Accufacts Inc.
"Clear Knowledge in the Over Information Age"

4643 192nd Dr. NE
Redmond, WA 98074
Ph (425) 836-4041
Fax (425) 836-1982
kuprewicz@comcast.net

Date: March 6, 2015

To: Mr. Casey LaLonde
Township Manager
West Goshen Township
1025 Paoli Pike
West Chester, PA 19380-4699

Re: Accufacts Report on Mariner East Project Affecting West Goshen Township

1. Introduction

Accufacts Inc. ("Accufacts") was asked to assist West Goshen Township ("Township") in evaluating a Sunoco Pipeline L.P. ("Sunoco") pipeline project identified as Mariner East, a project to repurpose an existing 8-inch pipeline and to modify an existing pump station within the Township to reverse flow and carry highly volatile liquids, or HVLs, eastward. Accufacts provides specialized technical and safety expertise in pipeline and pump station siting, design, operation/maintenance, and regulatory requirements, especially as it relates to HVLs, a category of liquids given special definition and regulation in the federal pipeline safety regulations.[1] Accufacts assisted the Township's legal team in collecting relevant technical information from Sunoco regarding the design and operation of the proposed Mariner East phase 1 ("Mariner East") pipeline project, and provided advice as to the safety and adequacy of Sunoco's approach, recommending several enhancements. Attachment 1 sets forth the list of confidential documents provided by Sunoco and reviewed by Accufacts.

The discussion and conclusions in this report are based on a careful review and analysis of the information provided by Sunoco to the representatives of the Township and to Accufacts. Accufacts understands that the Township is considering entering an agreement with Sunoco that codifies in writing the important safety systems and operating methods that factor into the conclusions reached in this report. Accufacts and the Township legal team were required to sign Nondisclosure Agreements ("NDA") with Sunoco that prevent Accufacts from disclosing certain sensitive information unless it is already in the public domain. While this

[1] 49CFR§195.2 Definitions.

limitation does not restrict Accufacts' ability to present its independent critical observations, the reader should be aware of the obligation to honor the NDA as Accufacts will not disclose certain sensitive details supporting our observations.

Accufacts' analysis and this report are limited to the segments of the Mariner East project that could affect the Township. Certain additional equipment physically outside of the Township was also reviewed, such as the overall control program, mainline valves, metering, and pump stations that could impact the Township in case of a release of HVL.

The Mariner East Pipeline crosses slightly over a mile of the Township as an 8-inch pipeline, primarily consisting of pipe manufactured in 1968, and newer pipe replacement segments, with the Boot Road Pump Station located within the Township that will be modified to allow the flow of HVLs consisting of ethane, propane or a mixture. These fluids are pressurized to remain liquid at operating conditions within the pipeline, but upon release would generate heavier than air hydrocarbon vapor clouds that can impact large areas. It is important that such a pipeline operation pay special attention to its design, operation, and maintenance practices to assure the pipeline's integrity to keep the fluid within the pipeline.

Federal pipeline safety regulations provide limited levels of safety assurance. Prudent pipeline operators moving HVLs should exceed these basic requirements to assure proper control of their system. These liquid pipeline safety regulations are codified in the Code of Federal Regulation ("CFR") at 49CFR§191, 49CFR§194, and 49CFR§195. The Federal pipeline safety regulations place the responsibility of safe pipeline operation squarely upon the pipeline operator. Many process safety management approaches have been codified into pipeline safety regulations under the label "integrity management," following a series of tragic pipeline ruptures. These high profile rupture failures have called into question the dedication of certain operators to comply with the intent of the safety regulations, especially in the area of integrity management.

I have observed over more than 40 years of incident investigations that some pipeline operators embrace the process safety management intent (or safety culture) to assure that they have their pipelines under control, while others do not. Accufacts has developed a series of process safety management questions concerning pipeline siting, design, operation, maintenance and performance standards that allow Accufacts to evaluate whether a pipeline operator is incorporating prudent management approaches to stay ahead of pipeline failures, especially ruptures. Ruptures are large volume releases associated with big openings typically from pipe fracture. It is not that difficult for an experienced pipeline person to readily ascertain if a pipeline operator embraces the process safety management approach to pipeline safety. The following general observations follow a process safety management

approach that I have successfully utilized over 40 years evaluating many complex operations, including pipelines.

