Hawke McKeon & Sniscak LLP
ATTORNEYS AT LAW

Thomas J. Sniscak
(717) 703-0800
tjsniscak@hmslegal.com

Whitney E. Snyder
(717) 703-0807
wesnyder@hmslegal.com

100 North Tenth Street, Harrisburg, PA 17101 Phone: 717.236.1300 Fax: 717.236.4841 www.hmslegal.com

July 28, 2020

VIA ELECTRONIC FILING
Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, Filing Room
Harrisburg, PA 17120

Re: Meghan Flynn, et al., Docket Nos. C-2018-3006116 & P-2018-3006117 (consolidated)
Melissa DiBernardino, Docket No. C-2018-3005025 (consolidated)
Rebecca Britton, Docket No. C-2019-3006898 (consolidated)
Laura Obenski, Docket No. C-2019-3006905 (consolidated)
Andover Homeowner's Association, Inc.; Docket No. C-2018-3003605 (consolidated)
v.
Sunoco Pipeline L.P.

SUNOCO PIPELINE L.P.'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON CONSEQUENCE WITHOUT PROBABILITY

Dear Secretary Chiavetta:

Attached for electronic filing with the Commission is Sunoco Pipeline L.P.'s Motion for Partial Summary Judgment on Consequence Without Probability. Because this document does not contain new averments of fact, it does not require a verification.

If you have any questions regarding this filing, please contact the undersigned.

Very truly yours,

/s/ Thomas J. Sniscak

Thomas J. Sniscak
Whitney E. Snyder
Counsel for Sunoco Pipeline L.P.

WES/das
Enclosure
cc: Honorable Elizabeth Barnes (by email ebarnes@pa.gov)
Per Certificate of Service

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

MEGHAN FLYNN et al.	:	Docket Nos. C-2018-3006116 (consolidated)
	:	P-2018-3006117
MELISSA DIBERNARDINO	:	Docket No. C-2018-3005025 (consolidated)
REBECCA BRITTON	:	Docket No. C-2019-3006898 (consolidated)
LAURA OBENSKI	:	Docket No. C-2019-3006905 (consolidated)
ANDOVER HOMEOWNER'S	:	Docket No. C-2018-3003605 (consolidated)
ASSOCIATION, INC.	:	
	:	
v.	:	
	:	
SUNOCO PIPELINE L.P.		

NOTICE TO PLEAD

Pursuant to 52 Pa. Code § 5.103, you are hereby notified that, if you do not file a written response to the enclosed Motion for Partial Summary Judgment on Consequence Without Probability within twenty (20) days from service of this notice, a decision may be rendered against you. Any Response to the Motion for Partial Summary Judgment must be filed with the Secretary of the Pennsylvania Public Utility Commission, with a copy served to counsel for Sunoco Pipeline, L.P., and where applicable, the Administrative Law Judge presiding over the issue.

File with:

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, Second Floor
Harrisburg, PA 17120

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

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ASSOCIATION, INC.	:	
	:	
v.	:	
	:	
SUNOCO PIPELINE L.P.		

SUNOCO PIPELINE L.P.'S
MOTION FOR PARTIAL SUMMARY JUDGMENT ON
CONSEQUENCE WITHOUT PROBABILITY

I. INTRODUCTION

Pursuant to 52 Pa. Code § 5.102, Sunoco Pipeline L.P. ("SPLP") moves for partial summary judgment of the above-captioned matter. Complainants'[1] primary allegation is that the Mariner East pipelines[2] are unsafe within the meaning of Section 1501 of the Pennsylvania Public Utility Code, 66 P.S. § 1501 because they are located in high consequence areas in Chester and Delaware counties and a release of highly volatile liquids from ME2 in these high consequence areas could cause significant injuries and death to residents. Fundamentally, Complainants allege that the potential consequences of a worst-case catastrophic release of highly volatile liquids from ME2 in a high consequence area, without offering any evidence of

[1] Unless otherwise noted, the term Complainants refers collectively to the following parties whose Complaints have been consolidated in this proceeding: Megan Flynn *et al.* (the "Flynn Complainants"); Complainant Andover Homeowner's Association, Inc.; *Pro Se* Complainant Melissa DiBernardino; *Pro Se* Complainant Rebecca Britton; and *Pro Se* Complainant Laura Obenski.

[2] The Mariner East pipelines consist of Marnier East 1, Mariner East 2, Mariner East 2X and a portion of a 12-inch diameter pipeline that is currently being used as part of Mariner East 2 (collectively "ME2").

the ***likelihood*** that such a release will actually occur, satisfies their burden of proof that ME2 is unsafe within the meaning of Section 1501.

On the contrary, Administrative Law Judge Elizabeth H. Barnes ("ALJ Barnes") and the unanimous Commission held that evidence of the consequences of a release from ME2 without evidence of the probability of that release actually occurring is insufficient to establish that ME2 violates Section 1501 of the Public Utility Code. ALJ Barnes' decision is consistent with the standard for establishing when a utility is unsafe under Section 1501. *See Povacz v. PECO Energy Company*, Docket No. C-2015-2475023, Opinion and Order (Order entered March 28, 2019), *appeal docketed*, No. 492 CD 2019 (Commw. Ct. April 26, 2019) (the fact that hazard exists and there is a potential for harm is not sufficient to prove utility is unsafe under Section 1501, actual harm must be proved; and it is a logical fallacy to equate a hazard with actual exposure to harm). *See also Randall v. PECO*, Docket No. C-2016-2537666, Opinion and Order (Order entered May 9, 2019), *appeal docketed*, No. 607 CD 2019 (Commw. Ct. May 22, 2019) (proper focus of an inquiry regarding the safety of a utility facility or service is whether the preponderance of the evidence demonstrates that a utility facility or service caused or will cause harm to the public.)

Despite offering Complainants the opportunity to provide the necessary expert testimony on probability at the initial in-person hearing seeking interim emergency relief, in the initial in-person hearing on the Complaint docket, in their direct written testimony and in their rebuttal testimony, and openly questioning whether Complainants "read my decision," Complainants either expressly stated that they would continue to provide only testimony on consequence, not probability, or stated that they intended to provide testimony on probability, but failed to do so. Therefore, Complainants have failed to present a genuine issue of material fact for hearing and meet their burden of proof to show a violation of Section 1501 of the Public Utility Code, Commission regulations or Commission Order on the basis of consequence without evidence of risk or probability.

Moreover, pipeline safety law and regulations expressly authorize the location and operation of hazardous volatile liquid pipelines in high consequence areas, such as the urbanized and heavily populated areas in Delaware and Chester counties. *See* 52 Pa. Code § 59.33(b) (incorporating 49 U.S.C.A. §§ 60101-60503 and 49 C.F.R. Part 195 regulations as safety standards for hazardous liquid public utilities); 49 U.S.C. § 60109; 49 C.F.R. §§ 195.1(a)(1), 195.450 and 195.452. Highly volatile liquid pipelines have been expressly authorized to safely operate in high consequence areas since minimum federal pipeline safety regulations were established over fifty years ago, including after the integrity management regulations were promulgated twenty years ago. Therefore, Complainants' argument that simply locating ME2 in a high consequence area is unsafe under Section 1501 directly conflicts with pipeline safety regulations and the authorizations contained in 49 U.S.C. § 60109 and 49 C.F.R. § 195.452.

Simply stated, Complainants have failed to present any evidence, much less substantial evidence necessary to sustain their burden, of the probability or risk of a catastrophic or other release from ME2. The potential consequences of a catastrophic release, without evidence of the likelihood of that release occurring, does not render ME2 unsafe within the meaning of Section 1501 as a matter of law. In addition, Complainants' arguments that ME2 is unsafe simply because it is located in high consequence areas in Delaware and Chester counties directly contravenes the Commission's regulations. Therefore, SPLP is entitled to summary judgment on this issue as a matter of law.

II. STATEMENT OF UNDISPUTED FACTS

1. Complainants challenge and are attempting to enjoin the continued operation of ME2 in Chester County and Delaware County.

2. Section 1501 of the Pennsylvania Public Utility Code requires public utilities, including SPLP's Mariner East pipelines, to "furnish and maintain adequate, efficient, safe and reasonable service and facilities, and shall make all such repairs, changes, alterations, substitutions, extensions, and improvements in or to such service and facilities as shall be necessary or proper for the accommodation, convenience, and safety of its patrons, employees, and the public." 66 Pa. C.S. § 1501.

3. The Flynn Complainants argue that ME2 violates Section 1501 because they claim the pipelines are unsafe for various reasons, including that the pipelines are inherently dangerous because they are located in high consequence areas in Chester and Delaware counties. *See e.g.*, Flynn Complainants Second Am. Compl. ¶ 24; *see also* 49 C.F.R. § 195.450 (definition of high consequence area includes high population areas, i.e., urbanized areas, or other areas with concentrated populations). Likewise, Complainant Andover Homeowner's Association, Inc. and *pro se* Complainants Ms. DiBernardino, Ms. Britton, and Ms. Obenski also allege that the location of ME2 in high consequence areas of Chester and Delaware counties make the pipelines inherently unsafe. *See* Andover Compl. ¶¶ 75, 88; DiBernardino Compl. at 15; Britton Compl. at 4, 7, 8, 19, 24; Obenski Compl. at 7-9.

4. Complainants and aligned-intervenors were provided four separate opportunities to present testimony and documentary evidence in this matter: (1) an in-person hearing on the Flynn Complainants' Petition for Interim Emergency Relief held on November 29-30, 2018; (2) a lay witness in-person hearing held on October 23-24, 2019 and continued on November 20,

2019; (3) pre-filed written expert testimony required to be submitted by January 15, 2020 in accordance with the Your Honor's procedures and case management orders; and (4) pre-filed written surrebuttal testimony required to be submitted by July 15, 2020.

5. In support of the allegations regarding potential consequences of a pipeline release or failure, the only party who presented any expert testimony on this issue was the Flynn Complainants, who presented the pre-filed direct testimony and surrebuttal testimony of Jeffrey Marx, a process safety engineer with Quest Consultants. Mr. Marx first testified by telephone during the November 29-30, 2018 hearing on the Flynn Complainants' Petition for Interim Emergency Relief. *See generally* N.T. at 247-343. Thereafter, Mr. Marx submitted pre-filed written, direct testimony on January 15, 2020, a copy of which is attached as Exhibit "1," and pre-filed written surrebuttal testimony on July 15, 2020, a copy of which is attached as Exhibit "2."

6. During the November 2018 hearing requesting interim emergency relief, the Flynn Complainants called Mr. Marx to testify, and Mr. Marx testified by telephone. Mr. Marx did not provide any testimony about the probability or likelihood of a catastrophic or other release from ME2 occurring, and his testimony was limited to the consequences should a catastrophic release occur. During the direct examination of Mr. Marx, the Flynn Complainants offered into evidence a report prepared by Mr. Marx for Quest Consultants entitled *Quantitative Risk Analysis for the Mariner East Pipeline Project* (Oct. 16, 2018) (the "Quest Report"). The Quest Report contained some discussion of the likelihood of a catastrophic release from ME2. ALJ Barnes admitted the Quest Report over SPLP's objection. *See* N.T. 277:3-10; *see also* P-5. During SPLP's cross-examination of Mr. Marx, however, the Flynn Complainants withdrew the Quest Report from evidence and it was not part of the record. *See* Tr. 329:14-330:3; *see also*

Order Denying Petition for Emergency Interim Relief and Certifying Material Question (Dec. 11, 2018) at 11.

7. During the in-person hearing for Emergency Interim Relief, Flynn Complainants' counsel also conceded during a colloquy on the issue of the admissibility of the Quest Report and Mr. Marx's related testimony that the Flynn Complainants would not present any evidence of the probability of a release from ME2, conceding that the likelihood or risk of a release is not part of the Flynn Complainants' case:

> ***Our case has not been about the frequency of events or risk analysis***, it's solely in the event that something happens, this is what is likely to occur. That's consequence analysis.
> . . .
> This particular aspect of the report has nothing to do with the case, because as Mr. Marx stated at the beginning, risk, as he uses it, is a function of both frequency and consequences. We have not talked about frequency. We've conceded that the relative incidence of events is small. If that's what he is trying to establish, we said that at the outset of the case . . .

N.T. 327:18-21, 328:11-17 (emphasis added); *see also* N.T. at 353:14-18 ("this case from our perspective is not about the risk of an event happening. . . We concede that.").

8. Following the hearing, ALJ Barnes issued an order denying the Flynn Complainants' Petition for Interim Emergency Relief. *See* Order Denying Petition for Emergency Interim Relief and Certifying Material Question (Dec. 11, 2018).

9. As a result of the withdrawal of the Quest Report during the November 2018 hearing, ALJ Barnes held in the December 11, 2018 Order that without evidence or probability of a pipeline release or failure, the potential consequence of such an event was insufficient as a matter of law to meet Complainants' burden on whether ME2 was unsafe so as to grant emergency relief:

> Petitioners' claims and arguments as to the hypothetical consequences of a release from the pipelines have little foundation.
> . . .
> Lastly, Petitioners conceded that the probability or risk of the catastrophic events including fatalities is not something they were attempting to prove. N.T. 327-328. ***Petitioners' argument that the showing of a consequence without the risk of consequence is sufficient to meet the standard of an emergency is not persuasive***. Therefore, I find in favor of Sunoco on this issue.

See Order Denying Petition for Emergency Interim Relief and Certifying Material Question (Dec. 11, 2018) at 11-13 (emphasis added).

10. ALJ Barnes further held that: "I find Petitioners have failed to demonstrate that the need for relief is immediate in that they presented no evidence regarding the likelihood, *i.e.* risk, of a fatality occurring due to an accidental leak on any of the Mariner East Projects." *Id.* at 13.

11. The Commission unanimously agreed and affirmed ALJ Barnes' December 11, 2018 Order denying the Flynn Complainants' Petition for Interim Emergency Relief. *See* Opinion and Order (Feb. 1, 2019), at 19-20. The Commission held that "[w]ithout ruling upon whether the Complainants may be able to prove any of their allegations against Sunoco in the accompanying complaint case, a review of the record shows that it does not set forth a clear and present danger to life or property under the facts presented by Petitioners in this matter." *Id.* at 18.

12. The Commission further noted that the case would proceed on the underlying allegations in the Complaint, in which Complainants "will now have a full opportunity to present their concerns and evidence to support their allegations of violations in the accompanying Complaint docket." *Id.* at 19.

13. Thus, all Complainants were given a second opportunity to introduce evidence in the record in this case to establish that ME2 is unsafe, including as relevant for this motion, to provide the necessary evidence on the probability of a pipeline release.

14. During the lay witness in-person hearings in October and November 2019, Complainants were provided the opportunity to present lay testimony in support of their Complaints.

15. During questioning of Eric Friedman, president of Complainant Andover Homeowner's Association, Inc., counsel attempted to again introduce the Quest Report for the limited purpose to show Mr. Friedman's knowledge and awareness of the report. ALJ Barnes denied admission of the Quest Report after a lengthy colloquy following SPLP's objection to the report's introduction. *See* N.T 753:11-756:21 (colloquy regarding Marx's prior testimony and report withdrawal from evidence); N.T. 768:21-770:1 (colloquy regarding attempt to introduce report and conclusions in report); NT 772:17-773:7 (colloquy and sustaining objection to introduce report); *see also* N.T. at 1045:5-21 (sustaining objection to narration in Exhibit Hughes 5 drone video regarding Quest Report, and confirming report was not in evidence).

16. During that colloquy, in direct response to questions from ALJ Barnes, counsel for the Flynn Complainants again reiterated that "[r]isk is not part of this case" and that "[i]t's not part of our case." N.T. 1171:13-1174:13. Also during that colloquy, ALJ Barnes expressly reminded the parties of her prior December 11, 2018 ruling about the requirement to introduce for evidence of the probability or likelihood that a release from ME2 will occur. ALJ Barnes could not have been any clearer: "Did you not read my decision?" N.T. 1174:9-10.

17. During the in-person lay witness hearing, only one of the Complainants, Ms. Britton, stated that probability of a pipeline release or failure remained part of her case. *See* N.T.

1173:17-18. But Ms. Britton did not present any expert testimony on the issue of the probability of pipeline or likelihood of a pipeline failure or release; indeed, Ms. Britton did not present expert testimony on any topic. No intervenor or Complainant has introduced any expert or other testimony on the probability or likelihood of a pipeline release or failure, particularly the worst-case, catastrophic failure that is the subject of Mr. Marx's testimony, and the entire predicate for the claim that the presence of ME2 in the high consequence areas of Chester and Delaware counties is unsafe.

18. Subsequent to the in-person hearing, Complainants and intervenors submitted direct written testimony on January 15, 2020. No testimony was submitted about the probability or likelihood of a release from ME2. Instead, the Flynn Complainants submitted the direct written testimony of Mr. Marx, which simply repeated his testimony at the hearing for interim emergency relief that focused on consequence only, and eschewed any testimony on likelihood or risk. (See Exhibit 1 hereto).

