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REPLY TO:
Center City

June 11, 2019

Via Electronic Filing

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

Re: Bureau of Investigation & Enforcements v.. Sunoco Pipeline L.P.,
Docket No. C-2018-3006534
FLYNN COMPLAINANTS' PETITION TO INTERVENE

Dear Secretary Chiavetta:

Attached for electronic filing with the Commission is Flynn Complainants' Petition to Intervene in the above-referenced matter.

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

Very truly yours,

MICHAEL S. BOMSTEIN, ESQ.

MSB:mik

cc: Per Certificate of Service

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Pennsylvania Public Utility Commission Bureau of Investigation and Enforcement, Complainant	:	Docket No. C-2018-3006534
v.	:	
Sunoco Pipeline L.P. a/k/a Energy Transfer Partners, Respondent	:	

FLYNN COMPLAINANTS' PETITION TO INTERVENE

Pursuant to 52 Pa. Code §§ 5.71-5.76, Megan Flynn, Rosemary Fuller, Michael Walsh, Nancy Harkins, Gerald McMullen, Caroline Hughes, and Melissa Haines ("Flynn Complainants" and "Petitioners"), through counsel, hereby petition to intervene in the above-captioned proceeding, and in support hereof, aver as follows:

1. Petitioners are all complainants in the case filed as *Flynn, et al. v. Sunoco Pipeline, LP*, docketed in the Commission at C-2018-3006116 and P-2018-3006117.

2. All of the Petitioners are residents of Chester and Delaware Counties.

3. Petitioners are represented in this action by Michael S. Bomstein, PA Attorney ID No. 21328, Pinnola & Bomstein, Attorneys at Law, with offices at Suite 2126, Land Title Building, 100 South Broad Street, Philadelphia, PA 19110, telephone number (215) 592-8383, and an electronic mail address of mbomstein@gmail.com. Petitioners request service via electronic mail delivered to counsel at the said email address.

4. The Second Amended Formal Complaint ("the Flynn Complaint") alleges that Complainants and their immediate families are persons who have been and will be adversely affected by Sunoco's Mariner East Project.

5. As noted in the June 6, 2019 Procedural Order, the Flynn Complaint raises six central issues, among which are (1) the safety and integrity of ME1, ME2, ME2X, and the 12 inch pipeline, and (5) SPLP's integrity management protocols. (June 6, 2019 Procedural Order at 4).

6. The issues identified in ¶ 4 above also are at the heart of the Complaint filed in the instant I&E proceedings ("the I&E Complaint").

7. As alleged in the I&E Complaint, on April 1, 2017 there was a leak of ethane and propane on ME1 in the vicinity of Morgantown, Berks County ("the Morgantown Incident"). Examination of the pipe both visually and by a laboratory demonstrated corrosion. The extent of corrosion in the eight foot section is not disclosed.

8. Sunoco repaired the pipeline and welded an eighty-three foot section into the pipeline. How and why an eighty-three foot piece of pipe was placed in an eight foot spot is never explained.

9. Following an investigation, I&E concluded that Sunoco's procedures had been revised since the date of the Morgantown Incident. Which procedures were revised is not explained.

10. After more than twenty months, I&E was not satisfied with Sunoco's response or the apparent condition of ME1 for the entire state and the agency filed its Complaint in the instant proceeding on December 13, 2018.

11. I&E's investigation "included a review of SPLP's operations and maintenance procedures, corrosion control procedures, maintenance records, corrosion control records and integrity management program, which were in existence at the time of the April 2017 leak." (I&E Complaint at ¶ 28).

12. After reviewing the I&E Complaint, Flynn Complainants sought leave to file a Second Amended Complaint that would use I&E's analysis of Sunoco's defective safety and integrity practices but limit its claims to Chester and Delaware Counties. (Flynn Complaint at ¶¶ 70 – 93).

13. In her June 6, 2018 Order Granting in part and Denying in Part Complainants' Motion for Reconsideration of Second Interim Order ("Reconsideration Order"), however, the ALJ ruled that Petitioners' adoption of the I&E claims, even though they were limited to Chester and Delaware Counties, would not be allowed because the Flynn Complainants do not have standing to assert a statewide claim and it would be unfair to require Sunoco to have to defend against the same claims in two separate proceedings. (Reconsideration Order at 6)

14. In her discovery rulings of the same date, the ALJ also ruled that Sunoco should not have to answer the Flynn Complainants' Interrogatories Nos. 14 – 103 and 197 – 205, some but not all of which stemmed from the allegations in the I&E Complaint in this proceeding.[1]

15. Petitioners have raised numerous objections to the proposed I&E/Sunoco settlement in this matter.

16. Sunoco, however, has objected to the Flynn response on the ground that the Flynn Complainants are neither parties nor intervenors in the instant proceeding and that, in any event, it is too late to do so.

[1] The Flynn Complaint in ¶ 119, however, also alleges separately that 49 C.F.R. § 195.452(i) requires an operator to "take measures to prevent and mitigate the consequences of a pipeline failure that could affect a high consequence area. These measures include: conducting a risk analysis of the pipeline segment to identify additional actions to enhance public safety or environmental protection. Such actions may include, but are not limited to, implementing damage prevention best practices, better monitoring of cathodic protection where corrosion is a concern, establishing shorter inspection intervals, installing EFRDs on the pipeline segment, modifying the systems that monitor pressure and detect leaks, providing additional training to personnel on response procedures, conducting drills with local emergency responders and adopting other management controls."

17. None of the current intervenors in this proceeding have filed objections to the proposed settlement.

18. Since the date of filing their objections to the proposed settlement, Flynn Complainants have obtained the services of Matergenics, LLC, an engineering and material sciences consulting firm. Matergenics was asked to comment on the settlement, limiting its investigation to the Joint Petition and its four appendices, "A" through "D."

19. A copy of the Matergenics Comment is attached hereto as Exhibit "A" under cover of a Verified Statement by Matergenics principal, Mehrooz Zamanzadeh, Ph.D. ("Dr. Zee").

20. Petitioners believe and aver that the Matergenics Comment supports the need for Flynn Complainants to intervene in this proceeding in order to protect the public and, in particular, the residents of Chester and Delaware Counties.

