BEFORE THE PUBLIC UTILITIES
COMMISSION OF THE STATE OF
SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION OF SCS CARBON TRANSPORT LLC FOR A PERMIT TO CONSTRUCT A CARBON DIOXIDE PIPELINE.	HP24-001

TESTIMONY OF

BRYAN LOUQUE

ON BEHALF OF

SCS CARBON TRANSPORT, LLC

SCS EXHIBIT # ________

December 20, 2024

Q. Please state your name, present position, and business address.

A. My name is Bryan Louque, PE. I am employed by Audubon Field Solutions, LLC (Audubon) as Vice President of Asset Integrity and Corrosion. My business address is 9920 E. 42nd Street, Tulsa, OK 74146. A copy of my CV is attached hereto as Exhibit 1.

Q. On whose behalf are you providing testimony in this proceeding?

A. SCS Carbon Transport LLC (SCS).

Q. How are you associated with SCS?

A. My employer, Audubon, has been engaged by SCS to perform vapor dispersion modeling and analysis for use in developing a high consequence (HCA) analysis, emergency flow restriction device (EFRD) analysis, and other analyses in connection with meeting the Pipeline and Hazardous Materials Safety Administration (PHMSA) requirements for pipelines under 49 C.F.R. Part 195.

Q. Please describe your educational and professional background.

A. I earned a Bachelor of Science degree in chemical engineering from Louisiana State University in 1992, and a Master of Arts in business from MidAmerica Nazarene University in 2001.

I have more than 30 years' experience in the pipeline industry, including experience in design, construction, operations, and maintenance of pipeline systems with specific emphasis on corrosion control, pipeline integrity, and regulatory compliance programs for natural gas (Part 192) and hazardous liquids (Part 195) pipeline systems. Prior to joining Audubon in 2017, I worked for approximately 15 years with Black & Veatch, a global energy infrastructure consulting and engineering firm. Prior to that, I worked for PHMSA form 2009 through 2012, conducting, coordinating, and managing comprehensive root cause failure investigations following pipeline release incidents.

I am a licensed professional engineer in the states of Kansas, Louisiana, Oklahoma, and Texas, and I hold certifications from and have held various committee and board seats within the National Association of Corrosion Engineers (NACE, now part of the Association for Materials Protection and Performance, AMPP).

Q. What is the purpose of your direct testimony?

A. The purpose of my testimony is to provide information regarding vapor dispersion modeling generally, the vapor dispersion analysis performed for SCS, and regulatory requirements which are applicable to vapor dispersion modeling for transportation of dense phase carbon dioxide (CO_2).

Q. What is vapor dispersion modeling and what information does it provide?

A. To anticipate the dynamics of a pipeline product release, specific processes and software tools have been developed and applied in the pipeline industry. Specific tools are employed to simulate liquid release from a pipeline, crude oil for example, and anticipate, among other things, how the product would flow along the ground or in water. Other simulations are used to create theoretical releases of gases or volatile liquids from pipelines carrying those products. These models mimic, in virtual reality, how a vapor or gas cloud would act in the real world. The model outputs are compared to mapping data to determine whether there could be an impact to what PHMSA refers to as "high consequence areas" or "HCAs".

Q. What is a High Consequence Area?

A. An HCA is an area defined by PHMSA regulations in 49 C.F.R. Part 195. Identification of HCAs for hazardous liquid pipelines focuses on populated areas, drinking water sources, and unusually sensitive ecological resources. Pipeline operators must determine which segments of their pipeline could affect HCAs in the event of a release. This determination must be made assuming that a release can occur at any point, even though the likelihood of a release at any given point is very small. Hazardous liquid pipelines that pass through an HCA, or that pass near enough that a release could reach the area by flowing over land or within a river, stream, lake, or other means are assumed to have the potential to affect that area. When a pipeline crosses an HCA, it must be included in the Operator's integrity management plan (IMP). In the case of vapor dispersion analysis, theoretical vapor plumes that the modeling shows could cross an HCA boundary are considered a "could-affect HCA" areas and must undergo further analyses as well. Operators of pipelines with direct affect or could-affect HCAs must take additional actions in the design, construction, and operation of those pipeline segments to further minimize risks in those areas.

Q. Is vapor dispersion analysis necessary to comply with PHMSA regulations?

A. Yes. Conducting a vapor dispersion analysis is a key part of compliance with PHMSA regulations. Audubon has used dispersion modeling on a wide variety of products covered by PHMSA regulations to determine the theoretic potential to reach HCAs along the pipeline. This modeling is used to comply with the requirement to identify whether the pipeline could affect an HCA, pursuant to 195.452(f)(1), and given the factors set out in Part 195 Appendix C, including vapor cloud behavior and terrain effects. SCS has also used and will continue to use the modeling to inform other areas of its IMP, including the risk analysis required by 195.452(e), 195.452(g), and 195.452(i). Beyond integrity management, SCS will also use relevant parts of the modeling results to conduct security vulnerability analyses and to inform development of its PHMSA required public awareness program under 195.440 and its emergency response program under 195.402, 195.403, and 195.408(b)(4).