19. Consistent with the representations of the Flynn Complainants' counsel at the in-person hearing, Mr. Marx's written direct testimony is entirely devoid of probability analysis, which is a necessary prerequisite for demonstrating that a pipeline is unsafe pursuant to Section 1501 of the Public Utility Code. *See* Exhibit 1.

20. Specifically, the Flynn Complainants offered Mr. Marx as an expert on a variety of topics, including a "consequence assessment for leaks/explosions in Chester and Delaware Counties." Exhibit 1 at 8. The probability of a leak/explosion of ME2 is not listed as a topic of Mr. Marx's testimony.

21. Mr. Marx further describes the purpose of his retention as follows:

> Q: So as far as you know, what is the reason Quest was retained in this proceeding?

> A: Quest was retained to assess the ***potential consequences*** associated with the Mariner East pipeline project in Chester and Delaware Counties, Pennsylvania. The objective of this work was to leverage previous work completed by Quest, along with an understanding of highly volatile liquid (HVL) release properties and the associated hazards in order to form a better understanding of the ***potential consequences*** to persons in the vicinity of the Mariner East pipeline project(s).

Exhibit 1, at 10:20, 11:1-6 (emphasis added). Again, Mr. Marx's testimony was limited to consequence analysis, not probability analysis.

22. In his summary of topics covered and key findings, Mr. Marx's direct testimony identifies hazards and consequences, but yet again no probability analysis. *Id.* at 11-12.

23. In his July 15, 2020 written surrebuttal testimony (Exhibit 2), Mr. Marx retains his sole focus on consequence analysis to the exclusion of probability analysis. Mr. Marx asserts over and over that consequence analysis is sufficient. As for evaluating the specific risk to people along a pipeline route, however, Mr. Marx concedes there are too many relevant parameters to use a qualitative approach, so a quantitative analysis is the proper method. Mr. Marx describes the quantitative analysis, which he admittedly did not perform, as follows:

> This type of analysis develops quantitative measures of ***both*** consequence and likelihood and combines them with a specific, defined methodology. The analysis incorporates consequence modeling to define the extent 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***.

Ex. 2, 6:28-33 (emphasis added).

24. Mr. Marx performed only the first part of that evaluation – consequence analysis. Mr. Marx ignored the second part of the evaluation – probability or likelihood analysis. Mr. Marx himself acknowledges that his testimony "was focused on consequences rather than consequence and likelihood." *Id*. at 7:42-43.

III. SUMMARY OF ARGUMENT

25. The absence of any evidence on probability is fatal to Complainants' claim that ME2 is unsafe solely because of the potential consequence in the unlikely event of a catastrophic release. As ALJ Barnes has already ruled and as the Commission has already unanimously affirmed, testimony regarding consequence without corresponding testimony of likelihood or risk is not substantial evidence to meet Complainants' burden of proving that the location of ME2 in high consequence areas is unsafe under Section 1501 of the PUC Code. *See* Order Denying Petition for Emergency Interim Relief and Certifying Material Question (Dec. 11, 2018), at 11-14; Opinion and Order (Feb. 1, 2019), at 19-20. ALJ Barnes' ruling follows precisely the Commission's standard for establishing what is unsafe under Section 1501. *See Povacz v. PECO Energy Company*, Docket No. C-2015-2475023, Opinion and Order (Order entered March 28, 2019), *appeal docketed*, No. 492 CD 2019 (Commw. Ct. April 26, 2019). *See also Randall v. PECO*, Docket No. C-2016-2537666, Opinion and Order (Order entered May 9, 2019), *appeal docketed*, No. 607 CD 2019 (Commw. Ct. May 22, 2019).

26. Mr. Marx's testimony is not only insufficient to meet Complainants' burden of proof on issues relating to safety under Section 1501, it also directly contradicts the Commission's regulations relating to hazardous volatile liquid pipelines which are authorized to be located in and provide transportation services through high consequence areas, like ME2. *See* 49 C.F.R. § 195.450 (definition of high consequence area); 49 C.F.R. § 195.452 (pipeline integrity management in high consequence areas); *see also* 49 U.S.C. § 60109. Contrary to Mr. Marx's testimony, 49 C.F.R. § 195.452 expressly authorizes the location of hazardous volatile liquid pipelines in the high consequence areas in Chester and Delaware counties that Mr. Marx testifies would be unsafe to do. Section 195.452 addresses the concerns Mr. Marx

identifies regarding consequences by imposing specific regulatory requirements for pipelines located in those high consequence areas to lower the risk of pipeline releases and/or failure. *See* 49 C.F.R. § 195.452; *see also* 49 U.S.C. § 60109.

27. In short, Mr. Marx's exclusive focus on consequences is of no consequence because, as a matter of law, location of ME2 in a high consequence area is expressly authorized by 49 C.F.R. § 195.452. *See also* 49 U.S.C. § 60109. Complainants' only remedy is through legislation and promulgation of a new regulation,[3] not through this adjudication.

28. There is no disputed issue of material fact – Complainants have not presented any evidence regarding the probability or likelihood that a pipeline release or failure might occur and Complainants' arguments contravene PUC's regulations authorizing ME2 to be located in high consequence areas. Therefore, SPLP is entitled to summary judgment on this issue as a matter of law under Section 1501 of the Public Utility Code and 49 C.F.R. § 195.452. *See also* 49 U.S.C. § 60109.

IV. <u>ARGUMENT</u>

A. <u>Legal Standards</u>

29. Pursuant to 52 Pa. Code § 5.102, SPLP moves for partial summary judgment as the pleadings and testimony show that there is no genuine issue as to a material fact and SPLP is entitled to a judgment as a matter of law regarding the safety of the Mariner East pipelines.

30. A ruling for summary judgment, where properly exercised, serves judicial economy by avoiding a hearing where no factual dispute exists. If no factual issue pertinent to

[3] Because federal law expressly allows for hazardous liquid pipelines, including highly volatile liquid pipelines, in high consequence areas, SPLP does not believe the Commission can validly promulgate a regulation without legislative change. 49 U.S.C. § 60109. Further, any safety standards adopted by the Commission must be "compatible with the minimum standards prescribed" under the Pipeline Safety Act and thus PHMSA rules at 49 C.F.R. Part 195. 49 U.S.C. § 60104(c).

the resolution of a case exists, a hearing is unnecessary. 66 Pa. C.S. § 703(a); *Lehigh Valley Power Committee v. Pa. PUC*, 563 A.2d 557 (Pa. Cmwlth. 1989); *S.M.E. Bessemer Cement, Inc. v. Pa. PUC*, 540 A.2d 1006 (Pa. Cmwlth. 1988); *Walter Painter and Donna Painter v. Aqua Pennsylvania, Inc.*, Dkt. No. C-2011-2239556 (Order entered May 22, 2014).

31. The Commission's regulation at 52 Pa. Code § 5.102(a) permits any party to move for summary judgment. A motion for summary judgment must be based on the pleadings and depositions, answers to interrogatories, admissions and supporting affidavits. 52 Pa. Code § 5.102(c).

32. Testimony served in a proceeding is treated as the affidavit of the submitting party for purposes of ruling on a motion for summary judgment. *See, e.g.*, *Re AT&T Communications of Pennsylvania, Inc.*, Dkt. No. P-880306, 80 Pa.P.U.C. 349, 1993 WL 493599, Initial Decision (ALJ Schnierle, entered Jan. 22, 1993) ("Here, I am treating the direct testimony filed by the Staff as the affidavits of that party."), *aff'd* (Order entered Sept. 13, 1993). Oral testimony may also be considered when deciding a motion for summary judgement. *See, e.g.*, *Application of Kenneth Scott Cobb*, Dkt. No. A-2011-2280175, Initial Decision (ALJ Barnes, entered Dec. 4, 2012) (Final by Act 294 Jan. 7, 2013).

33. The moving party bears the burden of showing that no genuine issue of material fact exists and that it is entitled to judgment as a matter of law. The Commission must view the record in the light most favorable to the non-moving party, giving that party the benefit of all reasonable inferences. *First Mortgage Co. of Pennsylvania v. McCall*, 459 A.2d 406 (Pa. Super. 1983).

34. The nonmoving party may not simply rest upon the mere allegations or denials of its pleading but must set forth facts showing that there is a genuine issue for trial. *CRH Catering*

Co., Inc., Dkt. No. C-2014-2415277, 2015 WL 849251, at *6 (Pa. P.U.C. 2015), citing *Fiffick v. GAF Corp.*, 603 A.2d 208 (Pa. Super. 1991) (discussing the Pennsylvania Rules of Civil Procedure). Assertions, personal opinions, or perceptions do not constitute evidence. *Mable Lekawa*, Dkt. No. F-2017-2629733, 2018 WL 5994785, at *11 (Nov. 6, 2018), *citing Pa. Bureau of Corrections v. City of Pittsburgh*, 532 A.2d 12 (Pa. 1987).

35. The Commission is granted discretion to dismiss any complaint without a hearing if, in its opinion, a hearing is not necessary in the public interest. 66 Pa. C.S. § 703(b); 52 Pa. Code § 5.21(d). A hearing is necessary only to resolve disputed questions of fact, and when the question presented is one of law, the Commission need not hold a hearing. *Lehigh Valley Power Comm. v. Pa. Pub. Util. Comm'n*, 563 A.2d 548 (Pa. Cmwlth. 1989); *Edan Transp. Corp. v. Pa. Pub. Util. Comm'n*, 623 A.2d 6 (Pa. Cmwlth. 1993).

36. As the proponent of an order, Complainants have the burden of proof under 66 Pa. C.S. § 332(a). To establish a sufficient case and satisfy the burden of proof, Complainants must show that the respondent public utility is responsible or accountable for the problem described in the Complaint. *Patterson v. Bell Telephone Co. of Pennsylvania*, 72 Pa. PUC 196 (1990); *Feinstein v. Philadelphia Suburban Water Co.*, 50 Pa. PUC 300 (1976). Such a showing must be by a preponderance of the evidence. *Samuel J. Lansberry, Inc. v. Pa. Pub. Util. Comm'n,* 578 A.2d 600, 602 (Pa. Cmwlth. 1990), *app. denied*, 529 Pa. 654 (Pa. 1992). A preponderance of the evidence is established by presenting evidence more convincing, by even the smallest amount, than that presented by the other party. *Se-Ling Hosiery v. Margulies*, 70 A.2d 854 (Pa. 1950).

37. Additionally, any finding of fact necessary to support the Commission's adjudication must be based upon substantial evidence. *Mill v. Pa. Pub. Util. Comm'n*, 447 A.2d 1100 (Pa. Cmwlth. 1982); *Edan Transportation Corp. v. Pa. Pub. Util. Comm'n*, 623 A.2d 6 (Pa.

Cmwlth. 1993); 2 Pa.C.S. § 704. "Substantial evidence has been defined as such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *Bethenergy Mines, Inc. v. Workmen's Compensation Appeal Bd.*, 612 A.2d 434, 436 (Pa. 1992); *see also Norfolk and Western Ry. v. Pa. Pub. Util. Comm'n*, 413 A.2d 1037, 1047 (Pa. 1980). "It requires more than a mere scintilla of evidence or suspicion of the existence of a fact to be established." *Murphy v. Dep't. of Public Welfare, White Haven Center*, 480 A.2d 382 (Pa. Cmwlth. 1984); *see also Erie Resistor Corp. v. Unemployment Compensation Bd. of Review*, 166 A.2d 96, 97 (Pa. Super. Ct. 1960) (same). Thus, substantial evidence requires competent and certain evidence.

38. "For the Commission to sustain a complaint brought under this section [66 Pa. C.S. § 1501], the utility must be in violation of its duty under this section. Without such a violation by the utility, the Commission does not have the authority, when acting on a customer's complaint, to require any action by the utility." *Seese v. PPL Elec. Util's Corp.*, Dkt. No. C-2015-2500818, Initial Decision at *5 (ALJ Barnes, entered Mar. 17, 2016) (Final via Act 294) (citing *West Penn Power Co. v. Pa. Pub. Util. Comm'n*, 478 A.2d 947 at 949 (Pa. Cmwlth. 1984)); *see also Rahn, Township of Spring, et al. v. Pennsylvania-American Water Company*, Dkt. Nos. C-20054919 et al, 2007 WL 2198196 at *6 (Order entered Jul. 27, 2007) (denying request for geophysical testing where no credible evidence that some act or omission by utility in violation of the Code or Commission regulations would be remedied by geophysical testing).

39. Here, to find a violation of 66 Pa. C.S. § 1501, the Commission must find that SPLP violated a pipeline safety regulation. *See Bennett v. UGI Central Penn Gas, Inc.*, Dkt. No. F-2013-23966l1, Initial Decision (ALJ Salapa) (Order final via Act 294 on April 10, 2014).

40. Moreover, a utility has managerial discretion in its operations that the Commission cannot interfere with unless it is proven that the utility has manifestly abused that discretion:

> Under the "management discretion doctrine," the Commission may not interfere with or micromanage utility management decisions, unless there is a manifest abuse of discretion or some showing of arbitrary utility action. *Pa. PUC v. Philadelphia Electric Co*., 522 Pa. 338, 561 A.2d 1224 (1989); and *Petition of Frank Bankard*, Docket No. P-00052172 (April 21, 2006). A public utility is not a guarantor of either perfect service or the best possible service. *Re: Metropolitan Edison Co.*, 80 Pa. P.U.C. 662 (1993), and *Troutman v. Somerset Rural Electric Cooperative*, 65 Pa. P.U.C. 170 (1987). A spectrum of acceptable behavior exists based upon the particular facts of each case. *Borough of Sewickley v. Verizon Pennsylvania Inc.*, Docket No. C-00003256, 2001 Pa. PUC LEXIS 29 (June 21, 2001).

Rahn, Township of Spring et al. v. Pennsylvania-American Water Company, Dkt. Nos. C-20054919 et al, 2007 WL 2198196 at *6 (Order entered Jul. 27, 2007).

41. Thus, any type of relief from this Commission requires a showing of a violation the Public Utility Code, Commission regulations, or Commission order. As to injunctive relief, it is an extreme remedy and must be narrowly tailored to abate the harm complained of:

> Injunctive relief must be narrowly tailored to abate the harm complained of. *Pye v. Com. Ins. Dep't*, 372 A.2d 33, 35 (Pa. Cmwlth. 1977) ("An injunction is an extraordinary remedy to be granted only with extreme caution"); *Woodward Twp. V. Zerbe*, 6 A.3d 651, 658 (Pa. Cmwlth. 2010) ("Even where the essential prerequisites of an injunction are satisfied, the court must narrowly tailor its remedy to abate the injury"); *West Goshen Township v. Sunoco Pipeline L.P.*, Docket No. C-2017-2589346 at 17-18 (Order entered Mar. 15, 2018).

West Goshen Township v. Sunoco Pipeline L.P., Dkt. No. C-2017-2589346, Initial Decision at 42, (ALJ Barnes entered Jul. 19, 2018), *aff'd* (Order entered Oct. 1, 2018).

B. SPLP is entitled to summary judgment on consequence analysis because Complainants failed to present any evidence on the probability or likelihood of a pipeline release or failure under Section 1501 of the PUC Code and because Complainants' position contravenes 49 U.S.C. § 195.452

42. It is undisputed that none of the Complainants or intervenors has presented any expert testimony on the probability or likelihood of a pipeline release or failure. Without this necessary evidence, Complainants have not, and cannot, sustain their burden of proving that the consequence of a pipeline release or failure alone renders the Mariner East pipelines unsafe or otherwise constitutes a violation of Section 1501 of the Public Utility Code.

43. In this case, Flynn Complainants request that the Commission permanently enjoin the operation of the Mariner East pipelines. *See* Flynn et al. Second Am. Compl. at 32, 33, 34. Complainant Andover Homeowner's Association likewise requests injunctive relief from the Commission, including performing a risk assessment and restricting operations of the Mariner East pipelines. *See* Andover HOA Compl. at 23. *Pro se* Complainant Melissa DiBernardino also requests that operation of the Mariner East pipelines be suspended. *See* DiBernardino Compl. at 15. *Pro se* Complainant Rebecca Britton requests that the Commission make various determinations regarding the safety of the operation and construction of the Mariner East pipelines. *See* Britton Compl. at 24-25. *Pro se* Complainant Laura Obenski likewise requests that SPLP suspend operation and construction of the Mariner East pipelines. *See* Obenski Compl. at 9.

44. The record in this case, viewed in the light most favorable to Complainants, does not support the injunctive relief requested. *See Williams Pipe Line Co. v. Mounds View*, 651 F.Supp. 544 (D. Minn. 1986) (Denying motion for preliminary injunction of pipeline operations based on citizens' safety concerns, acknowledging that "[h]azardous liquid pipelines run through 21 states, and presumably through small and large plots of land belonging to vast numbers of

persons. Were each of these landowners entitled to demand compliance with their own safety standards, the clear Congressional goal of a national standard for hazardous liquid pipeline safety would be thwarted.”).

