BEFORE THE PUBLIC UTILTIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

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| IN THE MATTER OF THE APPLICATION OF SCS CARBON TRANSPORT LLC FOR A PERMIT TO CONSTRUCT A CARBON DIOXIDE PIPELINE. | HP22-001 |

**SURREBUTTAL TESTIMONY OF**

**BRYAN LOUQUE**

**ON BEHALF OF**

**SCS CARBON TRANSPORT, LLC**

**SCS EXHIBIT #___**

August 31, 2023

EXHIBIT A-42

**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 from 2009 through 2012, conducting, coordination, 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. Have you previously provided testimony in this proceeding?**

A. No.

**Q. What is the purpose of your surrebuttal testimony?**

A. I respond to certain issues raised in testimony regarding $CO_2$ vapor dispersion modeling, including Dr. John Abraham in Support of Landowner Intervenors.

**Q. Dr. John Abraham testified about his view of the PHAST software model. Do you have a response to Dr. Abraham's testimony?**

A. I do. Dr. Abraham's testimony, which repeats nearly verbatim his testimony offered in proceedings elsewhere, is simply not relevant.

**Q. Why do you say that?**

A. Summit did not use PHAST. Based on Dr. Abraham's testimony, he was provided an incorrect assumption by Mr. Jorde that Summit used PHAST.

**Q. Why do you say that Dr. Abraham was provided incorrect assumptions?**

A. It appears that the Landowner Intervenors' lawyer provided Dr. Abraham fundamentally incorrect assumptions about the main topic of his testimony, which is the dispersion modeling software program, PHAST.

**Q. How do you know that the assumption is incorrect?**

A. SCS did not use PHAST software to perform any atmospheric vapor or terrain-aided vapor dispersion analyses as part of this project. Instead, SCS utilized CANARY, by Quest Consultant, a common atmospheric vapor dispersion analysis tool in the pipeline industry. There are a limited number of atmospheric 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 most 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 for this project.

**Q. How does the CANARY model compare to PHAST in terms of Dr. Abraham's claims about PHAST weaknesses?**

A. There are several points worth addressing. First, overall, Dr. Abraham's opinion is against the weight of consensus, which is that PHAST is an appropriate tool for vapor dispersion modeling.

Second, Dr. Abraham describes that PHAST "is based on wind tunnel experiments from other researchers." (Abraham Direct 5.) He goes on to suggest that wind-tunnel experiments are not relevant to Satartia or other real-world ruptures. Regardless of the point that Dr. Abraham is trying to make, it simply does not apply to CANARY, because no wind tunnel experiments were used for validation of CANARY. Instead, the heavy gas model in CANARY has been validated against data from large-scale outdoor experiments. Some of the tests include Kit Fox, Maplin Sands, Burro, Desert Tortoise, and Coyote.

Third, Dr. Abraham testified that PHAST presumed a horizontal release, then says that this is not like Satartia "where a significant portion of the CO2 was released vertically." (Abraham Direct 5.) It is not clear what Dr. Abraham relies on to opine about the orientation of the Satartia release, because the orientation of that release is unknown. There is not credible evidence that the Satartia release was vertically oriented. Based on the crater that resulted from the Sartartia release, the actual release orientation range could be near horizontal to vertical. Generally, releases are modeled with a horizontal / near horizontal orientation as part of a worst-case set of parameters.

Fourth, Dr. Abraham implies that the PHMSA conclusions support his conclusion that PHAST is not capable of accurately modeling the Satartia incident because the Denbury vapor dispersion buffers varied from conditions reported on the ground. (Abraham Direct 6-7.) To my knowledge, the actual Satartia vapor dispersion model has never been provided for review by Dr. Abraham. In addition, insufficient evidence exists to demonstrate that the PHAST model is not capable of accurately modeling the Satartia incident. The statement by PHMSA that the "PHAST model dispersion analysis was wrong" could be due to assumptions made in the analysis that proved to not accurately reflect reality. This result does not mean that the PHAST dispersion model is inappropriate for use in $CO_2$ analysis. And, regardless, as I have explained, SCS used CANARY, so Dr. Abraham's criticisms of PHAST remain misplaced.

**Q. Dr. Abraham also testifies about the use of Computational Fluid Dynamics (CFD) instead of PHAST software (Abraham Direct 7.) Ignoring Dr. Abraham's discussion of PHAST, do you have a response?**

A. Yes, I do. First, as noted above, SCS used CANARY, a software by Quest Consultants, which is widely accepted as an appropriate tool for atmospheric vapor dispersion modeling analysis. (See Frazell Direct 5:166-169.) The CANARY atmospheric dispersion analysis uses a Gaussian plume model to evaluate the dispersion of $CO_2$ under site-specific, seasonal weather conditions. When developing the CANARY models, SCS has incorporated worst-case climate data inputs, as opposed to average climate inputs, to produce the most conservative (largest) dispersion plumes. By worst-case climate data inputs, I do not mean the most extremely cold or least possible wind, but rather the climatic conditions that drive the largest dispersion plume.

CFD modeling comes at a cost compared to atmospheric vapor dispersion models (such as CANARY). The following points are worth considering when evaluating the use of CFD modeling:

1. CFD requires a wide range of input values and complex parameters be identified by the analyst. Due to the complexities of CFD models, the number of input values (actual and assumed) are multiple times greater than required by atmospheric dispersion models.
2. CFD models generally do not include the necessary thermodynamic and high velocity simulations necessary to accurately predict the release of a pressurized fluid, like the release from a pipeline.

3. CFD modeling is time intensive, limiting the number of scenarios / applications that can be modeled.

Atmospheric dispersion models are based on the assumption that the surrounding terrain is flat. It is also true that CFD can be used for modeling the effects of terrain on vapor dispersion. However, the exclusive application of CFD to understanding vapor dispersion due to a release along the entire length of a pipeline is not feasible.

Second, atmospheric vapor dispersion modeling is not the only modeling that is being employed by SCS.

**Q. What other modeling tool is Summit using?**

A. SCS has used and continues to use Flo-2-D to perform the overland flow / terrain-aided vapor dispersion analysis.

**Q. What is Flo-2-D?**

A. Flo-2-D uses an overland spread flow model to determine additional dispersion distance and whether or not the plume might impact a High Consequence Area ("HCA").

**Q. Why did SCS decide to use the Flo-2-D 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. Summit has applied the CANARY modeling across the entire pipeline length and applied the Flo-2-D 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 incorporated worst-case climate and other data inputs to produce the most conservative (largest) atmospheric vapor dispersion concentration plumes?**

A. Atmospheric variables that are input into the CANARY atmospheric vapor dispersion model include but are not limited to those listed below. 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, as noted above, 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 5 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 guillotine 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. Further detail regarding the inputs and results are set forth in Exhibit 2 attached hereto, titled, "Dispersion Analysis Midwest Carbon Express." which is filed subject to the Commission's confidentiality order in this docket.

**Q. Wouldn't it be prudent to require 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. On this point, I agree with SDPUC Staff witness Frazell's testimony. (Frazell Direct 5:146-169.) Moreover, as I noted above, the Flo-2-D modeling approach that SCS has 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 31st day of August, 2023.

*/s/ Bryan Louque*

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Bryan Louque