Q. What vapor dispersion tools did Audubon utilize for the vapor dispersion analysis performed for SCS?

A. Audubon utilized CANARY, by Quest Consultants, a vapor dispersion analysis tool commonly used in the pipeline industry. There are a limited number of vapor dispersion tools available commercially for use in pipeline modeling and regulatory compliance. When an operator chooses a modeling solution, they must take into consideration the nature of the release to be modeled. A supercritical (dense phase) CO_2 release is a high-velocity jet release, so the modeling solution must have the ability to model high-velocity jet releases. The solution must also handle the mixing and turbulence aspects of the release. These three aspects, among others, were considered when choosing CANARY as a vapor dispersion model.

Q. What key factors typically determine the extent of vapor dispersion after a release of CO_2?

A. While not exhaustive, primary factors include weather, topography, product composition, product temperature and pressure, pipeline size and length, full flow duration, and valve spacing.

Q. Did Audubon take these and other factors into account in performing vapor dispersion modeling for SCS?

A. Yes. The dispersion modeling performed for SCS accounts for a range of possible weather conditions, including atmospheric temperatures and pressures. This information was sourced from open-source geospatial data from the National Weather Service and the National Oceanic and Atmospheric Administration (NOAA) specific to the areas along the pipeline route.

Modeling input data relative to pipeline product and properties used in the modeling was sourced from SCS. This allowed for greater granularity and accuracy in the results for the areas being evaluated. In addition, the vapor dispersion modeling was further evaluated using a digital terrain map as discussed more fully below.

Q. Has SCS prepared a dispersion analysis to be entered into evidence and open to the public?

A. Yes. SCS's public dispersion analysis report, "*Dispersion Analysis – Report to the South Dakota Public Utilities Commission*" is attached to my testimony as Appendix 1.

Q. What is the purpose of this report?

A. To provide the Commission and public with credible information and important context around potential pipeline failures and associated potential impacts, as well as a discussion of the regulatory requirements regarding modeling – both vapor dispersion modeling and terrain-aided dispersion modeling. The dispersion models discussed within the report highlight two types of potential pipeline releases – mechanical damage punctures and full-bore ruptures, both considering average atmospheric conditions (rather than "worst case" conditions utilized in certain planning activities) in South Dakota. Although a pipeline rupture is the least common type of historical failure for CO_2 pipelines, Appendix 1 focuses on these types of failures as they have the largest potential impact. The reality is that the vast majority of CO_2 pipeline incidents are very minor in consequence, for example valve or flange leaks, and rarely extend beyond operator-owned property or the pipeline right-of-way. The atmospheric and overland flow vapor dispersion associated with incidents seldom approach the modeled dispersion distances.

Q. Did Audubon take heavy vapor overland flow and terrain into account in performing SCS's vapor dispersion analysis?

A. Yes. A typical vapor dispersion model produces results in two dimensions. At SCS's request, Audubon went a step further and modeled the supercritical (dense) phase CO_2 release a s a pooling spill component to consider the effects of terrain on a potential release. Audubon utilized the pipeline centerlines and a digital elevation model to identify critical valleys (a "critical valley" has been defined as any terrain that could transport heavy vapor CO_2 to a highly populated area ("HPA") or other populated area ("OPA")) along the pipeline right-of-way. This elevation analysis was performed as a surface study in three dimensions.

At each critical valley site, a heavy vapor CO_2 overland spread was modeled. The heavy vapor CO_2 component was then modeled with FLO-2D (a program discussed in more detail below) to create overland spread polygons of the release in reference to the digital elevation model. These overland spread polygons were then overlaid on the mapping to see if any of them intersected with HPAs or OPAs.

Q. In conducting its vapor dispersion analysis, has SCS considered past CO_2 releases and PHMSA investigations?

A. Yes. The modeling is informed by historical releases and the resulting PHMSA investigations and reports. For example, in February of 2020, a pipeline transporting CO_2, hydrogen sulfide (H_2S), and other compounds experienced a catastrophic guillotine (full bore) failure, and the released gases formed a vapor cloud that migrated downhill to the Village of Satartia, Mississippi. PHMSA's Failure Investigation Report following the incident indicates that the operator's CO_2 dispersion model underestimated the potential area that could be impacted by a release. This underestimation caused the pipeline segment at issue to not be identified as a "could affect" HCA by the operator, which resulted in the operator not including it in the operator's public awareness plan or emergency response planning efforts. To avoid a similar situation, SCS has had a more robust vapor dispersion analysis performed, modeling overland spread of CO_2 in critical valleys that could assist in the transport of a CO_2 release to HCAs.