45. Complainants have the burden of proving by substantial evidence that the Mariner East pipelines are unsafe or otherwise violate Section 1501 of the Public Utility Code, based on one of various theories alleged in their Complaints. Here, Complainants have the burden of establishing by substantial evidence both the probability or likelihood of a release from ME2 as well as the potential consequences of such a pipeline release in order to demonstrate that ME2 is unsafe under Section 1501. Without evidence of the likelihood that such a release or failure could occur, Complainants cannot meet their burden of proof to demonstrate that ME2 is unsafe.

46. The only expert testimony Complainants have presented on this issue is that of Mr. Marx, who expressly and unabashedly fails to present any testimony or other evidence regarding the probability of a pipeline release or failure. *See* Exhibits 1 and 2. Rather, Mr. Marx focuses only on the consequence of a hypothetical worst-case, catastrophic release or failure. *See id.*

47. The Flynn Complainants and their counsel have repeatedly conceded in writing and at two prior in-person hearings that they are not presenting any evidence of the probability or likelihood of a pipeline release or failure in this case. *See supra*. Instead, they attempt to meet their burden of proving that the ME2 is unsafe or violate the Commission’s regulations solely based upon the consequences of hypothetical release or worst case failure scenarios.

48. But ALJ Barnes and the Commission have already held that testimony regarding potential consequences of a pipeline incident without also demonstrating the corresponding risk or probability that the pipeline incident might occur is insufficient as a matter of law to

demonstrate that the pipelines are unsafe. *See* Order Denying Petition for Emergency Interim Relief and Certifying Material Question (Dec. 11, 2018), at 11-14; Opinion and Order (Feb. 1, 2019), at 19-20.

49. Judge Barnes' ruling properly applies the standard established by the Commission for determining whether a utility is unsafe and under Section 1501. In *Povacz v. PECO Energy Company*, Docket No. C-2015-2475023, Opinion and Order (Order entered March 28, 2019), *appeal docketed*, No. 492 CD 2019 (Commw. Ct. April 26, 2019), Complainant alleged that a PECO smart meter had the potential to cause her an adverse health effect and therefore was unsafe under Section 1501. Complainants' primary expert testified that although there was the "potential" for an adverse health effect, he could not render an opinion that the smart meter caused actual harm.

50. The Commission ruled that Complainant had not met its burden of proof under Section 1501. In so doing, the Commission held that "when the prevention of harm is involved, the question becomes whether the preponderance of the evidence demonstrates that a utility's service or facilities **will cause harm**." (emphasis added) Opinion at 29. For that reason, the Commission held that the Complainant "must demonstrate by a preponderance of the evidence a `conclusive casual connection' between the low-level RF exposure from a PECO smart meter and the alleged adverse human health effects." *Id.* at 28.

51. The Commission expressly rejected Complainant's position that it could meets its burden of proof under Section 1501 merely by offering evidence of the possibility of harm. The Commission held:

> Our concern with the Complainant's `potential for harm' or `capable of causing harm' standard under Section 1501, which we reject, is that it allows the mere demonstration by a preponderance of the

> evidence that a hazard exists in utility service to be sufficient to prevail under Section 1501 . . .
>
> The Complainants standard rests upon a logical fallacy that equates any hazard with exposure to harm and, on that basis, according to Complainant, all hazards must be removed from utility service or facilities in order to be safe. However, even a layperson knows that public utility operations are not, as a general matter, hazard free.

Id. at 30.

52. Indeed, the Commission goes on to hold that application of the "potential harm" standard is an "overreach" and would have "dire consequences to the daily functioning and operation of public utilities and the provision of utility services within the Commonwealth as well as to our execution of our safety oversight authority over public utility operations." *Id.* at 31. Because Complainants' expert would only offer an opinion on the potential for harm, not that an actual harm had or would occur, the Commission ruled that Complainants had not met its burden of proof .

53. *Povacz* is dispositive of the issue in this Complaint docket. In *Povacz*, Complainants at least offered expert testimony on the possibility that harm could occur. In the instant matter, the Flynn Complainants' expressly declined to do so and no other party offered evidence on the probability of a release from ME2. In the absence of any evidence of the probability of a release from ME2, the Complainants in this docket are left with only the fact that the operation of ME2 is not hazard or "consequence" free, the exact proof that the Commission has held to be insufficient under Section 1501. *See also Randall v. PECO*, Docket No. C-2016-2537666, Opinion and Order (Order entered May 9, 2019), *appeal docketed*, No. 607 CD 2019 (Commw. Ct. May 22, 2019).

54. Complainants were given nearly two years to develop this additional evidence. The Flynn Complainants concede that they have intentionally chosen not to present evidence of

risk or probability of pipeline failures. And the only other party who raised this issue, *pro se* Complainant Rebecca Britton, offered no expert testimony on risk, or any other expert testimony in this case.

55. In essence, what Complainants' are attempting to do is re-litigate an issue that has already been decided against them by ALJ Barnes and the Commission and is settled PUC law.

56. Complainants' reliance on consequence analysis alone is also an attempt to amend existing pipeline law and regulations, not through proper legislative and rulemaking procedures, but impermissibly through this adjudication. Specifically, to the extent that Complainants' position is that ME2 is inherently unsafe because the pipelines are located in a high consequence area, federal pipeline safety law and PHMSA regulations, which are adopted and incorporated into the Commission's regulations, also foreclose this argument as a matter of law. *See* 49 C.F.R. § 195.1(1)(a) (authorizing the transportation of highly volatile liquid in pipelines under PHMSA regulations); 49 C.F.R. § 195.450 (defining high consequence areas to include highly volatile liquid pipelines in certain populated or environmentally sensitive areas); 49 C.F.R. § 195.452 (detailing pipeline integrity management requirements applicable to pipelines in high consequence areas based on risk); *see also* 49 U.S.C. § 60109 (requiring integrity management regulations applicable to pipelines located in or near high consequence areas). The applicable law and regulations authorize the location of ME2 in the same high consequence areas of Delaware and Chester counties that Mr. Marx testifies are unsafe. Complainants' only potential avenue for a remedy is through a regulatory change, not in this adjudication.

57. As Complainants have not presented any evidence of the probability or likelihood of a pipeline release or failure, and because federal and state pipeline safety law and regulations expressly allow for pipelines to be located in a high consequence area, Complainants cannot

sustain their burden of demonstrating that ME2 is unsafe or presents a violation of Section 1501 of the Public Utility Code. Therefore, SPLP is entitled to summary judgment on these issues as a matter of law.

V. CONCLUSION

WHEREFORE, SPLP respectfully requests that Your Honor grant its motion for partial summary judgment and rule that Complainants have not met their burden with sufficient evidence to demonstrate that the Mariner East pipelines violate Section 1501 of the Public Utility Code based solely on the potential consequences of a release from or failure of the pipelines or location in a high consequence area.

Respectfully submitted,

/s/ Thomas J. Sniscak
Thomas J. Sniscak, Esq. (PA ID No. 33891)
Whitney E. Snyder, Esq. (PA ID No. 316625)
Hawke, McKeon & Sniscak LLP
100 North Tenth Street
Harrisburg, PA 17101
Tel: (717) 236-1300
tjsniscak@hmslegal.com
wesnyder@hmslegal.com

/s/ Robert D. Fox.
Robert D. Fox, Esq. (PA ID No. 44322)
Neil S. Witkes, Esq. (PA ID No. 37653)
Diana A. Silva, Esq. (PA ID No. 311083)
MANKO, GOLD, KATCHER & FOX, LLP
401 City Avenue, Suite 901
Bala Cynwyd, PA 19004
Tel: (484) 430-5700
rfox@mankogold.com
nwitkes@mankogold.com
dsilva@mankogold.com

Attorneys for Respondent Sunoco Pipeline L.P.

Dated: July 28, 2020

<u>Exhibit 1</u>

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	:	

DIRECT TESTIMONY OF

JEFFREY D. MARX

ON BEHALF OF

FLYNN COMPLAINANTS

JEFF MARX Q&A

I. Voir Dire and Background

Q. Mr. Marx, what do you do for a living?

A. I am a process safety engineer.

Q. **And by whom are you employed?**

A. Quest Consultants.

Q. **Would you tell the Court your educational background?**

A. I have a Bachelor's Degree in Mechanical Engineering from the University of Oklahoma, and a Master's Degree in Mechanical Engineering from Georgia Institute of Technology.

Q. **Do you have in front of you a copy your curriculum vitae, marked as Exhibit Marx-1?**

A. Yes.

Q: Is this a current copy of your CV?

A: Yes, it is.

We offer Flynn Complainants' Exhibit Marx-1 into evidence

Q. **Now, I note that even before you got your mechanical engineering degree in 1993, you already were working as an engineer trainee at Quest doing consequence analysis studies. What is consequence analysis study?**

A. Consequence analysis study is the evaluation of the potential hazards or impacts from generally, in our business, hazardous chemicals or waste.

Q. **And you've been doing this now for how long?**

A. I've been employed as a full time engineer for over 26 years now.

Q. **Now, in your undergraduate engineering program at the University of Oklahoma, did you take courses such as fluid mechanics, statistics, and other things that have a bearing ultimately today on pipeline analysis work?**

A. Yes, things like fluid mechanics and thermodynamics, they work into the modeling, the consequence analysis that we do for prediction events from pipelines and other hazardous chemical facilities.

Q. **Now, with respect to your work at Georgia Tech from 2002, how long were you in that program?**

A. I think it was about five years, because I was doing a distance learning program.

Q. **Did you also take courses there, at that time, which have a bearing on your ability to do pipeline analysis today?**

A. Yes, it would be the same topics in engineering, such as thermodynamics, heat transfer, fluid dynamics - those topics that do have application in pipeline hazards analysis.

Q. **Can you take a few minutes now to go through your CV and just highlight for Judge Barnes some of your professional publications that have a bearing on issues that you will testify about today?**

A. We have done quite a few studies over the years. I've probably been involved in hundreds of studies that involve consequence and/or risk analysis, and risk analysis always involves consequence analysis. One of the major topics in recent years has been building siting analysis, and many of the facilities we dealt with processed, stored, transferred, handled HVLs, which we'll be talking about, I'm sure, and we have done quantitative risk analysis in that framework. We have also done consequence analysis and quantitative risk analysis for many other facilities including refineries and gas plants and other projects, including pipelines.

Q. **Have you done work for the government?**

A. Yes, we have.

Q. **What agencies have you worked with?**

A. The primary one that we have worked with is PHMSA, and that work has been through the LNG Group in Washington, D.C.; we consult directly to them on LNG issues. LNG would be liquified natural gas. We have also worked for various government entities over the years on smaller projects throughout Quest's history, some of those in other countries. We've also worked for, for example, the Department of Energy in the U.S. and government entities in Canada.

Q**. On the second page of your resume, your C.V., do you see where you've identified you facilitated team meetings for hazardous operations studies?**

A. Yes

Q. **I note that you mentioned Williams Pipeline. Is that the petroleum distribution company?**

A. Yes. From memory, I don't recall what that particular job was, but the description in my resume appears to be natural gas pipeline systems.

Q. **And I see also you did some work with Bechtel on several different projects?**

A. Yes.

Q. **And you worked with SemGas. What kind of a company is SemGas?**

A. SemGas is a smaller pipeline and midstream company out of Tulsa. They were building natural gas plants and pipelines. They also have crude oil lines.

Q. Now, having reviewed your CV myself, is it fair to say that most of your work for the last 25 years has been in the field of quantitative risk analyses, consequence analysis studies involving refineries or refinery units, toxic and flammable gas pipeline systems, oil and natural gas production systems, LPG import/export terminals, gas treatment and processing plants, reinjection systems, and road and rail transportation systems? Is it fair to say most of your work has involved those things?

A. Yes, it did.

Q. Again, looking, at your CV, is it fair to say that your work in doing those projects included data gathering, accident selection, analysis structuring, consequence calculations, frequency analysis, risk mapping, and risk assessment?

A. Yes.

Q. Jeff, have you ever done any teaching or training in the areas that you've talked about?

A. Yes, I have.

Q. **Could you elaborate on that a little bit?**

A. Quest, for most of its existence, conducted a training class for PHMSA, the Pipeline and Hazardous Safety Administration, Hazardous Materials Safety Administration, regarding LNG, so we consulted with them on a yearly basis for that class. We have given classes, or I have given classes on quantitative risk analysis and consequence analysis and other topics such as process hazard analysis leadership, liquified gas hazards and other custom courses that clients have asked us to put together. Those courses ranged from just one day of education to a full week.

Q. **I see from your CV that you were the co-inventor of a patented community response guideline device. Would you tell the Judge exactly what that is?**

A. Years ago, we were trying to come up with a method that chemical plants or hydrocarbon processing plants could use to give themselves or local emergency responders a quick way to assess a situation and determine the impact there might be. The basis of the tool was that ision – two decisions were made very quickly in the emergency response time frame. One of them was a determination whether the event is a large release or a moderately sized release. The second decision is what are the weather conditions, which would include breezy or close to calm. This, together with general wind direction, form the inputs for a physical device consisting of a laminated card with a little dial that you could spin. On the card was a map of the facility and the dial shows the potential area impacted based on the magnitude of the hazard, the wind conditions, and wind direction. We put this out there and patented it; we thought it was a good idea. We fabricated these for a few facilities, and even for a few pipelines. The pipeline version did not have the dial; we showed the hazard zone as hazard corridors on a map.

Q. Did you also have some involvement in the development of risk quantification software?

A. Yes, I did. We also, since the inception the company, have had both consequence analysis software called CANARY by Quest®, and a risk analysis package that uses CANARY and brings in all of the probabilities and the various parameters that you would consider in a quantitative risk analysis. I have been involved in the development and application and support of those software packages ever since I've worked here. Many of the modules in CANARY and in our risk package I had direct responsibility for, often with assistance from a programmer for the code. The CANARY program is actually commercially available, and so we, the engineers at Quest, provide support for the users. The risk analysis package is an in-house tool; we don't market that.

Q. **Did you use the CANARY software in development of the Mariner Pipeline quantitative risk analysis report that you released last year?**

A. Yes, we did.

Q. **Did you use the software in connection with the analysis that you performed leading up to today's testimony?**

A. Yes.

Q. **Now, the complainants in this proceeding have asked you to comment on several points they raised their petition for interim emergency relief. Have you read and understood that petition as best you can?**

A. Yes.

Q: I am going to read to you a list of topics and then ask you, based upon your education, training and experience, if you believe you are professionally equipped to render an opinion on those topics to a reasonable scientific certainty. Here are those topics:

- **Characteristics of hazardous liquids and HVLs in particular**
- **Review of accidents involving HVL pipelines**
- **Review of vulnerable sites along mariner pipelines in Chester and Delaware Counties**
- **Event timing that leads to fires, explosions, etc.**
- **Implications for emergency response**
- **Consequence assessment for leaks/explosions in Chester and Delaware Counties**
- **Implications of your testimony for Sunoco's public awareness flyers**

A: Yes, I believe can so testify.

Flynn Complainants offer Jeffrey Marx to render his professional opinion as a process safety engineer on the following matters raised in the Second Amended Complaint:

- **Characteristics of hazardous liquids and HVLs in particular**
- **Review of accidents involving HVL pipelines**
- **Review of vulnerable sites along Mariner pipelines in Chester and Delaware Counties**
- **Event timing that leads to fires, explosions, etc.**
- **Implications for emergency response**
- **Consequence assessment for leaks/explosions in Chester and Delaware Counties**
- **Implications of your testimony for Sunoco's public awareness flyers**

Q: **Mr. Marx, do you understand that complainants in their Second Amended Complaint are alleging that (1) Mariner East HVL pipelines are being built and operating too close to their homes, places of work, and other facilities in Chester and Delaware Counties; that (2)**

Sunoco's public awareness program is inadequate; and that (3) Mariner East 1 and the 12-inch bypass pipeline are not being properly maintained?

A: Yes, I understand those are their allegations.

Q: **Are you aware that complainants contend that (a) Sunoco's public awareness program fails to comply with applicable law and in fact that (b) Sunoco cannot possibly comply with applicable law.**

A: Yes, I am aware of the contentions of the complainants.

Q: **Are you aware also that complainants are here today to ask that the PUC enter permanent relief directing Sunoco to cease operations of the Mariner Pipeline Project?**

A: Yes

Q: **So far as you know, is it true that Sunoco does own pipelines, terminals, and other assets used in the purchase, transfer and sale of: crude oil; refined products such as gasoline, diesel, and jet fuel; and also-called natural gas liquids ("NGLs") including propane, ethane and butane?**

A: Yes

Q: **So far as you know, is it true that Sunoco's Mariner East is a pipeline project in Pennsylvania, Delaware, Ohio, and West Virginia designed to transport NGLs such as propane, ethane, and butane to the Marcus Hook Industrial Complex in southeastern Pennsylvania and Delaware and other access points for distribution to other places?**

A: Yes

Q: **So far as you know, is it true that the Mariner East 1 pipeline is an 8 inch pipeline built in the 1930's that previously transported hazardous liquids but was repurposed in 2014 and is now transporting hazardous *volatile* liquids—HVLs?**

A: Yes

Q: **So far as you know, is it true that Sunoco has proposed to modify the plans for its Mariner East 2 pipeline in certain sections where it is unable to drill and build as planned by connecting it to an existing 12 inch pipeline also built in the 1930's to transport non-volatile liquids?**

A: Yes

Q: **You've seen in the Second Amended Complaint that complainants are referring to this hybrid pipeline as "the workaround" pipeline?**

A: Yes

Q: **Mr. Marx, as you understand it, is it true that if the workaround pipeline becomes operational it would increase the volume of hazardous, highly volatile liquids being transported near homes, schools, businesses, senior living facilities, and other densely populated areas?**

A: Yes

II. Executive Summary

Q: So far as you know, what is the reason Quest was retained in this proceeding?