2. Verification of Integrity of the Pipeline for High Pressure HVL Service

Pipe steel, even pipe steel manufactured over 80 years ago, does not age or wear out. Pipe steel has essentially an infinite life if properly assessed, maintained, and operated within its design parameters. Certain manufacturing processes and/or transportation, and construction techniques associated with older vintage pipe steel, as well as new pipe, can introduce some types of anomalies or imperfections that can grow to failure with time, such as cracks in pipelines. These imperfections are often associated with vintage electric resistance welded pipe, either low frequency (LF-ERW) or early high frequency (HF-ERW) pipe, that can exhibit axial crack rupture failure with time for various reasons. Also, after a pipeline is installed, certain imperfections can be introduced such as corrosion or third party damage that may merit that a particular segment of the pipeline be remediated or replaced. Additional pipe segments may also require replacement and relocation because of roadwork or other activities that have nothing to do with the condition of the pipeline. There are such pipe segments crossing the Township that replace the originally installed 8-inch pipe.

Federal pipeline safety regulatory advancements promulgated in the early 2000s, adopted as a result of some tragic transmission pipeline ruptures, improved on pipeline integrity assessments.[2] In addition, to the published regulations, the federal office responsible for pipeline safety, the Pipeline and Hazardous Materials and Safety Administration, or PHMSA, has issued Advisory Bulletins that can be implemented more quickly than the long process associated with regulation development.

One Advisory Bulletin especially significant in this matter is PHMSA's recently released bulletin addressing "repurposing," a change in service or reversal of flow in older pipelines.[3] This Bulletin provides guidance on the use of important hydrotesting assessment procedures utilizing a strength and spike test.

Federal regulations do not currently specify the hydrostatic strength test as a percent of specified minimum yield strength, "%SMYS," or require the use of an additional hydrotesting protocol known as a "spike" test which is very important in evaluating many pipe steels. The above referenced Bulletin indicates: "Operators should consider performing ILI **and** {emphasis added} hydrostatic pressure with a spike test prior to implementing any

[2] 49CFR§195.452 Pipeline integrity management in high consequence areas.
[3] PHMSA Advisory Bulletin, ADB-2014-04, "Pipeline Safety: Guidance for Pipeline Flow Reversals, Product Changes and Conversion to Service – Docket No. PHMSA-2014-0040," September 18, 2014.

of these changes, especially if historical records have indications of previous in-service or hydrostatic pressure test failures, selective seam corrosion, stress corrosion cracking, other cracking threats or other system concerns. A spike test 30 minutes in duration at 100 percent to 110 percent specified minimum yield strength **or** {emphasis added} between 1.39 to 1.5 times ...the maximum operating pressure for hazardous liquids is suggested as it is the best method for evaluating cracking threats at this time."

ILI stands for inline inspection, which involves the insertion, typically in an operating pipeline, of a "pig," a self-contained multi-ton device containing: a) measurement instruments, b) computers, c) storage devices to retain the information gathered, and d) batteries to support the remote device's gathering and retaining certain information about the pipeline's condition. Such ILI tools, also known as "smart pigs," are designed to measure various types of imperfections in the pipe, such as possible damage, corrosion, and with more recent developing technology, some types of crack threats. After a pig run is completed, the volume of ILI tool information must be further analyzed and evaluated off site by special analysts from the vendor supplying the ILI tool who utilize special proprietary software to determine which measured imperfections might be problematic (go to failure) before the next ILI tool run. This last step can take some time, involving months depending on the type of smart pig utilized and the amount/complexity of information gathered. Not all ILI tool runs are successful, especially if an ILI tool has not been proven field reliable for the type of threat, so a measure of precaution is warranted in ILI selection and subsequent analysis.