21. All of the practices challenged by I&E in its Complaint against Sunoco are challenged by Flynn Complainants in their Complaint, quite apart from the specific averments relating to the Morgantown Incident.

22. Count IV of the Flynn Complaint, captioned "Failure of Integrity Management Program," lays out Flynn Complainants' contention that such a program must include a baseline assessment. Quoting from 49 C.F.R. § 195.452(i), the Flynn Complaint avers that "the operator must take measures to prevent and mitigate the consequences of a pipeline failure that could affect a high consequence area. These measures include conducting a risk analysis of the pipeline segment to identify additional actions to enhance public safety or environmental protection. Such actions may include, but are not limited to, implementing damage prevention best practices, better monitoring of cathodic protection where corrosion is a concern, establishing shorter inspection intervals, installing EFRDs on the pipeline segment, modifying the systems that

monitor pressure and detect leaks, providing additional training to personnel on response procedures, conducting drills with local emergency responders and adopting other management controls. After completing the baseline integrity assessment, an operator must continue to assess the pipeline at specified intervals and periodically evaluate the integrity of each pipeline segment that could affect a high consequence area."

23. Flynn Complainants allege that this integrity management obligation applies just as much to Chester and Delaware Counties as it does to Morgantown and everywhere else in the Commonwealth. It is an obligation that may be enforced by Flynn Complainants in their own PUC proceeding independently of I&E's enforcement proceeding in the Morgantown Incident.

24. As ALJ Barnes as written, "The Commission's Rules of Practice and Procedure permit petitions to intervene. 52 Pa. Code §§ 5.71-5.76. The provision at 52 Pa. Code § 5.72 governs what entities are eligible to intervene in a proceeding and states as follows:

> **§ 5.72. Eligibility to intervene.**
>
> (a) Persons. A petition to intervene may be filed by a person claiming a right to intervene or an interest of such nature that intervention is necessary or appropriate to the administration of the statute under which the proceeding is brought. The right or interest may be one of the following:
>
> > (1) A right conferred by statute of the United States or of the Commonwealth.
> >
> > (2) An interest which may be directly affected and which is not adequately represented by existing participants, and as to which the petitioner may be bound by the action of the Commission in the proceeding.
> >
> > (3) Another interest of such nature that participation of the petitioner may be in the public interest.
>
> (b) Commonwealth. The Commonwealth or an officer or agency thereof may intervene as of right in a proceeding subject to paragraphs (1)-(3).

Allowance of intervention is a matter within the discretion of the Commission. *City of Pittsburgh v. Pennsylvania Pub. Util. Comm'n*, 33 A.2d 641 (Pa. Super. 1943); *N.A.A.C.P., Inc. v. Pennsylvania Pub. Util. Comm'n*, 290 A.2d 704 (Pa. Cmwlth. 1972). (June 6, 2019 Reconsideration Order at 5 – 6).

25. Flynn Complainants clearly have interests that may be directly affected and which are not adequately represented by existing participants, and as to which there is some possibility that they may be bound by the action of the Commission in the instant proceedings.

26. Petitioners believe and aver that that the allegations set forth in the BI&E Complaint are accurate. Petitioners seek the appointment of an independent expert – not an expert selected by Sunoco - to (a) evaluate all data pertinent to the Morgantown incident; (b) examine the condition of the entire ME1 and 12 inch pipeline system; (c) determine what steps need to be taken to repair and/or replace the said pipelines; (d) create a proper integrity management program going forward; (e) direct Sunoco to comply with the expert's recommendations; (f) direct Sunoco to pay for the expert; and (g) grant such other and further relief as may be appropriate, all following a full and complete evidentiary hearing.

27. Petitioners acknowledge that the present petition has not met the usual sixty day filing deadline. Until June 6, 2019, however Petitioners did not know that the ALJ would rule that Sunoco would not be required to defend against the allegations in ¶¶ 70 – 93 of the Flynn Complaint.

28. Under the circumstances, Petitioners believe they have shown good cause for the delay in the filing of their Petition to Intervene.

WHEREFORE, Flynn Complainants pray the Commission grant their Petition and give them leave to intervene so that they may participate fully in this proceeding

Respectfully submitted,

PINNOLA & BOMSTEIN

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Attorney for Complainants

Dated: June 11, 2019

EX. “A”

VERIFIED STATEMENT OF MEHROOZ ZAMANZADEH, PH.D

I. Mehrooz Zamanzadeh, Ph.D., also known as Dr. Zee, do hereby verify the following:

1. I am a principal in the firm Matergenics LLC.

2. Along with other employees of Matergenics LLC I have prepared and reviewed the attached Preliminary Comments on Proposed BI&E Sunoco Settlement.

3. The facts and opinions set forth therein are true and correct, to the best of my knowledge, information and belief.

4. I understand that statements therein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).

Mehrooz Zamanzadeh, Ph.D.

Dated: June 11, 2019

MATERGENICS
Materials and Energy Solutions

PRELIMINARY COMMENTS ON PROPOSED BI&E/SUNOCO MORGANTOWN SETTLEMENT

To

Michael Bomstein
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Fellow of NACE, Fellow of ASM
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/ Design/Cathodic Protection Specialist I-phone: 412-952-9441

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Ed Larkin
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June 10, 2019

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INTRODUCTION

Matergenics has been asked by counsel for the Complainants in the PUC case known as *Flynn v. Sunoco*, docketed at C-2018-3006116, to comment preliminarily on the Joint Petition of Sunoco and BI&E for Approval of Settlement ("Joint Petition") in the case known as *BI&E v. Sunoco*, docketed in the PUC at C-2018-3006534. The terms of the proposed settlement are laid out in Section III of the Joint Petition in §§ 17A-F, pages 5 – 7.

Counsel for Flynn Complainants has asked that we preliminarily review the Joint Petition, including its four appendixes. Those appendices, marked "A" through "D," consist of the parties' statements, the BI&E complaint and Sunoco's Answer with New Matter.[1]

Flynn Complainants' main concern is whether or not BI&E and Sunoco ("the Parties") have presented the Commission with information that would be adequate to make an informed decision approving or disapproving the proposed settlement's terms and conditions. As explained below, the answer is certainly not.