A: Quest was retained to assess the potential consequences associated with the Mariner East pipeline project in Chester and Delaware Counties, Pennsylvania. The objective of this work was to leverage a previous work completed by Quest, along with an understanding of highly volatile liquid (HVL) release properties and the associated hazards, in order to form a better understanding of the potential consequences to persons in the vicinity of the Mariner East pipeline project (s).

Q: Would you give the judge some background on your company?

A. Quest is an engineering consulting company, formed in 1989, that specializes in consequence and risk analysis for hazardous materials, such as HVLs. Quest's clients include many companies in the oil and gas or petrochemical business, as well as regulatory agencies and citizen's groups. Quest has completed many consequence and risk analysis studies for pipelines near residential areas or other sensitive locations, such as schools, for various locations in the USA, as well as several foreign countries.

Q: What are the topics covered in your analysis?

A: This work covers the following topics:

- *Hazard Analysis*: defining the HVL release scenarios, pipeline parameters and site properties
- *Consequence Analysis*: Application of Quest's proprietary software, CANARY, for calculations of exposure areas to fire or vapor cloud explosion effects that have a potential for impacts to the public. Property damage was not evaluated.
- *Assessment:* evaluation of the potential consequences and the means by which they could be realized to inform a set of findings related to potential pipeline accidents

Q: What were your key findings as a result of your work on this project?

A: Key findings from this assessment, within a reasonable degree of professional certainty, include the following points:

- There exists sufficient publicly available information in order to generate reasonably accurate calculations of both hazards and risk from potential Mariner East pipeline releases.
- The worst hazard zones are realized in the first few minutes of an HVL pipeline accident due to loss of inventory and pressure decay.
- Predicted fatal impacts of accidental pipeline rupture events were found to extend up to about 2,100 feet from the pipelines or their associated equipment. Moderate holes could create hazard zones extend up to about 1,000 feet from the pipeline.
- In the event of a pipeline release, persons in the vicinity of the pipeline may have difficulty escaping unharmed.
- The maximum hazards following an HVL pipeline rupture will be realized before the operator can affect any meaningful measures to shut down the release.
- It is extremely unlikely that emergency response activities will be activated before the maximum hazards of an HVL pipeline rupture are realized.
- It is difficult to define the proper public response to a pipeline incident (i.e., shelter in place or evacuate) due to the variability of the event magnitude and various possible hazards.
- First responders can help to extinguish secondary fires or to evacuate persons who have found shelter from the pipeline impacts.

Q: Explain briefly your methodology and the focus of your study.

A: Risk- and consequence-based methodologies have been employed by Quest in many studies for pipelines near residential areas or other sensitive locations, such as schools. These studies have been completed for various locations in the USA, as well as several foreign countries. On several occasions, the quantitative risk analysis (QRA) results were presented to government or regulatory officials.

The emphasis of this study was on suburban population areas along the pipeline route. The study was comprised of four general tasks:

Task 1. Hazards Identification: Determine the potential hazards associated with an HVL pipeline;

Task 2. Failure Cases: Define potential release scenarios that could result in significant impacts to persons in the vicinity of the pipeline, including the mode and characteristics of release scenarios;

Task 3. Hazard Zone Analysis: Perform consequence analysis calculations to define the potentially lethal hazard zones associated with release scenarios; and

Task 4. Assessment: Evaluate the potential accident scenarios associated with the pipeline(s) to inform further decision-making regarding the pipeline(s).

Q: What are the hazards associated with the Mariner East pipelines?

A: The potential hazards associated with the Mariner East pipelines are common to other HVL pipelines and are a function of the material being transported as well as the transport conditions and pipeline parameters. The hazards that are likely to exist are identified by the physical and chemical properties of HVLs and the pipeline operating conditions. HVLs, while transported as liquid, will quickly turn to vapor when released to the atmosphere. Because of this behavior, they are a category of materials that is potentially more hazardous than other pipeline products such as natural gas, gasoline, or crude oil. For the pipelines considered in this study, the common hazards (see definitions) are

- Jet fires;
- Pool fires;
- Flash fires; and
- Vapor cloud explosions.

These hazards form the primary contributors to the risk of injury or fatality following an accidental release from an HVL pipeline. Other hazards that are highly localized, such as initial explosion projectiles and asphyxiation (due to oxygen displacement) were not evaluated in a detailed manner for this analysis.

III. Characteristics of hazardous liquids and HVLs in particular

A. In General

Q: **Mr. Marx, what does the term "natural gas" refer to?**

A: Natural gas is the portion of typically naturally-occurring hydrocarbons that after extraction and clean-up are transported as a gas and are used for fuel or chemical feedstocks.

Q: **What is a natural gas liquid?**

A: Natural gas liquids is label given to the portion of extracted hydrocarbons that, typically, are liquid under pressure but gas at ambient conditions, and normally excludes the heavier hydrocarbons that are characterized as crude oil, natural gasoline, naphtha or condensate.

Q: **How are natural gas liquids produced?**

A: They are extracted from the ground with natural gas and the liquid hydrocarbons are separated by various processing means, so that the natural gas, as well as crude oil or condensates, can be transported independently. Natural gas liquids are sometimes further separated in to specific products such as ethane, propane, and butane.

Q: **How do you understand the term "hazardous liquid?"**

A: Within the context of pipelines, hazardous liquids are the class of materials transported as a liquid, and include crude oil, refined products (such as gasoline, jet fuel, diesel), and natural gas liquids, among other products such as ammonia or carbon dioxide.

Q: **Are some hazardous liquids highly volatile and others not highly volatile?**

A: Correct.

Q: **What are hazardous highly volatile liquids (HVLs)?**

A: HVLs are a class of materials that are gases at ambient conditions but are stored or transported as liquid by pressure. They are labelled "highly volatile" because upon loss of pressure, they quickly change from liquid to gas. For this reason, these materials are also referred to as liquefied gasses.

Q: **And is it a correct use of terminology to refer to ethane, propane and butane as HVLs?**

A: Yes

Q: **For present purposes then, is it fair to distinguish between methane on the one hand and ethane, propane and butane on the other hand?**

A: Yes

Q: **Can you explain what happens when HVLs such as ethane, propane and butane are released from a pipeline?**

A: Yes. In the initial instants of the release, liquid within the pipeline will be ejected at high velocity due to the pressure in the pipeline. There is a thermodynamic behavior called "flash" that describes how a portion of a liquefied gas instantly changes from liquid to vapor. During the flash process, the density of the material decreases several hundred times, and so the volume increases significantly. This process breaks up the remaining liquid into droplets, many of which are carried in the vapor stream that is mixing with air. This mixture is called an aerosol. There may also be some liquid that reaches the ground.

As this release from the pipeline process occurs, there is also a significant drop in temperature. This is called the Joule-Thompson effect, and is a characteristic of most materials: when the pressure drops, so does the temperature. Thus, the released material consists of an airborne cold aerosol (vapor plus liquid drops) and perhaps a pool of cold liquid on the ground. As air mixes with the aerosol, it quickly heats up the mixture, vaporizing the droplets. In the same way, any liquid that reaches the ground will be heated by the ground and will quickly vaporize.

This process puts a great deal of material into the atmosphere very quickly. But as the pressure in the pipeline decreases, the mass release rate also decreases. In addition, some material could begin to flash inside the pipe, restricting the flow of material out the hole. Overall, unless the loss of containment event is very small, is a rapid decline in release rate over time.

In a pipeline HVL release scenario, released material has a significant amount of momentum due to the velocity imparted by the pressure of the system. This material, as it mixes with air, slows down, but has the capacity to travel a significant distance due to its initial velocity.

Q: How does a release from a natural gas transmission line differ from a release from an HVL pipeline?

A: A release of natural gas, primarily methane, is a compressed gas in the pipe, and will be gas once released. In addition, methane at ambient conditions (typical atmospheric temperature and pressure) is lighter than air. HVLs begin as liquid in the pipeline and transition to vapor after release. HVL materials such as ethane, propane, and butane are naturally heavier than air at ambient conditions, and even more when they are cold and/or in aerosol forms. So the released material tends to slump toward the ground and remain there. After the momentum of the release is dissipated, they spread due to gravity effects, being heavier than air. In this way, HVLs do stay near grade level as they disperse, and tend to move downhill as well as downwind.

A material is released from a pipeline, it depressurizes. For a natural gas pipeline, this does take some time. But for and HVL pipeline, the material must change to vapor as it depressurizes. Accordingly, when comparing the same length, diameter, and starting pressure of natural gas pipeline to an HVL pipeline, the HVL will take longer to depressurize due to the larger amount of material in the pipeline.

Q: Can you give us some working definitions to understand your work better?

A: Yes, here are some definitions relevant to the hazards we consider:

Definitions - Hazards
Explosion – a sudden release of energy
Jet fire – an ignited release of gas or gas plus entrained liquids that forms a velocity-driven fire
Pool fire – a collection of released liquids on the ground that forms a pool, and when ignited forms a vertical flame column
Flash fire – the ignition of a released flammable material that has mixed with air to form a flammable vapor cloud
Vapor cloud explosion – the ignition of a flammable vapor cloud (flash fire) that forms a damaging blast wave. The strength of the blast depends on fuel reactivity, confinement, or enveloping repeated small obstacles
Asphyxiation – the state of being deprived of oxygen which can result in symptoms ranging from dizziness to death; in the context of pipeline releases, displacement of air by the released pipeline material

Q: How about failure cases?

A: Potential HVL release events are determined from a combination of past history of releases from similar pipelines, including previous reports, accident data, and engineering analysis.

Definition
Failure Case – An accident scenario involving a release of hazardous material, which is developed and defined as a part of a consequence or risk analysis study

The release conditions that are used to define a failure case include:

- Fluid composition, temperature, and pressure
- Release rate and duration
- Location and orientation of the release

Q: What are hazard zones and vulnerability zones?

A: First, some formal definitions:

Definitions
Hazard Zone – The area or zone that is predicted to be affected by a defined hazard *Vulnerability Zone* – The area or zone that could be affected by a given hazard zone when any potential wind direction is considered (a vulnerability zone appears as a circle when a fixed source is evaluated, or a corridor when a linear source is evaluated)

The release conditions (e.g., pressure, composition, temperature, hole size, inventory, etc.) from the failure case definitions are valuated to produce a set of hazard zones for each failure case. We use our CANARY computer software hazards analysis package to produce hazard zones for the fire and vapor cloud explosion (VCE) hazards associated with each failure case. In each calculation, the models account for:

- Thermodynamic and physical properties of the HVL materials
- Pipeline transport conditions such as temperature, pressure, and flow rate

- Ambient weather conditions (wind speed, air temperature, humidity, atmospheric stability)

Q: When you refer to an "assessment" in this context, what are you talking about?

A: Failure case information and consequence analysis are combined to provide a more developed understanding of the potential impact of a pipeline release. This information can be used to inform emergency response, public education, or legislative aspects of pipeline accident evaluation.

Q: Can you give us an overview of the Mariner East Pipelines?

A: The Mariner East (ME) project is composed of up to three pipelines that are intended for transportation of HVLs from the Marcellus Shale areas to Marcus Hook, Pennsylvania for export to market. Figure 1 shows the pipeline route (in red) through Chester and Delaware counties. The pipelines are being constructed by Sunoco Pipeline, a division of Energy Transfer Partners.

The three pipelines are:

- ME1 – an existing 8-inch diameter pipeline currently in service
- ME2 – a 20-inch diameter pipeline currently under construction
- ME2X – a 16-inch diameter pipeline currently under construction

For the most part these pipelines share the same right-of way as they traverse Chester and Delaware counties. There are exceptions where the ME1, ME2 and ME2X pipelines are routed in different right-of-way corridors. All three pipelines are intended for transportation of ethane, propane, or butane, all of which are HVL materials. In addition to the above pipelines, Sunoco has proposed to connect completed portions of the ME2 pipeline by using an existing 12-inch hazardous liquids line. This connection will bypass certain locations where the ME2 pipeline construction has been delayed. This analysis does not evaluate the 12-inch line or its effects on the consequences or risk imposed by ME2.

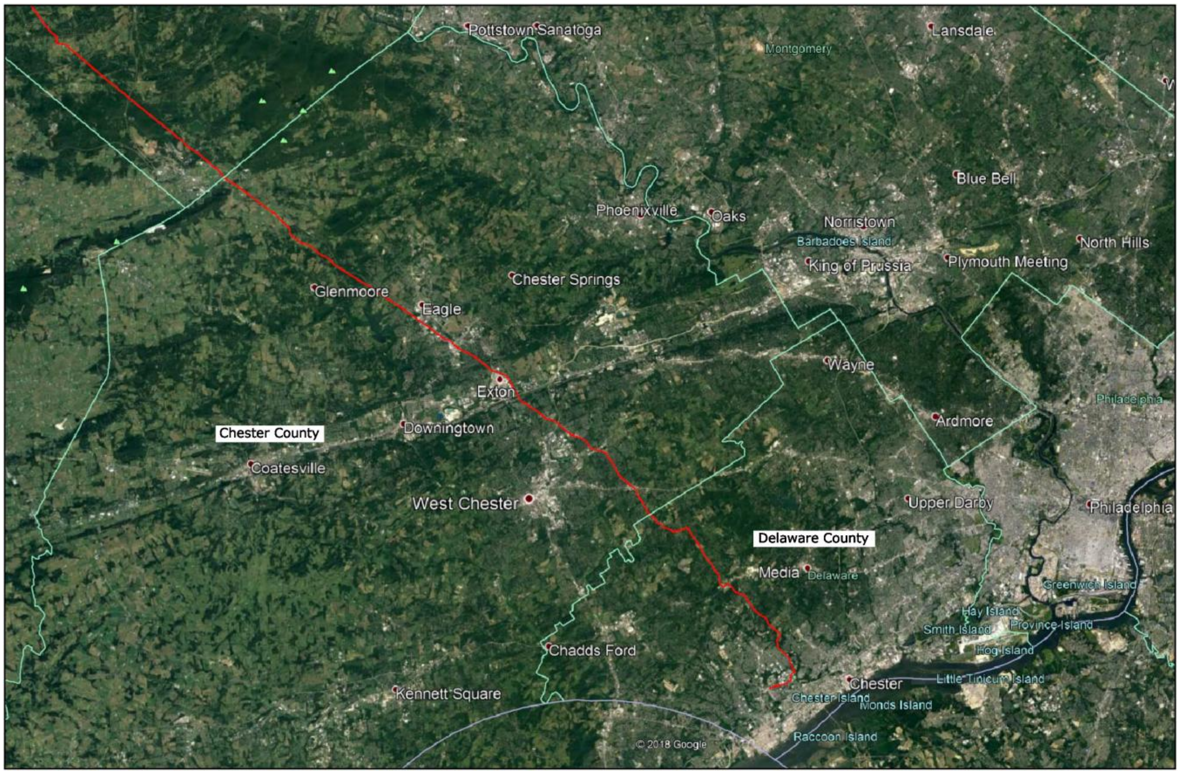


Figure 1
Mariner East Pipeline Route in Chester and Delaware Counties
(Image from Google Earth®)

The maximum operating pressure of each of the pipelines was originally modeled at 1,480 pounds per square inch gauge (psig). ME1 is fed by the Berks County pump station, approximately 30 miles upstream of the Chester/Delaware county line. ME2 and ME2X, in their initial operating state will be fed by the Middletown pump station in Dauphin County, approximately 75 miles upstream of the Chester/Delaware county line. Since Quest's QRA work on these pipelines, it has been reported that pressures of up to 2,100 psig may be seen in the pipeline(s).

IV. <u>Mariner's Leak and Rupture Detection System</u>

Q: **Like other petroleum products pipeline systems, the Mariner East Project in broad terms can be thought of as consisting of pipes, pump stations and valve stations.**

A: Yes

Q: **HVLs are pumped at pressures that are higher at some locations than other locations.**

A: Yes

Q: **Explain what a leak is.**

A: A leak would be a characterization of a loss of containment that is a "pinhole," or crack, or similar small hole in the pipeline.

Q: **Explain what a puncture is.**

A: A puncture is a loss of containment event that is characterized by a moderate hole, in the range of 1 inch or 2 inches diameter. This might be formed by something such as a backhoe tooth in an excavation accident.

Q: **Explain what a rupture is.**

A: "Rupture," while not a definite term, is generally interpreted as a full diameter or "full-bore" failure of the pipeline but can also be any large hole in the pipeline. In this context, large would be a hole approaching or equal to the diameter of the pipeline. A rupture generally represents a loss of containment event that is the largest potential event associated with a pipeline.