The best assessment method for ascertaining the suitability or integrity of the pipeline for its new service, especially if cracking threats may be present, are proper hydrotests performed in excess of the current minimum federal pipeline safety hydrotesting regulations that are meant for new pipe testing. Hydrotesting is superior due to its ability to assess/proof various forms of pipe crack threats particularly those cracks associated with certain types of vintage pipe that can grow over time to rupture failure, as ILI and associated engineering analyses has not yet proven sufficiently reliable to adequately assess. A prudent hydrotest (in excess of current federal pipeline safety regulations), is the proof test for cracking anomaly risks, given that ILI tools and related engineering assessments for discovering cracking potential are still in development.

Accufacts has reviewed the various types of ILI smart pig tools used to re-qualify the pipeline on the Mariner East project, and has carefully reviewed in detail the November 2014 hydrotest results provided by Sunoco on the segments that could affect the Township. Sunoco performed both strength and spike hydrotests. Accufacts can report that Sunoco tracked the percent minimum and maximum specified minimum yield strength, or %SMYS, during both the strength and the spike test phases of the hydrotesting. Hydrotesting pressures substantially exceeded the minimum 125 percent (1.25 times the maximum operating

pressure, or MOP) required in current federal regulations. These tests meet the test ranges identified in the above referenced Advisory Bulletin (at least 1.39 times MOP).[4] It should be noted that the maximum operating pressure on the 8-inch pipeline will be quite high, so hydrotesting pressures as a ratio of MOP were also quite high, indicating very good integrity of older sections of pipe in the Township, despite its age, as well as replacement sections.

In addition to the hydrotesting performance factors, Accufacts also reviewed information related to pipe replacements in the Township as well as Sunoco's ILI approach in re-qualifying the pipeline in the Township for the new operation. A review of Google Earth and alignment maps across the Township did not reveal any threat factors such as land movement that could result in abnormal loading pipeline failure. Accufacts has found no significant anomalies that could affect the pipeline in the Township segment to cause growth to rupture failure in the reasonable future, and concludes that Sunoco's ILI assessment management approaches are prudent.

The primary objective of an integrity management program is for the pipeline operator to undertake efforts to avoid pipeline failure in high consequence areas, such as the Township, from various types of threats that may be present on such sensitively located pipeline segments. It is Accufacts' opinion for the section of 8-inch pipeline that crosses the Township, that Sunoco far exceeds a number of requirements of the federal pipeline safety regulations, that it embraces the intent of integrity management, or IM, regulations that are meant to prevent pipe mainline rupture failure, and that their IM approach is currently prudent.

3. Operation of the Mariner East Pipeline affecting the Township

Components of the pipeline other than the mainline pipe in the Township play an important role in the operation of the HVL pipeline as it could affect the Township. These include: 1) the Boot Road Pump Station located within the Township, 2) upstream and downstream pump stations and mainline pipe beyond the Township, 3) certain mainline valves and their actuation, and 4) to a lesser extent, the elevation profile of the pipeline.

3a) The Boot Road Pump Station

There are certain minimum pump station requirements in federal regulation that set important obligations that the pipeline operator: a) have the station under their control (i.e., fenced boundaries), b) require the installation of certain emergency and fire protection equipment, and c) install separate power supplies that will allow the emergency shutdown of the station

[4] 49CFR§195.304 Test pressures.

by the pipeline operator.[5] With these additional requirements in place, while a failure/release in a pump station can be fairly spectacular, the release tonnage from a station failure is much more limited than that from a mainline pipeline rupture failure. At Accufacts' request, Sunoco provided Boot Road Pump Station piping and instrument diagrams ("P&ID") that identify the general existing and new additions to the station, indicating piping size and flow arrangements within the station, as well as key instrumentation and various safety approaches for the station. The Mariner East pump stations, including the Boot Road Pump Station, are designed to be shut down in an emergency, or ESD, either locally, remotely from the control room, or automatically via the computer system, isolating line segments if needed.

Based on a detailed review of the P&ID, Accufacts observes prudent pump station design that properly incorporates safety protection reflective of an HVL product operation, and also includes additional well thought out protections for the mainline in the event the pipeline is shut down. Some of this safety design requires the installation of a flare at the Boot Road Pump Station. This flare will have three types of operation:

1) a continuous pilot light within the flare to assure reliable ignition of combustibles that may be directed to the flare at any time;

2) an intermittent burn of smaller thermal or maintenance venting of pipeline/pump station equipment periodically released to the flare; and,

3) an intermittent burning of larger volumes of combustibles to quickly de-inventory segments of the pump station and sections of connecting mainline during an emergency.

