calculated impact distances. To understand what could contribute to this discrepancy, see the differences in project-specific values in Table 6.