Q: **Explain how operators monitor for leaks and ruptures.**

A: The operator, at a remote monitoring facility, watches the flow rate of product and its pressure, and potentially other parameters, at various locations along the pipeline. This will certainly include each pump station and delivery points, and likely includes many or all of the pipeline valve stations. As product is being moved, the conditions are expected to be consistent in flow rate along the line, with decreasing pressure, due to frictional losses, between pump stations. When unexpected fluctuations in flowrate (up or down) or unexpected drops in pressure are seen, the operator must identify the event and initiate a shutdown, which involves shutting down the supply pumps and closing valves.

Q: **Are fluctuations in pressures within a particular range normal?**

A: Yes, but those fluctuations should in general always be a decrease in pressure as you move down the pipeline from a pump station.

Q: **Operators have the ability to note changes in pressure in any given pipeline section between valve stations. In the Mariner system, the distance is typically what? About 5 miles?**

A: To the best of my knowledge, the valve spacing is approximately every 5 to 10 miles.

Q: **Describe range of leaks in accordance with amount of pressure lost in any given event.**

A: Proceeding with the general loss of containment categories discussed a few moments ago, we can start with a leak. This would release an amount of product that is small compared to what we refer to as the "normal" flow rate in the pipeline. I would not expect a leak, as previously defined, to be detected as a drop in pressure along the line, or as a drop in flow rate. In other words, leaks would probably not be detected by monitoring equipment.

Moving to punctures, these events represent a significant loss of containment that should be detected. I would expect that detection and decision making may require a few minutes.

Ruptures will definitely be detected within seconds of the event initiation, and the pipeline parameters should clearly indicate that a full shut down is immediately necessary.

V. Mariner Pipeline Information

Q: For purposes of your work, how difficult is it to get Mariner pipeline information?

A: Obtaining general pipeline location information is relatively straightforward. The National Pipeline Mapping System (NPMS) provides information about pipelines and their locations. Figure 2 provides a screen shot from the viewer shows part of the Mariner East pipeline in Delaware County.

Other publically available sources provide additional pipeline details. For example, as part of the regulatory filings with the Pennsylvania Department of Environmental Protection (DEP), specific pipeline parameters, pipeline routing, valve station locations, and alignment drawings, and HDD boring information, are provided as public record. Some of the graphical information (maps or drawings) available for the Mariner East Pipelines(s) are shown in Figures 3 and 4.

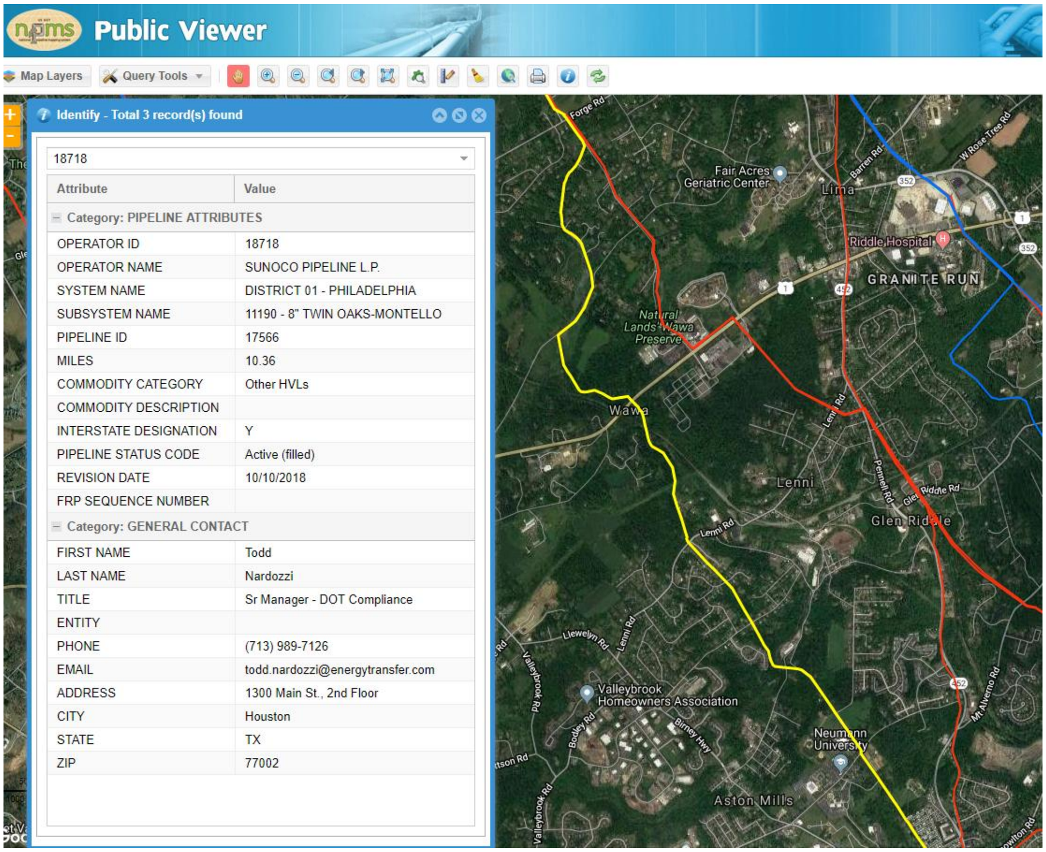


Figure 2
NPMS Pipeline Routing

Figure 3
Overview of Pipeline Route and Valve Stations in Chester and Delaware Counties
(Image from Google Earth®)

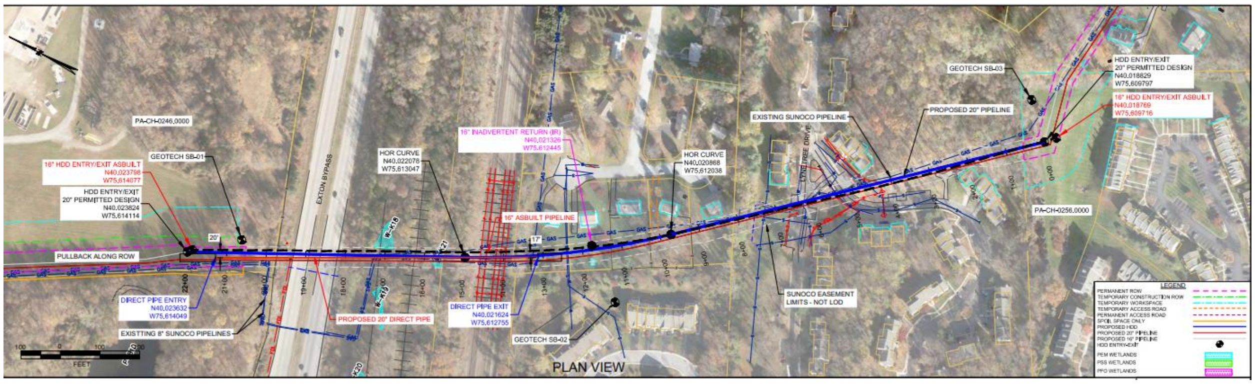


Figure 4
Example HDD Location and Specification Details

Q: Are pipeline accidental release scenarios available from publicly available sources?

A: Yes. Many of the necessary parameters used in modeling pipeline accidental release scenarios are also available from publicly available sources. Some of the basic pipeline information can be found on the Energy Transfer Partners Website concerning the Mariner East pipelines. Included here are piping diameters, reports about the 12-inch line "re-purpose" project with associated pipeline parameters.

The DEP website also has permit applications for pump stations. For example, the Mariner East pump station in Berks County application lists several pieces of information:

- The material: "Light Hydrocarbon – NGL Mix of Ethane and Propane @ 100F (Max)"
- The intended operating pressures: "Suction Pressure = 579 PSIG, Discharge = 1435 PSIG, Product Vapor Pressure of 531 PSIA"
- Maximum operating pressure of 1,480 psig

VI. Mariner Pipeline Hazards

Q: Can you explain the hazards analysis in the context of an HVL pipeline?

A: Yes. Potential releases of HVLs were considered for the Mariner East pipelines. Each potential release may result in one or more of the following hazards:

- Fire radiation occurs when released HVLs are ignited as either a jet fire or pool fire. The fire releases the energy of combustion as heat, light, and thermal radiation. Thermal radiation is what is felt by an observer of a fire. The impact depends upon the duration and intensity of thermal radiation. For example, consider a fire in a home's fireplace. Stand across the room and you can see the fire, but not feel it; stand a few feet away and you can feel the warmth of the fire; put your hands a few inches away from the fire and you feel heat, then pain, and if you stay there long enough your hands will receive burns. Likewise, if exposed to an HVL fire with thermal radiation intensity high enough and long enough, a person will receive burns that could result in injuries that may be fatal.
- The flash fire hazard develops from a dispersing release of HVL with a delayed ignition. As the released fluids mix with air and are carried downwind, a flammable mixture of HVL in air is created. As this continues, the vapor cloud is assumed to grow to its maximum size before finding an ignition source. When ignited, everything within the flammable vapor cloud zone is enveloped in flame. The fire burns out quickly because it has no continuing source of fuel, except the area near the release point, where the flash fire transitions into a continuous jet or pool fire. Fatality is assumed for all persons with the flash fire zone.
- In some instances, a flammable vapor cloud will have dispersed into an area of confinement or congestion. Confinement is a condition where a flash fire's combustion products cannot expand in all directions. Congestion is the presence of repeated small obstacles, and in this work, comes in the form of forested areas. As the flame front moves past these obstacles, it wraps around them, increasing the surface area of the flame and thus increasing the burning rate. In the case of either confinement or congestion, there is a build-up of pressure due to the combustion event. That build-up of pressure is called overpressure, which travels out from the explosion source in the form of a blast wave. A blast wave, depending on its strength, can damage structures, or result in injury or fatality to persons in the area.

- There also exists a non-zero probability that a hydrocarbon pipeline release will not be ignited. In this case, the end results is dissipation of the flammable material. However, in the immediate area of the release the hazard of asphyxiation does exist, which is displacement of oxygen in air that is breathed, to the point of injury or death. This can only occur, in the context of a pipeline release, if a person is very close to the release point and does not take corrective action. In all cases, the flammable hazard zones are much larger than the asphyxiation hazard zone.

Q: Please talk about you define the scenarios that could lead to these hazards.

For an impact from any one of the hazards inherent to the Mariner East pipelines, there must first be a loss of containment (LOC) event. If the material normally contained within the pipeline is released and ignited, the resulting consequences can be described by modeling. Thus, the first step in modeling involves defining the failure cases, or release event scenarios.

For all releases from conventionally buried piping, it is typically assumed that the pipe is buried at a conventional depth of 3-4 feet. Upon release, there is sufficient energy from the HVL depressurization that a crater will be formed above the release location. This allows for a free jet of material to be released to the atmosphere.

The Mariner East pipelines feature several locations where Sunoco is completing the pipeline installation through the use of horizontal directional drilling (HDD). This method bores a long tunnel and then pulls the pipe back into it before tying it into the conventional bury sections. The following concepts were applied in this work for HDD sections:

- The pipeline can be 30-150 feet below grade in HDD sections, making it extremely improbable that a pipeline failure would result in a surface crater.
- The probability of external damage from digging or heavy machinery in the HDD sections is extremely low.

- Because the HDD sections come back to the surface at the entry and exit points, these locations are viewed as the points where a release to atmosphere will manifest itself. Thus, the hazards for HDD sections are often located at the entry or exit points.

This approach effectively assumes that the released HVL, following a failure of the pipeline within the HDD zone, will travel along the HDD bore, which is assumed to be the path of least resistance to the surface. While it is possible for the released material to follow geological fissures or other natural or man-made conduits, the pipeline borehole is viewed as the "easiest" path to the surface for most locations.

At the valve stations, the equipment (piping, valves, instruments, etc.) is 2-3 feet above local grade. Thus, there will be no crater formed for these segments of the pipeline. Failures of the piping or associated equipment result in releases directly to atmosphere.

Q: Please explain Quest's consequence analysis models

A: To describe the hazards for any equipment handling or transporting hazardous materials, release scenarios are developed to simulate the potential LOC events. This first requires calculations of material release rates and the properties of the material following release. Following these calculations, hazard models are applied to describe the extent of a flammable vapor cloud (flash fire), jet fire radiation, pool fire radiation, or blast wave (from a VCE). Potential impacts can be determined from the results of these calculations.

When performing site-specific consequence analysis studies, the ability to accurately model the release, dilution, and dispersion of gases and aerosols is important if an accurate assessment of potential exposure is to be attained. For this reason, Quest has developed, and uses, a modeling package, CANARY by Quest®, that contains a set of complex models that calculate release conditions, initial dilution of the vapor (dependent upon the release characteristics), and subsequent dispersion of the vapor introduced into the atmosphere. The models contain algorithms that account for thermodynamics, mixture behavior, transient release rates, gas cloud density relative to air, initial velocity of the released gas, and heat transfer effects from the surrounding atmosphere and the substrate. The release and dispersion models contained in the QuestFOCUS package (the predecessor to CANARY) were reviewed in a United States Environmental Protection Agency (EPA) sponsored study and an American Petroleum Institute (API) study . In both studies, the QuestFOCUS software was evaluated on technical merit (appropriateness of models for specific applications) and on model predictions for specific releases. One conclusion drawn by both studies was that the dispersion software tended to overpredict the extent of the gas cloud travel, thus resulting in too large a cloud when compared to the test data (i.e., a conservative approach).

A study prepared for the Minerals Management Service (MMS) reviewed models for use in modeling routine and accidental releases of flammable and toxic gases. MMS recommends CANARY for use when evaluating toxic and flammable gas releases. The specific models (e.g., SLAB) contained in the CANARY software package have also been extensively reviewed.

CANARY also contains models for jet fire and pool fire radiation. These models account for material composition, target height relative to the flame, target distance from the flame, atmospheric attenuation (includes humidity), wind speed, and atmospheric temperature. The models are based on information in the public domain (published literature) and have been validated with experimental data.

In addition, Quest has designed and published a VCE model called QMEFS (Quest model for estimation of flame speeds) to model VCEs from confined and congested areas . This model is contained within the CANARY consequence modeling package.

VI. HVL Pipeline Release Scenarios

Q: **Did you apply your model to determine the physiological effects from HVL release scenarios?**

A: Yes, we did. The recent consequence analysis, as well as the QRA performed on the Mariner East pipelines, involved the evaluation of many unique potential hazardous material release scenarios. Each potential release may result in one or more of the hazards listed above. In order to compare the risks associated with each type of hazard, a common measure of consequence must be defined. In risk analysis studies, a common measure for such hazards is their impact on humans. However, when comparing a fire radiation hazard to a VCE hazard, the magnitude of the hazard's impact on humans must be identically defined. It would not be meaningful to compare human exposure to a nonlethal blast wave to human exposure to lethal thermal radiation.

In the QRA study, risk was defined as the potential exposure of humans to lethal hazards (i.e., radiant heat or VCE blast wave) that have the potential to occur as a result of accidents originating along the pipeline route. The QRA defined all hazard effects to be based on fatality for consistency within the analysis and to set up the study so that it may be compared to other forms of fatality, as well as international risk criteria, which are based on fatal exposures. For consequence analysis studies, injury impacts are often evaluated also. Injury effects result in larger impact zones than are predicted for fatality effects.

One of the initial tasks in modeling the potential impacts from a pipeline accident is to understand the release rate, or how quickly material in the pipeline is released to atmosphere. Most HVL pipeline accidents begin as an explosion – a sudden release of energy – due to the pressurized fluid in the pipeline. This initial explosion is accompanied by a very high release rate of material. As the first seconds of the release pass, fluids accelerate within the pipeline to flow toward the point of lower pressure (outside the pipe). But as the release scenario continues, the higher velocity flow, as well as thermodynamic effects, create pressure drop in the piping that restricts the flow of material to the break point. The result of this is a constantly decaying release flow rate, as demonstrated in Figure 5.