Section V of the Joint Petition is entitled "Conditions of Settlement." Paragraph 20 provides that the obligations contained in the agreement may not be changed. Paragraph 26 also requires the Commission, rather than an Administrative Law Judge, decide the matter directly. Whether these conditions are a good idea as a legal matter is not within the scope of this Comment. As an engineering matter, however, the settlement in its present form is seriously deficient.

[1] While we understand that Flynn Complainants filed a Response in Opposition to the Joint Petition, and we have reviewed that Response, it does not in any respects figure into or form a basis for our preliminary comment. Further, as the Comment is limited to information from the four documents, we do not below discuss other, possible external causes of corrosion, possible internal pipeline changes resulting from reversal of the flow of petroleum liquids, or the effect of other nearby utilities.

QUALIFICATIONS OF MATERGENICS TO RENDER OPINION

Matergenics is a materials science and engineering firm that provides a variety of services to the oil and gas, electrical power, and other industries. Matergenics.com. The company has on previous occasions made presentations to the PUC.

Dr. Mehrooz Zamanzadeh (Dr. Zee) is a principal in Matergenics with BS, MS and Ph.D. degrees in materials science and engineering. He is the holder of 35 patents and author of more than 60 technical publications as well as an approved speaker and instructor for the National Association of Corrosion Engineers ("NACE"). A condensed version of his curriculum vitae is found on the following matergenics.com.

OVERVIEW OF PROPOSED SETTLEMENT TERMS AND CONDITIONS

As set out in the Joint Petition, the terms and conditions are found in six sections marked "A" through "F." Section "A" relates to a civil penalty that is of no concern in this Comment.

Section "B" is entitled "Remaining Life Study." The proposal is for Sunoco to identify three experts, one of whom will be selected by BI&E. The evaluation is to be "forward-looking" with a purpose of assessing the longevity of ME1. While a 12-inch pipeline is operating in the same right of way (Complaint, Appendix "C" at ¶ 29), and is likely prone to some of the same vulnerabilities, the proposed settlement makes no provision for an evaluation of that pipeline.

Twelve bulleted points identify what is included in the study. In general, the study is to include evaluation of the pipe's corrosion growth rate, retirement thickness calculations, schedule of proposed remediation or replacement, listing of risks/threats to ME1, explanation of formation of anomalies, dents and ovalities, leak history, history of prior protective measures, and a discussion regarding management integrity. Further, Sunoco would provide an annual report of its efforts to maintain pipeline integrity along with planned actions and summary of prior year's enhancements.

In Section "C" Sunoco agrees to perform certain In-Line Inspections ("ILIs") and after three years hire a consultant to make ILI recommendations, without Sunoco being bound by those recommendations. Also in the same three year period, Sunoco would conduct a Close Interval Survey ("CIS") periodically.

Section "D" refers to certain unspecified procedures that Sunoco has supposedly implemented. BI&E states the revisions meet the relief it requested in its Complaint in ¶¶ 47 (c) and (d).

Section "E" states that the revisions noted in Section "D" have already been implemented.

Section "F" is captioned "Pipe Replacement as It Relates to Corrosion. This section gives Sunoco discretion as to how to address anomalies, low IR free potentials or inadequate depolarization.

ANALYSIS AND DISCUSSION

Before any settlement can be approved that would prescribe an adequate course of future testing, it is critical to be fully acquainted with the nature of the problem. In the present case, this would require a baseline determination of existing conditions and as complete a review of the pipelines' history as is feasible. The Commission, however, is being asked to approve this deal without any information regarding existing conditions or information as to the pipelines' history having been provided. SPLP and BI&E need to disclose and discuss the data that is already available to provide context and analysis for what is needed going forward.

By way of illustration, Section "D" of the settlement states that"[t]he parties agree that SPLP's May 2018 revisions to procedures Energy Transfer SOP HLD.22 have addressed I&E's requested relief set forth in Paragraphs 47(c) -(d) of the Complaint." Section "E" recites those procedures have already been implemented.

In Sections "D" and "E", the parties have given the Commission exactly no information as to the nature of the problem being addressed or the remedy that has been agreed upon.

The BI&E Complaint was apparently filed more than 20 months after the April 1, 2017 Morgantown incident. The Complaint refers to revisions in procedures but it does not identify what procedures were a problem or how the procedures were revised. The proposed settlement essentially repeats the same point and withdraws the relief requested in two parts of the Complaint.

Without this information, and the more detailed technical information described below, the Commission and the public are left without any basis for determining whether the proposed settlement will ensure the public's safety.

Specific Information Needed to Assess the Technical Issues

We have noticed that the following important information is missing in the case:

1. Laboratory analysis report of leaked pipe section extracted from the ME1 main pipeline. (See, Complaint, ¶¶ 24 – 27)
2. Type of Microbiological Induced Corrosion (MIC) detected during lab analysis i.e., the type of microbes involved in the corrosion process.
3. Cathodic protection (CP) Criteria used for MIC.
4. CP and ILI surveys prior to leaks.
5. Rectifier inspection data i.e., bimonthly inspection data.
6. Annual test station survey data.
7. Other instances on this pipe that resulted in leaks or cracking.
8. Presence of any weld at the leak.
9. If weld is present, the condition of the weld at and around the leak.
10. Type of coating and the condition of the coating at the leaked and non-leaked areas.
11. Coating surveys.
12. Stray current surveys.
13. Soil corrosivity mapping.
14. Chemical analysis of soils at leaked areas and other direct assessed areas.
15. Soil resistivity measurements at leaked areas and other direct assessed areas.

In Appendix A, page 2 it was stated that "SPLP voluntarily excavated, exposed and cleaned the affected area of the pipe after which inspectors in the I&E Safety Division observed localized corrosion at the bottom of the pipe in the six (6) o'clock position. SPLP sent an eight (8) foot section of this portion of ME1 to an independent laboratory for testing. Laboratory analysis of this section of the pipeline attributed the failure to corrosion".

