BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

MEGHAN FLYNN	:	
ROSEMARY FULLER	:	
MICHAEL WALSH	:	
NANCY HARKINS	:	
GERALD MCMULLEN	:	DOCKET NOS. C-2018-3006116
CAROLINE HUGHES and	:	P-2018-3006117
MELISSA HAINES,	:	
Complainants	:	
v.	:	
	:	
SUNOCO PIPELINE L.P.,	:	
Respondent	:	

SURREBUTTAL TESTIMONY OF JEFFREY D. MARX ON BEHALF OF FLYNN COMPLAINANTS

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Q. Mr. Marx, have you reviewed the written rebuttal testimony of John Zurcher?

A. Yes, I have read his statements.

Q. For the testimony that you are about to give, have you reached your own conclusions to a reasonable degree of professional and scientific certainty?

A. Yes, I have. All of my comments as well as conclusions in this surrebuttal testimony are given to a reasonable degree of professional and scientific certainty.

Q. In broad terms, can you explain what it is Mr. Zurcher says in his rebuttal testimony that has a bearing on your previous, direct testimony?

A. Yes. To generalize, Mr. Zurcher seems to believe that there is no value in performing a consequence analysis for persons living and working in areas close to hazardous volatile liquids (HVL) pipelines. He talks instead about evaluating pipelines based on risk, where both likelihood and consequence are defined. He goes on to suggest that Sunoco takes every reasonable step to minimize the likelihood of HVL pipeline failures in high consequence areas, since the consequences, in his view, are simply defined by the number of persons surrounding the pipeline. Finally, he asserts that there has never been an HVL accident in a high consequence area (HCA).

Q. Do you question his claims?

A. Yes, I do. Again, in generalizations only, the notion that it is inappropriate to do a consequence analysis without considering likelihood is not a scientific or engineering statement. It is not driven by data or historical precedent. It is simply the opinion of Mr. Zurcher presented on behalf of Sunoco. Mr. Zurcher's discussion is presented as a rebuttal testimony but does not truly rebut my direct testimony. He emphasizes his opinion that a consequence-only evaluation is meaningless and seeks to frame the argument in terms of risk. While his discussion of risk is partially based on generally accepted principles, it also contains many errors in fact and concept. Finally, the repeated statement that there has never been an HVL accident in a high consequence area is simply incorrect.

Q. Mr. Marx, when Mr. Zurcher commented on your previous testimony at line 4 of page 21, he insisted that "It is inappropriate to consider the consequence of an event without also considering the likelihood of an event occurring." In your professional experience, is this a valid approach?

A. Mr. Zurcher makes this statement within the context of my previous analysis that was consequence based. He is framing the problem as one that can only be addressed by looking at risk. While this is <u>one</u> approach to the problems of this pipeline, it is not the only approach. For instance, I am aware that Sunoco has, through subcontractors, obtained its own consequence analyses in connection with the proposed Mariner East 2 (ME2) pipelines. That analysis, to my knowledge, was not risk-based, nor has it been made public. So, the approach that Sunoco has taken with that analysis must be considered inappropriate if Mr. Zurcher's opinions are considered relevant to this proceeding.

In some analyses, consequences are the only consideration, or are the primary motivating factor. The Complainants in this case recognize that pipeline risk is relatively low but are concerned with the significant consequences of an HVL pipeline failure. Consider a resident near the Mariner East pipeline route. This person's consequence-based concerns may include the following issues:

(1) The original 90-year-old pipeline in the right-of-way moved crude oil, and later refined products. These fluids are not HVLs and have much less capability for harming people than do HVLs when released to the environment. Thus, the switch from a liquids pipeline to an HVL pipeline represents a significant increase in consequences of that pipeline's failure.

(2) Sunoco has used much of the existing right-of-way to add two additional HVL pipelines. Because these pipelines, at 16- and 20-inches diameter, are much larger than the original 8-inch diameter pipeline, the potential consequences of pipeline failure for these new pipelines are also much larger.

(3) The imposition of new and larger potential consequences is being imposed on persons who live or work near the Mariner East Pipeline route. While most people do consider risk when exposing themselves voluntarily to adverse consequences, the imposition of consequences by the Mariner pipelines is involuntary. The people living and working around the pipeline route had no input as to whether the new service and additional pipelines were an acceptable addition to the community.