Accufacts concurs with Sunoco's safety approach regarding integrating a flare into the pump station. Accufacts is well aware of public concerns regarding the installation of a flare at the Boot Road Pump Station, but Accufacts concurs that the flare is needed for various prudent safety reasons that cannot be publicly disclosed in detail.

The pump station flare should not often be operated at a high volume. Some of the public may be acquainted with flare operations associated with larger refinery flares that can generate considerably more heat and noise than the proposed flare at Boot Road. Although future pump station modifications from other pipeline projects (Mariner East 2) might increase flaring potential, the Boot Road Pump Station flare should not be operated as frequently as a refinery flare. Should such an integration occur from another project, it should still be a fairly infrequent safety operation. Basically, the Boot Road Pump Station

[5] 49CFR§195.262 Pumping equipment.

flare is needed to reduce volumes of combustibles that could be released into the environment in close proximity to the public in the Township. Accufacts thus concludes Sunoco's flare approach is fair and appropriate.

3b) Pipeline Mainline Valve Remote Actuation

Accufacts has reviewed the pipeline elevation profile provided by Sunoco that also identified various additional pump stations and mainline valve locations along the pipeline outside of the Township. The installation/placement of remotely operated valves along a pipeline, especially in an HVL pipeline, is not an exact science. In case of pipeline rupture, material in HVL pipelines (unlike most liquid pipelines) can flow uphill. This has made the development of regulations concerning the placement of such important valves subject to some interpretation, with a wide field of opinions. There is no absolute "one size fits all" solution to the placement of mainline valves on liquid pipelines, especially because valving with remote actuation can introduce additional operational complexities for a pipeline if an appropriate safety review has not been performed (such as surge analysis and thermal expansion potential) and incorporated into the installation.

Accufacts has recommended that two mainline valves that were installed as manually operated isolation valves beyond the Township be actuated to permit remote and automatic mainline valve closure, isolating segments of the pipeline in an emergency. Sunoco's acceptance to remotely actuate two suggested exiting manual mainline valves that span the Township, but are not within the Township boundaries, is a reasonable and necessary precaution and provides an additional level of protection to Township residents in the case of an emergency.

3c) Automatic and Remote Pipeline System Shutdown

Given its criticality to the overall operation of a high pressure HVL pipeline system in a highly populated area, Accufacts spent considerable time and effort reviewing and discussing with Sunoco's technical experts the system to automatically shut down the pipeline in the event of a possible rupture release. Sunoco information indicates that upon certain trigger events, usually indicative of a possible pipeline rupture, the Mariner East pipeline and pump stations will be automatically shut down, and the stations and segments of the mainline automatically isolated by strategically placed mainline valves closing. Sunoco further informs me that this important system-wide safety approach also covers major transients such as those that can occur during startup and shutdown, and major product changes. The control room operator can also manually initiate the automatic shutdown of the pipeline system.

3d) "Leak Detection" Systems

There are basically two types of pipeline releases, leaks and ruptures. Leaks are smaller rate releases from such conditions as minor cracks, pitting corrosion holes, punctures etc., where the minor size of the opening limits the rate of release. Leaks can nevertheless be dangerous depending on where they occur. The other type of releases are ruptures, high rate releases associated with large openings in the pipe caused by pipe fracture from certain anomalies or imperfections in the pipe. Ruptures by their nature are always dangerous,

Because of the complexity of hydrocarbons and pipeline operation, it is very difficult to design and install a leak detection system that can remotely identify all forms of pipeline releases. Accufacts advises that pipeline operators first focus on remotely identifying pipeline ruptures, and then attempt to improve on technology to possibly identify the much harder to recognize leaks. It is a significant challenge to reliably identify rupture releases, and technology has not yet been developed to dependably identify pipeline leaks. Too often Accufacts has observed pipeline operators trying to operate leak detection systems to capture all forms of releases only to be faced with excessive nuisance false release alarms. Leak detection approaches that generate such excessive false alarms, leak or rupture, set up control room operators to miss or ignore real release events when they occur. Accufacts has repeatedly observed in its investigations excessive false leak alarms causing control room operators to miss even pipeline rupture events. [6] One of the objectives of the control room management regulation promulgated in 2009/2010 was to assist the operators in removing such excessive false alarms.[7]