The excavation should have been done in the presence of an independent NACE coating, corrosion and cathodic protection specialist. The evidences of coating disbondment might have been lost. If the condition of the coating and the indications of coating disbondment is not recorded by SPLP prior to cleaning the pipe surface, it shows lack of knowledge on the influence of disbonded coating on pipeline corrosion or it could be deliberate attempt to clear the evidences.

We understand from the Joint Petition that, from the lab analysis of the cut pipe section from the leaked ME1 pipeline, MIC was reported as the cause for the leak. MIC is the primary cause of ME1 Pipeline leak but not the root cause. The root cause of the failure could be most likely coating disbondment at the leaked area. With the available information, we presume that the sequence of Sunoco pipeline leakage is as follows: coating disbondment at the leak area, permeation of water under the disbonded coating, shielding of CP current at the disbonded coating, environments favorable to bacterial growth at the disbonded area and finally perforation.

In the Joint Petition and appendices, no information was provided on the condition of the remaining ME1 pipeline. This is concerning for a number of reasons.

The Complaint in ¶ 26 stated that an eight foot section of the pipe was sent to a laboratory for analysis. The lab found corrosion. The Complaint does not state how much corrosion was found. Was it a two-square-inch piece or did it permeate the entire circumference of the pipe along the entire eight-foot length?

The Complaint in ¶ 27 makes this concern even more worrisome: Sunoco replaced the eight foot segment with eighty-three feet of new pipe. How does an eighty-three foot pipe segment fit into the eight foot gap left by the piece that had been removed? It does not. Either more pipe was removed and replaced or a brand new "loop" of pipe was hooked up in an otherwise straight line. The information regarding this strange operation is nowhere to be found in the materials supplied to the Commission.

The Joint Petition emphasizes only matters related to a single leak but it does not address the overall threat to public safety posed by the aged ME1 pipeline. As a proactive measure, and considering public safety, ILI on the selected digs based on the most recent ILI run should have been performed to build confidence and assure public that no such incidents occur on ME1 line. Detailed indirect and direct assessment at the selected digs based on the most recent ILI run is recommended.

In general, aging underground pipelines are at risk of corrosion failure due to coating degradation, external corrosion and stress corrosion cracking. Corrosion failures in aging pipelines are either sudden catastrophic ruptures or gradual leaks (ME1 pipeline case) due to localized corrosion. Many factors associated with these corrosion areas are coating failure, degradation, disbondment, blistering, delamination, mechanical pressure and stress concentration, galvanic action, corrosive ions, the presence of moisture, corrosive soils, AC interference, inadequate cathodic protection and shielding. These areas have a much higher statistical probability of catastrophic failure and rupture. No detailed information was provided on these factors.

Most of the time initiation of stress corrosion cracking (SCC) and pitting corrosion are detected by coincidence in excavation and digs and is not targeted or predicted by analysis of corrosion performance parameters. Internal or ILI tools have limited capability for detecting or identifying stress corrosion cracking and pitting corrosion initiation.

Primary Forms of Corrosion attack in Corrosive Soils

The two main forms of corrosion that have been observed are localized, (pitting), corrosion and stress corrosion cracking. Both pitting corrosion and stress corrosion cracking are localized in nature and occur when corrosive ions are exposed to the steel surface under delaminated coating or at coating defects.

Pitting corrosion is a type of corrosion that is confined to small area. It usually is an autocatalytic process in the absence of AC/DC stray current corrosion. Active pitting corrosion is considered structural corrosion when the corrosion penetrates the steel. Pitting corrosion can be initiated due to presence of corrosive ions under a disbonding coating that acts as a shield to cathodic protection or in the presence of AC interference.

Stress corrosion cracking (SCC) near Neutral pH is a form of corrosion cracking that is associated with near-neutral pH or high pH. For near neutral pH stress corrosion cracking, the electrolyte contains a dilute solution of carbon dioxide and bicarbonate ions with a pH between 6 and 7. This type of corrosion cracking is associated with limited branch transgranular cracking and the crack walls contain corrosion products. High pH SCC is caused by a solution of carbonate ions with pH between 9 and 10.5 exhibiting intergranular cracking with limited branching. Stress corrosion cracking can initiate under disbonded coatings that may shield cathodic protection.

Coatings

One of the oldest measures of corrosion protection is to coat the substrate with a polymeric material. An organic coating can protect a metal substrate by two mechanisms: serving as a barrier for the reactants: water, oxygen, and various ions and serving as a reservoir for corrosion inhibitors that may assist the surface in resisting corrosion attack.

There are a number of different types of coatings that have been used specifically to provide corrosion protection for buried or submerged metal structures including coal-tar based coatings, polyolefins, shrink sleeves, wax-based coatings, asphalt, urethanes and blends, epoxy phenolics, polyureas, esters, and fusion based epoxy coatings (FBEs).

The parties have supplied no information on the coating type and condition on ME1. It is important to check if any repair coating was applied on this ME1 line. Reports that discuss the condition of the coating should be produced.

Cathodic Protection

Cathodic protection ("CP") is a method for reducing corrosion by minimizing the potential difference between the anode and cathode. In this method, a current is applied from an outside source to the structure to be protected, such as a pipeline. When enough current is applied, the whole structure, (pipeline) will exhibit one potential and the anodic sites on a pipe will cease to exist.

From the documents, it is not clear what CP criteria was used on ME1 pipeline. It is evident that minimum -850mV CSE NACE CP criteria is not satisfied. Lab analysis reported that the leak is due to MIC. In case of MIC, the potentials used should be more negative than -850 mV CSE. No data or reference that shows that the potential is maintained at more negative than -850 mV CSE.

From Appendix C page 8, it was reported that "At station 2459±00, which is approximately 1,030 feet from the leak, SPLP's records indicated cathodic protection readings of -628 mV in 2016 and -739 mV in 2015. **Adequate cathodic protection is achieved at a negative cathodic potential of at least -850 mV (wrong statement)**". From readings, it is evident that the potentials are maintained at more positive than -850 mV CSE. Moreover, ON potentials are recorded. There is no mention of OFF potentials.

From the documents, including Sunoco's Answer and New Matter, it appears that Sunoco's position is that a negative potential of -850 mV need not be maintained because Sunoco has taken other approved steps to protect against corrosion. This alternative scheme is referred to below as the "100 mV criteria."