Q. When Mr. Zurcher insists on page 22, line 11 "As already stated, consequence without likelihood is meaningless when evaluating risk," is this a valid position within the context of evaluating pipeline incidents?

A. In my surrebuttal testimony given here, I am being asked to comment on Mr. Zurcher's risk-related testimony. What I say concerning risk, however, should not be construed to suggest that I believe my direct testimony on consequences is any less valid or that it does not stand on its own.

My previous testimony did not suggest that risk could be evaluated without likelihood. It is true that risk is a combination of consequence and likelihood, and if the discussion is strictly pertaining to risk, then this specific assertion made by Mr. Zurcher is valid. However, the presentation of pipeline impacts within a consequence-only framework is also valid – the discussion does not have to be confined to risk.

Risk can be addressed indirectly by only evaluating the consequences. This can be demonstrated with a simple example. Imagine two similar human activities that can involve incidents where people are impacted. Let's assume that the risk of these two activities are roughly equal. Suppose the first has several incidents that result in the fatality of one person. Then suppose the second activity has an incident that results in the simultaneous deaths of 100 people. These two activities may have equal risk – I have not addressed their likelihoods – but societally, we do not treat them the same. Which one do you see on the news? The event that results in 100 simultaneous fatalities receives much more attention (and regulation) than do the single-fatality

events. Thus, a focus on only consequences is far from meaningless. Likewise, the consideration of the consequences associated with the ME2 Pipelines in a densely populated area, while not discussing likelihood, is also a valid approach to addressing the relative risk of these pipelines.

Q. Mr. Zurcher makes the following statement on page 23, Line 4: "Yes, there are other transmission pipelines located in Chester and Delaware counties. Those pipelines are similarly located in high consequence areas and would create similar consequences were they to experience the type of catastrophic rupture that Mr. Marx hypothesizes, but has never occurred in a high consequence area." Does this statement have a basis in fact?

A. First, yes, there are other pipelines in Chester and Delaware counties. These include natural gas transmission pipelines, and a few miles of LPG pipeline, as well as hazardous liquids (refined products or crude oil) pipelines. However, there are no pipelines that would create similar consequences as the newer large-diameter ME2 pipelines. Natural gas pipelines, even large diameter ones, as well as hazardous liquids pipelines and smaller diameter HVL lines, would create smaller consequences when compared to the 16" and 20" ME2 lines. Thus, the assertion of similar consequences is not accurate when considering the actual characteristics of those other pipelines.

Q. Zurcher says at page 9, line 14, that "Approximately 90% of the United States population lives near one of the types of pipelines that I described." Are you able to state whether or not this is true?

A. No one can verify this statement without knowing what Mr. Zurcher means by "near" and he does not define the term. Does 'near' mean within 100 feet, 1,000 feet, or 5 miles? This is important due to the relative consequences following accidental releases from pipelines associated with the fluids they transport. If Mr. Zurcher meant to suggest that most persons in the U.S. are "at risk" from pipelines, that is a surprising statement from an engineer. In my initial direct testimony, I focused on the consequence of an HVL pipeline failure. It is clear from evaluating the potential consequences of various pipeline releases that the potentially harmful consequences are limited in the distance that they can travel from the release point. Additionally, if we do consider risk, the many potential consequences, depending on event magnitude, transported product, and weather conditions, create a risk profile that decays as the distance from the pipeline increases. Mr. Zurcher's statement, therefore, is meaningless without further quantitative support. I have found nothing further in his rebuttal testimony that provides such support.

Q. Zurcher states on page, line 19, that "Approximately one-half of HVL pipelines – or 35,000 to 40,000 miles of pipeline – traverse a high consequence area." How is this relevant to Chester and Delaware counties?

A. As Zurcher mentions in his testimony, high consequence areas (HCAs) include both high population areas and environmentally sensitive areas. The Department of Transportation rules found in 49 CFR § 195.450 define HCAs as (1) a *commercially navigable waterway*, (2) a *high population area*, (3) an *other populated area*, or (4) an *unusually sensitive area*. Unusually sensitive areas are further defined as drinking water sources and ecological resources. Zurcher states that half of HVL pipeline mileage passes through an HCA but makes no further distinction regarding the type of HCA. It matters which type of HCA zone these 35 to 40,000 miles cross.