Regarding "leak detection", the Mariner East project will first incorporate an advanced computer/automatic system that scans and monitors the pipeline and pump stations for certain parameters that are indicative of a possible pipeline rupture, and automatically initiates a full pipeline system shutdown and isolation, including pump station isolation and remote mainline valve closure, following a special required sequence. Sunoco information provided indicates a rational and progressive approach in trying to achieve pipeline rupture release detection with automated shutdown response without excessive false alarms. It is Accufacts' experience that Sunoco's particular approach may cause more false shutdowns than simple leak detection, but Sunoco has applied the use of this design that includes transient detection on their Mariner West operation, and false shutdowns have been very infrequent on that system since its startup slightly more than a year ago.

---

[6] National Transportation Safety Board, NTSB, "Enbridge Incorporated Hazardous Liquid Pipeline Rupture and Release Marshall, MI July 25, 2010," NTSB/PAR-12/01, adopted July 10, 2012.

[7] 49CFR§195.446 Control room management.

To complement the automatic shutdown system focused on possible larger pipeline releases, the pipeline will also incorporate a different separate non-automatic "leak detection" software package that is intended to assist the control room operator in possible pipeline leak as well as rupture identification. To enhance the effectiveness of this software leak detection system the pipeline is to be normally operated liquid full, or non-slack line. This separate approach requires the control room operator to interpret presented information of a possible release in a special format, decide if a possible release indication is real, and manually initiate a system wide shutdown if warranted. This second leak detection monitoring system relies on control room operator intervention, but is intended to supplement the automatic shutdown intended for larger releases.

Accufacts supports Sunoco's approach for both automatic shutdown and isolation for large releases, and the second "leak detection" approach that requires the control room operator to evaluate certain presented information and determine if a possible pipeline release is occurring, and manually initiate a pipeline shutdown.

3e) The Critical Role of the Control Room Operator.

While pipeline automation plays an important role in controlling and monitoring certain aspects of a pipeline operation, and can play a timely safety role in automatically shutting down and isolating a pipeline system, the control room operator nonetheless still serves an important function in pipeline operation. The control room operator is responsible for managing various operating parameters, as well as monitoring and responding to various computer signals, including responding to alarms, in their hierarchy of importance. A well designed computer system that initiates certain actions such as automatic shutdown and mainline valve closure can react faster than a human monitoring various aspects of a pipeline system. Such complexity should not override the ability of the control room operator to initiate a shutdown if he feels it is warranted. Accufacts considers Sunoco's computer monitoring and shutdown approach to be "progressive" in its efforts to assure a safe and prompt response in the event of a HVL rupture release, should it ever be needed.

Even in a system designed for automatic shutdown, the control room operator has an important role to assure that the safety equipment has performed as intended, especially in the case of a system-wide automatic shutdown. Accufacts did not see in Sunoco's original emergency procedure that, upon such an automatic shutdown, the control room operator is instructed to check the overall pipeline system to assure that the pump stations have shut down and that automatically operated valves along the mainline have properly closed to assure segment isolation. In too many pipeline rupture investigations, Accufacts has found deficient operating procedures that do not require the control room operator to assure remotely operated/actuated mainline valves have been quickly and properly closed. Sunoco has agreed to add a modification to their control room emergency procedures to assure that

the operator checks that the emergency shutdown system has performed as intended, and that mainline valves have properly closed.

3f) The Importance of Emergency Response Plans

Pipeline operators are required under federal pipeline regulation to have emergency response plans to deal with the emergencies associated with pipeline releases. Such procedures focus on protecting people first and then on property, establish who is in control and how control is handed off during various stages of a release, what type of command structure is utilized for such emergencies such as the Incident Command Structure (or ICS) that has proven to be highly effective in pipeline releases, and how communication is maintained with first responders who are usually the first to arrive at a release site. It is important that all key pipeline personnel be trained in their various roles and responsibilities in the event of a pipeline release emergency, especially pipelines moving HVL that can have serious consequences.