Sunoco gives the impression that the 100mV criteria were used as the pipe is 9 decades old and the coating might have relatively degraded and most importantly for economic reasons. The major disadvantage of these criteria is that polarized potentials could fall in the range of Stress Corrosion Cracking (SCC) on a pipeline. At room temperature of about 21°C, the potential range is from about –550mV CSE to –700mV CSE. For susceptible pipelines in ambient temperature conditions, polarized potentials within this range should be avoided.

The two charts below depict the difficulty of successfully maintaining the 100 mV criteria:

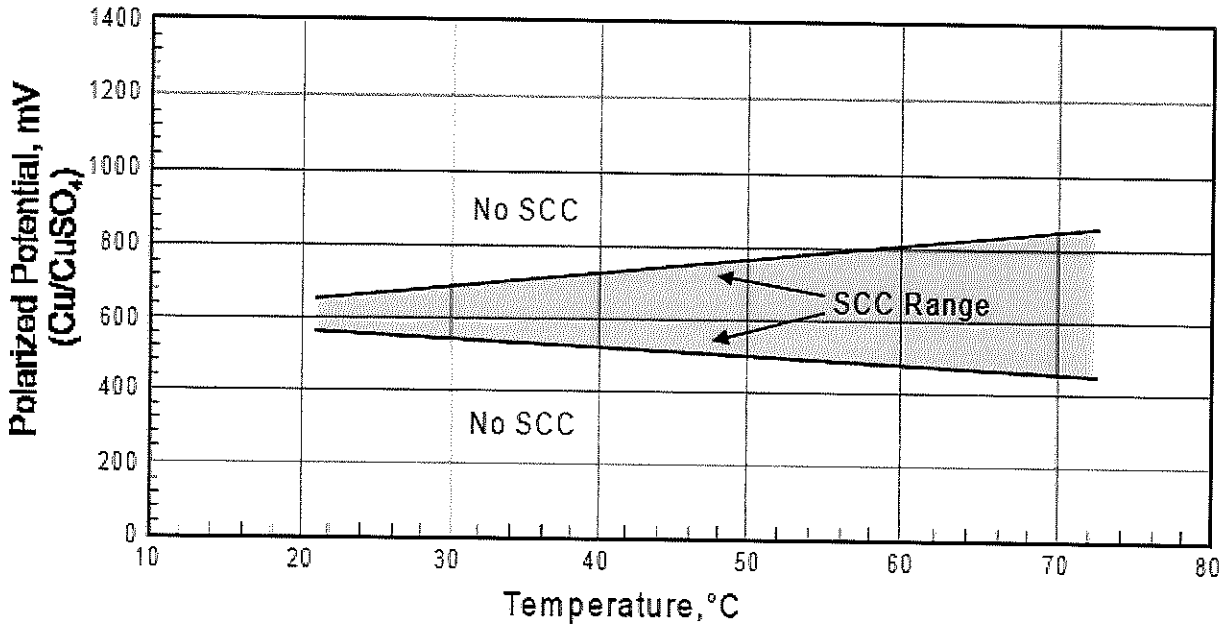

FIGURE – SCC Range in Carbonate/Bicarbonate Environments

Reference: R.A.Gummow, "Technical Considerations on the Use of the 100mV Cathodic Polarization Criterion", CORROSION/2007, paper no. 7035 (Houston, TX: NACE, 2007)