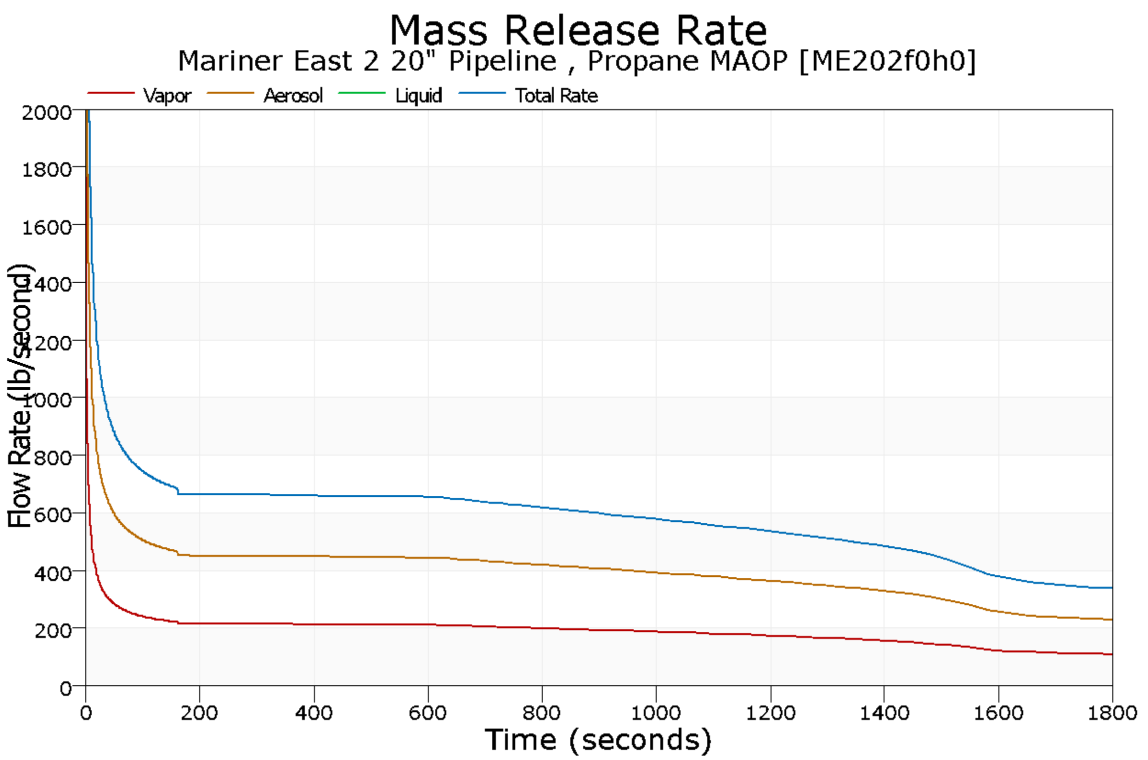


Figure 5
Mass Release Rate for ME2 Propane Pipeline Rupture

As shown in Figure 5, the first few seconds involve very high rates that decay quickly. After about two minutes, the release flow rates settle into a slowly decaying behavior. After about ten minutes, the release rate begins to decay more quickly, but persists for several hours for this pipeline (only the first 30 minutes are shown in Figure 5).

This behavior, typical for HVL pipeline releases, demonstrates that the maximum hazards are realized within the first few minutes of the release. The release rate, and therefore the hazard extents, get smaller as time passes and the pressure in the pipeline decays. While this may be altered by pump station shutdowns or valve closures along the pipeline, these are not expected to affect the release rate in the first few minutes where the maximum hazards are defined**.**

Q: **How do you factor in the matter of ignition timing?**

A: We evaluate loss of containment events for flammable materials through consideration of ignition timing. First, there is immediate ignition. This is characterized by ignition that occurs within the first seconds of the event. It can be initiated by the failure mechanism itself, for example, puncture by a backhoe tooth could cause a spark; or, a pipeline rupture might involve the collision of segments of the pipeline with each other such that a spark ignites the releasing material. The hazard in this case is a fire. For HVLs, this will be a jet fire, sometimes called a torch fire, as the material being released is at high pressure and will typically have a large velocity as it is expelled from the pipe. In some cases, there may also be a pool fire due to thermodynamic effects that result in liquid accumulation on the ground.

The second scenario is that of what we call delayed ignition. This means that the loss of containment event continues for some time, typically measured in minutes, before the released material reaches an ignition source. As the material is released, it mixes with air and in certain combinations of air plus vaporized HVL, the mixture is flammable, or able to be ignited. The hazard here is, first, the burning of that flammable vapor cloud. This is often called a flash fire.

Beginning at the ignition point, the released material that has mixed with air to a flammable state burns relatively quickly, finding its way back to the release point where the material that is still coming out of the pipe forms a jet fire, or possibly a pool fire. In some cases, where the flammable cloud envelops a region of confinement (walls) or congestion (obstacles), a vapor cloud explosion can result. With sufficient conditions, this explosion can create a damaging blast wave.

The last scenario is non-ignition. This is certainly more common for leaks than ruptures. The only hazard in this case is the potential for asphyxiation, which is displacement of oxygen in air that is breathed, to the point of injury or death. This can only occur, in the context of a pipeline release, if a person is very close to the release point and does not take corrective action.

Q: **Mr. Marx, complainants in their Second Amended Complaint claim to have identified three actual historical catastrophic events caused by pipeline leaks or ruptures. Would you take a look at pars. 49, 50 and 51 of the Second Amended Complaint?**

A: OK

Q: **Have you reviewed available public records and determined whether or not the three descriptions are accurate**

A: Yes.

Q: **Would you take a minute and read into the record what the Second Amended Complaint says happened in each of the three cases: I will read directly from the Second Amended Complaint.**

49. On November 1, 2007, a 12-inch-diameter pipeline transporting liquid propane ruptured in a rural area near Carmichael, Mississippi. The resulting gas cloud, formed from the 430,626 gallons of liquid propane that were released, expanded over nearby homes, forming a low-lying cloud of flammable gas. The gas found an ignition source about 7 1/2 minutes later. Witnesses miles away reported seeing and hearing a large fireball and heavy black smoke over the area. In the ensuing fire, two people were killed and seven people sustained minor injuries. Four houses were destroyed, and several others were damaged. About 71.4 acres of grassland and woodland were burned. This accident occurred in a sparsely populated area, with only about 200 people living within a 1-mile radius (about 3 square miles) of the location of the pipeline failure. A similarly sized area in Chester or Delaware Counties (about 3 square miles) might contain thousands of people. The National Transportation Safety Board identified the inadequacy of the pipeline operator's public education program as a factor that contributed to the severity of the accident.

50. On Saturday, August 24, 1996, at about 3:26 p.m. near Lively, Texas, an 8-inch pipeline transporting butane ruptured. The material volatilized into colorless, odorless, extremely flammable gas that stayed close to the ground as it drifted across the surrounding residential area. Danielle Smalley and Jason Stone, both 17 years old, ran to a pickup truck intending to warn neighbors. As they sped away, their truck ignited the vapor. Both suffered fatal thermal injuries. The fire continued to burn until about 6 p.m. the next day, which was how long it took the operator to isolate the failed section.

51. On December 9, 1970, in Franklin County, Missouri, an 8-inch pipeline transporting propane ruptured. Twenty-four minutes later, "the propane-air mixture exploded, destroyed all buildings at the blast origin, extensively damaged 13 homes within a 2-mile radius

[approximately 12 and a half square miles], sheared telephone poles, snapped tree trunks, smashed windows 12 miles away, and registered its impact on a seismograph in St. Louis, 55 miles distant. An expert from the United States Department of the Interior, Bureau of Mines, determined that the "detonation and initial fire consumed [only] 756 barrels of propane, giving rise to an estimated explosive force of 100,000 pounds of TNT." There were no fatalities due to the fact that accident occurred in a sparsely populated area while people were awake, and the few people in the area used the twenty-four minutes between the release and the explosion to self-evacuate themselves with expedition.

Q: How does your model deal with the matter of hazard distances?

A: As part of the QRA work, a significant set of hazard zones were calculated for varying hole sizes, release orientations, and weather conditions. The range of hazard distances achieved by potential flash fires, jet fires, and pool fires following releases from the Mariner East pipelines were calculated in this work.

For purposes of defining the largest potential impacts, ruptures of the Mariner pipelines when operating at their maximum operating pressure (MOP) of 1480 psig were considered. Release orientations for the largest impacts occur for horizontally or nearly horizontal events.

A summary of the maximum calculated hazard distances (generally resulting from the pipeline rupture scenario, and often associated with the aboveground equipment) is presented for the ME1, ME2, and ME2X pipelines, along with the variation of transported material (ethane, propane, or butane) in Table 1. As seen in Table 1, the fatal hazard zones predicted in this analysis are limited to a range of 2,135 feet from the pipeline; this distance results from a rupture of the ME2 pipeline at an above-ground valve station, where a horizontally-oriented release could occur. In all cases, the maximum distances reported are represented by:

- Flash Fire: Downwind extent of the flammable vapor cloud defined by the a gas concentration in air equal to the lower flammable limit
- Jet/Pool Fire: Downwind extent of thermal radiation sufficient to cause fatality in the most vulnerable portions of the population (the 1% fatality level, assuming a 30 second exposure)

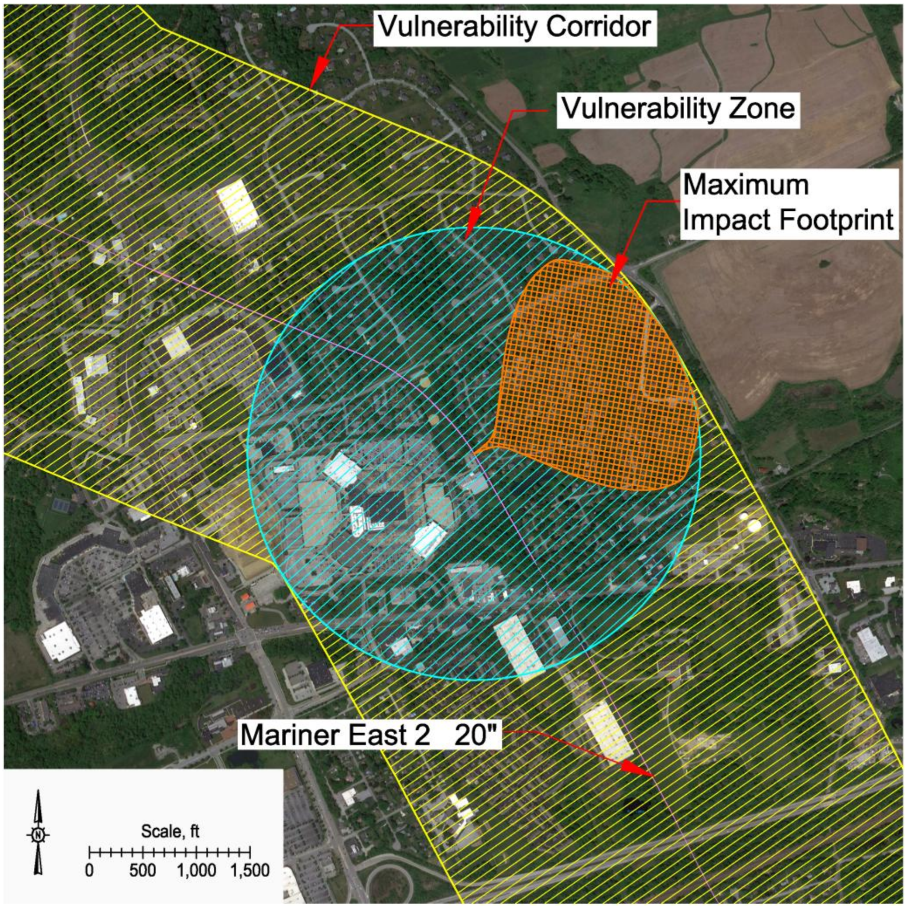
Table 1
Maximum Hazard Distances for the Mariner East Pipelines

Pipeline	Product	Maximum Hazard Zone Distance [feet] for	
		Flammable Vapor Cloud (LFL)	Jet Fire
ME1	Ethane	900	375
	Propane	1,035	420
	Butane	1,095	375
ME2	Ethane	1,800	955
	Propane	2,135	1,055
	Butane	2,130	900
ME2X	Ethane	1,420	645
	Propane	1,640	700
	Butane	1,680	645

An example of a maximum fatal hazard distance is illustrated in Figure 6. This figure shows:

- The maximum flammable vapor cloud (LFL) hazard footprint associated with a rupture of the ME2 pipeline when carrying propane – *the orange shaded area*.
- The vulnerability zone associated with this maximum hazard zone – *the blue shaded area*. A vulnerability zone is created by rotating a hazard footprint around its point of origin, creating a circular area where the location of impact is dependent on the wind direction.

- The vulnerability corridor along the ME2 pipeline – *the yellow shaded area*. A vulnerability corridor is similar to a vulnerability zone, except that it "slides" along the pipeline route to indicate the area that could be affected by the hazard footprint,



depending on wind direction and release location.

Figure 6
Maximum Hazard Footprint, Vulnerability Zone, and Vulnerability Corridor for a Rupture of the ME2 Pipeline - Chester County Library Area

Q: Were you able to do a comparison between natural gas and HVL events?

A: Yes. To provide a point of comparison, consider a local natural gas transmission pipeline. The Texas Eastern Pipeline runs across Pennsylvania to supply natural gas to the New York City area. A lateral line extends through Chester and Delaware counties toward the Philadelphia International Airport. The MOP of this 8” pipeline is 870 psig.

Results for this pipeline are as follows:

Maximum Flammable Vapor Cloud (Flash Fire) Extent:	115 feet
Maximum Jet Fire Thermal Radiation Extent (`1% fatality from burns)	175 feet

Q: You were asked to investigate the possibility of escape from the impacts of pipeline release events, is that correct?

A: Yes. Quest investigated the possibility of escaping the potential impacts of pipeline rupture events, with the assumption that the release is immediately ignited and forms a jet fire. This evaluation investigates the ability of people near the pipeline to escape injury or fatal effects during a pipeline incident.

For comparison, two similar pipelines were evaluated: (1) The 20” Mariner East 2 (ME2) pipeline, transporting propane, and (2) a hypothetical 20” natural gas transmission (NGT) pipeline. While the natural gas pipeline does not exist in Chester or Delaware Counties, this comparison was established so that the potential escape consequences could be based on pipelines of similar diameter and operating pressure.

The pipelines were each assumed to be operating at pressures of 1,480 psig and 2,100 psig. The analysis is based on escape from the fire at three escape speeds: 3, 4, and 5.6 mph. These are (effectively) walking or jogging speeds, but represent a range of ambulatory ability for potentially exposed persons.

The evaluation evaluated both receiving burns to exposed skin, and being fatally burned, by the radiation from an immediately ignited jet fire. The modeled jet fire represents the first minute of the incident; after this time the flame recedes as the release rate from the pipeline decays. While exposure to the fire's radiation is certainly possible after this first minute, the effects will be less severe. It is assumed that persons would have reached a safe place after about one minute, so this analysis is focused on the potential impacts in the first minute of the event.

The summary of the results presented in Tables 2 and 3 represent three possible impacts, based on starting distance from the pipeline and escape speed:

- Escape from the flame without skin burns
- Burns to exposed skin
- Fatality due to excessive skin burns

In each case, a dose-response relationship was used to calculate the time when either effect was reached, assuming an escape speed and starting point relative to the release location. The results in Table 2 assume that the person is traveling along the axis of the flame, away from it, but in the direction the flame is pointed. The results in Table 3 assume that the person is traveling perpendicular to the axis of the flame. Large jet fires such as this often orient themselves due to the high velocity of the released hydrocarbons. In some cases, the wind will affect a flame, and if so, Tables 2 and 3 can be thought of as escaping downwind or crosswind, respectively. For those entries in Tables 2 and 3 labeled "escape," it was found that a person moving away from the flame could escape both burns and being fatally burned.

The escape effects assume a starting point. These distances are in relationship to the pipeline rupture location, either along the flame axis or perpendicular to it. For distances within about 500 feet, there is no escape in either of these two directions. For locations "behind" the flame, or in the upwind direction, the impacts are significantly less, but were not calculated.

Further details regarding this investigation are provided in Appendix A.

Table 2
Impacts for Potential Escape Away from Flame

Pipeline	Operating Pressure [psig]	Starting Distance [ft]	Predicted Impact for Escape Speed [mph]		
			3	4	5.6
ME2	1480	500	Fatality	Fatality	Fatality
		700	Fatality	Burns	Burns
		1100	Burns	Burns	Escape
	2100	500	Fatality	Fatality	Fatality
		700	Fatality	Fatality	Fatality
		1100	Burns	Burns	Burns
Natural Gas Trans-mission	1480	500	Fatality	Fatality	Fatality
		700	Burns	Burns	Burns
		1100	Escape	Escape	Escape
	2100	500	Fatality	Fatality	Fatality
		700	Fatality	Burns	Burns
		1100	Burns	Escape	Escape

Table 3
Impacts for Potential Escape Perpendicular to Flame

Pipeline	Operating Pressure [psig]	Starting Distance [ft]	Predicted Impact for Escape Speed [mph]		
			3	4	5.6
ME2	1480	500	Fatality	Fatality	Fatality
		700	Fatality	Burns	Burns
		1100	Burns	Burns	Burns
	2100	500	Fatality	Fatality	Fatality
		700	Fatality	Fatality	Fatality
		1100	Burns	Burns	Burns

Natural Gas Trans-mission	1480	500	Burns	Burns	Burns
		700	Burns	Burns	Burns
		1100	Escape	Escape	Escape
	2100	500	Fatality	Fatality	Burns
		700	Burns	Burns	Burns
		1100	Escape	Escape	Escape

The results in Tables 2 or 3 assume a fully open escape area with no sheltering from the fire radiation. It is expected that in most cases, persons can evacuate to some type of shelter (behind trees or a car, behind or inside a home, etc.) within the first minute of the event (but likely within 20-30 seconds at most).

Q: Can you now discuss the matter of emergency response to pipeline release events?

