

**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF SOUTH DAKOTA**

<b>IN THE MATTER OF THE APPLICATION BY SCS CARBON TRANSPORT, LLC FOR A PERMIT TO CONSTRUCT A CARBON DIOXIDE TRANSMISSION PIPELINE</b>	<b>HP22-001</b>  <b>DR. JOHN ABRAHAM SURREBUTTAL TESTIMONY IN SUPPORT OF LANDOWNER INTERVENORS</b>
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1    **1.     Please state your name, position, and business address.**

2            Answer: My name is John Abraham. I am a Professor of Mechanical Engineering at the  
3    University of St. Thomas, 2115 Summit Avenue, St. Paul, MN 55105.

4    **2.     Have you previously submitted testimony in this proceeding?**

5            Answer: Yes. I submitted direct testimony dated June 16,, 2023, on behalf of  
6    Landowner Intervenors.

7    **3.     To whose testimony are you responding in surrebuttal?**

8            Answer: I am responding to the July 7<sup>th</sup>, 2023, rebuttal testimony of James Powell.

9    **4.     Please summarize your testimony.**

10            Answer: At page 2 line 8 through page 3 line 34 of his rebuttal testimony, Mr. Powell  
11    suggests risk modeling is a not a necessary variable when making hazardous pipeline siting  
12    decisions. I disagree with this presumption. It is also important to understand what type of risk  
13    modeling was used and all of the inputs and outputs must be shared with the Commission at a  
14    minimum to assist in evaluation of Summit’s proposed route in each county as that route location  
15    relates to the Commissions analysis of the 49-41B-22 factors namely to the treats of injury posed  
16    to the environment, or social and economic condition of current and future inhabitants as well as



1 whether approval of the proposed route will substantially impair the health, safety, or welfare of  
2 the inhabitants.

3 At page 3 line 37 of his rebuttal testimony Mr. Powell states that the dispersion modeling  
4 completed by SCS should not be used by the Commission to establish setback requirements. My  
5 opinion is that he is answering the wrong question and it is misleading to conclude as he did.

6 **5. Please address the concerns you raise above relative to risk modeling as a tool to**  
7 **inform location decision making relative to Summit’s hazardous pipeline application.**

8 Answer: There are PHMSA minimum level risk assessments for HCAs and then there is  
9 the Commission’s task of essentially determining if the proposed hazardous pipeline route is an  
10 intelligent one that satisfies all the 49-41B-22 factors. It is my opinion these two facts are not  
11 mutually exclusive. It is my opinion the Commission should absolutely require disclosure of any  
12 and all risk analysis Summit prepared or had prepare for this project, including but not limited to  
13 precisely what type of inputs were used in its Canary dispersion model and Overland Flow  
14 modeling, the values of each input used, proof they modeled worst-case scenarios and not just at  
15 federally determined HCA’s but near other sensitive areas as well, and all outputs and derived  
16 from such modeling. To date I have not seen nor am I aware of any outputs being produced by  
17 Summit relative to risk modeling other than this sole statement by Mr. Powell “...SCS has  
18 determined the within the approximately .35 miles of direct affect, population HCAs...” Powell  
19 Rebuttal page 2 line 25-26.

20 What we learned from the Navigator PUC hearing is that Navigators non-worst case  
21 scenario risk modeling for an 8” pipeline showed a hazard distance of 1,855 feet at 40,000 ppm  
22 concentration of CO2 (see [N68 from Navigator Docket](#)). For Mr. Powell to reference “.35 miles”  
23 of risk, or 1,848 feet, are we to presume that is the corollary to the Navigator data or is Summit

1 suggesting 1,848 feet is the hazard distance also for a 24” pipeline? This is unclear. Given Mr.  
2 Powell’s claims that the HCA’s they identified were all near their proposed emitter ethanol plants  
3 and if we can rely upon Summit’s publicly available map shown below, (see [Project Footprint -](#)  
4 [Summit Carbon Solutions](#) and click on South Dakota Map)(last accessed August 31, 2023) then  
5 the pipeline size at the location of each South Dakota ethanol plant is 6”, not 8”, and certainly not  
6 24”. This leads us to believe that the hazard distance for a 6” CO2 pipeline, according to Summit,  
7 is 1,848 feet. But what is the hazard distance for the bulk of their proposed route in South Dakota  
8 which is 24” diameter pipe? We don’t know because they don’t tell us, but even if they told us, a  
9 static number in feet would still be insufficient until we have the full analysis and study to  
10 determine the veracity and reliability of Summit’s claim of .35 miles or 1,848 feet. We should also  
11 be provided the risk data associated with the much larger 24” diameter pipe.