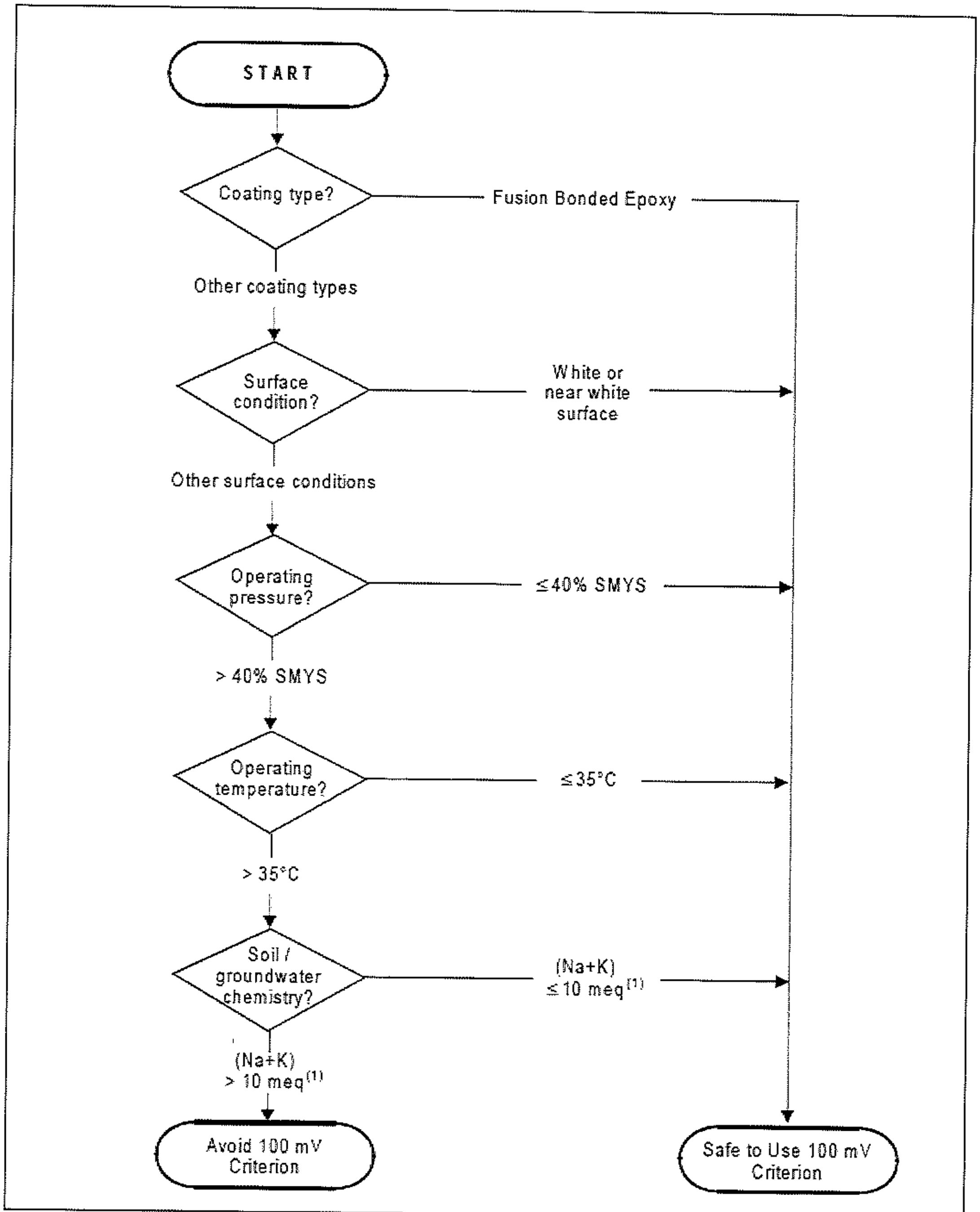

FIGURE – Flow Diagram for Decision-making with Respect to the Use of the 100mV Polarization Criterion to Avoid the Possibility of High-pH Stress Corrosion Cracking

Reference: J.A. Beavers, K.C. Garrity, "100 mV Polarization Criterion and External SCC of Underground Pipelines", CORROSION/2001, paper no. 592 (Houston, TX: NACE, 2001)

Note: The safe use of the 100mV cathodic polarization criterion in accordance with this chart does not guarantee that high pH SSC will not occur but only that it is extremely unlikely.

Moreover, just as the –850mV CSE polarized potential criterion needs to be more electronegative in the presence of sulfate reducing bacteria, the same is the case for the 100mV cathodic polarization criterion.

Close Interval survey (CIS) of the eight (8) inch pipeline and twelve (12) inch pipeline is recommended as these two lines are electrically bonded in the same impressed current system. Rectifier data is also missing. This information is important because it will give us an idea whether rectifier was functioning properly or not all these years.

Stray Current Corrosion

Stray current corrosion is due to currents following through paths other than the intended circuit. This type of corrosion is localized in coated pipes and takes place at discharge points (pinholes and mechanically damaged areas). Failure can occur in a rather short service time.

No information was provided on stray current survey. Sunoco needs to disclose if any stray current survey was performed on this ME1 line. If performed, data should be submitted for review.

AC Interference

Typically, coated pipelines are located near electric transmission lines and run parallel to high voltage transmission lines (HVTL). AC interference can take place by conduction or an induction mechanism causing corrosion in the blistered areas of the coating. The presence of AC interference can cause serious pitting corrosion even on pipes under cathodic protection. This is even the case if the -0.850 V CSE criterion is met. Uncertainties exist as to the reason for this.

No information was provided on AC interference surveying. Sunoco needs to disclose if any survey was performed on this ME1 line. If performed, data should be submitted for review.

Microbiological Induced Corrosion (MIC)

Generally, underground pipelines are protected from corrosion by coating and CP. However, the protective measures are not always effective to protect the pipelines, especially when the coating is disbonded and the CP current is shielded from reaching the trapped water/liquid. As a result, bacteria growth occurs on pipelines under disbonded coating.

Since nearly all soils are naturally rich with microbiological activity, detecting presence of MIC on external side of the buried structures and pipelines is really challenging. CP and coating are the only mitigation options for MIC on direct buried pipe. Sunoco needs to disclose if any soil analysis was performed at this location.

Cathodic Protection Shielding by Protective Coatings

Cathodic protection shielding is defined as preventing or diverting the cathodic protection current from its intended path. Many companies are aware of the problems with CP shielding, yet some continue to use the same coating types and construction practices that have tendencies to cause CP shielding because of economics involved. Information relating to this problem in the case of ME1 is missing.

The leak at Morgantown could have been caused by (MIC) as is typical under disbonded CP shielding pipeline coatings. CP cannot effectively protect the pipeline when CP shielding coatings disbond.

Several pipeline operators now list ***CP shielding disbonded coatings*** as their leading root cause of external corrosion. Coating systems like coal tar can cause increased demands on a CP system and often present difficulties in achieving adequate protection levels. If coatings disbond from the pipe and if electrolytes can enter into this area, a serious corrosion condition can result because the protective CP current may be shielded from reaching any active corrosion cells.

Depending on a coating resistivity, water absorption and oxygen permeation, the risk of corrosion of the underlying metal can be light uniform to significant corrosion, SCC or bacterial corrosion.

Shortcomings in the Inspections Proposed in the Settlement

Even setting aside the lack of baseline information, the inspections and studies the settlement proposes going forward are seriously deficient. A great deal more detail is required for the Commission to determine whether the proposed study and remediation plans are adequate. That detail is outlined below.

The scope of work needed can be divided into two parts for better evaluation and assessment of the coating, cathodic protection (CP) system, CIS on the selected areas of the pipeline, and soil resistivity measurements.

Part 1 covers on-site testing on the live pipeline which is a non-destructive testing (NDT). The tests covered under NDT are soil resistivity measurements, collection of soil samples close to the pipeline and potential measurements. The recommended non-destructive testing will not have any adverse effects on the mechanical integrity of the live pipeline.

Part 2 covers lab testing of the ME1 pipe remnant samples from the independent lab that has performed the analysis. Also, part 2 covers testing of soil samples collected from site, corrosion products if present on the ME1 pipe remnant samples, liquid samples from coating blisters and coating samples collected from the ME1 pipe remnant samples. The testing described in part 2 is a destructive testing.

<u>Part 1 a) On-Site Testing Protocol:</u>

The following should be performed based on pre-assessment/In-Line Inspection (ILI) in selected areas:

I. CIS in selected areas based on the previous ILI data.
II. Potential reads at test stations.
III. Rectifier inspection.
IV. Soil Resistivity and Barne's Layer Testing and Analysis
V. Soil Sampling and Field Testing for Corrosivity

A. Description of CIS Survey at Selected Areas

During CIS, there is not any disruption to the service of the pipeline and most importantly the CIS test does not result in any compromise to the pipeline. During CIS, a connection is made to the pipe test lead in a test station or the structure, and the pipe to soil potential is measured at 5-foot increments along the pipeline. Distance measuring is conducted using the survey wire in conjunction with an electronic distance counter to measure how much wire has been dispensed.