Q. Is the dispersion analysis periodically updated both prior to construction and after operations begin?

A. Yes. As the design of the pipeline evolves and route adjustments are made, the vapor dispersion analysis is updated. In addition, after operations begin, updates to all aspects of an IMP (including dispersion modeling) are required on at least an annual basis or as conditions change along the pipeline. This evaluation also includes the risk factors for evaluating whether a pipeline could affect a HCA, pursuant to 195.452(j)(2). As part of its IMP, SCS plans to update its dispersion modeling whenever either conditions along the pipeline or pipeline operational changes occur such that the dispersion modeling would be affected.

Q. What other modeling tool is SCS using?

A. As noted above, SCS has used and continues to us FLO-2D to perform the overland flow / terrain-aided vapor dispersion analysis.

Q. What is FLO-2D?

A. FLO-2D uses an overland spread flow model to determine the terrain-aided dispersion distance and whether or not a heavy vapor might impact a HCA.

Q. Why did SCS decide to use the FLO-2D tool as well as CANARY?

A. Modeling done with tools like CANARY can benefit from supplementation by additional modeling that can account better for terrain and topographic features. This is because elevation and topography changes may cause the modeled plume to change from what is predicted by using only the atmospheric vapor dispersion model. SCS has applied the CANARY modeling across the entire pipeline length and applied the FLO-2D overland spread / terrain-aided analysis where terrain and topography could cause the plume to impact an HCA. SCS's CO_2 vapor dispersion modeling approach is widely considered appropriate and is consistent with best practices and applicable regulations and guidance.

Q. When developing atmospheric vapor dispersion models, has SCS identified worst-case climate and other data inputs to produce the most conservative (largest) atmospheric vapor dispersion concentration plumes?

A. Audubon empirically determined which combination of the atmospheric inputs produced the maximum distance from centerline for a specified CO_2 concentration (ppm) at ground level due to a pipeline release. In other words, Audubon employed the variables that would produce the "worst case" scenario. For example, Audubon performed a sensitivity analysis to determine what wind speed to use for worst-case dispersion. That analysis resulted in a 4.47 mile per hour input; below that level, the plume remained stationary and, above that level, the turbulence and mixing effect reduced the distance the plume would travel at a specified concentration at grade.

It is also worth noting that Audubon likewise developed and employed worst-case data inputs for non-climatic inputs – for example, a full-bore break at ground level at an orientation (*i.e.*, angle) to produce the largest vapor dispersion for the modeling. The result is a credible, albeit overly conservative, presentation of the "worst-case" vapor dispersion model. This "worst-case" model was the basis for developing the could-affect pipeline segments which are illustrated in Application Appendix 10 – High Consequence Area Mainline Valves.

Q. Does this "worst-case" model differ from the models presented in Appendix 1?

A. Yes. SCS created Appendix 1 for the purposes of permitting the pipeline and providing a public-facing document that could be used by regulators and the public to understand the potential impacts of a CO_2 release from the project. Additional models, such as the more conservative "worst-case" model, are completed to comply with PHMSA regulations. The "worst-case" model was not presented within Appendix 1 as it tends to overstate the risk from a potential pipeline release. The "worst-case" model stacks a number of extremely conservative assumptions into a scenario that is so unlikely that it does not, in my view, provide a particularly credible or useful tool from the standpoint of informing and educating the public. For example, the "worst-case" scenario utilizes a product pressure that matches the pipeline maximum operating pressure, thus the "worst-case" model returns a conservative result. Another example is that the pipeline is modeled at ground level, allowing for an unrestricted release onto the ground. In reality, the pipeline is buried and during a large rupture, a crater would form due to the release force, and the crater would act to propel the released product upwards into the air, aiding in the dispersion of CO_2. Finally, the "worst-case" model also assumes the release occurred at the "worst-case" wind speed, humidity, temperature, wind stability class, terrain, release angle, and other required inputs to run the model. It is the summation of all of these "worst-case" inputs that creates a model that is not likely to occur. The models within Appendix 1 were chosen to educate and inform the public and regulators on potential impacts from a very rare pipeline rupture, but under more realistic atmospheric and operating conditions.

Q. Wouldn't it be prudent to require computational fluid dynamics ("CFD") modeling over the entire pipeline length?

A. No. There is little benefit to be achieved from deploying CFD modeling across the entire pipeline length. The combination of modeling that SCS is doing is a more prudent decision. Moreover, the amount of computational power required to run CFD modeling results in timelines and resource consumption that is not commensurate with any resulting benefits from a risk and safety perspective when compared to the results of the combination of modeling employed by SCS. Moreover, as I noted above, the FLO-2D modeling approach that SCS ha used for terrain-aided dispersion around HCAs provides a number of the benefits that CFD could provide, without the impracticality imposed by running CFD across the entire pipeline length.

Q. Does this conclude your testimony?

A. Yes.

Dated this 20th day of December, 2024.

/s/ Bryan Louque

Bryan Louque