A: In the event of a pipeline accident, as was presented in the previous sections of this report, there are two primary things that should happen: (A) the pipeline operator would recognize the event, begin shutting down the pipeline, and notify local responders, and (B) local responders will converge upon the release location to mitigate the effects of the accident.

It is helpful to consider the timeline of an event, beginning with the initiation of accident. For larger, energetic releases such as punctures or ruptures, the initial moments of the event can be characterized as an explosion – a sudden release of energy as the pressurized fluid begins to escape. If this is a conventional buried pipeline, the escaping material will blow away the overburden and form a crater, eventually resulting in a free jet of material. This initial release will be audible, easy to see, and will begin to create a large white cloud, which is characteristic of all HVL releases. This occurs because the released material becomes very cold due to the drop in pressure. Upon mixing with air, this cold material condenses water vapor in the air, similar to the natural formation of clouds in the sky or your breath on a cold morning.

Pipeline operators, typically at a remote monitoring facility, watch the product flow rate and pressure at various locations along the pipeline. Monitoring points include each pump station, as well as delivery points, and may include pipeline valve stations. As product is being moved, the conditions are expected to be consistent in flow rate along the line, with decreasing pressure, due to frictional losses, between pump stations. In the time frame of several seconds to a few minutes following a pipeline rupture or puncture, the pipeline operators will notice pressure or flow differentials. When unexpected fluctuations in flowrate (up or down) or unexpected drops in pressure are seen, the operator must (1) identify the event and its location, (2) initiate a shutdown, which involves stopping the supply pumps and closing valves, and (3) notify local responders.

Once local responders are notified, it may require between five and 30 minutes to mobilize and reach the area. A phone call from the pipeline operator initiates a chain of communication that mobilizes people and equipment, typically from several different agencies. These responders must then locate the accident site and determine the best way to approach the scene, keeping in mind the potential hazards to themselves and their equipment that may be present. Initial efforts will involve personnel coordination, command post establishment, and immediate fire response activities. As an understanding of the event develops, evacuation and other response activities can commence.

Q: Can you run through the chronology of an HVL pipeline rupture event?

A: Sure. As an example, consider a *hypothetical* HVL pipeline **rupture** event:

- The pipeline ruptures, and ignites immediately, forming a large jet fire.
- The remote monitoring operator recognizes the incident within a few seconds of the

rupture.

- The operator assesses the data and begins shutdown activities within 1-2 minutes. Pump stations are given the command to shut down and after an appropriate delay, automated valves are closed (often requires an additional 3-4 minutes for shutdown sequences to develop).
- The operator calls local responders, based on an assessment of where the rupture has occurred.
- The operator calls pipeline personnel for notification, and potentially to shut down pipeline valves that are not automated.
- Public in the area of the rupture call 911 reporting an explosion followed by a large fire.
- Local responders arrive at the scene 10-15 minutes after the rupture, set up a command post ½ mile upwind of the rupture site, and begin extinguishing secondary fires. The jet fire from the pipeline is unapproachable and inextinguishable.
- After 20 minutes, the pipeline operator notifies emergency responders that the pipeline has been isolated around the rupture site – 3 miles upstream and 8 miles downstream.
- After about 14 hours, the pipeline inventory is depleted and the fire is declared controlled.

Q: Can you run through the chronology of an HVL pipeline puncture event?

A: Consider a second example, involving a *hypothetical* **2-inch diameter hole** in an HVL pipeline:

- A small corrosion hole in the pipeline begins to release HVL and the hole quickly grows to approximately 2 inches in diameter in the weakened area. The force of the released material results in a crater being formed between the pipeline and the surface.
- Local residents hear the event, but aren't sure what it was.
- As the HVL mixes with air, a flammable vapor cloud develops, spreading over the immediate area, and is transported downwind, settling in low-lying and forested areas.

- Approximately 5 minutes later, a local resident out walking her dog, sees the vapor cloud. Because the weather conditions were not favorable for fog at that time, she realizes this is not a natural occurrence, and calls 911 to report the event.
- The 911 operator dispatches local responders to the area. After further conversation with the resident, the operator determines that is likely a pipeline release due to the proximity of the HVL pipeline, and places a call to the pipeline operator.
- At about 10 minutes into the event, the pipeline operator begins shutdown and isolation activities. Pump stations are given the command to shut down and after an appropriate delay, automated valves begin closing (often requiring an additional 3-4 minutes for shutdown sequences to develop).
- Local responders arrive and begin to assess the situation. After about15 minutes of assessment, a command post is set up about ¼ mile from the release point. Based on responder reports, the county emergency response office decides to activate its reverse 911 capability to warn residents and recommend evacuation.
- A few minutes later, a car drives through what appears to be a foggy area at a creek crossing about 800 feet from the release site. The car stalls. As the driver attempts to re-start the car, the flammable vapor cloud is ignited. The flash fire burns across the roadway and into the surrounding forest. The flames accelerate through the forest, resulting in a vapor cloud explosion that sends a blast wave out in all directions. The flammable cloud burns all of the available material, and forms a jet fire at the release site where HVL material is still being released from the pipeline.
- As responders begin to assess the event, they find that the driver of the car was fatally injured, several responders were injured from the blast, and there are multiple homes in the area that are now on fire. Many more homes were damaged by the blast, from broken windows to moderate structural failure.
- Although a 9-mile segment of the pipeline around the release point has been isolated, an inextinguishable jet fire continues to burn at the release location. Several secondary and structure fires continue to burn within about 500 feet of the release location.
- After about 3 hours into the event, firefighters have the secondary and structure fires under control and have begun recovery operations. Several victims are found in or

around homes that were within the flammable vapor cloud or close enough to be damaged by the vapor cloud explosion.

- After about 48 hours, the pipeline inventory is depleted and the fire is declared controlled.

Q: **Given the discussions we have had concerning HVL pipeline failures and the potential hazards, please explain the implications for emergency response.**

A: It is helpful to consider the timeline of an event, beginning with the initiation of the leak, puncture, or rupture. For now, we'll leave out leaks as they are less energetic and less severe. The initial moments of the event can be characterized as an explosion – a sudden release of energy as the pressurized fluid begins to escape. Provided that this is a conventional buried pipeline, the escaping material will blow away the overburden and form a crater, eventually resulting in a free jet of material. This initial release will be audible, easy to see, and will begin to create a large white cloud. In the time frame of several seconds to a few minutes, the pipeline operators will notice pressure or flow differentials and should initiate shutdown procedures, as well as communicating with local emergency responders. It will of course take responders several to tens of minutes to mobilize and reach the area. After arriving at the scene, fire response and evacuation activities are carried out. However, the release from the pipeline has likely already subsided as the pressure in the pipeline decreases and it de-inventories.

Q: **You mentioned a large white cloud. What is that and how does it relate to HVL releases?**

A: The large, white vapor cloud is characteristic of all HVL releases. This occurs because the released material becomes very cold due to the pressure drop. Upon mixing with air, this cold material creates condensation of the water vapor in the air. This is very similar to the natural formation of clouds that we see in the sky. It is useful because it makes what is normally a colorless gas a highly visible dispersing vapor cloud. As a rule of thumb, the visible cloud approximately represents the flammable cloud – but this is only approximate as this is not a scientific statement and varies with the HVL, its release characteristics, and the ambient humidity.

Q: **How does this compare to the accident history of HVL pipelines?**

A: As a generalization, it matches up well. Let's consider emergency response in light of an example scenario: the Carmichael, MS incident which is detailed in an NTSB report.

- The pipeline rupture occurred at 10:35 in the morning
- The remote operator recognized the pressure reduction as a loss of containment and began shutdown activities about 1 minute later
- 3 minutes into the event, local field personnel were called to respond
- 4 ½ minutes into the event, the first 911 call was made. A resident reported an "explosion" and could see a white cloud ("smoke") and could smell gas. This came from a house that was about 500 feet from the pipeline and was the location of one of the two fatalities.
- A second 911 call came in during the 1st, about 5 minutes into the event, reporting an explosion and "smoke."
- At about 6 minutes into the event, another resident called the toll-free number provided by Dixie pipeline to report the incident.
- Seven minutes into the event, emergency responders were dispatched.
- 7 ½ minutes into the event, the gas cloud was ignited. Ignition source unclear. The cloud area was described as approximately 950 feet by 1,250 feet.
- About 2 hours into the event, manual isolation valves were closed and the pipeline considered fully shut in.
- 30 hours into the incident, the fire was declared extinguished

In this particular accident, the takeaway from the report is the following:

1. I would characterize this as delayed ignition event. In the 7.5 minutes between rupture and ignition, a significant amount of propane was released.
2. Even prompt action by well-trained operators may not be sufficient to protect the public from disaster. In this incident, operators took action quickly, but they cannot quickly end the release of propane from the pipeline due to the inventory in the pipe.
3. Evacuation of the area was not be feasible in such a short time frame. Emergency responders could not get to the location before ignition occurred.
4. Residual propane in the affected pipeline continues to burn for several hours until the material is depleted. In this time, the hazard zone from the propane fire is diminishing, but secondary fires could spread.
5. Even timely, well executed and effective actions by law enforcement, fire departments and other agencies may not be sufficient to save lives in the event of a pipeline rupture. The hazards develop too quickly and are most severe at the beginning of the event.

Q: **What are the possible consequences following a HVL pipeline failure in Chester and Delaware counties?**

A: All or nearly all of the Mariner pipelines are in high consequence areas, meaning, in this case, that there is a significant population around the pipeline route or routes. A large leak, or a puncture or rupture at any location along the ME1 or the workaround pipeline has the potential to cause a fatality. The accident histories cited in the Second Amended Complaint involved fatalities due to the pipeline failure, but were all in rural or sparsely populated areas. Of course there have been many HVL pipeline accidents over the years that did not involve fatalities, but the population density surrounding the pipeline route increases the likelihood of public impact.

Q: **Can you identify and describe some specific locations that you are familiar with in Chester or Delaware counties that may be particularly vulnerable?**

A: Yes. I was able to go see several locations along the Mariner pipeline route in Delaware and Chester counties. One interesting location was at the northern edge of Delaware County where the Andover neighborhood is located. The pipeline route runs along one edge of that neighborhood, within 100 feet of several houses. Also in that area is a restaurant and bar, called "Duffers" that is within about 30 feet of the pipeline route and one of the valve stations. The outdoor seating area actually has a good view of the valve station. An accident in that area could endanger the restaurant, its patrons, and many persons in the Andover neighborhood.

Another location is the Wellington at Hershey's Mill, a senior living center in West Chester. The multi-story buildings there are all between about 80 and 500 feet from the Mariner pipeline route. This type of facility raises some interesting issues with the potential consequences of a pipeline failure, emergency response, and any evacuation that may be required, due to the number of persons in proximity to the pipeline, and the potential physical limitations of residents, which would make evacuation more difficult.

I also visited the Chester County Library in Exton, where the Mariner pipeline route is within 20 feet of that building, and within about 30 feet of residences on the other side of the easement.

An additional site I visited is Glenwood elementary in Delaware County. The school is about 600 feet away from the Mariner pipeline route, so only a very large event could affect the school. But if such an event occurred while children were present, there are concerns that have been voiced regarding evacuation – if that is the proper response – or shelter in place if that is the better action.

Q: **What do you know about the complainants' locations in relation to the Mariner pipelines?**

A: I have been to Carolyn Hughes' residence and have seen where that is in relation to the pipeline route. For the other complainants, I can only assume that the relative locations as to where they live, work, or where their children attend school are accurate.

Q: **Explain impact zones and effect of distance from source.**

A: The impact or vulnerability zones of course vary according to several parameters, primarily release hole size. Earlier, when discussing the event timelines I deferred the discussion of leaks. Leaks could be so small as to go undetected for days, or could be quickly identified by a hissing sound and perhaps a jet of material emanating from the ground. In this case, the vulnerability zone is very small and in individual would have to be in the pipeline right-of-way to be affected. As hole sizes grow larger, the vulnerability zone grows larger, from tens of feet to hundreds of feet, to one thousand or more.

Q: **Explain some of the factors that have a bearing on outcomes**

A: The primary factor is hole size, which we have discussed. Beyond that, issues such as release orientation, ignition timing (immediate, delayed or none), and weather conditions can have an impact on the vulnerability zone that is realized in a unique event.

Q: **Please explain to me what could happen at one of the Complainant's locations if a pipeline release were to occur. For example, let's say the ME1 pipeline ruptures. What kind of vulnerability zones could be expected?**

A: Based on the modeling we did for our QRA study, the maximum vulnerability zone around ME1 is approximately one-quarter of a mile. Within this distance, a flammable vapor cloud could envelop persons and houses, and if ignited, those people or houses would be within a flash fire. At a shorter distance, about 400 feet, is the extent of fatal burns from an ignited jet fire, with injuries possible at greater distances. At distances longer than about ¼ mile, residents could be expected to be evacuated after a pipeline event, although they would normally be outside of the immediate vulnerability zone.

Q: Mr. Marx, within a reasonable degree of professional certainty, please state the major findings of your analysis.

A: They can be summarized as follows:

- Although some information concerning the Mariner East Pipeline(s) project has not been made public, there exists sufficient publicly available information in order to generate reasonably accurate calculations of both hazards and risk from potential pipeline releases.
- Due to loss of inventory and pressure decay, the release rate from an HVL pipeline incident decreases with time. Consequently, the worst hazard zones are realized in the first few minutes of the pipeline accident.
- Predicted fatal impacts of accidental pipeline rupture events were found to extend up to greater than 2,000 feet from the Mariner pipelines or their associated equipment. Moderate holes could create hazard zones extend up to about 1,000 feet from the pipeline.
- Depending on the pipeline size and operating conditions, and the magnitude of the release scenario, persons in the vicinity of the pipeline may have difficulty escaping unharmed.
- The potential impacts of an HVL pipeline rupture are more severe than those for a natural gas transmission pipeline rupture at the same line diameter and operating pressure.

- The potentially lethal hazards associated with the Mariner pipelines are significantly larger than those associated with the natural gas transmission pipelines in Chester and Delaware Counties.

Q: Mr. Marx, within a reasonable degree of professional certain, please state the major implications for emergency response and public awareness that can be extracted from your analysis.

- In the event of an HVL pipeline loss of containment, especially a rupture event, the maximum hazards will be realized before the operator can affect any meaningful measures to shut down the release.
- In the event of an HVL pipeline loss of containment, especially a rupture event, it is extremely unlikely that emergency response activities can provide assistance before the maximum hazards are realized (and perhaps not even activated before the maximum hazards are realized).
- While pipeline shutdown and emergency responder activities are important, and can help to mitigate impacts in the range of tens of minutes after the event begins, there are no actions that can affect the hazards realized in the first minutes of the event.
- For members of the public in the vicinity of the Mariner pipelines, it is difficult to know what the proper reaction (i.e., shelter in place or evacuate) to a pipeline incident may be due to the variability of the event magnitude, various hazards that are possible, and timing of ignition.
- First responders can help to extinguish secondary fires, evacuate persons who have sheltered in place (e.g., in a home), or evacuate persons who have escaped the pipeline impacts by finding shelter.

Q: Mr. Marx, have all of your opinions above been given within a reasonable degree of professional certainty?

A: Yes.

Q: Mr. Marx, would you agree that if additional information becomes available it is conceivable you would have to review that information to determine whether it affects your opinion in this case.

A: Yes, of course.

APPENDIX A
ESCAPE ANALYSIS DETAILED RESULTS

Table A-1
Impacts for Potential Escape Away from Flame

Pipeline	Operating Pressure [psig]	Starting Distance [ft]	Escape Speed [mph]	Time to Burns [s]	Time to Fatality [s]
ME2	1480	500	3	2	8
			4	2	8
			5.6	2	9
		700	3	6	50
			4	7	escape
			5.6	7	escape
		1100	3	45	escape
			4	51	escape
			5.6	escape	escape
	2100	500	3	1	3
			4	1	3
			5.6	1	3
		700	3	3	16
			4	3	17
			5.6	3	19
		1100	3	20	escape
			4	21	escape
			5.6	23	escape
Natural Gas Trans-mission	1480	500	3	3	15
			4	3	18
			5.6	3	27
		700	3	19	escape
			4	21	escape
			5.6	26	escape
		1100	3	escape	escape
			4	escape	escape
			5.6	escape	escape
	2100	500	3	1	6
			4	1	6
			5.6	1	6
		700	3	6	51
			4	6	escape
			5.6	6	escape
		1100	3	6	escape
			4	escape	escape
			5.6	escape	escape

Table A-2
Impacts for Potential Escape Perpendicular to Flame

Pipeline	Operating Pressure [psig]	Starting Distance [ft]	Escape Speed [mph]	Time to Burns [s]	Time to Fatality [s]
ME2	1480	500	3	4	18
			4	4	20
			5.6	4	22
		700	3	8	55
			4	8	escape
			5.6	8	escape
		1100	3	30	escape
			4	32	escape
			5.6	35	escape
	2100	500	3	2	11
			4	2	11
			5.6	2	12
		700	3	5	26
			4	5	28
			5.6	5	32
		1100	3	16	escape
			4	16	escape
			5.6	17	escape
Natural Gas Trans-mission	1480	500	3	11	escape
			4	12	escape
			5.6	12	escape
		700	3	28	escape
			4	30	escape
			5.6	36	escape
		1100	3	escape	escape
			4	escape	escape
			5.6	escape	escape
	2100	500	3	7	48
			4	7	58
			5.6	8	escape
		700	3	15	escape
			4	16	escape
			5.6	17	escape
		1100	3	escape	escape
			4	escape	escape
			5.6	escape	escape

BEFORE THE

PENNSYLVANIA PUBLIC UTILITY COMMISSION

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

COMPLAINANTS' EXHIBITS
IN SUPPORT OF DIRECT TESTIMONY
OF JEFFREY MARX

EX. MARX - 1

Jeffrey D. Marx, P.E.
Quest Consultants Inc.®
Senior Engineer

EDUCATION

2002	M.S., Mechanical Engineering Georgia Institute of Technology, Atlanta, Georgia
1993	B.S., Mechanical Engineering University of Oklahoma, Norman, Oklahoma

EXPERIENCE

1993 - Present Quest Consultants Inc., Norman, Oklahoma
Staff Engineer, Project Engineer, Senior Engineer

Directs quantitative risk analysis (QRA) studies involving refineries or refinery units, toxic and flammable gas/liquid pipeline systems, oil and natural gas production systems, LPG import/export terminals, LNG import/export terminals, gas treatment and processing plants, reinjection systems, and road/rail transportation systems. Work on these projects included data gathering, accident selection, analysis structuring, consequence calculations, frequency analysis, risk mapping, and risk assessment. Organized and input all data required by the risk quantification software, CANARY+, and presented the results in the form of risk contours and F-N curves. Explained the results and findings of QRA studies in reports for client's internal use, presentation to the public, and for submission to regulatory authorities.