Pipe to soil potentials are measured as the reference electrodes are moved down the pipeline. These potentials are the basis of the CIS and provide a continuous pipe to soil profile of the pipeline in the form of graph.

Interruption: During CIS survey, both ON and OFF potentials are recorded. To record OFF potentials, all the line rectifiers that affect the line section being surveyed are interrupted using synchronized interrupters. Synchronized interrupters switch the rectifier current at various ratios of "on" time to "off" time mostly at 4:1.

Data Logger: The data loggers or computerized voltmeters Allegro QX isused for CIS to record all of the required data during a CIS. Apart from the data loggers or computerized voltmeters, a wire dispensing system should also be used. The survey wire, 1.5-mile spool of #32 awg or 3-mile spool of #34 awg coated copper wire, would be used for maintaining constant electrical contact with the pipeline through connections made at test stations.

Pipe Locator: In order to accurately record the pipeline pipe to soil potentials, pipe locator is used to place the reference electrodes over the pipeline. In this case, the engineer recording the CIS data would follow the engineer locating the pipeline immediately ahead of him.

B. Soil Resistivity and Barne's Layer Testing and Analysis

In general, we consider two methods to measure soil resistivity, as follows:

- Wenner four-pin method, recommended for in-situ soil resistivity measurement and soil layer analysis (Barnes analysis).

- Soil box method, recommended for resistivity measurement of soil samples.

ASTM G57 - This standard covers the equipment and procedures for measurement of soil resistivity. The standard describes two sets of equipment and procedures. One for *in situ* measurement of soil resistivity in the field, and another for measurement of soil resistivity of collected soil samples from the field. The latter can be performed in the laboratory or in the field. Our soil resistivity field measurements involve the use of four metallic pins (1 ft length approximately) driven into the ground. The instrument supplies a current to soil through outer pins and the voltage difference is read between the inner pins. To measure the soil resistivity at different depths, measurements can be performed with different spacing between the pins.

C. Soil Sampling and Field Testing for Corrosivity

In accordance with ASTM D4220 / D4220M, the following procedure need to be used to collect soil samples:

1. Soil samples will be collected from area (>8 ft) to the pipeline and 5 feet deep.
2. The collected soil samples will be placed in <u>clean plastic container</u>.
3. Soil samples will be identified with tags, labels, and markings prior to transporting them.
   1. Job name or number, or both,
   2. Sampling date,
   3. Sample/boring number and location,
   4. Depth or elevation, or both,
   5. Sample orientation,
   6. Collector name (minimum CP1 Technician)
   7. Special shipping laboratory handling instructions, or both including sampling orientation
4. Samples will be shipped to the attention of Tara Wockenfuss, Soils Testing Group at 100 Business Center Drive, Pittsburgh, PA 15205.

500 grams of soil is the minimum amount needed to perform the basic protocol. Once the soil samples are received at Matergenics Pittsburgh Lab, the procedures described in Part 2, Laboratory Testing, will be used for corrosivity determination.

Part 1 b) On-Site Testing Protocol at Digs:

Three 500 ft segments of the pipe should be selected for close interval survey (provided the pipe segments in these areas are not replaced and are the original coated pipes). The dig location selections should be based on previous CIS data, soil resistivity and corrosion characteristics. Excavation would be the responsibility of SPLP.

At all dig sites (3), soil, corrosion products and disbonded coating samples should be collected, labeled, logged in chain of custody form, and submitted to an independent lab. If no disbondment or other feature of interest was identified, samples would be discarded in the field. If SCC, localized corrosion or another feature of interest was found, small pipe sections should be cut and the samples should be shipped overnight to the lab.

The following tests will be performed on the exposed pipe section:

1. Visual examination, photographic documentation and macro-examination by digital microscope (Non-Destructive testing).
2. Coating Thickness Measurement by Positector 6000 (Non-Destructive testing).
3. pH measurement under disbonded coating by pH paper (Non-Destructive testing).

4. Blister liquid sampling for laboratory analysis (Non-Destructive testing).
5. Delaminated coating sample collection for laboratory analysis.
6. Adhesion testing near delaminated areas (Destructive testing).
7. Collection of corrosion products if present.

Part 2 Laboratory Testing Protocol:

The following laboratory testing of collected samples (soil, corrosion products, disbonded coating samples and cut pipe sections) should be performed:

I. Metallurgical Failure Evaluation
II. Soil Corrosivity Determination

I. Metallurgical Failure Evaluation

a) The failure analysis of cut pipe sections should include the following:

- Photographic documentation throughout project work.
- Visual examination including close-up inspection for contamination, texture, defects, microstructure, and cross-sectional examination using a low magnification stereo microscope.
- Metallographic preparation and examination (cutting, mounting and etching with a 2% nital solution) of selected steel pipe areas.
- Metallurgical cross-sectional optical microscopy to evaluate coating and substrate characteristics including microstructure, defects, voids, porosity, number of coating layers, layer thickness, contamination, and general characteristics.
- Fourier Transform infrared spectroscopy (FTIR) on both sides of coating sample to identify the coating system functional group chemistry and determine if degradation or contaminants are present.
- Scanning electron microscopy - energy dispersive x-ray spectroscopy (SEM-EDS) on fracture surface(s) of ruptured pipe at fracture initiation. If inorganic contaminants are identified on the coating surface, x-ray diffraction (XRD) may be performed.
- X-ray diffraction of corrosion products on fracture surface(s).
- Tensile, Charpy and Hardness testing to determine mechanical properties of steel pipe.
- Chemical analysis of steel pipe to determine properties.
- Adhesion testing of coating per ASTM D3359 and or ASTM D4541 to determine adhesion.
- Soil testing (chlorides, sulfates, resistivity, corrosion rate, etc.) of collected soils. (DESCRIPTION OF TESTING PROVIDED IN FOLLOWING SECTION)
- Final technical report providing the results of the examination, including analysis of data, determination and conclusions as to the cause of failure.

b) Examination of the coating chip and dollies with backside of the coating includes:

- Fourier Transform infrared spectroscopy (FTIR) on both sides of coating sample to identify the coating system functional group chemistry and determine if degradation or contaminants are present.
- Scanning electron microscopy - energy dispersive x-ray spectroscopy (SEM-EDS) on both sides of coating sample to perform elemental analysis of coating and possible contaminants. If inorganic contaminants are identified on the coating surface, x-ray diffraction (XRD) may be performed.

c) Examination of the liquid sample includes:

- Test for chlorides, sulfates, resistivity, corrosion rate.
- MIC test

d) Examination of the corrosion products and calcareous deposits include:

- SEM/EDS of corrosion products and AC nodules, if AC corrosion is present.
- XRD analysis of corrosion products and AC nodules, if AC corrosion is present.