Because no distinction is made in Zurcher's testimony about how many of those miles pass through *high population* areas, like many parts of Chester and Delaware counties, we are left to believe that HCAs are equivalent to high population areas. This simply obfuscates the issues at hand by ignoring the fraction of HVL pipeline mileage that are in high population HCAs.

Q. In his testimony regarding the Pipeline Integrity Management regulations, Zurcher, on page 18, Lines 6-8, states that "… there is risk, which is the mathematical product of the consequence of a pipeline failure times the likelihood of a pipeline failure. The risk is very small, and it remains steady irrespective of the population near a pipeline." Are these accurate statements?

A. Although a simplification of pipeline risk to people, this statement by Mr. Zurcher is generally true. The needed clarification is that this is true for individual risk: The risk along a pipeline to any one person at a location near that pipeline is the same, independent of the number of people. This measure of risk does not include the number of persons potentially affected; it only expresses the potential of the pipeline to inflict harm. However, if societal risk is calculated, the resulting measure of risk is a direct function of the number of persons near the pipeline and how often they may be affected. Societal risk, by definition, is larger where populations are higher. Consequently, Zurcher's statement is not true if populations or population densities are to be accounted for in a risk analysis.

The second part of this – the risk is small, but steady – is only partially correct. It is generally recognized that the risk from pipelines is low compared to other modes of transportation for hydrocarbons. I would not characterize it as "very small" but it is low. The "steady" nature of the risk along the pipeline is only correct if we are framing the problem with individual risk. The regions through which the pipeline passes, and the particular Integrity Management activities that are implemented, do not greatly affect the individual risk posed by a pipeline.

There is an additional problem with this testimony. It makes assumptions based on facts not in the record. It assumes that Sunoco's particular HVL pipelines – the operational ME1 and 12-inch workaround lines, as well as the ME2 lines under construction – pose a specific and constant level of risk along the pipeline route. That risk, however, is not defined by Mr. Zurcher. If that risk has been defined by a Sonoco analysis, it has not been made public. And if such a definition exists, it seems that it would have been useful to Mr. Zurcher's testimony.

Q. Zurcher continues, on page 18, lines 13-15, claiming that "As the consequence of a pipeline failure increases – as it would here in a high consequence area – the likelihood of that pipeline failing must be reduced to maintain the same risk across the entire pipeline." Is this the way risk along a pipeline route is managed?

A. Here, we must make two distinctions: (1) how consequences are defined, and (2) what type of HCA is being referenced. First, in some sense, the consequences of an HVL pipeline failure are independent of where it occurs – the flammable vapor cloud or jet fire may have the same size, roughly independent of location along the pipeline route. However, if we define consequences as the number of persons affected, or number of structures damaged, then the location certainly does matter, and consequences change based on location.

Second, referring to HCAs in general is insufficient when addressing the concerns of the Complainants. A pipeline failure that is near a navigable waterway will impact people differently than one near a farming community, as would one within a densely populated area, as exist in Chester and Delaware counties.

So, the assertion that pipeline failure likelihood must be reduced to maintain risk at some constant level is far too simplistic, and in many ways a misunderstanding of how risk is calculated. In a very general way, the risk due to pipelines is managed by prioritizing inspection, maintenance, and mitigative measures for areas that could impact an HCA. The Integrity Management Program rules do not, however, require any specific quantitative measurement of risk that drives operators to reduce likelihood as population around the pipeline increases.

In this context, it must be noted once again that Mr. Zurcher has not identified any data that would suggest Sunoco has taken steps to quantitatively reduce the likelihood of Mariner East pipeline failures in densely populated areas such as Chester and Delaware Counties.

Q. Please explain how risk is calculated.

A. There are two ways to look at risk: qualitatively and quantitatively. If the evaluation is qualitative, the likelihood and consequence elements are assigned vague classifications, such as high, medium, or low. This method does have some utility but is typically only used for prioritizing the implementation of preventative or mitigation measures. In some sense, this is what the Pipeline Integrity Management rules are doing by making pipeline operators prioritize maintenance and monitoring measures in HCAs: likelihood is qualitatively lowered where the consequences of pipeline failure could, qualitatively, be larger.