12

1 **6. What are your opinions about Summit using CANARY dispersion modeling?**

2 Answer: First and foremost, we aren't presented the modeling assumptions and poor  
3 modeling assumptions result in poor modeling results. But, even if we were to presume all  
4 the correct assumptions and inputs were used in Summit's CANARY dispersion model,  
5 CANARY has several limitations. CANARY, is modeling made available through Quest  
6 Consultants, see [CANARY by Quest – Quest Consultants](#). This webpage generally  
7 discusses CANARY and as you scroll to the bottom of the page it says "Next Section:  
8 Computational Fluids Dynamics (CFD)". When you go to Quest Consultants webpage on  
9 CFD, see [CFD – Quest Consultants](#), you see this statement:

10 **"In some situations, the simplifying assumptions made with practical modeling**  
11 **solutions do not apply.** In these cases, detailed analysis is needed. The techniques of  
12 Computational Fluid Dynamics (CFD) are required to find solutions to complex problems  
13 where other, simpler models are not appropriate. For these situations we turn to CFD."  
14 (bold in original)

15 I agree with this statement, practical modeling solutions like CANARY have their place,  
16 but it is not sufficient to obtain a complete picture of the risks presented. My overarching  
17 point is the people of South Dakota and the Commission need to know, deserve to know,  
18 the true worst-case scenarios posed by Summit's proposed 6", 8", 12", and 24" diameter  
19 CO2 pipeline. While you need not model every foot of the proposed route, it is critical in  
20 my view to perform CFD modeling at a handful of sensitive locations. It is also wise to  
21 select the areas of CFD not only based upon the federally determined HCA's but also by  
22 considering future or likely land uses in and near the proposed project footprint.

1 **7. Please expand on your prior comment that Mr. Powell was perhaps answering the**  
2 **wrong question as it pertains to using dispersion modeling to establish setbacks.**

3 Answer: This is along the lines of my testimony immediately above. I am not aware that  
4 the Commission is necessarily being asked to establish setbacks per se or to directly route  
5 the pipeline. My understanding is they are to determine the viability of Summit's  
6 application by applying the applicable law. So, the question as posed to Mr. Powell at page  
7 3 lines 35-36 when using the phrase "setback requirements" could be taken literally or  
8 generally. My opinion is utilizing the best available and most comprehensive modeling,  
9 CFD, is what South Dakotans deserve and the Commission should expect of Summit when  
10 asking the Commission to vote on the route proposed. Given the Commission is not directly  
11 determining setbacks per se I think the question posed to Mr. Powell and his denial could  
12 be misleading. Dispersion modeling absolutely should inform the Commission's ultimate  
13 decision on whether or not Summit has met its burdens of proof.

14 **8. Does your prior answer also generally apply in response to the question posed to Mr.**  
15 **Powell in his testimony at page 3 line 60?**

16 Answer: Yes, generally but when considering "appropriate" setback distances, or more  
17 precisely whether Summit's proposed pipeline location is reasonable, you have to have a  
18 good handle on the detailed inputs and outputs of the risk modeling – which I have not seen  
19 and am not aware that Summit has shared.

20 **9. Given that Summit has not shared detailed inputs and outputs related to risk**  
21 **modeling yet claims the only risk is at .35 miles and in isolated areas, I have two**  
22 **hypotheticals I would like you to consider. For hypothetical number one, please**

1 assume the following input variables in terms of rendering CO2 dispersion and  
2 hazard opinions:

3 Outer diameter pipeline in inches – 8.625 inches

4 Wall thickness in inches - 0.277 inches

5 Pipeline length in miles (distance between shutoff valves) – 20 miles

6 Molecules – CO2

7 Depth of Soil Cover in feet – 5 feet

8 Soil Type – Mixed

9 Release calculation method – average between 0 to 20 seconds

10 Release direction – Vertical

11 CO2 Release Rate (lb/s) – 1,428 lb/s

12 Atmospheric Temperature (F) – 90 degrees F

13 Atmospheric Stability Class – F (stable)

14 Wind Speed (mph) – 3.3 mph

15 Then considering hypothetical number one related to the 8.625-inch diameter CO2  
16 pipeline did you form opinions as to the likely distance human CO2 exposure could  
17 occur at a hazard level of 30,000 ppm and at a hazard level of 40,000 ppm?