II. Laboratory Soil Testing to Determine Corrosivity

A soil from field should be representative of the area of interest, where the stratum of interest contains a variety of soil types. It is desirable to sample each type separately. It may also be necessary to prepare a mixed sample. The sample should be reasonably large and thoroughly mixed so that it will be representative. The soil should be well-compacted in layers in the soil box, with air spaces eliminated as far as practicable.

The measured resistivity will be dependent on the degree of compaction, moisture content, constituent solubility, and temperature. The effect of variations in compaction and moisture content can be reduced by fully saturating the sample before placing it in the soil box. The saturated measurement will provide an approaching minimum resistivity, and can be usefully compared with "as-received" resistivity measurements.

Soil pH Test Methods

The recommended standard test method for soil pH is:

- ASTM G51, *Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.*

In ASTM G51, two apparatus are recommended for pH measurement:

- Calomel and glass electrodes
- A portable, battery-powered pH meter

Sulfate Test Methods

Based on condition (soil, water, or combination) the following standard test methods for sulfate content are recommended:

- ASTM C1580, *Standard Test Method for Water-Soluble Sulfate in Soil*
- ASTM D4327, *Standard Test Method for Anions in Water by Suppressed Ion Chromatography*

Sulfides Content

Sulfide ion, S^{-2}, is found in ground waters and wastewater, causing odor and serious corrosion problems. If acidified, these waters can release hydrogen sulfide (H_2S) which is extremely toxic even at low levels. There is no specific standard to measure soil sulfides; however, since sulfide ions play a critical role in internal corrosion of pipelines in water system, a specific standard test method for sulfide ions in water is developed in ASTM D4658.

Sulfides Test Methods

Recommended standard test method for water sulfides content is ASTM D4658, *Standard Test Method for Sulfide Ion in Water.* This test method uses an ion-selective electrode in conjunction with a double junction sleeve type reference electrode to potentiometrically detect sulfide ions, S^{-2}, in water.

The potentials are read using a pH meter with proper resolution (0.1 mV). Alternatively, ion meters with direct concentration scale for sulfide ions can be used. This test method is applicable in the range from 0.04 to 4,000 milligrams per litre (mg/L) of sulfide.

Chloride Content

The presence of chloride ion, Cl^{-}, significantly aggravates the conditions for pitting corrosion of most metals. Chloride ions can attack and destroy the passive films (corrosion product layers) and expose the bare metal substrate to corrosive environment.

Like sulfides, there is no direct standard to measure soil chlorides; however, since chloride ion is under regulation in the water industry, and must be measured accurately, a specific standard test method for chloride ions in water is developed in ASTM D512 and ASTM D4327.

Chlorides Test Methods

Recommended standard test method for water chlorides content is:

- ASTM D512, *Standard Test Methods for Chloride Ion in Water.* In this standard, the following three test methods are suggested:
    1. Test Method A: mercurimetric titration
    2. Test Method B: silver nitrate titration
    3. Test Method C: ion-selective electrode method

Soil Water Content

A dry soil, regardless of its type and texture, is a non-corrosive environment, and its resistivity is usually very high—a very good insulator. It is the moisture in soil that turns it into a corrosive environment. In fact, for most soils resistivity values decreases rapidly until approximately 20% of a soil weight is water. Variations in soil water content is usually drastic due to seasonal variations in rainfall and temperature seasonal variation in rainfall. Water content of soils also depends on soil drainage capability—a function of soil type and texture (ASTM D2487), particle size (ASTM D422), porosity, and mechanical pressure—which all change with lateral location and depth.

Water Content Test Method

Recommended standard test method for water (moisture) content of soil is ASTM D2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.* This test method is used to determine the water (moisture) content by mass of soil, rock, and aggregate where the reduction in mass by drying is due to loss of water. The recommended drying temperature in ASTM D2216 is 110°C; nonetheless, this temperature may result in decomposition of organic materials, and conversion of calcium sulfate dehydrate (gypsum) to calcium sulfate hemihydrate that is not normally present in natural materials except in some desert soils. In order to reduce the degree of dehydration of gypsum or to reduce decomposition in highly/fibrous organic soils, it may be desirable to dry the materials at 60°C or in a desiccator at room temperature.

Two test methods are provided in this standard. The methods differ in the significant digits reported and the size of the specimen (mass) required. In method A, the water content by mass is recorded to the nearest 1%. For cases of dispute, method A is the referee method. In method B, the water content by mass is recorded to the nearest 0.1%.

This standard requires the drying of soil in an oven, which takes several hours for proper drying. The following test methods provide less time-consuming processes for determining water content.

- ASTM D4643, *Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating*
- ASTM D4944, *Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester*
- ASTM D4959, *Standard Test Method for Determination of Water Content of Soil by Direct Heating*

Corrosion Rate Measurement

Recommended standard test method for evaluating the corrosion rate of test specimens is: ASTM G102, *Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements.* This standard covers the conversion of electrochemical measurements to rates of uniform corrosion. The conversion of polarization resistance values to corrosion rates is reported as mass loss in mils per year for a variety of metals and alloys.

CONCLUSION

The Commission and the public cannot fully assess the appropriateness of this settlement without significant additional information. From the information that was provided, it is clear that most of the technical information is missing that could have assisted in making a decision on settlement.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document upon the persons listed below as per the requirements of § 1.54 (relating to service by a party). The document also has been filed electronically on the Commission's electronic filing system.

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