When evaluating the specific risk to people along a pipeline route, there are too many relevant parameters to use a qualitative approach, so a quantitative analysis is done. This type of analysis develops quantitative measures of both consequence and likelihood and combines them with a specific, defined methodology. This analysis incorporates consequence modeling to define the extents of a wide range of potential outcomes of pipeline failure. It also incorporates historical pipeline failure rates, probabilistic weather data, and other numeric factors to fully describe the probability of unique events. The end products are measures of risk that demonstrate the declining risk as a function of distance from the pipeline or the cumulative, societal risk within a pipeline segment.

Q. On page 19, Lines 9-12, Mr. Zurcher states "So in sum, the regulations and integrity management require the risk in a high consequence area to be the same as in every other area, so that the risk is uniform across the pipeline. That means that the likelihood of a pipeline failure, by definition, is much, much lower in a high consequence area than in areas where there is low or no population …" Is this true, and is this how the Pipeline Integrity Management Program works?

A. This is false and demonstrates a significant lack of understanding regarding the risk due to pipelines. The Pipeline Integrity Management rules aim to reduce risk in HCAs, that is all. There

is no regulated metric for measuring risk to ensure that it is uniform across the pipeline as it passes through various areas.

Consider how population density might vary by orders of magnitude along a pipeline route, from areas where it is zero, through 1, 10, 1,000, or 10,000 people per square mile. By indirectly representing consequences as the number of persons affected, Mr. Zurcher implies that the expected likelihood of a pipeline failure would have to be reduced by orders of magnitude to account for increasing population. This is not feasible at the point of pipeline design, nor in operation, and in practice simply cannot be done. While certain prevention measures do reduce the likelihood of pipeline failure, there are none that can reduce the likelihood even by a factor of 10. The evaluation of Class Locations, and the associated safety factors integrated into pipeline design, does address this to some extent, but the likelihood of pipeline failure is not significantly affected by this approach.

Furthermore, Mr. Zurcher's approach would imply that a pipeline could fail every day in areas with zero population, because the risk would not be affected. Clearly this is not true, nor is it a reasonable operational strategy for a pipeline operator. The reality of pipelines is that the likelihood of failure varies only slightly along the pipeline. While prevention and mitigation measures are good things, and do marginally reduce the likelihood of pipeline failure, failures are influenced more by things such as excavation activities, metallurgical failures, terrain features, and soil corrosivity factors, even in HCAs.

Q. Why does Zurcher claim that you, as a subject matter expert, cannot focus on the likelihood of pipeline failures (page 19)?

A. Without assigning any specific motivation to Mr. Zurcher's testimony, I can only assume that he believes that pipeline failure likelihoods are more malleable than I would attribute to them. He seems to support this by suggesting that failure likelihoods are significantly affected by the types of prevention and mitigation measures that an Integrity Management Program may implement. In my experience with the PHMSA pipeline incident databases, as well as other pipeline failure analyses that have been conducted around the world, there is insufficient data to establish significant relationships between the likelihood of pipeline failure and factors such as wall thickness, inspection intervals, cathodic protection, external markings, or operating pressure as a function of maximum allowable operating pressure. So, while these factors do, arguably, reduce the likelihood of failure, there is no quantitative data that supports his assertion that implementation of these measures would reduce the likelihood to "much, much lower" (to use Mr. Zurcher's words) values than other pipelines or other portions of the same pipeline.

Failure rate differences are evident between pipes of different diameters, between different operators, and for transport of different products. Consequently, it is my experience that the likelihood of a given pipeline's failure is roughly consistent across geographic zones, including HCAs. Because of this, my previous testimony was focused on consequences rather than consequences and likelihood.

Q. So why does Mr. Zurcher, on page 19, Lines 17-19, insist that "… it is inappropriate to consider pipeline failures from the PHMSA data base that occurred in areas that were not high consequence areas."?