18 Answer: Yes, I did.

19 10. Are those opinions based upon your education, background, training, and experience  
20 after taking into consideration the hypothetical inputs posed to you?

21 Answer: Yes.

22 11. Do you hold your opinions to a reasonable degree of professional certainty in the field  
23 of engineering?

24 Answer: Yes.

25 12. What are your opinions?

26 Answer: It is my opinion that should a release occur as described considering the  
27 variables in hypothetical number one above, that human exposure at 30,000 ppm of CO2  
28 would more likely than not occur at a distance greater than 2,600 feet from the site of the  
29 release of CO2 and that human exposure at 40,000 ppm of CO2 would more likely than  
30 not occur at a distances greater than 1,850 feet from the site of the release of CO2.

1 **13. For hypothetical number two, please assume the following input variables in terms of**  
2 **rendering CO2 dispersion and hazard opinions:**

3 **Outer diameter pipeline in inches – 20 inches**

4 **Wall thickness in inches - 0.535 inches**

5 **Pipeline length in miles (distance between shutoff valves) – 20 miles**

6 **Molecules – CO2**

7 **Depth of Soil Cover in feet – 5 feet**

8 **Soil Type – Mixed**

9 **Release calculation method – average between 0 to 20 seconds**

10 **Release direction – Vertical**

11 **CO2 Release Rate (lb/s) – 10,320 lb/s**

12 **Atmospheric Temperature (F) – 90 degrees F**

13 **Atmospheric Stability Class – F (stable)**

14 **Wind Speed (mph) – 3.3 mph**

15 **Then, considering hypothetical number two related to the 20-inch diameter CO2**  
16 **pipeline did you form opinions as to the likely distance human CO2 exposure could**  
17 **occur at hazard level of 30,000 ppm and at hazard level of 40,000 ppm?**

18 **Answer:** Yes, I did.

19 **14. Are those opinions based upon your education, background, training, and experience**  
20 **after taking into consideration the hypothetical inputs posed to you?**

21 **Answer:** Yes.

22 **15. Do you hold your opinions to a reasonable degree of professional certainty in the field**  
23 **of engineering?**

24 **Answer:** Yes.

25 **16. What are your opinions?**

26 **Answer:** It is my opinion that should a release occur as described considering the  
27 variables in hypothetical number two above, that human exposure at 30,000 ppm of CO2  
28 would more likely than not occur at a distance of 4,000 feet from the site of the release of  
29 CO2 and that human exposure at 40,000 ppm of CO2 would more likely than not occur at  
30 a distance of 2,800 feet from the site of the release of CO2.

1 **17. When you say that exposure of CO2 could be experienced by humans at a level of**  
2 **40,000 ppm at 2,800 feet from the site of the release what do you mean?**

3 Answer: I mean that a person located at 2,800 feet in any direction from the specific  
4 location of the CO2 release from the 20-inch diameter CO2 pipeline and utilizing the inputs  
5 provided in that example would more likely than not experience CO2 exposure levels of  
6 40,000 ppm should the inputs utilized cause the plume to travel toward the location of such  
7 a person. To be clear, neither the plume nor the CO2 exposure levels discussed will be  
8 present everywhere at a 2,800-foot radius three-hundred and sixty degrees from the release  
9 point, but simply that a person in harms way of the plume travel would likely experience  
10 these CO2 levels at 2,800 feet away from the release point given the inputs provided.

11 **18. For your opinions given above to each of the two hypothetical do you believe those**  
12 **distances are the worst-case scenario for the 8” and 20” pipelines respectively?**

13 Answer: No. My opinions are based on the assumptions provided which are not necessarily  
14 worst-case assumptions or inputs.

15 **19. Would you expect a release from a 24” diameter pipeline to reach a greater distance**  
16 **for the exposures levels discussed above than a 20” pipeline?**

17 Answer: Assuming all other inputs are equal and you are simply increasing the  
18 volume of CO2 that could release under a similar event, then yes, more likely than not the  
19 increased volume escaping from the 24” diameter pipeline, all other factors being equal,  
20 would have the likelihood of traveling a further distance than a similar release from a 20”  
21 diameter pipeline.

22 **20. Have all your opinions expressed herein been given to a reasonable degree of scientific**  
23 **professional certainty and been informed by your education, training, background,**  
24 **and experience?**

25 Answer: Yes, they have, and I reserve the right to amend or modify these opinions  
26 upon presentation of any additional information that may justify such a change, if any.

27  
28 */s/ Dr. John Abraham*

29 Dr. John Abraham