During an emergency involving a release, the control room plays a critical role as the emergency contact actually controlling and monitoring the pipeline to assure that appropriate equipment has been properly shutdown. The control room also serves to maintain liaison with local emergency responders until hand-off to company onsite field incident command personnel can occur. The control room thus is a critically important initial contact with local emergency responders to assure everyone is properly communicating/coordinating during the important initial stages of a possible pipeline release where there can be much confusion.

Under federal pipeline safety regulations, the pipeline operator is required to notify and coordinate with emergency first responders during pipeline emergencies.[8] The control room should have a list of local emergency contacts, including "other public officials." Local first responders and these officials should also have company emergency contacts and, for obvious reasons as identified above, the important pipeline control room emergency contact number(s). Because of various changes that may occur in organizations, local official contact numbers can be frustratingly difficult to keep current, but the control room contact number should usually never change. Federal pipeline safety regulations place the responsibility to keep emergency contacts with Township officials squarely on the pipeline operator for very good reasons.[9] It is Accufacts' understanding that these important contacts for the Township have been recently updated and that Sunoco has a process for periodically updating the list.

[8] 49CFR§195.402 Procedural manual for operations, maintenance, and emergencies.
[9] 49CFR§195.402(e)(7).

4. Keeping Township Informed of Future Major Changes in the Pipeline's Integrity within the Township

As discussed above, a prudent safety management approach should initially assess the integrity of the pipe, periodically reassess the pipe for possible new threats, and install appropriate equipment to allow the monitoring and shutdown of the pipeline during a suspected possible emergency. At Accufacts' recommendation, Sunoco has agreed to keep the Township informed of a future possible integrity threat on the pipe within the Township identified under 49CFR§452(h)(4) (i), (ii), (iii), & (iv), *Special requirement for scheduling remediation,* once it has been discovered by the operator.[10] Based on Accufacts' extensive experience this reporting requirement should assist the Township to know that the pipeline operator continues to utilize a prudent integrity management approach to avoid threats of possible pipeline rupture failure on the segments in the Township. It again should be stressed that no pipeline is anomaly free, even new pipelines, so anomalies should be expected. The key is to catch those anomalies that can quickly lead to failure, especially rupture. The federal regulatory requirements as to identified threats for which the Township will receive notice should be sufficient, and reporting any changes should not be difficult or burdensome on either the pipeline operator or the Township.

5. Accufacts' Conclusions

As discussed above, the important hydrotesting protocols utilized in November 2014 by Sunoco on the Mariner East pipeline exceed federal regulatory protocols in the application of strength hydrotesting at adequate pressures and in % SMYS. In addition, Sunoco performed an important spike hydrotest which is not currently required by pipeline safety regulations. Accufacts finds that Sunoco exceeds federal hydrotest regulatory requirements and complies with the latest PHMSA Advisory Bulletin concerning pipeline reversals as discussed earlier (ADB-2014-04). These special hydrotest approaches play an important role in assuring the integrity of the pipeline at the time of the hydrotest, even for very old pipe.

It is also Accufacts' opinion that Sunoco, on the Mariner East pipeline segment that could affect the Township, is exceeding federal pipeline safety regulations in utilizing additional integrity management approaches, prudent pump station design, mainline valve placement and actuation, pipeline monitoring, as well as control room procedures, automatic release detection safety systems, and emergency notification protocols that reflect the level of respect that transporting HVL should require in a prudent pipeline operation. While these efforts cannot guarantee against a release, they reflect a safety attitude that applies up to date

[10] 49CFR§452(h)(2) *Discovery of condition* places an upper time limit of 180 days from an integrity assessment (e.g., ILI) for the threats that might be introduced in the future operation of Mariner East that can affect the Township.

steps to avoid a release and respect for the consequences a material release could produce, especially rupture. Accufacts concludes that the Mariner East phase 1 project, with the enhancements discussed above, meets or exceeds the prudent technical approaches commensurate with the safe transportation of HVL.

Richard B. Kuprewicz
President,
Accufacts Inc.