A. Again, this comment demonstrates a significant lack of understanding regarding the risk due to pipelines. Because pipeline failures are relatively uncommon, risk analysts MUST consider failures in all areas that a pipeline passes through. The various failure modes for pipelines are only rarely related to whether or not the pipeline is with in an HCA or not. In some sense, the pipeline doesn't care whether it is within an HCA, or whether or not it could affect an HCA. Corrosion, third-party damage, landslides, construction defects, metallurgical defects – none of these failure modes has any significant relationship to the number of persons aboveground or the sensitivity of the area along the pipeline's route. Thus, pipeline failures in all geographic regions are relevant to evaluation of failure likelihoods for pipelines.

Q. Do you believe that there is merit to Mr. Zurcher's claim on p 19, line 23 that "No such event has ever occurred in a high consequence area."?

A. No. This comment and other similar ones are simply wrong. While it may be true that there has not been a recent HVL pipeline rupture that resulted in multiple fatalities or injuries, there certainly have been ruptures within an HCA. There is ample evidence of this in the PHMSA database.

If you download and evaluate the PHMSA hazardous liquid pipelines database, you will find that there are 4,162 recorded pipeline incidents in the last ten years, that is between 2010 and June of 2020. Of those incidents, 655 involved an HVL pipeline. In 201 of those 655 incidents (31% of all incidents), the commodity reached an HCA, and in 64 of those instances the release reached a high population HCA. Additionally, 29 of the 655 HVL pipeline incidents were classified as ruptures. Cross-referencing ruptures and high population impacts shows that in the last 10 years, there have been 2 incidents classified as ruptures of HVL pipelines in high population HCAs (Sulfur, LA and Port Arthur, TX). Further analysis of the PHMSA database for previous decades would likely show similar occurrences. Thus, the assertion that such an event has never happened is false.

There is one notable incident worth mentioning within this subject matter. While not an HVL pipeline, the natural gas transmission line that ruptured in San Bruno, California (in 2010) was a pipeline rupture, was within a high population HCA, and it affected many people (unfortunately there were multiple fatalities with this incident). This pipeline was certainly subject to the pipeline integrity management rules for gas transmission pipelines and this incident demonstrates that pipeline ruptures do occur in high population areas.

Q. Mr. Marx, having read Mr. Zurcher's rebuttal testimony, what conclusions have you reached?

A. First, Mr. Zurcher's rebuttal testimony does not challenge the consequence analysis that is the core of my previous, direct testimony in this proceeding. He offers no details to suggest that the data or consequence analysis methodology I have relied upon are inaccurate. He offers no data

to suggest that my conclusions were in error. Nothing in Mr. Zurcher's rebuttal testimony has caused me to alter my opinions on the issues in this proceeding and the information and conclusions set out in my initial direct testimony stand.

Second, Mr. Zurcher's assertion that it is inappropriate to do a consequence analysis without considering likelihood is not a scientific or engineering judgement – it is just the opinion of Mr. Zurcher presented on behalf of Sunoco. He does not present data to support this opinion, nor offer any historical precedents that would suggest that this is necessary. Mr. Zurcher seems to believe that the consequences of pipeline failures can be fully defined by the numbers of persons near a pipeline, and the likelihood of pipeline failure is the variable that can be modified by pipeline operators to control risk.

Third, Mr. Zurcher's insistence on evaluating likelihood leads him to insist that Sunoco has significantly minimized the likelihood, and thus the risk, of HVL pipeline failures in high consequence areas through its Integrity Management Program. Such an assertion is not supported by the nearly two decades of pipeline incident data since the Pipeline Integrity Management Rules were promulgated. While his discussion of risk is partially based on generally recognized engineering principles, it also demonstrates a lack of understanding regarding the concepts surrounding development of risk.

Finally, Mr. Zurcher's insistence that there has never been an HVL accident in an HCA is simply incorrect. Data from PHMSA, and incidents in the public record, clearly show that there have been such incidents, both for HVL and other pipelines.

Q. Have all of your opinions and conclusions as stated in your surrebuttal testimony regarding Mr. Zurcher's rebuttal testimony been given to a reasonable degree of professional and scientific certainty?

A. Yes, they have. In the event that Sunoco or aligned intervenors provide additional testimony or documents, however, I reserve the right to modify my opinion or furnish additional evidence.