Manages and conducts building siting studies to assess occupied building damage from fires, vapor cloud explosions, and toxic or flammable vapor infiltration. Tasks include accident selection, hazard calculation, and results presentation in the form of overpressure exceedance curves, vulnerability zones, and location-specific risk contours, with building risk assessment and recommendations for hazard mitigations.

Responsible for software package and model development for the consequence modeling package CANARY by Quest®. Responsible for computer codes that model thermal radiation from pool fires, torch fires, flares, and BLEVE fireballs. Directs development and maintenance of the CANARY+ computer codes for risk quantification, as well as numerous supporting tools for risk analysis and assessment.

Conducts and coordinates consequence analysis studies including plant spacing and layout for regulatory compliance, pipeline integrity management program calculations, flare sizing and siting, and explosion impact analyses. Uses the CANARY consequence modeling package to perform vapor dispersion, explosion, and fire radiation calculations for refineries, pipelines, LNG and LPG terminals, chemical plants, and gas plants.

Instructor or co-instructor for several of Quest's short courses, including *Risk Analysis Methodology*, *Liquefied Gas Safety*, *LNG Safety Technology and Inspection* (conducted for the U.S. DOT to train 49 CFR 193 inspectors), and *Introduction to Consequence Analysis*. Instructor for CANARY by Quest® software training.

Facilitated team meetings for HAZOP studies, including the following projects.

RMS Engineering; US PolyCo RDS Asphalt process HAZOP
Bechtel; Driftwood LNG HAZID
Tonmoor International; HAZOP for LPG storage and distribution terminal
Bechtel; SPLNG Vendor Packages HAZOP and SIL assessment
Williams Pipeline; Distribution Lines and Valve/Meter Station HAZOPs
Bechtel; APLNG offsites facilities HAZID
Basic Engineering; Natural Gas Storage Caverns Fill/Withdrawal Systems; HAZOP
Bechtel; Denali Alaska Gas Pipeline Project; HAZID
CB&I; Southern LNG Expansion Projects; HAZOP
SemGas; Natural Gas Treatment and Compression Facilities; HAZOP
BE&K Engineers; LPG Storage, Pipeline, and Delivery Facilities; HAZOP
Keyspan; LNG Peakshaver; HAZOP
Willbros Engineers, Inc.; Unocal Bibyana Gas Plant; HAZOP
Engelhard Corporation; Fuel Cell; HAZOP
Willbros Engineers, Inc.; Explorer Mainline Expansion; "What if?"
Bechtel; Brass Offshore LNG; "What if?"

Co-inventor of a patented community response guideline device. The device allows local emergency response agencies (police, fire department, etc.) to quickly assess the nature and severity of hazards posed by accidental releases of hazardous fluids. It also provides a visual indication of the area in which the public might be told to evacuate or shelter-in-place, based on the specific properties of the material being released, the relative size of the release, and the wind direction.

1990 - 1993 Quest Consultants Inc., Norman, Oklahoma
Engineer Trainee (part-time)

Assisted in scenario definition, case input and results presentation for various consequence analysis studies. Used CAD to prepare technical drawings and illustrations for inclusion in reports, course texts, and presentations.

1990 - 1991 Hilti, Inc., Tulsa, Oklahoma
Co-op Student Intern in Mechanical Engineering

CADD operator for product design, development, and testing. Assisted with implementation and editing of CAD database. Assisted with development and testing of existing construction fastening system products, and the design, testing, and fabrication of new products.

Jeffrey D. Marx

PROFESSIONAL MEMBERSHIPS

American Society of Mechanical Engineers
American Institute of Chemical Engineers
Registered Professional Engineer – Oklahoma
Member of the Technical Committee for CSA Z276: *Liquefied natural gas (LNG) — Production, storage, and handling*
Member of the Industrial Advisory Board, *Fire Protection and Safety Engineering Technology Program*, Oklahoma State University

PUBLICATIONS

Marx, J.D. and B.R. Ishii (2019), "*A New Look at Release Event Frequencies.*" Presented at Mary Kay O'Connor Process Safety Center International Symposium, College Station, Texas, October 22-24, 2019.

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Marx, J.D. and B.R. Ishii, "*Revisions to the QMEFS Vapor Cloud Explosion Model*". 2017 AIChE Spring Meeting & 13th Global Congress on Process Safety, San Antonio, TX, March 2017.

Marx, J. D. and Ishii, B. R., "*A Comprehensive Approach to API RP 752 and 753 Building Siting Studies.*" Journal of Loss Prevention in the Process Industries, Volume 44, November 2016.

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Marx, J. D. and Ishii, B. R., "*Infiltration hazards for building siting studies.*" Process Safety Progress, Vol. 35, No. 1, 61–67, March 2016.

Marx, J.D. and B.R. Ishii (2014), "*Review of the Risk Analysis Option in NFPA 59A (2013).*" Presented at Mary Kay O'Connor Process Safety Center International Symposium, College Station, Texas, October 28-30, 2014.

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Marx, J.D., Werts, K.M., "*The Use of Overpressure Exceedance Curves in Building Siting*". 2011 AIChE Spring Meeting & 7th Global Congress on Process Safety, Chicago, IL, March 2011.

Marx, J.D., Cornwell, J.B., "*The Importance of Weather Variations in a Quantitative Risk Analysis*". Journal of Loss Prevention in the Process Industries, Vol. 22, Issue 6, 803-808, November 2009.

Melton, T.A., Marx, J.D., "*Estimating Flame Speeds for Use with the BST Blast Curves*". Process Safety Progress, Vol. 28, No. 1, 5-10, March 2009.

Marx, J.D., Cornwell, J.B., "*Selection and Evaluation of Release Scenarios for an LNG Import Terminal*". American Institute of Chemical Engineers 2005 Spring National Meeting Process Plant Safety Symposium, Atlanta, GA, April, 2005.

Martinsen, W. E., and J. D. Marx (1999), "*An Improved Model for the Prediction of Radiant Heat from Fireballs.*" Presented at the 1999 International Conference/Workshop on Modeling Consequences of Accidental Releases of Hazardous Materials, San Francisco, California, September, 1999.

Cornwell, J.B., Marx, J.D., and Lee, W.W. (1998), "*Application of Qualitative and Quantitative Risk Analysis Techniques to Building Siting Studies*". Process Plant Safety Symposium, Houston, TX, October 26-27, 1998.

RELEVANT PROJECT EXPERIENCE

LNG Facility Siting Review: ***Project Manager*** for a reviews of various submittals to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) regarding proposed liquefied natural gas (LNG) projects and compliance with the requirements of 49 CFR Part 193; assistance to PHMSA in reviews; subject matter expert consulting to PHMSA regarding general LNG issues and development of the frequently-asked-questions (FAQs) guidance to assist with compliance with the siting provisions of 49 CFR 193; coordination with the Federal Energy Regulatory Commission (FERC) regarding facility siting issues. *Client: PHMSA*

LNG Facility Siting Safety Study: ***Project Manager*** for a study to demonstrate compliance with the siting provisions of 49 CFR 193 and other PHMSA requirements, as well as requirements of the FERC. The study included design spill selection, vapor dispersion and fire radiation modeling, coordination of a contractor for computational fluid dynamics (CFD) studies, as well as verification of adequate facility layout and assistance with development of regulatory filings. *Client: Bechtel Oil, Gas, and Chemicals*

Buildings Siting Evaluation for Coal Gasification Plant: ***Project Manager*** for a study to evaluate the potential impacts at occupied permanent plant buildings and temporary buildings. Hazard types included toxic vapor exposure (CO, H_2S, SO_2), fire, and vapor cloud explosion. Recommended building mitigation measures. *Client: Duke Energy*

Quantitative Risk Analysis, Siting Study, Fire and Explosion Analysis, and Emergency Systems Survivability Analysis for a Large LNG Export Terminal: ***Project Manager*** for multiple risk studies for a competitive FEED LNG liquefaction and export terminal on the coast of Mozambique. Risk was calculated for workers, public, as well as equipment damage and risk of escalation. Risk studies were submitted as part of the FEED. *Client: Anadarko Petroleum Corporation through Bechtel*

Quantitative Risk Analysis for a Natural Gas Transmission Line: ***Project Manager*** for a QRA of a large diameter gas transmission line in the New Jersey and southern New York areas. The QRA was done to evaluate the risk to the public in sensitive locations along the pipeline route. *Client: Kiefner and Associates/ Spectra*

Quantitative Risk Analysis for a Proposed LPG Storage and Loading Facility: ***Project Manager*** for a full QRA of a facility for receipt, cavern storage, rail loading and truck loading of LPG (propane and butane) products. The QRA was used to demonstrate acceptable levels of public risk in the areas around the facility. *Client: Inergy Midstream*

LNG Facility Siting Safety Study: ***Project Manager*** for a study to demonstrate compliance with the siting provisions of CSA Z276, Canada's LNG safety code. The study included vapor dispersion and fire radiation, as well as verification of adequate facility layout and generally good engineering design. *Client: Fortis BC and Black & Veatch*

Quantitative Risk Analysis for a Proposed Gas-to-Liquids Facility: ***Lead Process Risk Analyst*** for a full QRA of a new gas-to-liquids facility along the Nigerian coast. QRA was submitted to local and Federal Nigerian authorities. *Client: Chevron Energy and Technology*

Pipeline Hazard Calculations: ***Lead Analyst*** for a study to evaluate the potential hazards associated with accidental NGL pipeline release events to evaluate high consequence area (HCA) impacts. The evaluation included flammable vapor cloud travel, product loss estimation, and blowdown time estimation. *Client: Williams Field Services*

Quantitative Risk Analysis for a Refinery: ***Lead Process Risk Analyst*** for a full QRA of a large refinery in the USA. QRA was conducted to understand the potential risk to the public, as well as to occupied buildings on the site. Analysis included evaluation of flammable and toxic fluids, vapor cloud explosions, and fires from crude units, hydrocrackers, separation and distillation units, sulfur recovery, and product storage and transportation facilities. *Client: Chevron Energy and Technology*

Process Hazards Analysis for Refinery and Petrochemical Facility: ***Lead Process Safety Engineer*** for coarse HAZOP of proposed design of a refinery and petrochemical facility in Malaysia. Facilitated coarse Hazard and Operability Studies (HAZOP) for multiple units of the refinery and integrated petrochemical facility. *Client: Technip, for Petronas (Malaysia)*

<u>Exhibit 2</u>

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

Michael S. Bomstein, Esq.
Pinnola & Bomstein
PA ID No. 21328
Email: mbomstein@gmail.com
Suite 2126 Land Title Building
100 South Broad Street
Philadelphia, PA 19110
Tel.: (215) 592-8383

Attorney for Complainants

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 <u>individual</u> 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 <u>societal</u> 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 <u>reduce</u> 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.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the forgoing document upon the persons listed below in accordance with the requirements of § 1.54 (relating to service by a party).

VIA ELECTRONIC MAIL

Michael S. Bomstein, Esquire
Pinnola & Bomstein
Suite 2126 Land Title Building
100 South Broad Street
Philadelphia, PA 19110
mbomstein@gmail.com

Counsel for Flynn et al. Complainants

Rich Raiders, Esquire
Raiders Law
606 North 5th Street
Reading, PA 19601
rich@raiderslaw.com

Counsel for
Andover Homeowner's Association, Inc.

Anthony D. Kanagy, Esquire
Garrett P. Lent, Esquire
Post & Schell PC
17 North Second Street, 12th Floor
akanagy@postschell.com
glent@postschell.com

Counsel for Intervenor
Range Resources – Appalachia LLC

Vincent M. Pompo
Guy A. Donatelli, Esq.
24 East Market St., Box 565
West Chester, PA 19382-0565
vpompo@lambmcerlane.com
gdonatelli@lambmcerlane.com

Counsel for Intervenors
West Whiteland Township,
Downingtown Area School District,
Rose Tree Media School District

Erin McDowell, Esquire
3000 Town Center Blvd.
Canonsburg, PA 15317
emcdowell@rangeresources.com

Counsel for Range Resources Appalachia

Leah Rotenberg, Esquire
Mays, Connard & Rotenberg LLP
1235 Penn Avenue, Suite 202
Wyomissing, PA 19610
rotenberg@mcr-attorneys.com

Counsel for Intervenor
Twin Valley School District

Margaret A. Morris, Esquire
Reger Rizzo & Darnall LLP
Cira Centre, 13th Floor
2929 Arch Street
Philadelphia, PA 19104
mmorris@regerlaw.com

Counsel for Intervenor
County of Chester

James R. Flandreau
Paul, Flandreau & Berger, LLP
320 W. Front Street
Media, PA 19063
jflandreau@pfblaw.com

Counsel for Intervenor
Middletown Township

Mark L. Freed
Joanna Waldron
Curtin & Heefner LP
2005 S. Easton Road, Suite 100
Doylestown, PA 18901
mlf@curtinheefner.com
jaw@curtinheefner.com

Counsel for Intervenor
Uwchlan Township

Josh Maxwell
Mayor of Downingtown
4 W. Lancaster Avenue
Downingtown, PA 19335
jmaxwell@downingtown.org

Pro se Intervenor

James C. Dalton, Esquire
Unruh Turner Burke & Frees
P.O. Box 515
West Chester, PA 19381-0515
jdalton@utbf.com

Counsel for West Chester Area School District, Chester County, Pennsylvania

Virginia Marcille-Kerslake
103 Shoen Road
Exton, PA 19341
vkerslake@gmail.com

Pro Se Intervenor

Thomas Casey
1113 Windsor Dr.
West Chester, PA 19380
Tcaseylegal@gmail.com

Pro se Intervenor

Patricia Sons Biswanger, Esquire
217 North Monroe Street
Media, PA 19063
patbiswanger@gmail.com

Counsel for County of Delaware

Melissa DiBernardino
1602 Old Orchard Lane
West Chester, PA 19380
lissdibernardino@gmail.com

Pro se Complainant

Joseph Otis Minott, Esquire
Alexander G. Bomstein, Esquire
Ernest Logan Welde, Esquire
Kathryn L. Urbanowicz, Esquire
Clean Air Council
135 South 19th Street, Suite 300
Philadelphia, PA 19103
Joe_minott@cleanair.org
abomstein@cleanair.org
lwelde@cleanair.org
kurbanowicz@cleanair.org

James J. Byrne, Esquire
Kelly S. Sullivan, Esquire
McNichol, Byrne & Matlawski, P.C.
1223 N. Providence Road
Media, PA 19063
jjbyrne@mbmlawoffice.com
ksullivan@mbmlawoffice.com

Counsel for Thornbury Township, Delaware County

Rebecca Britton
211 Andover Drive
Exton, PA 19341
rbrittonlegal@gmail.com

Pro se Complainant

Michael P. Pierce, Esquire
Pierce & Hughes, P.C.
17 Veterans Square
P.O. Box 604
Media, PA 19063
Mppierce@pierceandhughes.com

Counsel for Edgmont Township

Laura Obenski
14 South Village Avenue
Exton PA 19341
ljobenski@gmail.com

Pro se Complainant

Guy A. Donatelli, Esq.
24 East Market St., Box 565
West Chester, PA 19382-0565
gdonatelli@lambmcerlane.com

Counsel for Intervenor East Goshen Township

/s/ *Thomas J. Sniscak*
Thomas J. Sniscak, Esquire
Whitney E. Snyder, Esquire

Dated: July 28, 2020